OcNOS®

Open Compute Network Operating System for Service Providers Version 6.6.0

Carrier Ethernet Guide

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Contents

Preface

This guide describes how to configure OcNOS.

IP Maestro Support

Monitor devices running OcNOS Release 6.3.4-70 and above using IP Maestro software.

Audience

This guide is intended for network administrators and other engineering professionals who configure OcNOS.

Conventions

Table 1 on page 10 shows the conventions used in this guide.

Table 1: Conventions

Convention	Description
Italics	Emphasized terms; titles of books
Note:	Special instructions, suggestions, or warnings
`monospaced type`	Code elements such as commands, parameters, files, and directories

Chapter Organization

The chapters in command references are organized as described in Command Description Format.

The chapters in configuration guides are organized into these major sections:

- An overview that explains a configuration in words
- Topology with a diagram that shows the devices and connections used in the configuration
- Configuration steps in a table for each device where the left-hand side shows the commands you enter and the right-hand side explains the actions that the commands perform
- Validation which shows commands and their output that verify the configuration

Related Documentation

For information about installing OcNOS, see the *Installation Guide* for your platform.

Feature Availability

The features described in this document that are available depend upon the OcNOS SKU that you purchased. See the *Feature Matrix* for a description of the OcNOS SKUs.

Migration Guide

Check the *Migration Guide* for configuration changes to make when migrating from one version of OcNOS to another.

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Command Line Interface

This chapter introduces the OcNOS Command Line Interface (CLI) and how to use its features.

Overview

You use the CLI to configure, monitor, and maintain OcNOS devices. The CLI is text-based and each command is usually associated with a specific task.

You can give the commands described in this manual locally from the console of a device running OcNOS or remotely from a terminal emulator such as `putty` or `xterm`. You can also use the commands in scripts to automate configuration tasks.

Command Line Interface Help

You access the CLI help by entering a full or partial command string and a question mark “?”. The CLI displays the command keywords or parameters along with a short description. For example, at the CLI command prompt, type:

```
> show ?
```

The CLI displays this keyword list with short descriptions for each keyword:

```
show ?
  application-priority              Application Priority
  arp                               Internet Protocol (IP)
  bfd                               Bidirectional Forwarding Detection (BFD)
  bgp                               Border Gateway Protocol (BGP)
  bi-lsp                            Bi-directional lsp status and configuration
  bridge                            Bridge group commands
  ce-vlan                           COS Preservation for Customer Edge VLAN
  class-map                         Class map entry
  cli                               Show CLI tree of current mode
  clns                              Connectionless-Mode Network Service (CLNS)
  control-adjacency                 Control Adjacency status and configuration
  control-channel                   Control Channel status and configuration
  cspf                              CSPF Information
  customer                          Display Customer spanning-tree
  cvlan                             Display CVLAN information
  debugging                         Debugging functions
  etherchannel                      LACP etherchannel
  ethernet                          Layer-2
...
```

If you type the ? in the middle of a keyword, the CLI displays help for that keyword only.

```
> show de?
debugging  Debugging functions
```

If you type the ? in the middle of a keyword, but the incomplete keyword matches several other keywords, OcNOS displays help for all matching keywords.

```
> show i? (CLI does not display the question mark).
interface  Interface status and configuration
ip         IP information
isis       ISIS information
```

Command Completion

The CLI can complete the spelling of a command or a parameter. Begin typing the command or parameter and then press the tab key. For example, at the CLI command prompt type `sh`:

```
> sh
```

Press the tab key. The CLI displays:

```
> show
```

If the spelling of a command or parameter is ambiguous, the CLI displays the choices that match the abbreviation. Type `show i` and press the tab key. The CLI displays:

```
> show i
  interface  ip         ipv6       isis
> show i
```

The CLI displays the `interface` and `ip` keywords. Type `n` to select `interface` and press the tab key. The CLI displays:

```
> show in
> show interface
```

Type ? and the CLI displays the list of parameters for the `show interface` command.

```
> show interface
  IFNAME  Interface name
  |       Output modifiers
  >       Output redirection
  <cr>
```

The CLI displays the only parameter associated with this command, the `IFNAME` parameter.

Command Abbreviations

The CLI accepts abbreviations that uniquely identify a keyword in commands. For example:

```
> sh int xe0
```

is an abbreviation for:

```
> show interface xe0
```

Command Line Errors

Any unknown spelling causes the CLI to display the error `Unrecognized command` in response to the ?. The CLI displays the command again as last entered.

```
> show dd?
% Unrecognized command
> show dd
```

When you press the Enter key after typing an invalid command, the CLI displays:

```
(config)#router ospf here
                          ^
% Invalid input detected at '^' marker.
```

where the ^ points to the first character in error in the command.

If a command is incomplete, the CLI displays the following message:

```
> show
% Incomplete command.
```

Some commands are too long for the display line and can wrap mid-parameter or mid-keyword, as shown below. This does *not* cause an error and the command performs as expected:

```
area 10.10.0.18 virtual-link 10.10.0.19 authent
ication-key 57393
```

Command Negation

Many commands have a `no` form that resets a feature to its default value or disables the feature. For example:

- The `ip address` command assigns an IPv4 address to an interface
- The `no ip address` command removes an IPv4 address from an interface

Syntax Conventions

Table 2 on page 14 describes the conventions used to represent command syntax in this reference.

Table 2: Syntax conventions

<table>
<tr><th>Convention</th><th>Description</th><th>Example</th></tr>
<tr><td>monospaced font</td><td>Command strings entered on a command line</td><td>show ip ospf</td></tr>
<tr><td>lowercase</td><td>Keywords that you enter exactly as shown in the command syntax.</td><td>show ip ospf</td></tr>
<tr><td>UPPERCASE</td><td>See Variable Placeholders</td><td>IFNAME</td></tr>
<tr><td>()</td><td>Optional parameters, from which you must select one. Vertical bars delimit the selections. Do not enter the parentheses or vertical bars as part of the command.</td><td>(A.B.C.D|<0-4294967295>)</td></tr>
<tr><td>()</td><td>Optional parameters, from which you select one or none. Vertical bars delimit the selections. Do not enter the parentheses or vertical bars as part of the command.</td><td>(A.B.C.D|<0-4294967295>|)</td></tr>
<tr><td>()</td><td>Optional parameter which you can specify or omit. Do not enter the parentheses or vertical bar as part of the command.</td><td>(IFNAME|)</td></tr>
<tr><td>{}</td><td>Optional parameters, from which you must select one or more. Vertical bars delimit the selections. Do not enter the braces or vertical bars as part of the command.</td><td>{intra-area <1-255>|inter-area <1-255>|external <1-255>}</td></tr>
</table>

Table 2: Syntax conventions (Continued)

Convention	Description	Example
[]	Optional parameters, from which you select zero or more. Vertical bars delimit the selections. Do not enter the brackets or vertical bars as part of the command.	[<1-65535>|AA:NN|internet|local-AS|no-advertise|no-export]
?	Nonrepeatable parameter. The parameter that follows a question mark can only appear once in a command string. Do not enter the question mark as part of the command.	?route-map WORD
.	Repeatable parameter. The parameter that follows a period can be repeated more than once. Do not enter the period as part of the command.	set as-path prepend .<1-65535>

Variable Placeholders

Table 3 on page 15 shows the tokens used in command syntax use to represent variables for which you supply a value.

Table 3: Variable placeholders

Token	Description
WORD	A contiguous text string (excluding spaces)
LINE	A text string, including spaces; no other parameters can follow this parameter
IFNAME	Interface name whose format varies depending on the platform; examples are: eth0, Ethernet0, ethernet0, xe0
A.B.C.D	IPv4 address
A.B.C.D/M	IPv4 address and mask/prefix
X:X::X:X	IPv6 address
X:X::X:X/M	IPv6 address and mask/prefix
HH:MM:SS	Time format
AA:NN	BGP community value
XX:XX:XX:XX:XX:XX	MAC address
<1-5> <1-65535> <0-2147483647> <0-4294967295>	Numeric range

Command Description Format

Table 4 on page 16 explains the sections used to describe each command in this reference.

Table 4: Command descriptions

Section	Description
Command Name	The name of the command, followed by what the command does and when should it be used
Command Syntax	The syntax of the command
Parameters	Parameters and options for the command
Default	The state before the command is executed
Command Mode	The mode in which the command runs; see Command Modes
Example	An example of the command being executed

Keyboard Operations

Table 5 on page 16 lists the operations you can perform from the keyboard.

Table 5: Keyboard operations

Key combination	Operation
Left arrow or Ctrl+b	Moves one character to the left. When a command extends beyond a single line, you can press left arrow or Ctrl+b repeatedly to scroll toward the beginning of the line, or you can press Ctrl+a to go directly to the beginning of the line.
Right arrow or Ctrl-f	Moves one character to the right. When a command extends beyond a single line, you can press right arrow or Ctrl+f repeatedly to scroll toward the end of the line, or you can press Ctrl+e to go directly to the end of the line.
Esc, b	Moves back one word
Esc, f	Moves forward one word
Ctrl+e	Moves to end of the line
Ctrl+a	Moves to the beginning of the line
Ctrl+u	Deletes the line
Ctrl+w	Deletes from the cursor to the previous whitespace
Alt+d	Deletes the current word
Ctrl+k	Deletes from the cursor to the end of line
Ctrl+y	Pastes text previously deleted with Ctrl+k, Alt+d, Ctrl+w, or Ctrl+u at the cursor

Table 5: Keyboard operations (Continued)

Key combination	Operation
Ctrl+t	Transposes the current character with the previous character
Ctrl+c	Ignores the current line and redisplays the command prompt
Ctrl+z	Ends configuration mode and returns to exec mode
Ctrl+l	Clears the screen
Up Arrow or Ctrl+p	Scroll backward through command history
Down Arrow or Ctrl+n	Scroll forward through command history

Show Command Modifiers

You can use two tokens to modify the output of a `show` command. Enter a question mark to display these tokens:

```
# show users ?
  | Output modifiers
  > Output redirection
```

You can type the | (vertical bar character) to use output modifiers. For example:

```
> show rsvp | ?
  begin     Begin with the line that matches
  exclude   Exclude lines that match
  include   Include lines that match
  last      Last few lines
  redirect  Redirect output
```

Begin Modifier

The `begin` modifier displays the output beginning with the first line that contains the input string (everything typed after the `begin` keyword). For example:

```
# show running-config | begin xe1
...skipping
interface xe1
 ipv6 address fe80::204:75ff:fee6:5393/64
!
interface xe2
 ipv6 address fe80::20d:56ff:fe96:725a/64
!
line con 0
 login
!
end
```

You can specify a regular expression after the `begin` keyword, This example begins the output at a line with either “xe2” or “xe4”:

```
# show running-config | begin xe[2-4]

...skipping
```

```
interface xe2
 shutdown
!
interface xe4
 shutdown
!
interface svlan0.1
 no shutdown
!
route-map myroute permit 2
!
route-map mymap1 permit 10
!
route-map rmap1 permit 2
!
line con 0
 login
line vty 0 4
 login
!
end
```

Include Modifier

The `include` modifier includes only those lines of output that contain the input string. In the output below, all lines containing the word "input" are included:

```
# show interface xe1 | include input
    input packets 80434552, bytes 2147483647, dropped 0, multicast packets 0
    input errors 0, length 0, overrun 0, CRC 0, frame 0, fifo 1, missed 0
```

You can specify a regular expression after the `include` keyword. This examples includes all lines with "input" or "output":

```
#show interface xe0 | include (in|out)put
    input packets 597058, bytes 338081476, dropped 0, multicast packets 0
    input errors 0, length 0, overrun 0, CRC 0, frame 0, fifo 0, missed 0
    output packets 613147, bytes 126055987, dropped 0
    output errors 0, aborted 0, carrier 0, fifo 0, heartbeat 0, window 0
```

Exclude Modifier

The `exclude` modifier excludes all lines of output that contain the input string. In the following output example, all lines containing the word "input" are excluded:

```
# show interface xe1 | exclude input
Interface xe1
  Scope: both
  Hardware is Ethernet, address is 0004.75e6.5393
  index 3 metric 1 mtu 1500 <UP,BROADCAST,RUNNING,MULTICAST>
  VRF Binding: Not bound
  Administrative Group(s): None
  DSTE Bandwidth Constraint Mode is MAM
  inet6 fe80::204:75ff:fee6:5393/64
    output packets 4438, bytes 394940, dropped 0
    output errors 0, aborted 0, carrier 0, fifo 0, heartbeat 0, window 0
    collisions 0
```

You can specify a regular expression after the `exclude` keyword. This example excludes lines with “output” or “input”:

```
# show interface xe0 | exclude (in|out)put
Interface xe0
  Scope: both
  Hardware is Ethernet  Current HW addr: 001b.2139.6c4a
  Physical:001b.2139.6c4a  Logical:(not set)
  index 2 metric 1 mtu 1500 duplex-full arp ageing timeout 3000
  <UP,BROADCAST,RUNNING,MULTICAST>
  VRF Binding: Not bound
  Bandwidth 100m
  DHCP client is disabled.
  inet 10.1.2.173/24 broadcast 10.1.2.255
  VRRP Master of :  VRRP is not configured on this interface.
  inet6 fe80::21b:21ff:fe39:6c4a/64
    collisions 0
```

Redirect Modifier

The `redirect` modifier writes the output into a file. The output is not displayed.

```
# show cli history | redirect /var/frame.txt
```

The output redirection token (>) does the same thing:

```
# show cli history >/var/frame.txt
```

Last Modifier

The `last` modifier displays the output of last few number of lines (As per the user input). The last number ranges from 1 to 9999.

For example:

```
#show running-config | last 10
```

String Parameters

The restrictions in Table 6 on page 20 apply for all string parameters used in OcNOS commands, unless some other restrictions are noted for a particular command.

Table 6: String parameter restrictions

<table>
<tr><th>Restriction</th><th>Description</th></tr>
<tr><td>Input length</td><td>1965 characters or less</td></tr>
<tr><td>Restricted special characters</td><td>“?”, “,”, “>”, “|”, and “=”
The “|” character is allowed only for the <code>description</code> command in interface mode.</td></tr>
</table>

Command Modes

Commands are grouped into modes arranged in a hierarchy. Each mode has its own set of commands. Table P-7 lists the command modes common to all protocols.

Table 7: Common command modes

Name	Description
Executive mode	Also called *view* mode, this is the first mode to appear after you start the CLI. It is a base mode from where you can perform basic commands such as `show`, `exit`, `quit`, `help`, and `enable`.
Privileged executive mode	Also called *enable* mode, in this mode you can run additional basic commands such as `debug`, `write`, and `show`.
Configure mode	Also called *configure terminal* mode, in this mode you can run configuration commands and go into other modes such as interface, router, route map, key chain, and address family. Configure mode is single user. Only one user at a time can be in configure mode.
Interface mode	In this mode you can configure protocol-specific settings for a particular interface. Any setting you configure in this mode overrides a setting configured in router mode.
Router mode	This mode is used to configure router-specific settings for a protocol such as BGP or OSPF.

Command Mode Tree

The diagram below shows the common command mode hierarchy.

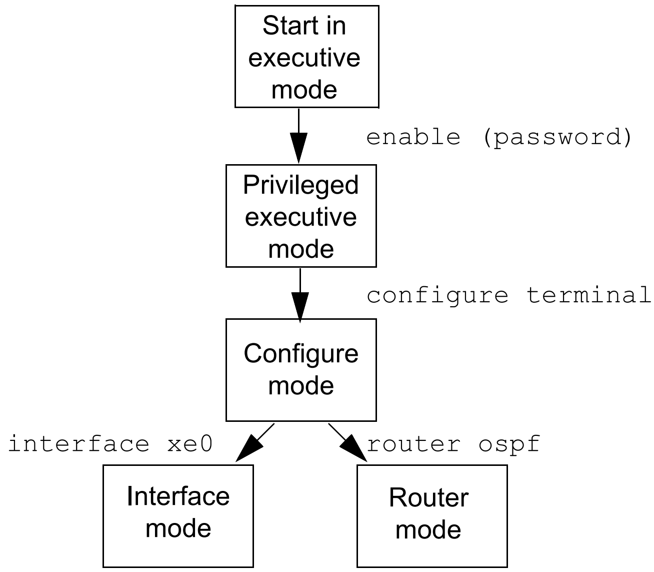


Figure P-1: Common command modes

To change modes:

1. Enter privileged executive mode by entering `enable` in Executive mode.
2. Enter configure mode by entering `configure terminal` in Privileged Executive mode.

The example below shows moving from executive mode to privileged executive mode to configure mode and finally to router mode:

```
> enable mypassword
# configure terminal
Enter configuration commands, one per line.  End with CNTL/Z.
(config)# router ospf
(config-router)#
```

Note: Each protocol can have modes in addition to the common command modes. See the command reference for the respective protocol for details.

Transaction-based Command-line Interface

The OcNOS command line interface is transaction based:

- Any changes done in configure mode are stored in a separate *candidate* configuration that you can view with the `show transaction current` command.
- When a configuration is complete, apply the candidate configuration to the running configuration with the `commit` command.
- If a `commit` fails, no configuration is applied as the entire transaction is considered failed. You can continue to change the candidate configuration and then retry the `commit`.
- Discard the candidate configuration with the `abort transaction` command.
- Check the last aborted transaction with the `show transaction last-aborted` command.
- Multiple configurations cannot be removed with a single `commit` . You must remove each configuration followed by a `commit`

Note: All commands MUST be executed only in the default CML shell (`cmlsh`). If you log in as root and start `imish`, then the system configurations will go out of sync. The `imish` shell is not supported and should not be started manually.

Carrier Ethernet Configuration

CHAPTER 1 Ethernet CFM Configurations

This chapter discusses Ethernet Operations, Administration and Management (OAM) configuration using the Connectivity Fault Management (CFM) protocol.

CFM detects, verifies, isolates and notifies connectivity failures on a Virtual Bridged LAN (B- VLAN) based on the protocol standard specified in IEEE 802.1ag 2007. It provides discovery and verification of paths through 802.1 bridges and LANs and is part of the OAM module. CFM is transparent to customer data being transported by a network and is capable of providing maximum fault management.

Note: CFM session flaps occur if the active LAG member transmitting and receiving CCM PDUs goes down and the LAG re-converges after hardware updates.

Continuity Check Message (CCM)

Topology

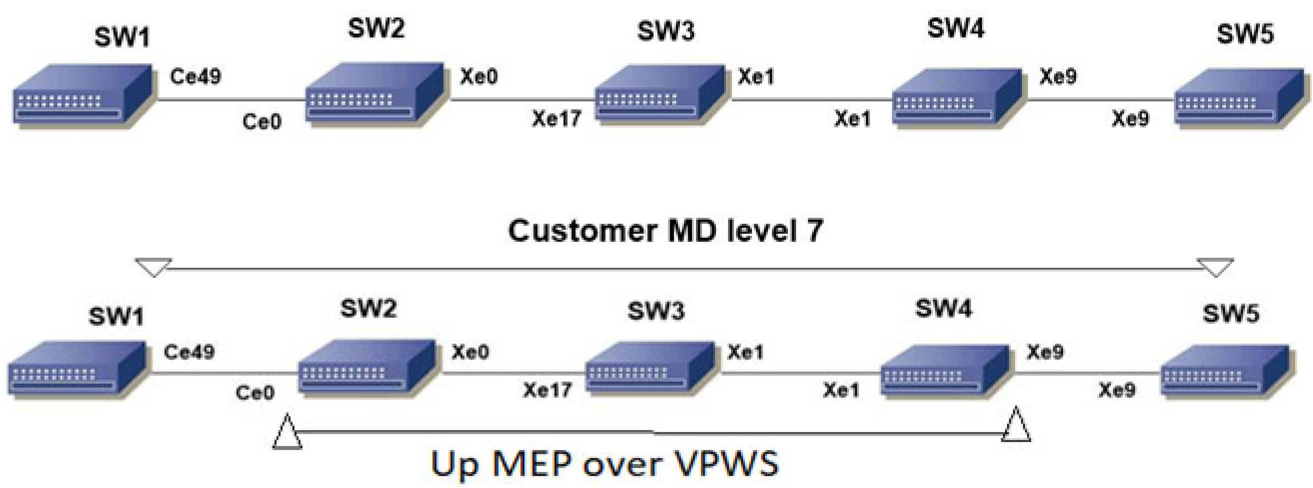


Figure 1-1: CFM Y.1731Topology

Prerequisite

Configure below hardware-profile commands related to CFM in configuration mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable
```

SW1

`SW1#configure terminal`	Enter configure mode.
`SW1(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.

`SW1(config)#vlan database`	Entering vlan database
`SW1(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW1(config-vlan)#exit`	Exit vlan database
`SW1(config)#interface ce49`	Configure interface ce49.
`SW1(config-if)#switchport`	Configure the interface as switch port.
`SW1(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW1(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW1(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce49.
`SW1(config-if)#exit`	Exit config mode.
`SW1(config)#ethernet cfm domain-type character-string domain-name mdnam level 7 mip-creation default`	Create cfm domain with type as character string and set mip creation criteria to default.
`SW1(config-ether-cfm)#service ma-type string ma-name testtm`	Create ma type as string and configure the ma
`SW1(config-ether-cfm-ma)#vlan 25 bridge 1`	Configure vlan-id to associate the vlan to the MA
`SW1(config-ether-cfm-ma)#mip-creation default`	Set the mip creation criteria to default for the MA
`SW1(config-ether-cfm-ma)#ethernet cfm mep down mpid 2 active true ce49`	Create down mep on ce49.
`SW1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast.
`SW1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit CFM MEP configuration mode.
`SW1(config-ether-cfm-ma)#mep crosscheck mpid 1`	Configure crosscheck to remote MEP in VLAN 512.
`SW1(config-ether-cfm-ma)#cc interval 10ms`	Enable cc interval for 10 millisecond.
`SW1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit CFM MA configuration mode.
`SW1(config-ether-cfm)#exit`	Exit ethernet CFM mode.
`SW1(config)#commit`	Commit the configuration
`SW1(config)#exit`	Exit the configure terminal mode

SW2

`SW2#configure terminal`	Enter configure mode.
`SW2(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW2(config)#vlan database`	Entering vlan database
`SW2(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW2(config-vlan)#exit`	Exit vlan database
`SW2(config)#interface ce0`	Configure interface ce0.
`SW2(config-if)#switchport`	Configure the interface as switch port.
`SW2(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW2(config-if)#switchport mode trunk`	Configure interface mode as trunk.

`SW2(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce0.
`SW2(config-if)#exit`	Exit config mode.
`SW2(config)#interface xe0`	Configure interface xe0.
`SW2(config-if)#switchport`	Configure the interface as switch port.
`SW2(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW2(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW2(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe1.
`SW2(config-if)#exit`	Exit the interface mode
`SW2(config)#commit`	Commit the configuration
`SW2(config)#exit`	Exit the configure terminal mode

SW3

`SW3#configure terminal`	Enter configure mode.
`SW3(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW3(config)#vlan database`	Entering vlan database
`SW3(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW3(config-vlan)#exit`	Exit vlan database
`SW3(config)#interface xe17`	Configure interface xe17
`SW3(config-if)#switchport`	Configure the interface as switch port.
`SW3(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW3(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW3(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe17.
`SW3(config-if)#exit`	Exit config mode.
`SW3(config)#interface xe1`	Configure interface xe1.
`SW3(config-if)#switchport`	Configure the interface as switch port.
`SW3(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW3(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW3(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe1.
`SW3(config-if)#exit`	Exit the interface mode
`SW3(config)#commit`	Commit the configuration
`SW3(config)#exit`	Exit the configure terminal mode

SW4

`SW4#configure terminal`	Enter configure mode.
`SW4(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.

`SW4(config)#vlan database`	Entering vlan database
`SW4(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW4(config-vlan)#exit`	Exit vlan database
`SW4(config)#interface xe1`	Configure interface xe1.
`SW4(config-if)#switchport`	Configure the interface as switch port.
`SW4(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW4(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW4(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe1.
`SW4(config-if)#exit`	Exit config mode.
`SW4(config)#interface xe9`	Configure interface xe9.
`SW4(config-if)#switchport`	Configure the interface as switch port.
`SW4(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW4(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW4(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe9.
`SW4(config-if)#exit`	Exit the interface mode
`SW4(config)#commit`	Commit the configuration
`SW4(config)#exit`	Exit the configure terminal mode

SW5

`SW5#configure terminal`	Enter configure mode.
`SW5(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW5(config)#vlan database`	Entering vlan database
`SW5(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW5(config-vlan)#exit`	Exit vlan database
`SW5(config)#interface xe9`	Configure interface xe9.
`SW5(config-if)#switchport`	Configure the interface as switch port.
`SW5(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW5(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW5(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe9.
`SW5(config-if)#exit`	Exit config mode.
`SW5(config)#ethernet cfm domain-type character-string domain-name mdnam level 7 mip-creation default`	Create cfm domain with type as character string and set mip creation criteria to default.
`SW5(config-ether-cfm)#service ma-type string ma-name testtm`	Create ma type as string and set mip creation criteria to default.
`SW5(config-ether-cfm-ma)#vlan 25 bridge 1`	Configure vlan-id to associate the vlan to the MA
`SW5(config-ether-cfm-ma)#mip-creation default`	Set the mip creation criteria to default for the MA

SW5(config-ether-cfm-ma)#ethernet cfm mep down mpid 1 active true xe9	Create down mep on xe9.
SW5(config-ether-cfm-ma-mep)#cc multicast state enable	Enable cc multicast.
SW5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit CFM MEP configuration mode
SW5(config-ether-cfm-ma)#mep crosscheck mpid 2	Configure crosscheck to remote MEP in VLAN 512.
SW5(config-ether-cfm-ma)#cc interval 10ms	Enable cc interval for 10 millisecond.
SW5(config-ether-cfm-ma)#exit-ether-ma-mode	Exit CFM MA configuration mode.
SW5(config-ether-cfm)#exit	Exit ethernet CFM mode.
SW5(config)#commit	Commit the configuration
SW5(config)#exit	Exit the configure terminal mode

Validation

```
SW1#ping ethernet mac 3c2c.9926.e683 unicast source 2 domain mdnam


SW1#traceroute ethernet 3c2c.9926.e683 mepid 2 domain mdnam
MP Mac Hops  Relay-action    Ingress/Egress      Ingress/Egress      action
3c2c.9926.e683    1     RlyHit     Ingress     IngOK

SW1#show ethernet cfm statistics
Continuity Check Messages
CCM Sent     : 184876
CCM Received     : 21651

Loop Back Messages
LBM Sent     : 10
LBR Received(Valid)     : 10
LBR Received(Bad msdu)     : 0
LBR Received(Out-of-Seq): 0

Link Trace Messages
LTM Sent     : 1
LTR Sent     : 0
LTR Received(Valid)     : 1
LTR Received(unexpected): 0

SW1#show ethernet cfm maintenance-points local mep domain mdnam
MPID Dir Lvl VLAN CC-Stat HW-Status     CC-Intvl MAC-Address     Def Port     MD Name
-------------------------------------------------------------------------------
--
2     Dn     7     512     Enable     Installed     10 ms     6cb9.c567.721d F     ce49
mdnam

SW1#show ethernet cfm maintenance-points remote domain mdnam
MEPID RMEPID  LEVEL    LAN     Rx CCM    RDI      PEER-MAC     TYPE
```

```
------------------------------------------------------------------------------
-2     1       7     512     Yes     False     3c2c.9926.e683 Configured

SW1#show ethernet cfm ma status domain mdnam
MA NAME     VLAN     STATUS
-------------------------------------------
testtm     512     Active
```

Continuity Check Message (CCM) Over VPWS

Note: The MEP should not be created on a network interface with L3 component (support is only for UpMep on VPWS).

SW1

`SW1#configure terminal`	Enter configure mode.
`SW1(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW1(config)#vlan database`	Entering VLAN database.
`SW1(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW1(config-vlan)#exit`	Exit config mode.
`SW1(config)#interface ce49`	Configure interface ce49.
`SW1(config-if)#switchport`	Configure the interface as switch port.
`SW1(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW1(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW1(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce49.
`SW1(config-if)#exit`	Exit interface mode.
`SW1(config)#commit`	Commit the configuration
`SW1(config)#exit`	Exit the configure terminal mode

SW2

`SW2#configure terminal`	Enter configure mode.
`SW2(config)#interface ce0`	Configure interface ce0.
`SW2(config-if)#switchport`	Configure interface as a switch port.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#interface xe0`	Configure interface xe0.
`SW2(config-if)#no switchport`	Configure interface as router port.
`SW2(config-if)#ip address 10.0.0.1/24`	Assign IP address to router port xe0
`SW2(config-if)#no shutdown`	Making the interface up
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#interface lo`	Configure interface lo

`SW2(config-if)#ip address 1.1.1.1/32 secondary`	Configure secondary IP address to loopback interface .
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#router ospf 100`	Configure ospf
`SW2(config-router)#network 10.0.0.0/24 area 0`	Advertising 10 network
`SW2(config-router)#network 1.1.1.1/32 area 0`	Advertising loopback IP
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#router rsvp`	Configuring rsvp
`SW2(config-router)#hello-receipt`	Configuring hello reception
`SW2(config-router)#no php`	Configuring device as not a PHP
`SW2(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#rsvp-trunk to-1 ipv4`	Configuring RSVP path
`SW2(config-trunk)#to 2.2.2.2`	Configuring first hop
`SW2(config-trunk)#to 3.3.3.3`	Configuring second hop
`SW2(config-trunk)#exit`	Exit trunk mode.
`SW2(config)#interface xe0`	Configuring interface
`SW2(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW2(config-if)#label-switching`	Enabling MPLS labeling
`SW2(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#router ldp`	Configuring LDP
`SW2(config-router)#targeted-peer ipv4 3.3.3.3`	Configuring LDP target peer for PW
`SW2(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit target peer mode
`SW2(config-router)#no multicast-hellos`	Disabling LDP multicast
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#mpls l2-circuit ETH-2001 1 3.3.3.3`	Creating VPWS PW
`(config-pseudowire)#exit`	Exit pseudowire config mode.
`SW2(config)#service-template ETH-2001`	Configuring service template profile for PW
`SW2(config-svc)#match outer-vlan 200`	Configuring match condition
`SW2(config-svc)# rewrite ingress push 2000`	Configuring action for match
`SW2(config-svc)#exit`	Exit service template mode
`SW2(config)#interface ce0`	Configuring interface
`SW2(config-if)#mpls-l2-circuit ETH-2001 service-template ETH-2001`	Mapping VPWS in AC
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#hardware-profile filter cfm-domain-name-str enable`	Enabling HW filter for character string domain name

`SW2(config)#ethernet cfm domain-type character-string domain-name 12345 level 7 mip-creation none`	Configuring CFM domain over VPWS
`SW2(config-ether-cfm-mpls-md)#service ma-type string ma-name 43981 mip-creation none`	Creating MA for domain
`SW2(config-ether-cfm-mpls-md-ma)#cc interval 100ms`	Configuring CFM interval
`SW2(config-ether-cfm-mpls-md-ma)#mep crosscheck mpid 1`	Configuring remote mep
`SW2(config-ether-cfm-mpls-md-ma)#ethernet cfm mep up mpid 4001 active true vpws ETH-2001`	Configuring local mep and mapping the same with vpws service
`SW2(config-ether-cfm-mpls-ma-mep)#cc multicast state enable`	Enabling the CFM multicast
`SW2(config-ether-cfm-mpls-ma-mep)#exit-ether-ma-mep-mode`	Exit CFM MEP configuration mode
`SW2(config-ether-cfm-mpls-md-ma)# exit-ether-ma-mode`	Exit Ethernet CFM MD configuration mode
`SW2(config-ether-cfm-mpls-md)# exit`	Configuring LM profile
`SW2(config)#ethernet cfm loss-measurement profile-name lmm`	Configuring LM profile
`SW2(config-cfm-lm)#measurement-type lmm`	Configuring measurement type as LMM
`SW2(config-cfm-lm)#message-period 3`	Configuring message period
`SW2(config-cfm-lm)#measurement-interval 1`	Configuring measurement interval
`SW2(config-cfm-lm)#intervals-stored 3`	Configuring number of interval to be stored
`SW2(config-cfm-lm)#exit`	Exit cfm loss measurement mode
`SW2(config)#commit`	Commit the configuration
`SW2(config)#exit`	Exit the configure terminal mode

SW3

`SW3#configure terminal`	Enter configure mode.
`SW3(config)#interface xe1`	Configure interface
`SW3(config-if)#no switchport`	Configure interface as router port.
`SW3(config-if)#ip address 20.0.0.1/24`	Assign IP address to router port
`SW3(config-if)#no shutdown`	Making the interface up
`SW3(config-if)#exit`	Exit interface mode.
`SW3(config)#interface xe17`	Configure interface
`SW3(config-if)#no switchport`	Configure interface as router port.
`SW3(config-if)#ip address 10.0.0.2/24`	Assign IP address to router port
`SW3(config-if)#no shutdown`	Making the interface up
`SW3(config-if)#exit`	Exit interface mode.
`SW3(config)#interface lo`	Configure interface lo
`SW3(config-if)#ip address 2.2.2.2/32 secondary`	Configure secondary IP address to loopback interface .
`SW3(config-if)#exit`	Exit interface mode.

`SW3(config)#router ospf 100`	Configure ospf
`SW3(config-router)#network 10.0.0.0/24 area 0`	Advertising 10 network
`SW3(config-router)#network 20.0.0.0/24 area 0`	Advertising 10 network
`SW3(config-router)#network 2.2.2.2/32 area 0`	Advertising loopback IP
`SW3(config-router)#exit`	Exit router mode.
`SW3(config)#router rsvp`	Configuring rsvp
`SW3(config-router)#hello-receipt`	Configuring hello reception
`SW3(config-router)#no php`	Configuring device as not a PHP
`SW3(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW3(config-router)#exit`	Exit router mode.
`SW3(config)#interface xe1`	Configuring interface
`SW3(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW3(config-if)#label-switching`	Enabling MPLS labeling
`SW3(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW3(config-if)#exit`	Exit interface mode.
`SW3(config)#interface xe17`	Configuring interface
`SW3(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW3(config-if)#label-switching`	Enabling MPLS labeling
`SW3(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW3(config-if)#exit`	Exit interface mode.
`SW3(config)#commit`	Commit the configuration
`SW3(config)#exit`	Exit configure terminal mode

SW4

`SW4#configure terminal`	Enter configure mode.
`SW4(config)#interface xe9`	Configure interface
`SW4(config-if)#switchport`	Configure interface as switch port.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#interface xe1`	Configure interface
`SW4(config-if)#no switchport`	Configure interface as router port.
`SW4(config-if)#ip address 20.0.0.2/24`	Assign IP address to router port
`SW4(config-if)#no shutdown`	Making the interface up
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#interface lo`	Configure interface lo
`SW4(config-if)#ip address 3.3.3.3/32 secondary`	Configure secondary IP address to loopback interface .
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#router ospf 100`	Configure ospf
`SW4(config-router)#network 20.0.0.0/24 area 0`	Advertising 10 network

`SW4(config-router)#network 3.3.3.3/32 area 0`	Advertising loopback IP
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#router rsvp`	Configuring rsvp
`SW4(config-router)#hello-receipt`	Configuring hello reception
`SW4(config-router)#no php`	Configuring device as not a PHP
`SW4(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#rsvp-trunk to-1 ipv4`	Configuring RSVP path
`SW4(config-trunk)#to 2.2.2.2`	Configuring first hop
`SW4(config-trunk)#to 1.1.1.1`	Configuring second hop
`SW4(config-trunk)#exit`	Exit trunk mode.
`SW4(config)#interface xe1`	Configuring interface
`SW4(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW4(config-if)#label-switching`	Enabling MPLS labeling
`SW4(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#router ldp`	Configuring LDP
`SW4(config-router)#targeted-peer ipv4 1.1.1.1`	Configuring LDP target peer for PW
`SW4(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit target peer mode
`SW4(config-router)#no multicast-hellos`	Disabling LDP multicast
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#mpls l2-circuit ETH-2001 1 1.1.1.1`	Creating VPWS PW
`(config-pseudowire)#exit`	Exit pseudowire config mode.
`SW4(config)#service-template ETH-2001`	Configuring service template profile for PW
`SW4(config-svc)# match outer-vlan 200`	Configuring match condition
`SW4(config-svc)# rewrite ingress push 2000`	Configuring action for match
`SW4(config-svc)#exit`	Exit service template mode
`SW4(config)#interface xe9`	Configuring interface
`SW4(config-if)#mpls-l2-circuit ETH-2001 service-template ETH-2001`	Mapping VPWS in AC
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#hardware-profile filter cfm-domain-name-str enable`	Enabling HW filter for character string domain name
`SW4(config)#ethernet cfm domain-type character-string domain-name 12345 level 7 mip-creation none`	Configuring CFM domain over VPWS
`SW4(config-ether-cfm-mpls-md)#service ma-type string ma-name 43981 mip-creation none`	Creating MA for domain
`SW4(config-ether-cfm-mpls-md-ma)#cc interval 100ms`	Configuring CFM interval

`SW4(config-ether-cfm-mpls-md-ma)#mep crosscheck mpid 4001`	Configuring remote mep
`SW4(config-ether-cfm-mpls-md-ma)#ethernet cfm mep up mpid 1 active true vpws ETH-2001`	Configuring local mep and mapping the same with vpws service
`SW4(config-ether-cfm-mpls-ma-mep)#cc multicast state enable`	Enabling the CFM multicast
`SW4(config-ether-cfm-mpls-ma-mep)#ethernet cfm loss-measurement reply lmm`	Configuring LMR
`SW4(config-ether-cfm-mpls-ma-mep)#exit-ether-ma-mep-mode`	Exit CFM MEP configuration mode
`SW4(config-ether-cfm-mpls-md-ma)#exit-ether-ma-mode`	Exit CFM MA configuration mode
`SW4(config-ether-cfm-mpls-md)#exit`	Exit Ethernet CFM MD configuration mode
`SW4(config)#commit`	Commit the configuration
`SW4(config)#exit`	Exit configure terminal mode

SW5

`SW5#configure terminal`	Enter configure mode.
`SW5(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW5(config)#vlan database`	Entering VLAN database.
`SW5(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW5(config-vlan)#exit`	Exit config mode.
`SW5(config)#interface xe9`	Configure interface ce49.
`SW5(config-if)#switchport`	Configure the interface as switch port.
`SW5(config-if)#bridge-group 1`	Configure interface in bridge group 1
`SW5(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW5(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce49.
`SW5(config-if)#exit`	Exit interface mode.
`SW5(config)#commit`	Commit the configuration
`SW5(config)#exit`	Exit configure terminal mode

Validation

```
SW1#show ethernet cfm maintenance-points remote domain 12345
 MEPID     RMEPID     LEVEL     Rx CCM    RDI    PEER-MAC        TYPE
----------------------------------------------------------------------
 200       100        7         Yes       False  b86a.97d2.27d0 Configured

SW1#show ethernet cfm ma status domain 12345
MA NAME                  STATUS
-------------------------------
  43981                  Active
```

EVPN-ELINE CFM Sub-Interface on Multi-Homing

The Connectivity Fault Management (CFM) feature enhances the product offering for the Ethernet LINE (ELINE) services in multi- homing scenarios. To route the traffic between two routers, create two sub interfaces within the physical interface, assign each sub interface an IP address within each subnet and then route the data between two subnets.

CFM multi-homing allows customer edge (CE) device to connect more than one provider edge (PE) device. Multi-homing ensures redundant connectivity. The redundant PE device ensures that there is no traffic disruption when there is a network failure.

The following topology, configurations and validation section describe EVPN-ELINE CFM Sub-Interface on Multi Homing devices.

Topology

The following topology consists of customer edge routers CE1 and CE2 with IPv2 Provider Edge routers PE1 and PE2. These are interconnected through the core router P in the IPv4 MPLS provider networks.

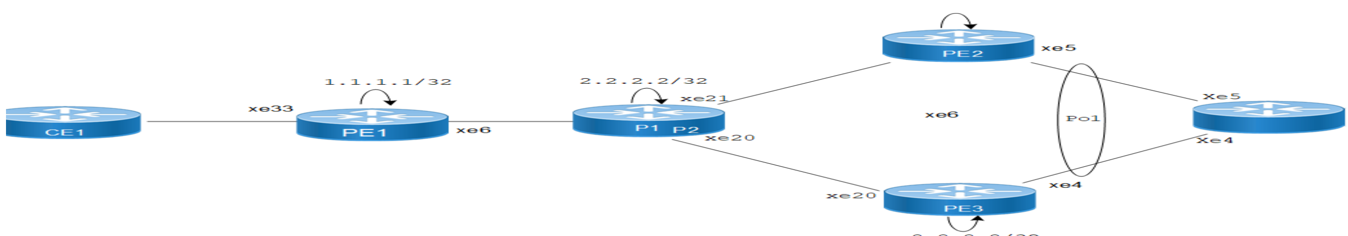


Figure 1-2: CFM Sub-Interface on Multi Homing

Configuration

The following sessions displays the detailed information about configurations, and validations for CFM over sub-interface.

PE1: Loopback Interface

Configure Loopback Interface on PE1

.

`PE1(#configure terminal`	Enter the configure mode
`PE1(config)#interface lo`	Enter the Interface mode for the loopback interface
`PE1(config-if)#ip address 1.1.1.1/32 secondary`	Configure IP address on loop-back interface
`PE1(config-if)#exit`	Exit the interface mode
`PE1(config-if)#commit`	Commit the transaction

PE1: Global LDP

Configure Global LDP on PE1

.

`PE1(config)#router ldp`	Enter the Router LDP mode
`PE1(config-router)#router-id 1.1.1.1`	Set the router ID to IP address 1.1.1.1
`PE1(config-router)#targeted-peer ipv4 7.7.7.7`	Configure targeted peer
`PE1(config-router)#targeted-peer ipv4 8.8.8.8`	Configure targeted peer
`PE1(config-router-targeted-peer)#exit`	Exit targeted-peer-mode
`PE1(config-router)#exit`	Exit from router target peer and LDP mode
`PE1(config-router)#commit`	Commit the transaction

PE1: Global EVPN MPLS Command

Configure Global EVPN MPLS Command on PE1

.

`PE1(config)#evpn mpls enable`	Enable EVPN MPLS
`PE1(config)#commit`	Commit candidate configuration to be running configuration
`PE1(config)#evpn mpls vtep-ip-global1.1.1.1`	Configure VTEP global IP to loopback IP

PE1: Interface Configuration Network Side

Configure Interface Network Side on PE1.

`PE1(config)#interface xe33`	Enter the Interface mode for xe33
`PE1(config-if)#ip address 10.1.0.1/16`	Configure IP address on the interface
`PE1(config-if)#enable-ldp ipv4`	Enable LDP on the physical interface
`PE1(config-if)#label-switching`	Enable label switching on the interface
`PE1(config-if)#exit`	Exit interface mode
`PE1(config-if)#commit`	Commit the transaction

PE1: OSPF Configuration

Configure OSPF on PE1

.

`PE1(config)#router ospf 1`	Enter the Router OSPF mode
`PE1(config-router)#ospf router-id 1.1.1.1`	Router-ID configurations
`PE1(config-router)#network 1.1.1.1/32 area 0.0.0.0`	Advertise the loopback address in the OSPF
`PE1(config-router)#network 10.1.0.0/16 area 0.0.0.0`	Advertise the network address in the OSPF
`PE1(config-router)#exit`	Exit router OSPF mode and return to Configure mode
`PE1(config)#commit`	Commit the transaction

PE1: BGP Configuration

Configure BGP on PE1.

`PE1(config)#router bgp 1`	Enter the Router BGP mode, ASN: 1
`PE1(config-router)#neighbor 7.7.7.7 remote-as 1`	Configure neighbor as iBGP neighbor
`PE1(config-router)#neighbor 7.7.7.7 update-source lo`	Source of routing updates as loop-back
`PE1(config-router)#neighbor 8.8.8.8 remote-as 1`	Configure Neighbor as iBGP neighbor
`PE1(config-router)#neighbor 8.8.8.8 update-source lo`	Source of routing updates as loop-back
`PE1(config-router)#address-family l2vpn evpn`	Enter into address family mode as EVPN
`PE1(config-router-af)#neighbor 7.7.7.7 activate`	Enable the EVPN Address family for neighbor
`PE1(config-router-af)#neighbor 8.8.8.8 activate`	Enable the EVPN Address family for neighbor
`PE1(config-router-af)#exit`	Exit the Address family mode
`PE1(config-router)#exit`	Exit the router Address
`PE1(config)#commit`	Commit the transaction
`PE1(config-router)#commit`	Commit the transaction

PE1: MAC VRF Configuration

Configure MAC VRF on PE1

.

`PE1(config)#mac vrf vrf2`	Enter VRF mode
`PE1(config-vrf)#rd 1.1.1.1:2`	Configure route-distinguisher value 1.1.1.1:2
`PE1(config-vrf)#route-target both 2:2`	Configure import and export value as 2:2
`PE1(config-vrf)#exit`	Exit VRF Mode
`PE1(config-router)#commit`	Commit the transaction

PE1: EVPN and VRF Mapping

Configure EVPN and VRF Mapping on PE1

.

`PE1(config)#evpn mpls id 52 xconnect target-mpls-id 2`	Configure the EVPN-VPWS identifier with source identifier2 and target identifier 2
`PE1(config-evpn-mpls)#host-reachability-protocol evpn-bgp vrf2`	Map VRF "VRF2" to EVPN-VPWS identifier

PE1: Access Port Configuration

Configure Access Port on PE1.

`PE1(config)#interface xe33`	Enter the Interface mode for xe33
`PE1(config-if)#interface xe33.2 switchport`	Create L2 sub interface of physical interface xe33
`PE1(config-if)#description access-side-int`	Provide the interface description
`PE1(config-if)#encapsulation dot1q 2`	Set encapsulation to dot1q with VLAN ID 2
`PE1(config-if)#access-if-evpn`	Enter the access mode for EVPN MPLS ID configuration

`PE1(config-access-if)#map vpn-id 52`	Map VPN-id 52 to interface xe33.2 (VPWS)
`PE1(config-access-if)#exit`	Exit out of access interface mode
`PE1(config)#exit`	Commit the transaction

P: Loop-back Interface

Configure Loopback Interface P.

`P(#configure terminal`	Enter configure mode
`P(config)#interface lo`	Enter the Interface mode for the loop-back interface
`P(config-if)#ip address 2.2.2.2/32secondary`	Configure IP address on loop-back interface
`P(config-if)#exit`	Exit interface mode
`P(config)#commit`	Commit the transaction

P: Global LDP

Configure Global LDP on P.

`P(config)#router ldp`	Enter the Router LDP mode
`P(config-router)#router-id 2.2.2.2`	Set the router ID to IP address 2.2.2.2
`P(config-router)#exit`	Exit from router target peer and LDP mode
`P(config-router)#commit`	Commit the transaction

P: Interface Configuration

Configure Interface on P.

`P(config)#interface xe6`	Enter the Interface mode for xe6
`P(config-if)#ip address 10.1.0.2/16`	Configure IP address on the interface
`P(config-if)#enable-ldp ipv4`	Enable LDP on the physical interface
`P(config-if)#label-switching`	Enable label switching on the interface
`P(config-if)#exit`	Exit interface mode
`P(config)#interface xe21`	Enter the Interface mode for xe21
`P(config-if)#ip address 123.1.1.1/24`	Configure IP address on the interface
`P(config-if)#enable-ldp ipv4`	Enable LDP on the physical interface
`P(config-if)#label-switching`	Enable label switching on the interface
`P(config-if)#exit`	Exit interface mode
`P(config)#interface xe20`	Enter the Interface mode for xe20
`P(config-if)#ip address 124.1.1.1/24`	Configure IP address on the interface
`P(config-if)#enable-ldp ipv4`	Enable LDP on the physical interface
`P(config-if)#label-switching`	Enable label switching on the interface
`P(config-if)#exit`	Exit the interface mode
`P(config)#commit`	Commit the transaction

P: OSPF Configuration

Configure OSPF on P.

P(config)#router ospf 1	Enter the router OSPF mode
P(config-router)#ospf router-id 2.2.2.2	Set the router ID as loop-back IP
P(config-router)#network 2.2.2.2/32 area0	Advertise loop-back address in OSPF
P(config-router)#network 10.1.0.0/16 area 0.0.0.0	Advertise xe3 network address in the OSPF that comes under same subnet
P(config-router)#network 123.1.1.0/24 area 0.0.0.0	Advertise the network address in the OSPF that comes under same subnet
P(config-router)#network 124.1.1.0/24 area 0.0.0.0	Advertise the network address in the OSPF that comes under same subnet
P(config-router)#exit	Exit the router OSPF mode and return to configure mode
POcNOS(config)#commit	Commit the candidate configuration to the running configuration

PE2: Loopback Interface

Configure Loopback Interface on PE2.

PE2#configure terminal	Enter the configure mode
PE2(config)#interface lo	Enter the Interface mode for the loopback interface
PE2(config-if)#ip address 7.7.7.7/32 secondary	Configure IP address on loopback interface.
PE2(config-if)#exit	Exit interface mode
PE2(config)#commit	Commit the transaction

PE2: Global LDP

Configure Global LDP on PE2.

.

PE2(config)#router ldp	Enter the router LDP mode
PE2(config-router)#router-id 7.7.7.7	Set the router ID to IP address 7.7.7.7
PE2(config-router)#targeted-peer ipv4 1.1.1.1	Configure the targeted peer
PE2(config-router-targeted-peer)# targeted-peer ipv4 8.8.8.8	Configure the targeted peer
PE2(config-router-targeted-peer)#exit	Exit targeted-peer-mode
PE2(config-router)#exit	Exit from router target peer and LDP mode
PE2(config)#commit	Commit the transaction

PE2: Global EVPN MPLS Command

Configure Global MPLS Command on PE2.

`PE2(config)#evpn mpls enable`	Enable EVPN MPLS Note: Reload is required after Enabling or Disabling EVPN MPLS
`PE2(config)#evpn mpls vtep-ip-global 7.7.7.7`	Configure VTEP global IP to loop-back IP
`PE2(config)#hardware-profile filter evpn-mpls-mh enable`	Enable hardware-profile filter EVPN-MPLS-MH
`PE2(config)#evpn mpls multihoming enable`	Enable Multi homing
`PE2(config)#commit`	Commit the transaction Reboot the system to bring up the ILM installation in hardware

PE2: Interface Configuration Network Side

Configure Interface Configuration Network Side on PE2.

`PE2(config)#interface xe21`	Enter the isnterface mode for xe21
`PE2(config-if)#ip address 123.1.1.2/24`	Configure IP address on the interface
`PE2(config-if)#enable-ldp ipv4`	Enable LDP on the physical interface
`PE2(config-if)#label-switching`	Enable label switching on the interface
`PE2(config-if)#exit`	Exit the interface mode
`PE2(config)#commit`	Commit the transaction

PE2: OSPF Configuration

Configure OSPF on PE2.

`PE2(config)#router ospf 1`	Enter the Router OSPF mode
`PE2(config-router)#ospf router-id 7.7.7.7`	Router-ID configurations
`PE2(config-router)#network 7.7.7.7/32 area 0.0.0.0`	Advertise the loop-back address in OSPF
`PE2(config-router)#network 123.1.1.0/24 area 0.0.0.0`	Advertise the network address in OSPF
`PE2(config-router)#exit`	Exit the router OSPF mode and return to configure mode
`PE2(config)#commit`	Commit the candidate configuration to the running configuration

PE2: BGP Configuration

Configure BGP on PE2.

`PE2(config)#router bgp 1`	Enter the Router BGP mode, ASN: 1
`PE2(config-router)#neighbor 1.1.1.1 remote-as 1`	Configure Neighbor as iBGP neighbor
`PE2(config-router)#neighbor 1.1.1.1 update-source lo`	Source of routing updates as loop-back
`PE2(config-router)#neighbor 8.8.8.8 remote-as 1`	Configure Neighbor as iBGP neighbor

PE2(config-router)#neighbor 8.8.8.8 update-source lo	Source of routing updates as loop-back
PE2(config-router)#address-family l2vpn evpn	Enter the address family mode as EVPN
PE2(config-router-af)#neighbor 1.1.1.1 activate	Enable EVPN Address family for neighbor
PE2(config-router-af)#neighbor 8.8.8.8 activate	Enable EVPN Address family for neighbor
PE2(config-router-af)#exit	Exit the Address family mode
PE2(config)#commit	Commit the transaction

PE2: MAC VRF Configuration

Configure MAC VRF on PE2.

PE2(config)#mac vrf vrf2	Enter VRF mode
PE2(config-vrf)#rd 7.7.7.7:2	Configure Route-Distinguisher value 7.7.7.7:2
PE2(config-vrf)#route-target both 2:2	Configure import and export value as 2:2 Support: route-target export route-target import
PE2(config-vrf)#exit	Exit the VRF Mode

PE2: Access Port Configuration

Configure on Access Port PE2.

PE2(config)#interface po1	Enter the Interface mode for po1
PE2(config-if)#load-interval 30	Load interval setting
PE2(config-if)#evpn multi-homed system-mac 0000.aaaa.bbbc	Configure ESI on a link on which Multi homed CE isconnected
PE2(config-if)#interface po1.2 switchport	Create L2 sub interface of Dynamic LAG PO1
PE2(config-if)#encapsulation dot1q 2	Set Encapsulation to dot1q with VLAN ID 2 Supported Encapsulation: dot1ad, dot1q, untagged, default
PE2(config-if)#access-if-evpn	Enter Access mode for EVPN MPLS ID configuration
PE2(config-access-if)#map vpn-id 2	Map VPN-id 2 to interface xe2.2 (VPWS)
PE2(config-access-if)#exit	Exit out of access interface mode

PE2: Interface Configuration Acess Side

Configure Interface Configuration Acess Side on PE2

PE2(config-if)#interface xe5	Enter the Interface mode for xe5
PE2(config-if)#channel-group 1 mode active	Move the interface to Dynamic LAG 1
PE2(config)#commit	Commit the transaction

PE3: Loopback Interface

Configure Loopback Interface on PE3.

PE3#configure terminal	Enter the configure mode
PE3(config)#interface lo	Enter the Interface mode for the loop-back interface
PE3(config-if)#ip address 8.8.8.8/32 secondary	Configure the IP address on loop-back interface
PE3(config-if)#exit	Exit interface mode
PE3(config)#commit	Commit the transaction

PE3: Global LDP

Configure Global LDP on PE3.

PE3(config)#router ldp	Enter the Router LDP mode
PE3(config-router)#router-id 8.8.8.8	Set the router ID to IP address 8.8.8.8
PE3(config-router)#targeted-peer ipv4 1.1.1.1	Configure the targeted peer
PE3(config-router-targeted-peer)# targeted-peer ipv4 7.7.7.7	Configure the targeted peer
PE3(config-router-targeted-peer)#exit	Exit targeted-peer-mode
PE3(config-router)#exit	Exit from router LDP mode
PE3(config)#commit	Commit the transaction

PE3: Global EVPN MPLS Command

Configure Global EVPN MPLS Command on PE3.

PE3(config)#evpn mpls enable	Enable EVPN MPLS
PE3(config)#commit	Commit candidate configuration to be running configuration
PE3(config)#evpn mpls vtep-ip-global8.8.8.8	Configure VTEP global IP to loopback IP
PE3(config)#hardware-profile filter evpn-mpls-mh enable	Enable hardware-profile filter EVPN-MPLS-MH
PE3(config)#evpn mpls multihoming enable	Enable Multi homing
PE3(config)#commit	Commit the transaction Note: Reboot the system to bring up the ILM installation in hardware

PE3: Interface Configuration Network Side

Configure Interface Configuration Network Side on PE3

PE3(config)#interface xe5	Enter the Interface mode for xe5
PE3(config-if)#ip address 124.1.1.2/24	Configure IP address on the interface
PE3(config-if)#enable-ldp ipv4	Enable LDP on the physical interface
PE3(config-if)#label-switching	Enable label switching on the interface
PE3(config-if)#exit	Exit interface mode
PE3(config-if)#interface xe4	Enter the Interface mode for xe4

`PE3(config-if)#channel-group 1 mode active`	Move the Interface to Dynamic LAG 1
`PE3(config)#commit`	Commit the transaction

PE3: Interface Configuration Access Side

Configure Interface Access Side on PE3.

`PE2(config-if)#interface xe4`	Enter the Interface mode for xe4
`PE2(config-if)#channel-group 1 mode active`	Move the Interface to Dynamic LAG 1
`PE2(config)#commit`	Commit the transaction

PE3: OSPF Configuration

Configure OSPF on PE3.

`PE3(config)#router ospf 1`	Enter the Router OSPF mode
`PE3(config-router)#ospf router-id 8.8.8.8`	Router-ID configurations
`PE3(config-router)#network 8.8.8.8/32 area 0.0.0.0`	Advertise loopback address in OSPF
`PE3(config-router)#network 124.1.1.0/24 area 0.0.0.0`	Advertise network address in OSPF
`PE3(config-router)#exit`	Exit the router OSPF mode and return to Configure mode.
`PE3(config)#commit`	Commit the transaction

PE3: BGP Configuration

Configure BGP on PE3.

`PE3(config)#router bgp 1`	Enter the Router BGP mode, ASN: 1
`PE3(config-router)#neighbor 1.1.1.1 remote-as 1`	Configure Neighbor as iBGP neighbor
`PE3(config-router)#neighbor 1.1.1.1 update-source lo`	Source of routing updates as loop-back
`PE3(config-router)#neighbor 7.7.7.7 remote-as 1`	Configure Neighbor as iBGP neighbor
`PE3(config-router)#neighbor 7.7.7.7 update-source lo`	Source of routing updates as loop-back
`PE3(config-router)#address-family l2vpn evpn`	Enter into address family mode as EVPN
`PE3(config-router-af)#neighbor 1.1.1.1 activate`	Enable the EVPN address family for neighbor
`PE3(config-router-af)#neighbor 7.7.7.7 activate`	Enable the EVPN address family for neighbor
`PE3(config-router-af)#exit`	Exit the address family mode
`PE3(config)#commit`	Commit the transaction

PE3: MAC VRF Configuration

Configure MAC VRF on PE3.

`PE3(config)#mac vrf vrf2`	Enter VRF mode
`PE3(config-vrf)#rd 8.8.8.8:2`	Configure Route-Distinguisher value 8.8.8.8:2
`PE3(config-vrf)#route-target both 2:2`	Configure import and export value as 2:2
`PE3(config-vrf)#exit`	Exit VRF mode

PE3: EVPN and MAC VRF Mapping

Configure EVPN and MAC VRF Mapping on PE3

`PE3(config)#evpn mpls id 2  xconnect target-mpls-id 52`	Configure the EVPN-VPWS identifier with source identifier 2 and target identifier 52
`PE3(config-evpn-mpls)#host-reachability-protocol evpn-bgp vrf2`	Map VRF "test" to EVPN-VPWS identifier

PE3: Access Port Configuration

Configure Access Port on PE3.

`PE3(config)#interface po1`	Enter the Interface mode for po1
`PE3(config-if)#load-interval 30`	Load interval setting
`PE3(config-if)#evpn multi-homed system-mac 0000.aaaa.bbbc`	Configure ESI on a link on which Multi homed CE is connected
`PE3(config-if)#interface po1.2 switchport`	Create L2 sub interface of Dynamic LAG po1
`PE3(config-if)#encapsulation dot1q 2`	Set the encapsulation to dot1q with VLAN ID 2 supported encapsulation: dot1ad, dot1q, untagged, default
`PE3(config-if)#access-if-evpn`	Enter the access mode for EVPN MPLS ID configuration
`PE3(config-access-if)#map vpn-id 2`	Map VPN-id 2 to dynamic LAG sub interface po1.2(VPWS)
`PE3(config-access-if)#exit`	Exit the access interface mode

CFM CONFIGURATION

Configure below hardware-profile commands related to CFM in configuration mode.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable
```

PE1

Configure PE1.

`PE1(config)# ethernet cfm domain-type character-string domain-name 12346 level 7 mip-creation none`	Create CFM domain for EVPN ELINE with type as character string and set MIP creation to none
`PE1(config-ether-cfm-mpls-md)# service ma-type string ma-name 124`	Create MA type with string and set MIP creation to none

`PE1(config-ether-cfm-mpls-ma)# ethernet cfm mep up mpid 10 active true xe33.2 vlan 2`	Create up-MEP for local.
`PE1(config-ether-cfm-mpls-ma-mep)#cc multicaststate enable`	Enable CC multicast
`PE1(config-ether-cfm-mpls-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet MA-MEP-mode
`PE1(config-ether-cfm-mpls-ma)#  mep auto-discovery enable`	Enable auto discovery for R-MEP
`PE1(config-ether-cfm-mpls-ma)#cc interval 100`	Enable CC interval with value 2 that is 100 milliseconds
`PE1(config-ether-cfm-mpls-ma)#exit-ether-ma-mode`	Exit the Ethernet MA mode
`PE1(config-ether-cfm-mpls)#exit`	Exit the Ethernet CFM mode
`PE1(config)#exit`	Exit the configure mode
`PE1(config)#commit`	Commit the candidate configuration to the running configuration

PE2/PE3 CFM CONFIG

Configure below hardware-profile commands related to CFM in configuration mode.

```
hardware-profile filter cfm-domain-name-str enable

hardware-profile statistics cfm-ccm enable
```

`PE2(config)# ethernet cfm domain-type character-string domain-name 12346 level 7 mip-creation none`	Create CFM domain for EVPN ELINE with type as character string and set MIP creation to none
`PE2(config-ether-cfm-mpls-md)# service ma-type string ma-name 124`	Create MA type with string and set MIP creation to none
`PE2(config-ether-cfm-mpls-ma)# ethernet cfm mep up mpid 20 active true po1.2 vlan 2`	Create up-MEP for local MEP for VLAN 2
`PE2(config-ether-cfm-mpls-ma-mep)#cc multicaststate enable`	Enable CC multicast
`PE2(config-ether-cfm-mpls-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet MA-MEP-mode
`PE2(config-ether-cfm-mpls-ma)#  mep auto-discovery enable`	Enable mep auto-discovery
`PE2(config-ether-cfm-mpls-ma)#cc interval 100`	Enable CC interval with value 2 that is 100 milliseconds
`PE2(config-ether-cfm-mpls-ma)#exit-ether-ma-mode`	Exit ethernet MA mode
`PE2(config-ether-cfm-mpls)#exit`	Exit ethernet CFM mode
`PE2(config)#exit`	Exit from the configure mode
`PE2(config)#commit`	Commit the candidate configuration to the running configuration

PE3

`PE3(config)# ethernet cfm domain-type character-string domain-name 12346 level 7 mip-creation none`	Create CFM domain for EVPN ELINE with type as character string and set MIP creation to none
`PE3(config-ether-cfm-mpls-md)# service ma-type string ma-name 124`	Create MA type with string and set MIP creation to none
`PE3(config-ether-cfm-mpls-ma)# ethernet cfm mep up mpid 30 active true po1.2 vlan 2`	Create up-MEP for local MEP for VLAN 2
`PE3(config-ether-cfm-mpls-ma-mep)#cc multicaststate enable`	Enable CC multicast
`PE3(config-ether-cfm-mpls-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet MA-MEP-mode
`PE3(config-ether-cfm-mpls-ma)#  mep auto-discovery enable`	Enable mep auto-discovery
`PE3(config-ether-cfm-mpls-ma)#cc interval 100`	Enable CC interval with value 2 that is 100 milliseconds
`PE3(config-ether-cfm-mpls-ma)#exit-ether-ma-mode`	Exit ethernet MA mode
`PE3(config-ether-cfm-mpls)#exit`	Exit ethernet CFM mode
`PE3(config)#exit`	Exit from the configure mode
`PE3(config)#commit`	Commit the candidate configuration to the running configuration

Validation

The following are the validations for PE1 and PE2.

PE1

The following validation is for PE1.

```
PE1#SH evpn mpls xconnect
EVPN Xconnect Info
========================
AC-AC: Local-Cross-connect
AC-NW: Cross-connect to Network
AC-UP: Access-port is up
AC-DN: Access-port is down
NW-UP: Network is up
NW-DN: Network is down
NW-SET: Network and AC both are up



Local                            Remote       Connection-Details
===================================================================================
VPN-ID       EVI-Name      MTU   VPN-ID       Source       Destination
PE-IP           MTU   Type   NW-Status
===================================================================================
52          ----          1500  2           xe33.2       00:00:00:aa:aa:bb:bb:00:00:00
7.7.7.7         1500  AC-NW  NW-SET
```

```
8.8.8.8         1500  ----   ----
PE1#show ethernet cfm errors domain 12346

Domain Name         Level     MEPID     Defects
-----------------------------------------------
12346               7         20        .....

PE1-7011#show ethernet cfm maintenance-points remote domain 12346 ma-name 124
 MEPID     RMEPID     LEVEL     Rx CCM    RDI    PEER-MAC        TYPE
----------------------------------------------------------------------
 10        20         7         Yes       False  00aa.bb00.0002 Learnt
 10        30         7         Yes       False  00aa.dd00.0003 Learnt


PE1-7011#show ethernet cfm maintenance-points local mep domain 12346 ma-name 124
MPID Dir Lvl CC-Stat HW-Status  CC-Intvl MAC-Address    Def Port  MD Name
---------------------------------------------------------------------------
10   Up  7   Enable  Installed  100 ms   3417.ebe4.af22 F   xe33.2 12346

PE1-7011#ping ethernet mac 00aa.bb00.0002 unicast source 10 domain 12346 ma 124
 success rate is  100 (5/5)
PE1-7011#traceroute ethernet 00aa.bb00.0002 mepid 10 domain 12346 ma 124
MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
00aa.bb00.0002   1     RlyHit                Ingress         IngOK

PE1-7011#ping ethernet mac 00aa.dd00.0003 unicast source 10 domain 12346 ma 124
 success rate is  100 (5/5)
PE1-7011#traceroute ethernet 00aa.dd00.0003 mepid 10 domain 12346 ma 124
MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
00aa.dd00.0003   1     RlyHit                Ingress         IngOK
```

PE2/PE3

The following validations for PE2 and PE3.

```
PE2#show evpn mpls xconnect
EVPN Xconnect Info
========================
AC-AC: Local-Cross-connect
AC-NW: Cross-connect to Network
AC-UP: Access-port is up
AC-DN: Access-port is down
NW-UP: Network is up
NW-DN: Network is down
NW-SET: Network and AC both are up

Local                            Remote       Connection-Details
================================ ============
=====================================================================================
VPN-ID       EVI-Name      MTU   VPN-ID       Source       Destination
PE-IP           MTU   Type   NW-Status
```

```
==================================================================================
2          ----         1500  52         po1.2       --- Single Homed Port ---
1.1.1.1         1500  AC-NW  NW-SET
PE2#sh ethernet cfm errors domain 12346

Domain Name          Level     MEPID     Defects
-----------------------------------------------
12346                7         20         .....
PE2#show ethernet cfm maintenance-points local mep domain 12346 ma-name 124
MPID Dir Lvl CC-Stat HW-Status  CC-Intvl MAC-Address    Def Port  MD Name
----------------------------------------------------------------------------
20   Up  7   Enable  Installed  100 ms   00aa.bb00.0002 F   po1.2 12346
PE2#show ethernet cfm maintenance-points remote domain 12346 ma-name 124
 MEPID     RMEPID     LEVEL     Rx CCM    RDI     PEER-MAC        TYPE
-----------------------------------------------------------------------
 20        10         7         Yes       False   3417.ebe4.af22 Learnt

PE2#ping ethernet mac 3417.ebe4.af22 unicast source 10 domain 12346 ma 124
 success rate is  100 (5/5)
PE2#traceroute ethernet 3417.ebe4.af22 mepid 10 domain 12346 ma 124
 MP Mac          Hops  Relay-action          Ingress/Egress  Ingress/Egress action
3417.ebe4.af22   1     RlyHit                 Ingress          IngOK
```

VPWS-CFM and Y1731 over Sub-Interface

To route traffic between two routers create a sub interfaces within the physical interface and assign each sub interface an IP address within each subnet and then route the data between two subnets.The Connectivity Fault Management (CFM) feature enhances Ethernet LINE (ELINE) services. CFM encompasses Continuity Check (CC) and Ping that help with network fault detection and isolation

Virtual Private Wire Service (VPWS) on EVPN-MPLS communicates between two customer points and establishes an EVPN instance between a pair of PEs in a sub interface. It forwards traffic from one network to another network without any Media Access Control (MAC) lookup.

Topology

The following topology consists of customer edge routers, CE1 and CE2 with Provider Edge routers PE1, PE2. They are all connected through the core router P in the IPv4 MPLS provider network.

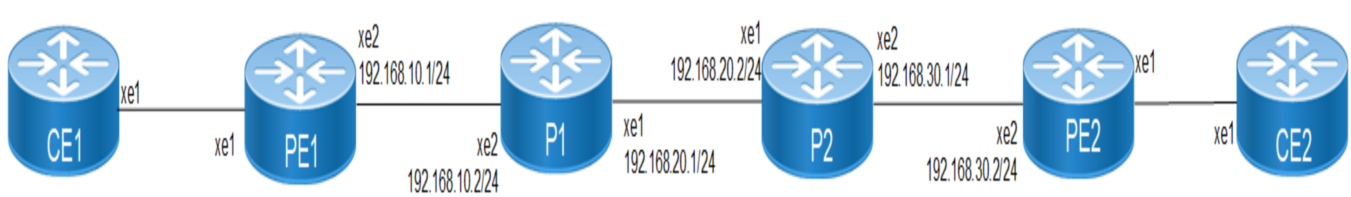


Figure 1-3: VPWS-CFM and Y1731 over Sub-Interface

Configuration

Configure the following hardware-profile commands related to CFM in configuration mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-lm enable
hardware-profile statistics cfm-ccm enable
hardware-profile statistics cfm-slm enable
```

CE1

Configure CE1.

CE1#configure terminal	Enter the configure mode
CE1(config)#bridge 1 protocol ieee vlan-bridge	Configure an IEEE VLAN-aware bridge
CE1(config-if)#commit	Commit the transaction
CE1(config)#vlan database	Enter VLAN configure mode
CE1(config-vlan)#vlan 2001-3000 bridge 1 state enable	Configure a VLAN and add it to the bridge
CE1(config-vlan)#commit	Commit the transaction
CE1(config-vlan)#exit	Exit the VLAN configuration mode
CE1(config)#interface xe1	Enter the interface mode for xe1
CE1(config-if)#switchport	Configure the interface as a layer 2 port
CE1(config-if)#bridge-group 1	Associate the interface to bridge-group 1
CE1(config-if)#switchport mode trunk	Configure the interface mode as trunk
CE1(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface xe1
CE1(config-if)#commit	Commit the transaction

CE2

Configure CE2.

CE2#configure terminal	Enter the configure mode
CE2(config)#bridge 1 protocol ieee vlan-bridge	Configure an IEEE VLAN-aware bridge
CE2(config-if)#commit	Commit the transaction
CE2(config)#vlan database	Enter VLAN configure mode
CE2(config-vlan)#vlan 2001-3000 bridge 1 state enable	Configure a VLAN and add it to the bridge
CE2(config-vlan)#commit	Commit the transaction
CE2(config-vlan)#exit	Exit the VLAN configuration mode
CE2(config)#interface xe1	Enter the Interface mode for xe1
CE2(config-if)#switchport	Configure the interface as a layer 2 port

`CE2(config-if)#bridge-group 1`	Associate the interface to bridge-group 1
`CE2(config-if)#switchport mode trunk`	Configure the interface mode as trunk
`CE2(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe1
`CE2(config-if)#commit`	Commit the transaction

PE1

Configure PE1

`PE1#configure terminal`	Enter configure mode
`PE1(config)#interface lo`	Enter the interface mode for the loopback interface
`PE1(config-if)#ip address 1.1.1.1/32 secondary`	Configure IP address on loopback interface
`PE1(config-if)#commit`	Commit the transaction
`PE1(config-if)#exit`	Exit interface mode
`PE1(config)#router ldp`	Enter the router LDP mode
`PE1(config-router)#targeted-peer ipv4 4.4.4.4`	Configure the targeted peer
`PE1(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit the targeted-peer-mode
`PE1(config-router)#commit`	Commit the transaction
`PE1(config-router)exit`	Exit the interface mode
`PE1(config)#interface xe2`	Enter the interface mode for xe2
`PE1(config-if)# load-interval 30`	Load interval setting
`PE1(config-if)# ip address 192.168.10.1/24`	Configure the IP address on the interface
`PE1(config-if)# label-switching`	Enable label switching on the interface
`PE1(config-if)# enable-ldp ipv4`	Enable LDP on the physical interface
`PE1(config-if)#commit`	Commit the transaction
`PE1(config-if)#exit`	Exit the interface mode
`PE1(config)#router ospf 1`	Enter the router OSPF mode
`PE1(config-router)# ospf router-id 1.1.1.1`	Configure the OSPF router-id
`PE1(config-router)# bfd all-interfaces`	Configure BFD
`PE1(config-router)# network 1.1.1.1/32 area 0.0.0.0`	Advertise the OSPF loopback address
`PE1(config-router)# network 192.168.10.0/24 area 0.0.0.0`	Advertise the OSPF network address
`PE1(config-router)#commit`	Commit the transaction
`PE1(config-router)#exit`	Exit the Interface mode
`PE1(config)#mpls l2-circuit test1 2001 4.4.4.4`	Configure the VC for PE2
`PE1(config-pseudowire)#commit`	Commit the pseudowire transaction
`PE1(config-pseudowire)#exit`	Exit pseudowire configure mode
`PE1(config)#interface xe1.2001 switchport`	Creating L2 sub interface of physical interface xe1

`PE1(config-if)#encapsulation default`	Configure encapsulation
`PE1(config-if)#rewrite push dot1q 2028`	Configure rewrite with push dot1q
`PE1(config-if)#access-if-vpws`	Create the VPWS access-port.
`PE1(config-acc-if-vpws)#mpls-l2-circuit test1 primary`	Add circuit-id on the sub-interface
`PE1(config-acc-if-vpws)#commit`	Commit the configuration
`PE1(config-acc-if-vpws)#exit`	Exit the configure mode
`PE1(config)#ethernet cfm domain-type character-string domain-name 12346 level 7 mip-creation none`	Create the CFM domain and set MIP creation to none
`PE1(config-ether-cfm)#service ma-type string ma-name 124`	Create MA type with string and set MIP creation to none
`PE1(config-ether-cfm-ma)#vpws test1`	Configure VPWS to associate to the MA
`PE1(config-ether-cfm-ma)#ethernet cfm mep up mpid 20 active true vpws test1`	Create MEP up on VPWS
`PE1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`PE1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet MA-MEP-mode
`PE1(config-ether-cfm-ma)#mep crosscheck mpid 10`	Configure cross check to remote MEP
`PE1(config-ether-cfm-ma)#cc interval 10ms`	Enable CC interval value 10 milliseconds
`PE1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet MA-MEP-mode
`PE1(config-ether-cfm)#commit`	Commit the transaction
`PE1(config-ether-cfm)exit`	Exit the transaction
`PE1(config)#ethernet cfm loss-measurement profile-name SLM`	Configuring SLM profile
`PE1(config-cfm-lm)# measurement-type slm`	Configure measurement type as SLM
`PE1(config-cfm-lm)# measurement-interval 1`	Configure measurement interval
`PE1(config-cfm-lm)# intervals-stored 3`	Configure number of interval to be stored
`PE1(config-cfm-lm)# message-period 1s`	Specify message period interval time
`PE1(config-cfm-lm)#exit`	Exit the transaction from SLM
`PE1(config)#ethernet cfm loss-measurement profile-name LM`	Configure LM profile
`PE1(config-cfm-lm)# measurement-type lmm`	Configure measurement type as LMM
`PE1(config-cfm-lm)# measurement-interval 1`	Configure measurement interval
`PE1(config-cfm-lm)# intervals-stored 3`	Configure number of interval to be stored
`PE1(config-cfm-lm)# message-period 1s`	Specify message period interval time
`PE1(config-cfm-lm)#exit`	Exit the transaction from LM
`PE1(config)#ethernet cfm delay-measurement profile-name DM`	Configure the DM profile
`PE1(config-cfm-dm)# measurement-interval 1`	Specify the measurement-interval in minutes
`PE1(config-cfm-dm)# intervals-stored 2`	Set the number of completed measurement intervals to store
`PE1(config-cfm-dm)# message-period 1s`	Specify message period interval time

PE2

Configure PE2.

PE2#config terminal	Enter configure mode
PE2(config)#interface lo	Enter the Interface mode for the loopback interface
PE2(config-if)#ip address 4.4.4.4/32 secondary	Configure IP address on loopback interface
PE2(config-if)#commit	Commit the transaction
PE2(config-if)#exit	Exit interface mode
PE2(config)#router ldp	Enter the router LDP mode
PE2(config-router)#targeted-peer ipv4 1.1.1.1	Configure targeted peer
PE2(config-router-targeted-peer)#exit-targeted-peer-mode	Exit the targeted peer
PE2(config-router)#commit	Commit the transaction
PE2(config-router)exit	Exit interface mode
PE2(config)#interface xe2	Enter the Interface mode for xe2
PE2(config-if)# load-interval 30	Load interval setting
PE2(config-if)# ip address 192.168.30.2/24	Configure IP address on the interface
PE2(config-if)# label-switching	Enable label switching on the interface
PE2(config-if)# enable-ldp ipv4	Enable LDP on the physical interface
PE2(config-if)#commit	Commit the configuration
PE2(config-if)#exit	Exit interface mode
PE2(config)#router ospf 1	Enter the Router OSPF mode.
PE2(config-router)# ospf router-id 4.4.4.4	Configure the OSPF router-id
PE2(config-router)# bfd all-interfaces	Configure BFD on the OSPF interfaces
PE2(config-router)# network 4.4.4.4/32 area 0.0.0.0	Advertise loopback address in OSPF
PE2(config-router)# network 192.168.30.0/24 area 0.0.0.0	Advertise the OSPF network address
PE2(config-router)#commit	Commit the transaction
PE2(config-router)#exit	Exit interface mode
PE2(config)#mpls l2-circuit test1 2001 1.1.1.1	Configure the VC for PE1
PE2(config-pseudowire)#commit	Commit the Pseudowire transaction
PE2(config-pseudowire)#exit	Exit the Pseudowire transaction mode
PE2(config)#interface xe1.2001 switchport	Create the L2 sub interface of physical interface xe1
PE2(config-if)# encapsulation default	Set the encapsulation to default
PE2(config-if)# rewrite push dot1q 2028	Configure rewrite with push dot1q
PE2(config-if)# access-if-vpws	Configure VPWS
PE2(config-acc-if-vpws)# mpls-l2-circuit test1 primary	Configure VPWS to bind an interface to a MPLS
PE2(config-acc-if-vpws)#commit	Commit the VPWS transaction

`PE2(config-acc-if-vpws)#exit`	Exit the VPWS transaction
`PE2(config)#ethernet cfm domain-type character-string domain-name 12346 level 7 mip-creation none`	Create CFM domain for MA type with string and set MIP creation to none
`PE2(config-ether-cfm)# service ma-type string ma-name 124`	Create the CFM MA type with string
`PE2(config-ether-cfm-ma)#vpws test1`	Configure VPWS to associate to the MA
`PE2(config-ether-cfm-ma)#ethernet cfm mep up mpid 10 active true vpws test1`	Create up-MEP for VPWS
`PE2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multi cast to enable
`PE2(config-ether-cfm-ma-mep)#ethernet cfm delay-measurement reply dmm`	Configure the DMR
`PE2(config-ether-cfm-ma-mep)#ethernet cfm loss-measurement reply lmm`	Configure the LMR
`PE2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet MP mode
`PE2(config-ether-cfm-ma)#mep crosscheck mpid 20`	Configure cross check to remote MEP
`PE2(config-ether-cfm-ma)#cc interval 10ms`	Enable CC interval with value 10 milliseconds
`PE2(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet MA mode
`PE2(config-ether-cfm)#commit`	Commit the transaction
`PE2(config-ether-cfm)exit`	Exit the VPWS transaction

P1

Configure P1.

`P1#configure terminal`	Enter configure mode
`P1(config)#interface lo`	Enter the Interface mode for the loopback interface
`P1(config-if)#ip address 2.2.2.2/32 secondary`	Commit the transaction
`P1(config-if)#commit`	Exit the Interface mode
`P1(config-if)#exit`	Configure IP address on loopback interface
`P1(config)#router ldp`	Enter the Router LDP mode
`P1(config-router)#transport-address ipv4 2.2.2.2`	Configure targeted peer
`P1(config-router)#commit`	Commit the transaction
`P1(config-router)exit`	Exit the transaction
`P1(config)#interface xe2`	Enter the Interface mode for xe2
`P1(config-if)# ip address 192.168.10.2/24`	Configure IP address on the interface
`P1(config-if)# label-switching`	Enable label switching on the interface
`P1(config-if)# enable-ldp ipv4`	Enable LDP on the physical interface
`P1(config-if)#commit`	Commit the transaction
`P1(config-if)#exit`	Exit the transaction
`P1(config)#interface xe1`	Enter the Interface mode for xe1

`P1(config-if)# ip address 192.168.20.1/24`	Configure IP address on the interface
`P1(config-if)# label-switching`	Enable label switching on the interface
`P1(config-if)# enable-ldp ipv4`	Enable LDP on the physical interface
`P1(config-if)#commit`	Commit the transaction
`P1(config-if)#exit`	Exit the transaction
`P1(config)#router ospf 1`	Enter the Router OSPF mode
`P1(config-router)# ospf router-id 2.2.2.2`	Configure the OSPF router-id
`P1(config-router)# bfd all-interfaces`	Configure the BFD
`P1(config-router)# network 2.2.2.2/32 area 0.0.0.0`	OSPF loopback address
`P1(config-router)# network 192.168.20.0/24 area 0.0.0.0`	Advertise OSPF network
`P1(config-router)# network 192.168.10.0/24 area 0.0.0.0`	Advertise OSPF network
`P1(config-router)#commit`	Commit the transaction

P2

Configure P2.

`P2#configure terminal`	Enter configure mode
`P2(config)#interface lo`	Enter the Interface mode for the loopback interface
`P2(config-if)#ip address 3.3.3.3/32 secondary`	Configure IP address on loopback interface
`P2(config-if)#commit`	Commit the transaction
`P2(config-if)#exit`	Exit the Interface mode
`P2(config)#router ldp`	Enter the Router LDP mode
`P2(config-router)#transport-address ipv4 3.3.3.3`	Configure targeted peer
`P2(config-router)#commit`	Commit the transaction
`P2(config-router)exit`	Exit the Interface mode
`P2(config)#interface xe1`	Enter the Interface mode for xe1
`P2(config-if)# ip address 192.168.20.2/24`	Configure IP address on the interface
`P2(config-if)# label-switching`	Enable label switching on the interface
`P2(config-if)# enable-ldp ipv4`	Enable LDP on the physical interface
`P2(config-if)#commit`	Commit the transaction
`P2(config-if)#exit`	Exit interface mode
`P2(config)#interface xe2`	Enter the Interface mode for xe2
`P2(config-if)# ip address 192.168.30.1/24`	Configure IP address on the interface
`P2(config-if)# label-switching`	Enable label switching on the interface

P2(config-if)# enable-ldp ipv4	Enable LDP on the physical interface
P2(config-if)#commit	Commit the transaction
P2(config-if)#exit	Exit interface mode
P2(config)#router ospf 1	Enter the Router OSPF mode
P2(config-router)# ospf router-id 3.3.3.3	Configure the OSPF router-id
P2(config-router)# network 3.3.3.3/32 area 0.0.0.0	Advertise loopback address in OSPF
P2(config-router)# network 192.168.30.0/24 area 0.0.0.0	Advertise OSPF network address
P2(config-router)# network 192.168.20.0/24 area 0.0.0.0	Advertise OSPF network address
P2(config-router)#commit	Commit the transaction

Validation

CFM

```
PE1#show ethernet cfm errors domain 12346

Domain Name          Level     MEPID     Defects
-----------------------------------------------
12346                7         20        .....


1. defRDICCM    2. defMACstatus  3. defRemoteCCM
4. defErrorCCM  5. defXconCCM

PE1#show ethernet cfm ma status domain 12346 ma-name 124
MA NAME                  STATUS
124                    Active
```

Ping

```
PE1#ping ethernet mac   e8c5.7ae3.37ee  unicast source 20 domain 12346 ma 124
 success rate is  100 (5/5)
PE1#
```

Traceroute

```
PE1#traceroute ethernet   e8c5.7ae3.37ee mepid 20 domain 12346 ma 124
 MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
e8c5.7ae3.37ee   1     RlyHit                Ingress         IngOK
```

Checking VC Status

```
PE1#show mpls vc-table
```

```
(m) - Service mapped over multipath transport
(e) - Service mapped over LDP ECMP

VC-ID       Vlan-ID  Inner-Vlan-ID  Access-Intf   Network-Intf  Out Label  Tunnel-Label
Nexthop          Status     UpTime
2001        N/A      N/A            xe12001        xe2         26240      25601
4.4.4.4          Active     00:38:0
```

Delay-measurement

```
PE1#delay-measurement type proactive profile-name DM rmep 10 mep 20 domain 12346 ma 124
PE1#2023 Oct 12 04:11:56.696 : PE1 : ONMD : INFO : [CFM_PM_SESSION_INFO_5]: CFM Frame
Delay Measurement session started for MEP Id 20 and RMEP Id 10

PE1#show ethernet cfm delay-measurement mep 20 domain 12346 ma-name 124
 MD                       : 12346
 MA                       : 124
 MEP                      : 20
 VC Name                  : test3
 Peer MAC Address         : e8c5.7ae3.37ee

CURRENT:

 RMEP ID        : 10
 Measurement ID : 1
 Measurement Type             : DMM
 Elapsed time(sec)            : 2
 Start Time                   : 2023 Oct 12 04:11:56
 Suspect Flag                 : FALSE
 Min Frame Delay(usec)        : 40
 Max Frame Delay(usec)        : 74
 Avg Frame Delay(usec)        : 57
 Min Inter FD Variation(usec): 34
 Max Inter FD Variation(usec): 34
 Avg Inter FD Variation(usec): 34



         FRAME DELAY BINS
Bin Number    Bin Threshold(usec)          Bin Counter
 1             0           - < 4999           2
 2             5000        - < 9999           0
 3             10000       - < 14999          0
 4             15000       - < 4294967295     0



       INTER-FRAME DELAY BINS
Bin Number    Bin Threshold(usec)          Bin Counter
 1             0           - < 4999           1
```

```
 2             5000      - < 9999          0
 3             10000     - < 4294967295    0
```

Loss-measurement

```
PE1#loss-measurement type proactive profile-name LM rmep 10 mep 20 domain 12346 ma 124
2023 Oct 12 04:18:43.667 : PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame Loss
Measurement  started for MEP:20 MA:124 MD:12346
PE1#show ethernet cfm loss-measurement mep 20 domain 12346 ma-name 124

MEP: 20 MA: 124
CURRENT:
 Measurement ID : 1
  Suspect                     : False
  Measurement Type            : lmm
  Elapsed time(sec)           : 10
  Start Time                  : 2023 Oct 12 04:18:43
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
  Near End frame loss ratio   : 0
  Far End frame loss ratio    : 0
```

Synthetic Loss Measurement

```
PE1#loss-measurement type proactive profile-name SLM rmep 10 mep 20 domain 12346 ma 124
PE1#2023 Sep 30 07:07:57.166 : PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame Loss
Measurement  started for MEP:20 MA:124 MD:12346

PE1#show ethernet cfm loss-measurement mep 20 domain 12346 ma-name 124
MEP: 20 MA: 124
CURRENT:
 Measurement ID : 2
  Suspect                     : False
  Measurement Type            : slm
  Elapsed time(sec)           : 10
  Start Time                  : 2023 Sep 30 07:08:56
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
  Near End frame loss ratio   : 0
  Far End frame loss ratio    : 0

HISTORY:

 Measurement ID : 1
  Suspect                     : False
```

```
  Measurement Type            : slm
  Elapsed time(sec)           : 60
  End Time                    : 2023 Sep 30 07:08:56
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
  Near End frame loss ratio   : 0
  Far End frame loss ratio    : 0
  Near End frame loss ratio min   : 0
  Far End frame loss ratio min   : 0
  Near End frame loss ratio max   : 0
  Far End frame loss ratio max   : 0
PE1#
PE1#show ethernet cfm maintenance-points count

Total No of MIPs                  : 0
Total No of MEPs                  : 2
Total No of UP MEPs               : 2
Total No of Down MEPs             : 0
Total No of Active CCM sessions   : 2
Total No of UP CCM sessions       : 2
Total No of Active LM sessions    : 2
Total No of Active DM sessions    : 1
```

CHAPTER 2 Y.1564 - Ethernet Service Activation Test Methodology

Overview

This document describes ITU-T Y.1564, a standard for Ethernet Service Activation Testing (SAT). It focuses on validating Service Level Agreements (SLAs) through Key Performance Indicators (KPIs) such as Frame Delay (FD), Frame Loss Ratio (FLR), and Frame Delay Variation (FDV) in a single test. The document also covers traffic classification, service prioritization using Quality of Service (QoS), and performance verification mechanisms like Loopback Messages (LBM).

The SAT feature allows service providers to verify Ethernet service configurations and performance before activating them for customers.

OcNOS switches execute SAT by generating test traffic, collecting performance data, and ensuring SLA compliance before activation. This supports validation for both upstream (traffic entering the network interface) and downstream (traffic exiting the network interface) directions, with results displayed post-test.

The SAT allows service providers to verify Ethernet service configurations and performance before activating them for customers.

Currently, this feature is supported on OcNOS devices equipped with the Qumran2 and Jericho2 chipsets.

Feature Characteristics

An SLA (Service Level Agreement) is a binding agreement between a service provider and a customer, ensuring that the delivered service meets agreed-upon performance levels.

To meet SLA obligations, ITU-T Y.1564 provides a standardized procedure for verifying SLAs by:

Validating service configuration: Ensuring each Ethernet service is correctly set up.

Validating service quality: Ensuring the delivered quality meets user expectations.

Each User Network Interface (UNI) runs multiple services qualified by KPIs. The SAT verifies the network's ability to handle traffic within design parameters, ensuring compliance with Bandwidth Rate Profiles and Performance Criteria.

Bandwidth Profile

The SAT generates traffic based on the configured bandwidth profiles:

- *Committed Information Rate (CIR):* The guaranteed bandwidth available at all times for a specific service.
- *Excess Information Rate (EIR):* Additional bandwidth above the CIR, available based on network load.

OcNOS applies bandwidth profiles that include KPIs to indicate minimum performance requirements. Both CIR and EIR are essential for maintaining SLA compliance.

Performance Criteria

The SAT collects the following KPIs to ensure SLA requirements are met:

- *Frame Delay (FD):* Measures latency, the time taken for a packet to travel from source to destination.
- *Frame Delay Variation (FDV):* Also known as jitter, it measures variability in packet arrival times.
- *Frame Loss Ratio (FLR):* The percentage of packets lost due to errors or network congestion.

Color Codes for Traffic Policing

OcNOS uses traffic color codes to police ingress packets and manage their priority:

- Green: Traffic guaranteed at all times for a specific service.
- Yellow: Best effort traffic, utilizing excess bandwidth when available.
- Red: Traffic dropped without disrupting guaranteed services.

Quality of Service (QoS)

QoS ensures efficient traffic prioritization in the network. By assigning priority levels to each service and using appropriate prioritization algorithms, OcNOS delivers higher service quality for critical traffic. QoS differentiates traffic using specific fields in frames, ensuring higher-priority traffic receives preferential treatment.

Service Traffic Test Types

OcNOS performs the SAT on interfaces provisioned with rate profiles. Performance statistics are collected during the test (either locally at PE1 by looping the traffic back from PE2, if the test is two-way or at PE2, if the test is one-way.), which operates in either:

Upstream: Traffic is generated at the UNI and forwarded towards the network (From PE1 UNI to PE2 UNI).

Downstream: Traffic exit at the interface (PE1 network interface to PE2 network interface).

The illustration below depicts the traffic flow of Upstream and Downstream.

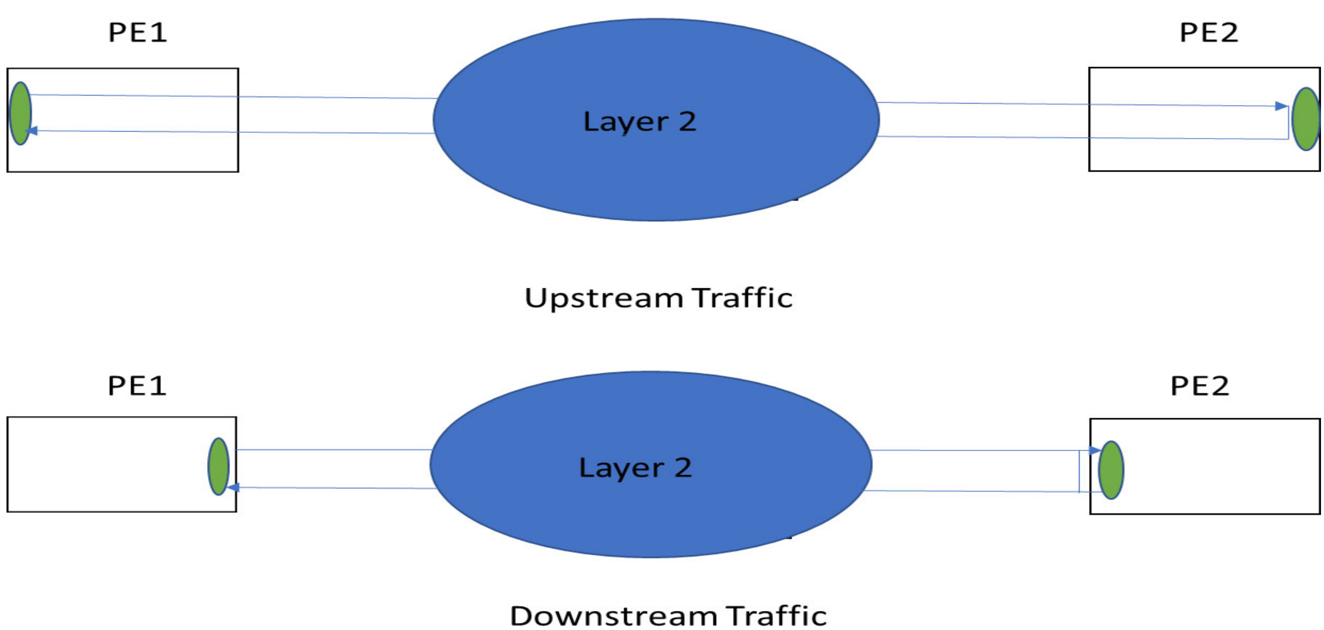


Figure 2-4: Upstream and Downstream Traffic Flow

SAT Performance Statistics

During SAT testing, the following statistics are collected to verify SLA compliance:

- Frame counts
- Errors
- Out-of-order frames

- Lost frames
- Minimum/maximum frame delay
- Frame delay variation

In two-way tests, Loopback Messages (LBM) and Loopback Replies (LBR) are used to measure throughput and frame loss. LBMs are sent as test traffic, while the peer device responds with LBR packets, allowing OcNOS to collect performance data.

SAT Profile Configuration

To perform SAT testing, a rate profile must be configured. It includes parameters such as CIR, EIR, Class of Service (CoS), and Drop Eligibility Indicator (DEI). Multiple test streams can be configured and run sequentially or in parallel.

For delay measurement, Delay Measurement Messages (DMMs) are used:

- When EIR is configured, VLAN priorities alternate between CIR CoS and EIR CoS.
- If EIR is not configured, only CIR CoS is used.

SAT profiles allow for the following operations:

- Create, abort, delete, or start a test
- Clear test history and results
- Configure frame size profiles for non-default frame sizes
- Accept or reject frame loss and delay criteria for CIR traffic
- Delete SAT rate profile or acceptance profile
- Create SAT rate profile or acceptance profile
- Delete SAT frame size profile
- Display SAT test summary and detailed SAT test results

Limitations:

- Supported only on Qumran2 and Jericho2C+ chipsets.
- Limited to 2-way traffic testing.
- CRC validation is not supported for SAT frames due to hardware limitations.
- LBM/LBR supports only a single TLV length, which may cause malformed frames for multiple frame sizes.
- LAG load balancing is supported only for UP MEPs; DOWN MEPs are unsupported.
- Supports a maximum of 8 CIR-EIR stream pairs, allowing up to 32 streams in various configurations. For example, you can configure 8 CIR-EIR pairs alongside 16 CIR-only streams, or alternatively, up to 32 CIR-only streams. This flexibility enables a variety of traffic configurations to accommodate different traffic scenarios.

Benefits

The ITU-T Y.1564-based SAT feature ensures Ethernet services meet SLA requirements before deployment. By validating configuration and performance, it minimizes service disruptions and reduces troubleshooting efforts. The ability to measure KPIs like latency, jitter, and frame loss enables precise SLA verification, resulting in:

- Higher customer satisfaction
- Improved network reliability
- Cost-effective service activation testing

Prerequisites

To implement ITU-T Y.1564 Service Activation Testing (SAT), the following prerequisites must be met:

- **Device Support** - Network devices (e.g., routers, switches) must support ITU-T Y.1564 standards and the necessary traffic generation and measurement features.
- **Configured Network Path** - A properly configured network path for test traffic between the source and destination endpoints is required.
- **Acceptance Criteria** - Clearly defined acceptance criteria for SLAs and performance KPIs (e.g., Frame Delay, Frame Loss Ratio, Frame Delay Variation) to validate test results.

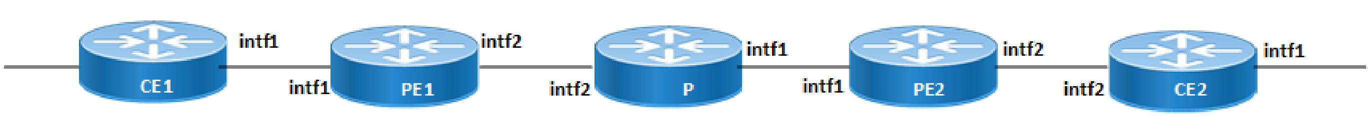
Configuration

Following are the steps required to configure SAT:

1. Configuring rate profiles (CIR, EIR, QoS) that defines the minimum performance standards to ensure.
2. Configuring acceptance profiles (CIR, FLR, FD, FDV). The service must operate at or above the performance levels defined in the acceptance profile to be considered for bringing into service.
3. Configuring frame size profile.
4. Configure a SAT test.
5. Setting up measurement tools, such as Loopback Message (LBM), Loopback Reply (LBR), and Delay Measurement Message (DMM). The packets are generated and responded by OcNOS devices.
6. Executing SAT test by generating traffic in upstream/downstream directions.
7. Collecting and analyzing KPIs.

Topology

The topology uses a EVPN MPLS ELINE services between PE1 and PE2 nodes. It consists of two CE1 and CE2 nodes. Traffic that complies with rate profile is generated on PE1 and sent out through the interface where the service is provisioned.



SAT Topology for EVPN MPLS ELINE Service

Procedure to configure SAT

The procedure given below performs SAT for EVPN MPLS ELINE service. It assumes that the EVPN MPLS ELINE service exist between PE1 and PE2. Ensure the CFM up mep session exists between PE1 and PE2 nodes along with delay-measurement reply on the PE2. Refer to Chapter 5, *Y.1731 and CFM Over EVPN ELINE Single Home*.

Configure PE1

1. Login to PE.

2. Set up SAT rate profile with rate parameters such as profile name, traffic direction two-way, mode generator-receiver, frame transfer delay times, color of the traffic frame is known, CIR value as 1000mbps, CoS 6 DEI 0, EIR value as 500 mbps, CoS 4 DEI 1 and the number of steps required to send the traffic load-step as 1. Following is the sample configuration.

```
(config)#ethernet sat rate-profile r1
(sat_rate_config_profile)#two-way
(sat_rate_config_profile)#mode generator-receiver
(sat_rate_config_profile)#delay-bins min us 1 max ms 1
(sat_rate_config_profile)#color-aware
(sat_rate_config_profile)#cir 1000 mbps cos 6 dei 0
(sat_rate_config_profile)#eir 500 mbps cos 4 dei 1
(sat_rate_config_profile)#load-step 1
(sat_rate_config_profile)#commit
```

3. Create SAT acceptance profile with the performance criteria such as FLR as 0.01, FLR policing as 25.00, FD as 100ms, FDV as 10ms. Following is the sample configuration.

```
(sat_rate_config_profile)#ethernet sat acceptance-profile a1
(sat_acceptance_config_profile)#cir frame-loss-ratio 0.0001
(sat_acceptance_config_profile)#cir frame-loss-ratio-policing 25.0000
(sat_acceptance_config_profile)#cir frame-delay-variation ms 10
(sat_acceptance_config_profile)#cir frame-delay ms 100
(sat_acceptance_config_profile)#commit
```

4. Set Frame size profile with various frame sizes for testing. Following is the sample configuration.

```
(sat_acceptance_config_profile)#ethernet sat frame-size-profile f1
(sat_frame_size_config_profile)#size-a 64
(sat_frame_size_config_profile)#size-b 128
(sat_frame_size_config_profile)#size-c 256
(sat_frame_size_config_profile)#size-d 512
(sat_frame_size_config_profile)#size-e 1024
(sat_frame_size_config_profile)#size-f 1280
(sat_frame_size_config_profile)#size-g 1518
(sat_frame_size_config_profile)#size-u 200
(sat_frame_size_config_profile)#commit
```

5. Configure SAT Test parameters such as traffic direction, streams type, service test for CIR-EIR, service stream, rate profile, acceptance profile, frame size profile, frame sequence, frame data pattern, frame payload, attach configured CFM MD, MA, MEP-ID, and destination MAC as learn from remote PE2 MAC. Following is the sample configuration.

```
(sat_frame_size_config_profile)#ethernet sat sat-test-1
(sat-test)#direction upstream
(sat-test)#stream-run parallel
(sat-test)#service-test cir-eir
(sat-test-service)#service-stream s1
(sat-test-stream)#rate-profile r1
(sat-test-stream)#acceptance-profile a1
(sat-test-stream)#frame-size-profile f1
(sat-test-stream)#frame-sequence bcd
(sat-test-stream)#frame-data-pattern null-sig
(sat-test-stream)#frame-payload
(sat-test-stream-payload)#cfm domain md000 ma ma10 mepid 10
```

```
(sat-test-stream-payload)#dst-mac e8c5.7adb.d59b
(sat-test-stream-payload)#commit
```

6. Execute the SAT test.

```
OcNOS#sat start sat-test-1
```

7. Validate and monitor the SAT test results. To view test summary, execute the below CLI.

```
OcNOS#show ethernet sat summary
```

8. To check the detailed SAT test results, execute the below CLI.

```
OcNOS#show ethernet sat detail sat-test-1
```

9. Abort or clear SAT tests, if required. To abort a running test, execute the below CLI.

```
OcNOS#sat abort sat-test-1
```

10. To clear SAT test data, execute the below CLI.

```
OcNOS#sat clear sat-test-1
```

11. Repeat test for failed streams. Following is the sample command to repeat the test.

```
OcNOS#sat start sat-test-1 repeat-last-fail-test
```

Validation

The following show output list the test summary of the SAT.

```
OcNOS#show ethernet sat summary
#Name Run Status
----------------------------------------------------------------------
sat-test-1 1 Passed (2019 Feb 14 10:16:23 - 2019 Feb 14 10:18:25)
sat-test-1 2 Aborted (2019 Feb 14 10:46:44 - 2019 Feb 14 10:48:04)
sat-test-1 3 Aborted (2019 Feb 14 10:52:13 - 2019 Feb 14 10:52:37)
sat-test-1 4 In-progress (2019 Feb 14 10:53:43 - )
OcNOS#
```

The following show output lists the detail report of the SAT.

```
OcNOS#! Show SAT test detail results
OcNOS#show ethernet sat detail sat-test-1
-----------------------------------------------------------------------
SAT sat-test-1, Run 4
-----------------------------------------------------------------------
Description : (Not Specified)
Oper state : Passed
Start Time : 2019 Feb 14 10:53:43
End Time : 2019 Feb 14 10:55:46
Direction : upstream

Stream Run : parallel
Stream s1 Config
-----------------------------------------------------------------------
Bandwidth profile : CIR 1000 mbps, COS 6, DEI 0
EIR 500 mbps, COS 4, DEI 1
Color aware : on, color-method (DEI)
acceptance : CIR - FLR NA FTD 100 ms, FDV 10 ms
```



```
MTU : 128, 256, 512,
CFM : domain md000, ma ma10, mep 10
Destination e8c5.7adb.d59b
Stream s1, Test (cir-eir)
-----------------------------------------------------
Oper State        : Failed
Test Duration     : 00:02:03 (hh:mm:ss)
Start Time        : 2019 Feb 14 10:53:43
End Time          : 2019 Feb 14 10:55:46
CIR:
Tx packets 50720289, bytes 15249900226
Rx packets 25445881, bytes 8694009171
FL 25274408, FLR 49.8309 %
FD 11 us, FDV 1 us
FD Min 10 us, FD Max 34 us, FD exceeded 0%
Out of Order packets 0
Error packets 0
EIR:
Tx packets 25358536, bytes 7624466320
Rx packets 12722142, bytes 4346731850
FL 12636394, FLR 49.8309 %
FD 11 us, FDV 1 us
FD Min 10 us, FD Max 36 us, FD exceeded 0%
Out of Order packets 0
Error packets 0
OcNOS#
```

The following shows the output of the SAT test executed again.

```
OcNOS# ! Run SAT test again
OcNOS#sat start sat-test-1
Name Run Status
-------------------------------------------------------------------------
sat-test-1 1 Passed (2019 Feb 14 10:16:23 - 2019 Feb 14 10:18:25)
sat-test-1 2 Aborted (2019 Feb 14 10:46:44 - 2019 Feb 14 10:48:04)
sat-test-1 3 Aborted (2019 Feb 14 10:52:13 - 2019 Feb 14 10:52:37)
sat-test-1 4 Passed (2019 Feb 14 10:53:43 - 2019 Feb 14 10:55:46)
OcNOS#
OcNOS#

OcNOS# ! Start and abort SAT test
OcNOS#sat start sat-test-1
OcNOS#sat abort sat-test-1
OcNOS#
OcNOS#! Show SAT test summary
OcNOS#show ethernet sat summary
OcNOS#
OcNOS#show ethernet sat summary
Name Run Status
--------------------------------------------------------------------------
sat-test-1 1 Passed (2019 Feb 14 10:16:23 - 2019 Feb 14 10:18:25)
```

```
sat-test-1 2 Aborted (2019 Feb 14 10:46:44 - 2019 Feb 14 10:48:04)
sat-test-1 3 Aborted (2019 Feb 14 10:52:13 - 2019 Feb 14 10:52:37)
sat-test-1 4 Passed (2019 Feb 14 10:53:43 - 2019 Feb 14 10:55:46)
sat-test-1 5 Aborted (2019 Feb 14 11:01:12 - 2019 Feb 14 11:01:54)
OcNOS#
OcNOS#

OcNOS#! Show SAT test detail results
OcNOS#show ethernet sat detail sat-test-1
-----------------------------------------------------------------------
SAT sat-test-1, Run 5
-----------------------------------------------------------------------
Description : (Not Specified)
Oper state : Passed
Start Time : 2019 Feb 14 11:01:12
End Time : 2019 Feb 14 11:01:54
Direction : upstream
Stream Run : parallel
Stream s1 Config
-----------------------------------------------------------------------
Bandwidth profile : CIR 1000 mbps, COS 6, DEI 0
EIR 500 mbps, COS 4, DEI 1
Color aware : on, color-method (DEI)
acceptance : CIR - FLR NA FTD 100 ms, FDV 10 ms
MTU : 128, 256, 512,
CFM : domain md000, ma ma10, mep 10
Destination e8c5.7adb.d59b
Stream s1, Test (cir-eir)
-----------------------------------------------------
Oper State : Aborted
Test Duration : 00:00:42 (hh:mm:ss)
Start Time : 2019 Feb 14 11:01:12
End Time : 2019 Feb 14 11:01:54
CIR:
Tx packets 16716322, bytes 5026040644
Rx packets 16716322, bytes 5711409846
FL 0, FLR 0.0000
FD 12 us, FDV 2 us
FD Min 10 us, FD Max 36 us, FD exceeded 0%
Out of Order packets 0
Error packets 0
EIR:
Tx packets 8357666, bytes 2512871364
Rx packets 8357666, bytes 2855535670
FL 0, FLR 0.0000
FD 0 us, FDV 0 us
FD Min 0 us, FD Max 0 us, FD exceeded 0%
Out of Order packets 0
Error packets 0
OcNOS#
```

Implementation Examples

Example 1

The following is a sample SAT configuration for CIR 38000mbps with the frame size of 1518 bytes for the duration of 1 minute.

```
ethernet sat rate-profile rate6
  delay-bins min us 1 max ms 1
  cir 380000 mbps cos 0 dei 0
!
ethernet sat acceptance-profile profile1
  cir frame-loss-ratio 0.0001
  cir frame-loss-ratio-policing 25.0000
  cir frame-delay-variation ms 10
  cir frame-delay ms 10
!
ethernet sat frame-size-profile size1
  size-a 64
  size-b 128
  size-c 256
  size-d 512
  size-e 1024
  size-f 1280
  size-g 1518
  size-h 9200
  size-u 80
!
ethernet sat test1
  direction upstream
  stream-run one-by-one
  service-test performance
    duration minutes 1
  service-stream stream1
    rate-profile rate6
    acceptance-profile profile1
    frame-size-profile size1
    frame-sequence g
    frame-payload
      cfm domain md001 ma ma001 mepid 444
      dst-mac  e001.a6b8.ed05
!
```

The following shows the output of the above SAT.

```
CE2#show ethernet sat detail test1
-----------------------------------------------------------------------
SAT test1, Run 1
-----------------------------------------------------------------------
Description      : (Not Specified)
```

```
Oper state       : Passed
Start Time       : 2025 Jan 06 13:41:14
End Time         : 2025 Jan 06 13:42:18
Direction        : upstream
Stream Run       : one-by-one

Stream stream1 Config
-----------------------------------------------------------------------
Bandwidth profile : CIR 380000 mbps, COS 0, DEI 0
                    EIR 0 mbps, COS 0, DEI 0
Color aware       : off, color-method (DEI)
Acceptance        : CIR - FLR 0.0001 %, FTD 10 ms, FDV 10 ms
MTU               : 1518,
Frame Info        : FD enabled, prbs pattern
CFM               : domain md001, ma ma001, mep 444
                    Destination e001.a6b8.ed05

Stream stream1, Test (performance)
-----------------------------------------------------
Oper State        : Passed
Test Duration     : 00:01:00 (hh:mm:ss)
Start Time        : 2025 Jan 06 13:41:14
End Time          : 2025 Jan 06 13:42:14

CIR:
Tx packets 1869134626, bytes 2837346362268
Rx packets 1869134626, bytes 2837346362268
FL 0, FLR 0.0000 %
FD 27 us, FDV 0 us
FD Min 25 us, FD Max 31 us, FD exceeded 0%
Out of Order packets 0
Error packets 1

EIR:
Tx packets 0, bytes 0
Rx packets 0, bytes 0
FL 0, FLR 0.0000 %
FD 19 us, FDV 0 us
FD Min 18 us, FD Max 19 us, FD exceeded 0%
Out of Order packets 0
Error packets 0
```

Example 2

The following is a sample SAT configuration for CIR and EIR 1000mbps with the frame delay of 1 ms.

```
PE1-7038-Ufi-Q2C#show ru sat
!
ethernet sat rate-profile rate1
  delay-bins min ms 1 max ms 1
```

```
  color-aware
  cir 1000 mbps cos 4 dei 0
  eir 1000 mbps cos 5 dei 1
!
ethernet sat acceptance-profile profile1
  cir frame-loss-ratio 0.0001
  cir frame-loss-ratio-policing 25.0000
  cir frame-delay-variation ms 10
  cir frame-delay ms 10
!
ethernet sat frame-size-profile size1
  size-a 64
  size-b 128
  size-c 256
  size-d 512
  size-e 1024
  size-f 1280
  size-g 1518
  size-h 9200
  size-u 80
!
ethernet sat test1
  direction upstream
  stream-run parallel
  service-test cir
    duration minutes 1
  service-test cir-eir
    duration minutes 1
  service-stream stream1
    rate-profile rate1
    acceptance-profile profile1
    frame-size-profile size1
    frame-sequence bcd
    frame-payload
      cfm domain test1 ma ma100 mepid 1001
      dst-mac 5c07.5851.c9d5
!

PE1-7038-Ufi-Q2C#show ethernet sat summary
Name                        Run  Status
---------------------------------------------------------------------------------------
test1                     1    Aborted     (2025 Jan 17 14:44:26 - 2025 Jan 17 14:44:39)
test1                     2    Passed      (2025 Jan 17 14:44:50 - 2025 Jan 17 14:46:57)
test1                     3    Passed      (2025 Jan 17 14:49:51 - 2025 Jan 17 14:50:54)
PE1-7038-Ufi-Q2C#

PE1-7038-Ufi-Q2C#show ethernet sat detail test1
-----------------------------------------------------------------------
SAT test1, Run 2
-----------------------------------------------------------------------
```

```
Description      : (Not Specified)
Oper state       : Passed
Start Time       : 2025 Jan 17 14:44:50
End Time         : 2025 Jan 17 14:46:57
Direction        : upstream
Stream Run       : parallel

Stream stream1 Config
-----------------------------------------------------------------------
Bandwidth profile : CIR 1000 mbps, COS 4, DEI 0
                    EIR 1000 mbps, COS 5, DEI 1
Color aware       : on, color-method (DEI)
Acceptance        : CIR - FLR 0.0001 %, FTD 10 ms, FDV 10 ms
MTU               : 128, 256, 512,
Frame Info        : FD enabled, prbs pattern
CFM               : domain test1, ma ma100, mep 1001
                    Destination 5c07.5851.c9d5

Stream stream1, Test (cir-step-1) Load 100%
-----------------------------------------------------
Oper State        : Passed
Test Duration     : 00:01:00 (hh:mm:ss)
Start Time        : 2025 Jan 17 14:44:50
End Time          : 2025 Jan 17 14:45:50

Tx packets 24945535, bytes 7450399616
Rx packets 24945535, bytes 7450399616
FL 0, FLR 0.0000 %
FD 12 us, FDV 2 us
FD Min 11 us, FD Max 41 us, FD exceeded 0%
Out of Order packets 0
Error packets 0

Stream stream1, Test (cir-eir)
-----------------------------------------------------
Oper State        : Passed
Test Duration     : 00:01:00 (hh:mm:ss)
Start Time        : 2025 Jan 17 14:45:54
End Time          : 2025 Jan 17 14:46:54

CIR:
Tx packets 24948497, bytes 7451284224
Rx packets 24948497, bytes 7451284224
FL 0, FLR 0.0000 %
FD 16 us, FDV 3 us
FD Min 11 us, FD Max 52 us, FD exceeded 0%
Out of Order packets 0
Error packets 0

EIR:
```

```
Tx packets 24948497, bytes 7451284224
Rx packets 24948497, bytes 7451284224
FL 0, FLR 0.0000 %
FD 11 us, FDV 0 us
FD Min 11 us, FD Max 11 us, FD exceeded 0%
Out of Order packets 0
Error packets 0

PE1-7038-Ufi-Q2C#sat start test1 cir-eir service-stream stream1
PE1-7038-Ufi-Q2C#2025 Jan 17 14:50:55.784 : PE1-7038-Ufi-Q2C : ONMD : INFO : [ETH SAT
STATUS CHANGE_5]: Tests completed for the test1 and run is 3

PE1-7038-Ufi-Q2C#show ethernet sat detail test1
-----------------------------------------------------------------------
SAT test1, Run 3
-----------------------------------------------------------------------
Description      : (Not Specified)
Oper state       : Passed
Start Time       : 2025 Jan 17 14:49:51
End Time         : 2025 Jan 17 14:50:54
Direction        : upstream
Stream Run       : parallel

Stream stream1 Config
-----------------------------------------------------------------------
Bandwidth profile : CIR 1000 mbps, COS 4, DEI 0
                    EIR 1000 mbps, COS 5, DEI 1
Color aware       : on, color-method (DEI)
Acceptance        : CIR - FLR 0.0001 %, FTD 10 ms, FDV 10 ms
MTU               : 128, 256, 512,
Frame Info        : FD enabled, prbs pattern
CFM               : domain test1, ma ma100, mep 1001
                    Destination 5c07.5851.c9d5

Stream stream1, Test (cir-eir)
-----------------------------------------------------
Oper State        : Passed
Test Duration     : 00:01:00 (hh:mm:ss)
Start Time        : 2025 Jan 17 14:49:51
End Time          : 2025 Jan 17 14:50:51

CIR:
Tx packets 24945587, bytes 7450415104
Rx packets 24945587, bytes 7450415104
FL 0, FLR 0.0000 %
FD 16 us, FDV 4 us
FD Min 11 us, FD Max 55 us, FD exceeded 0%
Out of Order packets 0
Error packets 0

EIR:
```

```
Tx packets 24945583, bytes 7450413952
Rx packets 24945583, bytes 7450413952
FL 0, FLR 0.0000 %
FD 11 us, FDV 0 us
FD Min 11 us, FD Max 11 us, FD exceeded 0%
Out of Order packets 0
Error packets 0


PE1-7038-Ufi-Q2C#
```

CLI Commands

The following configuration commands are introduced for SAT functionality.

- ethernet sat profile
- two-way
- mode generator-receiver | generator | receiver
- cir value cos dei
- eir VALUE cos dei
- color-aware
- delay-bins min max
- load-step
- sat acceptance-profile NAME
- cir frame-loss-ratio
- cir frame-loss-ratio-policing
- cir frame-delay-variation
- ethernet sat frame-size-profile NAME
- size-a|b|c|d|e|f|g|h|u
- ethernet sat NAME
- description WORD
- direction downstream | upstream
- stream-run
- service-test
- duration hours minutes seconds
- service-stream NAME
- rate-profile NAME
- acceptance-profile NAME
- frame-size-profile NAME
- frame-sequence WORD
- frame-data-pattern null-sig | prbs

- frame-payload
- cfm domain NAME ma NAME mepid <1-8191>
- dst-mac XXXX.XXXX.XXXX
- sat start NAME
- abort sat NAME
- clear sat NAME
- show ethernet sat summary
- show ethernet sat detail NAME

ethernet sat profile

Use this command to create Service Traffic Test (SAT) rate profile. A SAT rate profile defines various parameters such as traffic direction (one-way or two-way, refer to Service Traffic Test Types for more information.), test mode, CIR and/or EIR, and so on.

Note: In Jericho2 devices, a maximum of 8 CIR and EIR rate profiles and 32 CIR-only rate profiles are supported.

Command Syntax

```
ethernet sat profile NAME
```

Parameters

`sat profile NAME`

Specifies the name of the SAT rate profile.

Default

None

Command Mode

Configuration mode

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to create a SAT rate profile.

```
OcNOS(config)#ethernet sat rate-profile r1
```

two-way

Use this command to indicate that the traffic direction type is two-way.

Command Syntax

```
two-way
```

Parameters

None

Default

None

Command Mode

SAT_RATE_ CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the traffic direction is two-way.

```
OcNOS(sat-rate-config-profile)#two-way
```

mode generator-receiver | generator | receiver

Use this command to mention the traffic type. For a two-way test, use both the `generator-receiver`, whereas a one-way test requires only the `generator` or the `receiver`.

Command Syntax

```
mode generator-receiver | generator | receiver
```

Parameters

`mode generator-receiver`
: Specifies the traffic type is both generator and receiver.

`mode generator`
: Specifies the traffic type is generator only.

`mode receiver`
: Specifies the traffic type is receiver only.

Default

None

Command Mode

SAT_RATE_ CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the test traffic is both generator and receiver.

```
OcNOS(sat-rate-config-profile)# mode generator-receiver
```

cir value cos dei

Use this command to configure the Committed Information Rate (CIR), Class of Service (COS) and Drop Eligibility Indicator (DEI).

Command Syntax

```
cir VALUE kbps|mbps cos <0-7>  dei <0-1>
```

Parameters

cir VALUE	Specifies the CIR value in kbps or mbps
cos <0-7>	Specifies the COS value for the class of traffic
dei <0-1>	Specify the DEI value ‘0’ not to drop the traffic and ‘1’ to drop the traffic.

Default

None

Command Mode

SAT_RATE_ CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the CIR, COS and DEI rate value in SAT rate profile.

```
OcNOS(sat-rate-config-profile)#cir 1000 mbps cos 6 dei 0
```

eir VALUE cos dei

Use this command to configure the Excess Information Rate (EIR), Class of Service (COS) and Drop Eligibility Indicator (DEI).

Command Syntax

```
eir VALUE kbps|mbps cos <0-7> dei <0-1>
```

Parameters

eir VALUE	Specifies the EIR value in kbps or mbps
cos <0-7>	Specifies the COS value for the class of traffic
dei <0-1>	Specify the DEI value ‘0’ not to drop the traffic and ‘1’ to drop the traffic.

Default

None

Command Mode

SAT_RATE_ CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the EIR, COS and DEI rate value in SAT rate profile.

```
OcNOS(sat-rate-config-profile)#eir 500 mbps cos 4 dei 1
```

color-aware

Use this command to configure the color of the traffic frame is known.

- Green Traffic: Guaranteed at all times for a specific service.
- Yellow Traffic: Best effort, utilized when excess bandwidth is available.
- Red Traffic: Dropped without disrupting services.

Command Syntax

```
color-aware
```

Parameters

None

Default

None

Command Mode

SAT_RATE_ CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure that the traffic bandwidth color is known.

```
OcNOS(sat-rate-config-profile)#color-aware
```

delay-bins min max

Use this command to define the minimum and maximum frame transfer delay times. This measures the time delay between a packet's transmission and its reception.

Command Syntax

```
delay-bins min ns|us|ms <1-4000> max ns|us|ms <1-4000>
```

Parameters

```
delay-bins min ns|us|ms <1-4000>
```

Specifies the minimum frame transfer delay time.

```
max ns|us|ms <1-4000>
```

Specifies the maximum frame transfer delay time.

Default

None

Command Mode

SAT_RATE_ CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the frame transfer delay time for the SAT rate profile.

```
OcNOS(sat-rate-config-profile)#delay-bins min us 1 max ms 1
```

load-step

Use this command to configure the load steps which defines the number of iterations required to send the traffic load.

For instance, if you want to send 100 Mbps of traffic and configure the load-step as 4, the traffic will be incremented in four stages until the full load is transferred.

The traffic is divided into four parts, starting with 25 Mbps (100 Mbps ÷ 4). Initially, 25 Mbps is sent. After completing the first test, the load increases to 50 Mbps for the second step. Once the second test finishes, the traffic is increased to 75 Mbps. Finally, the full load of 100 Mbps is sent in the last step.

Command Syntax

```
load-step VALUE
```

Parameters

`load-step VALUE`

Specifies the number of iterations required to send the traffic load.

Default

None

Command Mode

SAT_RATE_ CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the load-step value for SAT rate profile.

```
OcNOS(sat-rate-config-profile)#load-step 1
```

sat acceptance-profile NAME

Use this command to create an acceptance SAT profile.

Command Syntax

```
sat acceptance-profile NAME
```

Parameters

`acceptance-profile NAME`
: Specifies the SAT acceptance profile name.

Default

None

Command Mode

SAT_RATE_CONFIG_PROFILE

SAT_ACCEPTANCE_ CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

The following command create a SAT acceptance profile.

```
OcNOS(sat-rate-config-profile)#ethernet sat acceptance-profile a1
OcNOS(sat-acceptance-config-profile)#
```

cir frame-loss-ratio

Use this command to configure the allowed frame loss ratio (FLR) for CIR traffic. The FLR refers to frames lost due to transmission errors or network congestion compared to the total frames sent.

Command Syntax

```
cir frame-loss-ratio <0.0001-100.0000>
```

Parameters

`cir frame-loss-ratio <0.0001-100.0000>`
: Specifies the frame loss ratio value.

Default

None

Command Mode

SAT_ACCEPTANCE_CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the FLR value for CIR traffic in acceptance SAT profile.

```
OcNOS(sat-acceptance-config-profile)#cir frame-loss-ratio 0.01
```

cir frame-loss-ratio-policing

Use this command to policing the CIR frame lose ratio.

Command Syntax

```
cir frame-loss-ratio-policing <0.0001-100.0000>
```

Parameters

`cir frame-loss-ratio-policing <0.0001-100.0000>`
Specifies the frame loss ratio policing value

Default

None

Command Mode

SAT_ACCEPTANCE_CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to policing the FLR for CIR traffic in acceptance SAT profile.

```
OcNOS(sat-acceptance-config-profile)#cir frame-loss-ratio-policing 0.01
```

cir frame-delay

Use this command to configure allowed frame delay for CIR traffic.

Command Syntax

```
cir frame-delay ns|us|ms <1-10000>
```

Parameters

`cir frame-delay ns|us|ms <1-10000>`
Specifies the allowed CIR frame delay.

Default

None

Command Mode

SAT_ACCEPTANCE_CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to specify the frame delay value for CIR traffic in acceptance SAT profile.

```
OcNOS(sat-acceptance-config-profile)#cir frame-delay ms 100
```

cir frame-delay-variation

Use this command to configure the allowed frame delay variation value for CIR traffic.

The frame delay variation refers to the variability in arrival time between packet deliveries.

Command Syntax

```
cir frame-delay-variation ns|us|ms <1-10000>
```

Parameters

`cir frame-delay-variation ns|us|ms <1-10000>`

Specifies the allowed CIR frame delay variation.

Default

None

Command Mode

SAT_ACCEPTANCE_CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the accepted CIR frame delay variation value.

```
OcNOS(sat-acceptance-config-profile)#cir frame-delay-variation ms 10
```

ethernet sat frame-size-profile NAME

Use this command to create SAT frame size profile to change the SAT frame size to non default values.

Command Syntax

```
ethernet sat frame-size-profile NAME
```

Parameters

`frame-size-profile NAME`

Specifies the SAT frame size profile name.

Default

None

Command Mode

SAT_FRAME_SIZE_CONFIG_PROFILE

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to create a SAT frame size profile.

```
OcNOS(sat-acceptance-config-profile#ethernet sat frame-size-profile f1
OcNOS(sat-frame-size-config-profile#
```

size-a|b|c|d|e|f|g|h|u

Use this command to configure the frame size value to be used in the service and performance SAT test.

Command Syntax

```
size-a|b|c|d|e|f|g|h|u VALUE
```

Parameters

`size-a|b|c|d|e|f|g|h|u VALUE`

Specify frame size value using `size-a, size-b, size-c` etc. The following denotes the value of each size.

a	b	c	d	e	f	g	h	u
64	128	256	512	1024	1280	1518	MTU	User defined

Default

None

Command Mode

SAT FRAME SIZE CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the frame size to use in SAT test.

```
OcNOS(sat-acceptance-config-profile#ethernet sat frame-size-profile f1
OcNOS(sat-frame-size-config-profile#size-a 64
OcNOS(sat-frame-size-config-profile#size-b 128
OcNOS(sat-frame-size-config-profile#size-c 256
OcNOS(sat-frame-size-config-profile#size-d 512
OcNOS(sat-frame-size-config-profile#size-e 1024
OcNOS(sat-frame-size-config-profile#size-f 1280
OcNOS(sat-frame-size-config-profile#size-g 1518
```


ethernet sat NAME

Use this command to configure a name to SAT test.

Command Syntax

```
ethernet sat NAME
```

Parameters

sat NAME	Specify the name of SAT test.

Default

None

Command Mode

SAT TEST CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command configures a name to SAT test.

```
OcNOS(sat-frame-size-config-profile#ethernet sat sat-test-1
OcNOS(sat-test)#
```

description WORD

Use this command to provide a description to the SAT test.

Command Syntax

```
description WORD
```

Parameters

description NAME	Describes the SAT test.

Default

None

Command Mode

SAT_TEST_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command tp add a description to the SAT test.

```
OcNOS(sat-test)description sat-test for service activation
```

direction downstream | upstream

Use this command to configure the SAT test direction. Refer to Service Traffic Test Types section for more information.

Command Syntax

```
direction downstream | upstream
```

Parameters

`direction downstream`

Describes the traffic test direction is downstream.

`direction upstream`

Describes the traffic test direction is upstream.

Default

None

Command Mode

SAT_TEST_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure traffic test direction as upstream for SAT test.

```
OcNOS(sat-test)#direction upstream
```

stream-run

Use this command to configure SAT test streams type sequential or concurrent.

Command Syntax

```
stream-run one-by-one | parallel
```

Parameters

`stream-run one-by-one`

Describes the traffic stream is in sequential mode

`stream-run parallel`

Describes the traffic stream is in concurrent mode.

Default

None

Command Mode

SAT_TEST_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the traffic stream type as parallel.

```
OcNOS(sat-test)#stream-run parallel
```

service-test

Use this command to specify the services to use in SAT.

Command Syntax

```
service-test cir | cir-eir | performance | policing
```

Parameters

`service-test cir`
: Specifies the CIR service test.

`service-test cir-eir`
: Specifies the CIR-EIR service test.

`service-test performance`
: Specifies the performance test.

`service-test policing`
: Specifies the SAT policing test.

Default

None

Command Mode

SAT_TEST_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to include CIR-EIR service in SAT.

```
OcNOS(sat-test)#service-test cir-eir
```

duration hours minutes seconds

Use this command to configure SAT service test duration.

Command Syntax

```
duration hours <1-60> minutes <1-60> seconds <1-60>
```

Parameters

`hours <1-60>`	Specifies the service test duration in hours.
`minutes <1-60>`	Specifies the service test duration in minutes.
`seconds <1-60>`	Specifies the service test duration in seconds.

Default

None

Command Mode

SAT_TEST_SERVICE_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure a duration to execute the SAT.

```
OcNOS(sat-test-service)# duration minutes 2 seconds 2
```

service-stream NAME

Use this command to specify the service stream name to use in SAT.

Command Syntax

```
service-stream NAME
```

Parameters

`service-stream NAME`

Describes the service stream name.

Default

None

Command Mode

SAT_TEST_SERVICE_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to define the service stream name to use in SAT.

```
OcNOS(sat-test-service)#service-stream s1
```

rate-profile NAME

Use this command to specify the rate profile name to use in SAT.

Command Syntax

```
rate-profile NAME
```

Parameters

`rate-profile NAME`
: Specifies the rate profile name to be used in the service test.

Default

None

Command Mode

SAT_TEST_STREAM_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the rate profile name to use in SAT.

```
OcNOS(sat-test-stream)#rate-profile r1
```

acceptance-profile NAME

Use this command to specify the name of the acceptance profile to use in SAT.

Command Syntax

```
acceptance-profile NAME
```

Parameters

`acceptance-profile NAME`
: Specifies the acceptance profile name.

Default

None

Command Mode

SAT_TEST_STREAM_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to specify the acceptance profile name to use in SAT.

```
OcNOS(sat-test-stream)#acceptance-profile a1
```

frame-size-profile NAME

Use this command to specify the name of the frame size profile to use in SAT.

Command Syntax

```
frame-size-profile NAME
```

Parameters

`frame-size-profile NAME`
: Specifies the frame size profile name.

Default

None

Command Mode

SAT_TEST_STREAM_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to specify the frame size profile name to use in SAT.

```
OcNOS(sat-test-stream)#frame-size-profile f1
```

frame-sequence WORD

Use this command to configure the frame sequence (`size-a|b|c|d|e|f|g|h|u`) to use in SAT.

Command Syntax

```
frame-sequence WORD
```

Parameters

`frame-sequence WORD`
: Specifies the frame size sequence.

Default

None

Command Mode

SAT_TEST_STREAM_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to specify the frame size sequence to use in SAT.

```
OcNOS(sat-test-stream)#frame-sequence bcd
```

frame-data-pattern null-sig | prbs

Use this command to configure different frame size patterns for testing. The pattern defines a repeated sequence of frame sizes. For instance, the pattern "aabc" corresponds to frame sizes 64, 64, 128, and 256 (as an example for a data pattern).

Command Syntax

```
frame-data-pattern null-sig | prbs |
```

Parameters

`frame-data-pattern null-sig`

Specifies the frame data pattern sequence as null signal.

`frame-data-pattern prbs`

Specifies the frame data pattern sequence as pseudo random binary sequence.

Default

None

Command Mode

SAT_TEST_STREAM_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to specify frame pattern to use in SAT.

```
OcNOS(sat-test-stream)#frame-data-pattern null-sig
```

frame-payload

Use this command to configure the frame payload to use in SAT.

Command Syntax

```
frame-payload
```

Parameters

`frame-payload`

Specifies the frame payload.

Default

None

Command Mode

SAT_TEST_STREAM_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the frame payload to use in SAT.

```
OcNOS(sat-test-stream)#frame-payload
```

cfm domain NAME ma NAME mepid <1-8191>

Use this command to configure CFM domain, `ma` and `mepid` to use in SAT.

Command Syntax

```
cfm domain NAME ma NAME mepid <1-8191>
```

Parameters

`cfm domain NAME`
Specifies the CFM domain name.

`ma NAME` Specifies the `ma` name.

`mepid <a-8191>` Specifies the `mepid` identifier.

Default

None

Command Mode

SAT_TEST_STREAM_PAYLOAD_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configure the CFM domain, ma and mepid to use in SAT.

```
OcNOS(sat-test-stream-payload)#cfm domain md000 ma ma10 mepid 10
```

dst-mac XXXX.XXXX.XXXX

Use this command to configure destination MAC address to use in SAT.

Command Syntax

```
dst-mac XXXX.XXXX.XXXX
```

Parameters

`dst-mac XXXX.XXXX.XXXX`

Specifies the CFM domain name.

Default

None

Command Mode

SAT_TEST_STREAM_PAYLOAD_CONFIG

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to configures the destination MAC address to use in SAT.

```
OcNOS(sat-test-stream-payload)#dst-mac e8c5.7adb.d59b
```

sat start NAME

Use this command to start a service activation test.

Command Syntax

```
sat start NAME <service test>
```

Parameters

`sat start NAME`

Specifies the service test name to start test.

`cir`	Executes cir test
`cir-eir`	Executes cir-eir test
`performance`	Executes performance test
`policing`	Executes policing test
`repeat-last-fail-test`	Repeat from the last failed SAT test case.
`service-stream`	Executes service stream test.

Default

None

Command Mode

Execute mode

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to start the SAT.

```
OcNOS#sat start sat-test-1
OcNOS#sat start sat-test-1 repeat-last-fail-test
```


abort sat NAME

Use this command to abort a service activation test.

Command Syntax

```
abort sat NAME
```

Parameters

`abort sat NAME`
: Specifies the service test name to abort test.

Default

None

Command Mode

Execute mode

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to abort the running SAT.

```
OcNOS#sat abort sat-test-1
```

clear sat NAME

Use this command to clear the results of a service activation test.

Command Syntax

```
clear sat NAME
```

Parameters

`clear sat NAME`
: Specifies the service test name to clear test results.

Default

None

Command Mode

Execute mode

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to clear the SAT results.

```
OcNOS#sat clear sat-test-1
```

show ethernet sat summary

Use this command to display the SAT results and status.

Command Syntax

```
show ethernet sat summary
```

Parameters

None

Default

None

Command Mode

Execute mode

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to display the SAT output.OcNOS#! Show SAT test summary

```
OcNOS#show ethernet sat summary
#Name                    Run  Status
---------------------------------------------------------------------------------------------
sat-test-1               1    Passed      (2019 Feb 14 10:16:23 - 2019 Feb 14 10:18:25)
sat-test-1               2    Aborted     (2019 Feb 14 10:46:44 - 2019 Feb 14 10:48:04)
sat-test-1               3    Aborted     (2019 Feb 14 10:52:13 - 2019 Feb 14 10:52:37)
sat-test-1               4    In-progress (2019 Feb 14 10:53:43 - )
OcNOS#
```

show ethernet sat detail NAME

Use this command to display specific SAT results detail.

Command Syntax

```
show ethernet sat detail NAME
```

Parameters

`sat detail NAME`
: Specifies the service test name to show the detail results.

Default

None

Command Mode

Execute mode

Applicability

Introduced in OcNOS version 6.6.0.

Example

Command to display the SAT results detail.

```
OcNOS#! Show SAT test detail results
```

```
OcNOS#show ethernet sat detail sat-test-1
-----------------------------------------------------------------------
SAT sat-test-1, Run 4
-----------------------------------------------------------------------
Description      : (Not Specified)
Oper state       : Passed
Start Time       : 2019 Feb 14 10:53:43
End Time         : 2019 Feb 14 10:55:46
Direction        : upstream
Stream Run       : parallel
Stream s1 Config
-----------------------------------------------------------------------
Bandwidth profile : CIR 1000 mbps, COS 6, DEI 0
                    EIR 500 mbps, COS 4, DEI 1
Color aware       : on, color-method (DEI)
acceptance        : CIR - FLR NA FTD 100 ms, FDV 10 ms
MTU               : 128, 256, 512,
CFM               : domain md000, ma ma10, mep 10
                    Destination e8c5.7adb.d59b
Stream s1, Test (cir-eir)
-----------------------------------------------------
Oper State        : Passed
Test Duration     : 00:02:03 (hh:mm:ss)
Start Time        : 2019 Feb 14 10:53:43
End Time          : 2019 Feb 14 10:55:46
CIR:
Tx packets 50720289, bytes 15249900226
Rx packets 25445881, bytes 8694009171
FL 25274408, FLR 0.0000
FD 11 us, FDV 1 us
FD Min 10 us, FD Max 34 us, FD exceeded 0%
Out of Order packets 0
Error packets 0
EIR:
Tx packets 25358536, bytes 7624466320
Rx packets 12722142, bytes 4346731850
FL 12636394, FLR 0.0000
FD 11 us, FDV 1 us
FD Min 10 us, FD Max 36 us, FD exceeded 0%
Out of Order packets 0
Error packets 0
OcNOS#
```

Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

Key Terms/Acronym	Description
CBS	Committed Burst Size
CIR	Committed Information Rate
CM	Color Mode

CTF	Collector Traffic Function
DEI	Drop Eligible Indicator
DMM	Delay Measurement Message
DP	Drop Precedence
EBS	Excess Burst Size
EIR	Excess Information Rate
EMIX	Ethernet Mix
FDV	Frame Delay Variation
FLR	Frame Loss Ratio
FTD	Frame Transfer Delay
GTF	Generate Test Function
IR	Information Rate
KPI	Key Performance Indicator
LBM	Loopback Message
LBR	Loopback Reply
MAC	Medium Access Control
MP	Measurement Point
MTU	Maximum Transmission Unit
QoS	Quality of Service
SAC	Service Acceptance Criteria
SAT	Service Activation Test
SLA	Service Level Agreement
SNMP	Simple Network Management Protocol
ToD	Time of Day
ULR	Utilized Line Rate
UNI	User Network Interface
UNI-C	UNI – Customer
UNI-N	UNI – Network
VLAN	Virtual LAN

CHAPTER 3 Y.1731 Performance Monitoring Configurations

ITU-T Y.1731 supports Performance Monitoring feature for Ethernet. Loss and Delay measurement can be achieved which can be significantly used to identify network problems before they impact. SLM is used to calculate the frame loss between endpoints using synthetic frames. Transmit and received counters at endpoints for received vs dropped are used to measure frame loss. CCM and LMM are used to calculate the frame loss of data traffic between endpoints. On CCM, loss measurement is encapsulated as part of CFM packets and it's dual ended. For LMM, separate loss measurement message and reply is shared on configured interval between endpoints to calculate the data frame loss. CCM and LMM service frames will have the counters which maintain a count of transmitted and received data frames between a pair of MEPs.Ethernet frame delay measurement provides fine control to operators for triggering delay measurement on a given service and can be used to monitor SLAs. Ethernet frame delay measure-ment also collects other useful information, such as worst and best case delays, average delay, and aver-age delay variation.

Synthetic Loss Measurement (SLM) over L2 Bridge

Topology

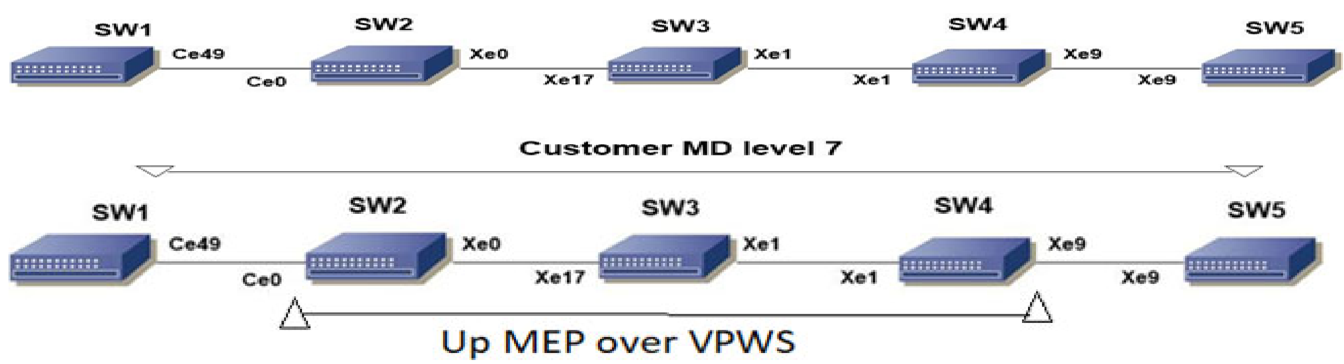


Figure 3-5: CFM Y.1731 SLM over L2 Bridge Topology

Prerequisite

Configure below hardware-profile commands related to CFM in configuration mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable
```

Synthetic Loss Measurement (SLM) over L2 Bridge

SW1

`SW1#configure terminal`	Enter configure mode.
`SW1(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.

`SW1(config)#vlan database`	Entering VLAN database.
`SW1(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW1(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-vlan)#exit`	Exit config mode.
`SW1(config)#int ce49`	Configure interface ce49.
`SW1(config-if)#switchport`	Configure the interface as switch port.
`SW1(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW1(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW1(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce49.
`SW1(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-if)#exit`	Exit config mode.
`SW1(config)#ethernet cfm domain-type character-string domain-name mdnam level 7 mip-creation default`	Create cfm domain with type as character string and set mip creation criteria to default.
`SW1(config-ether-cfm)#service ma-type string ma-name testtm`	Create ma type as string and set mip creation criteria to default.
`SW1(config-ether-cfm-ma)#vlan 512 bridge 1`	Configure primary VLAN ID
`SW1(config-ether-cfm-ma)#mip-creation default`	Configure MIP creation permission
`SW1(config-ether-cfm-ma)#ethernet cfm mep down mpid 2 active true  ce49`	Create down mep for local-vid on ce49.
`SW1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast.
`SW1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode.
`SW1(config-ether-cfm-ma)#mep crosscheck mpid 1`	Configure crosscheck to remote MEP in VLAN 512.
`SW1(config-ether-cfm-ma)#cc interval 10ms`	Enable cc interval for 10 millisecond.
`SW1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit ethernet ma mode.
`SW1(config-ether-cfm)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-ether-cfm)#exit`	Exit ethernet CFM mode.
`SW1(config)#ethernet cfm loss-measurement profile-name SLM`	Creating loss-measurement profile for SLM
`SW1(config-cfm-lm)#measurement-interval 1`	Specify the measurement-interval in minutes
`SW1(config)#intervals-stored 3`	Specify the number of history interval to be stored
`SW1(config)# message-period 1`	Specify message period interval time
`SW1(config)#commit`	Commit the candidate configuration to the running configuration.

SW2

`SW2#configure terminal`	Enter configure mode.
`SW2(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW2(config)#vlan database`	Entering VLAN database.
`SW2(config-vlan)#vlan 512 type customer bridge 1 state enable`	Create VLAN 512 for customer bridge.
`SW2(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-vlan)#exit`	Exit config mode.
`SW2(config)#interface ce0`	Configure interface ce0.
`SW2(config)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#switchport`	Configure interface as a switch port.
`SW2(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW2(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW2(config-if)#switchport trunk allowed vlan all`	Allow all customer VLANs on interface ce0.
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#int xe0`	Configure interface xe0
`SW2(config-if)#switchport`	Configure interface as switch port.
`SW2(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW2(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW2(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe1
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit config mode.

SW3

`SW3#configure terminal`	Enter configure mode.
`SW3(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW3(config)#vlan database`	Entering VLAN database.
`SW3(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW3(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-vlan)#exit`	Exit config mode.
`SW3(config)#int xe17`	Configure interface xe17.
`SW3(config-if)#switchport`	Configure the interface as switch port.
`SW3(config-if)#bridge-group 1`	Configure interface in bridge group 1.

`SW3(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW3(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe17.
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit config mode.
`SW3(config)#int xe1`	Configure interface xe1.
`SW3(config-if)#switchport`	Configure the interface as switch port.
`SW3(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW3(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW3(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe1.
`SW3(config-if)#exit`	Exit config mode.

SW4

`SW4#configure terminal`	Enter configure mode.
`SW4(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW4(config)#vlan database`	Entering VLAN database.
`SW4(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW4(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-vlan)#exit`	Exit config mode.
`SW4(config)#int xe1`	Configure interface xe1.
`SW4(config-if)#switchport`	Configure the interface as switch port.
`SW4(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW4(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW4(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe1.
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit config mode.
`SW4(config)#int xe9`	Configure interface xe9.
`SW4(config-if)#switchport`	Configure the interface as switch port.
`SW4(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW4(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW4(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe9.
`SW4(config-if)#exit`	Exit config mode.

SW5

`SW5#configure terminal`	Enter configure mode.
`SW5(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW5(config)#vlan database`	Entering VLAN database.
`SW5(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW5(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW5(config-vlan)#exit`	Exit config mode.
`SW5(config)#int xe9`	Configure interface xe9.
`SW5(config-if)#switchport`	Configure the interface as switch port.
`SW5(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW5(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW5(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe9.
`SW5(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW5(config-if)#exit`	Exit config mode.
`SW5(config)#ethernet cfm domain-type character-string domain-name mdnam level 7 mip-creation default`	Create cfm domain with type as character string and set mip creation criteria to default.
`SW5(config-ether-cfm)#service ma-type string ma-name testtm`	Create ma type as string and set mip creation criteria to default.
`SW5(config-ether-cfm-ma)#vlan 512 bridge 1`	Configure primary VLAN ID
`SW5(config-ether-cfm-ma)#mip-creation default`	Configure MIP creation permission
`SW5(config-ether-cfm-ma)#ethernet cfm mep down mpid 1 active true  xe9`	Create down mep for local-vid on xe9
`SW5(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast.
`SW5(config-ether-cfm-ma-mep)#ethernet cfm loss-measurement reply slm`	Generate and send SLR responses tacked
`SW5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode.
`SW5(config-ether-cfm-ma)#mep crosscheck mpid 2`	Configure crosscheck to remote MEP in VLAN 512.
`SW5(config-ether-cfm-ma)#cc interval 10ms`	Enable cc interval for 10 millisecond.
`SW5(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit ethernet ma mode.
`SW5(config-ether-cfm)#commit`	Commit the candidate configuration to the running configuration.
`SW5(config-ether-cfm)#exit`	Exit ethernet CFM mode.

Commands to initiate/abort loss measurement

```
SW1#loss-measurement type proactive profile-name <WORD> rmep mac-address
```

```
<HHHH.HHHH.HHHH>mep <MEPID> domain < DOMAIN_NAME> ma <MA NAME>

SW1#abort loss-measurement mep <MEPID> domain <DOMAIN_NAME> MA <MA NAME>
```

Validation

```
SW1#ping ethernet mac 3c2c.9926.e683 unicast source 2 domain mdnam ma


SW1#traceroute ethernet 3c2c.9926.e683 mepid 2 domain mdnam ma testtm
MP Mac            Hops   Relay-action     Ingress/Egress     Ingress/Egress ac-tion
3c2c.9926.e683     1     RlyHit           Ingress            IngOK

SW1#loss-measurement type proactive profile-name SLM rmep mac-address 3c2c.9926.e683
mep 2 domain mdnam ma testtm


SW1#show ethernet cfm loss-measurement mep 2 domain mdnam ma testtm
MEP: 2 MA: testtm
CURRENT:
Measurement ID             :1
Suspect                    :True
Measurement Type           :slm
Elapsed time(sec)          :7
Start Time                 :2019 Apr 30 14:43:41
Near End loss              :0
Far End loss               :0
Near End accumulated loss  : 0
Far End accumulated loss   : 0
SW1# abort loss-measurement mep 2 domain mdnam
```

Synthetic Loss Measurement (SLM) Over VPWS

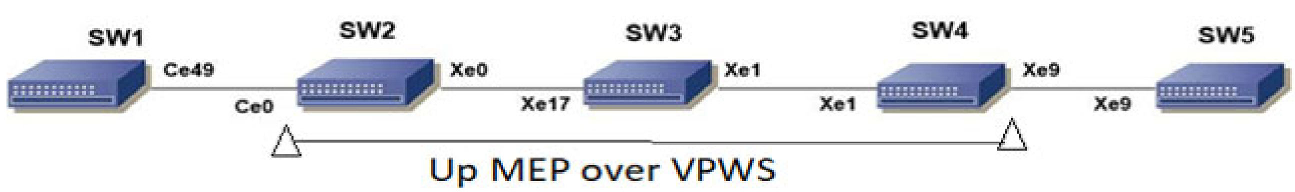


Figure 3-6: CFM Y.1731 SLM over VPWS Topology

SW1

`SW1#configure terminal`	Enter configure mode.
`SW1(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW1(config)#vlan database`	Entering VLAN database.
`SW1(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.

SW1(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW1(config-vlan)#exit	Exit config mode.
SW1(config)#interface ce49	Configure interface ce49.
SW1(config-if)#switchport	Configure the interface as switch port.
SW1(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW1(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW1(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface ce49.
SW1(config-if)#commit	Commit the candidate configuration to the running configuration.
SW1(config-if)#exit	Exit config mode.

SW2

SW2#configure terminal	Enter configure mode.
SW2(config)#interface ce0	Configure interface ce0.
SW2(config-if)#switchport	Configure interface as a switch port.
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit interface mode.
SW2(config)#interface xe0	Configure interface xe1.
SW2(config-if)#no switchport	Configure interface as router port.
SW2(config-if)#ip address 10.0.0.1/24	Assign IP address to router port xe0
SW2(config-if)#no shutdown	Making the interface up
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit interface mode.
SW2(config)#interface lo	Configure interface lo
SW2(config-if)#ip address 1.1.1.1/32 secondary	Configure secondary IP address to loopback interface .
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit interface mode.
SW2(config)#router ospf 100	Configure ospf
SW2(config-router)#network 10.0.0.0/24 area 0	Advertising 10 network
SW2(config-router)#network 1.1.1.1/32 area 0	Advertising loopback IP
SW2(config-router)#commit	Commit the candidate configuration to the running configuration.
SW2(config-router)#exit	Exit router mode.
SW2(config)#router rsvp	Configuring rsvp
SW2(config-router)#hello-receipt	Configuring hello reception
SW2(config-router)#no php	Configuring device as not a PHP
SW2(config-router)#revert-timer 10	Configuring reversion time of RSVP

`SW2(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#rsvp-trunk to-1 ipv4`	Configuring RSVP path
`SW2(config-trunk)#to 2.2.2.2`	Configuring first hop
`SW2(config-trunk)#to 3.3.3.3`	Configuring second hop
`SW2(config-trunk)#exit`	Exit trunk mode.
`SW2(config)#interface xe0`	Configuring interface
`SW2(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW2(config-if)#label-switching`	Enabling MPLS labeling
`SW2(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#router ldp`	Configuring LDP
`SW2(config-router)#targeted-peer ipv4 3.3.3.3`	Configuring LDP target peer for PW
`SW2(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit target peer mode
`SW2(config-router)#no multicast-hellos`	Disabling LDP multicast
`SW2(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#mpls l2-circuit ETH-2001 1 3.3.3.3`	Creating VPWS PW
`SW2(config-pseudowire)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-pseudowire)#exit`	Exit pseudowire config mode.
`SW2(config)#service-template ETH-2001`	Configuring service template profile for PW
`SW2(config-svc)#match outer-vlan 10`	Configuring match condition
`SW2(config-svc)# rewrite ingress push 2000`	Configuring action for match
`SW2(config-svc)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-svc)#exit`	Exit service template mode
`SW2(config)#interface ce0`	Configuring interface
`SW2(config-if)#mpls-l2-circuit ETH-2001 service-template ETH-2001`	Mapping VPWS in AC
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#hardware-profile filter cfm-domain-name-str enable`	Enabling HW filter for character string domain name
`SW2(config)#ethernet cfm domain-type character-string  domain-name 12345 level 7 mip-creation none`	Configuring CFM domain over VPWS

SW2(config-ether-cfm-mpls-md)#service ma-type string ma-name 43981 mip-creation none	Creating MA for domain
SW2(config-ether-cfm-mpls-md-ma)#cc interval 100ms	Configuring CFM interval
SW2(config-ether-cfm-mpls-md-ma)#mep cross-check mpid 1	Configuring remote mep
SW2(config-ether-cfm-mpls-md-ma)#ethernet cfm mep up mpid 4001 active true vpws ETH-2001	Configuring local mep and mapping the same with vpws service
SW2(config-ether-cfm-mpls-ma-mep)#cc multicast state enable	Enabling the CFM multicast
SW2(config-ether-cfm-mpls-ma-mep)#commit	Commit the candidate configuration to the running configuration.
SW2(config-ether-cfm-mpls-ma-mep)#exit	Exit CFM MEP configuration mode
SW2(config-ether-cfm-mpls-md-ma)#exit	Exit CFM MA configuration mode
SW2(config-ether-cfm-mpls-md)#exit	End current mode and down to previous mode
SW2(config)#ethernet cfm loss-measurement profile-name slm	Configuring LM profile
SW2(config-cfm-lm)#measurement-type slm	Configuring measurement type as SLM
SW2(config-cfm-lm)#message-period 3	Configuring message period
SW2(config-cfm-lm)#measurement-interval 1	Configuring measurement interval
SW2(config-cfm-lm)#intervals-stored 3	Configuring number of interval to be stored
SW2(config-cfm-lm)#commit	Commit the candidate configuration to the running configuration.
SW2(config-cfm-lm)#end	Exit config mode

SW3

SW3#configure terminal	Enter configure mode.
SW3(config)#interface xe17	Configure interface
SW3(config-if)#no switchport	Configure interface as router port.
SW3(config-if)#ip address 20.0.0.1/24	Assign IP address to router port
SW3(config-if)#no shutdown	Making the interface up
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit interface mode.
SW3(config)#interface xe1	Configure interface
SW3(config-if)#no switchport	Configure interface as router port.
SW3(config-if)#ip address 10.0.0.2/24	Assign IP address to router port
SW3(config-if)#no shutdown	Making the interface up
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit interface mode.
SW3(config)#interface lo	Configure interface lo
SW3(config-if)#ip address 2.2.2.2/32 secondary	Configure secondary IP address to loopback interface .

`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit interface mode.
`SW3(config)#router ospf 100`	Configure ospf
`SW3(config-router)#network 10.0.0.0/24 area 0`	Advertising 10 network
`SW3(config-router)#network 20.0.0.0/24 area 0`	Advertising 10 network
`SW3(config-router)#network 2.2.2.2/32 area 0`	Advertising loopback IP
`SW3(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-router)#exit`	Exit router mode.
`SW3(config)#router rsvp`	Configuring rsvp
`SW3(config-router)#hello-receipt`	Configuring hello reception
`SW3(config-router)#no php`	Configuring device as not a PHP
`SW3(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW3(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-router)#exit`	Exit router mode.
`SW3(config)#interface xe1`	Configuring interface
`SW3(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW3(config-if)#label-switching`	Enabling MPLS labeling
`SW3(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit interface mode.
`SW3(config)#interface xe17`	Configuring interface
`SW3(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW3(config-if)#label-switching`	Enabling MPLS labeling
`SW3(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit interface mode.

SW4

`SW4#configure terminal`	Enter configure mode.
`SW4(config)#interface xe9`	Configure interface
`SW4(config-if)#switchport`	Configure interface as switch port.
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#interface xe1`	Configure interface
`SW4(config-if)#no switchport`	Configure interface as router port.

`SW4(config-if)#ip address 20.0.0.2/24`	Assign IP address to router port
`SW4(config-if)#no shutdown`	Making the interface up
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#interface lo`	Configure interface lo
`SW4(config-if)#ip address 3.3.3.3/32 secondary`	Configure secondary IP address to loopback interface .
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#router ospf 100`	Configure ospf
`SW4(config-router)#network 20.0.0.0/24 area 0`	Advertising 10 network
`SW4(config-router)#network 3.3.3.3/32 area 0`	Advertising loopback IP
`SW4(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#router rsvp`	Configuring rsvp
`SW4(config-router)#hello-receipt`	Configuring hello reception
`SW4(config-router)#no php`	Configuring device as not a PHP
`SW4(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW4(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#rsvp-trunk to-1 ipv4`	Configuring RSVP path
`SW4(config-trunk)#to 2.2.2.2`	Configuring first hop
`SW4(config-trunk)#to 1.1.1.1`	Configuring second hop
`SW4(config-trunk)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-trunk)#exit`	Exit trunk mode.
`SW4(config)#interface xe1`	Configuring interface
`SW4(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW4(config-if)#label-switching`	Enabling MPLS labeling
`SW4(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#router ldp`	Configuring LDP
`SW4(config-router)#targeted-peer ipv4 1.1.1.1`	Configuring LDP target peer for PW
`SW4(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit target peer mode
`SW4(config-router)#no multicast-hellos`	Disabling LDP multicast

`SW4(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#mpls l2-circuit ETH-2001 1 1.1.1.1`	Creating VPWS PW
`SW4(config-pseudowire)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-pseudowire)#exit`	Exit pseudowire config mode.
`SW4(config)#service-template ETH-2001`	Configuring service template profile for PW
`SW4(config-svc)# match outer-vlan 200`	Configuring match condition
`SW4(config-svc)# rewrite ingress push 2000`	Configuring action for match
`SW4(config-svc)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-svc)#exit`	Exit service template mode
`SW4(config)#interface xe9`	Configuring interface
`SW4(config-if)#mpls-l2-circuit ETH-2001 service-template ETH-2001`	Mapping VPWS in AC
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#hardware-profile filter cfm-domain-name-str enable`	Enabling HW filter for character string domain name
`SW4(config)#ethernet cfm domain-type character-string domain-name 12345 level 7 mip-creation none`	Configuring CFM domain over VPWS
`SW4(config-ether-cfm-mpls-md)#service ma-type string ma-name 43981`	Creating MA for domain
`SW4(config-ether-cfm-ma)#mip-creation none`	Configuring MIP creation permission
`SW4(config-ether-cfm-mpls-md-ma)#cc interval 100ms`	Configuring CFM interval
`SW4(config-ether-cfm-mpls-md-ma)#cc interval 3`	Configuring CFM interval
`SW4(config-ether-cfm-mpls-md-ma)#mep crosscheck mpid 4001`	Configuring remote mep
`SW4(config-ether-cfm-mpls-md-ma)#ethernet cfm mep up mpid 1 active true vpws ETH-2001`	Configuring local mep and mapping the same with vpws service
`SW4(config-ether-cfm-mpls-ma-mep)#cc multicast state enable`	Enabling the CFM multicast
`SW4(config-ether-cfm-mpls-ma-mep)#ethernet cfm loss-measurement reply slm`	Configuring SLR
`SW4(config-ether-cfm-mpls-ma-mep)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-ether-cfm-mpls-ma-mep)#end`	Exit config mode

SW5

SW5#configure terminal	Enter configure mode.
SW5(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
SW5(config)#vlan database	Entering VLAN database.
SW5(config-vlan)#vlan 512 bridge 1 state enable	Create VLAN 512 on bridge 1.
SW5(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW5(config-vlan)#exit	Exit config mode.
SW5(config)#interface xe9	Configure interface ce49.
SW5(config-if)#switchport	Configure the interface as switch port.
SW5(config-if)#bridge-group 1	Configure interface in bridge group 1
SW5(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW5(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface ce49.
SW5(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW5(config-if)#exit	Exit config mode.

Commands to initiate/abort loss measurement

```
SW2#loss-measurement type proactive profile-name <WORD> rmep mac-address
<HHHH.HHHH.HHHH>mep <MEPID> domain < DOMAIN_NAME>

SW2#abort loss-measurement mep <MEPID> domain <DOMAIN_NAME>
```

Validation

```
SW2#loss-measurement type proactive profile-name slm rmep mac-address 3c2c.9926.e683
mep 1 domain 12345

SW2#show ethernet cfm loss-measurement mep 1 domain 12345
MEP: 2 MA: 43981
CURRENT:
Measurement ID             : 1
Suspect                    : False
Measurement Type           : slm
Elapsed time(sec)          : 7
Start Time                 : 2019 Apr 30 14:43:41
Near End loss              : 0
Far End loss               : 0
Near End accumulated loss  : 0
Far End accumulated loss   : 0

SW2# abort loss-measurement mep 1 domain 12345
```

Synthetic Loss Measurement (SLM) Over ELINE

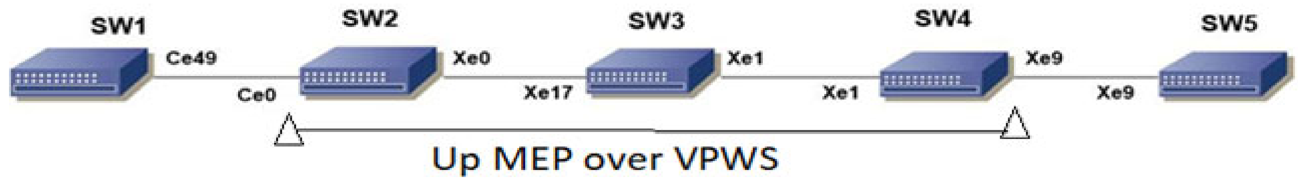


Figure 3-7: CFM Y.1731 SLM over ELINE Topology

SW1

`SW1#configure terminal`	Enter configure mode.
`SW1(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW1(config)#vlan database`	Entering VLAN database.
`SW1(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW1(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-vlan)#exit`	Exit config mode.
`SW1(config)#interface ce49`	Configure interface ce49.
`SW1(config-if)#switchport`	Configure the interface as switch port.
`SW1(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW1(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW1(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce49.
`SW1(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-if)#exit`	Exit config mode.

SW2

`SW2#configure terminal`	Enter configure mode.
`SW2(config)#interface ce0`	Configure interface ce0.
`SW2(config-if)#switchport`	Configure interface as a switch port.
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#interface xe0`	Configure interface xe1.
`SW2(config-if)#no switchport`	Configure interface as router port.
`SW2(config-if)#ip address 10.0.0.1/24`	Assign IP address to router port xe0
`SW2(config-if)#no shutdown`	Making the interface up
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.

`SW2(config)#interface lo`	Configure interface lo
`SW2(config-if)#ip address 1.1.1.1/32 secondary`	Configure secondary IP address to loopback interface .
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#router ospf 100`	Configure ospf
`SW2(config-router)#network 10.0.0.0/24 area 0`	Advertising 10 network
`SW2(config-router)#network 1.1.1.1/32 area 0`	Advertising loopback IP
`SW2(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#router rsvp`	Configuring rsvp
`SW2(config-router)#hello-receipt`	Configuring hello reception
`SW2(config-router)#no php`	Configuring device as not a PHP
`SW2(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW2(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#rsvp-trunk to-1 ipv4`	Configuring RSVP path
`SW2(config-trunk)#to 2.2.2.2`	Configuring first hop
`SW2(config-trunk)#to 3.3.3.3`	Configuring second hop
`SW2(config-trunk)#exit`	Exit trunk mode.
`SW2(config)#interface xe0`	Configuring interface
`SW2(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW2(config-if)#label-switching`	Enabling MPLS labeling
`SW2(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#router ldp`	Configuring LDP
`SW2(config-router)#targeted-peer ipv4 3.3.3.3`	Configuring LDP target peer for PW
`SW2(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit target peer mode
`SW2(config-router)#no multicast-hellos`	Disabling LDP multicast
`SW2(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#mpls l2-circuit ETH-2001 1 3.3.3.3`	Creating VPWS PW
`SW2(config-pseudowire)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-pseudowire)#exit`	Exit pseudowire config mode.

`SW2(config)#service-template ETH-2001`	Configuring service template profile for PW
`SW2(config-svc)#match outer-vlan 10`	Configuring match condition
`SW2(config-svc)# rewrite ingress push 2000`	Configuring action for match
`SW2(config-svc)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-svc)#exit`	Exit service template mode
`SW2(config)#interface ce0`	Configuring interface
`SW2(config-if)#mpls-l2-circuit ETH-2001 service-template ETH-2001`	Mapping VPWS in AC
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#hardware-profile filter cfm-domain-name-str enable`	Enabling HW filter for character string domain name
`SW2(config)#ethernet cfm domain-type character-string  domain-name 12345 level 7 mip-creation none`	Configuring CFM domain over VPWS
`SW2(config-ether-cfm-mpls-md)#service ma-type string ma-name 43981 mip-creation none`	Creating MA for domain
`SW2(config-ether-cfm-mpls-md-ma)#cc interval 100ms`	Configuring CFM interval
`SW2(config-ether-cfm-mpls-md-ma)#mep cross-check mpid 1`	Configuring remote mep
`SW2(config-ether-cfm-mpls-md-ma)#ethernet cfm mep up mpid 4001 active true vpws ETH-2001`	Configuring local mep and mapping the same with vpws service
`SW2(config-ether-cfm-mpls-ma-mep)#cc multicast state enable`	Enabling the CFM multicast
`SW2(config-ether-cfm-mpls-ma-mep)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-ether-cfm-mpls-ma-mep)#exit`	Exit CFM MEP configuration mode
`SW2(config-ether-cfm-mpls-md-ma)#exit`	Exit CFM MA configuration mode
`SW2(config-ether-cfm-mpls-md)#exit`	End current mode and down to previous mode
`SW2(config)#ethernet cfm loss-measurement profile-name slm`	Configuring LM profile
`SW2(config-cfm-lm)#measurement-type slm`	Configuring measurement type as SLM
`SW2(config-cfm-lm)#message-period 3`	Configuring message period
`SW2(config-cfm-lm)#measurement-interval 1`	Configuring measurement interval
`SW2(config-cfm-lm)#intervals-stored 3`	Configuring number of interval to be stored
`SW2(config-cfm-lm)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-cfm-lm)#end`	Exit config mode

SW3

`SW3#configure terminal`	Enter configure mode.
`SW3(config)#interface xe17`	Configure interface

SW3(config-if)#no switchport	Configure interface as router port.
SW3(config-if)#ip address 20.0.0.1/24	Assign IP address to router port
SW3(config-if)#no shutdown	Making the interface up
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit interface mode.
SW3(config)#interface xe1	Configure interface
SW3(config-if)#no switchport	Configure interface as router port.
SW3(config-if)#ip address 10.0.0.2/24	Assign IP address to router port
SW3(config-if)#no shutdown	Making the interface up
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit interface mode.
SW3(config)#interface lo	Configure interface lo
SW3(config-if)#ip address 2.2.2.2/32 secondary	Configure secondary IP address to loopback interface .
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit interface mode.
SW3(config)#router ospf 100	Configure ospf
SW3(config-router)#network 10.0.0.0/24 area 0	Advertising 10 network
SW3(config-router)#network 20.0.0.0/24 area 0	Advertising 10 network
SW3(config-router)#network 2.2.2.2/32 area 0	Advertising loopback IP
SW3(config-router)#commit	Commit the candidate configuration to the running configuration.
SW3(config-router)#exit	Exit router mode.
SW3(config)#router rsvp	Configuring rsvp
SW3(config-router)#hello-receipt	Configuring hello reception
SW3(config-router)#no php	Configuring device as not a PHP
SW3(config-router)#revert-timer 10	Configuring reversion time of RSVP
SW3(config-router)#commit	Commit the candidate configuration to the running configuration.
SW3(config-router)#exit	Exit router mode.
SW3(config)#interface xe1	Configuring interface
SW3(config-if)#enable-rsvp	Enabling RSVP in interface
SW3(config-if)#label-switching	Enabling MPLS labeling
SW3(config-if)#enable-ldp ipv4	Enabling ldp on interface
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit interface mode.
SW3(config)#interface xe17	Configuring interface
SW3(config-if)#enable-rsvp	Enabling RSVP in interface

`SW3(config-if)#label-switching`	Enabling MPLS labeling
`SW3(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit interface mode.

SW4

`SW4#configure terminal`	Enter configure mode.
`SW4(config)#interface xe9`	Configure interface
`SW4(config-if)#switchport`	Configure interface as switch port.
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#interface xe1`	Configure interface
`SW4(config-if)#no switchport`	Configure interface as router port.
`SW4(config-if)#ip address 20.0.0.2/24`	Assign IP address to router port
`SW4(config-if)#no shutdown`	Making the interface up
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#interface lo`	Configure interface lo
`SW4(config-if)#ip address 3.3.3.3/32 secondary`	Configure secondary IP address to loopback interface .
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#router ospf 100`	Configure ospf
`SW4(config-router)#network 20.0.0.0/24 area 0`	Advertising 10 network
`SW4(config-router)#network 3.3.3.3/32 area 0`	Advertising loopback IP
`SW4(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#router rsvp`	Configuring rsvp
`SW4(config-router)#hello-receipt`	Configuring hello reception
`SW4(config-router)#no php`	Configuring device as not a PHP
`SW4(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW4(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#rsvp-trunk to-1 ipv4`	Configuring RSVP path
`SW4(config-trunk)#to 2.2.2.2`	Configuring first hop
`SW4(config-trunk)#to 1.1.1.1`	Configuring second hop

`SW4(config-trunk)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-trunk)#exit`	Exit trunk mode.
`SW4(config)#interface xe1`	Configuring interface
`SW4(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW4(config-if)#label-switching`	Enabling MPLS labeling
`SW4(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#router ldp`	Configuring LDP
`SW4(config-router)#targeted-peer ipv4 1.1.1.1`	Configuring LDP target peer for PW
`SW4(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit target peer mode
`SW4(config-router)#no multicast-hellos`	Disabling LDP multicast
`SW4(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#mpls l2-circuit ETH-2001 1 1.1.1.1`	Creating VPWS PW
`SW4(config-pseudowire)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-pseudowire)#exit`	Exit pseudowire config mode.
`SW4(config)#service-template ETH-2001`	Configuring service template profile for PW
`SW4(config-svc)# match outer-vlan 200`	Configuring match condition
`SW4(config-svc)# rewrite ingress push 2000`	Configuring action for match
`SW4(config-svc)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-svc)#exit`	Exit service template mode
`SW4(config)#interface xe9`	Configuring interface
`SW4(config-if)#mpls-l2-circuit ETH-2001 service-template ETH-2001`	Mapping VPWS in AC
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#hardware-profile filter cfm-domain-name-str enable`	Enabling HW filter for character string domain name
`SW4(config)#ethernet cfm domain-type character-string domain-name 12345 level 7 mip-creation none`	Configuring CFM domain over VPWS
`SW4(config-ether-cfm-mpls-md)#service ma-type string ma-name 43981`	Creating MA for domain
`SW4(config-ether-cfm-ma)#mip-creation none`	Configuring MIP creation permission
`SW4(config-ether-cfm-mpls-md-ma)#cc interval 100ms`	Configuring CFM interval

SW4(config-ether-cfm-mpls-md-ma)#cc interval 3	Configuring CFM interval
SW4(config-ether-cfm-mpls-md-ma)#mep cross-check mpid 4001	Configuring remote mep
SW4(config-ether-cfm-mpls-md-ma)#ethernet cfm mep up mpid 1 active true vpws ETH-2001	Configuring local mep and mapping the same with vpws service
SW4(config-ether-cfm-mpls-ma-mep)#cc multicast state enable	Enabling the CFM multicast
SW4(config-ether-cfm-mpls-ma-mep)#ethernet cfm loss-measurement reply slm	Configuring SLR
SW4(config-ether-cfm-mpls-ma-mep)#commit	Commit the candidate configuration to the running configuration.
SW4(config-ether-cfm-mpls-ma-mep)#end	Exit config mode

SW5

SW5#configure terminal	Enter configure mode.
SW5(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
SW5(config)#vlan database	Entering VLAN database.
SW5(config-vlan)#vlan 512 bridge 1 state enable	Create VLAN 512 on bridge 1.
SW5(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW5(config-vlan)#exit	Exit config mode.
SW5(config)#interface xe9	Configure interface ce49.
SW5(config-if)#switchport	Configure the interface as switch port.
SW5(config-if)#bridge-group 1	Configure interface in bridge group 1
SW5(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW5(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface ce49.
SW5(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW5(config-if)#exit	Exit config mode.

Commands to initiate/abort loss measurement

```
SW2#loss-measurement type proactive profile-name <WORD> rmep mac-address
<HHHH.HHHH.HHHH>mep <MEPID> domain < DOMAIN_NAME>

SW2#abort loss-measurement mep <MEPID> domain <DOMAIN_NAME>
```

Validation

```
SW2#loss-measurement type proactive profile-name slm rmep mac-address 3c2c.9926.e683
mep 1 domain 12345

SW2#show ethernet cfm loss-measurement mep 1 domain 12345
```

```
MEP: 2 MA: 43981
CURRENT:
Measurement ID              : 1
Suspect                     : False
Measurement Type            : slm
Elapsed time(sec)           : 7
Start Time                  : 2019 Apr 30 14:43:41
Near End loss               : 0
Far End loss                : 0
Near End accumulated loss   : 0
Far End accumulated loss    : 0

SW2# abort loss-measurement mep 1 domain 12345
```

Loss Measurement Message(LMM) over L2 Bridge

Topology

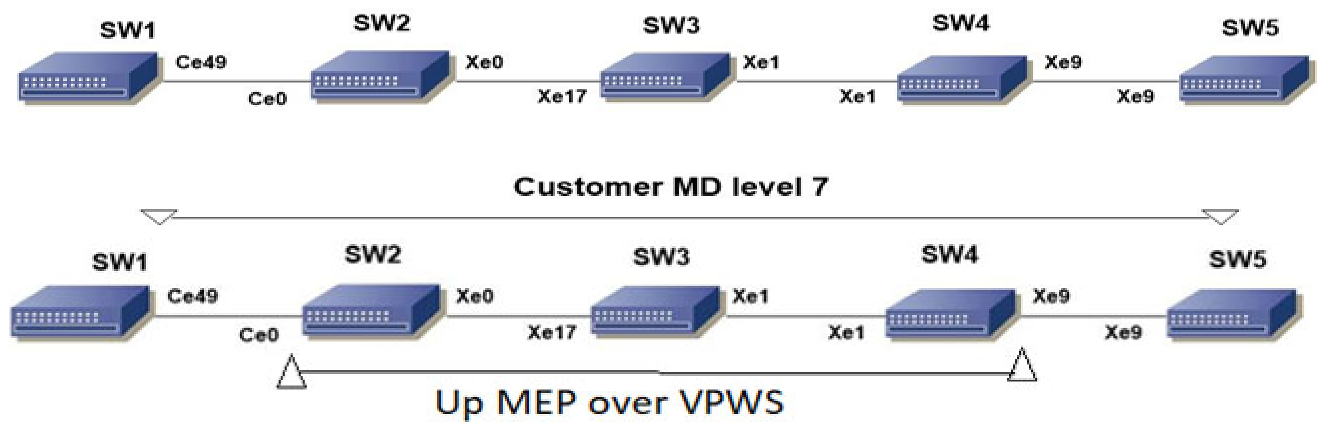


Figure 3-8: CFM Y.1731 LMM over L2 Bridge Topology

Prerequisite

Configure below hardware-profile commands related to CFM in configuration mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-lm enable
hardware-profile statistics cfm-ccm enable
```

SW1

`SW1#configure terminal`	Enter configure mode.
`SW1(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW1(config)#vlan database`	Entering vlan database

`SW1(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW1(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-vlan)#exit`	Exit vlan database
`SW1(config)#int ce49`	Configure interface ce49.
`SW1(config-if)#switchport`	Configure the interface as switch port.
`SW1(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW1(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW1(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce49.
`SW1(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-if)#exit`	Exit config mode.
`SW1(config)#ethernet cfm domain-type character-string domain-name mdnam level 7 mip-creation default`	Create cfm domain with type as character string and set mip creation criteria to default.
`SW1(config-ether-cfm)#service ma-type string ma-name testtm`	Create ma type as string and set mip creation criteria to default.
`SW1(config-ether-cfm)#vlan 512`	Configure primary VLAN ID
`SW1(config-ether-cfm-ma)#mip-creation default`	Configure MIP creation permission
`SW1(config-ether-cfm-ma)#ethernet cfm mep down mpid 2 active true local-vid 512 ce49`	Create down mep for local-vid on ce49.
`SW1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast.
`SW1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode.
`SW1(config-ether-cfm-ma)#mep crosscheck mpid 1`	Configure crosscheck to remote MEP in VLAN 512.
`SW1(config-ether-cfm-ma)#cc interval 10ms`	Enable cc interval for 10 millisecond.
`SW1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit ethernet ma mode.
`SW1(config-ether-cfm)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-ether-cfm)#exit`	Exit ethernet CFM mode.
`SW1(config)# ethernet cfm loss-measurement profile-name LMM`	Creating loss-measurement profile for LMM
`SW1(config-cfm-lm)# measurement-type lmm`	Specify the measurement type
`SW1(config-cfm-lm)# measurement-interval 1`	Specify the measurement-interval in minutes
`SW1(config)# intervals-stored 3`	Specify the number of history interval to be stored
`SW1(config)# message-period 1s`	Specify message period interval time
`SW1(config)#commit`	Commit the candidate configuration to the running configuration.

SW2

SW2#configure terminal	Enter configure mode.
SW2(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
SW2(config)#vlan database	Entering vlan database
SW2(config-vlan)#vlan 512 bridge 1 state enable	Create VLAN 512 on bridge 1.
SW2(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW2(config-vlan)#exit	Exit vlan database
SW2(config)#int ce0	Configure interface ce0.
SW2(config-if)#switchport	Configure the interface as switch port.
SW2(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW2(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW2(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface ce0.
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit config mode.
SW2(config)#int xe0	Configure interface xe0.
SW2(config-if)#switchport	Configure the interface as switch port.
SW2(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW2(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW2(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface xe1.
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit config mode.

SW3

SW3#configure terminal	Enter configure mode.
SW3(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
SW3(config)#vlan database	Entering vlan database
SW3(config-vlan)#vlan 512 bridge 1 state enable	Create VLAN 512 on bridge 1.
SW3(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW3(config-vlan)#exit	Exit vlan database
SW3(config)#int xe17	Configure interface xe17.
SW3(config-if)#switchport	Configure the interface as switch port.
SW3(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW3(config-if)#switchport mode trunk	Configure interface mode as trunk.

`SW3(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe17.
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit config mode.
`SW3(config)#int xe1`	Configure interface xe1.
`SW3(config-if)#switchport`	Configure the interface as switch port.
`SW3(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW3(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW3(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe1.
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit config mode.

SW4

`SW4#configure terminal`	Enter configure mode.
`SW4(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW4(config)#vlan database`	Entering vlan database
`SW4(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW4(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-vlan)#exit`	Exit vlan database
`SW4(config)#int xe1`	Configure interface xe1.
`SW4(config-if)#switchport`	Configure the interface as switch port.
`SW4(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW4(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW4(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe1.
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit config mode.
`SW4(config)#int xe9`	Configure interface xe9.
`SW4(config-if)#switchport`	Configure the interface as switch port.
`SW4(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW4(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW4(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface xe9.
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit config mode.

SW5

SW5#configure terminal	Enter configure mode.
SW5(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
SW5(config)#vlan database	Entering vlan database
SW5(config-vlan)#vlan 512 bridge 1 state enable	Create VLAN 512 on bridge 1.
SW5(config-if)#commit	Commit the candidate configuration to the running configuration.
SW5(config-vlan)#exit	Exit vlan database
SW5(config)#int xe9	Configure interface xe9.
SW5(config-if)#switchport	Configure the interface as switch port.
SW5(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW5(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW5(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface xe9.
SW5(config-if)#commit	Commit the candidate configuration to the running configuration.
SW5(config-if)#exit	Exit config mode.
SW5(config)#ethernet cfm domain-type character-string domain-name mdnam level 7 mip-creation default	Create cfm domain with type as character string and set mip creation criteria to default.
SW5(config-ether-cfm)#service ma-type string ma-name testtm	Create ma type as string and set mip creation criteria to default.
SW5(config-ether-cfm-ma)#vlan 512 bridge 1	Configure primary VLAN ID
SW5(config-ether-cfm-ma)#mip-creation default	Configure MIP creation permission
SW5(config-ether-cfm-ma)#ethernet cfm mep down mpid 1 active true xe9	Create down mep for local-vid on xe9
SW5(config-ether-cfm-ma-mep)#cc multicast state enable	Enable cc multicast.
SW5(config-ether-cfm-ma-mep)#ethernet cfm loss-measurement reply lmm	Generate and send LMR responses tacked
SW5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit ethernet cfm ma-mep mode.
SW5(config-ether-cfm-ma)#mep crosscheck mpid 2	Configure crosscheck to remote MEP in VLAN 512.
SW5(config-ether-cfm-ma)#cc interval 10ms	Enable cc interval for 10 millisecond.
SW5(config-ether-cfm-ma)#exit-ether-ma-mode	Exit ethernet ma mode.
SW5(config-ether-cfm-ma)#commit	Commit the candidate configuration to the running configuration.
SW5(config-ether-cfm)#exit	Exit ethernet CFM mode.

Commands to initiate/abort loss measurement

```
loss-measurement type on-demand profile-name <WORD> rmep mac-address <HHHH.HHHH.HHHH>
start-time <immediate|relative|absolute> stop-time <none|absolute|relative> repetition-
period <REP-TIME> mep <MEPID> domain < DOMAIN_NAME> ma <MA_NAME>

loss-measurement type proactive profile-name <WORD> rmep mac-address
<HHHH.HHHH.HHHH>mep <MEPID> domain < DOMAIN_NAME> ma <MA_NAME>

abort loss-measurement mep <MEPID> domain <DOMAIN_NAME> ma <MA_NAME>

clear ethernet cfm loss-measurement mep <MEPID> domain <DOMAIN_NAME> ma <MA_NAME>
```

Validation

```
SW1#ping ethernet mac 3c2c.9926.e683 unicast source 2 domain mdnam ma

SW1#traceroute ethernet 3c2c.9926.e683 mepid 2 domain mdnam ma testtm
 MP Mac          Hops  Relay-action          Ingress/Egress  Ingress/Egress action
3c2c.9926.e683   1      RlyHit                 Ingress         IngOK

SW1# loss-measurement type proactive profile-name LMM rmep mac-address 3c2c.9926.e683
mep 2 domain mdnam ma testtm

SW1# show ethernet cfm loss-measurement mep 2 domain mdnam ma testtm
MEP: 2 MA: testtm
CURRENT:
 Measurement ID              : 1
  Suspect                    : False
  Measurement Type           : lmm
  Elapsed time(sec)          : 24
  Start Time                 : 2019 Jul 21 00:10:36
  Near End loss              : 0
  Far End loss               : 0
  Near End accumulated loss  : 0
  Far End accumulated loss   : 0

SW1# abort loss-measurement mep 2 domain mdnam ma testtm
```

Loss Measurement Message (LMM) Over VPWS

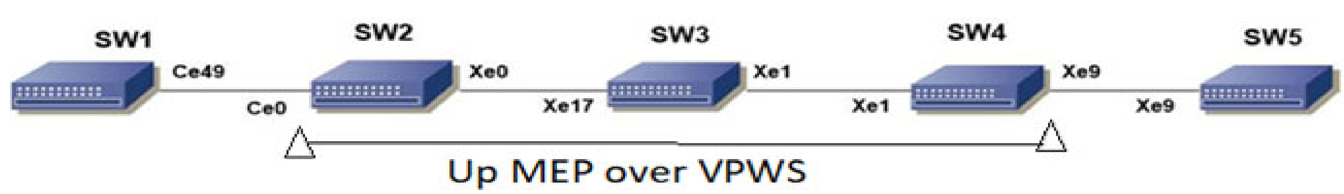


Figure 3-9: CFM Y.1731 LMM over VPWS Topology

SW1

SW1#configure terminal	Enter configure mode.
SW1(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
SW1(config)#vlan database	Entering VLAN database.
SW1(config-vlan)#vlan 512 bridge 1 state enable	Create VLAN 512 on bridge 1.
SW1(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW1(config-vlan)#exit	Exit config mode.
SW1(config)#interface ce49	Configure interface ce49.
SW1(config-if)#switchport	Configure the interface as switch port.
SW1(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW1(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW1(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface ce49.
SW1(config-if)#commit	Commit the candidate configuration to the running configuration.
SW1(config-if)#exit	Exit config mode.

SW2

SW2#configure terminal	Enter configure mode.
SW2(config)#interface ce0	Configure interface ce0.
SW2(config-if)#switchport	Configure interface as a switch port.
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit interface mode.
SW2(config)#interface xe0	Configure interface xe0.
SW2(config-if)#no switchport	Configure interface as router port.
SW2(config-if)#ip address 10.0.0.1/24	Assign IP address to router port xe0
SW2(config-if)#no shutdown	Making the interface up
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit interface mode.
SW2(config)#interface lo	Configure interface lo
SW2(config-if)#ip address 1.1.1.1/32 secondary	Configure secondary IP address to loopback interface .
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit interface mode.
SW2(config)#router ospf 100	Configure ospf
SW2(config-router)#network 10.0.0.0/24 area 0	Advertising 10 network

`SW2(config-router)#network 1.1.1.1/32 area 0`	Advertising loopback IP
`SW2(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#router rsvp`	Configuring rsvp
`SW2(config-router)#hello-receipt`	Configuring hello reception
`SW2(config-router)#no php`	Configuring device as not a PHP
`SW2(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW2(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#rsvp-trunk to-1 ipv4`	Configuring RSVP path
`SW2(config-trunk)#to 2.2.2.2`	Configuring first hop
`SW2(config-trunk)#to 3.3.3.3`	Configuring second hop
`SW2(config-trunk)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-trunk)#exit`	Exit trunk mode.
`SW2(config)#interface xe0`	Configuring interface
`SW2(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW2(config-if)#label-switching`	Enabling MPLS labeling
`SW2(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#router ldp`	Configuring LDP
`SW2(config-router)#targeted-peer ipv4 3.3.3.3`	Configuring LDP target peer for PW
`SW2(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit target peer mode
`SW2(config-router)#no multicast-hellos`	Disabling LDP multicast
`SW2(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#mpls l2-circuit ETH-2001 1 3.3.3.3`	Creating VPWS PW
`SW2(config-pseudowire)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-pseudowire)#exit`	Exit pseudowire config mode.
`SW2(config)#service-template ETH-2001`	Configuring service template profile for PW
`SW2(config-svc)#match outer-vlan 200`	Configuring match condition
`SW2(config-svc)# rewrite ingress push 2000`	Configuring action for match
`SW2(config-svc)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-svc)#exit`	Exit service template mode

SW2(config)#interface ce0	Configuring interface
SW2(config-if)#mpls-l2-circuit ETH-2001 service-template ETH-2001	Mapping VPWS in AC
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit interface mode.
SW2(config)#hardware-profile filter cfm-domain-name-str enable	Enabling HW filter for character string domain name
SW2(config)#ethernet cfm domain-type character-string domain-name 12345 level 7 mip-creation none	Configuring CFM domain over VPWS
SW2(config-ether-cfm-mpls-md)#service ma-type string ma-name 43981 mip-creation none	Creating MA for domain
SW2(config-ether-cfm-mpls-md-ma)#cc interval 100ms	Configuring CFM interval
SW2(config-ether-cfm-mpls-md-ma)#mep crosscheck mpid 1	Configuring remote mep
SW2(config-ether-cfm-mpls-md-ma)#ethernet cfm mep up mpid 4001 active true vpws ETH-2001	Configuring local mep and mapping the same with vpws service
SW2(config-ether-cfm-mpls-ma-mep)#cc multicast state enable	Enabling the CFM multicast
SW2(config-ether-cfm-mpls-ma-mep)#commit	Commit the candidate configuration to the running configuration.
SW2(config-ether-cfm-mpls-ma-mep)#exit	Exit CFM MEP configuration mode
SW2(config-ether-cfm-mpls-md-ma)#exit	Exit CFM MA configuration mode
SW2(config-ether-cfm-mpls-md)#exit	End current mode and down to previous mode
SW2(config)#ethernet cfm loss-measurement profile-name lmm	Configuring LM profile
SW2(config-cfm-lm)#measurement-type lmm	Configuring measurement type as LMM
SW2(config-cfm-lm)#message-period 3	Configuring message period
SW2(config-cfm-lm)#measurement-interval 1	Configuring measurement interval
SW2(config-cfm-lm)#intervals-stored 3	Configuring number of interval to be stored
SW2(config-cfm-lm)#commit	Commit the candidate configuration to the running configuration.
SW2(config-cfm-lm)#end	Exit config mode

SW3

SW3#configure terminal	Enter configure mode.
SW3(config)#interface xe17	Configure interface
SW3(config-if)#no switchport	Configure interface as router port.
SW3(config-if)#ip address 20.0.0.1/24	Assign IP address to router port
SW3(config-if)#no shutdown	Making the interface up
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit interface mode.

`SW3(config)#interface xe1`	Configure interface
`SW3(config-if)#no switchport`	Configure interface as router port.
`SW3(config-if)#ip address 10.0.0.2/24`	Assign IP address to router port
`SW3(config-if)#no shutdown`	Making the interface up
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit interface mode.
`SW3(config)#interface lo`	Configure interface lo
`SW3(config-if)#ip address 2.2.2.2/32 secondary`	Configure secondary IP address to loopback interface.
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit interface mode.
`SW3(config)#router ospf 100`	Configure ospf
`SW3(config-router)#network 10.0.0.0/24 area 0`	Advertising 10 network
`SW3(config-router)#network 20.0.0.0/24 area 0`	Advertising 10 network
`SW3(config-router)#network 2.2.2.2/32 area 0`	Advertising loopback IP
`SW3(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-router)#exit`	Exit router mode.
`SW3(config)#router rsvp`	Configuring rsvp
`SW3(config-router)#hello-receipt`	Configuring hello reception
`SW3(config-router)#no php`	Configuring device as not a PHP
`SW3(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW3(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-router)#exit`	Exit router mode.
`SW3(config)#interface xe1`	Configuring interface
`SW3(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW3(config-if)#label-switching`	Enabling MPLS labeling
`SW3(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit interface mode.
`SW3(config)#interface xe17`	Configuring interface
`SW3(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW3(config-if)#label-switching`	Enabling MPLS labeling
`SW3(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit interface mode.

SW4

`SW4#configure terminal`	Enter configure mode.
`SW4(config)#interface xe9`	Configure interface
`SW4(config-if)#switchport`	Configure interface as switch port.
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#interface xe1`	Configure interface
`SW4(config-if)#no switchport`	Configure interface as router port.
`SW4(config-if)#ip address 20.0.0.2/24`	Assign IP address to router port
`SW4(config-if)#no shutdown`	Making the interface up
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#interface lo`	Configure interface lo
`SW4(config-if)#ip address 3.3.3.3/32 secondary`	Configure secondary IP address to loopback interface .
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#router ospf 100`	Configure ospf
`SW4(config-router)#network 20.0.0.0/24 area 0`	Advertising 10 network
`SW4(config-router)#network 3.3.3.3/32 area 0`	Advertising loopback IP
`SW4(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#router rsvp`	Configuring rsvp
`SW4(config-router)#hello-receipt`	Configuring hello reception
`SW4(config-router)#no php`	Configuring device as not a PHP
`SW4(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#rsvp-trunk to-1 ipv4`	Configuring RSVP path
`SW4(config-trunk)#to 2.2.2.2`	Configuring first hop
`SW4(config-trunk)#to 1.1.1.1`	Configuring second hop
`SW4(config-trunk)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-trunk)#exit`	Exit trunk mode.
`SW4(config)#interface xe1`	Configuring interface
`SW4(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW4(config-if)#label-switching`	Enabling MPLS labeling
`SW4(config-if)#enable-ldp ipv4`	Enabling ldp on interface

`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#router ldp`	Configuring LDP
`SW4(config-router)#targeted-peer ipv4 1.1.1.1`	Configuring LDP target peer for PW
`SW4(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit target peer mode
`SW4(config-router)#no multicast-hellos`	Disabling LDP multicast
`SW4(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#mpls l2-circuit ETH-2001 1 1.1.1.1`	Creating VPWS PW
`SW4(config-pseudowire)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-pseudowire)#exit`	Exit pseudowire config mode.
`SW4(config)#service-template ETH-2001`	Configuring service template profile for PW
`SW4(config-svc)# match outer-vlan 200`	Configuring match condition
`SW4(config-svc)# rewrite ingress push 2000`	Configuring action for match
`SW4(config-svc)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-svc)#exit`	Exit service template mode
`SW4(config)#interface xe9`	Configuring interface
`SW4(config-if)#mpls-l2-circuit ETH-2001 service-template ETH-2001`	Mapping VPWS in AC
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#hardware-profile filter cfm-domain-name-str enable`	Enabling HW filter for character string domain name
`SW4(config)#ethernet cfm domain-type character-string domain-name 12345 level 7 mip-creation none`	Configuring CFM domain over VPWS
`SW4(config-ether-cfm-mpls-md)#service ma-type string ma-name 43981`	Creating MA for domain
`SW4(config-ether-cfm-ma)#mip-creation none`	Configuring MIP creation permission
`SW4(config-ether-cfm-mpls-md-ma)#cc interval 100ms`	Configuring CFM interval
`SW4(config-ether-cfm-mpls-md-ma)#mep crosscheck mpid 4001`	Configuring remote mep
`SW4(config-ether-cfm-mpls-md-ma)#ethernet cfm mep up mpid 1 active true vpws ETH-2001`	Configuring local mep and mapping the same with vpws service
`SW4(config-ether-cfm-mpls-ma-mep)#cc multicast state enable`	Enabling the CFM multicast
`SW4(config-ether-cfm-mpls-ma-mep)#ethernet cfm loss-measurement reply lmm`	Configuring LMR

`SW4(config-ether-cfm-mpls-ma-mep)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-ether-cfm-mpls-ma-mep)#end`	Exit config mode

SW5

`SW5#configure terminal`	Enter configure mode.
`SW5(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW5(config)#vlan database`	Entering VLAN database.
`SW5(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW5(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW5(config-vlan)#exit`	Exit config mode.
`SW5(config)#interface xe9`	Configure interface ce49.
`SW5(config-if)#switchport`	Configure the interface as switch port.
`SW5(config-if)#bridge-group 1`	Configure interface in bridge group 1
`SW5(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW5(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce49.
`SW5(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW5(config-if)#exit`	Exit config mode.

Commands to initiate/abort loss measurement

```
SW2#loss-measurement type proactive profile-name <WORD> rmep mac-address
<HHHH.HHHH.HHHH>mep <MEPID> domain < DOMAIN_NAME>

SW2#abort loss-measurement mep <MEPID> domain <DOMAIN_NAME>
```

Validation

```
SW2#loss-measurement type proactive profile-name lmm rmep mac-address 3c2c.9926.e683
mep 1 domain 12345

SW2#show ethernet cfm loss-measurement mep 1 domain 12345
MEP: 2 MA: 43981
CURRENT:
Measurement ID              : 1
Suspect                     : False
Measurement Type            : lmm
Elapsed time(sec)           : 7
Start Time                  : 2019 Apr 30 14:43:41
Near End loss               : 0
Far End loss                : 0
Near End accumulatedloss    : 0
```

```
Far End accumulated loss      : 0
SW2# abort loss-measurement mep 1 domain 12345
```

Delay Measurement (DM) over L2 Bridge

Topology

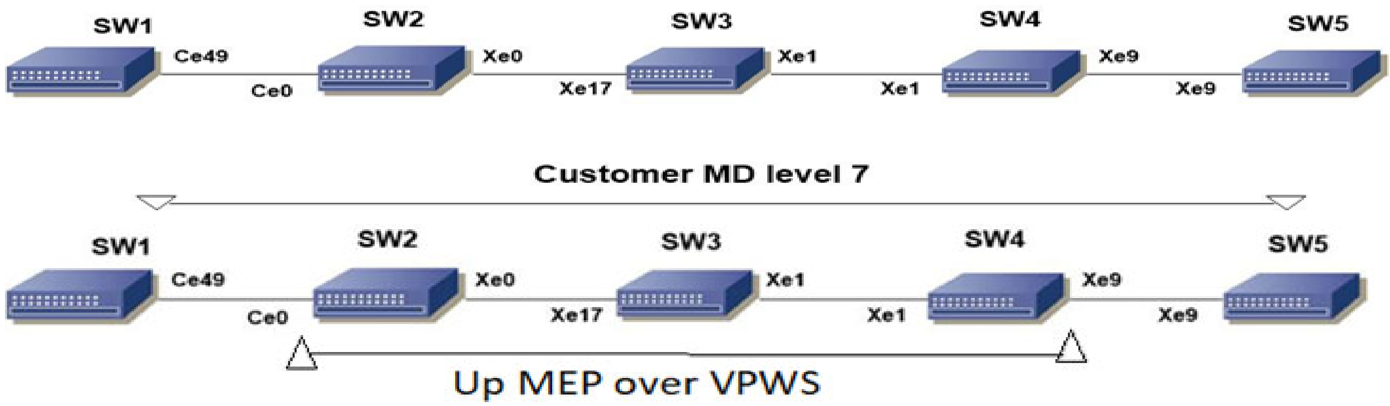


Figure 3-10: CFM Y.1731 DM over L2 Bridge Topology

Prerequisite

Configure below hardware-profile commands related to CFM in configuration mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics ingress-acl enable
hardware-profile statistics cfm-lm enable
hardware-profile statistics cfm-ccm enable
```

SW1

SW1#configure terminal	Enter configure mode.
SW1(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
SW1(config)#vlan database	Entering vlan database
SW1(config-vlan)#vlan 512 bridge 1 state enable	Create VLAN 512 on bridge 1.
SW1(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW1(config-vlan)#exit	Exit vlan database
SW1(config)#int ce49	Configure interface ce49.
SW1(config-if)#switchport	Configure the interface as switch port.
SW1(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW1(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW1(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface ce49.

`SW1(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-if)#exit`	Exit config mode.
`SW1(config)#ethernet cfm domain-type character-string domain-name mdnam level 7 mip-creation default`	Create cfm domain with type as character string and set mip creation criteria to default.
`SW1(config-ether-cfm)#service ma-type string ma-name testtm`	Create ma type as string and set mip creation criteria to default.
`SW1(config-ether-cfm-ma)#vlan 512 bridge 1`	Configure primary VLAN ID
`SW1(config-ether-cfm-ma)#mip-creation default`	Configure MIP creation permission
`SW1(config-ether-cfm-ma)#ethernet cfm mep down mpid 2 active true ce49`	Create down mep for local-vid on ce49.
`SW1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast.
`SW1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode.
`SW1(config-ether-cfm-ma)#mep crosscheck mpid 1`	Configure crosscheck to remote MEP in VLAN 512.
`SW1(config-ether-cfm-ma)#cc interval 10ms`	Enable cc interval for 10 millisecond.
`SW1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit ethernet ma mode.
`SW1(config-ether-cfm)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-ether-cfm)#exit`	Exit ethernet CFM mode.
`SW1(config)# ethernet cfm delay-measurement profile-name DM`	Creating loss-measurement profile for DM
`SW1(config-cfm-dm)# measurement-interval 1`	Specify the measurement-interval in minutes
`SW1(config-cfm-dm)# intervals-stored 3`	Specify the number of history interval to be stored
`SW1(config-cfm-dm)# message-period 1s`	Specify message period interval time
`SW1(config-cfm-dm)# bins-per-fd-interval 4`	Specify the number of measurement bins per Measurement Interval for Frame Delay measurements.
`SW1(config-cfm-dm)# bins-per-ifdv-interval 3`	Specify the number of measurement bins per Measurement Interval for Inter-Frame Delay Variation measurements.
`SW1(config-cfm-dm)#commit`	Commit the candidate configuration to the running configuration.

SW2

`SW2#configure terminal`	Enter configure mode.
`SW2(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW2(config)#vlan database`	Entering vlan database
`SW2(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW2(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-vlan)#exit`	Exit vlan database
`SW2(config)#int ce0`	Configure interface ce0.

SW2(config-if)#switchport	Configure the interface as switch port.
SW2(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW2(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW2(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface ce0.
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit config mode.
SW2(config)#int xe0	Configure interface xe0.
SW2(config-if)#switchport	Configure the interface as switch port.
SW2(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW2(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW2(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface xe1.
SW2(config-if)#commit	Commit the candidate configuration to the running configuration.
SW2(config-if)#exit	Exit config mode.

SW3

SW3#configure terminal	Enter configure mode.
SW3(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
SW3(config)#vlan database	Entering vlan database
SW3(config-vlan)#vlan 512 bridge 1 state enable	Create VLAN 512 on bridge 1.
SW3(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW3(config-vlan)#exit	Exit vlan database
SW3(config)#int xe17	Configure interface xe17.
SW3(config-if)#switchport	Configure the interface as switch port.
SW3(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW3(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW3(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface xe17.
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit config mode.
SW3(config)#int xe1	Configure interface xe1.
SW3(config-if)#switchport	Configure the interface as switch port.
SW3(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW3(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW3(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface xe1.

SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit config mode.

SW4

SW4#configure terminal	Enter configure mode.
SW4(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
SW4(config)#vlan database	Entering vlan database
SW4(config-vlan)#vlan 512 bridge 1 state enable	Create VLAN 512 on bridge 1.
SW4(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW4(config-vlan)#exit	Exit vlan database
SW4(config)#int xe1	Configure interface xe1.
SW4(config-if)#switchport	Configure the interface as switch port.
SW4(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW4(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW4(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface xe1.
SW4(config-if)#commit	Commit the candidate configuration to the running configuration.
SW4(config-if)#exit	Exit config mode.
SW4(config)#int xe9	Configure interface xe9.
SW4(config-if)#switchport	Configure the interface as switch port.
SW4(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW4(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW4(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface xe9.
SW4(config-if)#commit	Commit the candidate configuration to the running configuration.
SW4(config-if)#exit	Exit config mode.

SW5

SW5#configure terminal	Enter configure mode.
SW5(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
SW5(config)#vlan database	Entering vlan database
SW5(config-vlan)#vlan 512 bridge 1 state enable	Create VLAN 512 on bridge 1.
SW5(config-vlan)#commit	Commit the candidate configuration to the running configuration.
SW5(config-vlan)#exit	Exit vlan database
SW5(config)#int xe9	Configure interface xe9.

SW5(config-if)#switchport	Configure the interface as switch port.
SW5(config-if)#bridge-group 1	Configure interface in bridge group 1.
SW5(config-if)#switchport mode trunk	Configure interface mode as trunk.
SW5(config-if)#switchport trunk allowed vlan all	Allow all VLANs on interface xe9.
SW5(config-if)#commit	Commit the candidate configuration to the running configuration.
SW5(config-if)#exit	Exit config mode.
SW5(config)#ethernet cfm domain-type character-string domain-name mdnam level 7 mip-creation default	Create cfm domain with type as character string and set mip creation criteria to default.
SW5(config-ether-cfm)#service ma-type string ma-name testtm	Create ma type as string and set mip creation criteria to default.
SW5(config-ether-cfm)#vlan 512 bridge 1	Configure primary VLAN ID
SW5(config-ether-cfm-ma)#mip-creation default	Configure MIP creation permission
SW5(config-ether-cfm-ma)#ethernet cfm mep down mpid 1 active true xe9	Create down mep for local-vid on xe9
SW5(config-ether-cfm-ma-mep)#cc multicast state enable	Enable cc multicast.
SW5(config-ether-cfm-ma-mep)# ethernet cfm delay-measurement reply dmm	Generate and send DMM responses tacked
SW5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit ethernet cfm ma-mep mode.
SW5(config-ether-cfm-ma)#mep crosscheck mpid 2	Configure crosscheck to remote MEP in VLAN 512.
SW5(config-ether-cfm-ma)#cc interval 10ms	Enable cc interval for 10 millisecond.
SW5(config-ether-cfm-ma)#exit-ether-ma-mode	Exit ethernet ma mode.
SW5(config-ether-cfm)#commit	Commit the candidate configuration to the running configuration.
SW5(config-ether-cfm)#exit	Exit ethernet CFM mode.

Commands to initiate/abort on-demand delay measurement

```
delay-measurement type on-demand profile-name WORD rmep (mac-address MAC|RMEPID) start-
time (immediate|relative HH:MM:SS|absolute HH:MM:SS <1-31> MONTH <1993-2035>)
repetition-period <6000-4294967295> mep MEPID domain DOMAIN_NAME ma <MA_NAME>

abort delay-measurement mep <MEPID> domain <DOMAIN_NAME> ma <MA_NAME>
```

Validation

```
SW1#ping ethernet mac 3c2c.9926.e683 unicast source 2 domain mdnam ma

SW1#traceroute ethernet 3c2c.9926.e683 mepid 2 domain mdnam ma testtm
 MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
3c2c.9926.e683   1     RlyHit                Ingress         IngOK
```

```
SW1# delay-measurement type proactive profile-name DM rmep mac-address 3c2c.9926.e683
mep 2 domain mdnam ma testtm

SW1#show ethernet cfm delay-measurement mep 2 domain mdnam ma testtm
 MEP                       : 2
 MA                        : testtm
 VLAN ID                   : 512
 Peer MAC Address          : 3c2c.9926.e683

CURRENT:
======================
 RMEP ID                        : 1
 Measurement ID                 : 12
 Measurement Type               : DMM
 Elapsed time(sec)              : 24
 Start Time                     : 2019 Aug 06 13:23:53
 Suspect Flag                   : FALSE
 Min Frame Delay(usec)          : 13
 Max Frame Delay(usec)          : 13
 Avg Frame Delay(usec)          : 13
 Min Inter FD Variation(usec): 0
 Max Inter FD Variation(usec): 0
 Avg Inter FD Variation(usec): 0

             FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)    Bin Counter
==================================================
 1             0       - <    4999    3
 2             5000    - <    9999    0
 3             10000   - <   14999    0
 4             15000   - <     Inf    0

           INTER-FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)    Bin Counter
==================================================
 1             0       - <    4999    2
 2             5000    - <    9999    0
 3             10000   - <     Inf    0


HISTORY STATISTICS
======================
 MD                             : mdnam
 MA                             : testtm
 MEP                            : 2
 VLAN ID                        : 512
 RMEP ID                        : 1
 Measurement ID                 : 10
 Measurement Type               : DMM
 Elapsed time(sec)              : 60
 End Time                       : 2019 Aug 06 13:22:52
```

```
 Suspect Flag                : FALSE
 Min Frame Delay(usec)       : 13
 Max Frame Delay(usec)       : 13
 Avg Frame Delay(usec)       : 13
 Min Inter FD Variation(usec): 0
 Max Inter FD Variation(usec): 0
 Avg Inter FD Variation(usec): 0

             FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)    Bin Counter
==================================================
 1             0       - <    4999    6
 2             5000    - <    9999    0
 3             10000   - <   14999    0
 4             15000   - <     Inf    0

           INTER-FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)    Bin Counter
==================================================
 1             0       - <    4999    5
 2             5000    - <    9999    0
 3             10000   - <     Inf    0

 RMEP ID        : 1
 Measurement ID : 11
 Measurement Type            : DMM
 Elapsed time(sec)           : 60
 End Time                    : 2019 Aug 06 13:23:52
 Suspect Flag                : FALSE
 Min Frame Delay(usec)       : 13
 Max Frame Delay(usec)       : 13
 Avg Frame Delay(usec)       : 13
 Min Inter FD Variation(usec): 0
 Max Inter FD Variation(usec): 0
 Avg Inter FD Variation(usec): 0

             FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)    Bin Counter
==================================================
 1             0       - <    4999    6
 2             5000    - <    9999    0
 3             10000   - <   14999    0
 4             15000   - <     Inf    0

           INTER-FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)    Bin Counter
==================================================
 1             0       - <    4999    5
 2             5000    - <    9999    0
 3             10000   - <     Inf    0
```

```
SW1# abort delay-measurement mep 2 domain mdnam ma testtm
```

Delay Measurement Message (DMM) Over VPWS

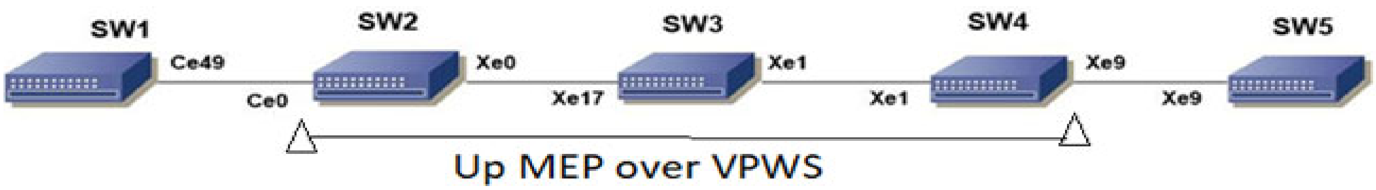


Figure 3-11: CFM Y.1731 DMM over VPWS Topology

SW1

`SW1#configure terminal`	Enter configure mode.
`SW1(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW1(config)#vlan database`	Entering VLAN database.
`SW1(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW1(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-vlan)#exit`	Exit config mode.
`SW1(config)#interface ce49`	Configure interface ce49.
`SW1(config-if)#switchport`	Configure the interface as switch port.
`SW1(config-if)#bridge-group 1`	Configure interface in bridge group 1.
`SW1(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW1(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce49.
`SW1(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW1(config-if)#exit`	Exit config mode.

SW2

`SW2#configure terminal`	Enter configure mode.
`SW2(config)#interface ce0`	Configure interface ce0.
`SW2(config-if)#switchport`	Configure interface as a switch port.
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#interface xe0`	Configure interface xe0.
`SW2(config-if)#no switchport`	Configure interface as router port.
`SW2(config-if)#ip address 10.0.0.1/24`	Assign IP address to router port xe0
`SW2(config-if)#no shutdown`	Making the interface up

`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#interface lo`	Configure interface lo
`SW2(config-if)#ip address 1.1.1.1/32 secondary`	Configure secondary IP address to loopback interface.
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#router ospf 100`	Configure ospf
`SW2(config-router)#network 10.0.0.0/24 area 0`	Advertising 10 network
`SW2(config-router)#network 1.1.1.1/32 area 0`	Advertising loopback IP
`SW2(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#router rsvp`	Configuring rsvp
`SW2(config-router)#hello-receipt`	Configuring hello reception
`SW2(config-router)#no php`	Configuring device as not a PHP
`SW2(config-router)#revert-timer 10`	Configuring reversion time of RSVP
`SW2(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.
`SW2(config)#rsvp-trunk to-1 ipv4`	Configuring RSVP path
`SW2(config-trunk)#to 2.2.2.2`	Configuring first hop
`SW2(config-trunk)#to 3.3.3.3`	Configuring second hop
`SW2(config-trunk)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-trunk)#exit`	Exit trunk mode.
`SW2(config)#interface xe0`	Configuring interface
`SW2(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW2(config-if)#label-switching`	Enabling MPLS labeling
`SW2(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#router ldp`	Configuring LDP
`SW2(config-router)#targeted-peer ipv4 3.3.3.3`	Configuring LDP target peer for PW
`SW2(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit target peer mode
`SW2(config-router)#no multicast-hellos`	Disabling LDP multicast
`SW2(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-router)#exit`	Exit router mode.

`SW2(config)#mpls l2-circuit ETH-2001 1 3.3.3.3`	Creating VPWS PW
`SW2(config-pseudowire)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-pseudowire)#exit`	Exit pseudowire config mode.
`SW2(config)#service-template ETH-2001`	Configuring service template profile for PW
`SW2(config-svc)#match outer-vlan 200`	Configuring match condition
`SW2(config-svc)# rewrite ingress push 2000`	Configuring action for match
`SW2(config-svc)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-svc)#exit`	Exit service template mode
`SW2(config)#interface ce0`	Configuring interface
`SW2(config-if)#mpls-l2-circuit ETH-2001 service-template ETH-2001`	Mapping VPWS in AC
`SW2(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-if)#exit`	Exit interface mode.
`SW2(config)#hardware-profile filter cfm-domain-name-str enable`	Enabling HW filter for character string domain name
`SW2(config)#ethernet cfm domain-type character-string domain-name 12345 level 7 mip-creation none`	Configuring CFM domain over VPWS
`SW2(config-ether-cfm-mpls-md)#service ma-type string ma-name 43981 mip-creation none`	Creating MA for domain
`SW2(config-ether-cfm-mpls-md-ma)#cc interval 100ms`	Configuring CFM interval
`SW2(config-ether-cfm-mpls-md-ma)#mep crosscheck mpid 1`	Configuring remote mep
`SW2(config-ether-cfm-mpls-md-ma)#ethernet cfm mep up mpid 4001 active true vpws ETH-2001`	Configuring local mep and mapping the same with vpws service
`SW2(config-ether-cfm-mpls-ma-mep)#cc multicast state enable`	Enabling the CFM multicast
`SW2(config-ether-cfm-mpls-ma-mep)#commit`	Commit the candidate configuration to the running configuration.
`SW2(config-ether-cfm-mpls-ma-mep)#exit`	Exit CFM MEP configuration mode
`SW2(config-ether-cfm-mpls-md-ma)#exit`	Exit CFM MA configuration mode
`SW2(config-ether-cfm-mpls-md)#exit`	End current mode and down to previous mode
`SW2(config)#ethernet cfm delay-measurement profile-name DM`	Configuring DM profile
`SW2(config-cfm-dm)#measurement interval`	Configuring measurement interval
`SW2(config-cfm-dm)#intervals-stored 3`	Configuring the number of history interval to be stored
`SW2(config-cfm-dm)# message-period 1s`	Configuring message period interval time
`SW2(config-cfm-dm)# bins-per-fd-interval 4`	Configuring the number of measurement bins per Measurement Interval for Frame Delay measurements.
`SW2(config-cfm-dm)# bins-per-ifdv-interval 3`	Configuring the number of measurement bins per Measurement Interval for Inter-Frame Delay Variation measurements.

SW2(config-cfm-dm)#commit	Commit the candidate configuration to the running configuration.
SW2(config-cfm-dm)#end	Exit config mode

SW3

SW3#configure terminal	Enter configure mode.
SW3(config)#interface xe17	Configure interface
SW3(config-if)#no switchport	Configure interface as router port.
SW3(config-if)#ip address 20.0.0.1/24	Assign IP address to router port
SW3(config-if)#no shutdown	Making the interface up
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit interface mode.
SW3(config)#interface xe1	Configure interface
SW3(config-if)#no switchport	Configure interface as router port.
SW3(config-if)#ip address 10.0.0.2/24	Assign IP address to router port
SW3(config-if)#no shutdown	Making the interface up
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit interface mode.
SW3(config)#interface lo	Configure interface lo
SW3(config-if)#ip address 2.2.2.2/32 secondary	Configure secondary IP address to loopback interface .
SW3(config-if)#commit	Commit the candidate configuration to the running configuration.
SW3(config-if)#exit	Exit interface mode.
SW3(config)#router ospf 100	Configure ospf
SW3(config-router)#network 10.0.0.0/24 area 0	Advertising 10 network
SW3(config-router)#network 20.0.0.0/24 area 0	Advertising 10 network
SW3(config-router)#network 2.2.2.2/32 area 0	Advertising loopback IP
SW3(config-router)#exit	Exit router mode.
SW3(config)#router rsvp	Configuring rsvp
SW3(config-router)#hello-receipt	Configuring hello reception
SW3(config-router)#no php	Configuring device as not a PHP
SW3(config-router)#revert-timer 10	Configuring reversion time of RSVP
SW3(config-router)#commit	Commit the candidate configuration to the running configuration.
SW3(config-router)#exit	Exit router mode.
SW3(config)#interface xe1	Configuring interface
SW3(config-if)#enable-rsvp	Enabling RSVP in interface
SW3(config-if)#label-switching	Enabling MPLS labeling

`SW3(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit interface mode.
`SW3(config)#interface xe17`	Configuring interface
`SW3(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW3(config-if)#label-switching`	Enabling MPLS labeling
`SW3(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW3(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW3(config-if)#exit`	Exit interface mode.

SW4

`SW4#configure terminal`	Enter configure mode.
`SW4(config)#interface xe9`	Configure interface
`SW4(config-if)#switchport`	Configure interface as switch port.
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#interface xe1`	Configure interface
`SW4(config-if)#no switchport`	Configure interface as router port.
`SW4(config-if)#ip address 20.0.0.2/24`	Assign IP address to router port
`SW4(config-if)#no shutdown`	Making the interface up
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#interface lo`	Configure interface lo
`SW4(config-if)#ip address 3.3.3.3/32 secondary`	Configure secondary IP address to loopback interface .
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#router ospf 100`	Configure ospf
`SW4(config-router)#network 20.0.0.0/24 area 0`	Advertising 10 network
`SW4(config-router)#network 3.3.3.3/32 area 0`	Advertising loopback IP
`SW4(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#router rsvp`	Configuring rsvp
`SW4(config-router)#hello-receipt`	Configuring hello reception
`SW4(config-router)#no php`	Configuring device as not a PHP
`SW4(config-router)#revert-timer 10`	Configuring reversion time of RSVP

`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#rsvp-trunk to-1 ipv4`	Configuring RSVP path
`SW4(config-trunk)#to 2.2.2.2`	Configuring first hop
`SW4(config-trunk)#to 1.1.1.1`	Configuring second hop
`SW4(config-trunk)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-trunk)#exit`	Exit trunk mode.
`SW4(config)#interface xe1`	Configuring interface
`SW4(config-if)#enable-rsvp`	Enabling RSVP in interface
`SW4(config-if)#label-switching`	Enabling MPLS labeling
`SW4(config-if)#enable-ldp ipv4`	Enabling ldp on interface
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#router ldp`	Configuring LDP
`SW4(config-router)#targeted-peer ipv4 1.1.1.1`	Configuring LDP target peer for PW
`SW4(config-router-targeted-peer)#exit-targeted-peer-mode`	Exit target peer mode
`SW4(config-router)#no multicast-hellos`	Disabling LDP multicast
`SW4(config-router)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-router)#exit`	Exit router mode.
`SW4(config)#mpls l2-circuit ETH-2001 1 1.1.1.1`	Creating VPWS PW
`SW4(config-pseudowire)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-pseudowire)#exit`	Exit pseudowire config mode.
`SW4(config)#service-template ETH-2001`	Configuring service template profile for PW
`SW4(config-svc)# match outer-vlan 200`	Configuring match condition
`SW4(config-svc)# rewrite ingress push 2000`	Configuring action for match
`SW4(config-svc)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-svc)#exit`	Exit service template mode
`SW4(config)#interface xe9`	Configuring interface
`SW4(config-if)#mpls-l2-circuit ETH-2001 service-template ETH-2001`	Mapping VPWS in AC
`SW4(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-if)#exit`	Exit interface mode.
`SW4(config)#hardware-profile filter cfm-domain-name-str enable`	Enabling HW filter for character string domain name
`SW4(config)#ethernet cfm domain-type character-string domain-name 12345 level 7 mip-creation none`	Configuring CFM domain over VPWS

`SW4(config-ether-cfm-mpls-md)#service ma-type string ma-name 43981`	Creating MA for domain
`SW4(config-ether-cfm-ma)#mip-creation none`	Configuring MIP creation permission
`SW4(config-ether-cfm-mpls-md-ma)#cc interval 100ms`	Configuring CFM interval
`SW4(config-ether-cfm-mpls-md-ma)#mep cross-check mpid 4001`	Configuring remote mep
`SW4(config-ether-cfm-mpls-md-ma)#ethernet cfm mep up mpid 1 active true vpws ETH-2001`	Configuring local mep and mapping the same with vpws service
`SW4(config-ether-cfm-mpls-ma-mep)#cc multicast state enable`	Enabling the CFM multicast
`SW4(config-ether-cfm-mpls-ma-mep)#ethernet cfm delay-measurement reply dmm`	Configuring DMR
`SW4(config-ether-cfm-mpls-ma-mep)#commit`	Commit the candidate configuration to the running configuration.
`SW4(config-ether-cfm-mpls-ma-mep)#end`	Exit config mode

SW5

`SW5#configure terminal`	Enter configure mode.
`SW5(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`SW5(config)#vlan database`	Entering VLAN database.
`SW5(config-vlan)#vlan 512 bridge 1 state enable`	Create VLAN 512 on bridge 1.
`SW5(config-vlan)#commit`	Commit the candidate configuration to the running configuration.
`SW5(config-vlan)#exit`	Exit config mode.
`SW5(config)#interface xe9`	Configure interface ce49.
`SW5(config-if)#switchport`	Configure the interface as switch port.
`SW5(config-if)#bridge-group 1`	Configure interface in bridge group 1
`SW5(config-if)#switchport mode trunk`	Configure interface mode as trunk.
`SW5(config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce49.
`SW5(config-if)#commit`	Commit the candidate configuration to the running configuration.
`SW5(config-if)#exit`	Exit config mode.

Commands to initiate/abort delay measurement

```
delay-measurement type proactive profile-name WORD rmep (mac-address MAC|mep-id MEPID)
mep MEPID domain DOMAIN_NAME ma <MA_NAME>

abort delay-measurement mep MEPID domain DOMAIN_NAME ma <MA_NAME>
```

Validation

```
SW2# delay-measurement type proactive profile-name DM rmep mac-address 3c2c.9926.e683
mep 200 domain 12345
SW2# show ethernet cfm delay-measurement mep 200 domain 12345
MD : 12345
MA : 43981
MEP : 200
VLAN ID : 0
VC Name : ETH-2001
Peer MAC Address : b86a.97d2.27d0
CURRENT:
======================
RMEP ID                   : 100
Measurement ID            : 3
Measurement Type          : DMM
Elapsed time(sec)         : 25
Start Time                : 2019 Nov 06 10:57:33
Suspect Flag                 : TRUE
Min Frame Delay(usec)        : 37
Max Frame Delay(usec)        : 65
Avg Frame Delay(usec)        : 51
Min Inter FD Variation(usec): 13
Max Inter FD Variation(usec): 15
Avg Inter FD Variation(usec): 14
FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
==================================================
1 0 - < 4999 3
2 5000 - < 9999 0
3 10000 - < 14999 0
4 15000 - < Inf 0
INTER-FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
==================================================
1 0 - < 4999 2
2 5000 - < 9999 0
3 10000 - < Inf 0
HISTORY STATISTICS
======================
MD : 12345
MA : 43981
MEP : 200
VLAN ID : 0
VC Name : ETH-2001
RMEP ID : 100
Measurement ID : 1
Measurement Type : DMM
Elapsed time(sec) : 60
End Time : 2019 Nov 06 10:50:19
Suspect Flag : FALSE
```

```
Min Frame Delay(usec) : 14
Max Frame Delay(usec) : 75
Avg Frame Delay(usec) : 47
Min Inter FD Variation(usec): 53
Max Inter FD Variation(usec): 53
Avg Inter FD Variation(usec): 24
FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
==================================================
1 0 - < 4999 5
2 5000 - < 9999 0
3 10000 - < 14999 0
4 15000 - < Inf 0
INTER-FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
==================================================
1 0 - < 4999 4
2 5000 - < 9999 0
3 10000 - < Inf 0
RMEP ID : 100
Measurement ID : 2
Measurement Type : DMM
Elapsed time(sec) : 60
End Time : 2019 Nov 06 10:51:20
Suspect Flag : FALSE
Min Frame Delay(usec) : 13
Max Frame Delay(usec) : 70
Avg Frame Delay(usec) : 37
Min Inter FD Variation(usec): 52
Max Inter FD Variation(usec): 52
Avg Inter FD Variation(usec): 21
FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
==================================================
1 0 - < 4999 6
2 5000 - < 9999 0
3 10000 - < 14999 0
4 15000 - < Inf 0
INTER-FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
==================================================
1 0 - < 4999 5
2 5000 - < 9999 0
3 10000 - < Inf 0

SW1# abort delay-measurement mep 2 domain mdnam
```

EVPN-ELINE (Y1731) Sub-Interface on Single Homing

To route traffic between two routers, create two sub interfaces within the physical interface, assign each sub interface an IP address within each subnet and then route the data between two subnets. Y.1731 is an enhancement of Connectivity Fault Management (CFM) and is used to monitor service performance.It provides a standard Ethernet ELINE function that includes Delay Measurement (DM) and Synthetic Loss Measurement (SLM).

As shown in the topology single-homing has a single ISP that provides static or dynamic routes to the customer edge router.

The following topology, configurations and validation section describe EVPN-ELINE Y1731 Sub-Interface on Single Homing devices.

Topology

This topology consists of customer edge routers. CE1 and CE2 with IPv2 Provider Edge routers PE1, PE2. These devices are all interconnected through the core router P in the IPv4 MPLS provider network.

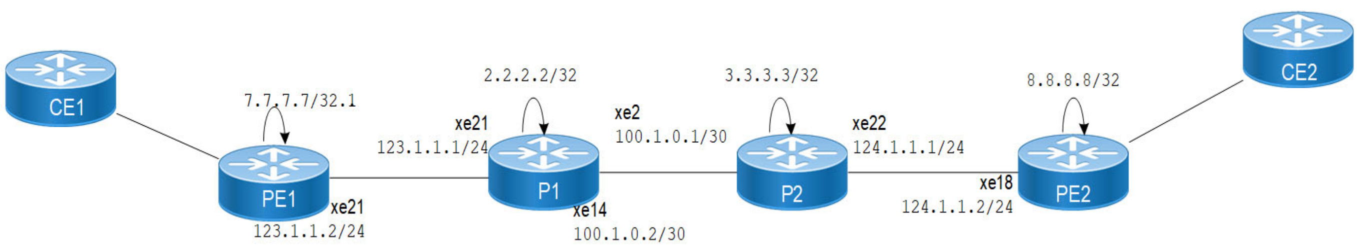


Figure 3-12: (Y1731) Sub-interface on Single Homing Devices

Prerequisite

Configure the following hardware-profile commands related to CFM in configuration mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable
```

Configuration

The following content provides configuration and validation information on CFM over sub-interfaces.

PE1: Loopback Interface

Configure loopback Interface on PE1.

`PE1#configure terminal`	Enter the configure mode
`PE1(config)#interface lo`	Enter the interface mode for the loopback interface
`PE1(config-if)#ip address 7.7.7.7/32 secondary`	Configure IP address on loopback interface
`PE1(config-if)#exit`	Exit the interface mode
`PE1(config)#commit`	Commit the candidate configuration to the running configuration

PE1: Global EVPN MPLS Command

Configure Global EVPN MPLS command on PE1.

`PE1#configure terminal`	Enter the configuration mode
`PE1(config)#evpn mpls enable`	Enable EVPN MPLS
`PE1(config-evpn-mpls)#evpn mpls vtep-ip-global 7.7.7.7`	Configure the VTEP global IP to loopback IP
`PE1(config)#commit`	Commit candidate configuration to the running configuration. Note: Reload is required after enabling or disabling EVPN MPLS

PE1: Global LDP

Configure Global EVPN LDP on PE1.

`PE1(config)#router ldp`	Enter the Router LDP mode
`PE1(config-router)#router-id 7.7.7.7`	Set the router ID to IP address 7.7.7.7
`PE1(config-router)#targeted-peer ipv4 8.8.8.8`	Configure the targeted peer 8.8.8.8
`PE1(config-router-targeted-peer)#exit`	Exit the targeted peer
`PE1OcNOS(config-router)#exit`	Exit from the LDP mode
`PE1(config)#commit`	Commit the candidate configuration to the running configuration

PE1: Interface Configuration Network Side

Configure the interface network side. on PE1.

`PE1(config)#interface xe21`	Enter the interface mode for xe21
`PE1(config-if)#ip address 123.1.1.2/24`	Configure the IP address on the interface
`PE1(config-if)#enable-ldp ipv4`	Enable LDP on the physical interface
`PE1(config-if)#label-switching`	Enable label switching on the interface
`PE1(config-if)#exit`	Exit the interface mode
`PE1(config)#commit`	Commit the candidate configuration to the running configuration

PE1: OSPF Configuration

Configure OSPF on PE1.

`PE1(config)#router ospf 1`	Enter the router OSPF mode
`PE1(config-router)#ospf router-id 7.7.7.7`	Configure the Router-ID
`PE1(config-router)#network 7.7.7.7/32 area 0.0.0.0`	Advertise the loopback address in OSPF
`PE1(config-router)#network 123.1.1.0/24 area 0.0.0.0`	Advertise xe21 network address in OSPF
`PE1(config-router)#exit`	Exit the router OSPF mode and return to Configure mode
`PE1(config)#commit`	Commit the candidate configuration to the running configuration

PE1: BGP Configuration

Configure BGP on PE1.

PE1(config)#router bgp 1	Enter the router BGP mode, AS number 1
PE1(config-router)#neighbor 8.8.8.8 remote-as 65010	Configure PE2 as iBGP neighbor using its loopback IP
PE1(config-router)#neighbor 8.8.8.8 update-source lo	Source of routing updates as loop-back
PE1(config-router)#address-family l2vpn evpn	Enter the address family mode as EVPN
PE1(config-router-af)#neighbor 8.8.8.8 activate	Enable the EVPN address family for the neighbor
PE1(config-router-af)#exit	Exit the address family mode
PE1(config-router)#commit	Commit the candidate configuration to the running configuration

PE1: MAC VRF Configuration

Configure MAC VRF on PE1.

PE1(config)#mac vrf vrf2	Enter the VRF mode
PE1(config-vrf)#rd 7.7.7.7:2	Configure the Route-Distinguisher (rd) value as 7.7.7.2
PE1(config-vrf)#route-target both 2:2	Configure the import and export value as 2:2
PE1(config-vrf)#exit	Exit the VRF mode
PE1(config)#commit	Commit the candidate configuration to the running configuration

PE1: EVPN and VRF Mapping

Configure EVPN and VRF Mapping on PE1.

PE1(config)#evpn mpls id 2 xconnect target-mpls-id 52	Configure the EVPN VPWS identifier with source identifier 2 and target identifier 52
PE1(config)#host-reachability-protocol evpn-bgp vrf2	Map VRF "VRF2" to the EVPN VPWS identifier
PE1(config)#commit	Commit candidate configuration to the running configuration

PE1: Access Port Configuration

Configure the Access Port Configuration on PE1.

PE1(config)#interface xe5	Enter the interface mode for xe5
PE1(config-if)#description access-side-int	Provide an Interface description
PE1(config-if)#interface xe5.2 switchport	Create the L2 subinterface for the physical interface xe6
PE1(config-if)#encapsulation dot1q 2	Set the encapsulation to dot1q with VLAN ID 2 Supported Encapsulation: dot1ad, dot1q, untagged, default
PE1(config-if)#access-if-evpn	Enter the access mode for EVPN MPLS ID configuration
PE1(config-access-if)#map vpn-id 2	Map VPN-id 252 to interface xe2.2 (VPWS)
PE1(config-access-if)#exit	Exit the access interface mode
PE1(config-if)#commit	Commit the candidate configuration to the running configuration

PE1: CFM Configuration

Configure CFM Configuration on PE1.

`PE1(config)#hardware-profile filter cfm-domain-name-str enable`	Configure the CFM-domain-name-SRR profile to enable CFM
`PE1(config)#ethernet cfm domain-type character-string domain-name evpn1 level 7 mip-creation none`	Create the CFM domain for EVPN ELINE with type as character string and set MIP creation to none
`PE1(config-ether-cfm-mpls-md)#service ma-type string ma-name evp1`	Create MA type with string and set MIP creation to none
`PE1(config-ether-cfm-mpls-ma)# evpn2`	Configure EVPN <EVPN-id>
`PE1(config-ether-cfm-mpls-ma)#ethernet cfm mep up mpid 10 active true evpn 2`	Create up-MEP for local EVPN id 2
`PE1(config-ether-cfm-mpls-ma-mep)#cc multicast state enable`	Enable CC multicast
`PE1(config-ether-cfm-mpls-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet MA-MEP-MEP-mode
`PE1(config-ether-cfm-mpls-ma)#mep crosscheck mpid 20`	Configure cross check remote MPID
`PE1(config-ether-cfm-mpls-ma)#cc interval 100`	Enable CC interval with value 2 that is 100 milliseconds
`PE1(config-ether-cfm-mpls-ma)#exit-ether-ma-mode`	Exit the Ethernet MA mode
`PE1(config-ether-cfm-mpls-md)#exit`	Exit the Ethernet CFM mode
`PE1(config)#commit`	Commit the candidate configuration to the running configuration

P1: Loopback nterface

Configure loopback interface on P1.

`P1#configure terminal`	Enter the configure mode
`P1(config)#interface lo`	Enter the interface mode for the loopback interface
`P1(config-if)#ip address 2.2.2.2/32 secondary`	Configure the IP address for the loopback interface
`P1(config-if)#exit`	Exit the interface mode
`P1(config)#commit`	Commit the candidate configuration to the running configuration

P1: Global LDP

Configure Global LDP on P1.

`P1(config)#router ldp`	Enter the router LDP mode
`P1(config-router)#router-id 2.2.2.2`	Set the router ID to IP address 2.2.2.2
`P1(config-router)#exit`	Exit from the LDP mode
`P1(config)#commit`	Commit the candidate configuration to the running configuration

P1: Interface Configuration

Configure Interface Configuration on P1.

P1(config)#interface xe21	Enter the interface mode for xe21
P1(config-if)#ip address 123.1.1.1/24	Configure the IP address on the interface
P1(config-if)#enable-ldp ipv4	Enable LDP on the physical interface
P1(config-if)#label-switching	Enable label switching on the interface
P1(config-if)#exit	Exit the interface mode
P1(config)#interface Se14	Enter the interface mode for xe14
P1(config-if)#ip address 100.1.0.1/30	Configure the IP address on the interface
P1(config-if)#enable-ldp ipv4	Enable LDP on the physical interface
P1(config-if)#label-switching	Enable label switching on the interface
P1(config-if)#exit	Exit the interface mode
P1(config)#commit	Commit the candidate configuration to the running configuration

P1: OSPF Configuration

Configure the OSPF Configuration on P1 for more information refer the Topology

P1(config)#router ospf 1	Enter the router OSPF mode
P1(config-router)#ospf router-id 2.2.2.2	Set the Router ID as the loopback IP
P1(config-router)#network 2.2.2.2/32 area 0.0.0.0	Advertise the loopback address in OSPF
P1(config-router)#network 100.1.0.0/16 area 0.0.0.0	Advertise the xe5 network address in OSPF
P1(config-router)#network 123.1.1.0/24 area 0.0.0.0	Advertise xe3 network address in OSPF
P1(config-router)#exit	Exit the router OSPF mode and return to configure mode
P1(config)#commit	Commit the candidate configuration to the running configuration

P2: Loop-back Interface

Configure the loop-back Interface P2.

P2#configure terminal	Enter configuration mode.
P2(config)#interface lo	Enter the interface mode for the loop-back interface
P2(config-if)#ip address 3.3.3.3/32 secondary	Configure the IP address on loop-back interface
P2(config-if)#exit	Exit interface mode
P2(config)#commit	Commit the candidate configuration to the running configuration

P2: Global LDP

Configure Global LDP on P2.

P2(config)#router ldp	Enter the router LDP mode
P2(config-router)#router-id 3.3.3.3	Set the router ID to IP address 10.143.73.3

`P2(config-router)#exit`	Exit from router target peer and LDP mode
`P2(config)#commit`	Commit the candidate configuration to the running configuration

P2: Interface Configuration

Configure Interface Configuration on P2.

`P2(config)#interface xe2`	Enter the Interface mode for xe2
`P2(config-if)# ip address 100.1.0.1/30`	Configure IP address on the interface
`P2(config-if)#enable-ldp ipv4`	Enable LDP on the physical interface
`P2(config-if)#label-switching`	Enable label switching on the interface
`P2(config-if)#exit`	Exit interface mode
`P2(config)#interface xe22`	Enter the Interface mode for xe22
`P2(config-if)# ip address 124.1.1.1/24`	Configure the IP address on the interface
`P2(config-if)#enable-ldp ipv4`	Enable LDP on the physical interface
`P2(config-if)#label-switching`	Enable label switching on the interface
`P2(config-if)#exit`	Exit the interface mode
`P2(config)#commit`	Commit the candidate configuration to the running configuration

P2: OSPF Configuration

Configure OSPF Configuration on P2.

`P2(config)#router ospf 1`	Enter the Router OSPF mode.
`P2(config-router)#ospf router-id 3.3.3.3`	Setting the Router ID as Loop-back IP
`P2(config-router)#network 3.3.3.3/32 area 0.0.0.0`	Advertise the loop-back address in OSPF
`P2(config-router)#network 100.1.0.0/16 area 0.0.0.0`	Advertise xe5 network address in OSPF
`(config-router)#network 124.1.1.0/24 area 0.0.0.0`	Advertise xe3 network address in OSPF
`P2(config-router)#exit`	Exit Router OSPF mode and return to Configure mode.
`P2(config)#commit`	Commit the candidate configuration to the running configuration

PE2: Loop-back Interface

Configure Loop-back Interface on PE2.

`PE2#configure terminal`	Enter the configuration mode
`PE2(config)#interface lo`	Enter the Interface mode for the loop-back interface
`PE2(config-if)#ip address 8.8.8.8/32 secondary`	Configure the IP address on loop-back interface
`PE2(config-if)#exit`	Exit the Interface mode
`PE2(config)#commit`	Commit the candidate configuration to the running configuration

PE2: Global LDP

Configure Global LDP on PE2.

`PE2(config)#router ldp`	Enter the Router LDP mode.
`PE2(config-router)#router-id 8.8.8.8`	Set the router ID to IP address 8.8.8.8
`PE2(config-router)#targeted-peer ipv4 7.7.7.7`	Configure targeted peer
`PE2(config-router)#exit`	Exit from the router target peer and LDP mode
`PE2(config)#commit`	Commit the candidate configuration to the running configuration

PE2: Global EVPN MPLS Command

Configure Global EVPN MPLS Command on PE2.

`PE2(config)#evpn mpls enable`	Enable EVPN MPLS
`PE2(config)#commit`	Commit the candidate configuration to the running configuration Note: Reload is required after Enabling or Disabling EVPN MPLS
`PE2(config-evpn-mpls)#evpn mpls vtep-ip-global8.8.8.8`	Configure the VTEP global IP to loop-back IP.‘
`PE2(config-evpn-mpls)#commit`	Commit the candidate configuration to the running configuration

PE2: Interface Configuration Network Side

Configure Interface Network Side on PE2.

`PE2(config)#interface xe18`	Enter the interface mode for xe18
`PE2(config-if)#enable-ldp ipv4`	Configure IP address on the interface
`PE2(config-if)#label-switching`	Enable label switching on the interface
`PE2(config-if)#exit`	Exit the interface mode
`PE2(config)#commit`	Commit the candidate configuration to the running configuration

PE2: OPSF Configuration

Configure OSPF on PE2.

`PE2(config)#router ospf 1`	Enter the interface mode for xe2
`PE2(config-router)#ospf router-id 8.8.8.8`	Router-ID configurations
`PE2(config-router)#network 8.8.8.8/32 area 0.0.0.0`	Advertise loop-back address in OSPF.
`PE2(config-router)#network 124.1.1.0/24 area 0.0.0.0`	Advertise the xe5 network address in OSPF
`PE2(config-router)#exit`	Exit the router OSPF mode and return to configure mode
`PE2(config)#commit`	Commit the candidate configuration to the running configuration

PE2: BGP Configuration

Configure BGP on PE2.

`PE2(config)#router bgp 1`	Enter the router BGP mode, ASN: 65010
`PE2(config-router)#neighbor 7.7.7.7 remote-as 65010`	Configure PE1 as iBGP neighbor using it's loopback IP address
`PE2(config-router)#neighbor 7.7.7.7 update-source lo`	Source of routing updates as loop-back
`PE2(config-router)#address-family l2vpn evpn`	Enter the address family mode as EVPN
`PE2(config-router-af)#neighbor 7.7.7.7 activate`	Enable the EVPN Address family for neighbor
`PE2(config-router-af)#exit`	Exit the address family mode
`PE2(config-router)#commit`	Commit the candidate configuration to the running configuration

PE2: MAC VRF Configuration

Configure MAC VRF on PE2.

`PE2(config)#mac vrf vrf2`	Enter the VRF mode
`PE2(config-vrf)#rd 8.8.8.8:2`	Configure the rd value 8.8.8.8:2
`PE2(config-vrf)#route-target both 2:2`	Configure the import and export value as 2:2
`PE2(config-vrf)#exit`	Exit the VRF Mode
`PE2(config)#commit`	Commit the candidate configuration to the running configuration

PE2: EVPN and VRF Mapping

Configure EVPN and VRF Mapping PE2.

`PE2(config)#evpn mpls id 52 xconnect target-mpls-id 2`	Configure the EVPN-ELINE identifier with source identifier52 and target identifier 2
`PE2(config-evpn-mpls)#host-reachability-protocol evpn-bgp vrf2`	Map VFRF "VRF2" to EVPN-ELINE identifier
`PE2(config-evpn-mpls)#commit`	Commit the candidate configuration to the running configuration

PE2: Access Port Configuration

Configure Access Port on PE2.

`PE2(config)#interface xe4`	Enter the interface mode for xe4
`PE2(config-if)#description access-side-int`	Provide an interface description
`PE2(config-if)#interface xe2 switchport`	Create L2 subinterface of physical interface xe2
`PE2(config-if)#encapsulation dot1q 2`	Set encapsulation to dot1q with VLAN ID 2 Supported encapsulation is dot1ad, dot1q, untagged, default
`PE2(config-if)#access-if-evpn`	Enter the access mode for EVPN MPLS ID configuration
`PE2(config-access-if)#map vpn-id 52`	Map VPN-id 52 to interface xe2.2 (VPWS)

`PE2(config-access-if)#exit`	Exit out of the access interface mode
`PE2(config-if)#commit`	Commit the candidate configuration to the running configuration

PE2: CFM Configuration

Configure CFM on PE2 CFM.

`PE2(config)#hardware-profile filter cfm-domain-name-str enable`	Configure the CFM-domain-name-str profile to enable CFM
`PE2(config)# ethernet cfm domain-type character-string domain-name evpn1 level 7 mip-creation none`	Create CFM domain for EVPN ELINE with type as character string and set MIP creation to none
`PE2(config-ether-cfm-mpls-md)# service ma-type string ma-name evp1`	Create MA type with string and set MIP creation to none
`PE2(config-ether-cfm-mpls-ma)# evpn 52`	Configure EVPN <EVPN-id>
`PE2(config-ether-cfm-mpls-ma)# ethernet cfm mep up mpid 20 active true evpn 52`	Create up-MEP for local EVPN id 52
`PE2s(config-ether-cfm-mpls-ma-mep)#cc multicaststate enable`	Enable CC multicast

Validation

The following is the validations for PE1 and PE2.

PE1

```
PE1#show evpn mpls xconnect id 2
EVPN-MPLS Xconnect Info
========================
AC-AC: Local-Cross-connect
AC-NW: Cross-connect to NetworkAC-UP: Access-port is up
AC-DN: Access-port is downNW-UP: Network is up
NW-DN: Network is down
NW-SET: Network and AC both are up

LocalRemoteConnection-Details
================================ ============
==================================================================================
VPN-IDEVI-NameMTUVPN-IDSourceDestinationPE-IPMTUTypeNW-Status
==================================================================================
2  ----1500  52xe5.2--- Single Homed Port ---8.8.8.81500  AC-NW  NW-SET

Total number of entries are 1
PE1#show ethernet cfm errors domain evpn1
Domain Name     Level    MEPID      Defects
-----------------------------------------
evpn1            2         10         .....
```

```
1. defRDICCM2. defMACstatus  3. defRemoteCCM
defErrorCCM  5. defXconCCM

PE1#show ethernet cfm ma status domain evpn1 ma-name evp1

MA NAMESTATUS
-------------------------------
   evp1Active

PE1#show ethernet cfm maintenance-points local mep domain evpn1 ma-name evp1
MPID Dir Lvl CC-Stat HW-Status  CC-Intvl MAC-Address     Def Port    MD Name
---------------------------------------------------------------------------
10    Up  2  Enable  Installed  100 ms    00aa.bb00.0002  F  xe5.2    evpn1

PE1#show ethernet cfm maintenance-points remote domain evpn1 ma-name evp1

MEPID RMEP ID   LEVEL     Rx CCM RDI     PEER-MAC        TYPE
----------------------------------------------------------------------
10     20        2        Yes    False  00cc.dd00.0034  Configured
```

LMM

Loss Measurement Management (LMM) is a loss monitoring feature developed to monitor the loss and delay traffic measurement data on the router.

`PE2(config)#ethernet cfm loss-measurement profile-name lmm`	Configure LM profile
`PE2(config-cfm-lm)#measurement-type lmm`	Configure measurement type as LMM
`PE2(config-cfm-lm)#measurement-interval 1`	Configure measurement interval
`PE2(config-cfm-lm)#intervals-stored 3`	Configure number of interval to be stored
`PE2(config-cfm-lm)#commit`	Commit the candidate configuration to the running configuration.
`PE2(config-cfm-lm)#end`	Exit configure mode

PE2: CFM Responder Configuration

Configure CFM Responder on PE2.

Prerequisite

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-lm enable
hardware-profile statistics cfm-ccm enable
```

`PE2(config)#hardware-profile filter cfm-domain-name-str enable`	Configure the CFM-domain-name-STR profile to enable CFM
`PE2(config)# ethernet cfm domain-type character-string domain-name evpn1 level 7 mip-creation none`	Create the CFM domain for EVPN ELINE with type as characterstring and set MIP creation to none
`PE2(config-ether-cfm-mpls-md)# service ma-type string ma-name evp1`	Create the MA type with string and set MIP creation to none
`PE2(config-ether-cfm-mpls-ma)# evpn 52`	Configure EVPN <EVPN-id>
`PE2(config-ether-cfm-mpls-ma)# ethernet cfm mep up mpid 20 active true evpn 52`	Create up-MEP for local EVPN id 52
`PE2(config-ether-cfm-mpls-ma)# ethernet cfm loss-measurement reply lmm`	Enable the LM responder
`PE2(config-ether-cfm-mpls-ma-mep)#cc multicaststate enable`	Enable CC multi cast

`PE2(config-ether-cfm-mpls-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet MA-MEP-mode
`PE2(config-ether-cfm-mpls-ma)#  mep crosscheck mpid 10`	Configure cross check to remote MEP for VLAN 2
`PE2(config-ether-cfm-mpls-ma)#cc interval 100`	Enable the CC interval with value 2 that is 10 milliseconds
`PE2(config-ether-cfm-mpls-ma)#exit-ether-ma-mode`	Exit the Ethernet MA mode
`PE2(config-ether-cfm-mpls)#exit`	Exit the Ethernet CFM mode
`PE2(config)#exit`	Exit the configure mode
`PE2(config)#commit`	Commit the candidate configuration to the running configuration

Commands to Initiate/Abort Loss Measurement

The following are the commands to initiate/abort loss measurement.

```
loss-measurement type on-demand profile-name <WORD> rmep mac-address <HHHH.HHHH.HHHH>
start-time <immediate|relative|absolute> stop-time <none|absolute|relative> repetition-
period <REP-TIME> mep <MEPID> domain < DOMAIN_NAME> ma <MA_NAME>
```

```
loss-measurement type proactive profile-name <WORD> rmep mac-address
<HHHH.HHHH.HHHH>mep <MEPID> domain < DOMAIN_NAME> ma <MA_NAME>
```

```
abort loss-measurement mep <MEPID> domain <DOMAIN_NAME> ma <MA_NAME>
```

```
clear ethernet cfm loss-measurement mep <MEPID> domain <DOMAIN_NAME> ma <MA_NAME>
```

Validation

The following are the validations for PE1.

```
PE1ping ethernet mac 00cc.dd00.0034 unicast source 10 domain evpn1 ma evp1
 success rate is  100 (5/5)

PE1#traceroute ethernet 00cc.dd00.0034 mepid 10 domain evpn1 ma evp1
 MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
00cc.dd00.0034   1     RlyHit                Ingress         IngOK
PE1# loss-measurement type proactive profile-name lmm rmep 20 mep 10 domain evpn1 ma
evp1

PE1# show ethernet cfm loss-measurement mep 10  domain evpn1 ma-name evp1
MEP: 10 MA: evp1
CURRENT:
 Measurement ID : 48
  Suspect                     : True
  Measurement Type            : lmm
  Elapsed time(sec)           : 14
  Start Time                  : 2023 Oct 16 15:51:24
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
  Near End frame loss ratio   : 0
  Far End frame loss ratio    : 0

HISTORY:

 Measurement ID : 45
  Suspect                     : True
  Measurement Type            : lmm
  Elapsed time(sec)           : 60
  End Time                    : 2023 Oct 16 15:49:24
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
  Near End frame loss ratio   : 0
  Far End frame loss ratio    : 0
  Near End frame loss ratio min  : 0
  Far End frame loss ratio min  : 0
  Near End frame loss ratio max  : 0
  Far End frame loss ratio max  : 0

PE1# abort loss-measurement mep 10 domain evpn1 ma evp1

PE1#ping ethernet mac 00cc.dd00.0034 unicast source 10 domain evpn1 ma evp1
       success rate is  100 (5/5)
```

```
PE1#traceroute ethernet 00cc.dd00.0034 mepid 10 domain evpn1 ma evp1
 MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
00cc.dd00.0034   1     RlyHit                Ingress         IngOK
PE1#sh ethernet cfm statistics mep 10 domain evpn1 ma-name evp1

 CFM Statistics for MEP 10 of MD evpn1
 ======================================
Continuity Check Messages
   CCM Sent                : 481375
   CCM Received            : 559371

Loop Back Messages
   LBM Sent                : 10
   LBR Received(Valid)     : 10
   LBR Received(Bad msdu)  : 0
   LBR Received(Out-of-Seq): 0

Link Trace Messages
   LTM Sent                : 2
   LTR Sent                : 0
   LTR Received(Valid)     : 2
   LTR Received(unexpected): 0
7023-mh1#
```

SLM

SLM is a software for managing the maintenance and repair products.

PE1: CFM Initiator Configuration

Configure SLM CFM Initiator on PE1.

`PE2(config)#ethernet cfm loss-measurement profile-name slm`	Configure the LM profile
`PE2(config-cfm-lm)#measurement-type lmm`	Configure measurement type as LMM
`PE2(config-cfm-lm)#message-period 3`	Configure the message period
`PE2(config-cfm-lm)#measurement-interval 1`	Configure the measurement interval
`PE2(config-cfm-lm)#intervals-stored 3`	Configure the number of interval to the stored
`PE2(config-cfm-lm)#commit`	Commit the candidate configuration to the running configuration
`PE2(config-cfm-lm)#end`	Exit the configure mode

PE2: CFM Responder Configuration

Configure SLM CFM Responder on PE2.

Prerequisite

Configure below hardware-profile commands related to CFM in configure mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-slm enable
```

```
hardware-profile statistics cfm-ccm enable
```

`PE2(config)#hardware-profile filter cfm-domain-name-str enable`	Configure CFM-domain-name-str profile to enable CFM
`PE2(config)# ethernet cfm domain-type character-string domain-name evpn1 level 7 mip-creation none`	Create CFM domain for EVPN ELINE with type as character string and set MIP creation to none
`PE2(config-ether-cfm-mpls-md)# service ma-type string ma-name evp1`	Create MA type with string and set MIP creation to none
`PE2(config-ether-cfm-mpls-ma)# evpn 52`	Configure EVPN <EVPN-id>
`PE2(config-ether-cfm-mpls-ma)# ethernet cfm mep up mpid 20 active true evpn 52`	Create up-MEP for local EVPN id 52
`PE2(config-ether-cfm-mpls-ma)# ethernet cfm loss-measurement reply slm`	Enable SLM responder
`PE2(config-ether-cfm-mpls-ma-mep)#cc multicaststate enable`	Enable CC multi cast
`PE2(config-ether-cfm-mpls-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet MA-MEP-mode
`PE2(config-ether-cfm-mpls-ma)#  mep crosscheck mpid 10`	Configure cross check to remote MEP for VLAN 2
`PE2(config-ether-cfm-mpls-ma)#cc interval 100`	Enable CC interval with value 2 that is 100 milliseconds
`PE2(config-ether-cfm-mpls-ma)#exit-ether-ma-mode`	Exit the Ethernet MA mode
`PE2(config-ether-cfm-mpls)#exit`	Exit the Ethernet CFM mode
`PE2(config)#exit`	Exit from configure mode
`PE2(config)#commit`	Commit the candidate configuration to the running configuration

SLM Initiation/Abort

The following is the SLM Initiation/Abort.

```
================================
PE1#loss-measurement type proactive profile-name slm rmep 10 mep 20 domain evpn1  ma evp1

PE1#show ethernet cfm loss-measurement mep 20 domain evpn1 ma-name evp1
MEP: 20 MA: evp1
CURRENT:
Measurement ID : 2
Suspect : False
Measurement Type : slm
Elapsed time(sec) : 10
Start Time : 2023 Sep 30 07:08:56
Near End loss : 0
Far End loss : 0
Near End accumulated loss : 0
Far End accumulated loss : 0
```

```
Near End frame loss ratio : 0
Far End frame loss ratio : 0
HISTORY:
Measurement ID : 1
Suspect : False
Measurement Type : slm
Elapsed time(sec) : 60
End Time : 2023 Sep 30 07:08:56
Near End loss : 0
Far End loss : 0
Near End accumulated loss : 0
Far End accumulated loss : 0
Near End frame loss ratio : 0
Far End frame loss ratio : 0
Near End frame loss ratio min : 0
Far End frame loss ratio min : 0
Near End frame loss ratio max : 0
Far End frame loss ratio max : 0
PE1#
PE1# abort loss-measurement mep 10 domain evpn1 ma evp1
```

DMM

DMM) specifies solutions for IP networks, the traffic between mobile and correspondent nodes takes an optimal route. DMM aims for the transparency above the IP layer.

PE1: CFM Initiator Configuration

Configure DMM CFM Initiator on PE1.

`PE1(config)# ethernet cfm delay-measurement profile-name dmm`	Create the loss-measurement profile for DM
`PE1(config-cfm-dm)# measurement-interval 1`	Specify the measurement-interval in minutes
`PE1(config-cfm-dm)# intervals-stored 3`	Specify the number of history interval to be stored
`PE1(config-cfm-dm)# message-period 1s`	Specify the message period interval time
`PE1(config-cfm-dm)# bins-per-fd-interval 4`	Specify the number of measurement bins per Measurement Interval for Frame Delay measurements
`PE1(config-cfm-dm)# bins-per-ifdv-interval 3`	Specify the number of measurement bins per Measurement Interval for Inter-Frame Delay Variation measurements
`PE1(config-cfm-dm)#commit`	Commit the candidate configuration to the running configuration

PE2: CFM Responder Configuration

Prerequisite

Configure below hardware-profile commands related to CFM in configuration mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable
```

`PE2(config)#hardware-profile filter cfm-domain-name-str enable`	Configure CFM-domain-name-str profile to enable CFM
`PE2(config)# ethernet cfm domain-type character-string domain-name evpn1 level 7 mip-creation none`	Create CFM domain for EVPN-ELINE with type as character string and set MIP creation to none
`PE2(config-ether-cfm-mpls-md)# service ma-type string ma-name evp1`	Create MA type with string and set MIP creation to none
`PE2(config-ether-cfm-mpls-ma)# evpn 52`	Configure EVPN <EVPN-id>
`PE2(config-ether-cfm-mpls-ma)# ethernet cfm mep up mpid 20 active true evpn 52`	Create up-MEP for local EVPN id 52
`PE2(config-ether-cfm-mpls-ma)# ethernet cfm delay-measurement reply dmm`	Enable DMM responder
`PE2(config-ether-cfm-mpls-ma-mep)#cc multicaststate enable`	Enable the CC multicast

`PE2(config-ether-cfm-mpls-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet MA-MEP-mode
`PE2(config-ether-cfm-mpls-ma)#  mep crosscheck mpid 10`	Configure cross check to remote MEP for VLAN 2
`PE2(config-ether-cfm-mpls-ma)#cc interval 100`	Enable CC interval with value 2 that is 10 milliseconds
`PE2(config-ether-cfm-mpls-ma)#exit-ether-ma-mode`	Exit the Ethernet MA mode
`PE2(config-ether-cfm-mpls)#exit`	Exit the Ethernet CFM mode
`PE2(config)#exit`	Exit from the configure mode
`PE2(config)#commit`	Commit the candidate configuration to the running configuration

Validation

The following output validates the DMM configuration validations for PE1 and PE2.

```
PE1#delay-measurement type proactive profile-name dmm rmep 10 mep 20 domain evpn1 ma evp1

PE1#show ethernet cfm delay-measurement mep 20 domain evpn1 ma-name evp1
MD : evpn1
MA :
MEP : 20
VC Name :
Peer MAC Address : 00cc.dd00.0034
CURRENT:
RMEP ID : 10
Measurement ID : 1
Measurement Type : DMM
Elapsed time(sec) : 2
Start Time : 2023 Oct 12 04:11:56
Suspect Flag : FALSE
Min Frame Delay(usec) : 40
Max Frame Delay(usec) : 74
Avg Frame Delay(usec) : 57
Min Inter FD Variation(usec): 34
```

```
Max Inter FD Variation(usec): 34
Avg Inter FD Variation(usec): 34
         FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
1 0 - < 4999 2
2 5000 - < 9999 0
3 10000 - < 14999 0
4 15000 - < 4294967295 0
       INTER-FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
1 0 - < 4999 1
2 5000 - < 9999 0
3 10000 - < 4294967295 0
```

CHAPTER 4 Y.1731 and CFM Over Cross-connect Sub-interface

Overview

The cross-connect feature establishes, manages, and optimizes communication paths within a network. It provides the infrastructure necessary for routing traffic, provisioning services, isolating faults, and improving network performance, ultimately contributing to the reliability and efficiency of the network infrastructure.

Y.1731 Connectivity Fault Management (CFM) over cross-connect interface allows for monitoring and managing the connectivity and performance of services across cross-connect interfaces within the network. This feature enables fault detection, performance monitoring, and fault management capabilities over cross-connect interfaces, enhancing network reliability and service quality.

Feature Characteristics

- Provides granular monitoring and management capabilities at the cross-connect interface level, allowing for detailed analysis of service performance.
- Allows customization of CFM parameters such as MEPs, MAs, and performance thresholds to meet specific network requirements and SLAs.
- Works seamlessly across different network topologies, including point-to-point, point-to-multipoint, and multipoint-to-multipoint configurations.
- Scalable to large network deployments, accommodating growing traffic demands and network expansion.

Benefits

- Provides real-time monitoring and detection of faults within cross-connect interfaces, enabling quick identification and resolution of issues.
- Proactively identifies connectivity issues and performance degradation, ensuring high service availability and reliability.
- Enables efficient troubleshooting by providing detailed fault information, facilitating faster resolution of network issues.
- Monitors performance metrics such as delay, jitter, and packet loss across cross-connect interfaces, ensuring adherence to Service Level Agreements (SLAs).
- Supports automated fault management processes, including fault isolation, notification, and recovery, minimizing service downtime.

Prerequisites

Ensure that the network devices involved in the configuration support Y.1731 CFM and have the necessary software version installed. CFM functionality might not be available in all devices or software versions.

Configuration

The configurations involve defining VLANs, specifying interface roles, creating cross-connects between interfaces, and configuring ethernet CFM parameters for continuity checks and delay measurement.

Topology

This topology establishes a network with CFM enabled between CE1, PE1, PE2, and CE2. CFM allows for monitoring connectivity and detecting faults within the network. Each device is configured with CFM parameters, including MEPs, and cross-connects are established between devices to facilitate CFM message exchange. This setup enables comprehensive fault detection and management, enhancing the overall reliability and performance of the network.

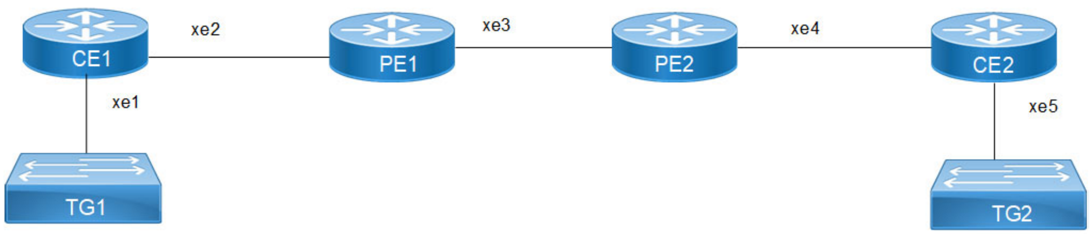


Figure 4-13: Y.1731 CFM Over Cross-connect Interface

Perform the following configurations to set up sub-interfaces, establish cross-connects, and configure ethernet CFM domains on CE and PE nodes:

1. Configure sub interfaces on CE1 to set the load interval to `30` seconds, create sub-interface `xe1.20`, `xe2.20` and configure it as a switchports, and specify the VLAN encapsulation as `802.1Q` with VLAN `ID 20`.

```
CE1(config)# interface xe1
CE1(config-if)# load-interval 30
CE1(config-if)# interface xe1.20 switchport
CE1(config-if)# encapsulation dot1q 20
CE1(config-if)# exit
CE1(config)# interface xe2
CE1(config-if)# load-interval 30
CE1(config-if)# interface xe2.20 switchport
CE1(config-if)# encapsulation dot1q 20
CE1(config-if)# exit
```

2. Set up cross-connect to define a cross-connect with the identifier `VC1`, specify interface `xe1.20` as the primary interface for the cross-connect, and specify interface `xe2.20` as the backup interface for the cross-connect:

```
CE1(config)# cross-connect VC1
CE1(config-xc)# interface xe1.20
CE1(config-bkp-xc)# interface xe2.20
CE1(config-bkp-xc)# commit
```

3. Configure ethernet CFM domain to specify the domain type as a character string with the domain name `crcn1`, the MA type as a string with the MA name `ma1C`, associate the MA with `VLAN 20`, configure a MEP with MEP ID `8001` as active on interface `xe2.20`, enable multicast state for continuity check, enable auto-discovery of RMEPs, and set the continuity check interval to `1 second`:

```
CE1(config)# ethernet cfm domain-type character-string domain-name crcn1
level 7 mip-creation default
CE1(config-ether-cfm)# service ma-type string ma-name ma1C1
CE1(config-ether-cfm-ma)# vlan 20
CE1(config-ether-cfm-ma)# ethernet cfm mep down mpid 8001 active true xe2.20
CE1(config-ether-cfm-ma-mep)# cc multicast state enable
```

```
CE1(config-ether-cfm-ma)# rmep auto-discovery enable
CE1(config-ether-cfm-ma)# cc interval 1s
CE1(config-ether-cfm)# commit
```

4. Configure sub interfaces on PE1 to set the load interval to `30` seconds, create sub-interface `xe2.20`, `xe3.20` and configure it as a switchports, and specify the VLAN encapsulation as `802.1Q` with VLAN `ID 20`:

```
PE1(config)# interface xe2
PE1(config-if)# load-interval 30
PE1(config-if)# interface xe2.20 switchport
PE1(config-if)# encapsulation dot1q 20
PE1(config-if)# exit
PE1(config)# interface xe3
PE1(config-if)# load-interval 30
PE1(config-if)# interface xe3.20 switchport
PE1(config-if)# encapsulation dot1q 20
PE1(config-if)# exit
```

5. Set up cross-connect on PE1 to define a cross-connect with the identifier `VC2`, specify interface `xe2.20` as the primary interface for the cross-connect, and specify interface `xe3.20` as the backup interface for the cross-connect:

```
PE1(config)# cross-connect VC2
PE1(config-xc)# interface xe2.20
PE1(config-bkp-xc)# interface xe3.20
PE1(config-bkp-xc)# commit
```

6. Configure Ethernet CFM on PE1 to specify the domain type as a character string with the domain name `crcn1`, the MA type as a string with the MA name `ma1C`, associate the MA with `VLAN 20`, configure a MEP with MEP ID `8002` as active on interface `xe2.20`, enable multicast state for continuity check, enable auto-discovery of RMEPs, and set the continuity check interval to `1 second`:

```
PE1(config)# ethernet cfm domain-type character-string domain-name crcn1
level 7 mip-creation default
PE1(config-ether-cfm)# service ma-type string ma-name ma1C1
PE1(config-ether-cfm-ma)# vlan 20
PE1(config-ether-cfm-ma)# ethernet cfm mep down mpid 8002 active true xe2.20
PE1(config-ether-cfm-ma-mep)# cc multicast state enable
PE1(config-ether-cfm-ma)# rmep auto-discovery enable
PE1(config-ether-cfm-ma)# cc interval 1s
PE1(config-ether-cfm)# commit
```

7. Perform Delay measurement between CE1 and PE1, and configure Delay Management profile on PE1 and responder config on CE1:

```
PE1(config-cfm-lm)#ethernet cfm delay-measurement profile-name DM
PE1(config-cfm-dm)# measurement-interval 1
PE1(config-cfm-dm)# intervals-stored 2
PE1(config-cfm-dm)# message-period 1s
PE1(config-cfm-dm)#!
PE1(config-cfm-dm)#commit

CE1(config)#ethernet cfm domain-type character-string domain-name crcn1
level 7 mip-creation default
CE1(config-ether-cfm)# service ma-type string ma-name ma1C1
CE1(config-ether-cfm-ma)#   ethernet cfm mep down mpid 8001 active true
xe2.20
CE1(config-ether-cfm-ma-mep)#ethernet cfm delay-measurement reply dmm
CE1(config-ether-cfm)#commit
```

8. Initiate the DM session on PE1:

```
PE1#delay-measurement type on-demand profile-name DM rmep 8001 start-time
immediate stop-time none repetition-period 6000 mep 8002 domain crcn1 ma
ma1C1
```

9. Perform SLM between CE1 and PE1,and configure SLM profile on PE1 and responder config on CE1:

```
CE1(config)#ethernet cfm domain-type character-string domain-name crcn1
level 7 mip-creation default
CE1(config-ether-cfm)#service ma-type string ma-name ma1C1
CE1(config-ether-cfm-ma)#ethernet cfm mep down mpid 8001 active true xe2.20
CE1(config-ether-cfm-ma-mep)#ethernet cfm loss-measurement reply slm
CE1(config-ether-cfm-ma-mep)#commit

PE1(config-cfm-lm)#ethernet cfm loss-measurement profile-name SLM
PE1(config-cfm-lm)# measurement-type slm
PE1(config-cfm-lm)# measurement-interval 1
PE1(config-cfm-lm)# intervals-stored 3
PE1(config-cfm-lm)# message-period 1s
```

10. Initiate the SLM session execute below on PE1:

```
PE1#loss-measurement type on-demand profile-name SLM rmep 8001 start-time
immediate stop-time none repetition-period 6002 mep 8002 domain crcn1 ma
ma1C1
```

Configuration Snapshot:

CE1

```
interface xe1
 load-interval 30
!
interface xe1.20
 switchport
 encapsulation dot1q 20
!
interface xe2
 load-interval 30
!
interface xe2.20
 switchport
 encapsulation dot1q 20
!
cross-connect VC1
 interface xe1.20
 interface xe2.20
!
ethernet cfm domain-type character-string domain-name crcn1 level 7 mip-creation
default
 service ma-type string ma-name ma1C1
  vlan 20
  ethernet cfm mep down mpid 8001 active true xe2.20
   cc multicast state enable
  rmep auto-discovery enable
  cc interval 1s
```

PE1

```
interface xe2
 load-interval 30
!
interface xe2.20
 switchport
 encapsulation dot1q 20
!
interface xe3
 load-interval 30
!
interface xe3.20
 switchport
 encapsulation dot1q 20
!
cross-connect VC2
 interface xe2.20
 interface xe3.20
!
ethernet cfm domain-type character-string domain-name crcn1 level 7 mip-creation
default
 service ma-type string ma-name ma1C1
  vlan 20
  ethernet cfm mep down mpid 8002 active true xe2.20
   cc multicast state enable
  rmep auto-discovery enable
  cc interval 1s
!
ethernet cfm delay-measurement profile-name DM
 measurement-interval 1
 intervals-stored 2
 message-period 1s
```

Validation

Verify the configured cross-connect interfaces on the PE device.

```
CE1#show cross-connect
cross-connect status
XC name                        Ep1              Bkp-Ep1          Ep2              Bkp-
Ep2          Status
-----------------------------+----------------+----------------+----------------+------
----------+-------
VC1                        xe1.20         -              xe2.20         -
UP
-----------------------------+----------------+----------------+----------------+------
----------+-------
AC cross-connect summary
Total : 1
Up    : 1
Down  : 0
```

Verify any errors related to the Ethernet CFM domain.

```
PE1#show ethernet cfm errors domain crcn1

Domain Name    MA Name       Level     VLAN     MEPID     Defects
-------------------------------------------------------------------
crcn1          ma1C1          7         20       8002      .....


1. defRDICCM    2. defMACstatus  3. defRemoteCCM
4. defErrorCCM  5. defXconCCM
PE1#show ethernet cfm ma status domain crcn1 ma ma1C1
MA NAME                  STATUS
-------------------------------
  ma1C1                  Active
PE1#show ethernet cfm maintenance-points local mep domain crcn1 ma-name ma1C1
MPID Dir Lvl VLAN CC-Stat HW-Status  CC-Intvl MAC-Address    Def Port  MD Name
--------------------------------------------------------------------------------
8002 Dn  7   20   Enable  Installed  1 sec    5c07.5854.1a27 F   xe2.20 crcn1
PE1#show ethernet cfm maintenance-points remote domain crcn1 ma-name ma1C1
 MA_NAME MEPID     RMEPID     LEVEL     Rx CCM    RDI    PEER-MAC        TYPE
------------------------------------------------------------------------------
 ma1C1     8002      8001       7         Yes       False  9819.2c5e.930e Learnt
PE1#
PE1#
PE1#ping ethernet mac 9819.2c5e.930e unicast source 8002 domain crcn1 ma ma1C1
 success rate is  100 (5/5)
PE1#traceroute ethernet 9819.2c5e.930e mepid 8002 domain crcn1 ma ma1C1
 MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
9819.2c5e.930e   1     RlyHit                Ingress         IngOK

CE2#show ethernet cfm errors domain crcn3

Domain Name    MA Name       Level     VLAN     MEPID     Defects
-------------------------------------------------------------------
crcn3          ma1C3          0         NA       8007      .....


1. defRDICCM    2. defMACstatus  3. defRemoteCCM
4. defErrorCCM  5. defXconCCM
CE2#show ethernet cfm ma status domain crcn3 ma ma1C3
MA NAME                  STATUS
-------------------------------
  ma1C3                  Active

PE2#show cross-connect
cross-connect status
XC name                        Ep1              Bkp-Ep1          Ep2              Bkp-
Ep2          Status
-----------------------------+----------------+----------------+----------------+------
----------+-------
VC1                        xe3.20         -              xe4.20         -
UP
```

```
-----------------------------+----------------+----------------+----------------+------
----------+-------
AC cross-connect summary
Total : 1
Up    : 1
Down  : 0
```

Verify the local Maintenance Points (MEPs) within the Ethernet CFM domain named associated with the Maintenance Association (MA)

```
PE1#show ethernet cfm delay-measurement mep 8002 domain crcn1 ma-name ma1C1
 MD                       : crcn1
 MA                       : ma1C1
 MEP                      : 8002
 VLAN ID                  : 0
 Interface                : xe2.20
 Peer MAC Address         : 6821.5f1f.4e22

CURRENT:
======================
 RMEP ID        : 8001
 Measurement ID : 3
 Measurement Type             : DMM
 Elapsed time(sec)            : 58
 Start Time                   : 2024 Mar 28 18:52:12
 Suspect Flag                 : FALSE
 Min Frame Delay(usec)        : 9
 Max Frame Delay(usec)        : 9
 Avg Frame Delay(usec)        : 9
 Min Inter FD Variation(usec): 0
 Max Inter FD Variation(usec): 0
 Avg Inter FD Variation(usec): 0

             FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999           57
 2             5000       - < 9999           0
 3             10000      - < 4294967295     0

           INTER-FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999           56
 2             5000       - < 4294967295     0


HISTORY STATISTICS
======================
 MD                       : crcn1
```

```
MA                      : ma1C1
MEP                     : 8002
VLAN ID                 : 0
Interface               : xe2.2
RMEP ID        : 8001
Measurement ID               : 1
Measurement Type             : DMM
Elapsed time(sec)            : 60
End Time                     : 294967295
Suspect Flag                 : FALSE
Min Frame Delay(usec)        : 9
Max Frame Delay(usec)        : 9
Avg Frame Delay(usec)        : 9
Min Inter FD Variation(usec): 0
Max Inter FD Variation(usec): 0
Avg Inter FD Variation(usec): 0

            FRAME DELAY BINS
Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
1             0          - < 4999           59
2             5000       - < 9999           0
3             10000      - < 4294967295     0

          INTER-FRAME DELAY BINS
Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
1             0          - < 4999           58
2             5000       - < 4294967295     0

RMEP ID        : 8001
Measurement ID               : 2
Measurement Type             : DMM
Elapsed time(sec)            : 60
End Time                     : 2024 Mar 28 18:52:12
Suspect Flag                 : FALSE
Min Frame Delay(usec)        : 9
Max Frame Delay(usec)        : 9
Avg Frame Delay(usec)        : 9
Min Inter FD Variation(usec): 0
Max Inter FD Variation(usec): 0
Avg Inter FD Variation(usec): 0

            FRAME DELAY BINS
Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
1             0          - < 4999           60
2             5000       - < 9999           0
3             10000      - < 4294967295     0
```

```
           INTER-FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999           59
 2             5000       - < 4294967295     0
```

Implementation Examples

UP MEP (User-Provided MEP):

- Scenario: To monitor the performance of Ethernet services between two customer locations.
- Use Case: Configure Y.1731 subinterface cross-connect with UP MEPs to monitor the performance of Ethernet services from the customer edge (CE) routers at each location. This allows the service provider to ensure service quality and troubleshoot any performance issues effectively.

Down MEP (Provider-Provided MEP):

- Scenario: To offer Ethernet services to multiple customers across its network infrastructure.
- Use Case: Configure Y.1731 subinterface cross-connect with Down MEPs on provider edge (PE) routers to monitor the performance of Ethernet services provided to individual customers. This allows the service provider to proactively detect and address any service degradation or faults, ensuring high service availability and customer satisfaction.

Default Untagged (Single-Tagged VLAN):

- Scenario: To offer Ethernet services over a single-tagged VLAN to simplify network configuration and management.
- Use Case: Configure Y.1731 subinterface cross-connect with default untagged settings on PE routers for Ethernet services provisioned over single-tagged VLANs. This enables the service provider to monitor the performance of Ethernet services efficiently while minimizing configuration complexity and overhead.

Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

Key Terms/Acronym	Description
Connectivity Fault Management (CFM)	CFM is a protocol used to detect, verify, and isolate connectivity faults in a network. It operates at the data link layer and is designed to monitor Ethernet networks.
Cross-connect Interface	A cross-connect interface is a network element or component responsible for forwarding traffic between different network segments or services. In the context of CFM, the cross-connect interface refers to the specific interfaces where CFM functionality is deployed and monitored.
Fault Detection	CFM over Cross-connect Interface enables the detection of faults such as link failures, excessive delay, or connectivity disruptions within the cross-connect infrastructure. By exchanging CFM messages and monitoring predefined parameters, network operators can identify and respond to faults promptly.
Fault Isolation and Diagnostics	Upon detecting a fault, CFM over Cross-connect Interface facilitates the isolation of the affected segment or service and provides diagnostic information to pinpoint the root cause of the issue. This information aids in troubleshooting and resolving network problems efficiently.

CHAPTER 5 Y.1731 and CFM Over EVPN ELINE Single Home

Overview

The Single Home EVPN ELINE Y.1731 CFM over Sub-interface feature enables the monitoring and management of Ethernet Virtual Private Network (EVPN) E-Line services using the Y.1731 Connectivity Fault Management (CFM) protocol over sub-interfaces. This feature enhances fault detection and performance monitoring capabilities for EVPN E-Line services, allowing network operators to ensure high availability and reliability of their networks. By extending Y.1731 CFM functionality to sub-interfaces in single home EVPN E-Line deployments, this feature provides comprehensive end-to-end visibility and control, enabling proactive fault detection, isolation, and troubleshooting.

Feature Characteristics

- Utilizes sub-interfaces to partition Ethernet traffic within the Single Home EVPN ELINE architecture, enabling efficient service delivery and management.
- Implements EVPN ELINE architecture with single-homing capabilities, facilitating the creation of Ethernet Virtual Private Networks with simplified configurations and reduced complexity.
- Provides robust fault detection mechanisms to identify connectivity issues, link failures, and service disruptions in Ethernet networks.

Benefits

- Provides detailed insights into Ethernet service performance, enabling proactive monitoring and optimization of network resources.
- Minimizes service downtime by promptly detecting and resolving faults, ensuring uninterrupted service delivery and customer satisfaction.
- Optimizes network resource utilization and bandwidth allocation by identifying and addressing connectivity issues in a timely manner.
- Facilitates rapid fault identification and isolation, accelerating troubleshooting processes and reducing mean time to repair (MTTR).
- Ensures compliance with Service Level Agreements (SLAs) by maintaining service quality metrics within defined thresholds and objectives.

Prerequisites

Ensure that the network devices (routers, switches) support Y.1731 CFM functionality and Single Home EVPN ELINE configuration.

Verify that the devices are running compatible software versions that include support for these features.

Configuration

Configure Single Home EVPN ELINE Y.1731 CFM over Sub-interface for enhanced fault management in EVPN networks.

Topology

The topology consists of two Customer Edge devices (CE1 and CE2) connected to Provider Edge devices (PE1 and PE2) through sub-interfaces. The Provider Edge devices are interconnected through Provider devices (P1 and P2). Y.1731 functionality is implemented over these sub-interfaces, allowing for fault detection and performance monitoring of Ethernet connectivity between the customer sites.

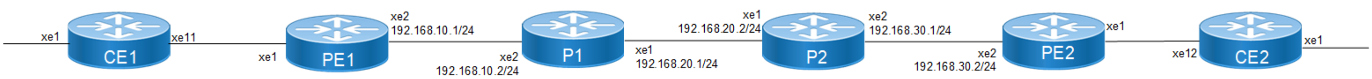


Figure 5-14: EVPN ELINE Over Sub-interface-Single Home

Perform the following configurations to configure Single Home EVPN ELINE Y.1731 CFM over Sub-interface:

1. On Customer Edge (CE) Nodes (CE1 and CE2), configure the interface xe1 and set it as a switchport with a load interval of (`30 seconds`):

```
CE1(config)#interface xe1
CE1(config-if)#switchport
CE1(config-if)#load-interval 30
CE1(config-if)#commit
CE1(config-if)#exit
```

Note: Similarly follow the same steps to configure xe11(CE1) and xe12(CE2).

2. Create sub-interface (`xe1.2001`) adding the VLAN:

```
CE1(config)#interface xe1.2001 switchport
CE1(config-if)#encapsulation dot1q 2028
CE1(config-if)#commit
CE1(config-if)#exit

CE1(config)#interface xe11.2001 switchport
CE1(config-if)#encapsulation dot1q 2028
CE1(config-if)#commit
CE1(config-if)#exit
```

3. Set up a cross-connect named (`test100`), specifying in and out interfaces:

```
CE1(config)#cross-connect test100
CE1(config-xc)#interface xe1.2001
CE1(config-xc)#interface xe11.2001
CE1(config-xc)#commit
```

4. Perform the following on PE1:

    1. Configure CFM related hardware profiles:

```
PE1(config)# hardware-profile filter cfm-domain-name-str enable
PE1(config)# hardware-profile statistics cfm-lm enable
PE1(config)# hardware-profile statistics cfm-ccm enable
PE1(config)#hardware-profile statistics cfm-slm enable
```

2. Configure the loopback interface with a secondary IP address(`1.1.1.1/32`):

```
PE1(config)#interface lo
PE1(config-if)#ip address 1.1.1.1/32 secondary
PE1(config-if)#commit
PE1(config-if)#exit
```

3. Configure LDP targeted peers:

```
PE1(config)#router ldp
PE1(config-router)#targeted-peer ipv4 4.4.4.4
PE1(config-router-targeted-peer)#exit-targeted-peer-mode
PE1(config-router)#commit
PE1(config-router)exit
```

4. Configure interface `xe2` with an IP address (`192.168.10.1/24`) and enable LDP:

```
PE1(config)#interface xe2
PE1(config-if)#load-interval 30
PE1(config-if)#ip address 192.168.10.1/24
PE1(config-if)#label-switching
PE1(config-if)#enable-ldp ipv4
PE1(config-if)#commit
PE1(config-if)#exit
```

5. Configure OSPF routing, specify the OSPF router ID as (`1.1.1.1`), enable BFD on all interfaces, define the network (`1.1.1.1/32`) in area (`0.0.0.0`), and define the network (`192.168.10.0/24`) in area (`0.0.0.0`):

```
PE1(config)#router ospf 1
PE1(config-router)#ospf router-id 1.1.1.1
PE1(config-router)#bfd all-interfaces
PE1(config-router)#network 1.1.1.1/32 area 0.0.0.0
PE1(config-router)#network 192.168.10.0/24 area 0.0.0.0
PE1(config-router)#commit
PE1(config-router)#exit
```

6. Enable EVPN MPLS globally and configure VTEP IP:

```
PE1(config)# evpn mpls enable
PE1(config)# commit
PE1(config)# evpn mpls vtep-ip-global 1.1.1.1
PE1(config)# commit
```

7. Configure BGP with the remote PE devices and activate EVPN:

```
PE1(config)# router bgp 100
PE1(config-router)# neighbor 4.4.4.4 remote-as 100
PE1(config-router)# neighbor 4.4.4.4 update-source lo
PE1(config-router)# address-family l2vpn evpn
PE1(config-router-af)# neighbor 4.4.4.4 activate
PE1(config-router-af)# exit
PE1(config-router)# exit
PE1(config)# commit
```

8. Configure MAC VRF with the appropriate RD and RT:

```
PE1(config)# mac vrf vrf2
PE1(config-vrf)# rd 1.1.1.1:2
PE1(config-vrf)# route-target both 2:2
PE1(config-vrf)# exit
```

9. Map the EVPN instance and VRF, specifying the EVPN ID:

```
PE1(config)# evpn mpls id 2 xconnect target-mpls-id 52
PE1(config-evpn-mpls)# host-reachability-protocol evpn-bgp vrf2
```

```
PE1(config-evpn-mpls)# evi-name test2
PE1(config-evpn-mpls)# commit
PE1(config-router-af)# exit
```

10. Configure access ports on PE1:

```
PE1(config)# interface xe1.2001 switchport
PE1(config-if)# encapsulation dot1q 2028
PE1(config-if)# access-if-evpn
PE1(config-acc-if-evpn)# map vpn-id 2
PE1(config-acc-if-evpn)# commit
```

11. Configure CFM MEP on PE1, define the FCM domain (`12346)`, create MA, configure MEP, and configure Remote MEP Auto-discovery,set CC Interval `10ms`:

```
PE1(config)# ethernet cfm domain-type character-string domain-name12346
level 7 mip-creation default
PE1(config-ether-cfm)# service ma-type string ma-name 124
PE1(config-ether-cfm-ma)# ethernet cfm mep up mpid 20 active true
xe1.2001 vlan 2028
PE1(config-ether-cfm-ma-mep)# cc multicast state enable
PE1(config-ether-cfm-ma-mep)# exit-ether-ma-mep-mode
PE1(config-ether-cfm-ma)# rmep auto-discovery enable
PE1(config-ether-cfm-ma)# cc interval 10ms
PE1(config-ether-cfm-ma)# exit-ether-ma-mode
PE1(config-ether-cfm)# commit
```

12. Provide CFM configuration, define a delay measurement profile named DM, set the measurement interval to `1 second`, specify the number of intervals stored as `2`, configure the message period as `1 second`, define a loss measurement profile named LM, set the measurement type to LMM, set the measurement interval to `1 second`, specify the number of intervals stored as `3`, define a service level measurement profile named SLM, set the measurement type to SLM:

```
PE1(config)# ethernet cfm delay-measurement profile-name DM
PE1(config-cfm-dm)# measurement-interval 1
PE1(config-cfm-dm)# intervals-stored 2
PE1(config-cfm-dm)# message-period 1s
PE1(config-cfm-dm)# commit

PE1(config)# ethernet cfm loss-measurement profile-name LM
PE1(config-cfm-lm)# measurement-type lmm
PE1(config-cfm-lm)# measurement-interval 1
PE1(config-cfm-lm)# intervals-stored 3
PE1(config-cfm-lm)# message-period 1s
PE1(config-cfm-lm)# commit

PE1(config)# ethernet cfm loss-measurement profile-name SLM
PE1(config-cfm-lm)# measurement-type slm
PE1(config-cfm-lm)# measurement-interval 1
PE1(config-cfm-lm)# intervals-stored 3
PE1(config-cfm-lm)# message-period 1s
PE1(config-cfm-lm)# commit
```

Configuration Snapshot:

CE1:

```
interface xe1
switchport
load-interval 30
!
```



```
interface xe1.2001 switchport
encapsulation dot1q 2028
!

interface xe11.2001 switchport
encapsulation dot1q 2028
!
cross-connect test100
interface xe1.2001
interface xe11.2001
```

CE2:

```
interface xe1
switchport
load-interval 30
!
interface xe1.2001 switchport
encapsulation dot1q 2028
!
interface xe12.2001 switchport
encapsulation dot1q 2028
!
cross-connect test100
interface xe1.2001
interface xe12.2001
```

PE1:

```
interface lo
ip address 1.1.1.1/32 secondary
!
router ldp
targeted-peer ipv4 4.4.4.4
exit-targeted-peer-mode
!
interface xe2
load-interval 30
ip address 192.168.10.1/24
label-switching
enable-ldp ipv4
!
router ospf 1
ospf router-id 1.1.1.1
bfd all-interfaces
network 1.1.1.1/32 area 0.0.0.0
network 192.168.10.0/24 area 0.0.0.0
!
evpn mpls enable
evpn mpls vtep-ip-global 1.1.1.1
!
router bgp 100
neighbor 4.4.4.4 remote-as 100
neighbor 4.4.4.4 update-source lo
address-family l2vpn evpn
neighbor 4.4.4.4 activate
exit
!
```

```
mac vrf vrf2
rd 1.1.1.1:2
route-target both 2:2
!
evpn mpls id 2
xconnect target-mpls-id 52
host-reachability-protocol evpn-bgp vrf2
evi-name test2
!
interface xe1
switchport
load-interval 30
!
interface xe1.2001 switchport
 encapsulation dot1q 2028
 access-if-evpn
  map vpn-id 2
ethernet cfm domain-type character-string domain-name 12346 level 7
mipcreation none
  service ma-type string ma-name 124
    ethernet cfm mep up mpid 20 active true xe1.2001 vlan 2028
      cc multicast state enable
      exit-ether-ma-mep-mode
    rmep auto-discovery enable
    cc interval 10ms
    exit-ether-ma-mode
ethernet cfm loss-measurement profile-name SLM
measurement-type slm
measurement-interval 1
intervals-stored 3
message-period 1s
!
ethernet cfm loss-measurement profile-name LM
measurement-type lmm
measurement-interval 1
intervals-stored 3
message-period 1s
!
ethernet cfm delay-measurement profile-name DM
measurement-interval 1
intervals-stored 2
message-period 1s
```

PE2:

```
interface lo
 ip address 4.4.4.4/32 secondary

router ldp
 targeted-peer ipv4 1.1.1.1

interface xe2
 load-interval 30
 ip address 192.168.30.2/24
 label-switching
 enable-ldp ipv4

router ospf 1
```

```
 bfd all-interfaces
 network 4.4.4.4/32 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0

evpn mpls enable
evpn mpls vtep-ip-global 4.4.4.4
!
router bgp 100
neighbor 1.1.1.1 remote-as 100
neighbor 1.1.1.1 update-source lo
address-family l2vpn evpn
neighbor 1.1.1.1 activate
exit
!
mac vrf vrf2
rd 4.4.4.4:2
route-target both 2:2
!
evpn mpls id 2 xconnect target-mpls-id 52
host-reachability-protocol evpn-bgp vrf2
evi-name test2
!
interface xe1
switchport
load-interval 30
!
interface xe1.2001 switchport
 encapsulation dot1q 2028
  access-if-evpn
   map vpn-id 52
ethernet cfm domain-type character-string domain-name 12346 level 7
mipcreation none
service ma-type string ma-name 124
  ethernet cfm mep up mpid 10 active true xe1.2001 vlan 2028
    cc multicast state enable
    ethernet cfm loss-measurement reply lmm
  ethernet cfm delay-measurement reply dmm
  exit-ether-ma-mep-mode
rmep auto-discovery enable
cc interval 10ms
exit-ether-ma-mode
```

P1:

```
interface lo
 ip address 2.2.2.2/32 secondary

router ldp
 transport-address ipv4 2.2.2.2

interface xe2
 ip address 192.168.10.2/24
 label-switching
 enable-ldp ipv4

interface xe1
 ip address 192.168.20.1/24
 label-switching
```

```
 enable-ldp ipv4

router ospf 1
 ospf router-id 2.2.2.2
 bfd all-interfaces
 network 2.2.2.2/32 area 0.0.0.0
 network 192.168.10.0/24 area 0.0.0.0
 network 192.168.20.0/24 area 0.0.0.0
```

P2:

```
interface lo
 ip address 3.3.3.3/32 secondary

router ldp
 transport-address ipv4 3.3.3.3

interface xe1
 ip address 192.168.20.2/24
 label-switching
 enable-ldp ipv4

interface xe2
 ip address 192.168.30.1/24
 label-switching
 enable-ldp ipv4

router ospf 1
 ospf router-id 3.3.3.3
 bfd all-interfaces
 network 3.3.3.3/32 area 0.0.0.0
 network 192.168.20.0/24 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0
```

Validation

Verify the EVPN xconnect status.

```
PE1#show evpn mpls xconnect
EVPN Xconnect Info
========================
AC-AC: Local-Cross-connect
AC-NW: Cross-connect to Network
AC-UP: Access-port is up
AC-DN: Access-port is down
NW-UP: Network is up
NW-DN: Network is down
NW-SET: Network and AC both are up
Local               Remote                          Connection-Details
=================================================================================
VPN-ID      EVI-Name    MTU VPN-ID    Source Destination
PE-IP        MTU      Type       NW-Status
=================================================================================
2 test2 1500 52 xe1.2001 --- Single Homed Port ---
4.4.4.4 1500 AC-NW NW-SET
```

Verify the CFM Errors:

```
PE1#show ethernet cfm errors domain 12346

Domain Name    MA Name    Level    VLAN      MEPID      Defects
-------------------------------------------------------------------
12346          124         7       2028       20          .....
```

Verify the RMEP is learned or not.

```
PE1#show ethernet cfm maintenance-points remote domain 12346
MA_NAME    MEPID    RMEPID    LEVEL    Rx CCM    RDI     PEER-MAC     TYPE
--------------------------------------------------------------------------------
124        20        10          7      Yes     False e8c5.7ae3.37ee  Learnt
```

Verify the Ping:

```
PE1#ping ethernet mac   e8c5.7ae3.37ee  unicast source 20 domain 12346 ma 124
 success rate is  100 (5/5)
```

Verify the local whether Local MEP is installed or not:

```
PE1#show ethernet cfm maintenance-points local mep domain 12346 ma-name 126
MPID Dir Lvl VLAN CC-Stat HW-Status CC-Intvl MAC-Address Def Port MD Name
----------------------------------------------------------------------------------
124 Up 7 2028 Enable Installed 10 ms e8c5.7afe.fae9 F xe1.2001 12346
```

Verify the ethernet cfm ma status domain is active or not.

```
PE1#show ethernet cfm ma status domain 12346 ma-name 124
MA NAME      STATUS
124          Active
```

Verify the Ping:

```
PE1#ping ethernet mac e8c5.7ae3.37ee unicast source 20 domain 12346 ma 124
success rate is 100 (5/5)
```

Verify the Traceroute:

```
PE1#traceroute ethernet e8c5.7ae3.37ee mepid 20 domain 12346 ma 124
MP Mac Hops Relay-action Ingress/Egress Ingress/Egress action
e8c5.7ae3.37ee 1 RlyHit Ingress IngOK
```

Verify the Delay-measurement:

```
PE1#delay-measurement type proactive profile-name DM rmep 10 mep 20 domain 12346 ma 124
PE1#2024 Apr 10 13:35:37.236 : PE1: ONMD : INFO : [CFM_PM_SESSION_INFO_5]: CFM Frame
Delay Measurement session started for MEP Id 20 and RMEP Id 10
PE2-7033#show ethernet cfm delay-measurement mep 20 domain 12346 ma-name 124
MD : 12346
MA : 124
MEP : 20
VLAN ID : 10
```

```
Interface : po1000.10
Peer MAC Address : 00cc.dd00.0000
CURRENT:
======================
RMEP ID : 10
Measurement ID : 1
Measurement Type : DMM
Elapsed time(sec) : 53
Start Time : 2024 Apr 10 13:35:37
Suspect Flag : FALSE
Min Frame Delay(usec) : 19
Max Frame Delay(usec) : 20
Avg Frame Delay(usec) : 19
Min Inter FD Variation(usec): 0
Max Inter FD Variation(usec): 1
Avg Inter FD Variation(usec): 0
FRAME DELAY BINS
Bin Number       Bin Threshold(usec)        Bin Counter
========================================================
1               0 - < 4999                    52
2               5000 - < 9999                 0
3               10000 - < 4294967295          0
INTER-FRAME DELAY BINS
Bin Number       Bin Threshold(usec)       Bin Counter
========================================================
1                 0 - < 4999                  51
2                 5000 - < 4294967295         0
```

Verify the Loss-measurement:

```
PE1#loss-measurement type proactive profile-name LM rmep 10 mep 20 domain 12346 ma 124
PE1#2024 Apr 10 13:35:05.345 : PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame Loss
Measurement started for MEP:20 MA:124 MD:12346
PE1#show ethernet cfm loss-measurement mep 20 domain 12346 ma-name 124

MEP: 20 MA: 124
CURRENT:
 Measurement ID : 1
  Suspect                     : False
  Measurement Type            : lmm
  Elapsed time(sec)           : 55
  Start Time                  : 2024 Apr 10 13:37:05
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
  Near End frame loss ratio   : 0
  Far End frame loss ratio    : 0
Far End frame loss ratio : 0
HISTORY:
Measurement ID : 1
Suspect : FALSE
```

```
Measurement Type : lmm
Elapsed time(sec) : 60
End Time : 2024 Apr 10 13:36:05
Near End loss : 0
Far End loss : 0
Near End accumulated loss : 0
Far End accumulated loss : 0
Near End frame loss ratio : 0
Far End frame loss ratio : 0
Near End frame loss ratio min : 0
Far End frame loss ratio min : 0
Near End frame loss ratio max : 0
Far End frame loss ratio max : 0
```

Verify the Synthetic Loss Measurement:

```
PE1#loss-measurement type proactive profile-name SLM rmep 10 mep 20 domain 12346 ma 124
PE1#2024 Apr 10 13:40:15.587 : PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame Loss
Measurement  started for MEP:20 MA:124 MD:12346
PE1#show ethernet cfm loss-measurement mep 20 domain 12346 ma-name 124
MEP: 20 MA: 124
CURRENT:
 Measurement ID : 2
  Suspect                     : False
  Measurement Type            : slm
  Elapsed time(sec)           : 17
  Start Time                  : 2024 Apr 10 13:41:15
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
  Near End frame loss ratio   : 0
  Far End frame loss ratio    : 0
HISTORY:
 Measurement ID : 1
  Suspect                     : False
  Measurement Type            : slm
  Elapsed time(sec)           : 60
  End Time                    : 2024 Apr 10 13:41:15
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
  Near End frame loss ratio   : 0
  Far End frame loss ratio    : 0
  Near End frame loss ratio min   : 0
  Far End frame loss ratio min   : 0
  Near End frame loss ratio max   : 0
  Far End frame loss ratio max   : 0
```

Implementation Examples

Enterprise Connectivity Monitoring:

Scenario: A large enterprise operates multiple branch offices connected via Ethernet services provided by a service provider network.

Use Case: Y.1731 CFM over sub-interface using Single Home EVPN ELINE enables the enterprise to monitor theconnectivity and performance of its branch office connections. It facilitates proactive fault detection and management, ensuring reliable and uninterrupted communication between the headquarters and branch offices.

Service Provider Network Operations:

Scenario: A service provider manages a diverse range of Ethernet services for its enterprise customers, including VPNs, Internet access, and cloud connectivity.

Use Case: Y.1731 CFM over sub-interface using Single Home EVPN ELINE empowers the service provider to deliverhigh-quality Ethernet services with enhanced fault management capabilities. It enables the provider to quickly identify and resolve connectivity issues, minimize service downtime, and maintain customer satisfaction.

Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

Key Terms/Acronym	Description
Y.1731	A standard defined by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) that specifies performance monitoring and fault management for Ethernet-based networks.
Sub-interface	A logical division of a physical interface, typically used to separate traffic based on VLANs or other criteria. In this context, sub-interfaces are employed to establish distinct connections within the EVPN ELINE SH topology.
EVPN	Ethernet Virtual Private Network (VPN) is a technology that enables the creation of virtual private networks over an Ethernet-based infrastructure. It provides multi-tenancy and allows for the segmentation of traffic in service provider networks.
ELINE	ELINE is a type of EVPN service that provides point-to-point Ethernet connectivity between two sites.
Single Home (SH)	Refers to the configuration where a Customer Edge device (CE) is connected to only one Provider Edge device (PE) within an EVPN setup. It contrasts with the multi-homed configuration, where a CE may be connected to multiple PEs.
Maintenance End Point (MEP)	MEP is a CFM entity that resides at the edge of a CFM domain. It is responsible for generating and transmitting CFM protocol packets to detect faults and collect performance data.
Maintenance Domain (MD)	MD is a logical grouping of MEPs within a CFM network. MEPs within the same MD can communicate with each other to perform CFM functions such as fault detection and performance monitoring.
Maintenance Association(MA)	MA is a collection of MEPs associated with a specific service or set of services. It defines the scope of CFM operations within a maintenance domain.

Maintenance Point Identifier (MPID)	MPID is a unique identifier assigned to each MEP within a maintenance association. It is used to distinguish between different MEPs within the same MA.
Service Level Measurement (SLM)	SLM is a CFM function used to measure the loss characteristics of a network path. It collects data on packet loss, delay, and jitter to assess the quality of service provided by the network.
Loopback Message Generation (LMM)	LMM is a CFM function used to test end-to-end connectivity by generating loopback messages. These messages are transmitted from a MEP and looped back to the same MEP to verify bidirectional communication.
Delay Measurement Message (DMM)	DMM is a CFM function used to measure the one-way delay of packets transmitted across a network. It helps assess the performance of the network in terms of packet delivery time.
Continuity Check (CC)	CC is a CFM function used to verify the continuity of a service or network path by periodically sending continuity check messages between MEPs. It helps detect connectivity faults such as link failures or misconfigurations.

CHAPTER 6 Y.1731 and CFM Over EVPN-ELINE Multi-home

Overview

The Multi Home EVPN ELINE Y.1731 CFM over Sub-interface feature enables the monitoring and management of Ethernet Virtual Private Network (EVPN) E-Line services using the Y.1731 Connectivity Fault Management (CFM) protocol over sub-interfaces. This feature enhances fault detection and performance monitoring capabilities for EVPN E-Line services, allowing network operators to ensure high availability and reliability of their networks. By extending Y.1731 CFM functionality to sub-interfaces in multi home EVPN E-Line deployments, this feature provides comprehensive end-to-end visibility and control, enabling proactive fault detection, isolation, and troubleshooting.

CFM multi-homing allows Customer Edge (CE) device to connect more than one Provider Edge (PE) device. Multi-homing ensures redundant connectivity. The redundant PE device ensures that there is no traffic disruption when there is a network failure.

Feature Characteristics

- Utilizes sub-interfaces to partition Ethernet traffic within the Multi home EVPN ELINE architecture, enabling efficient service delivery and management.
- Implements EVPN ELINE architecture with multi-homing capabilities, facilitating the creation of Ethernet Virtual Private Networks with simplified configurations and reduced complexity.
- Provides robust fault detection mechanisms to identify connectivity issues, link failures, and service disruptions in Ethernet networks.

Benefits

- Provides detailed insights into Ethernet service performance, enabling proactive monitoring and optimization of network resources.
- Minimizes service downtime by promptly detecting and resolving faults, ensuring uninterrupted service delivery and customer satisfaction.
- Optimizes network resource utilization and bandwidth allocation by identifying and addressing connectivity issues in a timely manner.
- Facilitates rapid fault identification and isolation, accelerating troubleshooting processes and reducing mean time to repair (MTTR).

Ensures compliance with Service Level Agreements (SLAs) by maintaining service quality metrics within defined thresholds and objectives.

Configuration

Configure Multi Home EVPN ELINE Y.1731 CFM over Sub-interface for enhanced fault management in EVPN networks.

Topology

The following topology consists of customer edge routers CE1 and CE2 with IPv2 Provider Edge routers PE1 and PE2. These are interconnected through the core router P in the IPv4 MPLS provider networks.

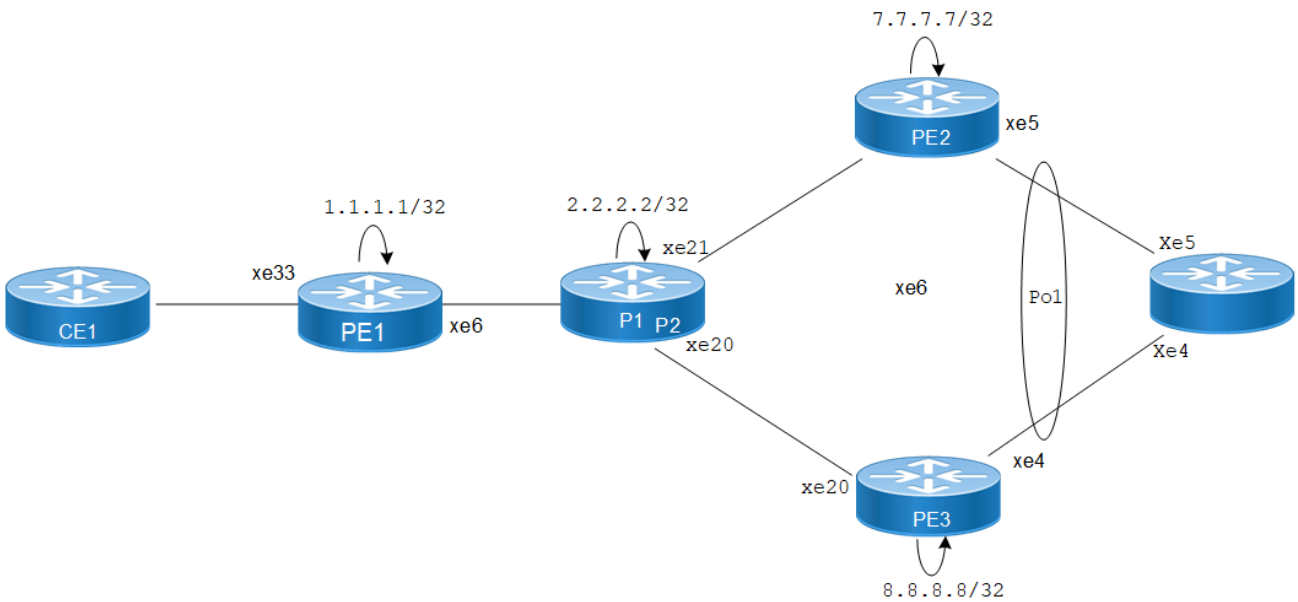


Figure 6-15: EVPN ELINE Over CFM Sub-interface

The following sessions displays the detailed information about configurations, and validations for CFM over sub-interface.

1. Configure Loopback Interface on PE1.

```
PE1(#configure terminal
PE1(config)#interface lo
PE1(config-if)#ip address 1.1.1.1/32
PE1(config-if)#exit
PE1(config-if)#commit
```

2. Configure Global LDP for distributing MPLS labels in the network.

```
PE1(config)# router ldp
PE1(config-router)# router-id 1.1.1.1
PE1(config-router)# targeted-peer ipv4 7.7.7.7
PE1(config-router)# targeted-peer ipv4 8.8.8.8
PE1(config-router-targeted-peer)#exit
PE1(config-router)# exit
PE1(config)# commit
```

3. Enable EVPN over MPLS and set a global VTEP IP.

```
PE1(config)# evpn mpls enable
PE1(config)# commit
PE1(config)# evpn mpls vtep-ip-global 1.1.1.1
PE1(config)# commit
```

4. Configure the interfaces connecting to the network, enabling LDP and MPLS label switching.

```
PE1(config)# interface xe6
PE1(config-if)# ip address 10.1.0.1/16
PE1(config-if)# enable-ldp ipv4
PE1(config-if)# label-switching
```

```
PE1(config-if)# exit
PE1(config)# commit
```

5. Set up OSPF for IP routing within the network.

```
PE1(config)# router ospf 1
PE1(config-router)# ospf router-id 1.1.1.1
PE1(config-router)# network 1.1.1.1/32 area 0
PE1(config-router)# network 10.1.0.0/16 area 0
PE1(config-router)# exit
PE1(config)# commit
```

6. Set up BGP for EVPN to exchange MAC and IP information.

```
PE1(config)# router bgp 1
PE1(config-router)# neighbor 7.7.7.7 remote-as 1
PE1(config-router)# neighbor 7.7.7.7 update-source lo
PE1(config-router)# neighbor 8.8.8.8 remote-as 1
PE1(config-router)# neighbor 8.8.8.8 update-source lo
PE1(config-router)# address-family l2vpn evpn
PE1(config-router-af)# neighbor 7.7.7.7 activate
PE1(config-router-af)# neighbor 8.8.8.8 activate
PE1(config-router-af)# exit
PE1(config-router)# exit
PE1(config)# commit
```

7. Configure MAC VRF.

```
PE1(config)# mac vrf vrf2
PE1(config-vrf)# rd 1.1.1.1:2
PE1(config-vrf)# route-target both 2:2
PE1(config-vrf)# exit
PE1(config)# commit
```

8. Configure EVPN and map VRF.

```
PE1(config)# evpn mpls id 52 xconnect target-mpls-id 2
PE1(config-evpn-mpls)# host-reachability-protocol evpn-bgp vrf2
PE1(config)# commit
```

9. Configure access port on interface xe33.2

```
PE1(config-if)# interface xe33.2 switchport
PE1(config-if)# description access-side-int
PE1(config-if)# encapsulation dot1q 2
PE1(config-if)# access-if-evpn
PE1(config-access-if)# map vpn-id 52
PE1(config-access-if)# exit
PE1(config)# commit
```

10. Set up CFM to monitor connectivity within the network.

```
PE1(config)#hardware-profile filter cfm-domain- name-str enable
PE1(config)# ethernet cfm domain-type character-string domain-name 12346 level 7
mip-creation none
PE1(config-ether-cfm-mpls-md)# service ma-type string ma-name 124
PE1(config-ether-cfm-mpls-ma)# ethernet cfm mep up mpid 10 active true xe33.2
vlan 2
PE1(config-ether-cfm-mpls-ma-mep)#cc multicast state enable
PE1(config-ether-cfm-mpls-ma-mep)#exit-ether- ma-mep-mode
PE1(config-ether-cfm-mpls-ma)#  rmep auto-discovery enable
PE1(config-ether-cfm-mpls-ma)#cc interval 10ms
PE1(config-ether-cfm-mpls-ma)#exit-ether-ma- mode
PE1(config-ether-cfm-mpls)#exit
```

```
PE1(config)#exit
PE1(config)#commit
```

Note: Similarly follow the same steps to configure respective `cfm mep up` and other CFM features for PE2 and PE3.

Configuration Snapshot:

PE1:

```
!
interface lo
 ip address 1.1.1.1/32
!
router ldp
 router-id 1.1.1.1
 targeted-peer 7.7.7.7
 targeted-peer 8.8.8.8
!
router ospf 1
 router-id 1.1.1.1
 network  1.1.1.1/32 area 0
 network  10.1.0.0/16 area 0
!
router bgp 1
 bgp log-neighbor-changes
 neighbor 7.7.7.7 remote-as 1
 neighbor 7.7.7.7 update-source lo
 neighbor 8.8.8.8 remote-as 1
 neighbor 8.8.8.8 update-source lo
  !
 address-family l2vpn evpn
 neighbor 7.7.7.7 activate
 neighbor 8.8.8.8 activate
 exit-address-family
!
evpn mpls enable
evpn mpls vtep-ip-global 1.1.1.1
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable
!
interface xe6
ip address 10.1.0.1/16
enable-ldp ipv4
label-switching
!
vrf definition vrf2
 rd 1.1.1.1:2
 route-target both 2:2
!
evpn mpls id 52 xconnect target-mpls-id 2
 host-reachability-protocol evpn-bgp vrf2
!
interface xe33.2 swicthport
 description access-side-int
 encapsulation dot1q 2
 access-if-evpn
```

```
  map vpn-id 52
!
ethernet cfm domain-type character-string domain-name 12346 level 7 mip-
creation none
 service ma-type string ma-name 124
  ethernet cfm mep up mpid 10 active true xe33.2 vlan 2
   cc multicast state enable
   exit-ether-ma- mode
   rmep auto-discovery enable
   cc interval 10ms
   exit-ether-ma- mode
!
```

P:

```
!
interface lo
 ip address 2.2.2.2/32
!
interface xe6
ip address 10.1.0.2/16
enable-ldp ipv4
label-switching
!
interface xe21
 ip address 123.1.1.1/24
 enable-ldp ipv4
label-switching
!
interface xe20
 ip address 124.1.1.1/24
 enable-ldp ipv4
label-switching
!
router ldp
 router-id 2.2.2.2
!
router ospf 1
 router-id 2.2.2.2
 network 2.2.2.2/32 area 0
 network 10.1.0.0/16 area 0
 network 123.1.1.0/24 area 0
 network 124.1.1.0/24 area 0
!
```

PE2:

```
!
interface lo
 ip address 7.7.7.7/32
!
interface xe21
 ip address 123.1.1.2/24
 enable-ldp ipv4
label-switching
!
router ldp
 router-id 7.7.7.7/32
 targeted-peer ipv4 1.1.1.1
```

```
 targeted-peer ipv4 8.8.8.8
!
router ospf 1
 router-id 7.7.7.7
 network  7.7.7.7/32 area 0
 network 123.1.1.0/24 area 0
!
router bgp 1
 bgp log-neighbor-changes
 neighbor 1.1.1.1 remote-as 1
 neighbor 1.1.1.1 update-source lo
 neighbor 8.8.8.8 remote-as 1
 neighbor 8.8.8.8 update-source lo
 address-family l2vpn evpn
 neighbor 1.1.1.1 activate
 neighbor 8.8.8.8 activate
 exit-address-family
!
evpn mpls enable
evpn mpls vtep-ip-global 7.7.7.7
hardware-profile filter evpn-mpls-mh enable
evpn mpls multihoming enable
!
vrf definition vrf2
 rd 7.7.7.7:2
 route-target both 2:2
!
interface Po1
 load-interval 30
 evpn multi-homed system-mac 0000.aaaa.bbbc
!
interface Po1.2 switchport
 encapsulation dot1q 2
 access-if-evpn
  map vpn-id 2
!
interface xe5
 channel-group 1 mode active
!
ethernet cfm domain-type character-string domain-name 12346 level 7 mip-
creation none
 service ma-type string ma-name 124
  ethernet cfm mep up mpid 20 active true po1.2 vlan 2
   cc multicast state enable
    ethernet cfm loss-measurement reply slm
    ethernet cfm delay-measurement reply dmm
   exit-ether-ma- mode
   rmep auto-discovery enable
   cc interval 10ms
   exit-ether-ma- mode
!
```

PE3:

```
!
interface lo
 ip address 8.8.8.8/32
!
```

```
interface xe20
 ip address 124.1.1.2/24
 enable-ldp ipv4
label-switching
!
interface xe4
 channel-group 1 mode active
!
router ldp
 router-id 8.8.8.8
 targeted-peer ipv4 1.1.1.1
 targeted-peer ipv4 7.7.7.7
!
router ospf 1
 router-id 8.8.8.8
 network  8.8.8.8/32 area 0
 network network 124.1.1.0/24 area 0
!
router bgp 1
 bgp log-neighbor-changes
 neighbor 1.1.1.1 remote-as 1
 neighbor 1.1.1.1 update-source lo
 neighbor 7.7.7.7 remote-as 1
 neighbor 7.7.7.7 update-source lo
 address-family l2vpn evpn
 neighbor 1.1.1.1 activate
 neighbor 7.7.7.7 activate
 exit-address-family
!
evpn mpls enable
evpn mpls vtep-ip-global 8.8.8.8
hardware-profile filter evpn-mpls-mh enable
evpn mpls multihoming enable
!
vrf definition vrf2
 rd 8.8.8.8:2
 route-target both 2:2
!
interface Po1
 load-interval 30
 evpn multi-homed system-mac 0000.aaaa.bbbc
!
interface Po1.2 switchport
 encapsulation dot1q 2
 access-if-evpn
  map vpn-id 2
!
ethernet cfm domain-type character-string domain-name 12346 level 7 mip-
creation none
 service ma-type string ma-name 124
  ethernet cfm mep up mpid 30 active true po1.2 vlan 2
   cc multicast state enable
    ethernet cfm loss-measurement reply slm
    ethernet cfm delay-measurement reply dmm
   exit-ether-ma- mode
   rmep auto-discovery enable
   cc interval 10ms
```

```
        exit-ether-ma- mode
        !
```

Validation

The following are the validations for PE1 and PE2.

PE1

The following validation is for PE1.

```
PE1#SH evpn mpls xconnect
EVPN Xconnect Info
========================
AC-AC: Local-Cross-connect
AC-NW: Cross-connect to Network
AC-UP: Access-port is up
AC-DN: Access-port is down
NW-UP: Network is up
NW-DN: Network is down
NW-SET: Network and AC both are up



Local                            Remote       Connection-Details
=================================================================================
VPN-ID       EVI-Name      MTU   VPN-ID       Source       Destination
PE-IP           MTU   Type   NW-Status
=================================================================================
52           ----          1500  2            xe33.2       00:00:00:aa:aa:bb:bb:00:00:00
7.7.7.7         1500  AC-NW  NW-SET

8.8.8.8         1500  ----   ----
PE1#show ethernet cfm errors domain 12346

Domain Name         Level     MEPID     Defects
-----------------------------------------------
12346               7         20        .....

PE1#show ethernet cfm ma status domain 12346 ma-name 124
MA NAME                  STATUS
-------------------------------
    124                  Active
PE1#show ethernet cfm maintenance-points remote domain 12346 ma-name 124
 MEPID     RMEPID     LEVEL     Rx CCM    RDI    PEER-MAC        TYPE
----------------------------------------------------------------------
 10        20         7         Yes       False  00aa.bb00.0002 Learnt
 10        30         7         Yes       False  00aa.dd00.0003 Learnt


PE1#show ethernet cfm maintenance-points local mep domain 12346 ma-name 124
MPID Dir Lvl CC-Stat HW-Status  CC-Intvl MAC-Address    Def Port  MD Name
```

```
---------------------------------------------------------------------------
10   Up  7   Enable  Installed  100 ms   3417.ebe4.af22 F   xe33.2 12346

PE1#ping ethernet mac 00aa.bb00.0002 unicast source 10 domain 12346 ma 124
 success rate is  100 (5/5)


PE1#traceroute ethernet 00aa.bb00.0002 mepid 10 domain 12346 ma 124
MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
00aa.bb00.0002   1     RlyHit                Ingress         IngOK

PE1#ping ethernet mac 00aa.dd00.0003 unicast source 10 domain 12346 ma 124
 success rate is  100 (5/5)
PE1-7011#traceroute ethernet 00aa.dd00.0003 mepid 10 domain 12346 ma 124
MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
00aa.dd00.0003   1     RlyHit                Ingress         IngOK
```

Verify Delay Measurement:

```
PE1#delay-measurement type proactive profile-name DM rmep 20 mep 10 domain 12346 ma 124
PE1-7011#2019 Feb 14 10:34:53.935 : PE2-7033 : ONMD : INFO : [CFM_PM_SESSION_INFO_5]:
CFM Frame Delay Measurement session started for MEP Id 10 and RMEP Id 20

PE1#show ethernet cfm delay-measurement mep 10 domain 12346 ma-name 124
 MD                      : 12346
 MA                      : 124
 MEP                     : 10
 VLAN ID                 : 2
 Interface               : xe33.2
 Peer MAC Address        : 00aa.bb00.0002

CURRENT:
======================
 RMEP ID        : 20
 Measurement ID : 3
 Measurement Type             : DMM
 Elapsed time(sec)            : 16
 Start Time                   : 2019 Feb 14 10:36:53
 Suspect Flag                 : FALSE
 Min Frame Delay(usec)        : 23
 Max Frame Delay(usec)        : 24
 Avg Frame Delay(usec)        : 23
 Min Inter FD Variation(usec): 0
 Max Inter FD Variation(usec): 1
 Avg Inter FD Variation(usec): 0

             FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999            16
 2             5000       - < 9999            0
 3             10000      - < 4294967295      0
```

```
          INTER-FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999           15
 2             5000       - < 4294967295     0


HISTORY STATISTICS
======================
 MD                       : 12346
 MA                       : 124
 MEP                      : 10
 VLAN ID                  : 2
 Interface                : xe33.2
 RMEP ID        : 20
 Measurement ID                : 1
 Measurement Type              : DMM
 Elapsed time(sec)             : 60
 End Time                      : 2019 Feb 14 10:35:53
 Suspect Flag                  : FALSE
 Min Frame Delay(usec)         : 23
 Max Frame Delay(usec)         : 24
 Avg Frame Delay(usec)         : 23
 Min Inter FD Variation(usec): 0
 Max Inter FD Variation(usec): 1
 Avg Inter FD Variation(usec): 0

             FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999           59
 2             5000       - < 9999           0
 3             10000      - < 4294967295     0

          INTER-FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999           58
 2             5000       - < 4294967295     0

 RMEP ID        : 20
 Measurement ID                : 2
 Measurement Type              : DMM
 Elapsed time(sec)             : 60
 End Time                      : 2019 Feb 14 10:36:53
 Suspect Flag                  : FALSE
 Min Frame Delay(usec)         : 23
 Max Frame Delay(usec)         : 24
 Avg Frame Delay(usec)         : 23
```

```
 Min Inter FD Variation(usec): 0
 Max Inter FD Variation(usec): 1
 Avg Inter FD Variation(usec): 0

            FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)         Bin Counter
========================================================
 1             0          - < 4999          60
 2             5000       - < 9999          0
 3             10000      - < 4294967295    0

          INTER-FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)         Bin Counter
========================================================
 1             0          - < 4999          59
 2             5000       - < 4294967295    0
```

Verify Synthetic Loss Measurement:

```
PE1#loss-measurement type proactive profile-name SLM rmep 20 mep 10 domain 12346 ma 124
PE1#2019 Feb 14 10:35:17.758 : PE2-7011 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame
Loss Measurement  started for MEP:10 MA:124 MD:12346
PE1-7011#show ethernet cfm loss-measurement mep 10 domain 12346 ma-name 124
MEP: 10 MA: 124
CURRENT:
 Measurement ID : 3
  Suspect                     : False
  Measurement Type            : slm
  Elapsed time(sec)           : 19
  Start Time                  : 2019 Feb 14 10:37:16
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
  Near End frame loss ratio   : 0
  Far End frame loss ratio    : 0

HISTORY:

 Measurement ID : 1
  Suspect                     : False
  Measurement Type            : slm
  Elapsed time(sec)           : 60
  End Time                    : 2019 Feb 14 10:36:16
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
  Near End frame loss ratio   : 0
  Far End frame loss ratio    : 0
  Near End frame loss ratio min  : 0
```

```
  Far End frame loss ratio min  : 0
  Near End frame loss ratio max  : 0
  Far End frame loss ratio max  : 0

 Measurement ID : 2
  Suspect                      : False
  Measurement Type             : slm
  Elapsed time(sec)            : 60
  End Time                     : 2019 Feb 14 10:37:16
  Near End loss                : 0
  Far End loss                 : 0
  Near End accumulated loss    : 0
  Far End accumulated loss     : 0
  Near End frame loss ratio    : 0
  Far End frame loss ratio     : 0
  Near End frame loss ratio min  : 0
  Far End frame loss ratio min  : 0
  Near End frame loss ratio max  : 0
  Far End frame loss ratio max  : 0
```

PE2/PE3

The following validations for PE2 and PE3.

```
PE2#show evpn mpls xconnect
EVPN Xconnect Info
========================
AC-AC: Local-Cross-connect
AC-NW: Cross-connect to Network
AC-UP: Access-port is up
AC-DN: Access-port is down
NW-UP: Network is up
NW-DN: Network is down
NW-SET: Network and AC both are up

Local                            Remote       Connection-Details
================================ ============
=================================================================================
VPN-ID       EVI-Name      MTU   VPN-ID       Source       Destination
PE-IP           MTU   Type   NW-Status
=================================================================================
2           ----         1500  52          po1.2        --- Single Homed Port ---
1.1.1.1         1500  AC-NW  NW-SET
PE2#show ethernet cfm errors domain 12346

Domain Name         Level     MEPID     Defects
-----------------------------------------------
12346               7         20        .....
PE2#show ethernet cfm ma status domain 12346 ma-name 124
MA NAME                  STATUS
-------------------------------
    124                  Active
```

```
PE2#show ethernet cfm maintenance-points local mep domain 12346 ma-name 124
MPID Dir Lvl CC-Stat HW-Status  CC-Intvl MAC-Address    Def Port  MD Name
---------------------------------------------------------------------------
20   Up  7   Enable  Installed  100 ms   00aa.bb00.0002 F   po1.2 12346
PE2#show ethernet cfm maintenance-points remote domain 12346 ma-name 124
 MEPID     RMEPID     LEVEL     Rx CCM    RDI    PEER-MAC        TYPE
----------------------------------------------------------------------
 20        10         7         Yes       False  3417.ebe4.af22 Learnt

PE2#ping ethernet mac 3417.ebe4.af22 unicast source 10 domain 12346 ma 124
 success rate is  100 (5/5)
PE2#traceroute ethernet 3417.ebe4.af22 mepid 10 domain 12346 ma 124
 MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
3417.ebe4.af22   1     RlyHit                Ingress         IngOK
```

CHAPTER 7 Y.1731 and CFM Over VPWS Sub-interface

Overview

Y.1731 Connectivity Fault Management (CFM) over Layer 2 Virtual Private Wire Service (VPWS) is a protocol and technology combination used for fault management in Layer 2 VPN networks. It allows for the detection and management of faults, performance monitoring, and fault localization within a VPWS network.

Feature Characteristics

- Facilitates end-to-end fault management across the VPWS network, covering provider and customer edges.
- Supports multi-level fault management, allowing operators to define different levels of fault detection and management for different parts of the network.
- Y.1731 CFM includes performance monitoring capabilities, such as delay measurement and frame loss measurement, to monitor service quality parameters.
- The protocol supports loopback and link trace functions to identify and troubleshoot faults within the VPWS network.

Benefits

- Enables rapid detection and localization of faults within the VPWS network, minimizing downtime and service disruptions.
- Provides performance monitoring capabilities, allowing to track key performance indicators and ensure service quality.
- Enhances network visibility by providing detailed fault and performance monitoring data, aiding in network troubleshooting and maintenance.

Prerequisites

Ensure the network devices participating in the L2VPN VPWS setup support Y.1731 CFM functionality. This includes the Provider Edge (PE) and Customer Edge (CE) devices.

Configuration

Configure Y.1731 CFM over sub-interface using L2VPN VPWS by defining the CFM domain, configuring service MEPs and MAs, and setting up cross-connects between primary and backup interfaces.

Topology

The topology consists of two Customer Edge devices (CE1 and CE2) connected to two Provider Edge devices (PE1 and PE2) via sub-interfaces (xe11 and xe12). The Provider Edge devices are interconnected through Provider Devices (P1 and P2). Y.1731 ethernet CFM is configured over these sub-interfaces to monitor and manage ethernet connectivity between the CE devices, ensuring fault detection and performance monitoring across the service provider's network.

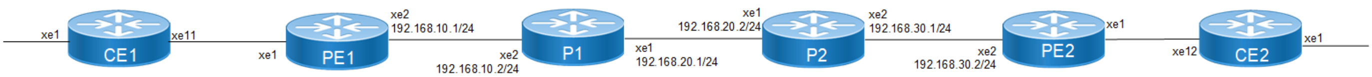


Figure 7-16: L2VPN VPWS Y1731 CFM Over Sub-interface

Perform the following configurations to configure Y.1731 CFM over sub-interface using L2VPN VPWS:

1. On Customer Edge (CE) Nodes (CE1 and CE2), configure the interface xe1 and set it as a switchport with a load interval of (`30 seconds`):

```
CE1(config)#interface xe1
CE1(config-if)#switchport
CE1(config-if)#load-interval 30
CE1(config-if)#commit
CE1(config-if)#exit
```

Note: Similarly follow the same steps to configure xe11(CE1) and xe12(CE2).

2. Create sub-interface (`xe1.2001`) adding the VLAN:

```
CE1(config)#interface xe1.2001 switchport
CE1(config-if)#encapsulation dot1q 2028
CE1(config-if)#commit
CE1(config-if)#exit

CE1(config)#interface xe11.2001 switchport
CE1(config-if)#encapsulation dot1q 2028
CE1(config-if)#commit
CE1(config-if)#exit
```

3. Set up a cross-connect named (`test100`), specifying in and out interfaces:

```
CE1(config)#cross-connect test100
CE1(config-xc)#interface xe1.2001
CE1(config-xc)#interface xe11.2001
CE1(config-xc)#commit
```

4. Perform the following on PE1:

   1. Configure CFM related hardware profiles:

   ```
   PE1(config)# hardware-profile filter cfm-domain-name-str enable
   PE1(config)# hardware-profile statistics cfm-lm enable
   PE1(config)# hardware-profile statistics cfm-ccm enable
   PE1(config)#hardware-profile statistics cfm-slm enable
   ```

   2. Configure the loopback interface with a secondary IP address(`1.1.1.1/32`):

   ```
   PE1(config)#interface lo
   PE1(config-if)#ip address 1.1.1.1/32 secondary
   PE1(config-if)#commit
   PE1(config-if)#exit
   ```

   3. Configure LDP targeted peers:

   ```
   PE1(config)#router ldp
   PE1(config-router)#targeted-peer ipv4 4.4.4.4
   PE1(config-router-targeted-peer)#exit-targeted-peer-mode
   PE1(config-router)#commit
   PE1(config-router)exit
   ```

   4. Configure interface `xe2` with an IP address (`192.168.10.1/24`) and enable LDP:

```
PE1(config)#interface xe2
PE1(config-if)#load-interval 30
PE1(config-if)#ip address 192.168.10.1/24
PE1(config-if)#label-switching
PE1(config-if)#enable-ldp ipv4
PE1(config-if)#commit
PE1(config-if)#exit
```

5. Configure OSPF routing, specify the OSPF router ID as (`1.1.1.1`), enable BFD on all interfaces, define the network (`1.1.1.1/32`) in area (`0.0.0.0`), and define the network (`192.168.10.0/24`) in area (`0.0.0.0`):

```
PE1(config)#router ospf 1
PE1(config-router)#ospf router-id 1.1.1.1
PE1(config-router)#bfd all-interfaces
PE1(config-router)#network 1.1.1.1/32 area 0.0.0.0
PE1(config-router)#network 192.168.10.0/24 area 0.0.0.0
PE1(config-router)#commit
PE1(config-router)#exit
```

6. Set up an L2VPN pseudowire (`test1`) between PE1 and PE2.

```
PE1(config)#mpls l2-circuit test1 2001 4.4.4.4
PE1(config-pseudowire)#commit
PE1(config-pseudowire)#exit
```

7. Configure sub-interface (`xe1.2001`) as an access interface for VPWS.

```
PE1(config)#interface xe1.2001 switchport
PE1(config-if)#encapsulation dot1q 2028
PE1(config-if)#access-if-vpws
PE1(config-acc-if-vpws)#mpls-l2-circuit test1 primary
PE1(config-acc-if-vpws)#commit
PE1(config-acc-if-vpws)#exit
```

8. Configure Up-mep CFM domain:
   - Set the domain type as a character string with the domain name (`12346`) and (`level 7`)
   - Specify the MA type as a string with the MA name (`124`)
   - Associate the MA with (`VLAN 2028`)
   - Set up a MEP with MEP ID (`20`) as active on interface (`xe1.2001`)
   - Enable multicast state for continuity check, and auto-discovery of RMEPs
   - Set the continuity check interval to (`10 milliseconds`)

   ```
   PE1(config)#ethernet cfm domain-type character-string domain-name
   12346 level 7 mip-creation none
   PE1(config-ether-cfm)# service ma-type string ma-name 124
   PE1(config-ether-cfm-ma)#ethernet cfm mep up mpid 20 active true
   xe1.2001 vlan 2028
   PE1(config-ether-cfm-ma-mep)#cc multicast state enable
   PE1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode
   PE1(config-ether-cfm-ma)#rmep auto-discovery enable
   PE1(config-ether-cfm-ma)#cc interval 10ms
   PE1(config-ether-cfm-ma)#exit-ether-ma-mode
   PE1(config-ether-cfm)#commit
   PE1(config-ether-cfm)exit
   ```

   - Create a loss measurement profile named SLM with measurement type SLM, measurement interval of `1`, intervals stored of `3`, and message period of `(1)` second.

```
PE1(config)#ethernet cfm loss-measurement profile-name SLM
PE1(config-cfm-lm)#measurement-type slm
PE1(config-cfm-lm)#measurement-interval 1
PE1(config-cfm-lm)#intervals-stored 3
PE1(config-cfm-lm)#message-period 1s
PE1(config-cfm-lm)#exit
```

- Create loss measurement profile named LM with measurement type LMM, measurement interval of (`1`), intervals stored of (`3`), and message period of (`1 second`),

```
PE1(config)#ethernet cfm loss-measurement profile-name LM
PE1(config-cfm-lm)#measurement-type lmm
PE1(config-cfm-lm)#measurement-interval 1
PE1(config-cfm-lm)#intervals-stored 3
PE1(config-cfm-lm)#message-period 1s
PE1(config-cfm-lm)#exit
```

- Create a delay measurement profile named DM with a measurement interval of (`1`), intervals stored of (`2`), and message period of `(1 second)`.

```
PE1(config)#ethernet cfm delay-measurement profile-name DM
PE1(config-cfm-dm)#measurement-interval 1
PE1(config-cfm-dm)#intervals-stored 2
PE1(config-cfm-dm)#message-period 1
```

Configuration Snapshot:

CE1:

```
interface xe1
switchport
 load-interval 30

interface xe1.2001 switchport
 encapsulation dot1q 2028

interface xe11.2001 switchport
 encapsulation dot1q 2028

cross-connect test100
 interface xe1.2001
 interface xe11.2001
```

CE2:

```
interface xe1
switchport
 load-interval 30

interface xe1.2001 switchport
 encapsulation dot1q 2028

interface xe12.2001 switchport
 encapsulation dot1q 2028

cross-connect test100
 interface xe1.2001
 interface xe12.2001
```

PE1:

```
interface lo
```

```
 ip address 1.1.1.1/32 secondary

router ldp
 targeted-peer ipv4 4.4.4.4

interface xe2
 load-interval 30
 ip address 192.168.10.1/24
 label-switching
 enable-ldp ipv4

router ospf 1
 ospf router-id 1.1.1.1
 bfd all-interfaces
 network 1.1.1.1/32 area 0.0.0.0
 network 192.168.10.0/24 area 0.0.0.0

mpls l2-circuit test1 2001 4.4.4.4

interface xe1.2001 switchport
 encapsulation dot1q 2028
 access-if-vpws
 mpls-l2-circuit test1 primary

ethernet cfm domain-type character-string domain-name 12346 level 7 mip-
creation none
 service ma-type string ma-name 124
   ethernet cfm mep up mpid 20 active true xe1.2001 vlan 2028
     cc multicast state enable
     exit-ether-ma-mep-mode
   rmep auto-discovery enable
   cc interval 10ms
   exit-ether-ma-mode

ethernet cfm loss-measurement profile-name SLM
 measurement-type slm
 measurement-interval 1
 intervals-stored 3
 message-period 1s
!
ethernet cfm loss-measurement profile-name LM
 measurement-type lmm
 measurement-interval 1
 intervals-stored 3
 message-period 1s
!
ethernet cfm delay-measurement profile-name DM
 measurement-interval 1
 intervals-stored 2
 message-period 1s
```

PE2:

```
interface lo
 ip address 4.4.4.4/32 secondary

router ldp
 targeted-peer ipv4 1.1.1.1
```

```
interface xe2
 load-interval 30
 ip address 192.168.30.2/24
 label-switching
 enable-ldp ipv4

router ospf 1
ospf router-id 4.4.4.4
 bfd all-interfaces
 network 4.4.4.4/32 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0

mpls l2-circuit test1 2001 1.1.1.1

interface xe1.2001 switchport
 encapsulation dot1q 2028
 access-if-vpws
 mpls-l2-circuit test1 primary

ethernet cfm domain-type character-string domain-name 12346 level 7 mip-
creation none
 service ma-type string ma-name 124
   ethernet cfm mep up mpid 10 active true xe1.2001 vlan 2028
     cc multicast state enable
     ethernet cfm loss-measurement reply lmm
     ethernet cfm delay-measurement reply dmm
     exit-ether-ma-mep-mode
   rmep auto-discovery enable
   cc interval 10ms
   exit-ether-ma-mode
```

P1:

```
interface lo
 ip address 2.2.2.2/32 secondary

router ldp
 transport-address ipv4 2.2.2.2

interface xe2
 ip address 192.168.10.2/24
 label-switching
 enable-ldp ipv4

interface xe1
 ip address 192.168.20.1/24
 label-switching
 enable-ldp ipv4

router ospf 1
 ospf router-id 2.2.2.2
 bfd all-interfaces
 network 2.2.2.2/32 area 0.0.0.0
 network 192.168.10.0/24 area 0.0.0.0
 network 192.168.20.0/24 area 0.0.0.0
```

P2:

```
interface lo
 ip address 3.3.3.3/32 secondary

router ldp
 transport-address ipv4 3.3.3.3

interface xe1
 ip address 192.168.20.2/24
 label-switching
 enable-ldp ipv4

interface xe2
 ip address 192.168.30.1/24
 label-switching
 enable-ldp ipv4

router ospf 1
 ospf router-id 3.3.3.3
 bfd all-interfaces
 network 3.3.3.3/32 area 0.0.0.0
 network 192.168.20.0/24 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0
```

Validation

Verify the RMEP is learned or not.

```
PE1#show ethernet cfm maintenance-points remote domain 12346
 MA_NAME  MEPID     RMEPID     LEVEL     Rx CCM    RDI    PEER-MAC        TYPE
-------------------------------------------------------------------------------
 124       20        10         7         Yes       False  e8c5.7ae3.37ee Learnt
```

Verify the CFM Errors:

```
PE1#show ethernet cfm errors domain 12346

Domain Name         Level     MEPID     Defects
----------------------------------------------
12346               7         20        .....


1. defRDICCM    2. defMACstatus  3. defRemoteCCM
4. defErrorCCM  5. defXconCCM
```

Verify the CFM status:

```
PE1#show ethernet cfm ma status domain 12346 ma-name 124
MA NAME                  STATUS
124                  Active
```

Verify the Ping:

```
PE1#ping ethernet mac   e8c5.7ae3.37ee  unicast source 20 domain 12346 ma 124
 success rate is  100 (5/5)
```

Verify the Traceroute:

```
PE1#traceroute ethernet   e8c5.7ae3.37ee mepid 20 domain 12346 ma 124
 MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
e8c5.7ae3.37ee   1     RlyHit                Ingress         IngOK
```

Verify the MPLS virtual circuit table, which contains information about MPLS label-switched paths (LSPs) and its associated virtual circuits in the network.

```
PE1#show mpls vc-table
(m) - Service mapped over multipath transport
(e) - Service mapped over LDP ECMP

VC-ID      Vlan-ID  Inner-Vlan-ID  Access-Intf   Network-Intf  Out Label  Tunnel-Label
Nexthop         Status     UpTime
2001        N/A      N/A            xe1.2001        xe2        26240      25601
4.4.4.4         Active     00:38:02
```

Verify the Delay-measurement:

```
PE1#delay-measurement type proactive profile-name DM rmep 10 mep 20 domain 12346 ma 124
PE1#2023 Oct 12 04:11:56.696 : PE1 : ONMD : INFO : [CFM_PM_SESSION_INFO_5]: CFM Frame
Delay Measurement session started for MEP Id 20 and RMEP Id 10

PE1#show ethernet cfm delay-measurement mep 20 domain 12346 ma-name 124
 MD                       : 12346
 MA                       : 124
 MEP                      : 20
 VC Name                  : test3
 Peer MAC Address         : e8c5.7ae3.37ee

CURRENT:

 RMEP ID        : 10
 Measurement ID : 1
 Measurement Type            : DMM
 Elapsed time(sec)           : 2
 Start Time                  : 2023 Oct 12 04:11:56
 Suspect Flag                : FALSE
 Min Frame Delay(usec)       : 40
 Max Frame Delay(usec)       : 74
 Avg Frame Delay(usec)       : 57
 Min Inter FD Variation(usec): 34
 Max Inter FD Variation(usec): 34
 Avg Inter FD Variation(usec): 34



         FRAME DELAY BINS
Bin Number    Bin Threshold(usec)          Bin Counter
 1             0          - < 4999           2
 2             5000       - < 9999           0
```

```
 3             10000      - < 14999         0
 4             15000      - < 4294967295    0



       INTER-FRAME DELAY BINS
Bin Number    Bin Threshold(usec)         Bin Counter
 1             0          - < 4999          1
 2             5000       - < 9999          0
 3             10000      - < 4294967295    0
```

Verify the Loss-measurement:

```
PE1#loss-measurement type proactive profile-name LM rmep 10 mep 20 domain 12346 ma 124
2023 Oct 12 04:18:43.667 : PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame Loss
Measurement  started for MEP:20 MA:124 MD:12346
PE1#show ethernet cfm loss-measurement mep 20 domain 12346 ma-name 124

MEP: 20 MA: 124
CURRENT:
 Measurement ID : 1
  Suspect                      : False
  Measurement Type             : lmm
  Elapsed time(sec)            : 10
  Start Time                   : 2023 Oct 12 04:18:43
  Near End loss                : 0
  Far End loss                 : 0
  Near End accumulated loss    : 0
  Far End accumulated loss     : 0
  Near End frame loss ratio    : 0
  Far End frame loss ratio     : 0
```

Verify the Synthetic Loss Measurement:

```
PE1#loss-measurement type proactive profile-name SLM rmep 10 mep 20 domain 12346 ma 124
PE1#2024 Apr 10 13:40:15.587 : PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame Loss
Measurement  started for MEP:20 MA:124 MD:12346
PE1#show ethernet cfm loss-measurement mep 20 domain 12346 ma-name 124
MEP: 20 MA: 124
CURRENT:
 Measurement ID : 2
  Suspect                      : False
  Measurement Type             : slm
  Elapsed time(sec)            : 17
  Start Time                   : 2024 Apr 10 13:41:15
  Near End loss                : 0
  Far End loss                 : 0
  Near End accumulated loss    : 0
  Far End accumulated loss     : 0
  Near End frame loss ratio    : 0
  Far End frame loss ratio     : 0
HISTORY:
```

```
 Measurement ID : 1
  Suspect                      : False
  Measurement Type             : slm
  Elapsed time(sec)            : 60
  End Time                     : 2024 Apr 10 13:41:15
  Near End loss                : 0
  Far End loss                 : 0
  Near End accumulated loss    : 0
  Far End accumulated loss     : 0
  Near End frame loss ratio    : 0
  Far End frame loss ratio     : 0
  Near End frame loss ratio min  : 0
  Far End frame loss ratio min  : 0
  Near End frame loss ratio max  : 0
  Far End frame loss ratio max  : 0
```

Verify the DM, LM, and SLM active sessions.

```
PE1#show ethernet cfm maintenance-points count

Total No of MIPs                   : 0
Total No of MEPs                   : 2
Total No of UP MEPs                : 2
Total No of Down MEPs              : 0
Total No of Active CCM sessions    : 2
Total No of UP CCM sessions        : 2
Total No of Active LM sessions     : 2
Total No of Active DM sessions     : 1
```

Implementation Examples

- To support a vast network infrastructure delivering VPWS to a multitude of enterprise clients, it is imperative to maintain uninterrupted connectivity and peak performance for these VPWS connections, all while minimizing the risk of downtime or disruptions.
- Understanding the role of fault detection, localization, and performance monitoring within the VPWS network, deploy Y.1731 CFM over Layer 2 VPN (VPWS) to enhance the network's resilience and operational efficiency.

Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

Key Terms/Acronym	Description
Connectivity Fault Management (CFM)	CFM is a protocol used to detect, verify, and isolate connectivity faults in a network. It operates at the data link layer and is designed to monitor ethernet networks.

Virtual Private Wire Service (VPWS)	VPWS is a Layer 2 VPN service that provides point-to-point connectivity between two sites over an MPLS network. It emulates a leased line or circuit between the customer premises equipment (CPE) devices.
Maintenance End Point (MEP)	MEP is a CFM entity that resides at the edge of a CFM domain. It is responsible for generating and transmitting CFM protocol packets to detect faults and collect performance data.
Maintenance Domain (MD)	MD is a logical grouping of MEPs within a CFM network. MEPs within the same MD can communicate with each other to perform CFM functions such as fault detection and performance monitoring.
Maintenance Association(MA)	MA is a collection of MEPs associated with a specific service or set of services. It defines the scope of CFM operations within a maintenance domain.
Maintenance Point Identifier (MPID)	MPID is a unique identifier assigned to each MEP within a maintenance association. It is used to distinguish between different MEPs within the same MA.
Service Level Measurement (SLM)	SLM is a CFM function used to measure the loss characteristics of a network path. It collects data on packet loss, delay, and jitter to assess the quality of service provided by the network.
Loopback Message Generation (LMM)	LMM is a CFM function used to test end-to-end connectivity by generating loopback messages. These messages are transmitted from a MEP and looped back to the same MEP to verify bidirectional communication.
Delay Measurement Message (DMM)	DMM is a CFM function used to measure the one-way delay of packets transmitted across a network. It helps assess the performance of the network in terms of packet delivery time.
Continuity Check (CC)	CC is a CFM function used to verify the continuity of a service or network path by periodically sending continuity check messages between MEPs. It helps detect connectivity faults such as link failures or misconfigurations.

CHAPTER 8 Y.1731 and CFM Over EVPN ELAN Single Home

Overview

The Single Home EVPN ELAN Y.1731 CFM over Sub-interface feature enables the monitoring and management ofEthernet Virtual Private Network (EVPN) Ethernet LAN services using the Y.1731 Connectivity Fault Management (CFM) protocol over sub-interfaces. This feature enhances fault detection and performance monitoring capabilities for EVPN E-LAN services, allowing network operators to ensure high availability and reliability of their networks. By extending Y.1731 CFM functionality to sub-interfaces in single home EVPN E-LAN deployments, this feature provides comprehensive end-to-end visibility and control, enabling proactive fault detection, isolation, and troubleshooting.

Feature Characteristics

- Utilizes sub-interfaces to partition Ethernet traffic within the Single Home EVPN ELAN architecture, enabling efficient service delivery and management.
- Implements EVPN ELAN architecture with single-homing capabilities, facilitating the creation of Ethernet Virtual Private Networks with simplified configurations and reduced complexity.
- Provides robust fault detection mechanisms to identify connectivity issues, link failures, and service disruptions in Ethernet networks.

Benefits

- Provides detailed insights into Ethernet service performance, enabling proactive monitoring and optimization of network resources.
- Minimizes service downtime by promptly detecting and resolving faults, ensuring uninterrupted service delivery and customer satisfaction.
- Optimizes network resource utilization and bandwidth allocation by identifying and addressing connectivity issues in a timely manner.
- Facilitates rapid fault identification and isolation, accelerating troubleshooting processes and reducing mean time to repair (MTTR).
- Ensures compliance with Service Level Agreements (SLAs) by maintaining service quality metrics within defined thresholds and objectives.

Prerequisites

Ensure that the network devices (routers, switches) support Y.1731 CFM functionality and Single Home EVPN ELAN configuration.

Verify that the devices are running compatible software versions that include support for these features.

Configuration

Configure Single Home EVPN ELAN Y.1731 CFM over Sub-interface for enhanced fault management in EVPN

networks.

Topology

The topology consists of three Customer Edge devices (CE1, CE2, and CE3) connected to Provider Edge devices (PE1,PE2, and PE3) through sub-interfaces. The Provider Edge devices are interconnected through Provider devices (P1 and P2).
Y.1731 functionality is implemented over these sub-interfaces, allowing for fault detection and performance monitoring of Ethernet connectivity between the customer sites.

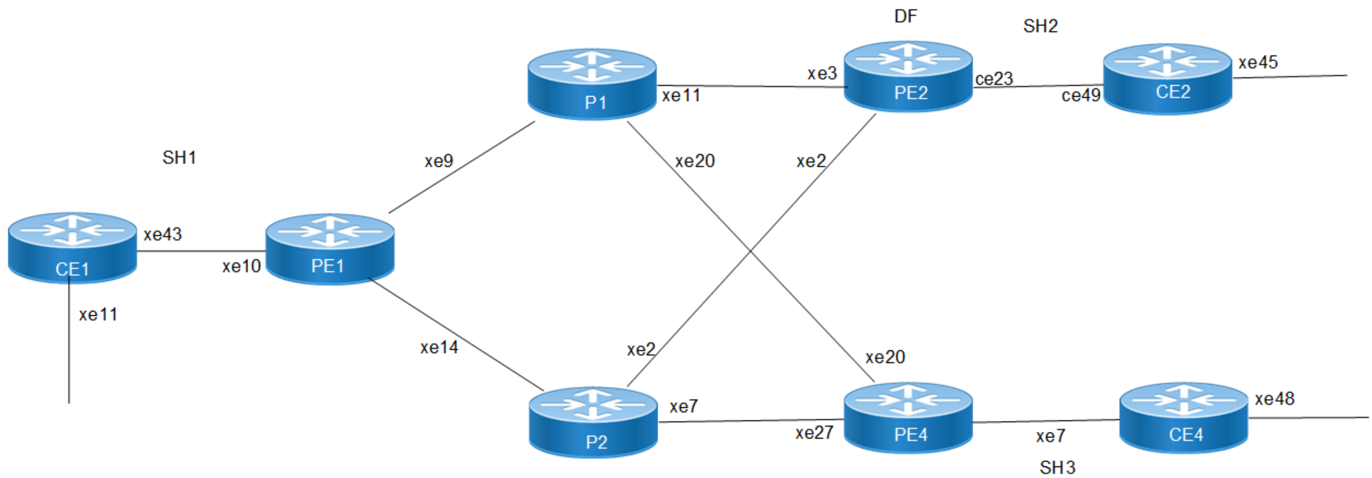


Figure 8-17: EVPN ELAN Over Sub-interface-Single Home

Perform the following configurations to configure Single Home EVPN ELAN Y.1731 CFM over Sub-interface:

1. On Customer Edge (CE) Nodes (CE1, CE2, and CE3), configure the interface xe1 and set it as a switchport with a load interval of (`30 seconds`):

```
CE1(config)#interface xe1
CE1(config-if)#switchport
CE1(config-if)#load-interval 30
CE1(config-if)#commit
CE1(config-if)#exit
```

Note: Similarly follow the same steps to configure xe11(CE1), xe12(CE2), and xe13(CE3).

2. Create sub-interface (`xe1.2001`) adding the VLAN:

```
CE1(config)#interface xe1.2001 switchport
CE1(config-if)#encapsulation dot1q 2028
CE1(config-if)#commit
CE1(config-if)#exit

CE1(config)#interface xe11.2001 switchport
CE1(config-if)#encapsulation dot1q 2028
CE1(config-if)#commit
CE1(config-if)#exit
```

3. Set up a cross-connect named (`test100`), specifying in and out interfaces:

```
CE1(config)#cross-connect test100
CE1(config-xc)#interface xe1.2001
CE1(config-xc)#interface xe11.2001
```

```
CE1(config-xc)#commit
```

4. Perform the following on PE1:

   1. Configure CFM related hardware profiles:

   ```
   PE1(config)# hardware-profile filter cfm-domain-name-str enable
   PE1(config)# hardware-profile statistics cfm-lm enable
   PE1(config)# hardware-profile statistics cfm-ccm enable
   PE1(config)#hardware-profile statistics cfm-slm enable
   ```

   2. Configure the loopback interface with a secondary IP address(`1.1.1.1/32`):

   ```
   PE1(config)#interface lo
   PE1(config-if)#ip address 1.1.1.1/32 secondary
   PE1(config-if)#commit
   PE1(config-if)#exit
   ```

   3. Configure LDP targeted peers:

   ```
   PE1(config)#router ldp
   PE1(config-router)#targeted-peer ipv4 4.4.4.4
   PE1(config-router-targeted-peer)#exit-targeted-peer-mode
   PE1(config-router)#commit
   PE1(config-router)exit
   ```

   4. Configure interface `xe2` with an IP address (`192.168.10.1/24`) and enable LDP:

   ```
   PE1(config)#interface xe2
   PE1(config-if)#load-interval 30
   PE1(config-if)#ip address 192.168.10.1/24
   PE1(config-if)#label-switching
   PE1(config-if)#enable-ldp ipv4
   PE1(config-if)#commit
   PE1(config-if)#exit
   ```

   5. Configure OSPF routing, specify the OSPF router ID as (`1.1.1.1`), enable BFD on all interfaces, define the network (`1.1.1.1/32`) in area (`0.0.0.0`), and define the network (`192.168.10.0/24`) in area (`0.0.0.0`):

   ```
   PE1(config)#router ospf 1
   PE1(config-router)#ospf router-id 1.1.1.1
   PE1(config-router)#bfd all-interfaces
   PE1(config-router)#network 1.1.1.1/32 area 0.0.0.0
   PE1(config-router)#network 192.168.10.0/24 area 0.0.0.0
   PE1(config-router)#commit
   PE1(config-router)#exit
   ```

   6. Enable EVPN MPLS globally and configure VTEP IP:

   ```
   PE1(config)# evpn mpls enable
   PE1(config)# commit
   PE1(config)# evpn mpls vtep-ip-global 1.1.1.1
   PE1(config)# commit
   ```

   7. Configure BGP with the remote PE devices and activate EVPN:

   ```
   PE1(config)# router bgp 100
   PE1(config-router)# neighbor 4.4.4.4 remote-as 100
   PE1(config-router)# neighbor 4.4.4.4 update-source lo
   PE1(config-router)# address-family l2vpn evpn
   PE1(config-router-af)# neighbor 4.4.4.4 activate
   PE1(config-router-af)# exit
   PE1(config-router)# exit
   PE1(config)# commit
   ```

8. Configure MAC VRF with the appropriate RD and RT:

```
PE1(config)# mac vrf vrf2
PE1(config-vrf)# rd 1.1.1.1:2
PE1(config-vrf)# route-target both 2:2
PE1(config-vrf)# exit
```

9. Map the EVPN instance and VRF, specifying the EVPN ID:

```
PE1(config)#evpn mpls id 101
PE1(config-evpn-mpls)# host-reachability-protocol evpn-bgp vrf2
PE1(config-evpn-mpls)#commit
PE1(config-evpn-mpls)# commit
PE1(config-router-af)# exit
```

10. Configure access ports on PE1:

```
PE1(config)# interface xe1.2001 switchport
PE1(config-if)# encapsulation dot1q 2028
PE1(config-if)# access-if-evpn
PE1(config-acc-if-evpn)# map vpn-id 101
PE1(config-acc-if-evpn)# commit
```

11. Configure CFM MEP on PE1, define the FCM domain (`12346)`, create MA, configure MEP, and configure Remote MEP Auto-discovery,set CC Interval `10ms`:

```
PE1(config)# ethernet cfm domain-type character-string domain-name12346
level 7 mip-creation default
PE1(config-ether-cfm)# service ma-type string ma-name 124
PE1(config-ether-cfm-ma)# ethernet cfm mep up mpid 20 active true
xe1.2001 vlan 2028
PE1(config-ether-cfm-ma-mep)# cc multicast state enable
PE1(config-ether-cfm-ma-mep)# exit-ether-ma-mep-mode
PE1(config-ether-cfm-ma)# rmep auto-discovery enable
PE1(config-ether-cfm-ma)# cc interval 10ms
PE1(config-ether-cfm-ma)# exit-ether-ma-mode
PE1(config-ether-cfm)# commit
```

12. Provide CFM configuration, define a delay measurement profile named DM, set the measurement interval to 1 second, specify the number of intervals stored as 2, configure the message period as 1 second, set the measurement type to LMM, set the measurement interval to 1 second, specify the number of intervals stored as 3, define a service level measurement profile named SLM, set the measurement type to SLM:

```
PE1(config)# ethernet cfm delay-measurement profile-name DM
PE1(config-cfm-dm)# measurement-interval 1
PE1(config-cfm-dm)# intervals-stored 2
PE1(config-cfm-dm)# message-period 1s
PE1(config-cfm-dm)# commit

PE1(config)# ethernet cfm loss-measurement profile-name SLM
PE1(config-cfm-lm)# measurement-type slm
PE1(config-cfm-lm)# measurement-interval 1
PE1(config-cfm-lm)# intervals-stored 3
PE1(config-cfm-lm)# message-period 1s
PE1(config-cfm-lm)# commit
```

Configuration Snapshot:

CE1:

```
interface xe1
switchport
load-interval 30
```

```
!
interface xe1.2001 switchport
encapsulation dot1q 2028
!

interface xe11.2001 switchport
encapsulation dot1q 2028
!
cross-connect test100
interface xe1.2001
interface xe11.2001
```

CE2:

```
interface xe1
switchport
load-interval 30
!
interface xe1.2001 switchport
encapsulation dot1q 2028
!
interface xe12.2001 switchport
encapsulation dot1q 2028
!
cross-connect test100
interface xe1.2001
interface xe12.2001
```

PE1:

```
interface lo
 ip address 1.1.1.1/32 secondary
!
router ldp
 targeted-peer ipv4 4.4.4.4
  exit-targeted-peer-mode
 targeted-peer ipv4 5.5.5.5
  exit-targeted-peer-mode
transport-address ipv4 1.1.1.1
!
interface xe2
 load-interval 30
 ip address 192.168.10.1/24
 label-switching
 enable-ldp ipv4
!
router ospf 1
 ospf router-id 1.1.1.1
 bfd all-interfaces
 network 1.1.1.1/32 area 0.0.0.0
 network 192.168.10.0/24 area 0.0.0.0
!
evpn mpls enable
evpn mpls vtep-ip-global 1.1.1.1
!
router bgp 100
 neighbor 4.4.4.4 remote-as 100
 neighbor 4.4.4.4 update-source lo
```

```
 neighbor 5.5.5.5 remote-as 100
 neighbor 5.5.5.5 update-source lo
 address-family l2vpn evpn
 neighbor 4.4.4.4 activate
 neighbor 5.5.5.5 activate
exit
!
mac vrf vrf2
 rd 1.1.1.1:2
 route-target both 2:2
!
evpn mpls id 101
 host-reachability-protocol evpn-bgp vrf2
!
interface xe1
 switchport
 load-interval 30
!
interface xe1.2001 switchport
 encapsulation dot1q 2028
 access-if-evpn
 map vpn-id 101
!
ethernet cfm domain-type character-string domain-name 12346 level 7
mipcreation none
 service ma-type string ma-name 124
 ethernet cfm mep up mpid 20 active true xe1.2001 vlan 2028
 cc multicast state enable
 exit-ether-ma-mep-mode
 rmep auto-discovery enable
 cc interval 10ms
 exit-ether-ma-mode
!
ethernet cfm loss-measurement profile-name SLM
 measurement-type slm
 measurement-interval 1
 intervals-stored 3
 message-period 1s
!
ethernet cfm delay-measurement profile-name DM
 measurement-interval 1
 intervals-stored 2
 message-period 1s
```

PE2:

```
interface lo
 ip address 4.4.4.4/32 secondary
!
router ldp
 targeted-peer ipv4 1.1.1.1
exit-targeted-peer-mode
targeted-peer ipv4 5.5.5.5
exit-targeted-peer-mode
transport-address ipv4 4.4.4.4
!
interface xe2
 load-interval 30
```

```
 ip address 192.168.30.2/24
 label-switching
 enable-ldp ipv4
!
router ospf 1
 ospf router-id 4.4.4.4
 bfd all-interfaces
 network 4.4.4.4/32 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0
!
evpn mpls enable
evpn mpls vtep-ip-global 4.4.4.4
!
router bgp 100
 neighbor 1.1.1.1 remote-as 100
 neighbor 1.1.1.1 update-source lo
 neighbor 5.5.5.5 remote-as 100
 neighbor 5.5.5.5 update-source lo
 address-family l2vpn evpn
 neighbor 1.1.1.1 activate
 neighbor 5.5.5.5 activate
exit
!
mac vrf vrf2
 rd 4.4.4.4:2
 route-target both 2:2
!
evpn mpls id 101
 host-reachability-protocol evpn-bgp vrf2
!
interface xe1
 switchport
 load-interval 30
!
interface xe1.2001 switchport
 encapsulation dot1q 2028
 access-if-evpn
 map vpn-id 101
!
ethernet cfm domain-type character-string domain-name 12346 level 7
mipcreation none
 service ma-type string ma-name 124
 ethernet cfm mep up mpid 10 active true xe1.2001 vlan 2028
 cc multicast state enable
 ethernet cfm loss-measurement reply slm
 ethernet cfm delay-measurement reply dmm
 exit-ether-ma-mep-mode
 rmep auto-discovery enable
 cc interval 10ms
 exit-ether-ma-mode
!
```

PE3:

```
interface lo
 ip address 5.5.5.5/32 secondary
!
router ldp
```

```
 targeted-peer ipv4 1.1.1.1
exit-targeted-peer-mode
targeted-peer ipv4 4.4.4.4
exit-targeted-peer-mode
transport-address ipv4 5.5.5.5
!
interface xe3
 load-interval 30
 ip address 192.168.40.2/24
 label-switching
 enable-ldp ipv4
!
router ospf 1
 ospf router-id
 bfd all-interfaces
 network 5.5.5.5/32 area 0.0.0.0
 network 192.168.40.0/24 area 0.0.0.0
!
evpn mpls enable
evpn mpls vtep-ip-global 5.5.5.5
!
router bgp 100
 neighbor 1.1.1.1 remote-as 100
 neighbor 1.1.1.1 update-source lo
 neighbor 4.4.4.4 remote-as 100
 neighbor 4.4.4.4 update-source lo
 address-family l2vpn evpn
 neighbor 1.1.1.1 activate
 neighbor 4.4.4.4 activate
exit
!
mac vrf vrf2
 rd 5.5.5.5:2
 route-target both 2:2
!
evpn mpls id 101
 host-reachability-protocol evpn-bgp vrf2
!
interface xe1
 switchport
 load-interval 30
!
interface xe1.2001 switchport
 encapsulation dot1q 2028
 access-if-evpn
  map vpn-id 101
!
ethernet cfm domain-type character-string domain-name 12346 level 7
mipcreation none
 service ma-type string ma-name 124
 ethernet cfm mep up mpid 30 active true xe1.2001 vlan 2028
 cc multicast state enable
  ethernet cfm loss-measurement reply slm
 ethernet cfm delay-measurement reply dmm
 exit-ether-ma-mep-mode
 rmep auto-discovery enable
 cc interval 10ms
```

```
 exit-ether-ma-mode
!
```

P1:

```
interface lo
 ip address 2.2.2.2/32 secondary

router ldp
 transport-address ipv4 2.2.2.2

interface xe2
 ip address 192.168.10.2/24
 label-switching
 enable-ldp ipv4

interface xe1
 ip address 192.168.20.1/24
 label-switching
 enable-ldp ipv4

router ospf 1
 ospf router-id 2.2.2.2
 bfd all-interfaces
 network 2.2.2.2/32 area 0.0.0.0
 network 192.168.10.0/24 area 0.0.0.0
 network 192.168.20.0/24 area 0.0.0.0
```

P2:

```
interface lo
 ip address 3.3.3.3/32 secondary

router ldp
 transport-address ipv4 3.3.3.3

interface xe1
 ip address 192.168.20.2/24
 label-switching
 enable-ldp ipv4

interface xe2
 ip address 192.168.30.1/24
 label-switching
 enable-ldp ipv4

router ospf 1
 ospf router-id 3.3.3.3
 bfd all-interfaces
 network 3.3.3.3/32 area 0.0.0.0
 network 192.168.20.0/24 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0
```

CE3:

```
interface xe1
switchport
```

```
 load-interval 30
!
interface xe1.2001 switchport
 encapsulation dot1q 2028
!
interface xe13.2001 switchport
 encapsulation dot1q 2028
!
cross-connect test100
 interface xe1.2001
 interface xe13.2001
```

Validation

Verify the EVPN MPLS status.

```
PE1#show evpn mpls
EVPN-MPLS Information
=====================
   Codes: NW - Network Port
          AC - Access Port
         (u) - Untagged

VPN-ID   EVI-Name     EVI-Type Type Interface ESI                          VLAN      DF-
Status Src-Addr         Dst-Addr
________________________________________________________________________________________
________________________________________
101      ----         L2       NW   ----      ----                          ----      -
---      1.1.1.1          4.4.4.4
101      ----         L2       NW   ----      ----                          ----      -
---      1.1.1.1          5.5.5.5
101      ----         --       AC   xe1.2001  --- Single Homed Port ---     ----      -
---      ----             ----
Total number of entries are 4
```

Verify the RMEP is learned or not:

```
PE1#show ethernet cfm maintenance-points remote domain 12346
 MA_NAME MEPID RMEPID LEVEL Rx CCM RDI PEER-MAC TYPE
--------------------------------------------------------------------------------
 124 20 10 7 Yes False e8c5.7ae3.37ee Learnt
 124 20 30 7 Yes False e8c5.7ae3.38ee Learnt
```

Verify the Ping:

```
PE1#ping ethernet mac e8c5.7ae3.37ee unicast source 20 domain 12346 ma 124
 success rate is 100 (5/5)

PE1#ping ethernet mac e8c5.7ae3.38ee unicast source 20 domain 12346 ma 124
 success rate is 100 (5/5))
```

Verify the Traceroute:

```
PE1#traceroute ethernet e8c5.7ae3.37ee mepid 20 domain 12346 ma 124
```

```
 MP Mac Hops Relay-action Ingress/Egress Ingress/Egress action
e8c5.7ae3.37ee 1 RlyHit Ingress IngOK

PE1#traceroute ethernet e8c5.7ae3.38ee mepid 20 domain 12346 ma 124
 MP Mac Hops Relay-action Ingress/Egress Ingress/Egress action
e8c5.7ae3.38ee 1 RlyHit Ingress IngOK
```

Verify the Delay-measurement:

```
PE1#delay-measurement type proactive profile-name DM rmep 10 mep 20 domain 12346 ma 124
PE1#2024 Apr 10 13:35:37.236 : PE1: ONMD : INFO : [CFM_PM_SESSION_INFO_5]: CFM Frame
Delay Measurement session started for MEP Id 20 and RMEP Id 10
PE2-7033#show ethernet cfm delay-measurement mep 20 domain 12346 ma-name 124
MD : 12346
MA : 124
MEP : 20
VLAN ID : 10
Interface : po1000.10
Peer MAC Address : 00cc.dd00.0000
CURRENT:
======================
RMEP ID : 10
Measurement ID : 1
Measurement Type : DMM
Elapsed time(sec) : 53
Start Time : 2024 Apr 10 13:35:37
Suspect Flag : FALSE
Min Frame Delay(usec) : 19
Max Frame Delay(usec) : 20
Avg Frame Delay(usec) : 19
Min Inter FD Variation(usec): 0
Max Inter FD Variation(usec): 1
Avg Inter FD Variation(usec): 0
FRAME DELAY BINS
Bin Number       Bin Threshold(usec)        Bin Counter
========================================================
1               0 - < 4999                    52
2               5000 - < 9999                 0
3               10000 - < 4294967295          0
INTER-FRAME DELAY BINS
Bin Number       Bin Threshold(usec)       Bin Counter
========================================================
1                 0 - < 4999                  51
2                 5000 - < 4294967295         0
```

Verify the Synthetic Loss Measurement:

```
PE1#loss-measurement type proactive profile-name SLM rmep 10 mep 20 domain 12346 ma 124
PE1#2024 Apr 10 13:40:15.587 : PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame Loss
Measurement  started for MEP:20 MA:124 MD:12346
PE1#show ethernet cfm loss-measurement mep 20 domain 12346 ma-name 124
MEP: 20 MA: 124
```

```
CURRENT:
 Measurement ID : 2
  Suspect                      : False
  Measurement Type             : slm
  Elapsed time(sec)            : 17
  Start Time                   : 2024 Apr 10 13:41:15
  Near End loss                : 0
  Far End loss                 : 0
  Near End accumulated loss    : 0
  Far End accumulated loss     : 0
  Near End frame loss ratio    : 0
  Far End frame loss ratio     : 0
HISTORY:
 Measurement ID : 1
  Suspect                      : False
  Measurement Type             : slm
  Elapsed time(sec)            : 60
  End Time                     : 2024 Apr 10 13:41:15
  Near End loss                : 0
  Far End loss                 : 0
  Near End accumulated loss    : 0
  Far End accumulated loss     : 0
  Near End frame loss ratio    : 0
  Far End frame loss ratio     : 0
  Near End frame loss ratio min  : 0
  Far End frame loss ratio min  : 0
  Near End frame loss ratio max  : 0
  Far End frame loss ratio max  : 0
```

Implementation Examples

Enterprise Connectivity Monitoring:

Scenario: A large enterprise operates multiple branch offices connected via Ethernet services provided by a service provider network.

Use Case: Y.1731 CFM over sub-interface using Single Home EVPN ELAN enables the enterprise to monitor theconnectivity and performance of its branch office connections. It facilitates proactive fault detection and management, ensuring reliable and uninterrupted communication between the headquarters and branch offices.

Service Provider Network Operations:

Scenario: A service provider manages a diverse range of Ethernet services for its enterprise customers, including VPNs, Internet access, and cloud connectivity.

Use Case: Y.1731 CFM over sub-interface using Single Home EVPN ELAN empowers the service provider to deliverhigh-quality Ethernet services with enhanced fault management capabilities. It enables the provider to quickly identify and resolve connectivity issues, minimize service downtime, and maintain customer satisfaction.

Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

Key Terms/Acronym	**Description**
Y.1731	A standard defined by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) that specifies performance monitoring and fault management for Ethernet-based networks.
Sub-interface	A logical division of a physical interface, typically used to separate traffic based on VLANs or other criteria. In this context, sub-interfaces are employed to establish distinct connections within the EVPN ELAN SH topology.
EVPN	Ethernet Virtual Private Network (VPN) is a technology that enables the creation of virtual private networks over an Ethernet-based infrastructure. It provides multi-tenancy and allows for the segmentation of traffic in service provider networks.
ELAN	ELAN is a type of EVPN service that provides point-to-multi point Ethernet connectivity between two sites.
Single Home (SH)	Refers to the configuration where a Customer Edge device (CE) is connected to only one Provider Edge device (PE) within an EVPN setup. It contrasts with the multi-homed configuration, where a CE may be connected to multiple PEs.
Maintenance End Point (MEP)	MEP is a CFM entity that resides at the edge of a CFM domain. It is responsible for generating and transmitting CFM protocol packets to detect faults and collect performance data.
Maintenance Domain (MD)	MD is a logical grouping of MEPs within a CFM network. MEPs within the same MD can communicate with each other to perform CFM functions such as fault detection and performance monitoring.
Maintenance Association(MA)	MA is a collection of MEPs associated with a specific service or set of services. It defines the scope of CFM operations within a maintenance domain.
Maintenance Point Identifier (MPID)	MPID is a unique identifier assigned to each MEP within a maintenance association. It is used to distinguish between different MEPs within the same MA.
Service Level Measurement (SLM)	SLM is a CFM function used to measure the loss characteristics of a network path. It collects data on packet loss, delay, and jitter to assess the quality of service provided by the network.
Loopback Message Generation (LMM)	LMM is a CFM function used to test end-to-end connectivity by generating loopback messages. These messages are transmitted from a MEP and looped back to the same MEP to verify bidirectional communication.
Delay Measurement Message (DMM)	DMM is a CFM function used to measure the one-way delay of packets transmitted across a network. It helps assess the performance of the network in terms of packet delivery time.
Continuity Check (CC)	CC is a CFM function used to verify the continuity of a service or network path by periodically sending continuity check messages between MEPs. It helps detect connectivity faults such as link failures or misconfigurations.

CHAPTER 9 Y.1731 and CFM Over EVPN-ELAN Multi-home

Overview

The Multi Home EVPN ELAN Y.1731 CFM over Sub-interface feature enables the monitoring and management of Ethernet Virtual Private Network (EVPN) Ethernet-LAN services using the Y.1731 Connectivity Fault Management (CFM) protocol over sub-interfaces. This feature enhances fault detection and performance monitoring capabilities for EVPN E-LAN services, allowing network operators to ensure high availability and reliability of their networks. By extending Y.1731 CFM functionality to sub-interfaces in single home EVPN E-LAN deployments, this feature provides comprehensive end-to-end visibility and control, enabling proactive fault detection, isolation, and troubleshooting.

CFM multi-homing allows Customer Edge (CE) device to connect more than one Provider Edge (PE) device. Multi-homing ensures redundant connectivity. The redundant PE device ensures that there is no traffic disruption when there is a network failure.

Feature Characteristics

- Utilizes sub-interfaces to partition Ethernet traffic within the Multi Home EVPN ELAN architecture, enabling efficient service delivery and management.
- Implements EVPN ELAN architecture with single-homing capabilities, facilitating the creation of Ethernet Virtual Private Networks with simplified configurations and reduced complexity.
- Provides robust fault detection mechanisms to identify connectivity issues, link failures, and service disruptions in Ethernet networks.

Benefits

- Provides detailed insights into Ethernet service performance, enabling proactive monitoring and optimization of network resources.
- Minimizes service downtime by promptly detecting and resolving faults, ensuring uninterrupted service delivery and customer satisfaction.
- Optimizes network resource utilization and bandwidth allocation by identifying and addressing connectivity issues in a timely manner.
- Facilitates rapid fault identification and isolation, accelerating troubleshooting processes and reducing mean time to repair (MTTR).

Ensures compliance with Service Level Agreements (SLAs) by maintaining service quality metrics within defined thresholds and objectives.

Configuration

Configure Multi Home EVPN ELAN Y.1731 CFM over Sub-interface for enhanced fault management in EVPN networks.

Topology

The following topology consists of Customer Edge routers CE1 and CE2 with IPv2 Provider Edge routers PE1, PE2, and PE3. These are interconnected through the core router P in the IPv4 MPLS provider networks.

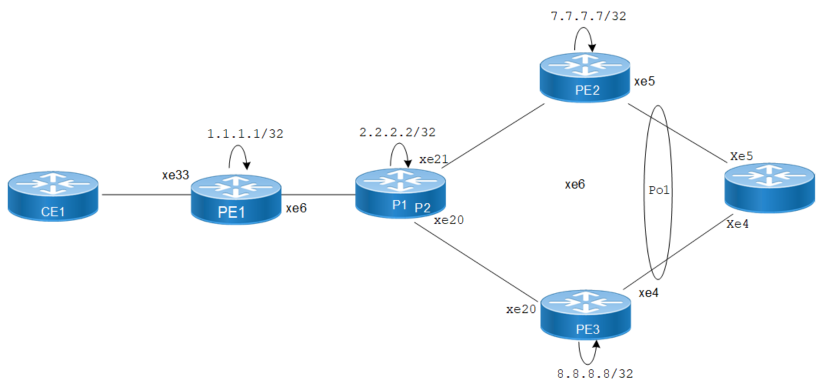


Figure 9-18: EVPN ELAN Over CFM Sub-interface

The following sessions displays the detailed information about configurations, and validations for CFM over sub-interface.

1. Configure Loopback Interface for router identification and BGP peering.

   1. Enter global configuration mode, create the loopback interface.

      ```
      PE1#configure terminal
      PE1#interface lo
      ```

   2. Assign an IP address to the loopback interface, exit interface configuration mode, and commit the changes.

      ```
      PE1(config)# interface lo
      PE1(config-if)# ip address 1.1.1.1/32
      PE1(config-if)# exit
      PE1(config)# commit
      ```

2. Configure Global LDP for distributing MPLS labels in the network.

   1. Enter LDP configuration mode.

   2. Set Router ID and configure targeted peers.

      ```
      PE1(config)# router ldp
      PE1(config-router)# router-id 1.1.1.1
      PE1(config-router)# targeted-peer ipv4 7.7.7.7
      PE1(config-router)# targeted-peer ipv4 8.8.8.8
      PE1(config-router-targeted-peer)#exit
      PE1(config-router)# exit
      PE1(config)# commit
      ```

3. Enable EVPN over MPLS and set a global VTEP IP.

   ```
   PE1(config)# evpn mpls enable
   PE1(config)# commit
   PE1(config)# evpn mpls vtep-ip-global 1.1.1.1
   PE1(config)# commit
   ```

4. Configure the interfaces connecting to the network, enabling LDP and MPLS label switching.

   ```
   PE1(config)# interface xe33
   PE1(config-if)# ip address 10.1.0.1/16
   PE1(config-if)# enable-ldp ipv4
   PE1(config-if)# label-switching
   PE1(config-if)# exit
   ```

```
PE1(config)# commit
```

5. Set up OSPF for IP routing within the network.

```
PE1(config)# router ospf 1
PE1(config-router)# ospf router-id 1.1.1.1
PE1(config-router)# network 1.1.1.1/32 area 0.0.0.0
PE1(config-router)# network 10.1.0.0/16 area 0.0.0.0
PE1(config-router)# exit
PE1(config)# commit
```

6. Set up BGP for EVPN to exchange MAC and IP information.

```
PE1(config)# router bgp 1
PE1(config-router)# neighbor 7.7.7.7 remote-as 1
PE1(config-router)# neighbor 7.7.7.7 update-source lo
PE1(config-router)# neighbor 8.8.8.8 remote-as 1
PE1(config-router)# neighbor 8.8.8.8 update-source lo
PE1(config-router)# address-family l2vpn evpn
PE1(config-router-af)# neighbor 7.7.7.7 activate
PE1(config-router-af)# neighbor 8.8.8.8 activate
PE1(config-router-af)# exit
PE1(config-router)# exit
PE1(config)# commit
```

7. Configure MAC VRF.

```
PE1(config)# mac vrf vrf2
PE1(config-vrf)# rd 1.1.1.1:2
PE1(config-vrf)# route-target both 2:2
PE1(config-vrf)# exit
PE1(config)# commit
```

8. Configure EVPN and map VRF.

```
PE1(config)# evpn mpls id 101
PE1(config-evpn-mpls)# host-reachability-protocol evpn-bgp vrf2
PE1(config)# exit
PE1(config)# commit
```

9. Configure access port on interface xe33.

```
PE1(config)# interface xe33
PE1(config-if)# interface xe33.2 switchport
PE1(config-if)# description access-side-int
PE1(config-if)# encapsulation dot1q 2
PE1(config-if)# access-if-evpn
PE1(config-access-if)# map vpn-id 101
PE1(config-access-if)# exit
PE1(config)# commit
```

10. Configure Y1731 SLM and DM profile.

```
PE1(config)#ethernet cfm loss-measurement profile-name SLM
PE1(config-cfm-lm)# measurement-type slm
PE1(config-cfm-lm)# measurement-interval 1
PE1(config-cfm-lm)# intervals-stored 3
PE1(config-cfm-lm)# message-period 1s
PE1(config-cfm-lm)# exit
PE1(config)# commit
PE1(config-cfm-lm)#ethernet cfm delay-measurement profile-name DM
PE1(config-cfm-dm)# measurement-interval 1
PE1(config-cfm-dm)# intervals-stored 2
PE1(config-cfm-dm)# message-period 1s
```

```
PE1(config-cfm-dm)#exit
PE1(config)# commit
```

Note: Similarly follow the same steps to configure respective cfm mep up and other CFM features for PE2 and PE3.

Configuration Snapshot:

PE1:

```
!
interface lo
 ip address 1.1.1.1/32
!
router ldp
 router-id 1.1.1.1
 targeted-peer 7.7.7.7
 targeted-peer 8.8.8.8
!
router ospf 1
 router-id 1.1.1.1
 network  1.1.1.1/32 area 0
 network  10.1.0.0/16 area 0
!
router bgp 1
 bgp log-neighbor-changes
 neighbor 7.7.7.7 remote-as 1
 neighbor 7.7.7.7 update-source lo
 neighbor 8.8.8.8 remote-as 1
 neighbor 8.8.8.8 update-source lo
 !
 address-family l2vpn evpn
  neighbor 7.7.7.7 activate
  neighbor 8.8.8.8 activate
 exit-address-family
!
evpn mpls enable
evpn mpls vtep-ip-global 1.1.1.1
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable
!
evpn mpls id 101
 host-reachability-protocol evpn-bgp vrf2

interface xe33
 ip address 10.1.0.1/16
enable-ldp ipv4
label-switching
!
vrf definition vrf2
 rd 1.1.1.1:2
 route-target both 2:2
!
evpn mpls id 52 xconnect target-mpls-id 2
 host-reachability-protocol evpn-bgp vrf2
!
interface xe33.2
 description access-side-int
 encapsulation dot1q 2
```

```
 access-if-evpn
  map vpn-id 101
!
ethernet cfm domain-type character-string domain-name 12346 level 7 mip-
creation none
 service ma-type string ma-name 124
  ethernet cfm mep up mpid 10 active true xe33.2 vlan 2
   cc multicast state enable
   exit-ether-ma- mode
   mep auto-discovery enable
   cc interval 10ms
   exit-ether-ma- mode
!
```

P:

```
!
interface lo
 ip address 2.2.2.2/32
!
interface xe6
 ip address 10.1.0.2/16
 mpls ip
!
interface xe21
 ip address 123.1.1.1/24
 enable-ldp ipv4
label-switching
!
interface xe20
 ip address 124.1.1.1/24
 enable-ldp ipv4
label-switching
!
router ldp
 router-id 2.2.2.2
!
router ospf 1
 router-id 2.2.2.2
 network 2.2.2.2/32 area 0
 network 10.1.0.0/16 area 0
 network 123.1.1.0/24 area 0
 network 124.1.1.0/24 area 0
!
```

PE2:

```
!
interface lo
 ip address 7.7.7.7/32
!
interface xe21
 ip address 123.1.1.2
 enable-ldp ipv4
label-switching
!
router ldp
 router-id 7.7.7.7/32
 targeted-peer ipv4 1.1.1.1
```



```
 targeted-peer ipv4 8.8.8.8
!
router ospf 1
 router-id 7.7.7.7
 network  7.7.7.7/32 area 0
 network 123.1.1.0/24 area 0
!
router bgp 1
 bgp log-neighbor-changes
 neighbor 1.1.1.1 remote-as 1
 neighbor 1.1.1.1 update-source lo
 neighbor 8.8.8.8 remote-as 1
 neighbor 8.8.8.8 update-source lo
 address-family l2vpn evpn
  neighbor 1.1.1.1 activate
  neighbor 8.8.8.8 activate
 exit-address-family
!
evpn mpls enable
evpn mpls vtep-ip-global 7.7.7.7
hardware-profile filter evpn-mpls-mh enable
evpn mpls multihoming enable
!
vrf definition vrf2
 rd 7.7.7.7:2
 route-target both 2:2
!
evpn mpls id 101
 host-reachability-protocol evpn-bgp vrf2
!
interface Po1
load-interval 30
evpn multi-homed system-mac 0000.aaaa.bbbc
!
interface Po1.2
switchport
encapsulation dot1q 2
access-if-evpn
map vpn-id 101
!
interface xe5
 channel-group 1 mode active
!
ethernet cfm domain-type character-string domain-name 12346 level 7 mip-
creation none
 service ma-type string ma-name 124
  ethernet cfm mep up mpid 20 active true po1.2 vlan 2
   cc multicast state enable
   exit-ether-ma- mode
   mep auto-discovery enable
   cc interval 10ms
   exit-ether-ma- mode
!
```

PE3:

```
!
interface lo
```

```
 ip address 8.8.8.8/32
!
interface xe5
 ip address 124.1.1.2/24
 enable-ldp ipv4
label-switching
!
interface xe4
 channel-group 1 mode active
!
router ldp
 router-id 8.8.8.8
 targeted-peer ipv4 1.1.1.1
 targeted-peer ipv4 7.7.7.7
!
router ospf 1
 router-id 8.8.8.8
 network  8.8.8.8/32 area 0
 network network 124.1.1.0/24 area 0
!
router bgp 1
 bgp log-neighbor-changes
 neighbor 1.1.1.1 remote-as 1
 neighbor 1.1.1.1 update-source lo
 neighbor 7.7.7.7 remote-as 1
 neighbor 7.7.7.7 update-source lo
 address-family l2vpn evpn
  neighbor 1.1.1.1 activate
  neighbor 7.7.7.7 activate
 exit-address-family
!
evpn mpls enable
evpn mpls vtep-ip-global 8.8.8.8
hardware-profile filter evpn-mpls-mh enable
evpn mpls multihoming enable
!
vrf definition vrf2
 rd 8.8.8.8:2
 route-target both 2:2

evpn mpls id 101
 host-reachability-protocol evpn-bgp vrf2
!
interface Po1
load-interval 30
evpn multi-homed system-mac 0000.aaaa.bbbc
!
interface Po1.2
switchport
encapsulation dot1q 2
access-if-evpn
map vpn-id 101
!
ethernet cfm domain-type character-string domain-name 12346 level 7 mip-
creation none
 service ma-type string ma-name 124
  ethernet cfm mep up mpid 30 active true po1.2 vlan 2
```

```
        cc multicast state enable
        exit-ether-ma- mode
        mep auto-discovery enable
        cc interval 10ms
        exit-ether-ma- mode
    !
```

Validation

The following are the validations for PE1.

PE1

The following validation is for PE1.

```
PE1#show ethernet cfm errors
domain
12346
Domain Name         Level        MEPID        Defects
12346                  7         20              .....

PE1-7011#show ethernet cfm maintenance-points remote domain 12346 ma-name 124
MEPID         RMEPID   LEVEL   Rx CCM  RDI   PEER-MAC        TYPE
10              20     7      Yes   False 00aa.bb00.0002  Learnt
10              30     7     Yes  False   00aa.dd00.0003  Learnt


PE1-7011#show ethernet cfm maintenance-points local mep domain 12346 ma-name 124 MPID
Dir Lvl CC-Stat HW-Status CC-Intvl MAC-AddressDef Port MD Name

10  Up 7Enable Installed 100 ms3417.ebe4.af22 Fxe33.2 12346

PE1-7011#ping ethernet mac 00aa.bb00.0002 unicast source 10 domain 12346 ma 124 success
rate is 100 (5/5)


PE1-7011#traceroute ethernet 00aa.bb00.0002 mepid 10 domain 12346 ma 124
MP MacHops Relay-actionIngress/Egress Ingress/Egress action 00aa.bb00.00021RlyHit
IngressIngOK

PE1-7011#ping ethernet mac 00aa.dd00.0003 unicast source 10 domain 12346 ma 124 success
rate is 100 (5/5)
PE1-7011#traceroute ethernet 00aa.dd00.0003 mepid 10 domain 12346 ma 124
MP MacHops Relay-actionIngress/Egress Ingress/Egress action 00aa.dd00.00031RlyHit
IngressIngOK
```

Verify Synthetic Loss Measurement

```
PE1#loss-measurement type proactive profile-name SLM rmep 10 mep 20 domain 12346 ma 124
PE1#2023 Sep 30 07:07:57.166 : PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame Loss
Measurement started for MEP:20 MA:124 MD:12346
PE1#show ethernet cfm loss-measurement mep 20 domain 12346 ma-name 124
```

```
MEP: 20 MA: 124
CURRENT:
 Measurement ID : 2
 Suspect : False
 Measurement Type : slm
 Elapsed time(sec) : 10
 Start Time : 2023 Sep 30 07:08:56
 Near End loss : 0
 Far End loss : 0
 Near End accumulated loss : 0
 Far End accumulated loss : 0
 Near End frame loss ratio : 0
 Far End frame loss ratio : 0
HISTORY:
 Measurement ID : 1
 Suspect : False
 Measurement Type : slm
 Elapsed time(sec) : 60
 End Time : 2023 Sep 30 07:08:56
 Near End loss : 0
 Far End loss : 0
 Near End accumulated loss : 0
 Far End accumulated loss : 0
 Near End frame loss ratio : 0
 Far End frame loss ratio : 0
 Near End frame loss ratio min : 0
 Far End frame loss ratio min : 0
 Near End frame loss ratio max : 0
 Far End frame loss ratio max : 0
```

Verify Delay-measurement

```
PE1#delay-measurement type proactive profile-name DM rmep 10 mep 20 domain 12346 ma 124
PE1#2023 Oct 12 04:11:56.696 : PE1 : ONMD : INFO : [CFM_PM_SESSION_INFO_5]: CFM Frame
Delay Measurement session started for MEP Id 20 and RMEP Id 10
PE1#show ethernet cfm delay-measurement mep 20 domain 12346 ma-name 124
 MD : 12346
 MA : 124
 MEP : 20
 VC Name : test3
 Peer MAC Address : e8c5.7ae3.37ee
CURRENT:
 RMEP ID : 10
 Measurement ID : 1
 Measurement Type : DMM
 Elapsed time(sec) : 2
 Start Time : 2023 Oct 12 04:11:56
 Suspect Flag : FALSE
 Min Frame Delay(usec) : 40
 Max Frame Delay(usec) : 74
 Avg Frame Delay(usec) : 57
```

```
 Min Inter FD Variation(usec): 34
 Max Inter FD Variation(usec): 34
 Avg Inter FD Variation(usec): 34
 FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
 1 0 - < 4999 2
 2 5000 - < 9999 0
 3 10000 - < 14999 0
 4 15000 - < 4294967295 0
 INTER-FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
 1 0 - < 4999 1
 2 5000 - < 9999 0
 3 10000 - < 4294967295 0
```

PE2/PE3

The following validations for PE2 and PE3.

```
The following validations for PE2 and PE3.

PE2#show evpn mpls
EVPN-MPLS Information
=================
   Codes: NW - Network Port
          AC - Access Port
         (u) - Untagged

VPN-ID   EVI-Name     EVI-Type Type Interface ESI                          VLAN      DF-
Status Src-Addr         Dst-Addr
________________________________________________________________________________________
________________________________________
101      ----         L2       NW   ----      ----                          ----      -
---      7.7.7.7          1.1.1.1
101      ----         L2       NW   ----      ----                          ----      -
---      7.7.7.7          8.8.8.8
101      ----         --       AC   po1.2 00:00:00:aa:aa:bb:bb:00:00:00  ----    DF
----             ----


Total number of entries are 4

Note: Refer sub-interface config for VLAN information.

PE3#

PE2#sh evpn mpls
EVPN-MPLS Information
=================
   Codes: NW - Network Port
          AC - Access Port
         (u) - Untagged
```

```
VPN-ID   EVI-Name     EVI-Type Type Interface ESI                          VLAN      DF-
Status Src-Addr         Dst-Addr
______________________________________________________________________________________
________________________________________
101      ----         L2       NW   ----      ----                          ----      -
---      8.8.8.8         1.1.1.1
101      ----         L2       NW   ----      ----                          ----      -
---      8.8.8.8         7.7.7.7
101      ----         --       AC   po1.2 00:00:00:aa:aa:bb:bb:00:00:00  ----      NON-
DF        ----            ----


Total number of entries are 4

Note: Refer sub-interface config for VLAN information.
PE3#

PE2#sh ethernet cfm errors domain 12346

Domain NameLevelMEPIDDefects

123467 20  .....
PE2#show ethernet cfm maintenance-points local mep domain 12346 ma-name 124 MPID Dir Lvl
CC-Stat HW-Status CC-Intvl MAC-AddressDef Port MD Name

20  Up 7Enable Installed 100 ms00aa.bb00.0002 Fpo1.2 12346

PE2#show ethernet cfm maintenance-points remote domain 12346 ma-name 124
MEPIDRMEPIDLEVELRx CCMRDIPEER-MACTYPE
20  10  7   Yes False 3417.ebe4.af22 Learnt PE2#ping ethernet mac 3417.ebe4.af22 unicast
source 10 domain 12346 ma 124
success rate is 100 (5/5)
PE2#traceroute ethernet 3417.ebe4.af22 mepid 10 domain 12346 ma 124
MP MacHops Relay-actionIngress/Egress Ingress/Egress action 3417.ebe4.af221RlyHit
IngressIngOK
```

CHAPTER 10 Y.1731 and CFM Over VPLS Sub-Interface

Overview

Y.1731 Connectivity Fault Management (CFM) over Layer 2 Virtual Private LAN Service (VPLS) is a protocol and technology combination used for fault management in Layer 2 VPN networks. It allows for the detection and management of faults, performance monitoring, and fault localization within a VPLS network

Feature Characteristics

- Facilitates end-to-end fault management across the VPLS network, covering provider and customer edges.
- Supports multi-level fault management, allowing operators to define different levels of fault detection and management for different parts of the network.
- Y.1731 CFM includes performance monitoring capabilities, such as delay measurement and frame loss measurement, to monitor service quality parameters.
- The protocol supports loopback and link trace functions to identify and troubleshoot faults within the VPLS network.

Benefits

- Enables rapid detection and localization of faults within the VPLS network, minimizing downtime and service disruptions.
- Provides performance monitoring capabilities, allowing to track key performance indicators and ensure service quality.
- Enhances network visibility by providing detailed fault and performance monitoring data, aiding in network troubleshooting and maintenance.

Prerequisites

Ensure the network devices participating in the L2VPN VPLS setup support Y.1731 CFM functionality. This includes the Provider Edge (PE) and Customer Edge (CE) devices.

Configuration

Configure Y.1731 CFM over sub-interface using L2VPN VPLS by defining the CFM domain, configuring service MEPs and MAs, and setting up cross-connects between primary and backup interfaces.

Topology

The topology consists of three Customer Edge devices (CE1, CE2, and CE3) connected to three Provider Edge devices (PE1, PE2, and PE3) via sub-interfaces (xe1, xe12, and xe13). The Provider Edge devices are interconnected through Provider Devices (P1 and P2). Y.1731 ethernet CFM is configured over these sub-interfaces to monitor and manage ethernet connectivity between the CE devices, ensuring fault detection and performance monitoring across the service provider's network.

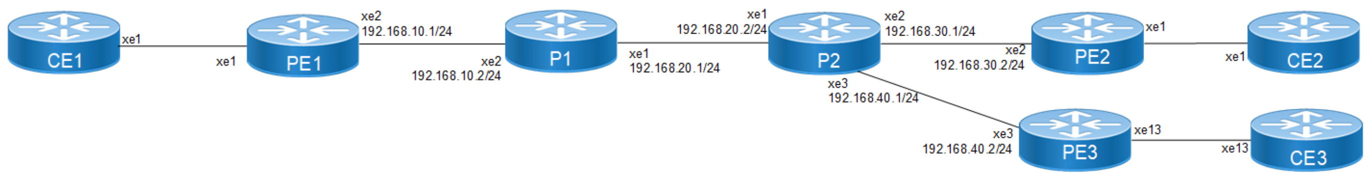


Figure 10-19: L2VPN VPLS Y1731 CFM Over Sub-interface

Perform the following configurations to configure Y.1731 CFM over sub-interface using L2VPN VPLS:

1. On Customer Edge (CE) Nodes (CE1, CE2, and CE3), configure the interface xe1 and set it as a switchport with a load interval of (30 seconds):

```
CE1(config)#interface xe1
CE1(config-if)#switchport
CE1(config-if)#load-interval 30
CE1(config-if)#commit
CE1(config-if)#exit
```

Note: Similarly follow the same steps to configure xe11(CE1), xe12(CE2), and xe13(CE3).

2. Create sub-interface (xe1.2001)adding the VLAN:

```
CE1(config)#interface xe1.2001 switchport
CE1(config-if)#encapsulation dot1q 2028
CE1(config-if)#commit
CE1(config-if)#exit
CE1(config)#interface xe11.2001 switchport
CE1(config-if)#encapsulation dot1q 2028
CE1(config-if)#commit
CE1(config-if)#exit
```

3. Set up a cross-connect named (`test100`), specifying in and out interfaces:

```
CE1(config)#cross-connect test100
CE1(config-xc)#interface xe1.2001
CE1(config-xc)#interface xe11.2001
CE1(config-xc)#commit
```

4. Perform the following on PE1:

   1. Configure CFM related hardware profiles:

   ```
   PE1(config)# hardware-profile filter cfm-domain-name-str enable
   PE1(config)# hardware-profile statistics cfm-lm enable
   PE1(config)# hardware-profile statistics cfm-ccm enable
   PE1(config)#hardware-profile statistics cfm-slm enable
   ```

   2. Configure the loopback interface with a secondary IP address(`1.1.1.1/32`):

   ```
   PE1(config)#interface lo
   PE1(config-if)#ip address 1.1.1.1/32 secondary
   PE1(config-if)#commit
   PE1(config-if)#exit
   ```

   3. Configure LDP targeted peers:

   ```
   PE1(config)#router ldp
   PE1(config-router)#targeted-peer ipv4 4.4.4.4
   PE1(config-router-targeted-peer)#exit-targeted-peer-mode
   PE1(config-router)#targeted-peer ipv4 5.5.5.5
   PE1(config-router-targeted-peer)#exit-targeted-peer-mode
   PE1(config-router)#transport-address ipv4 1.1.1.1
   ```

```
PE1(config-router)#commit
PE1(config-router)exit
```

4. Configure interface `xe2` with an IP address (`192.168.10.1/24)` and enable LDP:

```
PE1(config)#interface xe2
PE1(config-if)#load-interval 30
PE1(config-if)#ip address 192.168.10.1/24
PE1(config-if)#label-switching
PE1(config-if)#enable-ldp ipv4
PE1(config-if)#commit
PE1(config-if)#exit
```

5. Configure OSPF routing, specify the OSPF router ID as (`1.1.1.1)`, enable BFD on all interfaces, define the network (`1.1.1.1/32)` in area (`0.0.0.0)`, and define the network (`192.168.10.0/24)` in area (`0.0.0.0)`:

```
PE1(config)#router ospf 1
PE1(config-router)#ospf router-id 1.1.1.1
PE1(config-router)#bfd all-interfaces
PE1(config-router)#network 1.1.1.1/32 area 0.0.0.0
PE1(config-router)#network 192.168.10.0/24 area 0.0.0.0
PE1(config-router)#commit
PE1(config-router)#exit
```

6. Set up an L2VPN VPLS between PE1, PE2, and PE3.

```
PE1(config)#mpls vpls vpls-301 301
PE1(config-vpls)# signaling ldp
PE1(config-vpls-sig)#  vpls-type vlan
PE1(config-vpls-sig)#  vpls-peer 4.4.4.4
PE1(config-vpls-sig)#  vpls-peer 5.5.5.5
PE1(config-vpls-sig)#  exit-signaling
PE1(config-vpls)# exit-vpls
PE1(config)#commit
PE1(config)#exit
```

7. Configure sub-interface (xe1.2001) as an access interface for VPLS.

```
PE1(config)#interface xe1.2001 switchport
PE1(config-if)#encapsulation dot1q 2028
PE1(config-if)# access-if-vpls
PE1(config-acc-if-vpls)#mpls-vpls vpls-301
PE1(config-acc-if-vpls)#commit
PE1(config-acc-if-vpls)#exit
```

8. Configure Up-mep CFM domain:
   - Set the domain type as a character string with the domain name (12346) and (level 7)
   - Specify the MA type as a string with the MA name (124)
   - Set up a MEP with MEP ID (20) as active on interface (xe1.2001) and Associate the vlan (VLAN 2028)
   - Enable multicast state for continuity check, and auto-discovery of RMEPs
   - Set the continuity check interval to (10 milliseconds)

```
PE1(config)#ethernet cfm domain-type character-string domain-name
12346 level 7 mip-creation none
PE1(config-ether-cfm)# service ma-type string ma-name 124
PE1(config-ether-cfm-ma)#ethernet cfm mep up mpid 20 active true
xe1.2001 vlan 2028
PE1(config-ether-cfm-ma-mep)#cc multicast state enable
PE1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode
```

```
PE1(config-ether-cfm-ma)#rmep auto-discovery enable
PE1(config-ether-cfm-ma)#cc interval 10ms
PE1(config-ether-cfm-ma)#exit-ether-ma-mode
PE1(config-ether-cfm)#commit
PE1(config-ether-cfm)exit
```

- Create a loss measurement profile named SLM with measurement type SLM, measurement interval of `1`, intervals stored of `3`, and message period of `(1)` second.

```
PE1(config)#ethernet cfm loss-measurement profile-name SLM
PE1(config-cfm-lm)#measurement-type slm
PE1(config-cfm-lm)#measurement-interval 1
PE1(config-cfm-lm)#intervals-stored 3
PE1(config-cfm-lm)#message-period 1s
PE1(config-cfm-lm)#exit
```

- Create a delay measurement profile named DM with a measurement interval of (`1)`, intervals stored of (`2)`, and message period of `(1 second).`

```
PE1(config)#ethernet cfm delay-measurement profile-name DM
PE1(config-cfm-dm)#measurement-interval 1
PE1(config-cfm-dm)#intervals-stored 2
PE1(config-cfm-dm)#message-period 1
```

Configuration Snapshot:

PE1:

```
interface lo
 ip address 1.1.1.1/32 secondary
!
router ldp
 targeted-peer ipv4 4.4.4.4
  exit-targeted-peer-mode
 targeted-peer ipv4 5.5.5.5
  exit-targeted-peer-mode
transport-address ipv4 1.1.1.1
!
mpls vpls vpls-301 301
 signaling ldp
  vpls-type vlan
  vpls-peer 4.4.4.4
  vpls-peer 5.5.5.5
  exit-signaling
 exit-vpls
!
interface xe2
 load-interval 30
 ip address 192.168.10.1/24
 label-switching
 enable-ldp ipv4
!
router ospf 1
 ospf router-id 1.1.1.1
 bfd all-interfaces
 network 1.1.1.1/32 area 0.0.0.0
 network 192.168.10.0/24 area 0.0.0.0
```

```
!
interface xe1
 switchport
 load-interval 30
!
interface xe1.2001 switchport
 encapsulation dot1q 2028
 access-if-vpls
  mpls-vpls vpls-301
!
ethernet cfm domain-type character-string domain-name 12346 level 7 mipcreation none
 service ma-type string ma-name 124
 ethernet cfm mep up mpid 20 active true xe1.2001 vlan 2028
 cc multicast state enable
 exit-ether-ma-mep-mode
 rmep auto-discovery enable
 cc interval 10ms
 exit-ether-ma-mode
!
ethernet cfm loss-measurement profile-name SLM
 measurement-type slm
 measurement-interval 1
 intervals-stored 3
 message-period 1s
!
ethernet cfm delay-measurement profile-name DM
 measurement-interval 1
 intervals-stored 2
 message-period 1s
```

PE2:

```
interface lo
 ip address 4.4.4.4/32 secondary
!
router ldp
 targeted-peer ipv4 1.1.1.1
exit-targeted-peer-mode
targeted-peer ipv4 5.5.5.5
exit-targeted-peer-mode
transport-address ipv4 4.4.4.4
!
interface xe2
 load-interval 30
 ip address 192.168.30.2/24
 label-switching
 enable-ldp ipv4
!
router ospf 1
 ospf router-id 4.4.4.4
 bfd all-interfaces
```

```
 network 4.4.4.4/32 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0
!
mpls vpls vpls-301 301
 signaling ldp
  vpls-type vlan
  vpls-peer 1.1.1.1
  vpls-peer 5.5.5.5
  exit-signaling
 exit-vpls
!
interface xe1
 switchport
 load-interval 30
!
interface xe1.2001 switchport
 encapsulation dot1q 2028
 access-if-vpls
  mpls-vpls vpls-301
!
ethernet cfm domain-type character-string domain-name 12346 level 7 mipcreation none
 service ma-type string ma-name 124
 ethernet cfm mep up mpid 10 active true xe1.2001 vlan 2028
 cc multicast state enable
 ethernet cfm loss-measurement reply slm
 ethernet cfm delay-measurement reply dmm
 exit-ether-ma-mep-mode
 rmep auto-discovery enable
 cc interval 10ms
 exit-ether-ma-mode
!
```

PE3:

```
interface lo
 ip address 5.5.5.5/32 secondary
!
router ldp
 targeted-peer ipv4 1.1.1.1
exit-targeted-peer-mode
targeted-peer ipv4 4.4.4.4
exit-targeted-peer-mode
transport-address ipv4 5.5.5.5
!
interface xe3
 load-interval 30
 ip address 192.168.40.2/24
 label-switching
 enable-ldp ipv4
!
router ospf 1
 ospf router-id 5.5.5.5
```

```
 bfd all-interfaces
 network 5.5.5.5/32 area 0.0.0.0
 network 192.168.40.0/24 area 0.0.0.0
!
mpls vpls vpls-301 301
 signaling ldp
  vpls-type vlan
  vpls-peer 1.1.1.1
  vpls-peer 4.4.4.4
  exit-signaling
 exit-vpls
!
interface xe1
 switchport
 load-interval 30
!
interface xe1.2001 switchport
 encapsulation dot1q 2028
 access-if-vpls
  mpls-vpls vpls-301
!
ethernet cfm domain-type character-string domain-name 12346 level 7 mipcreation none
 service ma-type string ma-name 124
 ethernet cfm mep up mpid 30 active true xe1.2001 vlan 2028
 cc multicast state enable
  ethernet cfm loss-measurement reply slm
 ethernet cfm delay-measurement reply dmm
 exit-ether-ma-mep-mode
 rmep auto-discovery enable
 cc interval 10ms
 exit-ether-ma-mode
!
```

P2:

```
interface lo
 ip address 3.3.3.3/32 secondary
!
router ldp
 transport-address ipv4 3.3.3.3
!
interface xe1
 ip address 192.168.20.2/24
 label-switching
 enable-ldp ipv4
!
interface xe2
 ip address 192.168.30.1/24
 label-switching
 enable-ldp ipv4
!
interface xe3
```

```
 ip address 192.168.40.1/24
 label-switching
 enable-ldp ipv4
!
router ospf 1
 ospf router-id 3.3.3.3
 bfd all-interfaces
 network 3.3.3.3/32 area 0.0.0.0
 network 192.168.20.0/24 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0
 network 192.168.40.0/24 area 0.0.0.0
```

CE3:

```
interface xe1
switchport
 load-interval 30
!
interface xe1.2001 switchport
 encapsulation dot1q 2028
!
interface xe13.2001 switchport
 encapsulation dot1q 2028
!
cross-connect test100
 interface xe1.2001
 interface xe13.2001
```

CE1:

```
interface xe1
switchport
 load-interval 30

interface xe1.2001 switchport
 encapsulation dot1q 2028

interface xe11.2001 switchport
 encapsulation dot1q 2028

cross-connect test100
 interface xe1.2001
 interface xe11.2001
```

CE2:

```
interface xe1
switchport
 load-interval 30

interface xe1.2001 switchport
 encapsulation dot1q 2028

interface xe12.2001 switchport
 encapsulation dot1q 2028

cross-connect test100
```

```
    interface xe1.2001
    interface xe12.2001
```

Validation

Verify the L2VPN VPLS status.

```
==========================
PE1#  show mpls vpls mesh
(m) - Service mapped over multipath transport
(e) - Service mapped over LDP ECMP

VPLS-ID    Peer Addr        Tunnel-Label  In-Label   Network-Intf   Out-Label  Lkps/St
PW-INDEX SIG-Protocol   Status     UpTime
301        4.4.4.4          52481         26240      xe2            28160      2/Up
2         LDP            Active     1d00h02m
301        5.5.5.5          52497         26256      xe2            26256      2/Up
3         LDP            Active     1d00h57m
PE1#
```

Verify the RMEP is learned or not.

```
PE1#show ethernet cfm maintenance-points remote domain 12346
 MA_NAME MEPID RMEPID LEVEL Rx CCM RDI PEER-MAC TYPE
-------------------------------------------------------------------------------
 124 20 10 7 Yes False e8c5.7ae3.37ee Learnt
 124 20 30 7 Yes False e8c5.7ae3.38ee Learnt
```

Verify the Ping:

```
PE1#ping ethernet mac e8c5.7ae3.37ee unicast source 20 domain 12346 ma 124
 success rate is 100 (5/5)

PE1#ping ethernet mac e8c5.7ae3.38ee unicast source 20 domain 12346 ma 124
 success rate is 100 (5/5)
```

Verify the Traceroute:

```
PE1#traceroute ethernet e8c5.7ae3.37ee mepid 20 domain 12346 ma 124
 MP Mac Hops Relay-action Ingress/Egress Ingress/Egress action
e8c5.7ae3.37ee 1 RlyHit Ingress IngOK

PE1#traceroute ethernet e8c5.7ae3.38ee mepid 20 domain 12346 ma 124
 MP Mac Hops Relay-action Ingress/Egress Ingress/Egress action
e8c5.7ae3.38ee 1 RlyHit Ingress IngOK
```

Implementation Examples

- To support a vast network infrastructure delivering VPLS to a multitude of enterprise clients, it is imperative to maintain uninterrupted connectivity and peak performance for these VPLS connections, all while minimizing the risk of downtime or disruptions.
- Understanding the role of fault detection, localization, and performance monitoring within the VPLS network, deploy Y.1731 CFM over Layer 2 VPN (VPLS) to enhance the network's resilience and operational efficiency.

Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

Key Terms/Acronym	Description
Virtual Private LAN Service (VPLS)	Allows multiple sites in different geographical locations to connect over a wide area network (WAN), creating the experience of being part of a single local area network (LAN).
Connectivity Fault Management (CFM)	CFM is a protocol used to detect, verify, and isolate connectivity faults in a network. It operates at the data link layer and is designed to monitor ethernet networks.
Virtual Private LAN Service (VPLS)	Allows multiple dispersed sites to connect over a wide area network (WAN), creating the experience of being part of a single local area network (LAN).
Maintenance End Point (MEP)	MEP is a CFM entity that resides at the edge of a CFM domain. It is responsible for generating and transmitting CFM protocol packets to detect faults and collect performance data.
Maintenance Domain (MD)	MD is a logical grouping of MEPs within a CFM network. MEPs within the same MD can communicate with each other to perform CFM functions such as fault detection and performance monitoring.
Maintenance Association(MA)	MA is a collection of MEPs associated with a specific service or set of services. It defines the scope of CFM operations within a maintenance domain.
Maintenance Point Identifier (MPID)	MPID is a unique identifier assigned to each MEP within a maintenance association. It is used to distinguish between different MEPs within the same MA.
Service Level Measurement (SLM)	SLM is a CFM function used to measure the loss characteristics of a network path. It collects data on packet loss, delay, and jitter to assess the quality of service provided by the network.
Loopback Message Generation (LMM)	LMM is a CFM function used to test end-to-end connectivity by generating loopback messages. These messages are transmitted from a MEP and looped back to the same MEP to verify bidirectional communication.
Delay Measurement Message (DMM)	DMM is a CFM function used to measure the one-way delay of packets transmitted across a network. It helps assess the performance of the network in terms of packet delivery time.
Continuity Check (CC)	CC is a CFM function used to verify the continuity of a service or network path by periodically sending continuity check messages between MEPs. It helps detect connectivity faults such as link failures or misconfigurations.

CHAPTER 11 Y.1731 and CFM Over VXLAN ELINE Single Home

Overview

The Single Home VxLAN ELINE Y.1731 CFM over Sub-interface feature enables the monitoring and management of Virtual Extensible LAN (VxLAN) E-Line services using the Y.1731 Connectivity Fault Management (CFM) protocol over sub-interfaces. This feature enhances fault detection and performance monitoring capabilities for VxLAN E-Line services, allowing network operators to ensure high availability and reliability of their networks. By extending Y.1731 CFM functionality to sub-interfaces in single home VxLAN E-Line deployments, this feature provides comprehensive end-to-end visibility and control, enabling proactive fault detection, isolation, and troubleshooting.

Feature Characteristics

- Utilizes sub-interfaces to partition Ethernet traffic within the Single Home VxLAN ELINE architecture, enabling efficient service delivery and management.
- Implements VxLAN ELINE architecture with single-homing capabilities, facilitating the creation of Virtual Extensible LAN (VxLAN) with simplified configurations and reduced complexity.
- Provides robust fault detection mechanisms to identify connectivity issues, link failures, and service disruptions in Ethernet networks.

Benefits

- Provides detailed insights into Ethernet service performance, enabling proactive monitoring and optimization of network resources.
- Minimizes service downtime by promptly detecting and resolving faults, ensuring uninterrupted service delivery and customer satisfaction.
- Optimizes network resource utilization and bandwidth allocation by identifying and addressing connectivity issues in a timely manner.
- Facilitates rapid fault identification and isolation, accelerating troubleshooting processes and reducing mean time to repair (MTTR).
- Ensures compliance with Service Level Agreements (SLAs) by maintaining service quality metrics within defined thresholds and objectives.

Prerequisites

Ensure that the network devices (routers, switches) support Y.1731 CFM functionality and Single Home VxLAN ELINE configuration.

Verify that the devices are running compatible software versions that include support for these features.

Configuration

Configure Single Home EVPN ELINE Y.1731 CFM over Sub-interface for enhanced fault management in EVPN

networks.

Topology

The topology consists of two Customer Edge devices (CE1 and CE2) connected to Provider Edge devices (PE1 and PE2) through sub-interfaces. The Provider Edge devices are interconnected through Provider devices (P1 and P2). Y.1731 functionality is implemented over these sub-interfaces, allowing for fault detection and performance monitoring of Ethernet connectivity between the customer sites.

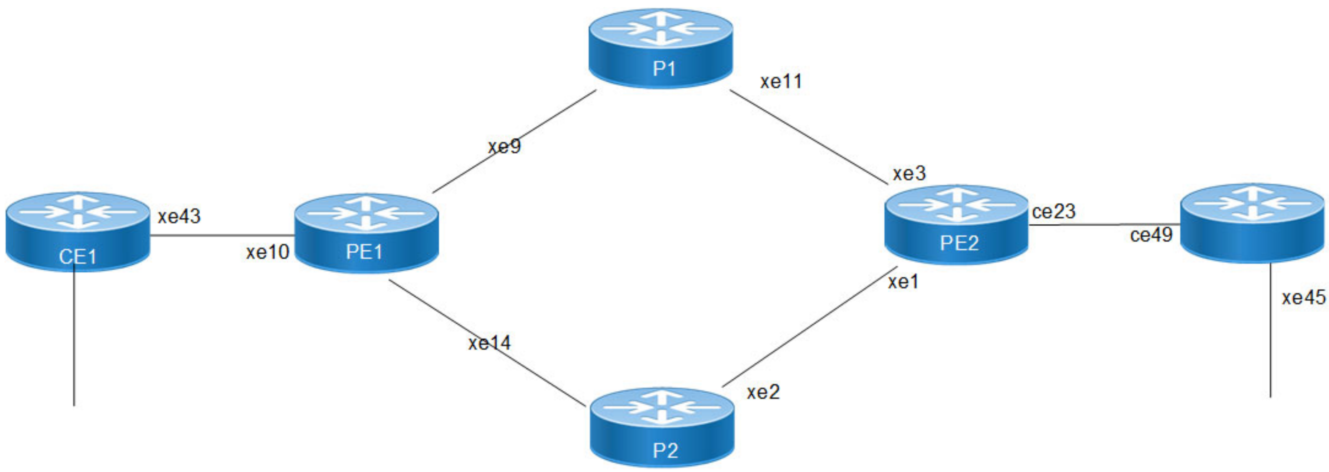


Figure 11-20: VXLAN ELINE Over Sub-interface-Single Home

Perform the following configurations to configure Single Home VxLAN ELINE Y.1731 CFM over Sub-interface:

1. On Customer Edge (CE) Nodes (CE1, and CE2), configure the interface xe1 and set load interval of (`30 seconds`):

```
CE1(config)#interface xe11
CE1(config-if)#load-interval 30
CE1(config-if)#commit
CE1(config-if)#exit
```

Note: Similarly follow the same steps to configure xe11(CE1) and xe12(CE2).

2. Create sub-interface `(xe11.10)` adding the VLAN:

```
CE1(config)#interface xe11.10 switchport
CE1(config-if)#encapsulation dot1q 20
CE1(config-if)#commit
CE1(config-if)#exit

CE1(config)#interface xe43.10 switchport
CE1(config-if)#encapsulation dot1q 10
CE1(config-if)#commit
CE1(config-if#exit
```

3. Set up a cross-connect named `(SH10)`, specifying in and out interfaces:

```
CE1(config)#cross-connect SH10
CE1(config-xc)#interface xe11.10
CE1(config-xc)#interface xe43.20
CE1(config-xc)#commit
```

4. Perform the following on PE1:

    1. Configure CFM related hardware profiles:

```
PE1(config)# hardware-profile filter cfm-domain-name-str enable
PE1(config)# hardware-profile statistics cfm-lm enable
PE1(config)# hardware-profile statistics cfm-ccm enable
PE1(config)#hardware-profile statistics cfm-slm enable
```

Note: In Q2 devices, `hardware-profile filter cfm-domain-name-str enable` by default is enabled.

    2. Configure the loopback interface with a secondary IP address (`1.1.1.1/32`):

```
PE1(config)#interface lo
PE1(config-if)#ip address 1.1.1.1/32 secondary
PE1(config-if)#commit
PE1(config-if)#exit
```

    3. Configure interface `xe9` and `xe14` with an IP address ((`192.168.10.1/24` and `192.168.20.1/24`):

```
PE1(config)#interface xe9
PE1(config-if)#load-interval 30
PE1(config-if)#ip address 192.168.10.1/24
PE1(config-if)#label-switching
PE1(config-if)#commit
PE1(config-if)#exit
PE1(config)#interface xe14
PE1(config-if)#load-interval 30
PE1(config-if)#ip address 192.168.20.1/24
PE1(config-if)#label-switching
PE1(config-if)#commit
PE1(config-if)#exit
```

    4. Configure OSPF routing, specify the OSPF router ID as (`1.1.1.1`), enable BFD on all interfaces, define the network (`1.1.1.1/32`) in area (`0.0.0.0`), and define the network (`192.168.10.0/24` and `192.168.20.0/24`) in area (`0.0.0.0`):

```
PE1(config)#router ospf 1
PE1(config-router)#ospf router-id 1.1.1.1
PE1(config-router)#bfd all-interfaces
PE1(config-router)#network 1.1.1.1/32 area 0.0.0.0
PE1(config-router)#network 192.168.10.0/24 area 0.0.0.0
PE1(config-router)#network 192.168.20.0/24 area 0.0.0.0
PE1(config-router)#commit
PE1(config-router)#exit
```

    5. Enable VxLAN globally and configure VTEP IP:

```
PE1(config)# nvo vxlan enable
PE1(config)# nvo vxlan vtep-ip-global 1.1.1.1
PE1(config)# commit
```

    6. Configure BGP with the remote PE devices and activate EVPN:

```
PE1(config)# router bgp 100
PE1(config-router)# neighbor 2.2.2.2 remote-as 100
PE1(config-router)# neighbor 2.2.2.2 update-source lo
PE1(config-router)# address-family l2vpn evpn
PE1(config-router-af)# neighbor 2.2.2.2 activate
PE1(config-router-af)# exit
PE1(config-router)# exit PE1(config)# commit
```

7. Configure MAC VRF with the appropriate RD and RT:

```
PE1(config)#mac vrf vrf10
PE1(config-vrf)# rd 1.1.1.1:10
PE1(config-vrf)# route-target both 10:10
PE1(config-vrf)#commit
PE1(config-vrf)#exit
```

8. Map the VxLAN instance and VRF, specifying the VxLAN ID:

```
PE1(config)# nvo vxlan id 10 xconnect target-vxlan-id 100
PE1(config-nvo)# vxlan host-reachability-protocol evpn-bgp vrf20
PE1(config-nvo)#vni-name SH10
PE1(config-nvo)#commit
```

9. Configure VxLAN access interface on PE1:

```
PE1(config)# interface xe10.10 switchport
PE1(config-if)# encapsulation dot1q 10
PE1(config-if)# access-if-evpn
PE1(config-acc-if-evpn)#map vpn-id 10
PE1(config-acc-if-evpn)# commit
```

10. Configure CFM UP MEP on PE1, define the CFM domain (`SH001`), create MA, configure UP MEP, and configure Remote MEP Auto-discovery enable, set CC Interval `3ms`:

```
PE1(config)#ethernet cfm domain-type character-string domain-name SH002
 level 6 mip-creation default
PE1(config-ether-cfm)#service ma-type string ma-name ma10
PE1(config-ether-cfm-ma)#ethernet cfm mep up mpid 110 active true xe3.10
vlan 10
PE1(config-ether-cfm-ma-mep)#cc multicast state enable
PE1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode
PE1(config-ether-cfm-ma)#rmep auto-discovery enable
PE1(config-ether-cfm-ma)#cc interval 3ms
PE1(config-ether-cfm-ma)#exit-ether-ma-mode
PE1(config-ether-cfm)#commit
```

11. Provide CFM configuration, define a delay measurement profile named DM, set the measurement interval to `1 second`, specify the number of intervals stored as `2`, configure the message period as `1 second`, set the measurement type to LMM, set the measurement interval to `1 second`, specify the number of intervals stored as `3`:

```
PE1(config)# ethernet cfm delay-measurement profile-name DM
PE1(config-cfm-dm)# measurement-interval 1
PE1(config-cfm-dm)# intervals-stored 2
PE1(config-cfm-dm)# message-period 1s
PE1(config-cfm-dm)# commit

PE1(config)# ethernet cfm loss-measurement profile-name LM
PE1(config-cfm-lm)# measurement-type lmm
PE1(config-cfm-lm)# measurement-interval 1
PE1(config-cfm-lm)# intervals-stored 3
PE1(config-cfm-lm)# message-period 1s
PE1(config-cfm-lm)# commit
```

Configuration Snapshot:

CE1:

```
interface xe11
 load-interval 30
!
interface xe43
 switchport
 load-interval 30
!
interface xe11.10 switchport
 encapsulation dot1q 10
!
interface xe43.10 switchport
 encapsulation dot1q 10

cross-connect SH10
 interface xe43.10
 interface xe11.10
```

CE2:

```
interface ce23
 load-interval 30
!
interface ce49
 switchport
 load-interval 30
!
interface ce23.10 switchport
 encapsulation dot1q 10
!
interface ce49.10 switchport
 encapsulation dot1q 10

cross-connect SH10
 interface ce23.10
 interface ce49.10
```

PE1:

Interface configuration:

```
interface lo
 ip address 127.0.0.1/8
 ip address 1.1.1.1/32 secondary

interface xe9
 speed 10g
 load-interval 30
 ip address 192.168.10.1/24
 mtu 9216

interface xe14
 speed 10g
 load-interval 30
 ip address 192.168.20.1/24
 mtu 9216
```

OSPF configuration:

```
router ospf 100
 ospf router-id 1.1.1.1
 network 1.1.1.1/32 area 0.0.0.0
 network 192.168.10.0/24 area 0.0.0.0
 network 192.168.20.0/24 area 0.0.0.0
```

BGP configuration:

```
router bgp 100
 bgp router-id 1.1.1.1
 neighbor 2.2.2.2 remote-as 100
 neighbor 2.2.2.2 update-source lo
 address-family l2vpn evpn
 neighbor 2.2.2.2 activate
 exit-address-family
```

VxLAN configuration:

```
nvo vxlan enable
!
evpn vxlan multihoming enable
!
nvo vxlan vtep-ip-global 1.1.1.1
!

mac vrf vrf10
 rd 1.1.1.1:10
 route-target both 10:10
!

nvo vxlan id 10 xconnect target-vxlan-id 100
 vxlan host-reachability-protocol evpn-bgp vrf10
 vni-name SH10


interface xe10.10 switchport
 encapsulation dot1q 10
 load-interval 30
 access-if-evpn
  map vpn-id 10
!
```

CFM Configurations:

```
ethernet cfm domain-type character-string domain-name SH001 level
6 mip-creation default
  service ma-type string ma-name ma10
ethernet cfm mep up mpid 110 active true xe10.10 vlan 10
     cc multicast state enable
     exit-ether-ma-mep-mode
   rmep auto-discovery enable
   cc interval 3ms
   exit-ether-ma-mode
```

P1 Configurations:

Interface configuration:

```
interface lo
 ip address 127.0.0.1/8
 ip address 11.11.11.11/32 secondary

interface xe9
 speed 10g
 load-interval 30
 ip address 192.168.10.2/24
 mtu 9216

interface xe11
 speed 10g
 load-interval 30
 ip address 192.168.30.1/24
 mtu 9216
```

OSPF configuration:

```
router ospf 100
 ospf router-id 11.11.11.11
 network 11.11.11.11/32 area 0.0.0.0
 network 192.168.10.0/24 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0
```

PE2:

Interface configuration:

```
interface lo
 ip address 127.0.0.1/8
 ip address 22.22.22.22/32 secondary

interface xe14
 speed 10g
 load-interval 30
 ip address 192.168.20.2/24
 mtu 9216

interface xe2
 speed 10g
 load-interval 30
 ip address 192.168.40.1/24
 mtu 9216
```

OSPF configuration:

```
router ospf 100
 ospf router-id 22.22.22.22
 network 22.22.22.22/32 area 0.0.0.0
 network 192.168.20.0/24 area 0.0.0.0
 network 192.168.40.0/24 area 0.0.0.0
 network 192.168.60.0/24 area 0.0.0.0
```

PE2:

Interface configuration:

```
interface lo
 ip address 127.0.0.1/8
 ip address 2.2.2.2/32 secondary

interface xe1
 speed 10g
 load-interval 30
 ip address 192.168.40.1/24
 mtu 9216

interface xe3
 speed 10g
 load-interval 30
 ip address 192.168.30.1/24
 mtu 9216
```

OSPF configuration:

```
 router ospf 100
 ospf router-id 2.2.2.2
 network 2.2.2.2/32 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0
 network 192.168.40.0/24 area 0.0.0.0
```

BGP configuration:

```
router bgp 100
 bgp router-id 2.2.2.2
 neighbor 1.1.1.1 remote-as 100
 neighbor 1.1.1.1 update-source lo
 address-family l2vpn evpn
 neighbor 1.1.1.1 activate
 exit-address-family
!
```

VxLAN configuration:

```
nvo vxlan enable
!
evpn vxlan multihoming enable
!
nvo vxlan vtep-ip-global 2.2.2.2
!

mac vrf vrf10
 rd 2.2.2.2:10
 route-target both 10:10
!

nvo vxlan id 100 xconnect target-vxlan-id 10
 vxlan host-reachability-protocol evpn-bgp vrf10
 vni-name SH10
```

```
interface ce23.10 switchport
 encapsulation dot1q 10
 load-interval 30
 access-if-evpn
  map vpn-id 100
!
```

CFM Configurations:

```
ethernet cfm domain-type character-string domain-name SH001 level
6 mip-creation default
  service ma-type string ma-name ma10
ethernet cfm mep up mpid 210 active true ce23.10 vlan 10
     cc multicast state enable
     exit-ether-ma-mep-mode
   rmep auto-discovery enable
   cc interval 3ms
   exit-ether-ma-mode
```

Validation

Verify the nvo vxlan xconnect status:

```
PE1#show nvo vxlan xconnect id 10
EVPN Xconnect Info
========================
AC-AC: Local-Cross-connect
AC-NW: Cross-connect to Network
AC-UP: Access-port is up
AC-DN: Access-port is down
NW-UP: Network is up
NW-DN: Network is down
NW-SET: Network and AC both are up

Local                            Remote       Connection-Details
================================ ============
=========================================================================================
========
VPN-ID     EVI-Name    MTU  VPN-ID     Source     vlan-info   Destination
PE-IP           MTU   Type   NW-Status
                                                           outer,inner
================================ ============
=========================================================================================
========
10          SH10         1500  100         xe3.10       ----,----    --- Single Homed
Port ---     2.2.2.2         1500  AC-NW  NW-SET

Total number of entries are 1
```

Verify the CFM Errors:

```
PE1#show ethernet cfm errors domain SH001
```

```
Domain Name    MA Name       Level VLAN  InnerVLAN  MEPID  Defects
-----------------------------------------------------------------------
SH001          ma10          6     10    NA         110    ....
```

Verify the ethernet cfm ma status domain is active or not:

```
PE1#show ethernet cfm ma status domain SH001 ma-name ma10
MA NAME                  STATUS
-------------------------------
   ma10                  Active
```

Verify the local MEP is installed or not:

```
PE1#show ethernet cfm maintenance-points local mep domain SH001 ma-name ma10
MPID Dir Lvl VLAN CC-Stat HW-Status  CC-Intvl MAC-Address    Def Port  MD Name
--------------------------------------------------------------------------------
110  Up  6   10   Enable  Installed  3 ms     e8c5.7afe.fae9 F   xe3.10 SH001
```

Verify the RMEP is learned or not:

```
PE1#show ethernet cfm maintenance-points remote domain SH001 ma-name ma10
 MA_NAME MEPID     RMEPID     LEVEL     Rx CCM    RDI    PEER-MAC        TYPE
--------------------------------------------------------------------------------
 ma10      110       210        6         Yes       False  5c07.5851.cfad Learnt
```

Verify the Ping:

```
PE1#ping ethernet mac 5c07.5851.cfad unicast source 110 domain SH001 ma ma10
 success rate is  100 (5/5)
```

Verify the traceroute:

```
PE1#traceroute ethernet 5c07.5851.cfad mepid 110 domain SH001 ma ma10
 MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
5c07.5851.cfad   1     RlyHit                Ingress         IngOK
```

Verify the Delay-measurement:

```
PE1#delay-measurement type proactive profile-name DM rmep 210 mep 110 domain SH001 ma 
ma10
PE1#2024 Oct 02 02:07:58.409 : PE1 : ONMD : INFO : [CFM_PM_SESSION_INFO_5]: CFM Frame 
Delay Measurement session started for MEP Id 110 and RMEP Id 210

PE1#
PE1#show ethernet cfm delay-measurement
mep      profile
PE1#show ethernet cfm delay-measurement mep 110 domain SH001 ma-name ma10
 MD                       : SH001
 MA                       : ma10
 MEP                      : 110
 VLAN ID                  : 10
 Interface                : xe3.10
 Peer MAC Address         : 5c07.5851.cfad
```

```
CURRENT:
======================
 RMEP ID        : 210
 Measurement ID : 1
 Measurement Type             : DMM
 Elapsed time(sec)            : 12
 Start Time                   : 2024 Oct 02 02:07:58
 Suspect Flag                 : FALSE
 Min Frame Delay(usec)        : 20
 Max Frame Delay(usec)        : 21
 Avg Frame Delay(usec)        : 20
 Min Inter FD Variation(usec): 0
 Max Inter FD Variation(usec): 1
 Avg Inter FD Variation(usec): 0

             FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999           12
 2             5000       - < 9999           0
 3             10000      - < 4294967295     0

           INTER-FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999           11
 2             5000       - < 4294967295     0
```

Verify the Loss Measurement:.

```
PE1#loss-measurement type proactive profile-name LM rmep 210 mep 110 domain SH001 ma ma10
PE1#2024 Oct 02 02:09:24.850 : PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame Loss Measurement  started for MEP:110 MA:ma10 MD:SH001

PE1#show ethernet cfm loss-measurement mep 1100 domain SH001 ma-name ma10

  Suspect                      : False
  Measurement Type             : slm
  Elapsed time(sec)            : 10
  Start Time                   : 2024 Oct 04 08:33:02
  Near End loss                : 0
  Far End loss                 : 0
  Near End accumulated loss    : 0
  Far End accumulated loss     : 0
  Near End frame loss ratio    : 0
  Far End frame loss ratio     : 0

HISTORY:
```

```
Measurement ID : 1
 Suspect                    : False
 Measurement Type           : lmm
 Elapsed time(sec)          : 60
 End Time                   : 2024 Oct 04 08:33:02
 Near End loss              : 0
 Far End loss               : 0
 Near End accumulated loss  : 0
 Far End accumulated loss   : 0
 Near End frame loss ratio  : 0
 Far End frame loss ratio   : 0
 Near End frame loss ratio min  : 0
 Far End frame loss ratio min  : 0
 Near End frame loss ratio max  : 0
 Far End frame loss ratio max  : 0
```

Implementation Examples

Enterprise Connectivity Monitoring:

Scenario: A large enterprise operates multiple branch offices connected via Ethernet services provided by a service provider network.

Use Case: Y.1731 CFM over sub-interface using Single Home VxLAN ELINE enables the enterprise to monitor theconnectivity and performance of its branch office connections. It facilitates proactive fault detection and management, ensuring reliable and uninterrupted communication between the headquarters and branch offices.

Service Provider Network Operations:

Scenario: A service provider manages a diverse range of Ethernet services for its enterprise customers, including VPNs, Internet access, and cloud connectivity.

Use Case: Y.1731 CFM over sub-interface using Single Home VxLAN ELINE empowers the service provider to deliverhigh-quality Ethernet services with enhanced fault management capabilities. It enables the provider to quickly identify and resolve connectivity issues, minimize service downtime, and maintain customer satisfaction.

Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

Key Terms/Acronym	Description
Y.1731	A standard defined by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) that specifies performance monitoring and fault management for Ethernet-based networks.
Sub-interface	A logical division of a physical interface, typically used to separate traffic based on VLANs or other criteria. In this context, sub-interfaces are employed to establish distinct connections within the VxLAN ELINE SH topology.

EVPN	Ethernet Virtual Private Network (VPN) is a technology that enables the creation of virtual private networks over an Ethernet-based infrastructure. It provides multi-tenancy and allows for the segmentation of traffic in service provider networks.
ELINE	ELINE is a type of VxLAN service that provides point-to-point Ethernet connectivity between two sites.
Single Home (SH)	Refers to the configuration where a Customer Edge device (CE) is connected to only one Provider Edge device (PE) within an VxLAN setup. It contrasts with the multi-homed configuration, where a CE may be connected to multiple PEs.
Maintenance End Point (MEP)	MEP is a CFM entity that resides at the edge of a CFM domain. It is responsible for generating and transmitting CFM protocol packets to detect faults and collect performance data.
Maintenance Domain (MD)	MD is a logical grouping of MEPs within a CFM network. MEPs within the same MD can communicate with each other to perform CFM functions such as fault detection and performance monitoring.
Maintenance Association(MA)	MA is a collection of MEPs associated with a specific service or set of services. It defines the scope of CFM operations within a maintenance domain.
Maintenance Point Identifier (MPID)	MPID is a unique identifier assigned to each MEP within a maintenance association. It is used to distinguish between different MEPs within the same MA.
Service Level Measurement (SLM)	SLM is a CFM function used to measure the loss characteristics of a network path. It collects data on packet loss, delay, and jitter to assess the quality of service provided by the network.
Loopback Message Generation (LMM)	LMM is a CFM function used to test end-to-end connectivity by generating loopback messages. These messages are transmitted from a MEP and looped back to the same MEP to verify bidirectional communication.
Delay Measurement Message (DMM)	DMM is a CFM function used to measure the one-way delay of packets transmitted across a network. It helps assess the performance of the network in terms of packet delivery time.
Continuity Check (CC)	CC is a CFM function used to verify the continuity of a service or network path by periodically sending continuity check messages between MEPs. It helps detect connectivity faults such as link failures or misconfigurations.

CHAPTER 12 Y.1731 and CFM Over VXLAN ELAN Single Home

Overview

The Single Home VxLAN ELAN Y.1731 CFM over Sub-interface feature enables the monitoring and management of Virtual Extensible LAN (VxLAN) Ethernet LAN services using the Y.1731 Connectivity Fault Management (CFM) protocol over sub-interfaces. This feature enhances fault detection and performance monitoring capabilities for VxLAN E-LAN services, allowing network operators to ensure high availability and reliability of their networks. By extending Y.1731 CFM functionality to sub-interfaces in single home VxLAN E-LAN deployments, this feature provides comprehensive end-to-end visibility and control, enabling proactive fault detection, isolation, and troubleshooting.

Feature Characteristics

- Utilizes sub-interfaces to partition Ethernet traffic within the Single Home VxLAN ELAN architecture, enabling efficient service delivery and management.
- Implements VxLAN ELAN architecture with single-homing capabilities, facilitating the creation of Virtual Extensible LAN (VxLAN) with simplified configurations and reduced complexity.
- Provides robust fault detection mechanisms to identify connectivity issues, link failures, and service disruptions in Ethernet networks.

Benefits

- Provides detailed insights into Ethernet service performance, enabling proactive monitoring and optimization of network resources.
- Minimizes service downtime by promptly detecting and resolving faults, ensuring uninterrupted service delivery and customer satisfaction.
- Optimizes network resource utilization and bandwidth allocation by identifying and addressing connectivity issues in a timely manner.
- Facilitates rapid fault identification and isolation, accelerating troubleshooting processes and reducing mean time to repair (MTTR).
- Ensures compliance with Service Level Agreements (SLAs) by maintaining service quality metrics within defined thresholds and objectives.

Prerequisites

Ensure that the network devices (routers, switches) support Y.1731 CFM functionality and Single Home VxLAN ELAN configuration.
Verify that the devices are running compatible software versions that include support for these features.

Configuration

Configure Single Home VxLAN ELAN Y.1731 CFM over Sub-interface for enhanced fault management in VxLAN

networks.

Topology

The topology consists of three Customer Edge devices (CE1, CE2, and CE3) connected to Provider Edge devices (PE1,PE2, and PE3) through sub-interfaces. The Provider Edge devices are interconnected through Provider devices (P1 and P2).
Y.1731 functionality is implemented over these sub-interfaces, allowing for fault detection and performance monitoring of Ethernet connectivity between the customer sites.

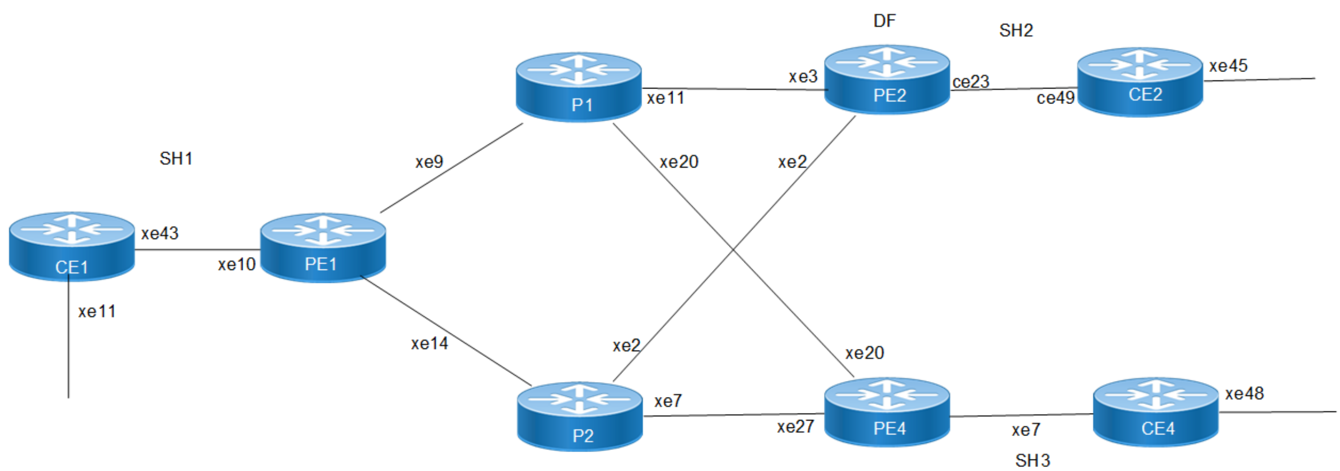


Figure 12-21: VXLAN ELAN Over Sub-interface-Single Home

Perform the following configurations to configure Single Home VxLAN ELAN Y.1731 CFM over Sub-interface:

1. On Customer Edge (CE) Nodes (CE1, CE2, and CE3), configure the interface xe1 and set load interval of (`30 seconds`):

```
CE1(config)#interface xe11
CE1(config-if)#load-interval 30
CE1(config-if)#commit
CE1(config-if)#exit
```

Note: Similarly follow the same steps to configure xe11(CE1) and xe12(CE2).

2. Create sub-interface (`xe11.20`) adding the VLAN:

```
CE1(config)#interface xe11.20
CE1(config-if)#encapsulation dot1q 20
CE1(config-if)#commit
CE1(config-if)#exit

CE1(config)#interface xe43.20 switchport
CE1(config-if)#encapsulation dot1q 20
CE1(config-if)#commit
CE1(config-if)#exit
```

3. Set up a cross-connect named (`VC20`), specifying in and out interfaces:

```
CE1(config)#cross-connect VC20
CE1(config-xc)#interface xe11.20
CE1(config-xc)#interface xe43.20
CE1(config-xc)#commit
```

4. Perform the following on PE1:

   1. Configure CFM related hardware profiles:

```
PE1(config)# hardware-profile filter cfm-domain-name-str enable
PE1(config)# hardware-profile statistics cfm-lm enable
PE1(config)# hardware-profile statistics cfm-ccm enable
PE1(config)#hardware-profile statistics cfm-slm enable
```

Note: In Q2 devices, `hardware-profile filter cfm-domain-name-str enable` by default is enabled.

   2. Configure the loopback interface with a secondary IP address(`1.1.1.1/32`):

```
PE1(config)#interface lo
PE1(config-if)#ip address 1.1.1.1/32 secondary
PE1(config-if)#commit
PE1(config-if)#exit
```

   3. Configure interface `xe9` and `xe14` with an IP address (`192.168.10.1/24` and `192.168.20.1/24`):

```
PE1(config)#interface xe9
PE1(config-if)#load-interval 30
PE1(config-if)#ip address 192.168.10.1/24
PE1(config-if)#label-switching PE1(config-if)#commit
PE1(config-if)#exit

PE1(config)#interface xe14
PE1(config-if)#load-interval 30
PE1(config-if)#ip address 192.168.20.1/24
PE1(config-if)#label-switching PE1(config-if)#commit
PE1(config-if)#exit
```

   4. Configure OSPF routing, specify the OSPF router ID as (`1.1.1.1`), enable BFD on all interfaces, define the network (`1.1.1.1/32`) in area (`0.0.0.0`), and define the network (`192.168.10.0/24 & 192.168.20.0/24`) in area (`0.0.0.0`):

```
PE1(config)#router ospf 1
PE1(config-router)#ospf router-id 1.1.1.1
PE1(config-router)#bfd all-interfaces
PE1(config-router)#network 1.1.1.1/32 area 0.0.0.0
PE1(config-router)#network 192.168.10.0/24 area 0.0.0.0
PE1(config-router)#network 192.168.20.0/24 area 0.0.0.0
PE1(config-router)#commit
PE1(config-router)#exit
```

   5. Enable VxLAN globally and configure VTEP IP:

```
PE1(config)# nvo vxlan enable
PE1(config)# nvo vxlan vtep-ip-global 1.1.1.1
PE1(config)# commit
```

   6. Configure BGP with the remote PE devices and activate EVPN:

```
PE1(config)# router bgp 100
PE1(config-router)# neighbor 2.2.2.2 remote-as 100
PE1(config-router)# neighbor 2.2.2.2 update-source lo
PE1(config-router)# neighbor 3.3.3.3 remote-as 100
PE1(config-router)# neighbor 3.3.3.3 update-source lo
PE1(config-router)# address-family l2vpn evpn
PE1(config-router-af)#  neighbor 2.2.2.2 activate
PE1(config-router-af)# neighbor 3.3.3.3 activate
```

```
PE1(config-router-af)# exit
PE1(config-router)# exit
PE1(config)# commit
```

7. Configure MAC VRF with the appropriate RD and RT:

```
PE1(config)#mac vrf vrf20
PE1(config-vrf)# rd 1.1.1.1:20
PE1(config-vrf)# route-target both 20:20
PE1(config-vrf)#commit
PE1(config-vrf)#exit
PE1(config)#exit
```

8. Map the VXLAN instance and VRF, specifying the EVPN ID:

```
PE1(config)# nvo vxlan id 20 ingress-replication
PE1(config-nvo)# vxlan host-reachability-protocol evpn-bgp vrf20
PE1(config-nvo)#vni-name SH20
PE1(config-nvo)#commit
```

9. Configure VXLAN access ports on PE1:

```
PE1(config)# interface xe10.20 switchport
PE1(config-if)# encapsulation dot1q 20
PE1(config-if)# access-if-evpn
PE1(config-acc-if-evpn)#map vpn-id 20
PE1(config-acc-if-evpn)# commit
```

10. Configure CFM MEP on PE1, define the FCM domain (`SH002)`, create MA, configure MEP, and configure Remote MEP Auto-discovery,set CC Interval `3ms`:

```
PE1(config)#ethernet cfm domain-type character-string domain-name SH002
level 6 mip-creation default
PE1(config-ether-cfm)#service ma-type string ma-name ma20
PE1(config-ether-cfm-ma)#ethernet cfm mep up mpid 120 active true xe10.20
vlan 20
PE1(config-ether-cfm-ma-mep)#cc multicast state enable
PE1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode
PE1(config-ether-cfm-ma)#rmep auto-discovery enable
PE1(config-ether-cfm-ma)#cc interval 3ms
PE1(config-ether-cfm-ma)#exit-ether-ma-mode
PE1(config-ether-cfm)#commit
```

11. Provide CFM configuration, define a delay measurement profile named DM, set the measurement interval to `1 second`, specify the number of intervals stored as `2`, configure the message period as `1 second`, define a loss measurement profile named LM, set the measurement type to LMM, set the measurement interval to `1 second`, specify the number of intervals stored as `3`, define a service level measurement profile named SLM, set the measurement type to SLM:

```
PE1(config)# ethernet cfm delay-measurement profile-name DM
PE1(config-cfm-dm)# measurement-interval 1
PE1(config-cfm-dm)# intervals-stored 2
PE1(config-cfm-dm)# message-period 1s
PE1(config-cfm-dm)# commit

PE1(config)# ethernet cfm loss-measurement profile-name LM
PE1(config-cfm-lm)# measurement-type lmm
PE1(config-cfm-lm)# measurement-interval 1
PE1(config-cfm-lm)# intervals-stored 3
PE1(config-cfm-lm)# message-period 1s
PE1(config-cfm-lm)# commit

PE1(config)# ethernet cfm loss-measurement profile-name SLM
```

```
PE1(config-cfm-lm)# measurement-type slm
PE1(config-cfm-lm)# measurement-interval 1
PE1(config-cfm-lm)# intervals-stored 3
PE1(config-cfm-lm)# message-period 1s
PE1(config-cfm-lm)# commit
```

Configuration Snapshot:

CE1:

```
interface xe11
  load-interval 30
!
interface xe43
 load-interval 30
!
interface xe11.20 switchport
 encapsulation dot1q 20
!
interface xe43.20 switchport
 encapsulation dot1q 20

cross-connect SH20
 interface xe43.20
 interface xe11.20
```

CE2:

```
interface ce23
 load-interval 30
!
interface ce45
 load-interval 30
!
interface ce23.20 switchport
 encapsulation dot1q 20
!
interface ce45.20 switchport
 encapsulation dot1q 20

cross-connect SH20
 interface ce23.20
 interface ce45.20
```

CE3:

```
interface xe7
  load-interval 30
!
interface ce48
  load-interval 30
!
interface xe7.20 switchport
 encapsulation dot1q 20
!
interface ce48.20 switchport
 encapsulation dot1q 20

cross-connect SH20
```

```
 interface xe7.20
 interface ce48.20
```

PE1:

Interface configuration:

```
interface lo
 ip address 127.0.0.1/8
 ip address 1.1.1.1/32 secondary

interface xe9
 speed 10g
 load-interval 30
 ip address 192.168.10.1/24
 mtu 9216

interface xe14
 speed 10g
 load-interval 30
 ip address 192.168.20.1/24
 mtu 9216
```

OSPF configuration:

```
router ospf 100
 ospf router-id 1.1.1.1
 network 1.1.1.1/32 area 0.0.0.0
 network 192.168.10.0/24 area 0.0.0.0
 network 192.168.20.0/24 area 0.0.0.0
```

BGP configuration:

```
router bgp 100
 bgp router-id 1.1.1.1
 neighbor 2.2.2.2 remote-as 100
 neighbor 2.2.2.2 update-source lo
 neighbor 3.3.3.3 remote-as 100
 neighbor 3.3.3.3 update-source lo
 address-family l2vpn evpn
 neighbor 2.2.2.2 activate
 neighbor 3.3.3.3 activate
 exit-address-family
```

VxLAN configuration:

```
nvo vxlan enable
!
evpn vxlan multihoming enable
!
nvo vxlan vtep-ip-global 1.1.1.1
!

mac vrf vrf20
 rd 1.1.1.1:20
 route-target both 20:20
!
nvo vxlan id 20 ingress-replication
 vxlan host-reachability-protocol evpn-bgp vrf20
```

```
 vni-name SH20

interface xe10.20 switchport
 encapsulation dot1q 20
 load-interval 30
 access-if-evpn
  map vpn-id 20
!
```

CFM Configurations:

```
ethernet cfm domain-type character-string domain-name SH002 level
6 mip-creation default
  service ma-type string ma-name ma20
ethernet cfm mep up mpid 120 active true xe10.20 vlan 20
     cc multicast state enable
     exit-ether-ma-mep-mode
   rmep auto-discovery enable
   cc interval 3ms
   exit-ether-ma-mode
```

P1:

Interface configuration:

```
interface lo
 ip address 127.0.0.1/8
 ip address 11.11.11.11/32 secondary

interface xe9
 speed 10g
 load-interval 30
 ip address 192.168.10.2/24
 mtu 9216

interface xe11
 speed 10g
 load-interval 30
 ip address 192.168.30.1/24
 mtu 9216

interface xe20
 speed 10g
 load-interval 30
 ip address 192.168.40.1/24
 mtu 9216
```

OSPF configuration:

```
router ospf 100
 ospf router-id 11.11.11.11
 network 11.11.11.11/32 area 0.0.0.0
 network 192.168.10.0/24 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0
 network 192.168.40.0/24 area 0.0.0.0
```

PE2:

Interface configuration:

```
interface lo
 ip address 127.0.0.1/8
 ip address 2.2.2.2/32 secondary


interface xe2
 speed 10g
 load-interval 30
 ip address 192.168.50.2/24
 mtu 9216

interface xe3
 speed 10g
 load-interval 30
 ip address 192.168.30.2/24
 mtu 9216
```

OSPF configuration:

```
router ospf 100
 ospf router-id 2.2.2.2
 network 2.2.2.2/32 area 0.0.0.0
 network 192.168.30.0/24 area 0.0.0.0
 network 192.168.50.0/24 area 0.0.0.0
```

BGP configuration:

```
router bgp 100
 bgp router-id 2.2.2.2
 neighbor 1.1.1.1 remote-as 100
 neighbor 1.1.1.1 update-source lo
 neighbor 3.3.3.3 remote-as 100
 neighbor 3.3.3.3 update-source lo
 address-family l2vpn evpn
 neighbor 1.1.1.1 activate
 neighbor 3.3.3.3 activate
 exit-address-family
```

VxLAN configuration:

```
nvo vxlan enable
!
evpn vxlan multihoming enable
!
nvo vxlan vtep-ip-global 2.2.2.2
!

mac vrf vrf20
 rd 2.2.2.2:20
 route-target both 20:20
!
nvo vxlan id 20 ingress-replication
 vxlan host-reachability-protocol evpn-bgp vrf20
 vni-name SH20
```

```
interface ce23.20 switchport
 encapsulation dot1q 20
 load-interval 30
 access-if-evpn
  map vpn-id 20
!
```

CFM Configurations:

```
ethernet cfm domain-type character-string domain-name SH002 level
6 mip-creation default
  service ma-type string ma-name ma10
ethernet cfm mep up mpid 220 active true ce23.20 vlan 20
     cc multicast state enable
     exit-ether-ma-mep-mode
   rmep auto-discovery enable
   cc interval 3ms
   exit-ether-ma-mode
```

PE3:

Interface configuration:

```
interface lo
 ip address 127.0.0.1/8
 ip address 3.3.3.3/32 secondary

interface xe20
 speed 10g
 load-interval 30
 ip address 192.168.40.2/24
 mtu 9216

interface xe27
 speed 10g
 load-interval 30
 ip address 192.168.60.2/24
 mtu 9216
```

OSPF configuration:

```
router ospf 100
 ospf router-id 3.3.3.3
 network 3.3.3.3/32 area 0.0.0.0
 network 192.168.40.0/24 area 0.0.0.0
 network 192.168.60.0/24 area 0.0.0.0
```

BGP configuration:

```
router bgp 100
 bgp router-id 3.3.3.3
 neighbor 1.1.1.1 remote-as 100
 neighbor 1.1.1.1 update-source lo
 neighbor 2.2.2.2 remote-as 100
 neighbor 2.2.2.2 update-source lo
 address-family l2vpn evpn
```

```
     neighbor 1.1.1.1 activate
     neighbor 2.2.2.2 activate
     exit-address-family
```

VxLAN configuration:

```
    nvo vxlan enable
    !
    evpn vxlan multihoming enable
    !
    nvo vxlan vtep-ip-global 3.3.3.3
    !

    mac vrf vrf20
     rd 3.3.3.3:20
     route-target both 20:20
    !
    nvo vxlan id 20 ingress-replication
     vxlan host-reachability-protocol evpn-bgp vrf20
     vni-name SH20

    interface xe7.20 switchport
     encapsulation dot1q 20
     load-interval 30
     access-if-evpn
      map vpn-id 20
    !
```

CFM Configurations:

```
    ethernet cfm domain-type character-string domain-name SH002 level
    6 mip-creation default
      service ma-type string ma-name ma10
    ethernet cfm mep up mpid 420 active true xe7.20 vlan 20
         cc multicast state enable
         exit-ether-ma-mep-mode
       rmep auto-discovery enable
       cc interval 3ms
       exit-ether-ma-mode
```

Validation

Verify the nvo vxlan status:

```
7033-PE1#show nvo vxlan
VXLAN Information
=================
   Codes: NW - Network Port
          AC - Access Port
         (u) - Untagged

VNID     VNI-Name     VNI-Type Type Interface ESI                          VLAN      DF-
Status Src-Addr         Dst-Addr
____________________________________________________________________________________________
________________________________________
```

```
20       SH20         L2        NW   ----      ----                          ----      -
---      1.1.1.1          3.3.3.3
20       SH20         L2        NW   ----      ----                          ----      -
---      1.1.1.1          2.2.2.2
20       SH20         --        AC   xe3.20    --- Single Homed Port ---     ----      -
---      ----             ----Total number of entries are 4
```

Verify the CFM Errors Status:

```
7033-PE1#show ethernet cfm errors domain SH002
      Domain Name    MA Name       Level VLAN  InnerVLAN  MEPID  Defects
      -----------------------------------------------------------------------
SH002          ma20           6     20    NA         120    .....
```

Verify the CFM MA status:

```
7033-PE1#show ethernet cfm maintenance-points remote domain SH002 ma-name ma20
 MA_NAME MEPID     RMEPID     LEVEL     Rx CCM    RDI    PEER-MAC        TYPE
------------------------------------------------------------------------------
 ma20      120       420        6         Yes       False  e001.a6b8.ed09 Learnt
 ma20      120       220        6         Yes       False  5c07.5851.cfad Learnt
```

Verify the Ping:

```
7033-PE1#ping ethernet mac 5c07.5851.cfad unicast source 120 domain SH002 ma ma20
 success rate is  100 (5/5)
7033-PE1#ping ethernet mac e001.a6b8.ed09 unicast source 120 domain SH002 ma ma20
 success rate is  100 (5/5)
```

Verify the Traceroute:

```
7033-PE1#traceroute ethernet 5c07.5851.cfad mepid 120 domain SH002 ma ma20
 MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
5c07.5851.cfad   1     RlyHit                Ingress         IngOK
7033-PE1#traceroute ethernet e001.a6b8.ed09 mepid 120 domain SH002 ma ma20
 MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress action
e001.a6b8.ed09   1     RlyHit                Ingress         IngOK
7033-PE1#
```

Verify the Delay-measurement:

```
7033-PE1#delay-measurement type proactive profile-name DM rmep 220 mep 120 domain SH002
ma ma20
7033-PE1#2024 Oct 04 08:29:40.642 : 7033-PE1 : ONMD : INFO : [CFM_PM_SESSION_INFO_5]:
CFM Frame Delay Measurement session started for MEP Id 120 and RMEP Id 220

7033-PE1#show ethernet cfm delay-measurement mep 120 domain SH002 ma-name ma20
 MD                      : SH002
 MA                      : ma20
 MEP                     : 120
 VLAN ID                 : 20
 Interface               : xe3.20
 Peer MAC Address        : 5c07.5851.cfad
```

```
CURRENT:
======================
 RMEP ID        : 220
 Measurement ID : 1
 Measurement Type            : DMM
 Elapsed time(sec)           : 13
 Start Time                  : 2024 Oct 04 08:29:40
 Suspect Flag                : FALSE
 Min Frame Delay(usec)       : 20
 Max Frame Delay(usec)       : 20
 Avg Frame Delay(usec)       : 20
 Min Inter FD Variation(usec): 0
 Max Inter FD Variation(usec): 0
 Avg Inter FD Variation(usec): 0

             FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999           14
 2             5000       - < 9999           0
 3             10000      - < 4294967295     0

           INTER-FRAME DELAY BINS
 Bin Number    Bin Threshold(usec)          Bin Counter
========================================================
 1             0          - < 4999           13
 2             5000       - < 4294967295     0
```

Verify the Synthetic Loss Measurement:

```
7033-PE1#loss-measurement type proactive profile-name SLM rmep 220 mep 120 domain SH002
ma ma20
7033-PE1#2024 Oct 04 08:32:02.959 : 7033-PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM
Frame Loss Measurement  started for MEP:120 MA:ma20 MD:SH002

7033-PE1#show ethernet cfm loss-measurement mep 120 domain SH002 ma-name ma20
MEP: 120 MA: ma20
CURRENT:
 Measurement ID : 2
  Suspect                    : False
  Measurement Type           : slm
  Elapsed time(sec)          : 10
  Start Time                 : 2024 Oct 04 08:33:02
  Near End loss              : 0
  Far End loss               : 0
  Near End accumulated loss  : 0
  Far End accumulated loss   : 0
  Near End frame loss ratio  : 0
  Far End frame loss ratio   : 0

HISTORY:
```

```
Measurement ID : 1
 Suspect                    : False
 Measurement Type           : slm
 Elapsed time(sec)          : 60
 End Time                   : 2024 Oct 04 08:33:02
 Near End loss              : 0
 Far End loss               : 0
 Near End accumulated loss  : 0
 Far End accumulated loss   : 0
 Near End frame loss ratio  : 0
 Far End frame loss ratio   : 0
 Near End frame loss ratio min  : 0
 Far End frame loss ratio min  : 0
 Near End frame loss ratio max  : 0
 Far End frame loss ratio max  : 0
```

Implementation Examples

Enterprise Connectivity Monitoring:

Scenario: A large enterprise operates multiple branch offices connected via Ethernet services provided by a service provider network.

Use Case: Y.1731 CFM over sub-interface using Single Home VxLAN enables the enterprise to monitor theconnectivity and performance of its branch office connections. It facilitates proactive fault detection and management, ensuring reliable and uninterrupted communication between the headquarters and branch offices.

Service Provider Network Operations:

Scenario: A service provider manages a diverse range of Ethernet services for its enterprise customers, including VPNs, Internet access, and cloud connectivity.

Use Case: Y.1731 CFM over sub-interface using Single Home VxLAN empowers the service provider to deliverhigh-quality Ethernet services with enhanced fault management capabilities. It enables the provider to quickly identify and resolve connectivity issues, minimize service downtime, and maintain customer satisfaction.

Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

Key Terms/Acronym	Description
Y.1731	A standard defined by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) that specifies performance monitoring and fault management for Ethernet-based networks.
Sub-interface	A logical division of a physical interface, typically used to separate traffic based on VLAN or other criteria. In this context, sub-interfaces are employed to establish distinct connections within the VxLAN ELAN SH topology.

ELAN	ELAN is a type of VxLAN service that provides point-to-multi point Ethernet connectivity between two sites.
Single Home (SH)	Refers to the configuration where a Customer Edge device (CE) is connected to only one Provider Edge device (PE) within an VxLAN setup. It contrasts with the multi-homed configuration, where a CE may be connected to multiple PEs.
Maintenance End Point (MEP)	MEP is a CFM entity that resides at the edge of a CFM domain. It is responsible for generating and transmitting CFM protocol packets to detect faults and collect performance data.
Maintenance Domain (MD)	MD is a logical grouping of MEPs within a CFM network. MEPs within the same MD can communicate with each other to perform CFM functions such as fault detection and performance monitoring.
Maintenance Association(MA)	MA is a collection of MEPs associated with a specific service or set of services. It defines the scope of CFM operations within a maintenance domain.
Maintenance Point Identifier (MPID)	MPID is a unique identifier assigned to each MEP within a maintenance association. It is used to distinguish between different MEPs within the same MA.
Service Level Measurement (SLM)	SLM is a CFM function used to measure the loss characteristics of a network path. It collects data on packet loss, delay, and jitter to assess the quality of service provided by the network.
Loopback Message Generation (LMM)	LMM is a CFM function used to test end-to-end connectivity by generating loopback messages. These messages are transmitted from a MEP and looped back to the same MEP to verify bidirectional communication.
Delay Measurement Message (DMM)	DMM is a CFM function used to measure the one-way delay of packets transmitted across a network. It helps assess the performance of the network in terms of packet delivery time.
Continuity Check (CC)	CC is a CFM function used to verify the continuity of a service or network path by periodically sending continuity check messages between MEPs. It helps detect connectivity faults such as link failures or misconfigurations.

CHAPTER 13 Y.1731 and CFM Over VXLAN ELAN Multi Home

Overview

The Multi Home VxLAN ELAN Y.1731 CFM over Sub-interface feature enables the monitoring and management of Virtual Extensible LAN (VxLAN) Ethernet LAN services using the Y.1731 Connectivity Fault Management (CFM) protocol over sub-interfaces. This feature enhances fault detection and performance monitoring capabilities for VxLAN E-LAN services, allowing network operators to ensure high availability and reliability of their networks. By extending Y.1731 CFM functionality to sub-interfaces in single home VxLAN E-LAN deployments, this feature provides comprehensive end-to-end visibility and control, enabling proactive fault detection, isolation, and troubleshooting.

CFM multi-homing allows Customer Edge (CE) device to connect more than one Provider Edge (PE) device. Multi-homing ensures redundant connectivity. The redundant PE device ensures that there is no traffic disruption when there is a network failure.

Feature Characteristics

- Utilizes sub-interfaces to partition Ethernet traffic within the Multi Home VxLAN ELAN architecture, enabling efficient service delivery and management.
- Implements VxLAN ELAN architecture with multi-homing capabilities, facilitating the creation of Virtual Extensible LAN (VxLAN) with simplified configurations and reduced complexity.
- Provides robust fault detection mechanisms to identify connectivity issues, link failures, and service disruptions in Ethernet networks.

Benefits

- Provides detailed insights into Ethernet service performance, enabling proactive monitoring and optimization of network resources.
- Minimizes service downtime by promptly detecting and resolving faults, ensuring uninterrupted service delivery and customer satisfaction.
- Optimizes network resource utilization and bandwidth allocation by identifying and addressing connectivity issues in a timely manner.
- Facilitates rapid fault identification and isolation, accelerating troubleshooting processes and reducing mean time to repair (MTTR).
- Ensures compliance with Service Level Agreements (SLAs) by maintaining service quality metrics within defined thresholds and objectives.

Prerequisites

Ensure that the network devices (routers, switches) support Y.1731 CFM functionality and Multi- Home VxLAN ELAN configuration.
Verify that the devices are running compatible software versions that include support for these features.

Configuration

Configure Multi- Home VxLAN ELAN Y.1731 CFM over Sub-interface for enhanced fault management in VxLAN networks.

Topology

The topology consists of two Customer Edge devices (CE1 and CE2) connected to Provider Edge devices (PE1,PE2, and PE3) through sub-interfaces. The Provider Edge devices are interconnected through Provider device (P1). Y.1731 functionality is implemented over these sub-interfaces, allowing for fault detection and performance monitoring of Ethernet connectivity between the customer sites.

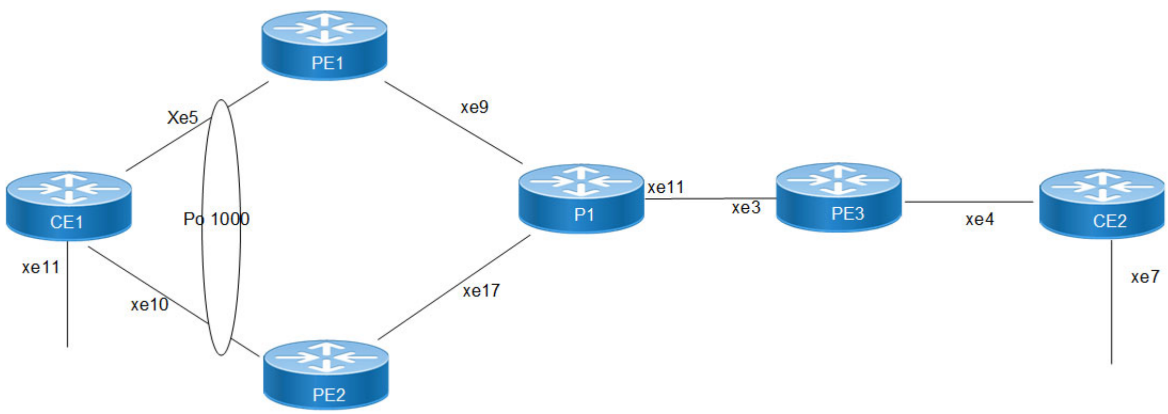


Figure 13-22: VXLAN ELAN-Multi Home

Perform the following configurations to configure Multihome Home VxLAN ELINE Y.1731 CFM over Sub-interface:

Customer Edge (CE) Nodes Configuration (CE1, CE2):

1. Configure the interface xe1 and set load interval of (`30 seconds`):

```
CE1(config)#interface xe11
CE1(config-if)# switchport
CE1(config-if)#load-interval 30
CE1(config-if)#commit
CE1(config-if)#exit
```

2. Configure Port-Channel interface:

```
CE1(config)#interface po1000
CE1(config-if)# switchport
CE1(config-if)# load-interval 30
CE1(config-if)#commit
```

3. Assign physical interfaces to Port-Channel:

```
CE1(config)#interface xe5
CE1(config-if)# channel-group 1000 mode active
CE1(config-if)#commit
CE1(config-if)#exit
CE1(config)#interface xe10
CE1(config-if)# channel-group 1000 mode active
CE1(config-if)#commit
CE1(config-if)#exit
```

4. Create sub-interface `po1000.100` and `xe11.100` adding the VLAN:

```
CE1(config)#interface po1000.100 switchport
CE1(config-if)#encapsulation dot1q 100
CE1(config-if)#commit
CE1(config-if)#exit
CE1(config)#interface xe11.100 switchport
CE1(config-if)#encapsulation dot1q 100
CE1(config-if)#commit
```

5. Set up a cross-connect named (`MH1`),specifying in and out interfaces:

```
CE1(config)#cross-connect MH1
CE1(config-xc)#interface xe11.100
CE1(config-xc)#interface po1000.100
CE1(config-xc)#commit
```

6. On `CE2` Node, configure the interface `xe4` and `xe7` switchport and set load interval `30seconds`):

```
CE2(config)#interface xe4
CE2(config-if)# switchport
CE2(config-if)#load-interval 30
CE2(config-if)#commit
CE2(config-if)#exit
CE2(config)#interface xe7
CE2(config-if)# switchport
CE2(config-if)#load-interval 30
CE2(config-if)#commit
CE2(config-if)#exit
```

7. Create sub-interface (`xe4.100`) and (`xe7.100)` adding the `VLAN 100`:

```
CE2(config)#interface xe4.100 switchport
CE2(config-if)#encapsulation dot1q 100
CE2(config-if)#commit
CE2(config-if)#exit
CE2(config)#interface xe7.100 switchport
CE2(config-if)#encapsulation dot1q 100
CE2(config-if)#commit
CE2(config-if)#exit
```

8. Set up a cross-connect named (`SH1`),specifying in and out interfaces:

```
CE2(config)#cross-connect SH1
CE2(config-xc)#interface xe4.100
CE2(config-xc)#interface xe7.100
CE2(config-xc)#commit
```

Provider Edge (PE) & Provider (P) Router Configuration:

1. Configure CFM and VXLAN related hardware profiles:

```
PE1(config)# hardware-profile filter cfm-domain-name-str enable
PE1(config)# hardware-profile statistics cfm-lm enable
PE1(config)# hardware-profile statistics cfm-ccm enable
PE1(config)# hardware-profile statistics cfm-slm enable
```

Note:

- In Q2 devices, hardware-profile filter cfm-domain-name-str enable by default.
- Perform the same Port-Channel configuration on PE2 router, changing the interface numbers accordingly.

2. Configure the loopback interface with a secondary IP address (1.1.1.1/32):

```
PE1(config)#interface lo
PE1(config-if)#ip address 1.1.1.1/32 secondary
PE1(config-if)#commit
PE1(config-if)#exit
```

Note: Configure loopback and interface IP addresses on PE2 using the respective values assigned.

3. Configure network interface as `xe9` with an IP address (`192.168.10.1/24`):

```
PE1(config)#interface xe9
PE1(config-if)#load-interval 30
PE1(config-if)#ip address 192.168.10.1/24
PE1(config-if)#label-switching
PE1(config-if)#commit
PE1(config-if)#exit
```

4. Configure OSPF routing, specify the OSPF router ID as (`1.1.1.1`), enable BFD on all interfaces, define the network (`1.1.1.1/32`) in area (`0.0.0.0`), and define the network (`192.168.10.0/24`):

```
PE1(config)#router ospf 1
PE1(config-router)#ospf router-id 1.1.1.1
PE1(config-router)#bfd all-interfaces
PE1(config-router)#network 1.1.1.1/32 area 0.0.0.0
PE1(config-router)#network 192.168.10.0/24 area 0.0.0.0
PE1(config-router)#commit
PE1(config-router)#exit
```

Note: Modify the OSPF router ID and networks on PE2 with unique IP address.

5. Enable VxLAN globally and configure VTEP IP:

```
PE1(config)# nvo vxlan enable
PE1(config)# evpn vxlan multihoming enable
PE1(config)#evpn esi hold-time 100
PE1(config)# nvo vxlan vtep-ip-global 1.1.1.1
PE1(config)# commit
```

Note: Apply VXLAN settings with PE2 corresponding VTEP IP address.

6. Configure BGP with the remote PE devices and activate EVPN:

```
PE1(config)# router bgp 100
PE1(config-router)# neighbor 3.3.3.3 remote-as 100
PE1(config-router)# neighbor 3.3.3.3 update-source lo
PE1(config-router)# address-family l2vpn evpn
PE1(config-router-af)# neighbor 3.3.3.3 activate
PE1(config-router-af)# exit
PE1(config-router)# exit
PE1(config)# commit
```

Note: Modify the BGP neighbor configurations on PE2 to establish correct peering with other routers.

7. Configure MAC VRF with the appropriate RD and RT:

```
PE1(config)#mac vrf vrf10
PE1(config-vrf)# rd 1.1.1.1:10
PE1(config-vrf)# route-target both 10:10
PE1(config-vrf)#commit
PE1(config-vrf)#exit
```

8. Map the VxLAN instance and VRF, specifying the VxLAN ID:

```
PE1(config)# nvo vxlan id 2000 ingress-replication
PE1(config-nvo)# vxlan host-reachability-protocol evpn-bgp vrf10
```

```
PE1(config-nvo)#vni-name MH
PE1(config-nvo)#commit
```

Note: VXLAN and BGP configurations align across all PE routers with respective neighbor modifications.

9. Configure the PO interface with ESI MAC.

```
PE1(config)#interface po1000
PE1(config-if)# switchport
PE1(config-if)# load-interval 30
PE1(config-if)# evpn multi-homed system-mac 0000.aaaa.bbbb
PE1(config-if-es)#
PE1(config-if-es)#commit
```

Note: Provide the similar configurations for PE2.

10. Add the interface into PO

```
PE1(config)# interface po1000.100 switchport
PE1(config-if)# encapsulation dot1q 100
PE1(config-if)# access-if-evpn
PE1(config-acc-if-evpn)#map vpn-id 2000
PE1(config-acc-if-evpn)# commit
```

Note: Provide the similar configurations for PE2.

11. Configure CFM UP MEP on PE1, define the CFM domain (`MD001`), create MA, configure UP MEP, andconfigure Remote MEP Auto-discovery enable, set CC Interval `10ms`:

```
PE1(config)#ethernet cfm domain-type character-string domain-name MD001
level 6 mip-creation default
PE1(config-ether-cfm)#service ma-type string ma-name ma1
PE1(config-ether-cfm-ma)#ethernet cfm mep up mpid 50 active true
po1000.100 vlan 100
PE1(config-ether-cfm-ma-mep)#cc multicast state enable
PE1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode
PE1(config-ether-cfm-ma)#rmep auto-discovery enable
PE1(config-ether-cfm-ma)#cc interval 10ms
PE1(config-ether-cfm-ma)#exit-ether-ma-mode
PE1(config-ether-cfm)#commit
```

Note:

- Similarly, configure the UP MEP CFM for PE2 router with different MEP id.
- Similarly, configure the UP MEP CFM for PE3 router with different MEP id and SLM and DMM reply configurations:

```
PE3(config)#ethernet cfm domain-type character-string domain-name MD001 level 6
mip-creation default

PE3(config-ether-cfm)#service ma-type string ma-name ma1

PE3(config-ether-cfm-ma)#ethernet cfm mep up mpid 52 active true xe4.100 vlan 100

PE3(config-ether-cfm-ma-mep)#cc multicast state enable

PE3(config-ether-cfm-ma-mep)#ethernet cfm loss-measurement reply slm

PE3(config-ether-cfm-ma-mep)#ethernet cfm delay-measurement reply dmm

PE3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode

PE3(config-ether-cfm-ma)#rmep auto-discovery enable

PE3(config-ether-cfm-ma)#cc interval 10ms
```

```
PE3(config-ether-cfm-ma)#exit-ether-ma-mode
PE3(config-ether-cfm)#commit
```

12. Provide SLM and DM profile configuration, define a delay measurement profile named `DM`, set the measurement interval to `1 second`, specify the number of intervals stored as `2`, configure the message period as `1 second`, set the loss measurement type to SLM, set the measurement interval to `1 second`, specify the number of intervals stored as `3`.

```
PE1(config)# ethernet cfm delay-measurement profile-name DM
PE1(config-cfm-dm)# measurement-interval 1
PE1(config-cfm-dm)# intervals-stored 2
PE1(config-cfm-dm)# message-period 1s
PE1(config-cfm-dm)# commit

PE1(config)# ethernet cfm loss-measurement profile-name SLM
PE1(config-cfm-lm)# measurement-type slm
PE1(config-cfm-lm)# measurement-interval 1
PE1(config-cfm-lm)# intervals-stored 3
PE1(config-cfm-lm)# message-period 1s
PE1(config-cfm-lm)# commit
```

Note: Modify the delay measurement profile on PE2 router.

Configuration Snapshot:

CE1:

```
interface xe11
switchport
load-interval 30
!
interface po1000
switchport
load-interval 30
!
interface xe5
channel-group 1000 mode active
!

interface xe10
channel-group 1000 mode active
!
interface po1000.100 switchport
encapsulation dot1q 100
!

interface xe11.100 switchport
encapsulation dot1q 100
!
cross-connect MH
interface xe11.100
interface po1000.100
!
```

CE2:

```
interface xe4
switchport
load-interval 30
```

```
!
interface xe7
switchport
load-interval 30
!

interface xe4.100 switchport
encapsulation dot1q 100
!

interface xe7.100 switchport
encapsulation dot1q 100
!
cross-connect SH1
interface xe4.100
interface xe7.100
!
```

PE1:

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-lm enable
hardware-profile statistics cfm-ccm enable
hardware-profile statistics cfm-slm enable


interface lo
ip address 1.1.1.1/32 secondary
!

interface xe9
load-interval 30
ip address 192.168.10.1/24
label-switching

!
router ospf 1
ospf router-id 1.1.1.1
bfd all-interfaces
network 1.1.1.1/32 area 0.0.0.0
network 192.168.10.0/24 area 0.0.0.0
!
nvo vxlan enable
!
evpn esi hold-time 100
!
evpn vxlan multihoming enable
!
nvo vxlan vtep-ip-global 1.1.1.1

!
router bgp 100
neighbor 3.3.3.3 remote-as 100
neighbor 3.3.3.3 update-source lo
address-family l2vpn evpn
neighbor 3.3.3.3 activate
!
```

```
mac vrf vrf10
rd 1.1.1.1:10
route-target both 10:10
!

nvo vxlan id 2000 ingress-replication
vxlan host-reachability-protocol evpn-bgp vrf10
vni-name MH
!

interface po1000
switchport
load-interval 30
evpn multi-homed system-mac 0000.aaaa.bbbb
!
interface xe5
channel-group 1000 mode active
!

interface po1000.100 switchport
encapsulation dot1q 100
access-if-evpn
map vpn-id 2000
!

ethernet cfm domain-type character-string domain-name MD001 level 6 mip-
creation default
service ma-type string ma-name ma1
ethernet cfm mep up mpid 50 active true po1000.100 vlan 100
cc multicast state enable
exit-ether-ma-mep-mode
rmep auto-discovery enable
cc interval 10ms
exit-ether-ma-mode
!

ethernet cfm delay-measurement profile-name DM
measurement-interval 1
intervals-stored 2
message-period 1s
!

ethernet cfm loss-measurement profile-name SLM
measurement-type slm
measurement-interval 1
intervals-stored 3
message-period 1s
 !
```

PE2:

```
hardware-profile filter cfm-domain-name-str enable
conhardware-profile statistics cfm-lm enable
hardware-profile statistics cfm-ccm enable
hardware-profile statistics cfm-slm enable
!
interface lo
```

```
ip address 2.2.2.2/32 secondary
!
interface xe17
load-interval 30
ip address 192.168.20.1/24
label-switching
!
router ospf 1
ospf router-id 2.2.2.2
bfd all-interfaces
network 2.2.2.2/32 area 0.0.0.0
network 192.168.20.0/24 area 0.0.0.0
!
nvo vxlan enable
!
evpn esi hold-time 100
!
evpn vxlan multihoming enable
!
nvo vxlan vtep-ip-global 2.2.2.2
!
router bgp 100
neighbor 3.3.3.3 remote-as 100
neighbor 3.3.3.3 update-source lo
address-family l2vpn evpn
neighbor 3.3.3.3 activate
!
mac vrf vrf10
rd 2.2.2.2:10
route-target both 10:10
!
nvo vxlan id 2000 ingress-replication
vxlan host-reachability-protocol evpn-bgp vrf10
vni-name MH
!
interface po1000
switchport
load-interval 30
evpn multi-homed system-mac 0000.aaaa.bbbb
!
interface xe5
channel-group 1000 mode active
!
interface po1000.100 switchport
encapsulation dot1q 100
access-if-evpn
map vpn-id 2000
!
ethernet cfm domain-type character-string domain-name MD001 level 6 mip-creation
default
service ma-type string ma-name ma1
```

```
ethernet cfm mep up mpid 51 active true po1000.100 vlan 100
cc multicast state enable
exit-ether-ma-mep-mode
rmep auto-discovery enable
cc interval 10ms
exit-ether-ma-mode
!
```

P1:

```
interface lo
ip address 4.4.4.4/32 secondary
!
interface xe9
load-interval 30
ip address 192.168.10.2/24
label-switching
!
interface xe17
load-interval 30
ip address 192.168.20.2/24
label-switching
!
interface xe11
load-interval 30
ip address 192.168.30.1/24
label-switching
!
router ospf 1
ospf router-id 4.4.4.4
bfd all-interfaces
network 4.4.4.4/32 area 0.0.0.0
network 192.168.10.0/24 area 0.0.0.0
network 192.168.20.0/24 area 0.0.0.0
network 192.168.30.0/24 area 0.0.0.0
!
```

PE3:

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-lm enable
hardware-profile statistics cfm-ccm enable
hardware-profile statistics cfm-slm enable
!
interface lo
ip address 3.3.3.3/32 secondary
!
interface xe3
load-interval 30
ip address 192.168.30.2/24
label-switching
!
router ospf 1
ospf router-id 3.3.3.3
bfd all-interfaces
```

```
network 3.3.3.3/32 area 0.0.0.0
network 192.168.30.0/24 area 0.0.0.0
!
nvo vxlan enable
!
evpn esi hold-time 100
!
nvo vxlan vtep-ip-global 3.3.3.3
!
router bgp 100
neighbor 1.1.1.1 remote-as 100
neighbor 1.1.1.1 update-source lo
neighbor 2.2.2.2 remote-as 100
neighbor 2.2.2.2 update-source lo
address-family l2vpn evpn
neighbor 1.1.1.1 activate
neighbor 2.2.2.2 activate
 !
mac vrf vrf10
rd 3.3.3.3:10
route-target both 10:10
!
nvo vxlan id 2000 ingress-replication
vxlan host-reachability-protocol evpn-bgp vrf10
vni-name SH
!
interface xe4
switchport
load-interval 30
!
interface xe4.100 switchport
encapsulation dot1q 100
access-if-evpn
map vpn-id 2000
!
ethernet cfm domain-type character-string domain-name MD001 level 6 mip-
creation default
service ma-type string ma-name ma1
ethernet cfm mep up mpid 52 active true xe4.100 vlan 100
cc multicast state enable
ethernet cfm loss-measurement reply slm
ethernet cfm delay-measurement reply dmm
exit-ether-ma-mep-mode
rmep auto-discovery enable
cc interval 10ms
exit-ether-ma-mode
!
```

Validation

Verify the nvo vxlan status:

```
PE1#show nvo vxlan
VXLAN Information
=================
   Codes: NW - Network Port
```

```
          AC - Access Port
         (u) - Untagged

VNID     VNI-Name     VNI-Type Type Interface ESI                          VLAN      DF-
Status Src-Addr         Dst-Addr
_____________________________________________________________________________________________
________________________________________
2000      ----         L2       NW   ----      ----                         ----      -
---      1.1.1.1          3.3.3.3
2000     ----       --      AC   po1000.100 00:00:00:aa:aa:bb:bb:00:00:00 ----     DF
----             ----

Total number of entries are 2

Note: Refer sub-interface config for VLAN information.
```

Verify the CFM Errors Status:

```
PE1#show ethernet cfm errors domain MD001

Domain Name MA Name Level VLAN InnerVLAN MEPID Defects
-----------------------------------------------------------------------
MD001       ma1      6    100      NA     50 ....
```

Verify the ethernet cfm ma status domain is active or not::

```
PE1#show ethernet cfm ma status domain MD001 ma-name ma1
MA NAME            STATUS
-------------------------------
 ma1               Active
```

Verify the local MEP is installed or not:

```
PE1#show ethernet cfm maintenance-points local mep domain MD001 ma-name ma1
MPID Dir Lvl VLAN CC-Stat HW-Status CC-Intvl MAC-Address  Def  Port  MD Name
--------------------------------------------------------------------------------
50  Up   6   100  Enable Installed   10 ms  e8c5.7afe.fae9 F  xe3.10  MD001
```

Verify the RMEP is learned or not:

```
PE1#show ethernet cfm maintenance-points remote domain MD001 ma-name ma1
MA_NAME   MEPID  RMEPID  LEVEL Rx  CCM RDI    PEER-MAC      TYPE
------------------------------------------------------------------------------
ma1        50     52     6     Yes   False  5c07.5851.cfad   Learnt
```

Verify the Ping:

```
PE1#ping ethernet mac 5c07.5851.cfad unicast source 50 domain MD001 ma ma1
success rate is 100 (5/5)
```

Verify the traceroute:

```
PE1#traceroute ethernet 5c07.5851.cfad mepid 50 domain MD001 ma ma1
MP Mac          Hops    Relay-action Ingress/Egress Ingress/Egress action
5c07.5851.cfad 1      RlyHit           Ingress         IngOK
```

Verify the Delay-measurement:

```
PE1#delay-measurement type proactive profile-name DM rmep 52 mep 50 domain MD001 ma ma11
PE1#2025 Feb 07 14:49:08.416  : PE1 : ONMD : INFO : [CFM_PM_SESSION_INFO_5]: CFM Frame
Delay Measurement session started for MEP Id 50 and RMEP Id 52
PE1#
PE1#show ethernet cfm delay-measurement mep 50 domain MD001 ma-name ma1
MD : MD001
MA : ma1
MEP : 50
VLAN ID : 100
Interface : po1000.100
Peer MAC Address : 5c07.5851.cfad
CURRENT:
======================
RMEP ID : 210
Measurement ID : 1
Measurement Type : DMM
Elapsed time(sec) : 12
Start Time : 2025 Feb 07 14:49:08
Suspect Flag : FALSE
Min Frame Delay(usec) : 20
Max Frame Delay(usec) : 21
Avg Frame Delay(usec) : 20
Min Inter FD Variation(usec): 0
Max Inter FD Variation(usec): 1
Avg Inter FD Variation(usec): 0
FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
========================================================
1 0 - < 4999 12
2 5000 - < 9999 0
3 10000 - < 4294967295 0
INTER-FRAME DELAY BINS
Bin Number Bin Threshold(usec) Bin Counter
========================================================
1 0 - < 4999 11
2 5000 - < 4294967295 0
```

Verify the SLM:

```
PE1#loss-measurement type proactive profile-name SLM rmep 52 mep 50 domain MD001 ma ma1
PE1#2025 Feb 07 14:53:24.850 : PE1 : ONMD : INFO : [CFM_DEFECT_INFO_5]: CFM Frame Loss
Measurement started for MEP:50 MA:ma1 MD:MD001

PE1#show ethernet cfm loss-measurement mep 50 domain MD001 ma-name ma1
CURRENT:
Measurement ID : 2
Suspect : False
Measurement Type : slm
```

```
Elapsed time(sec) : 10
Start Time : 2025 Feb 15:03:43:02
Near End loss : 0
Far End loss : 0
Near End accumulated loss : 0
Far End accumulated loss : 0
Near End frame loss ratio : 0
Far End frame loss ratio : 0

HISTORY:

Measurement ID : 1
Suspect : False
Measurement Type : slm
Elapsed time(sec) : 60
End Time : 2025 Feb 15:03:43:02
Near End loss : 0
Far End loss : 0
Near End accumulated loss : 0
Far End accumulated loss : 0
Near End frame loss ratio : 0
Far End frame loss ratio : 0
Near End frame loss ratio min : 0
Far End frame loss ratio min : 0
Near End frame loss ratio max : 0
Far End frame loss ratio max : 0
```

Implementation Examples

Enterprise Connectivity Monitoring:

Scenario: A large enterprise operates multiple branch offices connected via Ethernet services provided by a service provider network.

Use Case: Y.1731 CFM over sub-interface using Single Home VxLAN enables the enterprise to monitor theconnectivity and performance of its branch office connections. It facilitates proactive fault detection and management, ensuring reliable and uninterrupted communication between the headquarters and branch offices.

Service Provider Network Operations:

Scenario: A service provider manages a diverse range of Ethernet services for its enterprise customers, including VPNs, Internet access, and cloud connectivity.

Use Case: Y.1731 CFM over sub-interface using Single Home VxLAN empowers the service provider to deliverhigh-quality Ethernet services with enhanced fault management capabilities. It enables the provider to quickly identify and resolve connectivity issues, minimize service downtime, and maintain customer satisfaction.

Glossary

The following provides definitions for key terms or abbreviations and their meanings used throughout this document:

Key Terms/Acronym	**Description**
Y.1731	A standard defined by the International Telecommunication Union Telecommunication Standardization Sector (ITU-T) that specifies performance monitoring and fault management for Ethernet-based networks.
Sub-interface	A logical division of a physical interface, typically used to separate traffic based on VLAN or other criteria. In this context, sub-interfaces are employed to establish distinct connections within the VxLAN ELAN SH topology.
ELAN	ELAN is a type of VxLAN service that provides point-to-multi point Ethernet connectivity between two sites.
Single Home (SH)	Refers to the configuration where a Customer Edge device (CE) is connected to only one Provider Edge device (PE) within an VxLAN setup. It contrasts with the multi-homed configuration, where a CE may be connected to multiple PEs.
Maintenance End Point (MEP)	MEP is a CFM entity that resides at the edge of a CFM domain. It is responsible for generating and transmitting CFM protocol packets to detect faults and collect performance data.
Maintenance Domain (MD)	MD is a logical grouping of MEPs within a CFM network. MEPs within the same MD can communicate with each other to perform CFM functions such as fault detection and performance monitoring.
Maintenance Association(MA)	MA is a collection of MEPs associated with a specific service or set of services. It defines the scope of CFM operations within a maintenance domain.
Maintenance Point Identifier (MPID)	MPID is a unique identifier assigned to each MEP within a maintenance association. It is used to distinguish between different MEPs within the same MA.
Service Level Measurement (SLM)	SLM is a CFM function used to measure the loss characteristics of a network path. It collects data on packet loss, delay, and jitter to assess the quality of service provided by the network.
Loopback Message Generation (LMM)	LMM is a CFM function used to test end-to-end connectivity by generating loopback messages. These messages are transmitted from a MEP and looped back to the same MEP to verify bidirectional communication.
Delay Measurement Message (DMM)	DMM is a CFM function used to measure the one-way delay of packets transmitted across a network. It helps assess the performance of the network in terms of packet delivery time.
Continuity Check (CC)	CC is a CFM function used to verify the continuity of a service or network path by periodically sending continuity check messages between MEPs. It helps detect connectivity faults such as link failures or misconfigurations.

CHAPTER 14 Ethernet Linear Protection Switching Configuration

The feature Ethernet Linear Protection Switching (ELPS) adds a fast mechanism to switch from a failing Ethernet transport entity to a working Ethernet transport entity, thereby restoring node to node link up condition.

The objective of fast protection switching is achieved by integrating mature Ethernet operations, administration, and maintenance (OAM) functions and a simple automatic protection switching (APS) protocol for Ethernet linear networks. Since protection switching requires monitoring of both working and protection transport enti-ties, it is required that MEPs be activated for the purpose of monitoring the working and protection transport entities. Both transport entities are monitored individually by exchanging Continuity Check Messages (CCMs).

ELPS protocol is optimized to provide Protection Switching between two distinct endpoints on a point to point vlan-based Ethernet network. It can be used as an alternative to spanning tree protocol (STP) for fast transiting the port status without complex computation, provisioning overhead, and excessive information exchange, to thus achieve much faster (i.e., 50ms) protection switching. With ELPS, it is much convenient for network operator to grasp the status of network (eg. Active network topology) with protection switching than with other survivability mechanisms, such as STP.

Note: A loop-breaking mechanism (such as STP or ELPS) must be present at all times. If a loop exists before ELPS

Limitations

- 1:1 is supported for sub interfaces over cross-connect.
- Supported on both Q1 and Q2 devices.
- CLI restructure: Make CLI more modular and flexible.
- Make ELPS control plane code bridge independent.

In the linear 1:1 protection switching architecture, the protection transport entity is dedicated to the working transport entity. However, the normal traffic signal is transported either on the working transport entity or on the protection transport entity using a selector bridge at the source of the protected domain.

Prerequisite

The prerequisites for implementing **G.8031** with cross-connects are:

- Devices in the network (for example, routers and switches) must support **G.8031 with cross connect** and relevant traffic generation features.
- A network path configured for test traffic between source and destination endpoints.
- CFM down mep should configured between the devices.

Note: The initial Layer 2 movement will take some time to settle after configuring ELPS.

Topology

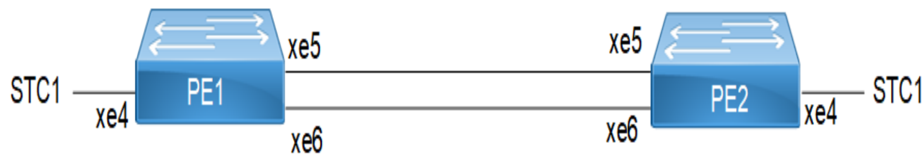


Figure 14-23: ELPS Topology

Configuration

Prerequisite

Configure below hardware-profile commands related to CFM in configuration mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable
```

PE1 Configurations

Interface Configuration: Configure L2 sub-interface with encapsulation type dot1q/dot1ad on node as mentioned below:

Access-interface configuration:

```
interface xe4
 speed 10g
!
interface xe4.100 switchport
 encapsulation dot1q 100
 load-interval 30
```

Network interface configuration:

```
interface xe5
 speed 10g
!
interface xe5.100 switchport
 encapsulation dot1q 100
 load-interval 30
!
interface xe6
 speed 10g
!
interface xe6.100 switchport
 encapsulation dot1q 100
 load-interval 30
```

G8031 ELPS Configuration:

1. Configure g8031 eps-protection group with working-port and protection-port as mentioned below:

```
g8031 eps-protection group PG12
```

```
 working-port xe5.100
 protection-port xe6.100
```

2. Configure g8031 profile with mode as one-and-one-bidirectional (1:1) and swith mode as revertive/non-revertive on node as below:

```
g8031 profile profile1
 mode one-and-one-bidirectional
 switching mode revertive
```

3. Configure g8031 eps-instance with eps-protection group, g8031 profile, aps-channel level and control vlan on node as below:

```
g8031 eps-instance eps12
 eps-protection-group PG12
 g8031-profile profile1
 aps-channel level 7
 control vlan 100
 !
```

4. **CFM Configuration**: Configure Ethernet CFM down mep using g8031 eps-protection group working-port (xe5.100) and protection-ports (xe6.100) on node as mentioned below:

```
ethernet cfm domain-type character-string domain-name AB001 level 7 mip-creation none
 service ma-type string ma-name ma01
   ethernet cfm mep down mpid 102 active true xe5.100 vlan 100
     cc multicast state enable
     exit-ether-ma-mep-mode
   mep crosscheck mpid 201
   cc interval 3ms
   exit-ether-ma-mode
service ma-type string ma-name ma02
   ethernet cfm mep down mpid 112 active true xe6.100 vlan 100
     cc multicast state enable
     exit-ether-ma-mep-mode
   mep crosscheck mpid 211
   cc interval 3ms
   exit-ether-ma-mode
```

5. **Cross-connect Configuration**: Configure cross-connect using g8031 protection-group working-port and protection-port as backup port and map the elps instance as mentioned below:

```
cross-connect 100
 interface xe5.100
  backup xe6.100
  g8031-eps eps12
 interface xe4.100
```

PE2 Configurations:

1. Interface Configuration: Configure L2 sub-interface with encapsulation type dot1q/dot1ad on node as mentioned.
2. Access-interface configuration: Enter the interface xe4 and set the interface speed to 10G.

```
interface xe4
 speed 10g
!
```

3. Configure VLAN sub-interface xe4.100, and then exit the interface mode.
```
interface xe4.100 switchport
encapsulation dot1q 100
load-interval 30
exit
```
4. Configure Network Interfaces (xe5): Enter interface xe5 and set the speed to 10G.
5. Configure VLAN sub-interface xe5.100.
```
interface xe5.100 switchport
encapsulation dot1q 100
load-interval 30
```
6. Configure Network Interfaces (xe6): Enter interface xe6 and set the speed to 10G.
```
interface xe6.100 switchport
encapsulation dot1q 100
load-interval 30
```
7. Configure VLAN sub-interface xe6.100.
```
interface xe6.100 switchport
encapsulation dot1q 100
load-interval 30
```

G8031 ELPS Configuration:

1. Configure G.8031 EPS-Protection Group: Define the EPS-protection group with the specified working and protection ports.
```
g8031 eps-protection group PG12
 working-port xe5.100
 protection-port xe6.100
```
2. Configure G.8031 Profile: Set up the G.8031 profile with the required mode and switching configuration.
```
g8031 profile profile1
 mode one-and-one-bidirectional
 switching mode revertive
```
3. Configure G.8031 EPS-Instance: Associate the EPS-instance with the previously defined protection group and profile. Also, configure the APS-channel level and control VLAN:
```
g8031 eps-instance eps12
 eps-protection-group PG12
 g8031-profile profile1
 aps-channel level 7
 control vlan 100
```

Ethernet Connectivity Fault Management (CFM) Configuration

1. Configured Ethernet CFM down mep using g8031 eps-protection group working-port (xe5.100) and protection-ports (xe6.100) on node as mentioned below.
2. Configure the CFM Domain: Define the CFM domain with the required domain type, name, and level.
```
ethernet cfm domain-type character-string domain-name AB001 level 7 mip-creation none
```
3. Configure CFM Service and Maintenance Association (MA): For MA01 on Interface xe5.100.

4. Define the CFM service with the MA name ma01, and configure the Maintenance Endpoint (MEP).
```
service ma-type string ma-name ma01
ethernet cfm mep down mpid 201 active true xe5.100 vlan 100
```
5. Enable Continuity Check (CC) Multicast Stat and then configure MEP Crosscheck.
```
cc multicast state enable
exit-ether-ma-mep-mode
mep crosscheck mpid 102
```
6. Set the Continuity Check (CC) Interval.
```
cc interval 3ms
exit-ether-ma-mode
```
7. Configure CFM Service and Maintenance Association (MA): For MA02 on Interface xe6.100.
```
service ma-type string ma-name ma02
```
8. Define the CFM service with the MA name ma02, and then configure the MEP.
```
ethernet cfm mep down mpid 211 active true xe6.100 vlan 100
```
9. Enable Continuity Check (CC) Multicast State, and then configure MEP Crosscheck:
```
cc multicast state enable
exit-ether-ma-mep-mode
mep crosscheck mpid 112
```
10. Set the Continuity Check (CC) Interval.
```
cc interval 3ms
exit-ether-ma-mode
```

Cross-connect Configuration

Configure cross-connect using g8031 protection-group working-port and protection-port as backup port and map the ELPS instance as mentioned below.

1. Configure Cross-Connect ID: Define the cross-connect ID, and then assign interface xe5.100 as the primary interface.
```
cross-connect 100
interface xe5.100
```
2. Set interface xe6.100 as the backup interface, associate the G.8031 EPS instance (eps12)
```
backup xe6.100
g8031-eps eps12
```
3. Assign interface xe4.100 to the cross-connect.
```
interface xe4.100
```

Validation

PE1 node

:

Verify ELPS instance status using below command.

```
PE1#show g8031 eps-instance
EPS-Name       Id  Mode    Working-Path  State Protection-Path State Control-VLAN
CFM
```

```
-----------------------------------------------------------------------------------------
--------
eps12         1   1:1,BI  xe5.100 (A)   Up    xe6.100        Up    100
Yes
PE1#

PE1#show g8031 eps-instance eps12
Inst Name        : eps12 (1), Profile (profile1), Protection Group (PG12)
Mode & Group     : Bridge (1:1), Direction (Bi), Revertive (Yes)
                 : Working port (po1.100, Up) Protection port (xe5.100, Up)
Current State    : No Request, Request signal (Null), Active-Path (Working)
                   dFOP State - Not in defect mode
working_cfm      : mep_id (102), cc-interval (3ms), Domain (AB001), MA (ma01)
Protection_cfm   : mep_id (112), cc-interval (3ms), Domain (AB001), MA (ma02)
APS channel Info: vlan (100) Level (7)
APS Statistics   : Tx - 11  Rx - 6
PE1#
```

CFM status using below command

```
DUT1#show ethernet cfm maintenance-points count
--------------------------------------------
Total No of MIPs                 : 0
Total No of MEPs                 : 2
Total No of UP MEPs              : 0
Total No of Down MEPs            : 2
Total No of Active MEPs          : 2
Total No of UP CCM sessions      : 2
Total No of Active Test sessions : 0
Total No of Active LM sessions   : 0
Total No of Active DM sessions   : 0
--------------------------------------------
DUT1#
DUT1#show ethernet cfm errors

Domain Name    MA Name       Level VLAN  InnerVLAN  MEPID  Defects
-----------------------------------------------------------------------
AB001          ma01          7     100   NA         102    .....
AB001          ma02          7     100   NA         112    .....

1. defRDICCM    2. defMACstatus  3. defRemoteCCM
4. defErrorCCM  5. defXconCCM
DUT1#
```

CHAPTER 15 G.8032 ERPS Version 2

G.8032 is an International Telecommunication Union (ITU) standard for ERPS. It prevents loops on a per-VLAN basis with networks that are wired in a simple ring topology. The loops are prevented by blocking traffic on either a predetermined link or a failed link.

G.8032 Version 2 provides enhancements in support of multiple ring and ladder topologies. G.8032 offers a rapid detection and recovery time if a link or node.

This guide contains topologies and examples on how to configure g8032 ERPS configuration.

Topology

Figure 15-24 displays a sample Ring Protection topology on which protection switching is configured with four bridges. The Ring Protection Link (RPL) owner is the link between Bridge 3 and Bridge 4 (xe16), on which one side of the link is defined explicitly as RPL owner (Bridge 4) and RPL neighbor (Bridge 3). The rest of the bridges are explicitly configured RPL non owner to enable ERPS in the ring.

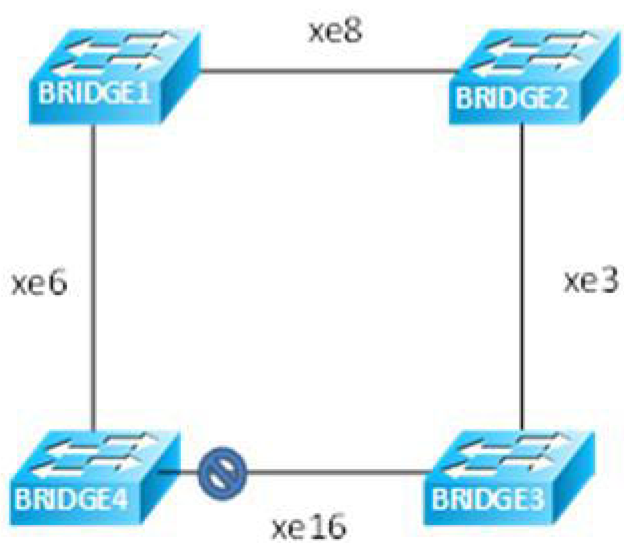


Figure 15-24: Major Ring Topology

Prerequisite

Configure below hardware-profile commands related to CFM in configuration mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable
```

Bridge 1

`Bridge1#configure terminal`	Enter configure mode
`Bridge1(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.

`Bridge1(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge1(config)#vlan database`	Configure VLAN database
`Bridge1(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge1(config-vlan)#interface xe6`	Configure interface xe6
`Bridge1(config-if)#switchport`	Configure xe6 as a layer 2 port
`Bridge1(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge1(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge1(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on xe6 interface
`Bridge1(config-if)#interface xe8`	Configure interface xe8
`Bridge1(config-if)#switchport`	Configure xe8 as a layer 2 port
`Bridge1(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge1(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge1(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on xe8 interface
`Bridge1(config-if)#ethernet cfm domain-type character-string domain-name nod12 level 7 mip-creation none`	Create cfm domain with type as character string with name nod12 and set MIP creation criteria to default with level 7
`Bridge1(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982
`Bridge1(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge1(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 12 active true xe8`	Create down MEP 12 for xe8 interface
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 21`	Configure crosscheck to remote MEP with value 21
`Bridge1(config-ether-cfm-ma)#cc  interval 100ms`	Enable cc interval with 100ms
`Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode

`Bridge1(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod41 level 7 mip-creation none`	Create cfm domain with type as character string with name nod41 and set mip creation criteria to default with level 7
`Bridge1(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982.
`Bridge1(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge1(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 14 active true xe6`	Create down MEP 14 for xe6 interface
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 41`	Configure crosscheck to remote MEP with value 41
`Bridge1(config-ether-cfm-ma)#cc  interval 100ms`	Enable CC interval with 100ms
`Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge1(config-ether-cfm)#g8032 ring RING1`	Create g8032 ring with name RING1
`Bridge1(g8032-ring-config)#east-interface xe6`	Associate xe6 interface as east-interface
`Bridge1(g8032-ring-config)#west-interface xe8`	Associate xe8 interface as west-interface
`Bridge1(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge1(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge1(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge1(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge1(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge1(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge1(g8032-config-switch)#ring RING1`	Associate ring RING1 to erp1 instance
`Bridge1(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node
`Bridge1(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance

`Bridge1(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge1(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge1(g8032-config-switch)#data vlan 201-205`	Configure traffic vlan from 201-205
`Bridge1(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge1(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge1(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 2

`Bridge2#config terminal`	Enter configure mode
`Bridge2(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge2(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge2(config)#vlan database`	Configure VLAN database
`Bridge2(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge2(config-vlan)#interface xe3`	Configure interface xe3
`Bridge2(config-if)#switchport`	Configure xe3 as a layer 2 port
`Bridge2(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge2(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge2(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on xe3 interface
`Bridge2(config-if)#interface xe8`	Configure interface xe8
`Bridge2(config-if)#switchport`	Configure xe8 as a layer 2 port
`Bridge2(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge2(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge2(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on xe8 interface
`Bridge2(config-if)#ethernet cfm domain-type character-string domain-name nod23 level 7 mip-creation none`	Create cfm domain with type as character string with name nod23 and set mip creation criteria to default with level 7
`Bridge2(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982.
`Bridge2(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge2(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none

`Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 23 active true local-vid 200 xe3`	Create down MEP 23 with local VID 200 for xe3 interface
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 32`	Configure crosscheck to remote MEP with value 32
`Bridge2(config-ether-cfm-ma)#cc  interval 100ms`	Enable CC interval with 100ms
`Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet MA mode
`Bridge2(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod12 level 7 mip-creation none`	Create CFM domain with type as character string with name nod12 and set mip creation criteria to default with level 7
`Bridge2(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982.
`Bridge2(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge2(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 21 active true xe8`	Create down MEP 21 for xe8 interface
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 12`	Configure crosscheck to remote MEP with value 12
`Bridge2(config-ether-cfm-ma)#cc  interval 100ms`	Enable CC interval with 100ms
`Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet MA mode
`Bridge2(config-ether-cfm)#g8032 ring RING1`	Create g8032 ring with name RING1
`Bridge2(g8032-ring-config)#east-interface xe8`	Associate xe8 interface as east-interface
`Bridge2(g8032-ring-config)#west-interface xe3`	Associate xe3 interface as west-interface
`Bridge2(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge2(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge2(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge2(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge2(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode

`Bridge2(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge2(g8032-config-switch)#ring RING1`	Associate ring RING1 to erp1 instance
`Bridge2(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node
`Bridge2(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge2(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge2(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge2(g8032-config-switch)#data vlan 201-205`	Configure traffic vlan from 201-205
`Bridge2(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge2(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge2(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 3

`Bridge3#config terminal`	Enter configure mode
`Bridge3(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge3(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge3(config)#vlan database`	Configure VLAN database
`Bridge3(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge3(config-vlan)#interface xe3`	Configure interface xe3
`Bridge3(config-if)#switchport`	Configure xe3 as a layer 2 port
`Bridge3(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge3(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge3(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge3(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on xe3 interface
`Bridge3(config-if)#interface xe16`	Configure interface xe16
`Bridge3(config-if)#switchport`	Configure xe16 as a layer 2 port
`Bridge3(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge3(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge3(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge3(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on xe16 interface

`Bridge3(config-if)#ethernet cfm domain-type character-string domain-name nod23 level 7 mip-creation none`	Create cfm domain with type as character string with name nod23 and set mip creation criteria to default with level 7
`Bridge3(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982.
`Bridge3(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge3(config-ether-cfm-ma)# mip-creation none`	Set mip-creation criteria to none
`Bridge3(config-ether-cfm-ma)#ethernet cfm mep down mpid 32 active true xe3`	Create down MEP 32 for xe3 interface
`Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 23`	Configure crosscheck to remote MEP with value 23
`Bridge3(config-ether-cfm-ma)#cc  interval 100ms`	Enable CC interval with 100ms
`Bridge3(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge3(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod34 level 7 mip-creation none`	Create cfm domain with type as character string with name nod34 and set mip creation criteria to default with level 7
`Bridge3(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982.
`Bridge3(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge3(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge3(config-ether-cfm-ma)#ethernet cfm mep down mpid 34 active true xe16`	Create down MEP 34 for xe16 interface
`Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 43`	Configure crosscheck to remote MEP with value 43
`Bridge3(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge3(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet MA mode
`Bridge3(config-ether-cfm)#g8032 ring RING1`	Create g8032 ring with name RING1
`Bridge3(g8032-ring-config)#east-interface xe3`	Associate xe3 interface as east-interface
`Bridge3(g8032-ring-config)#west-interface xe16`	Associate xe16 interface as west-interface
`Bridge3(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1

`Bridge3(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge3(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge3(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge3(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge3(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge3(g8032-config-switch)#ring RING1`	Associate ring RING1 to erp1 instance
`Bridge3(g8032-config-switch)#rpl role neighbor west-interface`	Configure RPL node as neighbor node on west-interface
`Bridge3(g8032-config-switch)#g8032-profile profile1`	Associate profile profile1 to erp1 instance
`Bridge3(g8032-config-switch)#aps-chanel level 7`	Configure level as 7
`Bridge3(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge3(g8032-config-switch)#data vlan 201-205`	Configure traffic vlan from 201-205
`Bridge3(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge3(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge3(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 4

`Bridge4#config term`	Enter configure mode
`Bridge4(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge4(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge4(config)#vlan database`	Configure VLAN database
`Bridge4(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge4(config-vlan)#interface xe6`	Configure interface xe6
`Bridge4(config-if)#switchport`	Configure xe6 as a layer 2 port
`Bridge4(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge4(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge4(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge4(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on xe6 interface
`Bridge4(config-if)#interface xe16`	Configure interface xe16
`Bridge4(config-if)#switchport`	Configure xe16 as a layer 2 port

`Bridge4(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge4(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge4(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge4(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on xe16 interface
`Bridge4(config-if)#ethernet cfm domain-type character-string domain-name nod34 level 7 mip-creation none`	Create cfm domain with type as character string with name nod34 and set mip creation criteria to default with level 7
`Bridge4(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge4(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge4(config-ether-cfm-ma)# mip-creation none`	Set mip-creation criteria to none
`Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 43 active true xe16`	Create down MEP 43 for xe16 interface
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 34`	Configure crosscheck to remote MEP with value 34
`Bridge4(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet MA mode
`Bridge4(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod41 level 7 mip-creation none`	Create CFM domain with type as character string with name nod41 and set mip creation criteria to default with level 7
`Bridge4(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982.
`Bridge4(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge4(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 41 active true xe6`	Create down MEP 41 for xe6 interface
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 14`	Configure crosscheck to remote MEP with value 14
`Bridge4(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge4(config-ether-cfm)#g8032 ring RING1`	Create g8032 physical ring with name RING1

`Bridge4(g8032-ring-config)#east-interface xe16`	Associate xe16 interface as east-interface
`Bridge4(g8032-ring-config)#west-interface xe6`	Associate xe6 interface as west-interface
`Bridge4(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge4(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge4(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge4(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge4(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge4(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge4(g8032-config-switch)#ring RING1`	Associate ring RING1 to erp1 instance
`Bridge4(g8032-config-switch)#rpl role owner east-interface`	Configure the node as owner node on east-interface
`Bridge4(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge4(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge4(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge4(g8032-config-switch)#data vlan 201-205`	Configure traffic vlan from 201-205
`Bridge4(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge4(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge4(g8032-config-switch)#end`	Exit g8032 erp instance mode

Validation

```
Bridge1:
show g8032 aps-statistics erp1

Instance    : erp1
==========
Tx    : 3205
Rx    : 27

show g8032 ring RING1

Ring           : RING1
===============
Description    :
East           : xe16
West           : xe6
ERP Inst       : erp1
```

```
show g8032 profile profile1

Profile : profile1
=========
 Wait-To-Restore : 1 mins
 Hold Off Timer  : 0.00 secs
 Guard Timer     : 10 ms
 Wait-To-Block   : 5010 ms
 Protection Type : Revertive

Bridge1:
show g8032 erp-instance erp1

Inst Name       : erp7
Description     :
State           : G8032_ST_IDLE
Phy Ring        : RING1
Ring Type       : MAJOR-RING
Role            : NON-OWNER
Node ID         : 3c:2c:99:26:e6:80
-----------------------------------------------------------
                   East Link           West Link
===========================================================
Interface       :  xe6                 xe8
State           :  Unblocked           Unblocked
Remote NodeId   :  34:17:eb:e4:af:11   -
Remote BPR      :  1                   -
Endpoint Info
-------------
Domain Name     :  nod41               nod12
MEP ID          :  14                  12
MA Name         :  43982               43982
===========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   1)         |
===========================

DataTraffic vlan: 201-205
Profile : profile1

Bridge2:
show g8032 erp-instance erp1

Inst Name       : erp1
Description     :
State           : G8032_ST_IDLE
Phy Ring        : RING1
Ring Type       : MAJOR-RING
Role            : NON-OWNER
Node ID         : d8:9e:f3:5e:f8:29
-----------------------------------------------------------
                   East Link           West Link
===========================================================
```

```
Interface       :  xe8                 xe3
State           :  Unblocked           Unblocked
Remote NodeId   :  34:17:eb:e4:af:11   -
Remote BPR      :  1                   -
Endpoint Info
-------------
Domain Name     :  nod12               nod23
MEP ID          :  21                  23
MA Name         :  43982               43982
==========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   1)         |
===========================

DataTraffic vlan: 201-205
Profile : profile1

sBridge3:
show g8032 erp-instance erp1
Inst Name       : erp1
Description     :
State           : G8032_ST_IDLE
Phy Ring        : RING1
Ring Type       : MAJOR-RING
Role            : NEIGHBOR (WEST)
Node ID         : 3c:2c:99:1a:da:7d
----------------------------------------------------------
                   East Link           West Link
==========================================================
Interface       :  xe3                 xe16
State           :  Unblocked           Blocked
Remote NodeId   :  34:17:eb:e4:af:11   34:17:eb:e4:af:11
Remote BPR      :  1                   1
Endpoint Info
-------------
Domain Name     :  nod23               nod34
MEP ID          :  32                  34
MA Name         :  43982               43982
==========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   1)         |
===========================

DataTraffic vlan: 201-205
Profile : profile1

Bridge4:
show g8032 erp-instance erp1

Inst Name       : erp1
Description     :
```

```
State              : G8032_ST_IDLE
Phy Ring           : RING1
Ring Type          : MAJOR-RING
Role               : OWNER (EAST)
Node ID            : 34:17:eb:e4:af:11
-----------------------------------------------------------
                     East Link           West Link
===========================================================
Interface          :  xe16                xe6
State              :  Blocked             Unblocked
Remote NodeId      :  -                   -
Remote BPR         :  -                   -
Endpoint Info
-------------
Domain Name        :  nod34               nod41
MEP ID             :  43                  41
MA Name            :  43982               43982
===========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   1)         |
===========================

DataTraffic vlan: 201-205
Profile : profile1
```

Sub-ring with Virtual Channel

An ethernet ring that is connected to a Major Ring at the Interconnection Nodes. By itself, the Sub-Ring does not constitute a closed ring. A Sub-Ring is connected to the Interconnection nodes on only one port which is configured as east-interface.

Topology

Figure 15-25 displays a sample Ring Protection topology on which protection switching is configured with six bridges. This constitutes of one major ring (Bridge2, Bridge3, Bridge4 and Bridge 5) and one sub-ring (Bridge2, Bridge1, Bridge6 and Bridge5).

Major ring's RPL in enabled between Bridge 3(owner node) and Bridge 4(neighbor node) on xe4 and other devices are non-owner nodes for that ring. Sub-ring's RPL is enabled between bridge 1(owner node) and bridge 2 (neighbor node) on link xe2 and other devices on the non-owner nodes. Bridge 2 and Bridge 5 are called interconnected nodes since they are common node between major ring and subring. Virtual channel is enabled for this Subring on interconnected nodes on vlan 100 and tcn propagation is enabled.

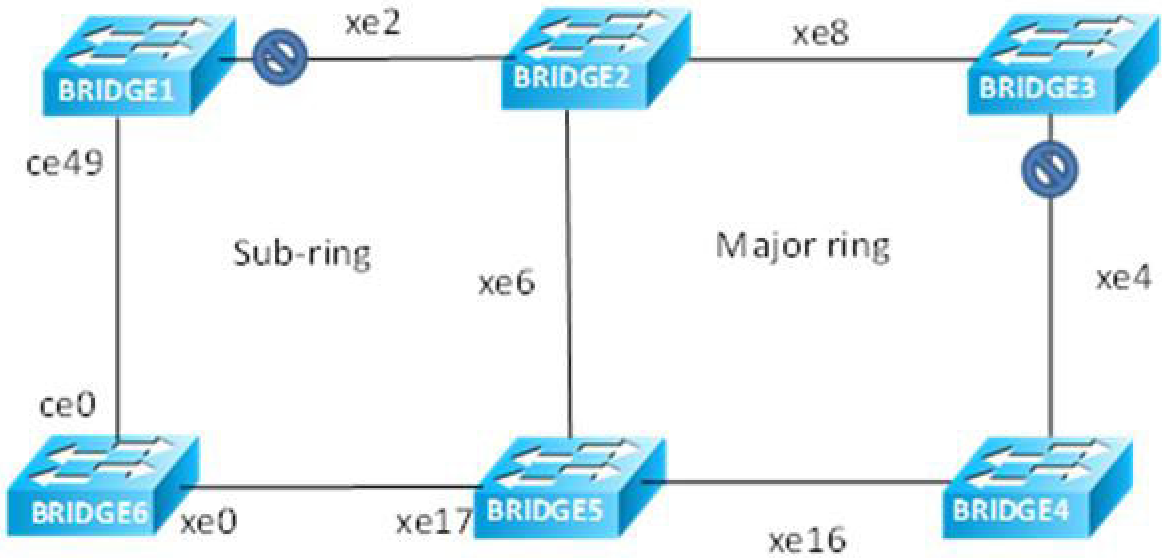


Figure 15-25: Major ring and Sub-ring with Virtual Channel Topology

Configuration

Bridge 1

`Bridge1#config term`	Enter configure mode
`Bridge1(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge1(config)#vlan database`	Configure VLAN database
`Bridge1(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge1(config)#interface ce49`	Configure interface ce49
`Bridge1(config-if)#switchport`	Configure ce49 as a layer 2 port
`Bridge1(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge1(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge1(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on ce49 interface
`Bridge1(config-if)#interface xe2`	Configure interface xe2
`Bridge1(config-if)#switchport`	Configure xe2 as a layer 2 port
`Bridge1(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge1(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge1(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on xe2 interface

`Bridge1(config-if)#ethernet cfm domain-type character-string domain-name 00061 level 7 mip-creation none`	Create cfm domain with type as character string with name 00061 and set mip creation criteria to default with level 7
`Bridge1(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982.
`Bridge1(config-ether-cfm-ma)# vlan 201 bridge 1`	Add VLAN 201
`Bridge1(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 16 active true ce49`	Create down MEP 16 for ce49 interface
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 61`	Configure crosscheck to remote MEP with value 61
`Bridge1(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet MA mode
`Bridge1(config-ether-cfm)#ethernet cfm domain-type character-string domain-name 00012 level 7 mip-creation none`	Create CFM domain with type as character string with name 00012 and set mip creation criteria to default with level 7
`Bridge1(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982
`Bridge1(config-ether-cfm-ma)# vlan 201 bridge 1`	Add VLAN 201
`Bridge1(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 12 active true xe2`	Create down MEP 12 for xe2 interface
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 21`	Configure crosscheck to remote MEP with value 21
`Bridge1(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge1(config-ether-cfm)#g8032 ring subring`	Create g8032 ring with name subring
`Bridge1(g8032-ring-config)#east-interface ce49`	Associate ce49 interface as east-interface
`Bridge1(g8032-ring-config)#west-interface xe2`	Associate xe2 interface as west-interface
`Bridge1(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1

`Bridge1(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge1(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge1(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge1(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge1(g8032-profile-config)#g8032 erp-instance erp2`	Create g8032 erp instance erp2
`Bridge1(g8032-config-switch)#ring-type sub-ring-vc`	Configure ring type as subring virtual channel
`Bridge1(g8032-config-switch)#ring subring`	Associate ring subring to erp2 instance
`Bridge1(g8032-config-switch)#rpl role owner west-interface`	Configure the node as owner node on west-interface
`Bridge1(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp2 instance
`Bridge1(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge1(g8032-config-switch)#aps-channel vlan 201`	Configure RAPS channel vlan as 201
`Bridge1(g8032-config-switch)#data vlan 202-205`	Configure traffic vlan from 202-205
`Bridge1(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge1(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge1(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 2

`Bridge2#config term`	Enter configure mode
`Bridge2(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge1(config)#vlan database`	Configure VLAN database
`Bridge2(config-vlan)#vlan 100 bridge 1 state enable`	Create VLAN 100 on bridge 1
`Bridge2(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge2(config)#interface xe2`	Configure interface xe2
`Bridge2(config-if)#switchport`	Configure xe2 as a layer 2 port
`Bridge2(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge2(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge2(config-if)#switchport trunk allowed vlan add 100,200-205`	Allow vlan 100,200-205 on xe2 interface
`Bridge2(config-if)#interface xe6`	Configure interface xe6

`Bridge2(config-if)#switchport`	Configure xe6 as a layer 2 port
`Bridge2(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge2(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge2(config-if)#switchport trunk allowed vlan add 100,200-205`	Allow vlan 100,200-205 on xe6 interface
`Bridge2(config-if)#interface xe8`	Configure interface xe8
`Bridge2(config-if)#switchport`	Configure xe8 as a layer 2 port
`Bridge2(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge2(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge2(config-if)#switchport trunk allowed vlan add 100,200-205`	Allow vlan 100,200-205 on xe8 interface
`Bridge2(config-if)#ethernet cfm domain-type character-string domain-name 00012 level 7 mip-creation none`	Create cfm domain with type as character string with name 00012 and set mip creation criteria to default with level 7
`Bridge2(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge2(config-ether-cfm-ma)# vlan 201 bridge 1`	Add VLAN 201
`Bridge2(config-ether-cfm-ma)# mip-creation none`	Set mip-creation criteria to none
`Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 21 active true xe2`	Create down MEP 21 for xe2 interface
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 12`	Configure crosscheck to remote MEP with value 12
`Bridge2(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge2(config-ether-cfm)#ethernet cfm domain-type character-string domain-name 00052 level 7 mip-creation none`	Create cfm domain with type as character string with name 00052 and set mip creation criteria to default with level 7
`Bridge2(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge2(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge2(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 25 active true xe6`	Create down MEP 25 for xe6 interface
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast

Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit ethernet CFM MA-MEP mode
Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 52	Configure crosscheck to remote MEP with value 52
Bridge2(config-ether-cfm-ma)#cc interval 100ms	Enable CC interval with 100ms
Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode	Exit Ethernet ma mode
Bridge2(config-ether-cfm)#ethernet cfm domain-type character-string domain-name 00023 level 7 mip-creation none	Create CFM domain with type as character string with name 00023 and set mip creation criteria to default with level 7
Bridge2(config-ether-cfm)#service ma-type string ma-name 43982	Create MA type as string with name 43982
Bridge2(config-ether-cfm-ma)# vlan 200 bridge 1	Add VLAN 200
Bridge2(config-ether-cfm-ma)# mip-creation none	Set MIP-creation criteria to none
Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 23 active true xe8	Create down MEP 23 for xe8 interface
Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable	Enable CC multicast
Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit ethernet CFM MA-MEP mode
Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 32	Configure crosscheck to remote MEP with value 32
Bridge2(config-ether-cfm-ma)#cc interval 100ms	Enable CC interval with 100ms
Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode	Exit Ethernet MA mode
Bridge2(config-ether-cfm)#g8032 ring ring	Create g8032 ring with name ring on bridge 1
Bridge2(g8032-ring-config)#east-interface xe6	Associate xe6 interface as east-interface
Bridge2(g8032-ring-config)#west-interface xe8	Associate xe8 interface as west-interface
Bridge2(g8032-ring-config)#g8032 profile profile1	Create g8032 profile with profile name profile1
Bridge2(g8032-profile-config)#timer wait-to-restore 1	Configure wait to restore time as 1 min
Bridge2(g8032-profile-config)#timer hold-off 0	Configure hold-off timer value as 0
Bridge2(g8032-profile-config)#timer guard-timer 10	Configure guard-timer value as 10ms
Bridge2(g8032-profile-config)#switching mode revertive	Configure Switching mode as revertive Switching mode
Bridge2(g8032-profile-config)#g8032 erp-instance erp1	Create g8032 erp instance erp1
Bridge2(g8032-config-switch)#ring ring	Associate ring RING1 to erp1 instance
Bridge2(g8032-config-switch)#ring-type major-ring	Configure ring-type as major ring

`Bridge2(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node
`Bridge2(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge2(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge2(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge2(g8032-config-switch)#data vlan 202-205, 100`	Configure traffic vlan from 202-205, 100
`Bridge2(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge2(g8032-config-switch)#g8032 ring subring`	Create g8032 ring with name subring
`Bridge2(g8032-ring-config)#east-interface xe2`	Associate xe2 interface as east-interface
`Bridge2(g8032-ring-config)#g8032 erp-instance erp2`	Create g8032 erp instance erp2
`Bridge2(g8032-config-switch)#ring-type sub-ring-vc`	Configure ring-type as sub-ring virtual channel
`Bridge2(g8032-config-switch)#ring subring`	Associate ring RING1 to erp2 instance
`Bridge2(g8032-config-switch)#rpl role neighbor east-interface`	Configure the node as neighbor node on east interface
`Bridge2(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp2 instance
`Bridge2(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge2(g8032-config-switch)#aps-channel vlan 201`	Configure RAPS channel vlan as 201
`Bridge2(g8032-config-switch)#data vlan 202-205`	Configure traffic vlan from 202-205
`Bridge2(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge2(g8032-config-switch)#virtual-channel 100 attached-to-instance erp1`	Configure virtual channel with vlan 100 and attach erp2 to erp1
`Bridge1(g8032-config-switch)# enable-tcn-propagation`	Enable tcn propagation
`Bridge2(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge2(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 3

`Bridge3#config term`	Enter configure mode
`Bridge3(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge3(config)#vlan database`	Configure VLAN database
`Bridge3(config-vlan)#vlan 100 bridge 1 state enable`	Create VLAN 100 on bridge 1

`Bridge3(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge3(config)#interface xe8`	Configure interface xe8
`Bridge3(config-if)#switchport`	Configure xe8 as a layer 2 port
`Bridge3(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge3(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge3(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge3(config-if)#switchport trunk allowed vlan add 100,200-205`	Allow vlan 100,200-205 on xe8 interface
`Bridge3(config-if)#interface xe4`	Configure interface xe4
`Bridge3(config-if)#switchport`	Configure xe4 as a layer 2 port
`Bridge3(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge3(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge3(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge3(config-if)#switchport trunk allowed vlan add 100,200-205`	Allow VLAN 100,200-205 on xe4 interface
`Bridge3(config-if)#ethernet cfm domain-type character-string domain-name 00023 level 7 mip-creation none`	Create CFM domain with type as character string with name 00023 and set mip creation criteria to default with level 7
`Bridge3(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982
`Bridge3(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge3(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge3(config-ether-cfm-ma)#ethernet cfm mep down mpid 32 active true xe8`	Create down MEP 32 for xe8 interface
`Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 23`	Configure crosscheck to remote MEP with value 23
`Bridge3(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge3(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet MA mode
`Bridge3(config-ether-cfm)#ethernet cfm domain-type character-string domain-name 00034 level 7 mip-creation none`	Create cfm domain with type as character string with name 00034 and set mip creation criteria to default with level 7
`Bridge3(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge3(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge3(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none

`Bridge3(config-ether-cfm-ma)#ethernet cfm mep down mpid 34 active true xe4`	Create down MEP 34 for xe4 interface
`Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 43`	Configure crosscheck to remote MEP with value 43
`Bridge3(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge3(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge3(config-ether-cfm)#g8032 ring ring`	Create g8032 ring with name ring
`Bridge3(g8032-ring-config)#east-interface xe8`	Associate xe8 interface as east-interface
`Bridge3(g8032-ring-config)#west-interface xe4`	Associate xe4 interface as west-interface
`Bridge3(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge3(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge3(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge3(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge3(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge3(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge3(g8032-config-switch)#ring ring`	Associate ring ring to erp1 instance
`Bridge3(g8032-config-switch)#ring-type major-ring`	Configure ring-type as major ring
`Bridge3(g8032-config-switch)#rpl role owner west-interface`	Configure the node as owner node on west interface
`Bridge3(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge3(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge3(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge3(g8032-config-switch)#data vlan 202-205,100`	Configure traffic vlan from 202-205, 100
`Bridge3(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge3(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge3(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 4

Bridge4#config term	Enter configuration mode
Bridge4(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
Bridge4(config)#vlan database	Configure VLAN database
Bridge5(config-vlan)#vlan 100 bridge 1 state enable	Create VLAN 100 on bridge 1
Bridge4(config-vlan)#vlan 200-205 bridge 1 state enable	Create VLAN 200-205 on bridge 1
Bridge4(config)#interface xe4	Configure interface xe4
Bridge4(config-if)#switchport	Configure xe4 as a layer 2 port
Bridge4(config-if)#bridge-group 1	Configure interface in bridge group 1
Bridge4(config-if)#bridge-group 1 spanning-tree disable	Disable spanning tree for bridge group 1 on that interface
Bridge4(config-if)#switchport mode trunk	Configure port as trunk port
Bridge4(config-if)#switchport trunk allowed vlan add 100,200-205	Allow vlan 100,200-205 on xe4 interface
Bridge4(config-if)#interface xe16	Configure interface xe16
Bridge4(config-if)#switchport	Configure xe4 as a layer 2 port
Bridge4(config-if)#bridge-group 1	Configure interface in bridge group 1
Bridge4(config-if)#bridge-group 1 spanning-tree disable	Disable spanning tree for bridge group 1 on that interface
Bridge4(config-if)#switchport mode trunk	Configure port as trunk port
Bridge4(config-if)#switchport trunk allowed vlan add 100,200-205	Allow vlan 100,200-205 on xe16 interface
Bridge4(config-if)#ethernet cfm domain-type character-string domain-name 00034 level 7 mip-creation none	Create cfm domain with type as character string with name 00023 and set mip creation criteria to default with level 7
Bridge4(config-ether-cfm)#service ma-type string ma-name 43982	Create ma type as string with name 43982
Bridge4(config-ether-cfm-ma)# vlan 200 bridge 1	Add VLAN 200
Bridge4(config-ether-cfm-ma)# mip-creation none	Set mip-creation criteria to none
Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 43 active true xe4	Create down MEP 43 for xe4 interface
Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable	Enable CC multicast
Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit ethernet CFM MA-MEP mode
Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 34	Configure crosscheck to remote MEP with value 34
Bridge4(config-ether-cfm-ma)#cc interval 100ms	Enable CC interval with 100ms
Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode	Exit Ethernet ma mode

`Bridge4(config-ether-cfm)#ethernet cfm domain-type character-string domain-name 00045 level 7 mip-creation none`	Create cfm domain with type as character string with name 00045 and set mip creation criteria to default with level 7
`Bridge4(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge4(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge4(config-ether-cfm-ma)# mip-creation none`	Set mip-creation criteria to none
`Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 45 active true xe16`	Create down MEP 45 for xe16 interface
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 54`	Configure crosscheck to remote MEP with value 54
`Bridge4(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet MA mode
`Bridge4(config-ether-cfm)#g8032 ring ring`	Create g8032 ring with name ring
`Bridge4(g8032-ring-config)#east-interface xe4`	Associate xe4 interface as east-interface
`Bridge4(g8032-ring-config)#west-interface xe16`	Associate xe16 interface as west-interface
`Bridge4(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge4(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge4(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge4(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge4(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge4(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge4(g8032-config-switch)#ring-type major-ring`	Configure ring-type as major ring
`Bridge4(g8032-config-switch)#ring ring`	Associate ring ring to erp1 instance
`Bridge4(g8032-config-switch)#rpl role neighbor east-interface`	Configure the node as neighbor node on east interface
`Bridge4(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge4(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge4(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200

`Bridge4(g8032-config-switch)#data vlan 202-205, 100`	Configure traffic vlan from 202-205, 100
`Bridge4(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge4(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge4(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 5

`Bridge5#config term`	Enter configure mode
`Bridge5(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge1(config)#vlan database`	Configure VLAN database
`Bridge5(config-vlan)#vlan 100 bridge 1 state enable`	Create VLAN 100 on bridge 1
`Bridge5(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge5(config)#interface xe16`	Configure interface xe16
`Bridge5(config-if)#switchport`	Configure xe16 as a layer 2 port
`Bridge5(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge5(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge5(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge5(config-if)#switchport trunk allowed vlan add 100,200-205`	Allow vlan 100,200-205 on xe16 interface
`Bridge5(config-if)#interface xe6`	Configure interface xe6
`Bridge5(config-if)#switchport`	Configure xe6 as a layer 2 port
`Bridge5(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge5(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge5(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge5(config-if)#switchport trunk allowed vlan add 100,200-205`	Allow vlan 100,200-205 on xe6 interface
`Bridge5(config-if)#interface xe17`	Configure interface xe17
`Bridge5(config-if)#switchport`	Configure xe17 as a layer 2 port
`Bridge5(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge5(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge5(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge5(config-if)#switchport trunk allowed vlan add 100,200-205`	Allow vlan 100,200-205 on xe17 interface
`Bridge5(config-if)#ethernet cfm domain-type character-string domain-name 00045 level 7 mip-creation none`	Create cfm domain with type as character string with name 00045 and set mip creation criteria to default with level 7
`Bridge5(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982

`Bridge5(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge5(config-ether-cfm-ma)# mip-creation none`	Set mip-creation criteria to none
`Bridge5(config-ether-cfm-ma)#ethernet cfm mep down mpid 54 active true xe16`	Create down MEP 54 for xe16 interface
`Bridge5(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM ma-mep mode
`Bridge5(config-ether-cfm-ma)#mep crosscheck mpid 45`	Configure crosscheck to remote MEP with value 45
`Bridge5(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge5(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge5(config-ether-cfm)#ethernet cfm domain-type character-string domain-name 00052 level 7 mip-creation none`	Create cfm domain with type as character string with name 00052 and set mip creation criteria to default with level 7
`Bridge5(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982
`Bridge5(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge5(config-ether-cfm-ma)# mip-creation none`	Set mip-creation criteria to none
`Bridge5(config-ether-cfm-ma)#ethernet cfm mep down mpid 52 active true xe6`	Create down MEP 52 for xe6 interface
`Bridge5(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge5(config-ether-cfm-ma)#mep crosscheck mpid 25`	Configure crosscheck to remote MEP with value 25
`Bridge5(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge5(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge5(config-ether-cfm)#ethernet cfm domain-type character-string domain-name 00056 level 7 mip-creation none`	Create cfm domain with type as character string with name 00056 and set mip creation criteria to default with level 7
`Bridge5(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge5(config-ether-cfm-ma)# vlan 201 bridge 1`	Add VLAN 201
`Bridge5(config-ether-cfm-ma)# mip-creation none`	Set mip-creation criteria to none
`Bridge5(config-ether-cfm-ma)#ethernet cfm mep down mpid 56 active true xe17`	Create down MEP 56 for xe17 interface
`Bridge5(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast

`Bridge5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge5(config-ether-cfm-ma)#mep crosscheck mpid 65`	Configure crosscheck to remote MEP with value 65
`Bridge5(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge5(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge5(config-ether-cfm)#g8032 ring ring`	Create g8032 ring with name ring
`Bridge5(g8032-ring-config)#east-interface xe16`	Associate xe16 interface as east-interface
`Bridge5(g8032-ring-config)#west-interface xe6`	Associate xe6 interface as west-interface
`Bridge5(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge5(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge5(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge5(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge5(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge5(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge5(g8032-config-switch)#ring ring`	Associate ring ring to erp1 instance
`Bridge5(g8032-config-switch)#ring-type major-ring`	Configure ring-type as major ring
`Bridge5(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node
`Bridge5(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge5(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge5(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge5(g8032-config-switch)#data vlan 202-205,100`	Configure traffic vlan from 202-205, 100
`Bridge5(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge5(g8032-config-switch)#g8032 ring subring`	Create g8032 physical ring with name subring
`Bridge5(g8032-ring-config)#east-interface xe17`	Associate xe17 interface as east-interface
`Bridge5(g8032-profile-config)#g8032 erp-instance erp2`	Create g8032 erp instance erp2
`Bridge5(g8032-config-switch)#ring-type sub-ring-vc`	Configure ring-type as sub-ring virtual channel
`Bridge5(g8032-config-switch)#ring subring`	Associate ring subring to erp2 instance

`Bridge5(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node
`Bridge5(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp2 instance
`Bridge5(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge5(g8032-config-switch)#aps-channel vlan 201`	Configure RAPS channel vlan as 201
`Bridge5(g8032-config-switch)#data vlan 202-205`	Configure traffic vlan from 202-205
`Bridge5(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge5(g8032-config-switch)#virtual-channel 100 attached-to-instance erp1`	Configure virtual channel with vlan 100 and attach erp2 to erp1
`Bridge5(g8032-config-switch)# enable-tcn-propagation`	Enable tcn propagation
`Bridge5(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge5(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 6

`Bridge6#config term`	Enter configuration mode
`Bridge6(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge1(config)#vlan database`	Configure VLAN database
`Bridge6(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge6(config-vlan)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge6(config)#interface xe0`	Configure interface xe0
`Bridge6(config-if)#switchport`	Configure xe0 as a layer 2 port
`Bridge6(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge6(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge6(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge6(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on xe0 interface
`Bridge6(config-if)#interface ce0`	Configure interface ce0
`Bridge6(config-if)#switchport`	Configure ce0 as a layer 2 port
`Bridge6(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge6(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge6(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge6(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on ce0 interface

`Bridge6(config-if)#ethernet cfm domain-type character-string domain-name 00056 level 7 mip-creation none`	Create cfm domain with type as character string with name 00056 and set mip creation criteria to default with level 7
`Bridge6(config-ether-cfm)#service ma-type string ma-name 43982`	Create MA type as string with name 43982.
`Bridge6(config-ether-cfm-ma)# vlan 201 bridge 1`	Add VLAN 201
`Bridge6(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge6(config-ether-cfm-ma)#ethernet cfm mep down mpid 65 active true xe0`	Create down MEP 65 for xe0 interface
`Bridge6(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge6(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge6(config-ether-cfm-ma)#mep crosscheck mpid 56`	Configure crosscheck to remote MEP with value 56
`Bridge6(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge6(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge6(config-ether-cfm)#ethernet cfm domain-type character-string domain-name 00061 level 7 mip-creation none`	Create cfm domain with type as character string with name 00061 and set mip creation criteria to default with level 7
`Bridge6(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge6(config-ether-cfm-ma)# vlan 201 bridge 1`	Add VLAN 201
`Bridge6(config-ether-cfm-ma)# mip-creation none`	Set MIP-creation criteria to none
`Bridge6(config-ether-cfm-ma)#ethernet cfm mep down mpid 61 active true ce0`	Create down MEP 61 for ce0 interface
`Bridge6(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge6(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge6(config-ether-cfm-ma)#mep crosscheck mpid 16`	Configure crosscheck to remote MEP with value 16
`Bridge6(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge6(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge6(config-ether-cfm)#g8032 ring subring`	Create g8032 physical ring with name subring
`Bridge6(g8032-ring-config)#east-interface xe0`	Associate xe0 interface as east-interface
`Bridge6(g8032-ring-config)#west-interface ce0`	Associate ce0 interface as west-interface
`Bridge6(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1

`Bridge6(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge6(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge6(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge6(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge6(g8032-profile-config)#g8032 erp-instance erp2`	Create g8032 erp instance erp2
`Bridge6(g8032-config-switch)#ring-type sub-ring-vc`	Configure ring type as subring virtual channel
`Bridge6(g8032-config-switch)#ring subring`	Associate ring subring to erp2 instance
`Bridge6(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node
`Bridge6(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp2 instance
`Bridge6(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge6(g8032-config-switch)#aps-channel vlan 201`	Configure RAPS channel vlan as 201
`Bridge6(g8032-config-switch)#data-traffic-vlan 202-205`	Configure traffic vlan from 202-205
`Bridge6(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge6(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge6(g8032-config-switch)#end`	Exit g8032 erp instance mode

Validation

```
Bridge1#show g8032 erp-instance erp2

Inst Name        : erp2
Description      :
State            : G8032_ST_IDLE
Phy Ring         : subring
Ring Type        : SUB-RING (VIRTUAL)
Role             : OWNER (WEST)
Node ID          : 6c:b9:c5:67:72:1d
------------------------------------------------------------
                   East Link           West Link
============================================================
Interface        :  ce49               xe2
State            :  Unblocked          Blocked
Remote NodeId    :  -                  -
Remote BPR       :  -                  -
Endpoint Info
-------------
Domain Name      :  00061              00012
MEP ID           :  16                 12
MA Name          :  43982              43982
============================================================
----------------------------
```

```
     Channel                |
 (LEVEL, VLAN, RING ID)     |
============================
 (7,    201,    1)          |
============================

DataTraffic vlan: 202-205
Profile : profile1


Bridge2#show g8032 erp-instance erp2

Inst Name        : erp2
Description      :
State            : G8032_ST_IDLE
Phy Ring         : subring
Ring Type        : SUB-RING (VIRTUAL)
Role             : NEIGHBOR (EAST)
Node ID          : 3c:2c:99:26:e6:7c
----------------------------------------------------------------
                   East Link            West Link
================================================================
Interface        :  xe2                 -
State            :  Blocked             -
Remote NodeId    :  6c:b9:c5:67:72:1d   -
Remote BPR       :  0                   -
Endpoint Info
-------------
Domain Name      :  00012               -
MEP ID           :  21                  -
MA Name          :  43982               -
================================================================
TCN Propagation : Enabled
Attached         : -
Attached To      : erp1,
Virtual ID       : 100 : 1
----------------------------
     Channel                |
 (LEVEL, VLAN, RING ID)     |
============================
 (7,    201,    1)          |
============================

DataTraffic vlan: 202-205
Profile : profile1


Bridge2#show g8032 erp-instance erp1

Inst Name        : erp1
Description      :
State            : G8032_ST_IDLE
Phy Ring         : ring
Ring Type        : MAJOR-RING
Role             : NON-OWNER
Node ID          : 3c:2c:99:26:e6:80
----------------------------------------------------------------
```

```
                       East Link            West Link
======================================================================
Interface          :  xe6                   xe8
State              :  Unblocked             Unblocked
Remote NodeId      :  -                     d8:9e:f3:5e:f8:29
Remote BPR         :  -                     0
Endpoint Info
-------------
Domain Name        :  00052                 00023
MEP ID             :  25                    23
MA Name            :  43982                 43982
======================================================================
TCN Propagation : Disabled
Attached         : erp2,
Attached To      : -
Virtual ID       : -:-
---------------------------
     Channel               |
 (LEVEL, VLAN, RING ID)    |
===========================
 (7,    200,   1)          |
===========================

DataTraffic vlan: 202-205,100
Profile : profile1


Bridge3#show g8032 erp-instance erp1

Inst Name        : erp1
Description      :
State            : G8032_ST_IDLE
Phy Ring         : ring
Ring Type        : MAJOR-RING
Role             : OWNER (WEST)
Node ID          : d8:9e:f3:5e:f8:29
----------------------------------------------------------------------
                       East Link            West Link
======================================================================
Interface          :  xe8                   xe4
State              :  Unblocked             Blocked
Remote NodeId      :  -                     -
Remote BPR         :  -                     -
Endpoint Info
-------------
Domain Name        :  00023                 00034
MEP ID             :  32                    34
MA Name            :  43982                 43982
======================================================================
---------------------------
     Channel               |
 (LEVEL, VLAN, RING ID)    |
===========================
 (7,    200,   1)          |
===========================

DataTraffic vlan: 202-205,100
```

```
Profile : profile1


Bridge4#show  g8032 erp-instance erp1

Inst Name       : erp1
Description     :
State           : G8032_ST_IDLE
Phy Ring        : ring
Ring Type       : MAJOR-RING
Role            : NEIGHBOR (EAST)
Node ID         : 3c:2c:99:1a:da:7e
-----------------------------------------------------------
                   East Link          West Link
===========================================================
Interface       :  xe4                xe16
State           :  Blocked            Unblocked
Remote NodeId   :  d8:9e:f3:5e:f8:29  d8:9e:f3:5e:f8:29
Remote BPR      :  0                  0
Endpoint Info
-------------
Domain Name     :  00034              00045
MEP ID          :  43                 45
MA Name         :  43982              43982
===========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   1)         |
===========================

DataTraffic vlan: 202-205,100
Profile : profile1


Bridge5#show g8032 erp-instance erp2

Inst Name       : erp2
Description     :
State           : G8032_ST_IDLE
Phy Ring        : subring
Ring Type       : SUB-RING (VIRTUAL)
Role            : NON-OWNER
Node ID         : 34:17:eb:e4:af:12
-----------------------------------------------------------
                   East Link          West Link
===========================================================
Interface       :  xe17               -
State           :  Unblocked          -
Remote NodeId   :  6c:b9:c5:67:72:1d  -
Remote BPR      :  0                  -
Endpoint Info
-------------
Domain Name     :  00056              -
MEP ID          :  56                 -
MA Name         :  43982              -
```

```
==========================================================
TCN Propagation : Enabled
Attached        : -
Attached To     : erp1,
Virtual ID      : 100 : 1
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    201,   1)         |
===========================

DataTraffic vlan: 202-205
Profile : profile1


Bridge5#show g8032 erp-instance erp1

Inst Name       : erp1
Description     :
State           : G8032_ST_IDLE
Phy Ring        : ring
Ring Type       : MAJOR-RING
Role            : NON-OWNER
Node ID         : 34:17:eb:e4:af:11
----------------------------------------------------------
                   East Link           West Link
==========================================================
Interface       :  xe16                xe6
State           :  Unblocked           Unblocked
Remote NodeId   :  -                   d8:9e:f3:5e:f8:29
Remote BPR      :  -                   0
Endpoint Info
-------------
Domain Name     :  00045               00052
MEP ID          :  54                  52
MA Name         :  43982               43982
==========================================================
TCN Propagation : Disabled
Attached        : erp2,
Attached To     : -
Virtual ID      : -:-
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   1)         |
===========================

DataTraffic vlan: 202-205,100
Profile : profile1


Bridge6#show g8032 erp-instance erp2

Inst Name       : erp2
Description     :
```

```
State           : G8032_ST_IDLE
Phy Ring        : subring (VIRTUAL)
Ring Type       : SUB-RING
Role            : NON-OWNER
Node ID         : b8:6a:97:d2:27:c6
-----------------------------------------------------------
                   East Link           West Link
===========================================================
Interface       :  xe0                 ce0
State           :  Unblocked           Unblocked
Remote NodeId   :  -                   6c:b9:c5:67:72:1d
Remote BPR      :  -                   0
Endpoint Info
-------------
Domain Name     :  00056               00061
MEP ID          :  65                  61
MA Name         :  43982               43982
===========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    201,   1)         |
===========================

DataTraffic vlan: 202-205
Profile : profile1
```

Sub-ring without Virtual Channel on a LAG interface

Figure 3 displays a sample Ring Protection topology on which protection switching is configured with 5 bridges on lag interfaces. The topology contains one major ring and one subring with non-virtual channel. The Ring Protection Link (RPL) for major ring is the link between Bridge 4 (owner) and Bridge 3 (neighbor) on lag interface po3. The subring is configured with no virtual channel and it's RPL link is configured between bridge 1 (neighbor) and bridge 5 (owner) on lag interface po6. The rest of the bridges are explicitly configured RPL non owner to enable ERPS in the ring in both major and subring.

Topology

Figure 15-26 displays a sample Ethernet Ring Protection Switching topology.

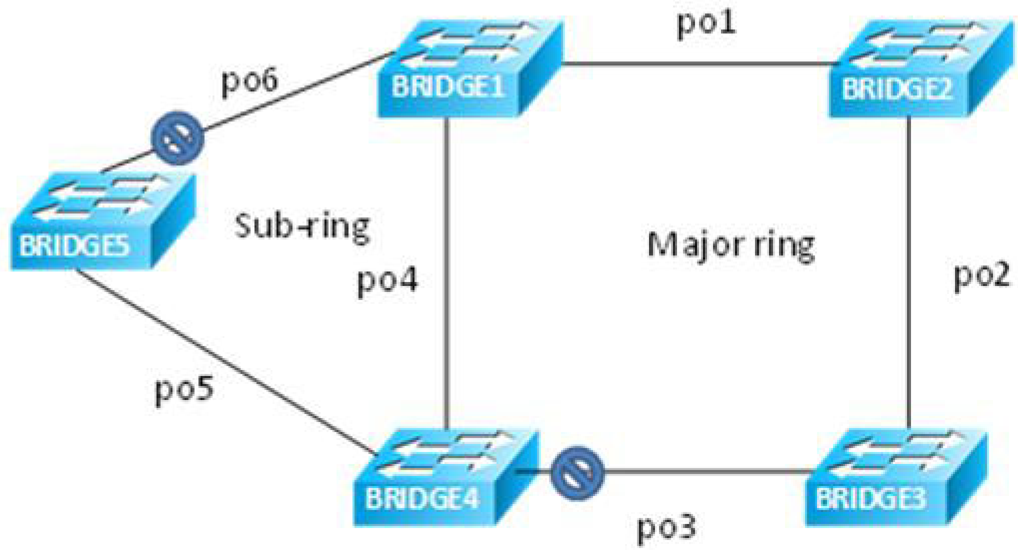


Figure 15-26: Major ring and sub-ring topology using LAG interface without a virtual channel

Configuration

Bridge 1

Bridge1#config term	Enter configure mode
Bridge1(config)#bridge 1 protocol rstp vlan-bridge	Create bridge 1 as an RSTP VLAN-aware bridge.
Bridge1(config)#hardware-profile filter cfm-domain-name-str enable	Enable CFM domain name as string
Bridge1(config)#vlan database	Configure VLAN database
Bridge1(config-vlan)#vlan 200-205 bridge 1 state enable	Create VLAN 200-205 on bridge 1
Bridge1(config-vlan)#interface po1	Configure lag interface po1
Bridge1(config-if)#switchport	Configure po1 as a layer 2 port

`Bridge1(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge1(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge1(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po1 interface
`Bridge1(config-if)#interface po4`	Configure lag interface po4
`Bridge1(config-if)#switchport`	Configure po4 as a layer 2 port
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Configure interface in bridge group 1
`Bridge1(config-if)#switchport mode trunk`	Disable spanning tree for bridge group 1 on that interface
`Bridge1(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po4 interface
`Bridge1(config-if)#interface po6`	Configure lag interface po6
`Bridge1(config-if)#switchport`	Configure po6 as a layer 2 port
`Bridge1(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge1(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge1(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po6 interface
`Bridge1(config-if)#interface xe1`	Configure interface xe1
`Bridge1(config-if)#channel-group 6 mode active`	Configure xe1 as part of po6
`Bridge1(config-if)#interface xe2`	Configure interface xe2
`Bridge1(config-if)#channel-group 6 mode active`	Configure xe2 as part of po6
`Bridge1(config-if)#interface xe6`	Configure interface xe6
`Bridge1(config-if)#channel-group 4 mode active`	Configure xe6 as part of po4
`Bridge1(config-if)#interface xe7`	Configure interface xe7
`Bridge1(config-if)#channel-group 4 mode active`	Configure xe7 as part of po4
`Bridge1(config-if)#interface xe8`	Configure interface xe8
`Bridge1(config-if)#channel-group 1 mode active`	Configure xe8 as part of po1
`Bridge1(config-if)#interface xe9`	Configure interface xe9
`Bridge1(config-if)#channel-group 1 mode active`	Configure xe9 as part of po1
`Bridge1(config-if)#ethernet cfm domain-type character-string domain-name nod12 level 7 mip-creation none`	Create cfm domain with type as character string with name nod12 and set mip creation criteria to default with level 7
`Bridge1(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge1(config-ether-cfm-ma)# vlan 200 bridge 1`	Add vlan 200

Bridge1(config-ether-cfm-ma)#mip-creation none	Set mip-creation criteria to none
Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 12 active true po1	Create down mep 12 for po1 interface
Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable	Enable cc multicast
Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit ethernet cfm ma-mep mode
Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 21	Configure crosscheck to remote MEP with value 21
Bridge1(config-ether-cfm-ma)#cc interval 100ms	Enable CC interval with 100ms
Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode	Exit Ethernet ma mode
Bridge1(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod41 level 7 mip-creation none	Create cfm domain with type as character string with name nod41 and set mip creation criteria to default with level 7
Bridge1(config-ether-cfm)#service ma-type string ma-name 43982	Create ma type as string with name 43982
Bridge1(config-ether-cfm-ma)# vlan 200 bridge 1	Add VLAN 200
Bridge1(config-ether-cfm-ma)#mip-creation none	Set mip-creation criteria to none
Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 14 active true po4	Create down MEP 14 for po4 interface
Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable	Enable CC multicast
Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit ethernet CFM ma-mep mode
Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 41	Configure crosscheck to remote MEP with value 41
Bridge1(config-ether-cfm-ma)#cc interval 23ms	Enable CC interval with 100ms
Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode	Exit Ethernet ma mode
Bridge1(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod15 level 7 mip-creation none	Create cfm domain with type as character string with name nod15 and set mip creation criteria to default with level 7
Bridge1(config-ether-cfm)#service ma-type string ma-name 43982	Create ma type as string with name 43982
Bridge1(config-ether-cfm-ma)# vlan 200 bridge 1	Add VLAN 200
Bridge1(config-ether-cfm-ma)#mip-creation none	Set mip-creation creation criteria to none
Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 51 active true po6	Create down mep 51 for po6 interface
Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable	Enable cc multicast
Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit ethernet cfm ma-mep mode

`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 15`	Configure crosscheck to remote MEP with value 15
`Bridge1(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge1(config-ether-cfm)#g8032 ring lagring`	Create g8032 ring with name lagring
`Bridge1(g8032-ring-config)#east-interface po4`	Associate po4 interface as east-interface
`Bridge1(g8032-ring-config)#west-interface po1`	Associate po1 interface as west-interface
`Bridge1(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge1(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge1(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge1(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge1(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge1(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge1(g8032-config-switch)#ring lagring`	Associate ring lagring to erp1 instance
`Bridge1(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node
`Bridge1(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge1(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge1(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge1(g8032-config-switch)#data vlan 201-205`	Configure traffic vlan from 201-205
`Bridge1(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge1(g8032-config-switch)#g8032 ring lagsubring`	Create g8032 ring with name lagsubring
`Bridge1(g8032-ring-config)#east-interface po6`	Associate po6 interface as east-interface
`Bridge1(g8032-ring-config)#g8032 erp-instance erp2`	Create g8032 erp instance erp2
`Bridge1(g8032-config-switch)#ring-type sub-ring`	Configure ring-type as sub-ring
`Bridge1(g8032-config-switch)#ring lagsubring`	Associate ring lagsubring to erp2 instance
`Bridge1(g8032-config-switch)#rpl role neighbor east-interface`	Configure the node as neighbor node on east interface
`Bridge1(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp2 instance

`Bridge1(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge1(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge1(g8032-config-switch)#data vlan 201-205`	Configure traffic vlan from 201-205
`Bridge1(g8032-config-switch)#ring-id 2`	Configure ring-id as 2
`Bridge1(g8032-config-switch)#non-virtual-channel`	Enable Non Virtual Channel
`Bridge1(g8032-config-switch)# enable-tcn-propagation`	Enable tcn propagation
`Bridge1(g8032-config-switch)# tcn-to-instance erp1`	Attach erp1 instance to erp2 instance to notify any changes in subring to major ring
`Bridge1(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge1(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 2

`Bridge2#config term`	Enter configure mode
`Bridge2(config)#hardware-profile filter cfm-domain-name-str enable`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge2(config)#bridge 1 protocol rstp vlan-bridge`	Enable CFM domain name as string
`Bridge1(config)#vlan database`	Configure VLAN database
`Bridge2(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge2(config-vlan)#interface po1`	Configure lag interface po1
`Bridge2(config-if)#switchport`	Configure po1 as a layer 2 port
`Bridge2(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge2(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge2(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po1 interface
`Bridge2(config-if)#interface po2`	Configure lag interface po2
`Bridge2(config-if)#switchport`	Configure po2 as a layer 2 port
`Bridge2(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge2(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge2(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po2 interface
`Bridge2(config-if)#interface xe8`	Configure interface xe8
`Bridge2(config-if)#channel-group 1 mode active`	Configure xe8 as part of po1
`Bridge2(config-if)#interface xe9`	Configure interface xe9

`Bridge2(config-if)#channel-group 1 mode active`	Configure xe9 as part of po1
`Bridge2(config-if)#interface xe3`	Configure interface xe3
`Bridge2(config-if)#channel-group 2 mode active`	Configure xe3 as part of po2
`Bridge2(config-if)#interface xe4`	Configure interface xe4
`Bridge2(config-if)#channel-group 2 mode active`	Configure xe4 as part of po2
`Bridge2(config-if)#ethernet cfm domain-type character-string domain-name nod12 level 7 mip-creation none`	Create cfm domain with type as character string with name nod12 and set mip creation criteria to default with level 7
`Bridge2(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge2(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge2(config-ether-cfm-ma)#mip-creation none`	Set mip-creation creation criteria to none
`Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 21 active true po1`	Create down mep 21 for po1 interface
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 12`	Configure crosscheck to remote MEP with value 12
`Bridge2(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge2(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod23 level 7 mip-creation none`	Create cfm domain with type as character string with name nod23 and set mip creation criteria to default with level 7
`Bridge2(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge2(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge2(config-ether-cfm-ma)#mip-creation none`	Set mip-creation creation criteria to none
`Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 23 active true po2`	Create down mep 23 for po2 interface
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 32`	Configure crosscheck to remote MEP with value 32
`Bridge2(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode

`Bridge2(config-ether-cfm)#g8032 ring lagring`	Create g8032 ring with name lagring
`Bridge2(g8032-ring-config)#east-interface po1`	Associate po1 interface as east-interface
`Bridge2(g8032-ring-config)#west-interface po2`	Associate po2 interface as west-interface
`Bridge2(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge2(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge2(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge2(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge2(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge2(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge2(g8032-config-switch)#ring lagring`	Associate ring lagring to erp1 instance
`Bridge2(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node
`Bridge2(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge2(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge2(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge2(g8032-config-switch)#data van 201-205`	Configure traffic vlan from 201-205
`Bridge2(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge2(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge2(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 3

`Bridge3#config term`	Enter configuration mode
`Bridge3(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge3(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge1(config)#vlan database`	Configure VLAN database
`Bridge3(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge3(config-vlan)#interface po2`	Configure lag interface po2
`Bridge3(config-if)#switchport`	Configure po2 as a layer 2 port
`Bridge3(config-if)#bridge-group 1`	Configure interface in bridge group 1

`Bridge3(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge3(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge3(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po2 interface
`Bridge3(config-if)#interface po3`	Configure lag interface po3
`Bridge3(config-if)#switchport`	Configure po3 as a layer 2 port
`Bridge3(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge3(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge3(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge3(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po3 interface
`Bridge3(config-if)#interface xe3`	Configure interface xe3
`Bridge3(config-if)#channel-group 2 mode active`	Configure xe3 as part of po2
`Bridge3(config-if)#interface xe4`	Configure interface xe4
`Bridge3(config-if)#channel-group 2 mode active`	Configure xe4 as part of po2
`Bridge3(config-if)#interface xe15`	Configure interface xe3
`Bridge3(config-if)#channel-group 3 mode active`	Configure xe3 as part of po3
`Bridge3(config-if)#interface xe16`	Configure interface xe16
`Bridge3(config-if)#channel-group 3 mode active`	Configure xe16 as part of po3
`Bridge3(config-if)#ethernet cfm domain-type character-string domain-name nod23 level 7 mip-creation none`	Create cfm domain with type as character string with name nod23 and set mip creation criteria to default with level 7
`Bridge3(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge3(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge3(config-ether-cfm-ma)#mip-creation none`	Set mip-creation creation criteria to none
`Bridge3(config-ether-cfm-ma)#ethernet cfm mep down mpid 32 active true po2`	Create down mep 32 for po2 interface
`Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast
`Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 23`	Configure crosscheck to remote MEP with value 23
`Bridge3(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge3(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode

Bridge3(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod34 level 7 mip-creation none	Create cfm domain with type as character string with name nod34 and set mip creation criteria to default with level 7
Bridge3(config-ether-cfm)#service ma-type string ma-name 43982	Create ma type as string with name 43982
Bridge3(config-ether-cfm-ma)# vlan 200 bridge 1	Add VLAN 200
Bridge3(config-ether-cfm-ma)#mip-creation none	Set mip-creation creation criteria to none
Bridge3(config-ether-cfm-ma)#ethernet cfm mep down mpid 34 active true po3	Create down mep 34 for po3 interface
Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable	Enable cc multicast
Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit ethernet cfm ma-mep mode
Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 43	Configure crosscheck to remote MEP with value 43
Bridge3(config-ether-cfm-ma)#cc interval 100ms	Enable CC interval with 100ms
Bridge3(config-ether-cfm-ma)#exit-ether-ma-mode	Exit Ethernet ma mode
Bridge3(config-ether-cfm)#g8032 ring lagring	Create g8032 physical ring with name lagring
Bridge3(g8032-ring-config)#east-interface po2	Associate po2 interface as east-interface
Bridge3(g8032-ring-config)#west-interface po3	Associate po3 interface as west-interface
Bridge3(g8032-ring-config)#g8032 profile profile1	Create g8032 profile with profile name profile1
Bridge3(g8032-profile-config)#timer wait-to-restore 1	Configure wait to restore time as 1 min
Bridge3(g8032-profile-config)#timer hold-off 0	Configure hold-off timer value as 0
Bridge3(g8032-profile-config)#timer guard-timer 10	Configure guard-timer value as 10ms
Bridge3(g8032-profile-config)#switching mode revertive	Configure Switching mode as revertive Switching mode
Bridge3(g8032-profile-config)#g8032 erp-instance erp1	Create g8032 erp instance erp1
Bridge3(g8032-config-switch)#ring lagring	Associate ring lagring to erp1 instance
Bridge3(g8032-config-switch)#rpl role neighbor west-interface	Configure the node as neighbor node on west interface
Bridge3(g8032-config-switch)#g8032-profile profile1	Associate Profile profile1 to erp1 instance
Bridge3(g8032-config-switch)#aps-channel level 7	Configure level as 7
Bridge3(g8032-config-switch)#aps-channel vlan 200	Configure RAPS channel vlan as 200
Bridge3(g8032-config-switch)#data vlan 201-205	Configure traffic vlan from 201-205

`Bridge3(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge3(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge3(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 4

`Bridge4#config term`	Enter configure mode
`Bridge4(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge4(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge1(config)#vlan database`	Configure VLAN database
`Bridge4(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge4(config-vlan)#interface po3`	Configure lag interface po3
`Bridge4(config-if)#switchport`	Configure po3 as a layer 2 port
`Bridge4(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge4(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge4(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge4(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po3 interface
`Bridge4(config-if)#interface po4`	Configure lag interface po4
`Bridge4(config-if)#switchport`	Configure po4 as a layer 2 port
`Bridge4(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge4(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge4(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge4(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po4 interface
`Bridge4(config-if)#interface po5`	Configure lag interface po5
`Bridge4(config-if)#switchport`	Configure po5 as a layer 2 port
`Bridge4(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge4(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge4(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge4(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po5 interface
`Bridge4(config-if)#interface xe6`	Configure interface xe6
`Bridge4(config-if)#channel-group 4 mode active`	Configure xe6 as part of po4
`Bridge4(config-if)#interface xe7`	Configure interface xe7
`Bridge4(config-if)#channel-group 4 mode active`	Configure xe7 as part of po4
`Bridge4(config-if)#interface xe10`	Configure interface xe10

`Bridge4(config-if)#channel-group 5 mode active`	Configure xe10 as part of po5
`Bridge4(config-if)#interface xe11`	Configure interface xe11
`Bridge4(config-if)#channel-group 5 mode active`	Configure xe11 as part of po5
`Bridge4(config-if)#interface xe15`	Configure interface xe15
`Bridge4(config-if)#channel-group 3 mode active`	Configure xe15 as part of po3
`Bridge4(config-if)#interface xe16`	Configure interface xe16
`Bridge4(config-if)#channel-group 3 mode active`	Configure xe16 as part of po3
`Bridge4(config-if)#ethernet cfm domain-type character-string domain-name nod34 level 7 mip-creation none`	Create cfm domain with type as character string with name nod34 and set mip creation criteria to default with level 7
`Bridge4(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge4(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge4(config-ether-cfm-ma)#mip-creation none`	Set mip-creation creation criteria to none
`Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 43 active true po3`	Create down mep 43 for po3 interface
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 34`	Configure crosscheck to remote MEP with value 34
`Bridge4(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge4(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod41 level 7 mip-creation none`	Create cfm domain with type as character string with name nod41 and set mip creation criteria to default with level 7
`Bridge4(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge4(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge4(config-ether-cfm-ma)#mip-creation none`	Set mip-creation creation criteria to none
`Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 41 active true po4`	Create down mep 41 for po4 interface
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 14`	Configure crosscheck to remote MEP with value 14

`Bridge4(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge4(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod45 level 7 mip-creation none`	Create cfm domain with type as character string with name nod45 and set mip creation criteria to default with level 7
`Bridge4(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge4(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge4(config-ether-cfm-ma)#mip-creation none`	Set mip-creation creation criteria to none
`Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 54 active true po5`	Create down mep 54 for po5 interface
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 45`	Configure crosscheck to remote MEP with value 45
`Bridge4(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge4(config-ether-cfm)#g8032 ring lagring`	Create g8032 ring with name lagring
`Bridge4(g8032-ring-config)#east-interface po3`	Associate po3 interface as east-interface
`Bridge4(g8032-ring-config)#west-interface po4`	Associate po4 interface as west-interface
`Bridge4(g8032-ring-config)#g8032 ring lagsubring`	Create g8032 ring with name lagsubring
`Bridge4(g8032-ring-config)#east-interface po5`	Associate po5 interface as east-interface
`Bridge4(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge4(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge4(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge4(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge4(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge4(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge4(g8032-config-switch)#ring lagring`	Associate ring lagring to erp1 instance
`Bridge4(g8032-config-switch)#rpl role owner east-interface`	Configure the node as owner node on east interface

`Bridge4(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge4(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge4(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge4(g8032-config-switch)#data vlan 201-205`	Configure traffic vlan from 201-205
`Bridge4(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge4(g8032-config-switch)#g8032 erp-instance erp2`	Create g8032 erp instance erp2
`Bridge4(g8032-config-switch)#ring-type sub-ring`	Configure ring-type as sub-ring
`Bridge4(g8032-config-switch)#ring lagsubring`	Associate ring lagsubring to erp2 instance
`Bridge4(g8032-config-switch)#rpl role non-owner`	Configure the node as neighbor node on east interface
`Bridge4(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp2 instance
`Bridge4(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge4(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge4(g8032-config-switch)#data vlan 201-205`	Configure traffic vlan from 201-205
`Bridge4(g8032-config-switch)#ring-id 2`	Configure ring-id as 2
`Bridge4(g8032-config-switch)#non-virtual-channel`	Enable Non Virtual Channel
`Bridge4(g8032-config-switch)# enable-tcn-propagation`	Enable tcn propagation
`Bridge4(g8032-config-switch)# tcn-to-instance erp1`	Attach erp1 instance to erp2 instance to notify any changes in subring to major ring
`Bridge4(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge4(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 5

`Bridge5#config term`	Enter config mode
`Bridge5(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge5(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge1(config)#vlan database`	Configure VLAN database
`Bridge5(config-vlan)#vlan 200-205 bridge 1 state enable`	Create VLAN 200-205 on bridge 1
`Bridge5(config-vlan)#interface po5`	Configure lag interface po5
`Bridge5(config-if)#switchport`	Configure po5 as a layer 2 port

`Bridge5(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge5(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge5(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge5(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po3 interface
`Bridge5(config-if)#interface po6`	Configure lag interface po3
`Bridge5(config-if)#switchport`	Configure po3 as a layer 2 port
`Bridge5(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge5(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge5(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge5(config-if)#switchport trunk allowed vlan add 200-205`	Allow vlan 200-205 on po3 interface
`Bridge5(config-if)#interface xe1`	Configure interface xe1
`Bridge5(config-if)#channel-group 6 mode active`	Configure xe1 as part of po6
`Bridge5(config-if)#interface xe2`	Configure interface xe2
`Bridge5(config-if)#channel-group 6 mode active`	Configure xe2 as part of po6
`Bridge5(config-if)#interface xe10`	Configure interface xe10
`Bridge5(config-if)#channel-group 5 mode active`	Configure xe10 as part of po5
`Bridge5(config-if)#interface xe11`	Configure interface xe11
`Bridge5(config-if)#channel-group 5 mode active`	Configure xe11 as part of po5
`Bridge5(config-if)#ethernet cfm domain-type character-string domain-name nod15 level 7 mip-creation none`	Create cfm domain with type as character string with name nod15 and set mip creation criteria to default with level 7
`Bridge5(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge5(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge5(config-ether-cfm-ma)#mip-creation none`	Set mip-creation creation criteria to none
`Bridge5(config-ether-cfm-ma)#ethernet cfm mep down mpid 15 active true po6`	Create down mep 15 for po6 interface
`Bridge5(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast
`Bridge5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge5(config-ether-cfm-ma)#mep crosscheck mpid 51`	Configure crosscheck to remote MEP with value 51
`Bridge5(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge5(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode

`Bridge5(config-ether-cfm)#ethernet cfm domain-type character-string domain-name nod45 level 7 mip-creation none`	Create cfm domain with type as character string with name nod45 and set mip creation criteria to default with level 7
`Bridge5(config-ether-cfm)#service ma-type string ma-name 43982`	Create ma type as string with name 43982
`Bridge5(config-ether-cfm-ma)# vlan 200 bridge 1`	Add VLAN 200
`Bridge5(config-ether-cfm-ma)#mip-creation none`	Set mip-creation criteria to none
`Bridge5(config-ether-cfm-ma)#ethernet cfm mep down mpid 45 active true po5`	Create down mep 45 for po5 interface
`Bridge5(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable cc multicast
`Bridge5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet cfm ma-mep mode
`Bridge5(config-ether-cfm-ma)#mep crosscheck mpid 54`	Configure crosscheck to remote MEP with value 54
`Bridge5(config-ether-cfm-ma)#cc interval 100ms`	Enable CC interval with 100ms
`Bridge5(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge5(config-ether-cfm)#g8032 ring lagsubring`	Create g8032 ring with name lagsubring
`Bridge5(g8032-ring-config)#east-interface po5`	Associate po5 interface as east-interface
`Bridge5(g8032-ring-config)#west-interface po6`	Associate po6 interface as west-interface
`Bridge5(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge5(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge5(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge5(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge5(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge5(g8032-profile-config)#g8032 erp-instance erp2`	Create g8032 erp instance erp2
`Bridge5(g8032-config-switch)#ring lagsubring`	Associate Physical ring lagsubring to erp2 instance
`Bridge5(g8032-config-switch)#ring-type sub-ring`	Configure ring-type as subring
`Bridge5(g8032-config-switch)#rpl role owner west-interface`	Configure the node as owner node on west interface
`Bridge5(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp2 instance
`Bridge5(g8032-config-switch)#aps-channel level 7`	Configure level as 7

`Bridge5(g8032-config-switch)#aps-channel vlan 200`	Configure RAPS channel vlan as 200
`Bridge5(g8032-config-switch)#data vlan 201-205`	Configure traffic vlan from 201-205
`Bridge5(g8032-config-switch)#ring-id 2`	Configure ring-id as 2
`Bridge5(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge5(g8032-config-switch)#end`	Exit g8032 erp instance mode

Validation

```
Bridge1#show g8032 erp-instance erp2
Inst Name        : erp2
Description      :
State            : G8032_ST_IDLE
Phy Ring         : lagsubring
Ring Type        : SUB-RING (NON VIRTUAL)
Role             : NEIGHBOR (EAST)
Node ID          : 3c:2c:99:26:e6:7b
----------------------------------------------------------
                   East Link           West Link
==========================================================
Interface        :  po6                -
State            :  Blocked            -
Remote NodeId    :  6c:b9:c5:67:72:f6  -
Remote BPR       :  0                  -
Endpoint Info
-------------
Domain Name      :  nod15              -
MEP ID           :  51                 -
MA Name          :  43982              -
==========================================================
TCN Propagation : Enabled
TCN Propagation List: erp1,

     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   2)         |
===========================

Bridge1#show g8032 erp-instance erp1

Inst Name        : erp
Description      :
State            : G8032_ST_IDLE
Phy Ring         : lagring
Ring Type        : MAJOR-RING
Role             : NON-OWNER
Node ID          : 3c:2c:99:26:e6:80
----------------------------------------------------------
                   East Link           West Link
==========================================================
Interface        :  po4                po1
```

```
State            :  Unblocked            Unblocked
Remote NodeId    :  34:17:eb:e4:af:10    -
Remote BPR       :  1                    -
Endpoint Info
-------------
Domain Name      :  nod41                nod12
MEP ID           :  14                   12
MA Name          :  43982                43982
==========================================================
---------------------------
     Channel               |
 (LEVEL, VLAN, RING ID)    |
===========================
 (7,    200,   1)          |
===========================

DataTraffic vlan: 201-205
Profile : profile1

Bridge2#show g8032 erp-instance erp1

Description      :
State            : G8032_ST_IDLE
Phy Ring         : lagring
Ring Type        : MAJOR-RING
Role             : NON-OWNER
Node ID          : d8:9e:f3:5e:f8:29
----------------------------------------------------------
                    East Link            West Link
==========================================================
Interface        :  po1                  po2
State            :  Unblocked            Unblocked
Remote NodeId    :  34:17:eb:e4:af:10    -
Remote BPR       :  1                    -
Endpoint Info
-------------
Domain Name      :  nod12                nod23
MEP ID           :  21                   23
MA Name          :  43982                43982
==========================================================
---------------------------
     Channel               |
 (LEVEL, VLAN, RING ID)    |
===========================
 (7,    200,   1)          |
===========================

DataTraffic vlan: 201-205
Profile : profile1

Bridge3#show  g8032 erp-instance erp1

Inst Name        : erp1
Description      :
State            : G8032_ST_IDLE
Phy Ring         : lagring
Ring Type        : MAJOR-RING
```

```
Role             : NEIGHBOR (WEST)
Node ID          : 3c:2c:99:1a:da:7d
----------------------------------------------------------
                   East Link           West Link
==========================================================
Interface        :  po2                po3
State            :  Unblocked          Blocked
Remote NodeId    :  34:17:eb:e4:af:10  34:17:eb:e4:af:10
Remote BPR       :  1                  1
Endpoint Info
-------------
Domain Name      :  nod23              nod34
MEP ID           :  32                 34
MA Name          :  43982              43982
==========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   1)         |
===========================

DataTraffic vlan: 201-205
Profile : profile1

Bridge4#show g8032 erp-instance erp2

Inst Name        : erp2
Description      :
State            : G8032_ST_IDLE
Phy Ring         : lagsubring
Ring Type        : SUB-RING (NON VIRTUAL)
Role             : NON-OWNER
Node ID          : 34:17:eb:e4:af:0b
----------------------------------------------------------
                   East Link           West Link
==========================================================
Interface        :  po5                -
State            :  Unblocked          -
Remote NodeId    :  6c:b9:c5:67:72:f6  -
Remote BPR       :  0                  -
Endpoint Info
-------------
Domain Name      :  nod45              -
MEP ID           :  54                 -
MA Name          :  43982              -
==========================================================
TCN Propagation : Enabled
TCN Propagation List: erp1,

     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   2)         |
===========================

DataTraffic vlan: 201-205
```

```
Profile : profile1

Bridge4#show g8032 erp-instance erp1

Inst Name        : erp1
Description      :
State            : G8032_ST_IDLE
Phy Ring         : lagring
Ring Type        : MAJOR-RING
Role             : OWNER (EAST)
Node ID          : 34:17:eb:e4:af:10
-----------------------------------------------------------
                   East Link           West Link
===========================================================
Interface        :  po3                po4
State            :  Blocked            Unblocked
Remote NodeId    :  -                  -
Remote BPR       :  -                  -
Endpoint Info
-------------
Domain Name      :  nod34              nod41
MEP ID           :  43                 41
MA Name          :  43982              43982
===========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   1)         |
===========================

DataTraffic vlan: 201-205
Profile : profile1

Bridge5#show g8032 erp-instance erp2

Inst Name        : erp2
Description      :
State            : G8032_ST_IDLE
Phy Ring         : lagsubring
Ring Type        : SUB-RING
Role             : OWNER (WEST)
Node ID          : 6c:b9:c5:67:72:f6
-----------------------------------------------------------
                   East Link           West Link
===========================================================
Interface        :  po5                po6
State            :  Unblocked          Blocked
Remote NodeId    :  -                  -
Remote BPR       :  -                  -
Endpoint Info
-------------
Domain Name      :  nod45              nod15
MEP ID           :  45                 15
MA Name          :  43982              43982
===========================================================
---------------------------
```

```
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   2)         |
===========================

DataTraffic vlan: 201-205
Profile : profile1

Bridge3#show  g8032 erp-instance erp1

Inst Name       : erp1
Description     :
State           : G8032_ST_IDLE
Phy Ring        : lagring
Ring Type       : MAJOR-RING
Role            : NEIGHBOR (WEST)
Node ID         : 3c:2c:99:1a:da:7d
-----------------------------------------------------------
                   East Link          West Link
===========================================================
Interface       :  po2                po3
State           :  Unblocked          Blocked
Remote NodeId   :  34:17:eb:e4:af:10  34:17:eb:e4:af:10
Remote BPR      :  1                  1
Endpoint Info
-------------
Domain Name     :  nod23              nod34
MEP ID          :  32                 34
MA Name         :  43982              43982
===========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    200,   1)         |
===========================

DataTraffic vlan: 201-205
Profile : profile1
```

ERPS Managing Non-Data VLAN's

An Ethernet ring that is connected to a Major Ring at the Interconnection Nodes. Non-Bridged AC-VLAN’s should follow the port state (block/forward) as ERPS data VLAN’s.

User can give control for non-bridged AC_Vlans by configuring "erps-instance <id|none>". In sub-interface, user can add “erps-instance (NAME | none)” CLI. This will exclude the sub-intf/lif’s to be processed by ERPS.

Erps-instance <name>, this sub-interface will follow specified erps-instance state for non-data vlan's.

This is useful in case of multiple instances, where one instance is in forward and another is block. So non-data vlan’s has to follow specific instance configured by user. Default is lower instance id, if not configured.

Erps-instance none, this sub-interface will not managed by ERPS. (It will be always in forward state with ERPS not controlling it).

No command specified in sub-intf mode, this sub-intf/lif will be managed by ERPS and default erps-instance id will be used for LIF/sub-intf to follow the ERPS block/forward state. Default value is lower configured instance-id

Topology

displays a sample Ring Protection topology on which protection switching is configured with five bridges. This constitutes of one major ring (Bridge1, Bridge2, Bridge3, Bridge4 and Bridge 5) and MPLS/VPLS is running between Bridge4, Bridge5 and Bridge6)

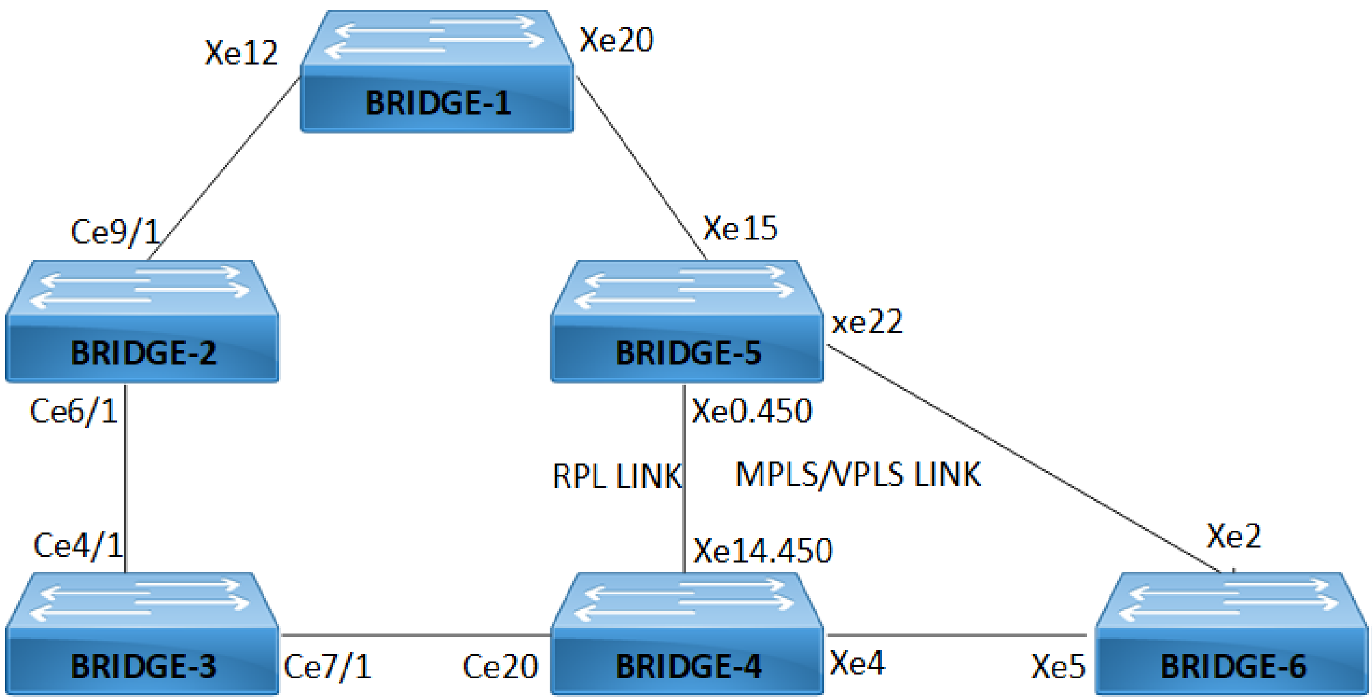


Figure 15-27: Major ring running both ERPS and MPLS/VPLS between Bridge-4 and Bridge-5.

Bridge 1

`Bridge1#configure terminal`	Enter configure mode
`Bridge1(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge1(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge1(config)#vlan database`	Configure VLAN database
`Bridge1(config-vlan)# vlan 450 bridge 1 state enable`	Create VLAN 450 on bridge 1
`Bridge1(config-vlan)# vlan 900-1010 bridge 1 state enable`	Create VLAN 900-1010 on bridge 1
`Bridge1(config-vlan)#interface xe12`	Configure interface xe12
`Bridge1(config-if)#switchport`	Configure xe12 as a layer 2 port
`Bridge1(config-if)#bridge-group 1`	Configure interface in bridge group 1

`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge1(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge1(config-if)#switchport trunk allowed vlan add 450,900-1010`	Allow vlan 450,900-1010 on xe12 interface
`Bridge1(config-if)#interface xe20`	Configure interface xe20
`Bridge1(config-if)#switchport`	Configure xe20 as a layer 2 port
`Bridge1(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge1(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge1(config-if)#switchport trunk allowed vlan add 450,900-1010`	Allow vlan 450,900-1010 on xe20 interface
`Bridge1(config-if)#interface xe24`	Configure interface xe24
`Bridge1(config-if)#switchport`	Configure xe24 as a layer 2 port
`Bridge1(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge1(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge1(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge1(config-if)#switchport trunk allowed vlan add 450,900-1010`	Allow vlan 450,900-1010 on xe24 interface
`Bridge1(config-if)# ethernet cfm domain-type character-string domain-name mdna1 level 7 mip-creation default`	Create cfm domain with type as character string with name mdna1 and set MIP creation criteria to default with level 7
`Bridge1(config-ether-cfm)#service ma-type string ma-name n27`	Create MA type as string with name n27
`Bridge1(config-ether-cfm-ma)# vlan 900 bridge 1`	Add VLAN 900
`Bridge1(config-ether-cfm-ma)# mip-creation default`	Set MIP-creation criteria to default
`Bridge1(config-ether-cfm-ma)# ethernet cfm mep down mpid 2027 active true xe12`	Create down MEP 2027 for xe12 interface
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 27`	Configure crosscheck to remote MEP with value 27
`Bridge1(config-ether-cfm-ma)#cc  interval 10s`	Enable cc interval with 10s

`Bridge1(config-ether-cfm-ma)# exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge1(config-if)# ethernet cfm domain-type character-string domain-name mdna2 level 7 mip-creation default`	Create cfm domain with type as character string with name mdna2 and set MIP creation criteria to default with level 7
`Bridge1(config-ether-cfm)#service ma-type string ma-name n27`	Create MA type as string with name n27
`Bridge1(config-ether-cfm-ma)# vlan 900 bridge 1`	Add VLAN 900
`Bridge1(config-ether-cfm-ma)# mip-creation default`	Set MIP-creation criteria to default
`Bridge1(config-ether-cfm-ma)# ethernet cfm mep down mpid 3037 active true xe20`	Create down MEP 3037 for xe20 interface
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 37`	Configure crosscheck to remote MEP with value 37
`Bridge1(config-ether-cfm-ma)#cc  interval 10s`	Enable cc interval with 10s
`Bridge1(config-ether-cfm-ma)# exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge1(config-ether-cfm)#g8032 ring RING1`	Create g8032 ring with name RING1
`Bridge1(g8032-ring-config)#east-interface xe20`	Associate xe20 interface as east-interface
`Bridge1(g8032-ring-config)#west-interface xe12`	Associate xe12 interface as west-interface
`Bridge1(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge1(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge1(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge1(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge1(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge1(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge1(g8032-config-switch)#ring RING1`	Associate ring RING1 to erp1 instance

`Bridge1(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node
`Bridge1(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge1(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge1(g8032-config-switch)#aps-channel vlan 900`	Configure RAPS channel vlan as 900
`Bridge1(g8032-config-switch)#data vlan 950`	Configure traffic vlan 950
`Bridge1(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge1(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge1(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 2

`Bridge2#configure terminal`	Enter configure mode
`Bridge2(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge2(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge2(config)#vlan database`	Configure VLAN database
`Bridge2(config-vlan)# vlan 450 bridge 1 state enable`	Create VLAN 450 on bridge 1
`Bridge2(config-vlan)# vlan 900-1010 bridge 1 state enable`	Create VLAN 900-1010 on bridge 1
`Bridge2(config-vlan)#interface ce9/1`	Configure interface ce9/1
`Bridge2(config-if)#switchport`	Configure ce9/1 as a layer 2 port
`Bridge2(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge2(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge2(config-if)#switchport trunk allowed vlan add 450,900-1010`	Allow vlan 450,900-1010 on ce9/1 interface
`Bridge2(config-if)#interface ce6/1`	Configure interface ce6/1
`Bridge2(config-if)#switchport`	Configure ce6/1 as a layer 2 port
`Bridge2(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge2(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge2(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge2(config-if)#switchport trunk allowed vlan add 450,900-1010`	Allow vlan 450,900-1010 on ce6/1 interface

`Bridge2(config-if)# ethernet cfm domain-type character-string domain-name mdna1 level 7 mip-creation default`	Create cfm domain with type as character string with name mdna1 and set MIP creation criteria to default with level 7
`Bridge2(config-ether-cfm)#service ma-type string ma-name n27`	Create MA type as string with name n27
`Bridge2(config-ether-cfm-ma)# vlan 900 bridge 1`	Add VLAN 900
`Bridge2(config-ether-cfm-ma)# mip-creation default`	Set MIP-creation criteria to default
`Bridge2(config-ether-cfm-ma)# ethernet cfm mep down mpid 27 active true ce9/1`	Create down MEP 27 for ce9/1 interface
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 2027`	Configure crosscheck to remote MEP with value 2027
`Bridge2(config-ether-cfm-ma)#cc  interval 10s`	Enable cc interval with 10s
`Bridge2(config-ether-cfm-ma)# exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge2(config-if)# ethernet cfm domain-type character-string domain-name mdna5 level 7 mip-creation default`	Create cfm domain with type as character string with name mdna5 and set MIP creation criteria to default with level 7
`Bridge2(config-ether-cfm)#service ma-type string ma-name n27`	Create MA type as string with name n27
`Bridge2(config-ether-cfm-ma)# vlan 900 bridge 1`	Add VLAN 900
`Bridge2(config-ether-cfm-ma)# mip-creation default`	Set MIP-creation criteria to default
`Bridge2(config-ether-cfm-ma)# ethernet cfm mep down mpid 6067 active true ce6/1`	Create down MEP 3037 for xe20 interface
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 67`	Configure crosscheck to remote MEP with value 67
`Bridge2(config-ether-cfm-ma)#cc  interval 10s`	Enable cc interval with 10s

`Bridge2(config-ether-cfm-ma)# exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge2(config-ether-cfm)#g8032 ring RING1`	Create g8032 ring with name RING1 on bridge 1
`Bridge2(g8032-ring-config)#east-interface ce9/1`	Associate ce9/1 interface as east-interface
`Bridge2(g8032-ring-config)#west-interface ce6/1`	Associate ce6/1 interface as west-interface
`Bridge2(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge2(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge2(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge2(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge2(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge2(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge2(g8032-config-switch)#ring RING1`	Associate ring RING1 to erp1 instance
`Bridge2(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node
`Bridge2(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge2(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge2(g8032-config-switch)#aps-channel vlan 900`	Configure RAPS channel vlan as 900
`Bridge2(g8032-config-switch)#data vlan 950`	Configure traffic vlan 950
`Bridge2(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge2(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge2(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 3

`Bridge3#configure terminal`	Enter configure mode
`Bridge3(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge3(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge3(config)#vlan database`	Configure VLAN database

`Bridge3(config-vlan)# vlan 450 bridge 1 state enable`	Create VLAN 450 on bridge 1
`Bridge3(config-vlan)# vlan 900-1010 bridge 1 state enable`	Create VLAN 900-1010 on bridge 1
`Bridge3(config-vlan)#interface ce4/1`	Configure interface ce4/1
`Bridge3(config-if)#switchport`	Configure ce4/1 as a layer 2 port
`Bridge3(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge3(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge3(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge3(config-if)#switchport trunk allowed vlan add 450,900-1010`	Allow vlan 450,900-1010 on ce4/1 interface
`Bridge3(config-if)#interface ce7/1`	Configure interface ce7/1
`Bridge3(config-if)#switchport`	Configure ce7/1 as a layer 2 port
`Bridge3(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge3(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge3(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge3(config-if)#switchport trunk allowed vlan add 450,900-1010`	Allow vlan 450,900-1010 on ce7/1 interface
`Bridge3(config-if)# ethernet cfm domain-type character-string domain-name mdna4 level 7 mip-creation default`	Create cfm domain with type as character string with name mdna4 and set MIP creation criteria to default with level 7
`Bridge3(config-ether-cfm)#service ma-type string ma-name n27`	Create MA type as string with name n27
`Bridge3(config-ether-cfm-ma)# vlan 900 bridge 1`	Add VLAN 900
`Bridge3(config-ether-cfm-ma)# mip-creation default`	Set MIP-creation criteria to default
`Bridge3(config-ether-cfm-ma)# ethernet cfm mep down mpid 5057 active true ce7/1`	Create down MEP 5057 for ce7/1 interface
`Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 57`	Configure crosscheck to remote MEP with value 57
`Bridge3(config-ether-cfm-ma)#cc  interval 10s`	Enable cc interval with 10s
`Bridge3(config-ether-cfm-ma)# exit-ether-ma-mode`	Exit Ethernet ma mode

`Bridge3(config-if)# ethernet cfm domain-type character-string domain-name mdna5 level 7 mip-creation default`	Create cfm domain with type as character string with name mdna5 and set MIP creation criteria to default with level 7
`Bridge3(config-ether-cfm)#service ma-type string ma-name n27`	Create MA type as string with name n27
`Bridge3(config-ether-cfm-ma)# vlan 900 bridge 1`	Add VLAN 900
`Bridge3(config-ether-cfm-ma)# mip-creation default`	Set MIP-creation criteria to default
`Bridge3(config-ether-cfm-ma)# ethernet cfm mep down mpid 67 active true ce4/1`	Create down MEP 67 for ce4/1 interface
`Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 6067`	Configure crosscheck to remote MEP with value 6067
`Bridge3(config-ether-cfm-ma)#cc  interval 10s`	Enable cc interval with 10s
`Bridge3(config-ether-cfm-ma)# exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge3(config-ether-cfm)#g8032 ring RING1`	Create g8032 physical ring with name RING1
`Bridge3(g8032-ring-config)#east-interface ce4/1`	Associate ce4/1 interface as east-interface
`Bridge3(g8032-ring-config)#west-interface ce7/1`	Associate ce7/1 interface as west-interface
`Bridge3(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge3(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge3(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge3(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge3(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge3(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge3(g8032-config-switch)#ring RING1`	Associate ring RING1 to erp1 instance
`Bridge3(g8032-config-switch)#rpl role non-owner`	Configure the node as non-owner node

`Bridge3(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge3(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge3(g8032-config-switch)#aps-channel vlan 900`	Configure RAPS channel vlan as 900
`Bridge1(g8032-config-switch)#data vlan 950`	Configure traffic vlan 950
`Bridge3(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge3(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge3(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 4s

`Bridge4#configure terminal`	Enter configure mode
`Bridge4(config)#ip router isis 1`	Enable routing process - Intermediate System (IS-IS)
`Bridge4(config-router)#net 49.3600.3600.0001.00`	Configure net
`Bridge4(config-router)#exit`	End current mode and down to previous mode
`Bridge4(config)#interface lo`	Configure interface loopback
`Bridge4(config-if)#ip address 1.1.1.1/32 secondary`	Configure secondary ip address
`Bridge4(config-if)#ip router isis 1`	Enable routing process - Intermediate System (IS-IS)
`Bridge4(config-if)#commit`	Commit the candidate configuration to the running configuration
`Bridge4(config-if)#exit`	End current mode and down to previous mode
`Bridge4(config)#router ldp`	Enable LDP protocol
`Bridge4(config-router)#router-id 1.1.1.1`	Set router id
`Bridge4(config-router)#targeted-peer ipv4 2.2.2.2`	Configure targeted peer
`Bridge4(config-router)#exit-targeted-peer-mode`	Exit Targeted Peer configuration mode
`Bridge4(config-router)#targeted-peer ipv4 3.3.3.3`	Configure targeted peer
`Bridge4(config-router)#exit-targeted-peer-mode`	Exit Targeted Peer configuration mode
`Bridge4(config-router)#transport-address ipv4 1.1.1.1`	Configure a transport address for a label space
`Bridge4(config-router)#commit`	Commit the candidate configuration to the running configuration
`Bridge4(config-router)#exit`	End current mode and down to previous mode
`Bridge4(config)#mpls vpls vpls450 450`	Create an instance of MPLS based Virtual Private Lan Service (VPLS)

`Bridge4(config-vpls)#signaling ldp`	Establishing pseudowires with other PE routers using ldp protocol
`Bridge4(config-vpls-sig)#vpls-peer 2.2.2.2`	Add a peer to VPLS domain
`Bridge4(config-vpls-sig)#vpls-peer 3.3.3.3`	Add a peer to VPLS domain
`Bridge4(config-vpls-sig)#exit-signaling`	Exit from Signaling configuration mode and start signaling
`Bridge4(config-vpls)# exit-vpls`	Exit from vpls mode
`Bridge4(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge4(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge4(config)#vlan database`	Configure VLAN database
`Bridge4(config-vlan)# vlan 900-1010 bridge 1 state enable`	Create VLAN 900-1010 on bridge 1
`Bridge4(config-vlan)#interface ce20`	Configure interface ce20
`Bridge4(config-if)#switchport`	Configure ce20 as a layer 2 port
`Bridge4(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge4(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge4(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge4(config-if)#switchport trunk allowed vlan add 900-1010`	Allow vlan 900-1010 on ce20 interface
`Bridge4(config-if)#interface interface ce20.450 switchport`	Configure interface ce20.450 as L2 subinterface
`Bridge4(config-if)#encapsulation dot1q 450`	Configure dotq encapsulation for vlan 450 packets
`Bridge4(config-if)#access-if-vpls`	Enter to VPLS MPLS Access interface mode
`Bridge4(config-acc-if-vpls)#mpls-vpls vpls450`	Attach VPLS instance
`Bridge4(config-acc-if-vpls)#exit`	End current mode and down to previous mode
`Bridge4(config-if)#interface xe14`	Configure interface xe14
`Bridge4(config-if)#switchport`	Configure xe14 as a layer 2 port
`Bridge4(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge4(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge4(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge4(config-if)#switchport trunk allowed vlan add 900-1010`	Allow vlan 900-1010 on xe14 interface
`Bridge4(config-if)#interface xe14.450`	Configure sub-interface of xe14
`Bridge4(config-if)#encapsulation dot1q 450`	Configure dotq encapsulation for vlan 450 packets
`Bridge4(config-if)#ip address 10.1.1.2/30`	Configure ip address

`Bridge4(config-if)#label-switching`	Enable label-switching on interface
`Bridge4(config-if)#ip router isis 1`	Enable routing process - Intermediate System (IS-IS)
`Bridge4(config-if)#enable-ldp ipv4`	Enable LDP protocol
`Bridge4(config-if)#erps-instance none`	Configure erps-instance in this subinterface
`Bridge4(config-if)#interface xe4`	Configure interface xe24
`Bridge4(config-if)#ip address 30.1.1.2/30`	Configure ip address
`Bridge4(config-if)#label-switching`	Enable label-switching on interface
`Bridge4(config-if)#ip router isis 1`	Enable routing process - Intermediate System (IS-IS)
`Bridge4(config-if)#enable-ldp ipv4`	Enable LDP protocol
`Bridge1(config-if)# ethernet cfm domain-type character-string domain-name mdna3 level 7 mip-creation default`	Create cfm domain with type as character string with name mdna3 and set MIP creation criteria to default with level 7
`Bridge4(config-ether-cfm)#service ma-type string ma-name n27`	Create MA type as string with name n27
`Bridge4(config-ether-cfm-ma)#vlan 900 bridge 1`	Add VLAN 900
`Bridge4(config-ether-cfm-ma)# mip-creation default`	Set MIP-creation criteria to default
`Bridge4(config-ether-cfm-ma)# ethernet cfm mep down mpid 4047 active true xe14`	Create down MEP 4047 for xe14 interface
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 47`	Configure crosscheck to remote MEP with value 47
`Bridge4(config-ether-cfm-ma)#cc  interval 10s`	Enable cc interval with 10s
`Bridge4(config-ether-cfm-ma)# exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge4(config-if)# ethernet cfm domain-type character-string domain-name mdna4 level 7 mip-creation default`	Create cfm domain with type as character string with name mdna4 and set MIP creation criteria to default with level 7
`Bridge4(config-ether-cfm)#service ma-type string ma-name n27`	Create MA type as string with name n27
`Bridge4(config-ether-cfm-ma)# vlan 900 bridge 1`	Add VLAN 900

`Bridge4(config-ether-cfm-ma)# mip-creation default`	Set MIP-creation criteria to default
`Bridge4(config-ether-cfm-ma)# ethernet cfm mep down mpid 57 active true ce20`	Create down MEP 57 for ce20 interface
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 5057`	Configure crosscheck to remote MEP with value 5057
`Bridge4(config-ether-cfm-ma)#cc  interval 10s`	Enable cc interval with 10s
`Bridge4(config-ether-cfm-ma)# exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge4(config-ether-cfm)#g8032 ring RING1`	Create g8032 ring with name RING1
`Bridge4(g8032-ring-config)#east-interface ce20`	Associate ce20 interface as east-interface
`Bridge4(g8032-ring-config)#west-interface xe14`	Associate xe14 interface as west-interface
`Bridge4(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge4(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge4(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge4(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge4(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge4(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge4(g8032-config-switch)#ring RING1`	Associate ring RING1 to erp1 instance
`Bridge4(g8032-config-switch)#rpl role neighbor west-interface`	Configure the node as neighbor towards west-interface
`Bridge4(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge4(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge4(g8032-config-switch)#aps-channel vlan 900`	Configure RAPS channel vlan as 900
`Bridge4(g8032-config-switch)#data vlan 950`	Configure traffic vlan 950

Bridge4(g8032-config-switch)#ring-id 1	Configure ring-id as 1
Bridge4(g8032-config-switch)#commit	Commit the candidate configuration to the running configuration
Bridge4(g8032-config-switch)#end	Exit g8032 erp instance mode

Bridge 5

Bridge5#configure terminal	Enter configure mode
Bridge5(config)#ip router isis 1	Enable routing process - Intermediate System (IS-IS)
Bridge5(config-router)# net 49.3600.3600.0002.00	Configure net
Bridge5(config-router)#exit	End current mode and down to previous mode
Bridge5(config)#interface lo	Configure interface loopback
Bridge5(config-if)# ip address 2.2.2.2/32 secondary	Configure secondary ip address
Bridge5(config-if)#ip router isis 1	Enable routing process - Intermediate System (IS-IS)
Bridge5(config-if)#commit	Commit the candidate configuration to the running configuration
Bridge5(config-if)#exit	End current mode and down to previous mode
Bridge5(config)#router ldp	Enable LDP protocol
Bridge5(config-router)#router-id 2.2.2.2	Set router id
Bridge5(config-router)#targeted-peer ipv4 1.1.1.1	Configure targeted peer
Bridge5(config-router)#exit-targeted-peer-mode	Exit Targeted Peer configuration mode
Bridge5(config-router)#targeted-peer ipv4 3.3.3.3	Configure targeted peer
Bridge5(config-router)#exit-targeted-peer-mode	Exit Targeted Peer configuration mode
Bridge5(config-router)#transport-address ipv4 2.2.2.2	Configure a transport address for a label space
Bridge5(config-router)#commit	Commit the candidate configuration to the running configuration
Bridge5(config-router)#exit	End current mode and down to previous mode
Bridge5(config)#mpls vpls vpls450 450	Create an instance of MPLS based Virtual Private Lan Service (VPLS)
Bridge5(config-vpls)#signaling ldp	Establishing pseudowires with other PE routers using ldp protocol
Bridge5(config-vpls-sig)#vpls-peer 1.1.1.1	Add a peer to VPLS domain
Bridge5(config-vpls-sig)#vpls-peer 3.3.3.3	Add a peer to VPLS domain
Bridge5(config-vpls-sig)#exit-signaling	Exit from Signaling configuration mode and start signaling
Bridge5(config-vpls)# exit-vpls	Exit from vpls mode

`Bridge5(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge5(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge5(config)#vlan database`	Configure VLAN database
`Bridge5(config-vlan)# vlan 900-1010 bridge 1 state enable`	Create VLAN 900-1010 on bridge 1
`Bridge5(config-vlan)#interface xe15`	Configure interface xe15
`Bridge5(config-if)#switchport`	Configure xe15 as a layer 2 port
`Bridge5(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge5(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge5(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge5(config-if)#switchport trunk allowed vlan add 900-1010`	Allow vlan 900-1010 on xe15 interface
`Bridge5(config-if)#interface interface xe15.450 switchport`	Configure interface xe15.450 as L2 subinterface
`Bridge5(config-if)#encapsulation dot1q 450`	Configure dotq encapsulation for vlan 450 packets
`Bridge5(config-if)#access-if-vpls`	Enter to VPLS MPLS Access interface mode
`Bridge5(config-acc-if-vpls)#mpls-vpls vpls450`	Attach VPLS instance
`Bridge5(config-acc-if-vpls)#exit`	End current mode and down to previous mode
`Bridge5(config-if)#interface xe0`	Configure interface xe0
`Bridge5(config-if)#switchport`	Configure xe0 as a layer 2 port
`Bridge5(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge5(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge5(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge5(config-if)#switchport trunk allowed vlan add 900-1010`	Allow vlan 900-1010 on xe0 interface
`Bridge5(config-if)#interface xe0.450`	Configure sub-interface of xe0
`Bridge5(config-if)#encapsulation dot1q 450`	Configure dotq encapsulation for vlan 450 packets
`Bridge5(config-if)#ip address 10.1.1.1/30`	Configure ip address
`Bridge5(config-if)#label-switching`	Enable label-switching on interface
`Bridge5(config-if)#ip router isis 1`	Enable routing process - Intermediate System (IS-IS)
`Bridge5(config-if)#enable-ldp ipv4`	Enable LDP protocol
`Bridge5(config-if)#erps-instance none`	Configure erps-instance in this subinterface
`Bridge5(config-if)#interface xe22`	Configure interface xe24
`Bridge5(config-if)#ip address 20.1.1.1/30`	Configure ip address

`Bridge5(config-if)#label-switching`	Enable label-switching on interface
`Bridge5(config-if)#ip router isis 1`	Enable routing process - Intermediate System (IS-IS)
`Bridge5(config-if)#enable-ldp ipv4`	Enable LDP protocol
`Bridge5(config-if)# ethernet cfm domain-type character-string domain-name mdna2 level 7 mip-creation default`	Create cfm domain with type as character string with name mdna2 and set MIP creation criteria to default with level 7
`Bridge5(config-ether-cfm)#service ma-type string ma-name n27`	Create MA type as string with name n27
`Bridge5(config-ether-cfm-ma)#vlan 900 bridge 1`	Add VLAN 900
`Bridge5(config-ether-cfm-ma)# mip-creation default`	Set MIP-creation criteria to default
`Bridge5(config-ether-cfm-ma)# ethernet cfm mep down mpid 37 active true xe15`	Create down MEP 37 for xe15 interface
`Bridge5(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode
`Bridge5(config-ether-cfm-ma)#mep crosscheck mpid 3037`	Configure crosscheck to remote MEP with value 3037
`Bridge5(config-ether-cfm-ma)#cc  interval 10s`	Enable cc interval with 10s
`Bridge5(config-ether-cfm-ma)# exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge5(config-if)# ethernet cfm domain-type character-string domain-name mdna3 level 7 mip-creation default`	Create cfm domain with type as character string with name mdna3 and set MIP creation criteria to default with level 7
`Bridge5(config-ether-cfm)#service ma-type string ma-name n27`	Create MA type as string with name n27
`Bridge5(config-ether-cfm-ma)# vlan 900 bridge 1`	Add VLAN 900
`Bridge5(config-ether-cfm-ma)# mip-creation default`	Set MIP-creation criteria to default
`Bridge5(config-ether-cfm-ma)# ethernet cfm mep down mpid 47 active true xe0`	Create down MEP 47 for xe0 interface
`Bridge5(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable CC multicast
`Bridge5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit ethernet CFM MA-MEP mode

`Bridge5(config-ether-cfm-ma)#mep crosscheck mpid 4047`	Configure crosscheck to remote MEP with value 4047
`Bridge5(config-ether-cfm-ma)#cc  interval 10s`	Enable cc interval with 10s
`Bridge5(config-ether-cfm-ma)# exit-ether-ma-mode`	Exit Ethernet ma mode
`Bridge5(config-ether-cfm)#g8032 ring RING1`	Create g8032 ring with name RING1
`Bridge5(g8032-ring-config)#east-interface xe0`	Associate ce20 interface as east-interface
`Bridge5(g8032-ring-config)#west-interface xe15`	Associate xe14 interface as west-interface
`Bridge5(g8032-ring-config)#g8032 profile profile1`	Create g8032 profile with profile name profile1
`Bridge5(g8032-profile-config)#timer wait-to-restore 1`	Configure wait to restore time as 1 min
`Bridge5(g8032-profile-config)#timer hold-off 0`	Configure hold-off timer value as 0
`Bridge5(g8032-profile-config)#timer guard-timer 10`	Configure guard-timer value as 10ms
`Bridge5(g8032-profile-config)#switching mode revertive`	Configure Switching mode as revertive Switching mode
`Bridge5(g8032-profile-config)#g8032 erp-instance erp1`	Create g8032 erp instance erp1
`Bridge5(g8032-config-switch)#ring RING1`	Associate ring RING1 to erp1 instance
`Bridge5(g8032-config-switch)#rpl role owner east-interface`	Configure the node as owner towards east-interface
`Bridge5(g8032-config-switch)#g8032-profile profile1`	Associate Profile profile1 to erp1 instance
`Bridge5(g8032-config-switch)#aps-channel level 7`	Configure level as 7
`Bridge5(g8032-config-switch)#aps-channel vlan 900`	Configure RAPS channel vlan as 900
`Bridge5(g8032-config-switch)#data vlan 950`	Configure traffic vlan 950
`Bridge5(g8032-config-switch)#ring-id 1`	Configure ring-id as 1
`Bridge5(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge5(g8032-config-switch)#end`	Exit g8032 erp instance mode

Bridge 6

`Bridge6#configure terminal`	Enter configure mode
`Bridge6(config)#ip router isis 1`	Enable routing process - Intermediate System (IS-IS)

`Bridge6(config-router)# net 49.3600.3600.0003.00`	Configure net
`Bridge6(config-router)#exit`	End current mode and down to previous mode
`Bridge6(config)#interface lo`	Configure interface loopback
`Bridge6(config-if)# ip address 3.3.3.3/32 secondary`	Configure secondary ip address
`Bridge6(config-if)#ip router isis 1`	Enable routing process - Intermediate System (IS-IS)
`Bridge6(config-if)#commit`	Commit the candidate configuration to the running configuration
`Bridge6(config-if)#exit`	End current mode and down to previous mode
`Bridge6(config)#router ldp`	Enable LDP protocol
`Bridge6(config-router)#router-id 3.3.3.3`	Set router id
`Bridge6(config-router)#targeted-peer ipv4 1.1.1.1`	Configure targeted peer
`Bridge6(config-router)#exit-targeted-peer-mode`	Exit Targeted Peer configuration mode
`Bridge6(config-router)#targeted-peer ipv4 2.2.2.2`	Configure targeted peer
`Bridge6(config-router)#exit-targeted-peer-mode`	Exit Targeted Peer configuration mode
`Bridge6(config-router)#transport-address ipv4 3.3.3.3`	Configure a transport address for a label space
`Bridge6(config-router)#commit`	Commit the candidate configuration to the running configuration
`Bridge6(config-router)#exit`	End current mode and down to previous mode
`Bridge6(config)#mpls vpls vpls450 450`	Create an instance of MPLS based Virtual Private Lan Service (VPLS)
`Bridge6(config-vpls)#signaling ldp`	Establishing pseudowires with other PE routers using ldp protocol
`Bridge6(config-vpls-sig)#vpls-peer 1.1.1.1`	Add a peer to VPLS domain
`Bridge6(config-vpls-sig)#vpls-peer 2.2.2.2`	Add a peer to VPLS domain
`Bridge6(config-vpls-sig)#exit-signaling`	Exit from Signaling configuration mode and start signaling
`Bridge6(config-vpls)# exit-vpls`	Exit from vpls mode
`Bridge6(config)#bridge 1 protocol rstp vlan-bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Bridge6(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string
`Bridge6(config)#vlan database`	Configure VLAN database
`Bridge6(config-vlan)# vlan 450 bridge 1 state enable`	Create VLAN 450 on bridge 1
`Bridge6(config-vlan)# vlan 900-1010 bridge 1 state enable`	Create VLAN 900-1010 on bridge 1

`Bridge6(config-vlan)#interface xe4`	Configure interface xe4
`Bridge6(config-if)#switchport`	Configure xe4 as a layer 2 port
`Bridge6(config-if)#bridge-group 1`	Configure interface in bridge group 1
`Bridge6(config-if)#bridge-group 1 spanning-tree disable`	Disable spanning tree for bridge group 1 on that interface
`Bridge6(config-if)#switchport mode trunk`	Configure port as trunk port
`Bridge6(config-if)#switchport trunk allowed vlan add 900-1010`	Allow vlan 900-1010 on xe4 interface
`Bridge6(config-if)#interface interface xe4.450 switchport`	Configure interface xe4.450 as L2 subinterface
`Bridge6(config-if)#encapsulation dot1q 450`	Configure dotq encapsulation for vlan 450 packets
`Bridge6(config-if)#access-if-vpls`	Enter to VPLS MPLS Access interface mode
`Bridge6(config-acc-if-vpls)#mpls-vpls vpls450`	Attach VPLS instance
`Bridge6(config-acc-if-vpls)#exit`	End current mode and down to previous mode
`Bridge6(config-if)#interface xe2`	Configure sub-interface of xe2
`Bridge6(config-if)#ip address 20.1.1.2/30`	Configure ip address
`Bridge6(config-if)#label-switching`	Enable label-switching on interface
`Bridge6(config-if)#ip router isis 1`	Enable routing process - Intermediate System (IS-IS)
`Bridge6(config-if)#enable-ldp ipv4`	Enable LDP protocol
`Bridge6(config-if)#interface xe5`	Configure interface xe24
`Bridge6(config-if)#ip address 30.1.1.1/30`	Configure ip address
`Bridge6(config-if)#label-switching`	Enable label-switching on interface
`Bridge6(config-if)#ip router isis 1`	Enable routing process - Intermediate System (IS-IS)
`Bridge6(config-if)#enable-ldp ipv4`	Enable LDP protocol
`Bridge6(config-if)#commit`	Commit the candidate configuration to the running configuration
`Bridge6(config-if)#end`	Exit g8032 erp instance mode

Validation

Bridge1:

```
show g8032 erp-instance erp1

Inst Name        : erp1
Description      :
State            : G8032_ST_IDLE
Phy Ring         : RING1
Ring Type        : MAJOR-RING
Role             : NON-OWNER
```

```
Node ID          : 14:44:8f:9c:20:dd
-----------------------------------------------------------
                   East Link           West Link
===========================================================
Interface        :  xe20               xe12
Protocol State   :  Unblocked          Unblocked
Link Status      :  UP                 UP
Remote NodeId    :  f8:8e:a1:f3:25:42  -
Remote BPR       :  1                  -
Endpoint Info
-------------
Domain Name      :  mdna2              mdna1
MEP ID           :  3037               2027
MA Name          :  n27                n27
===========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    900,   1)         |
===========================

DataTraffic vlan: 950
Profile : profile1
```

Bridge2:

```
    show g8032 erp-instance erp1

Inst Name        : erp1
Description      :
State            : G8032_ST_IDLE
Phy Ring         : RING1
Ring Type        : MAJOR-RING
Role             : NON-OWNER
Node ID          : 34:ef:b6:2f:45:86
-----------------------------------------------------------
                   East Link           West Link
===========================================================
Interface        :  ce9/1              ce6/1
Protocol State   :  Unblocked          Unblocked
Link Status      :  UP                 UP
Remote NodeId    :  f8:8e:a1:f3:25:42  -
Remote BPR       :  1                  -
Endpoint Info
-------------
Domain Name      :  mdna1              mdna5
MEP ID           :  27                 6067
MA Name          :  n27                n27
===========================================================
```

```
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    900,   1)         |
===========================

DataTraffic vlan: 950
     Profile : profile1
```

Bridge3:

```
     show g8032 erp-instance erp1

Inst Name        : erp1
Description      :
State            : G8032_ST_IDLE
Phy Ring         : RING1
Ring Type        : MAJOR-RING
Role             : NON-OWNER
Node ID          : 34:ef:b6:3c:55:c6
----------------------------------------------------------
                   East Link           West Link
==========================================================
Interface        :  ce4/1              ce7/1
Protocol State   :  Unblocked          Unblocked
Link Status      :  UP                 UP
Remote NodeId    :  f8:8e:a1:f3:25:42  -
Remote BPR       :  1                  -
Endpoint Info
-------------
Domain Name      :  mdna5              mdna4
MEP ID           :  67                 5057
MA Name          :  n27                n27
==========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    900,   1)         |
===========================

DataTraffic vlan: 950
     Profile : profile1
```

Bridge4:

```
show g8032 erp-instance erp1

Inst Name        : erp1
```

```
Description     :
State           : G8032_ST_IDLE
Phy Ring        : RING1
Ring Type       : MAJOR-RING
Role            : NEIGHBOR (WEST)
Node ID         : e8:c5:7a:47:c8:37
----------------------------------------------------------
                   East Link           West Link
==========================================================
Interface       :  ce20                xe14
Protocol State  :  Unblocked           Blocked
Link Status     :  UP                  UP
Remote NodeId   :  f8:8e:a1:f3:25:42   f8:8e:a1:f3:25:42
Remote BPR      :  1                   1
Endpoint Info
-------------
Domain Name     :  mdna4               mdna3
MEP ID          :  57                  4047
MA Name         :  n27                 n27
==========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    900,   1)         |
===========================

DataTraffic vlan: 950
     Profile : profile1
```

Bridge4:

```
show mpls vpls mesh
(m) - Service mapped over multipath transport
(e) - Service mapped over LDP ECMP

VPLS-ID    Peer Addr        Tunnel-Label  In-Label   Network-Intf   Out-Label  Lkps/St
PW-INDEX SIG-Protocol  Status
450        2.2.2.2           3            26240      xe14.450       26241      2/Up
1         LDP            Active
450        3.3.3.3           3            26241      xe4            26241      2/Up
2         LDP            Active
```

Bridge4:

```
show hsl ifmgr l3 xe14.450
Interface: xe14.450 Ifindex: 164331970 Type: IP [mpls] Oper Count 1 Ref Count 2
FIB: 0 Status : UP/RUNNING
Ethertpe : 0x8100 (NOT CONFIGURED)
L3  Info | Ifindex : 4150    VID : 4150               : HW FIB_ID : 0L3 egress
ID : 536875008
lport: 0x800000f
```

```
Lif Id : 0x44802018 Encap Id : 0x2018
Configured ERPS Instance   : NONE <0>
   Current ERPS Instance   : NONE <0>
   Current ERPS Port State : Forward

Total number of Children port count : 1
 IPv4 Address (Count: 1):
  Pfx: 10.1.1.2/30  flags: 0  int_flags: 16
 IPv6 Address (Count: 1):
     Pfx: fe80::eac5:7aff:fe47:c831/64  flags: 0  int_flags: 16
```

Bridge4:

```
    show hsl hw unit 0   ac-lif | grep 450
16     0x4480200f    0x200f    none              0x0        0        4149     450
0x1b         0x2011        Forward
25     0x44802018    0x2018    port*vlan         0x241c00e4 450      4150     450
0x11         0x201a        Forward
```

Bridge5:

```
show g8032 erp-instance erp1

Inst Name        : erp1
Description      :
State            : G8032_ST_IDLE
Phy Ring         : RING1
Ring Type        : MAJOR-RING
Role             : OWNER (EAST)
Node ID          : f8:8e:a1:f3:25:42
----------------------------------------------------------
                   East Link           West Link
==========================================================
Interface        :  xe0                xe15
Protocol State   :  Blocked            Unblocked
Link Status      :  UP                 UP
Remote NodeId    :  -                  -
Remote BPR       :  -                  -
Endpoint Info
-------------
Domain Name      :  mdna3              mdna2
MEP ID           :  47                 37
MA Name          :  n27                n27
==========================================================
---------------------------
     Channel              |
 (LEVEL, VLAN, RING ID)   |
===========================
 (7,    900,   1)         |
===========================
```

```
DataTraffic vlan: 950
     Profile : profile1
```

Bridge5:

```
show mpls vpls mesh
(m) - Service mapped over multipath transport
(e) - Service mapped over LDP ECMP

VPLS-ID    Peer Addr        Tunnel-Label  In-Label   Network-Intf   Out-Label  Lkps/St
PW-INDEX SIG-Protocol  Status
450        1.1.1.1          3             26241      xe0.450        26240      2/Up
1         LDP           Active
450        3.3.3.3          3             26240      xe22           26240      2/Up
2         LDP           Active
```

Bridge6:

```
show  mpls vpls mesh
(m) - Service mapped over multipath transport
(e) - Service mapped over LDP ECMP

VPLS-ID    Peer Addr        Tunnel-Label  In-Label   Network-Intf   Out-Label  Lkps/St
PW-INDEX SIG-Protocol  Status
450        1.1.1.1          3             26241      xe5            26241      2/Up
1         LDP           Active
450        2.2.2.2          3             26240      xe2            26240      2/Up
2         LDP           Active-
```

CHAPTER 16 ERPS with CFM Down-MEP over Bridge-Domain

Overview

Ethernet Ring Protection Switching (ERPS) over a bridge domain is a network feature that allows the implementation of ring protection in Ethernet networks using bridge domains. ERPS, a protocol specified by ITU-T G.8032, is designed to provide fast and seamless protection switching in ring topologies to ensure network availability. Previously, all ERPS instances were mapped to a single bridge domain. It is now possible to map different flooding domains with ERPS instances.

Feature Characteristics

1. **ERPS Configuration over L2 Sub-Interface:** OcNOS allows the configuration of ERPS over Layer 2 sub-interfaces mapped under Bridge-Domains, enabling efficient utilization of network resources.
2. **L2 Sub-Interface Configuration as Ring Ports:** Layer 2 sub-interfaces can be easily configured as east and west ring ports of an ERPS ring, providing a flexible and intuitive setup.
3. **Support for Multiple ERPS Instances:** The software supports the creation of multiple ERPS instances, facilitating the deployment of different logical ERPS rings across various Bridge-Domains.
4. **Shared ERPS Instances for Logical Rings:** Optionally, multiple ERPS logical rings can utilize a single ERPS instance if the ring ports share the same parent interface, streamlining the configuration process.
5. **Single Bridge-Domain per ERPS Instance:** A single ERPS instance can only have ring ports from a single Bridge-Domain, ensuring consistent and efficient ring management.
6. **CFM Triggering for ERPS Instances:** Configuration of Continuity Fault Management (CFM) over L2-sub-interfaces will trigger signal fail events for ERPS instances created over the same L2-sub-interface upon link fault detection.
7. **Single ERPS Instance Monitoring Multiple ERPS Rings:** The software allows a single ERPS instance to monitor multiple ERPS rings, offering centralized management and improved network oversight.

   Note: When a single instance is utilized to monitor multiple ERPS rings, only a fault detected by the primary ring will trigger a switchover (ERPS) in `associate` rings. Individual sub-interface (`subifp`) link shutdowns of `associate` ring member interfaces will not initiate a switchover in that instance.

Benefits

Network Resilience: ERPS enhances network resiliency by creating a ring topology, where traffic can be rerouted in case of a link or node failure, ensuring uninterrupted connectivity.

Faster Traffic Switchover: In case of a link or node failure within the ring, ERPS ensures rapid traffic switchover to the backup path, minimizing service disruptions.

Prerequisites

Before configuring ERPS over bridge-domains, ensure the following prerequisites are met:

Properly configure the bridge-domains and L2 sub-interfaces. For more details, refer *Bridging Support Over Layer2 Sub Interface* and *Layer 2 Subinterface Configuration* chapters in the *Layer 2 Guide*.

- Understand the network topology and ERPS requirements. For more details, refer G.8032 ERPS Version 2 chapter in the *Carrier Ethernet Configuration Guide*.
- Knowledge of CFM configuration if integrating CFM with ERPS. For more details, refer *Carrier Ethernet Guide.*

Major Ring Configuration

The major ring is the primary ring in an ERPS configuration. It carries the traffic under normal operating conditions. When no failure occurs, traffic flows through the major ring.

Topology

Figure 16-28 illustrates a sample Ring Protection topology in which protection switching is configured using four bridges. The Ring Protection Link (RPL) owner is the link between Bridge 3 and Bridge 4 (xe16), with Bridge 4 explicitly defined as the RPL owner and Bridge 3 as the RPL neighbor on one side of the link. The other bridges are explicitly configured as RPL non-owners to enable Ethernet Ring Protection Switching (ERPS) within the ring.

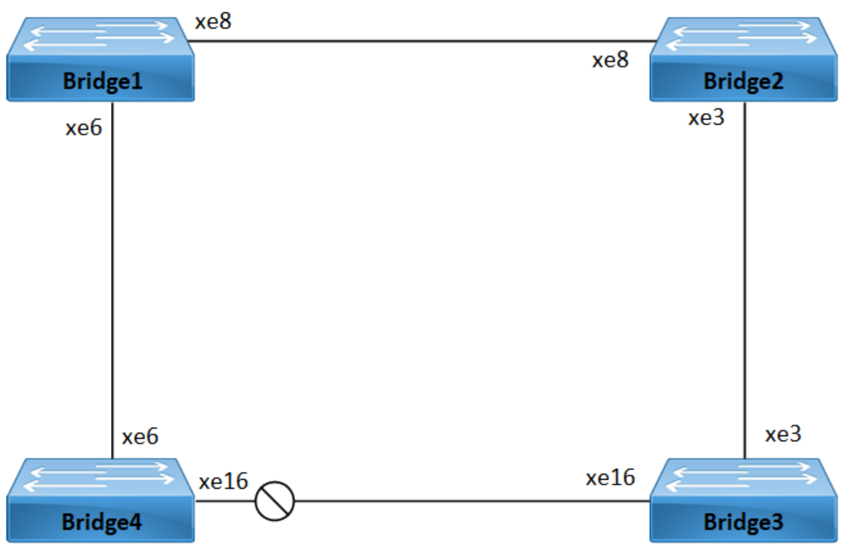


Figure 16-28: Major Ring Topology

Prerequisite

In configuration mode, enable the following `hardware-profile` commands related to CFM and then reboot the nodes:

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable
```

The following steps provide a detailed configuration of commands for setting up ERPS and CFM on Bridge1, Bridge2, Bridge3, and Bridge4 nodes. These commands enable the creation of rings, maintenance associations, Maintenance End Points (MEPs), and various parameters to ensure network reliability and protection against faults.

Bridge1

`Bridge1#configure terminal`	Enter configure mode.
`Bridge1(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string.
`Bridge1(config)#interface xe6`	Enter interface mode `xe6`.
`Bridge1(config-if)#dot1ad ethertype 0x88a8`	Configure `xe6` as a Layer 2 port with an Ethernet Type of `0x88a8`.
`Bridge1(config-if)#interface xe6.1 switchport`	Create a Layer 2 sub-interface `xe6.1` within the physical interface `xe6`.
`Bridge1(config-if)encapsulation dot1ad 200`	Encapsulate the sub-interface with APS-channel VLAN ID `200`.
`Bridge1(config-if)encapsulation dot1ad 700`	Encapsulate the sub-interface with data VLAN ID `700`.
`Bridge1(config-if)#exit`	Exit interface mode `xe6`.
`Bridge1(config)#interface xe8`	Enter interface mode `xe8`.
`Bridge1(config-if)#dot1ad ethertype 0x88a8`	Configure `xe8` as a Layer 2 port with an Ethernet Type of `0x88a8`.
`Bridge1(config)#interface xe8.1 switchport`	Create a Layer 2 sub-interface `xe8.1` within the physical interface `xe8`.
`Bridge1(config-if)encapsulation dot1ad 200`	Encapsulate the sub-interface with APS-channel VLAN ID `200`.
`Bridge1(config-if)encapsulation dot1ad 700`	Encapsulate the sub-interface with data VLAN ID `700`.
`Bridge1(config-if)#exit`	Exit interface mode `xe8`.
`Bridge1(config)#bridge-domain 1`	Enter bridge domain configure mode and configure bridge domain instance `1`.
`Bridge1(config-bridge-domain)#interface xe6.1`	Attach the sub-interface `xe6.1` to the bridge domain instance.
`Bridge1(config-bridge-domain)#interface xe8.1`	Attach the sub-interface `xe8.1` to the bridge domain instance.
`Bridge1(config-bridge-domain)#exit`	Exit bridge domain mode.
`Bridge1(config)#ethernet cfm domain-type character-string domain-name P542 level 5`	Create a CFM domain with character string type, name `P542`, and level `5`.
`Bridge1(config-ether-cfm)#service ma-type string ma-name ma542`	Create a CFM Maintenance Association (MA) type as a string with the name `ma542`.
`Bridge1(config-ether-cfm-ma)#vlan 200`	Add VLAN `200` to the CFM MA.
`Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 542 active true xe8.1`	Create a down MEP `542` for `xe8.1` interface and activate it.
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable Continuity Check (CC) multicast for the MEP.
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.

`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 452`	Configure crosscheck for the remote MEP with value `452`.
`Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge1(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge1(config)#ethernet cfm domain-type character-string domain-name P522 level 5`	Create a CFM domain with character string type, name `P522`, and level `5`.
`Bridge1(config-ether-cfm)#service ma-type string ma-name ma522`	Create a CFM MA type as a string with the name `ma522.`
`Bridge1(config-ether-cfm-ma)#vlan 200`	Add VLAN `200` to the CFM MA.
`Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 522 active true xe6.1`	Create a down MEP 522 for `xe6.1` interface and activate it.
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enables CC multicast for the MEP.
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 252`	Configure crosscheck for the remote MEP with value `252`.
`Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge1(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge1(config)#g8032 ring RING1`	Create a G.8032 ring named `RING1`.
`Bridge1(g8032-ring-config)#east-interface xe8.1`	Associate `xe8.1` interface as the east interface in `RING1`.
`Bridge1(g8032-ring-config)#west-interface xe6.1`	Associate `xe6.1` interface as the west interface in `RING1`.
`Bridge1(g8032-ring-config)#g8032 profile profile1`	Create a G.8032 profile named `profile1`.
`Bridge1(g8032-profile-config)#timer wait-to-restore 1`	Configure the wait-to-restore timer for `1` minute.
`Bridge1(g8032-profile-config)#timer hold-off 0`	Configure the hold-off timer with a value of `0`.
`Bridge1(g8032-profile-config)#timer guard-timer 10`	Configure the guard timer with a value of `10` milliseconds.
`Bridge1(g8032-profile-config)#switching mode revertive`	Configure the switching mode as `revertive`.
`Bridge1(g8032-profile-config)#exit`	Exit profile configure mode and return to the ring configure mode.
`Bridge1(g8032-ring-config)#exit`	Exit ring configure mode and return to the configure mode.
`Bridge1(config)#g8032 erp-instance erp1`	Create a G.8032 Ethernet Ring Protection (ERP) instance named `erp1`.
`Bridge1(g8032-config-switch)#ring-type major-ring`	Configure the ring type as a `major ring`.

`Bridge1(g8032-config-switch)#ring RING1`	Associate `RING1` with the ERP instance `erp1`.
`Bridge1(g8032-config-switch)#rpl role non-owner`	Configure the node as a `non-owner` node in the ring.
`Bridge1(g8032-config-switch)#g8032-profile profile1`	Associate `profile1` with `erp1` instance.
`Bridge1(g8032-config-switch)#aps-channel level 7`	Configure the R-APS channel level as `7`.
`Bridge1(g8032-config-switch)#aps-channel vlan 200`	Configure the APS channel VLAN as `200`.
`Bridge1(g8032-config-switch)#ring-id 1`	Configure the ring ID as `1`.
`Bridge1(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge1(g8032-config-switch)#end`	Exit G.8032 configure mode.

Bridge2

`Bridge2#configure terminal`	Enter configure mode.
`Bridge2(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string.
`Bridge2(config)#interface xe3`	Enter interface mode `xe3`.
`Bridge2(config-if)#dot1ad ethertype 0x88a8`	Configure `xe6` as a Layer 2 port with an Ethernet Type of `0x88a8`.
`Bridge2(config-if)#interface xe3.1 switchport`	Create a Layer 2 sub-interface `xe3.1` within the physical interface `xe3`.
`Bridge2(config-if)encapsulation dot1ad 200`	Encapsulate the sub-interface with APS-channel VLAN ID `200`.
`Bridge2(config-if)encapsulation dot1ad 700`	Encapsulate the sub-interface with data VLAN ID `700`.
`Bridge2(config-if)#exit`	Exit interface mode `xe6`.
`Bridge2(config)#interface xe8`	Enter interface mode `xe8`.
`Bridge2(config-if)#dot1ad ethertype 0x88a8`	Configure `xe8` as a Layer 2 port with an Ethernet Type of `0x88a8`.
`Bridge2(config)#interface xe8.1 switchport`	Create a Layer 2 sub-interface `xe8.1` within the physical interface `xe8`.
`Bridge2(config-if)encapsulation dot1ad 200`	Encapsulate the sub-interface with APS-channel VLAN ID `200`.
`Bridge2(config-if)encapsulation dot1ad 700`	Encapsulate the sub-interface with data VLAN ID `700`.
`Bridge2(config-if)#exit`	Exit interface mode `xe8`.
`Bridge2(config)#bridge-domain 1`	Enter bridge domain configure mode and configure bridge domain instance `1`.
`Bridge2(config-bridge-domain)#interface xe3.1`	Attach the sub-interface `xe3.1` to the bridge domain instance.
`Bridge2(config-bridge-domain)#interface xe8.1`	Attach the sub-interface `xe8.1` to the bridge domain instance.
`Bridge2(config-bridge-domain)#exit`	Exit bridge domain mode.

`Bridge2(config)#ethernet cfm domain-type character-string domain-name P542 level 5`	Create a CFM domain with character string type, name `P542`, and level `5`.
`Bridge2(config-ether-cfm)#service ma-type string ma-name ma542`	Create a CFM Maintenance Association (MA) type as a string with the name `ma542`.
`Bridge2(config-ether-cfm-ma)#vlan 200`	Add VLAN `200` to the CFM MA.
`Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 452 active true xe8.1`	Create a down MEP `452` for `xe8.1` interface and activate it.
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable Continuity Check (CC) multicast for the MEP.
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 542`	Configure crosscheck for the remote MEP with value `542`.
`Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge2(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge2(config)#ethernet cfm domain-type character-string domain-name P432 level 5`	Create a CFM domain with character string type, name `P432`, and level `5`.
`Bridge2(config-ether-cfm)#service ma-type string ma-name ma432`	Create a CFM MA type as a string with the name `ma432.`
`Bridge2(config-ether-cfm-ma)#vlan 200`	Add VLAN `200` to the CFM MA.
`Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 432 active true xe3.1`	Create a down MEP `432` for `xe3.1` interface and activate it.
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enables CC multicast for the MEP.
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 532`	Configure crosscheck for the remote MEP with value `532`.
`Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge2(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge2(config)#g8032 ring RING1`	Create a G.8032 ring named `RING1`.
`Bridge2(g8032-ring-config)#east-interface xe3.1`	Associate `xe3.1` interface as the east interface in `RING1`.
`Bridge2(g8032-ring-config)#west-interface xe8.1`	Associate `xe8.1` interface as the west interface in `RING1`.

Bridge2(g8032-ring-config)#g8032 profile profile1	Create a G.8032 profile named `profile1`.
Bridge2(g8032-profile-config)#timer wait-to-restore 1	Configure the wait-to-restore timer for `1` minute.
Bridge2(g8032-profile-config)#timer hold-off 0	Configure the hold-off timer with a value of `0`.
Bridge2(g8032-profile-config)#timer guard-timer 10	Configure the guard timer with a value of `10` milliseconds.
Bridge2(g8032-profile-config)#switching mode revertive	Configure the switching mode as `revertive`.
Bridge2(g8032-profile-config)#exit	Exit profile configure mode and return to the ring configure mode.
Bridge2(g8032-ring-config)#exit	Exit ring configure mode and return to the configure mode.
Bridge2(config)#g8032 erp-instance erp1	Create a G.8032 Ethernet Ring Protection (ERP) instance named `erp1`.
Bridge2(g8032-config-switch)#ring-type major-ring	Configure the ring type as a `major ring`.
Bridge2(g8032-config-switch)#ring RING1	Associate `RING1` with the ERP instance `erp1`.
Bridge2(g8032-config-switch)#rpl role non-owner	Configure the node as a `non-owner` node in the ring.
Bridge2(g8032-config-switch)#g8032-profile profile1	Associate `profile1` with `erp1` instance.
Bridge2(g8032-config-switch)#aps-channel level 7	Configure the R-APS channel level as `7`.
Bridge2(g8032-config-switch)#aps-channel vlan 200	Configure the APS channel VLAN as `200`.
Bridge2(g8032-config-switch)#commit	Commit the candidate configuration to the running configuration
Bridge2(g8032-config-switch)#end	Exit G.8032 configure mode.

Bridge3

Bridge3#configure terminal	Enter configure mode.
Bridge3(config)#hardware-profile filter cfm-domain-name-str enable	Enable CFM domain name as string.
Bridge3(config)#interface xe3	Enter interface mode `xe3`.
Bridge3(config-if)#dot1ad ethertype 0x88a8	Configure `xe6` as a Layer 2 port with an Ethernet Type of `0x88a8`.
Bridge3(config-if)#interface xe3.1 switchport	Create a Layer 2 sub-interface `xe3.1` within the physical interface `xe3`.
Bridge3(config-if)encapsulation dot1ad 200	Encapsulate the sub-interface with APS-channel VLAN ID `200`.
Bridge3(config-if)encapsulation dot1ad 700	Encapsulate the sub-interface with data VLAN ID `700`.
Bridge3(config-if)#exit	Exit interface mode `xe3`.
Bridge3(config)#interface xe16	Enter interface mode `xe8`.
Bridge3(config-if)#dot1ad ethertype 0x88a8	Configure `xe16` as a Layer 2 port with an Ethernet Type of `0x88a8`.

Bridge3(config)#interface xe16.1 switchport	Create a Layer 2 sub-interface xe16.1 within the physical interface xe16.
Bridge3(config-if)encapsulation dot1ad 200	Encapsulate the sub-interface with APS-channel VLAN ID 200.
Bridge3(config-if)encapsulation dot1ad 700	Encapsulate the sub-interface with data VLAN ID 700.
Bridge3(config-if)#exit	Exit interface mode xe16.
Bridge3(config)#bridge-domain 1	Enter bridge domain configure mode and configure bridge domain instance 1.
Bridge3(config-bridge-domain)#interface xe3.1	Attach the sub-interface xe3.1 to the bridge domain instance.
Bridge3(config-bridge-domain)#interface xe16.1	Attach the sub-interface xe16.1 to the bridge domain instance.
Bridge3(config-bridge-domain)#exit	Exit bridge domain mode.
Bridge3(config)#ethernet cfm domain-type character-string domain-name P542 level 5	Create a CFM domain with character string type, name P542, and level 5.
Bridge3(config-ether-cfm)#service ma-type string ma-name ma542	Create a CFM Maintenance Association (MA) type as a string with the name ma542.
Bridge3(config-ether-cfm-ma)#vlan 200	Add VLAN 200 to the CFM MA.
Bridge3(config-ether-cfm-ma)#ethernet cfm mep down mpid 452 active true xe16.1	Create a down MEP 452 for xe16.1 interface and activate it.
Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable	Enable Continuity Check (CC) multicast for the MEP.
Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit Ethernet CFM MA-MEP mode.
Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 542	Configure crosscheck for the remote MEP with value 542.
Bridge3(config-ether-cfm-ma)#exit-ether-ma-mode	Exit Ethernet CFM MA mode.
Bridge3(config-ether-cfm)#exit	Exit Ethernet CFM mode and return to the configure mode.
Bridge3(config)#ethernet cfm domain-type character-string domain-name P432 level 5	Create a CFM domain with character string type, name P432, and level 5.
Bridge3(config-ether-cfm)#service ma-type string ma-name ma432	Create a CFM MA type as a string with the name ma432.
Bridge3(config-ether-cfm-ma)#vlan 200	Add VLAN 200 to the CFM MA.
Bridge3(config-ether-cfm-ma)#ethernet cfm mep down mpid 342 active true xe3.1	Create a down MEP 342 for xe3.1 interface and activate it.
Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable	Enables CC multicast for the MEP.

`Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 432`	Configure crosscheck for the remote MEP with value `432`.
`Bridge3(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge3(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge3(config)#g8032 ring RING1`	Create a G.8032 ring named `RING1`.
`Bridge3(g8032-ring-config)#east-interface xe16.1`	Associate `xe16.1` interface as the east interface in `RING1`.
`Bridge3(g8032-ring-config)#west-interface xe3.1`	Associate `xe3.1` interface as the west interface in `RING1`.
`Bridge3(g8032-ring-config)#g8032 profile profile1`	Create a G.8032 profile named `profile1`.
`Bridge3(g8032-profile-config)#timer wait-to-restore 1`	Configure the wait-to-restore timer for `1` minute.
`Bridge3(g8032-profile-config)#timer hold-off 0`	Configure the hold-off timer with a value of `0`.
`Bridge3(g8032-profile-config)#timer guard-timer 10`	Configure the guard timer with a value of `10` milliseconds.
`Bridge3(g8032-profile-config)#switching mode revertive`	Configure the switching mode as `revertive`.
`Bridge3(g8032-profile-config)#exit`	Exit profile configure mode and return to the ring configure mode.
`Bridge3(g8032-ring-config)#exit`	Exit ring configure mode and return to the configure mode.
`Bridge3(config)#g8032 erp-instance erp1`	Create a G.8032 Ethernet Ring Protection (ERP) instance named `erp1`.
`Bridge3(g8032-config-switch)#ring-type major-ring`	Configure the ring type as a `major ring`.
`Bridge3(g8032-config-switch)#ring RING1`	Associate `RING1` with the ERP instance `erp1`.
`Bridge3(g8032-config-switch)#rpl role neighbor east-interface`	Configure the node as the `neighbor` node for the ERPS ring and designate the `east interface` as the owner node in the ring.
`Bridge3(g8032-config-switch)#g8032-profile profile1`	Associate `profile1` with `erp1` instance.
`Bridge3(g8032-config-switch)#aps-channel level 7`	Configure the R-APS channel level as `7`.
`Bridge3(g8032-config-switch)#aps-channel vlan 200`	Configure the APS channel VLAN as `200`.
`Bridge3(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge3(g8032-config-switch)#end`	Exit G.8032 configure mode.

Bridge4

`Bridge4#configure terminal`	Enter configure mode.
`Bridge4(config)#hardware-profile filter cfm-domain-name-str enable`	Enable CFM domain name as string.
`Bridge4(config)#interface xe6`	Enter interface mode `xe6`.
`Bridge4(config-if)#dot1ad ethertype 0x88a8`	Configure `xe6` as a Layer 2 port with an Ethernet Type of `0x88a8`.
`Bridge4(config-if)#interface xe6.1 switchport`	Create a Layer 2 sub-interface `xe6.1` within the physical interface `xe6`.
`Bridge4(config-if)encapsulation dot1ad 200`	Encapsulate the sub-interface with APS-channel VLAN ID `200`.
`Bridge4(config-if)encapsulation dot1ad 700`	Encapsulate the sub-interface with data VLAN ID `700`.
`Bridge4(config-if)#exit`	Exit interface mode `xe6`.
`Bridge4(config)#interface xe16`	Enter interface mode `xe8`.
`Bridge4(config-if)#dot1ad ethertype 0x88a8`	Configure `xe16` as a Layer 2 port with an Ethernet Type of `0x88a8`.
`Bridge4(config)#interface xe16.1 switchport`	Create a Layer 2 sub-interface `xe16.1` within the physical interface `xe16`.
`Bridge4(config-if)encapsulation dot1ad 200`	Encapsulate the sub-interface with APS-channel VLAN ID `200`.
`Bridge4(config-if)encapsulation dot1ad 700`	Encapsulate the sub-interface with data VLAN ID `700`.
`Bridge4(config-if)#exit`	Exit interface mode `xe16`.
`Bridge4(config)#bridge-domain 1`	Enter bridge domain configure mode and configure bridge domain instance `1`.
`Bridge4(config-bridge-domain)#interface xe6.1`	Attach the sub-interface `xe6.1` to the bridge domain instance.
`Bridge4(config-bridge-domain)#interface xe16.1`	Attach the sub-interface `xe16.1` to the bridge domain instance.
`Bridge4(config-bridge-domain)#exit`	Exit bridge domain mode.
`Bridge4(config)#ethernet cfm domain-type character-string domain-name P522 level 5`	Create a CFM domain with character string type, name `P522`, and level `5`.
`Bridge4(config-ether-cfm)#service ma-type string ma-name ma522`	Create a CFM Maintenance Association (MA) type as a string with the name `ma522`.
`Bridge4(config-ether-cfm-ma)#vlan 200`	Add VLAN `200` to the CFM MA.
`Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 452 active true xe16.1`	Create a down MEP `452` for `xe16.1` interface and activate it.
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable Continuity Check (CC) multicast for the MEP.
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.

`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 542`	Configure crosscheck for the remote MEP with value `542`.
`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge4(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge4(config)#ethernet cfm domain-type character-string domain-name P522 level 5`	Create a CFM domain with character string type, name `P522`, and level `5`.
`Bridge4(config-ether-cfm)#service ma-type string ma-name ma522`	Create a CFM MA type as a string with the name `ma522.`
`Bridge4(config-ether-cfm-ma)#vlan 200`	Add VLAN `200` to the CFM MA.
`Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 252 active true xe6.1`	Create a down MEP `252` for `xe6.1` interface and activate it.
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enables CC multicast for the MEP.
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 522`	Configure crosscheck for the remote MEP with value `522`.
`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge4(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge4(config)#g8032 ring RING1`	Create a G.8032 ring named `RING1`.
`Bridge4(g8032-ring-config)#east-interface xe6.1`	Associate `xe6.1` interface as the east interface in `RING1`.
`Bridge4(g8032-ring-config)#west-interface xe16.1`	Associate `xe16.1` interface as the west interface in `RING1`.
`Bridge4(g8032-ring-config)#g8032 profile profile1`	Create a G.8032 profile named `profile1`.
`Bridge4(g8032-profile-config)#timer wait-to-restore 1`	Configure the wait-to-restore timer for `1` minute.
`Bridge4(g8032-profile-config)#timer hold-off 0`	Configure the hold-off timer with a value of `0`.
`Bridge4(g8032-profile-config)#timer guard-timer 10`	Configure the guard timer with a value of `10` milliseconds.
`Bridge4(g8032-profile-config)#switching mode revertive`	Configure the switching mode as `revertive`.
`Bridge4(g8032-profile-config)#exit`	Exit profile configure mode and return to the ring configure mode.
`Bridge4(g8032-ring-config)#exit`	Exit ring configure mode and return to the configure mode.
`Bridge4(config)#g8032 erp-instance erp1`	Create a G.8032 Ethernet Ring Protection (ERP) instance named `erp1`.
`Bridge4(g8032-config-switch)#ring-type major-ring`	Configure the ring type as a `major ring`.

Bridge4(g8032-config-switch)#ring RING1	Associate RING1 with the ERP instance erp1.
Bridge4(g8032-config-switch)#rpl role owner west-interface	Configure the node as the owner node for the ERPS ring and designate the west interface as the neighbor node in the ring.
Bridge4(g8032-config-switch)#g8032-profile profile1	Associate profile1 with erp1 instance.
Bridge4(g8032-config-switch)#aps-channel level 7	Configure the R-APS channel level as 7.
Bridge4(g8032-config-switch)#aps-channel vlan 200	Configure the APS channel VLAN as 200.
Bridge4(g8032-config-switch)#commit	Commit the candidate configuration to the running configuration
Bridge4(g8032-config-switch)#end	Exit G.8032 configure mode.

Validation

The following details provide validation for the G.8032 ERPS configuration on Bridge1, Bridge2, Bridge3, and Bridge4.

Bridge1

```
Bridge1#show g8032 erp-instance
Instance         ID  State       East          state     West          state   Ring
-----------------------------------------------------------------------------------------------
 erp1             1   IDLE        xe8.1         Unblocked xe6.1         Unblocked  ring1

Bridge1#show g8032 erp-instance data-traffic
Instance         ID  Data-vlan                 East           West           Ring
-------------------------------------------------------------------------------------------
erp1             1   bridge_domain 1           xe8.100 (F)      xe6.1 (F)    ring1


Bridge1#show g8032 erp-instance erp1
Inst Name        : erp1 (1), node-id e8:c5:7a:a8:7c:b6, Profile (1)
Description      :
Ring             : MAJOR-RING (ring1), NON-OWNER,
                   Attached (erp3,),tcn_propagation (0)

State            : G8032_ST_IDLE

East             : xe8.1, Unblocked, UP  , BPR (-), remote (-)
West             : xe6.1, Unblocked, UP  , BPR (0), remote (b8:6a:97:25:a7:d4)

East (cfm)       : mep_id (542), cc-interval (1s), Domain (P5P42), MA (ma542)
West (cfm)       : mep_id (522), cc-interval (1s), Domain (P5P22), MA (ma522)

Channel          : Level (5), vlan (200), RING_ID (1)
```

Bridge2

```
Bridge2#show g8032 erp-instance
Instance         ID  State       East          state     West          state      Ring
-----------------------------------------------------------------------------------------------
erp1             1   IDLE        xe3.1         Unblocked xe8.1         Unblocked  ring1

Bridge2#show g8032 erp-instance erp1
Inst Name        : erp1 (1), node-id e4:9d:73:b1:c3:05, Profile (1)
Description      :
Ring             : MAJOR-RING (ring1), NON-OWNER,

State            : G8032_ST_IDLE

East             : xe3.1, Unblocked, UP  , BPR (-), remote (-)
West             : xe8.1, Unblocked, UP  , BPR (0), remote (b8:6a:97:25:a7:d4)
```

```
East (cfm)      : mep_id (432), cc-interval (1s), Domain (P4P32), MA (ma432)
West (cfm)      : mep_id (452), cc-interval (1s), Domain (P5P42), MA (ma542)

Channel         : Level (5), vlan (200), RING_ID (1)
```

```
Bridge2#show g8032 erp-instance data-traffic
Instance         ID  Data-vlan                East           West           Ring
------------------------------------------------------------------------------------------
erp1             1   bridge_domain 1          xe3.1 (F)      xe8.1 (F)      ring1
```

Bridge3

```
Bridge3#show g8032 erp-instance erp1
Inst Name       : erp1 (1), node-id 00:e0:4b:71:f1:26, Profile (1)
Description     :
Ring            : MAJOR-RING (ring1), NEIGHBOR (EAST),

State           : G8032_ST_IDLE

East            : xe16.1, Blocked  , UP  , BPR (0), remote (b8:6a:97:25:a7:d4)
West            : xe3.1, Unblocked, UP  , BPR (0), remote (b8:6a:97:25:a7:d4)

East (cfm)      : mep_id (322), cc-interval (1s), Domain (P3P22), MA (ma322)
West (cfm)      : mep_id (342), cc-interval (1s), Domain (P4P32), MA (ma432)

Channel         : Level (5), vlan (200), RING_ID (1)
```

```
Bridge3#show g8032 erp-instance
Instance         ID  State       East          state     West          state      Ring
---------------------------------------------------------------------------------------------
erp1             1   IDLE        xe16.1 (N)     Blocked   xe3.1         Unblocked  ring1
```

```
Bridge3#show g8032 erp-instance data-traffic
Instance         ID  Data-vlan                East           West           Ring
------------------------------------------------------------------------------------------
erp1             1   bridge_domain 1          xe16.1 (B)      xe3.1 (F)      ring1
```

Bridge4

```
Bridge4#show g8032 erp-instance
Instance         ID  State       East          state     West          state      Ring
---------------------------------------------------------------------------------------------
erp1             1   IDLE        xe6.1        Unblocked xe16.1 (O)    Blocked    ring1
```

```
Bridge4#show g8032 erp-instance erp1
Inst Name       : erp1 (1), node-id b8:6a:97:25:a7:d4, Profile (1)
Description     :
Ring            : MAJOR-RING (ring1), OWNER (WEST),
                  Attached (erp3,),tcn_propagation (0)

State           : G8032_ST_IDLE

East            : xe6.1, Unblocked, UP  , BPR (-), remote (-)
West            : xe16.1, Blocked  , UP  , BPR (-), remote (-)

East (cfm)      : mep_id (252), cc-interval (1s), Domain (P5P22), MA (ma522)
West (cfm)      : mep_id (223), cc-interval (1s), Domain (P3P22), MA (ma322)

Channel         : Level (5), vlan (200), RING_ID (1)
```

```
Bridge4#show g8032 erp-instance data-traffic
Instance         ID  Data-vlan                East           West           Ring
------------------------------------------------------------------------------------------
erp1             1   bridge_domain 1          xe6.1 (F)     xe16.1 (B)     ring1
```

Associate Ring Configuration

The `associate-ring` is a newly introduced command for supporting ERPS within a bridge-domain. This command is used when there is a need to establish a single ERPS instance that can manage multiple rings. It is essential that all rings associated with the `associate-ring` share the same parent interface as the primary ring linked to the ERPS instance. For more details, refer to the associate-ring command section.

Prerequisite

Before using the `associate-ring` command, it is necessary to configure the major ring for Bridge1, Bridge2, Bridge3, and Bridge4 as described in the Major Ring Configuration section.

Bridge1

`Bridge1#configure terminal`	Enter configure mode.
`Bridge1(config)#interface xe6.2 switchport`	Create a Layer 2 sub-interface `xe6.2` for the physical interface `xe6`.
`Bridge1(config-if)encapsulation dot1ad 2003`	Encapsulate the sub-interface with APS-channel VLAN ID `2003`.
`Bridge1(config-if)encapsulation dot1ad 800`	Encapsulate the sub-interface with data VLAN ID `800`.
`Bridge1(config-if)#exit`	Exit interface mode `xe6.2`.
`Bridge1(config)#interface xe8.2 switchport`	Create a Layer 2 sub-interface `xe8.2` for the physical interface `xe8`.
`Bridge1(config-if)encapsulation dot1ad 2003`	Encapsulate the sub-interface with APS-channel VLAN ID `2003`.
`Bridge1(config-if)encapsulation dot1ad 800`	Encapsulate the sub-interface with data VLAN ID `800`.
`Bridge1(config-if)#exit`	Exit interface mode `xe8.2`.
`Bridge1(config)#bridge-domain 2`	Enter bridge domain configure mode and configure bridge domain instance `2`.
`Bridge1(config-bridge-domain)#interface xe6.2`	Attach the sub-interface `xe6.2` to the bridge domain instance.
`Bridge1(config-bridge-domain)#interface xe8.2`	Attach the sub-interface `xe8.2` to the bridge domain instance.
`Bridge1(config-bridge-domain)#exit`	Exit bridge domain mode.
`Bridge1(config)#ethernet cfm domain-type character-string domain-name P543 level 5`	Create a CFM domain with character string type, name `P543`, and level `5`.
`Bridge1(config-ether-cfm)#service ma-type string ma-name ma543`	Create a CFM Maintenance Association (MA) type as a string with the name `ma543`.
`Bridge1(config-ether-cfm-ma)#vlan 2003`	Add VLAN `2003` to the CFM MA.
`Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 543 active true xe8.2`	Create a down MEP `543` for `xe8.2` interface and activate it.
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable Continuity Check (CC) multicast for the MEP.
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 453`	Configure crosscheck for the remote MEP with value `453`.

`Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge1(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge1(config)#ethernet cfm domain-type character-string domain-name P523 level 5`	Create a CFM domain with character string type, name `P523`, and level `5`.
`Bridge1(config-ether-cfm)#service ma-type string ma-name ma523`	Create a CFM MA type as a string with the name `ma523`.
`Bridge1(config-ether-cfm-ma)#vlan 2003`	Add VLAN `2003` to the CFM MA.
`Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 523 active true xe6.2`	Create a down MEP 523 for `xe6.2` interface and activate it.
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enables CC multicast for the MEP.
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge1(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge1(config)#g8032 ring RING2`	Create a G.8032 ring named `RING2`.
`Bridge1(g8032-ring-config)#east-interface xe8.2`	Associate `xe8.2` interface as the east interface in `RING2`.
`Bridge1(g8032-ring-config)#west-interface xe6.2`	Associate `xe6.2` interface as the west interface in `RING2`.
`Bridge1(g8032-ring-config)#exit`	Exit ring configure mode and return to the configure mode.
`Bridge1(config)#g8032 erp-instance erp1`	Create a G.8032 Ethernet Ring Protection (ERP) instance named `erp1`.
`Bridge1(g8032-config-switch)#associate-ring  RING2`	**Map the associate ring named `RING2` to the ERPS instance `erp1`.**
`Bridge1(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge1(g8032-config-switch)#end`	Exit G.8032 configure mode.

Bridge2

`Bridge2#configure terminal`	Enter configure mode.
`Bridge2(config)#interface xe3.2 switchport`	Create a Layer 2 sub-interface `xe3.2` for the physical interface `xe3`.
`Bridge2(config-if)encapsulation dot1ad 2003`	Encapsulate the sub-interface with APS-channel VLAN ID `2003`.
`Bridge2(config-if)encapsulation dot1ad 800`	Encapsulate the sub-interface with data VLAN ID `800`.
`Bridge2(config-if)#exit`	Exit interface mode `xe3.2`.
`Bridge2(config)#interface xe8.2 switchport`	Create a Layer 2 sub-interface `xe8.2` for the physical interface `xe8`.

`Bridge2(config-if)encapsulation dot1ad 2003`	Encapsulate the sub-interface with APS-channel VLAN ID `2003`.
`Bridge2(config-if)encapsulation dot1ad 800`	Encapsulate the sub-interface with data VLAN ID `800`.
`Bridge2(config-if)#exit`	Exit interface mode `xe8.2`.
`Bridge2(config)#bridge-domain 2`	Enter bridge domain configure mode and configure bridge domain instance `2`.
`Bridge2(config-bridge-domain)#interface xe3.2`	Attach the sub-interface `xe3.2` to the bridge domain instance.
`Bridge2(config-bridge-domain)#interface xe8.2`	Attach the sub-interface `xe8.2` to the bridge domain instance.
`Bridge2(config-bridge-domain)#exit`	Exit bridge domain mode.
`Bridge2(config)#ethernet cfm domain-type character-string domain-name P543 level 5`	Create a CFM domain with character string type, name `P543`, and level `5`.
`Bridge2(config-ether-cfm)#service ma-type string ma-name ma543`	Create a CFM Maintenance Association (MA) type as a string with the name `ma543`.
`Bridge2(config-ether-cfm-ma)#vlan 2003`	Add VLAN `2003` to the CFM MA.
`Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 453 active true xe8.2`	Create a down MEP `453` for `xe8.2` interface and activate it.
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable Continuity Check (CC) multicast for the MEP.
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 543`	Configure crosscheck for the remote MEP with value `543`.
`Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge2(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge2(config)#ethernet cfm domain-type character-string domain-name P433 level 5`	Create a CFM domain with character string type, name `P433`, and level `5`.
`Bridge2(config-ether-cfm)#service ma-type string ma-name ma433`	Create a CFM MA type as a string with the name `ma433.`
`Bridge2(config-ether-cfm-ma)#vlan 2003`	Add VLAN `2003` to the CFM MA.
`Bridge2(config-ether-cfm-ma)#ethernet cfm mep down mpid 433 active true xe3.2`	Create a down MEP 433 for `xe3.2` interface and activate it.
`Bridge2(config-ether-cfm-ma-mep)#cc multicast state enable`	Enables CC multicast for the MEP.
`Bridge2(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.

`Bridge2(config-ether-cfm-ma)#mep crosscheck mpid 533`	Configure crosscheck for the remote MEP with value `533`.
`Bridge2(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge2(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge2(config)#g8032 ring RING2`	Create a G.8032 ring named `RING2`.
`Bridge2(g8032-ring-config)#east-interface xe3.2`	Associate `xe3.2` interface as the east interface in `RING2`.
`Bridge2(g8032-ring-config)#west-interface xe8.2`	Associate `xe8.2` interface as the west interface in `RING2`.
`Bridge2(g8032-ring-config)#exit`	Exit ring configure mode and return to the configure mode.
`Bridge2(config)#g8032 erp-instance erp1`	Create a G.8032 Ethernet Ring Protection (ERP) instance named `erp1`.
`Bridge2(g8032-config-switch)#associate-ring  RING2`	Map the associate ring named `RING2` to the ERPS instance `erp1`.
`Bridge2(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge2(g8032-config-switch)#end`	Exit G.8032 configure mode.

Bridge3

`Bridge3#configure terminal`	Enter configure mode.
`Bridge3(config)#interface xe3.2 switchport`	Create a Layer 2 sub-interface `xe3.2` for the physical interface `xe3`.
`Bridge3(config-if)encapsulation dot1ad 2003`	Encapsulate the sub-interface with APS-channel VLAN ID `2003`.
`Bridge3(config-if)encapsulation dot1ad 800`	Encapsulate the sub-interface with data VLAN ID `800`.
`Bridge3(config-if)#exit`	Exit interface mode `xe3.2`.
`Bridge3(config)#interface xe16.2 switchport`	Create a Layer 2 sub-interface `xe16.2` for the physical interface `xe16`.
`Bridge3(config-if)encapsulation dot1ad 2003`	Encapsulate the sub-interface with APS-channel VLAN ID `2003`.
`Bridge3(config-if)encapsulation dot1ad 800`	Encapsulate the sub-interface with data VLAN ID `800`.
`Bridge3(config-if)#exit`	Exit interface mode `xe16.2`.
`Bridge3(config)#bridge-domain 2`	Enter bridge domain configure mode and configure bridge domain instance `2`.
`Bridge3(config-bridge-domain)#interface xe3.2`	Attach the sub-interface `xe3.2` to the bridge domain instance.
`Bridge3(config-bridge-domain)#interface xe16.2`	Attach the sub-interface `xe16.2` to the bridge domain instance.
`Bridge3(config-bridge-domain)#exit`	Exit bridge domain mode.
`Bridge3(config)#ethernet cfm domain-type character-string domain-name P433 level 5`	Create a CFM domain with character string type, name `P433`, and level `5`.

`Bridge3(config-ether-cfm)#service ma-type string ma-name ma433`	Create a CFM Maintenance Association (MA) type as a string with the name `ma433`.
`Bridge3(config-ether-cfm-ma)#vlan 2003`	Add VLAN `2003` to the CFM MA.
`Bridge3(config-ether-cfm-ma)#ethernet cfm mep down mpid 343 active true xe16.2`	Create a down MEP `343` for `xe16.2` interface and activate it.
`Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable Continuity Check (CC) multicast for the MEP.
`Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 433`	Configure crosscheck for the remote MEP with value `433`.
`Bridge3(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge3(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge3(config)#ethernet cfm domain-type character-string domain-name P323 level 5`	Create a CFM domain with character string type, name `P323`, and level `5`.
`Bridge3(config-ether-cfm)#service ma-type string ma-name ma323`	Create a CFM MA type as a string with the name `ma323.`
`Bridge3(config-ether-cfm-ma)#vlan 2003`	Add VLAN `2003` to the CFM MA.
`Bridge3(config-ether-cfm-ma)#ethernet cfm mep down mpid 323 active true xe3.2`	Create a down MEP 323 for `xe3.2` interface and activate it.
`Bridge3(config-ether-cfm-ma-mep)#cc multicast state enable`	Enables CC multicast for the MEP.
`Bridge3(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge3(config-ether-cfm-ma)#mep crosscheck mpid 233`	Configure crosscheck for the remote MEP with value `233`.
`Bridge3(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge3(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge3(config)#g8032 ring RING2`	Create a G.8032 ring named `RING2`.
`Bridge3(g8032-ring-config)#east-interface xe16.2`	Associate `xe16.2` interface as the east interface in `RING2`.
`Bridge3(g8032-ring-config)#west-interface xe3.2`	Associate `xe3.2` interface as the west interface in `RING2`.
`Bridge3(g8032-ring-config)#exit`	Exit ring configure mode and return to the configure mode.
`Bridge3(config)#g8032 erp-instance erp1`	Create a G.8032 Ethernet Ring Protection (ERP) instance named `erp1`.

Bridge3(g8032-config-switch)#associate-ring RING2	Map the associate ring named RING2 to the ERPS instance erp1.
Bridge3(g8032-config-switch)#commit	Commit the candidate configuration to the running configuration
Bridge3(g8032-config-switch)#end	Exit G.8032 configure mode.

Bridge4

Bridge4#configure terminal	Enter configure mode.
Bridge4(config)#interface xe6.2 switchport	Create a Layer 2 sub-interface xe6.2 for the physical interface xe6.
Bridge4(config-if)encapsulation dot1ad 2003	Encapsulate the sub-interface with APS-channel VLAN ID 2003.
Bridge4(config-if)encapsulation dot1ad 800	Encapsulate the sub-interface with data VLAN ID 800.
Bridge4(config-if)#exit	Exit interface mode xe6.2.
Bridge4(config)#interface xe16.2 switchport	Create a Layer 2 sub-interface xe16.2 for the physical interface xe16.
Bridge4(config-if)encapsulation dot1ad 2003	Encapsulate the sub-interface with APS-channel VLAN ID 2003.
Bridge4(config-if)encapsulation dot1ad 800	Encapsulate the sub-interface with data VLAN ID 800.
Bridge4(config-if)#exit	Exit interface mode xe16.2.
Bridge4(config)#bridge-domain 2	Enter bridge domain configure mode and configure bridge domain instance 2.
Bridge4(config-bridge-domain)#interface xe6.2	Attach the sub-interface xe6.2 to the bridge domain instance.
Bridge4(config-bridge-domain)#interface xe16.2	Attach the sub-interface xe16.2 to the bridge domain instance.
Bridge4(config-bridge-domain)#exit	Exit bridge domain mode.
Bridge4(config)#ethernet cfm domain-type character-string domain-name P523 level 5	Create a CFM domain with character string type, name P523, and level 5.
Bridge4(config-ether-cfm)#service ma-type string ma-name ma523	Create a CFM Maintenance Association (MA) type as a string with the name ma523.
Bridge4(config-ether-cfm-ma)#vlan 2003	Add VLAN 2003 to the CFM MA.
Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 253 active true xe6.2	Create a down MEP 253 for xe6.2 interface and activate it.
Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable	Enable Continuity Check (CC) multicast for the MEP.
Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit Ethernet CFM MA-MEP mode.
Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 523	Configure crosscheck for the remote MEP with value 523.

`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge4(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge4(config)#ethernet cfm domain-type character-string domain-name P323 level 5`	Create a CFM domain with character string type, name `P323`, and level `5`.
`Bridge4(config-ether-cfm)#service ma-type string ma-name ma323`	Create a CFM MA type as a string with the name `ma323`.
`Bridge4(config-ether-cfm-ma)#vlan 2003`	Add VLAN `2003` to the CFM MA.
`Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 233 active true xe16.2`	Create a down MEP 233 for `xe16.2` interface and activate it.
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enables CC multicast for the MEP.
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 323`	Configure crosscheck for the remote MEP with value `323`.
`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge4(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge4(config)#g8032 ring RING2`	Create a G.8032 ring named `RING2`.
`Bridge4(g8032-ring-config)#east-interface xe6.2`	Associate `xe6.2` interface as the east interface in `RING2`.
`Bridge4(g8032-ring-config)#west-interface xe16.2`	Associate `xe16.2` interface as the west interface in `RING2`.
`Bridge4(g8032-ring-config)#exit`	Exit ring configure mode and return to the configure mode.
`Bridge4(config)#g8032 erp-instance erp1`	Create a G.8032 Ethernet Ring Protection (ERP) instance named `erp1`.
`Bridge4(g8032-config-switch)#associate-ring RING2`	Map the associate ring named `RING2` to the ERPS instance `erp1`.
`Bridge4(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge4(g8032-config-switch)#end`	Exit G.8032 configure mode.

Validation

The following validation output displays data traffic details for ERP instances and provides details for the specified ERP instance using the `show g8032 erp-instance data-traffic` command on Bridge1, Bridge2, Bridge3, and Bridge4.

```
Bridge1#show g8032 erp-instance data-traffic
Instance          ID  Data-vlan                  East          West          Ring
-----------------------------------------------------------------------------------------
erp1              1   bridge_domain 1            xe8.1 (F)     xe25.1 (F)    ring1
                      bridge_domain 2            xe8.2         xe25.2        ring2
```

```
Bridge2#show g8032 erp-instance data-traffic
Instance         ID  Data-vlan                 East           West           Ring
-----------------------------------------------------------------------------------------
erp1             1   bridge_domain 1           xe3.1  (F)     xe82.1  (F)     ring1
                     bridge_domain 2           xe3.2          xe8.2           ring2

Bridge3#show g8032 erp-instance data-traffic
Instance         ID  Data-vlan                 East           West           Ring
-----------------------------------------------------------------------------------------
erp1             1   bridge_domain 1           xe16.1  (B)     xe3.1  (F)     ring1
                     bridge_domain 2           xe16.2          xe3.2          ring2

Bridge4#show g8032 erp-instance data-traffic
Instance         ID  Data-vlan                 East           West           Ring
-----------------------------------------------------------------------------------------
erp1             1   bridge_domain 1           xe16.1  (F)    xe16.1  (B)    ring1
                     bridge_domain 2           xe16.2         xe6.2          ring2
```

Sub-ring with Virtual Channel Configuration

An Ethernet ring connects to a Major Ring at the interconnection nodes. The Sub-Ring, by itself, does not constitute a closed ring. It connects to the interconnection nodes on only one port, which is configured as the east-interface.

Topology

Figure 16-29 displays a sample Ring Protection topology with five bridges, consisting of one major ring (Bridge1, Bridge2, Bridge3, and Bridge4) and one sub-ring (Bridge5, Bridge1, and Bridge2). In the major ring, the RPL is enabled between Bridge 3 (owner node) and Bridge 4 (neighbor node) on the xe16 interface, while other devices are non-owner nodes for that ring. In the sub-ring, the RPL is enabled between Bridge 5 (neighbor node) and Bridge 4 (owner node) on link xe7, with other devices as non-owner nodes. A virtual channel is enabled for this Sub-Ring on interconnected nodes on VLAN 100, and TCN propagation is also enabled.

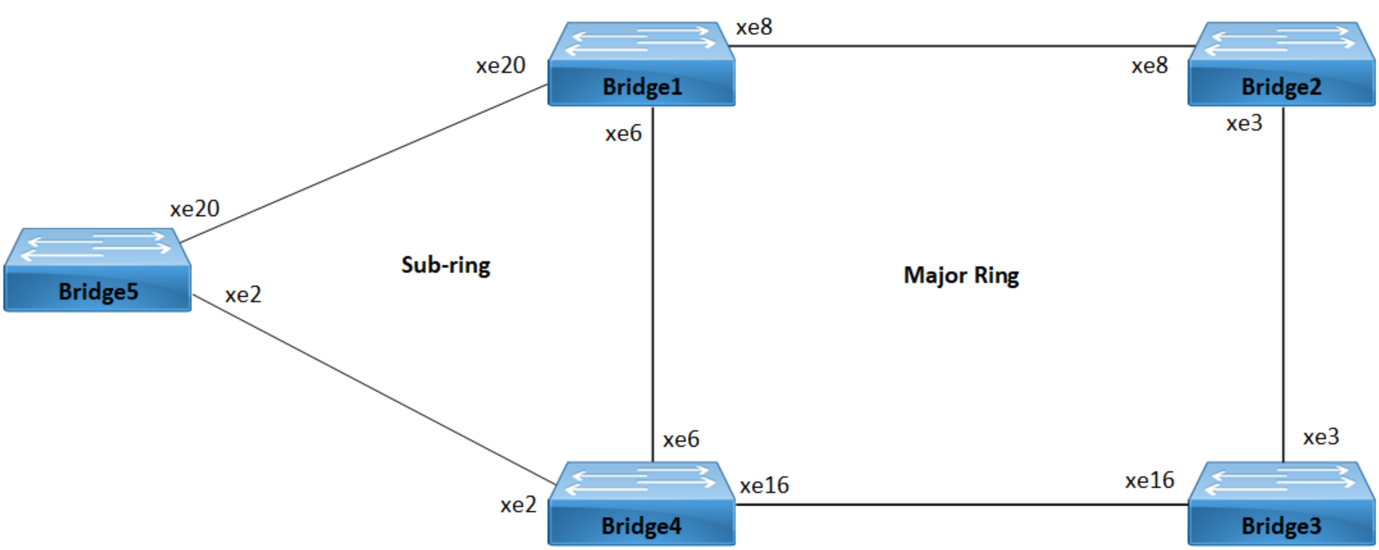


Figure 16-29: Sub-ring with Virtual Channel

Prerequisite

Before configuring the sub-ring with virtual channel, it is necessary to configure the major ring for Bridge1, Bridge2, Bridge3, and Bridge4 as described in the Major Ring Configuration section.

Bridge5

`Bridge5#configure terminal`	Enter configure mode.
`Bridge5(config)#interface xe2`	Enter interface mode `xe2`.
`Bridge5(config-if)#dot1ad ethertype 0x88a8`	Configure `xe2` as a Layer 2 port with an Ethernet Type of `0x88a8`.
`Bridge5(config-if)#interface xe2.1 switchport`	Create a Layer 2 sub-interface `xe2.1` within the physical interface `xe2`.
`Bridge5(config-if)encapsulation dot1ad 200`	Encapsulate the sub-interface with APS-channel VLAN ID `200`.
`Bridge5(config-if)encapsulation dot1ad 600`	Encapsulate the sub-interface with data VLAN ID `600`.
`Bridge5(config-if)#exit`	Exit interface mode `xe2`.
`Bridge5(config)#interface xe20`	Enter interface mode `xe20`.
`Bridge5(config-if)#dot1ad ethertype 0x88a8`	Configure `xe20` as a Layer 2 port with an Ethernet Type of `0x88a8`.
`Bridge5(config)#interface xe20.1 switchport`	Create a Layer 2 sub-interface `xe20.1` within the physical interface `xe20`.
`Bridge5(config-if)encapsulation dot1ad 200`	Encapsulate the sub-interface with APS-channel VLAN ID `200`.
`Bridge5(config-if)encapsulation dot1ad 600`	Encapsulate the sub-interface with data VLAN ID `600`.
`Bridge5(config-if)#exit`	Exit interface mode `xe20`.
`Bridge5(config)#bridge-domain 1`	Enter bridge domain configure mode and configure bridge domain instance `1`.
`Bridge5(config-bridge-domain)#interface xe2.1`	Attach the sub-interface `xe2.1` to the bridge domain instance.
`Bridge5(config-bridge-domain)#interface xe20.1`	Attach the sub-interface `xe20.1` to the bridge domain instance.
`Bridge5(config-bridge-domain)#exit`	Exit bridge domain mode.
`Bridge5(config)#ethernet cfm domain-type character-string domain-name P271 level 5`	Create a CFM domain with character string type, name `P271`, and level `5`.
`Bridge5(config-ether-cfm)#service ma-type string ma-name ma8`	Create a CFM Maintenance Association (MA) type as a string with the name `ma8`.
`Bridge5(config-ether-cfm-ma)#vlan 200`	Add VLAN `200` to the CFM MA.
`Bridge5(config-ether-cfm-ma)#ethernet cfm mep down mpid 801 active true xe2.1`	Create a down MEP `801` for `xe2.1` interface and activate it.
`Bridge5(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable Continuity Check (CC) multicast for the MEP.

`Bridge5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge5(config-ether-cfm-ma)#mep crosscheck mpid 800`	Configure crosscheck for the remote MEP with value `800`.
`Bridge5(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge5(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge5(config)#ethernet cfm domain-type character-string domain-name P571 level 5`	Create a CFM domain with character string type, name `P571`, and level `5`.
`Bridge5(config-ether-cfm)#service ma-type string ma-name ma7`	Create a CFM MA type as a string with the name `ma7`.
`Bridge5(config-ether-cfm-ma)#vlan 200`	Add VLAN `200` to the CFM MA.
`Bridge5(config-ether-cfm-ma)#ethernet cfm mep down mpid 905 active true xe20.1`	Create a down MEP `905` for `xe20.1` interface and activate it.
`Bridge5(config-ether-cfm-ma-mep)#cc multicast state enable`	Enables CC multicast for the MEP.
`Bridge5(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge5(config-ether-cfm-ma)#mep crosscheck mpid 906`	Configure crosscheck for the remote MEP with value `906`.
`Bridge5(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge5(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge5(config)#g8032 ring subring2`	Create a G.8032 ring named `subring2`.
`Bridge5(g8032-ring-config)#east-interface xe2.1`	Associate `xe2.1` interface as the east interface in `subring2`.
`Bridge5(g8032-ring-config)#west-interface xe20.1`	Associate `xe20.1` interface as the west interface in `subring2`.
`Bridge5(g8032-ring-config)#g8032 profile profile1`	Create a G.8032 profile named `profile1`.
`Bridge5(g8032-profile-config)#timer wait-to-restore 2`	Configure the wait-to-restore timer for `2` minute.
`Bridge5(g8032-profile-config)#timer hold-off 200`	Configure the hold-off timer with a value of `200`.
`Bridge5(g8032-profile-config)#timer guard-timer 20`	Configure the guard timer with a value of `20` milliseconds.
`Bridge5(g8032-profile-config)#switching mode revertive`	Configure the switching mode as `revertive`.
`Bridge5(g8032-profile-config)#exit`	Exit profile configure mode and return to the ring configure mode.
`Bridge5(g8032-ring-config)#exit`	Exit ring configure mode and return to the configure mode.

Bridge5(config)#g8032 erp-instance erp2	Create a G.8032 Ethernet Ring Protection (ERP) instance named erp2.
Bridge5(g8032-config-switch)#ring-type sub-ring-vc	Configure the ring type as a sub-ring-vc.
Bridge5(g8032-config-switch)#ring subring2	Associate subring2 with the ERP instance erp2.
Bridge5(g8032-config-switch)#rpl role neighbor east-interface	Configure the node as the neighbor node for the specified ERPS ring and designate the east interface as the owner node in the ring.
Bridge5(g8032-config-switch)#g8032-profile profile1	Associate profile1 with erp2 instance.
Bridge5(g8032-config-switch)#aps-channel level 5	Configure the R-APS channel level as 5.
Bridge5(g8032-config-switch)#aps-channel vlan 200	Configure the APS channel VLAN as 200.
Bridge5(g8032-config-switch)#ring-id 3	Configure the ring ID as 3.
Bridge5(g8032-config-switch)#commit	Commit the candidate configuration to the running configuration
Bridge5(g8032-config-switch)#end	Exit G.8032 configure mode.

Bridge1

Bridge1#configure terminal	Enter configure mode.
Bridge1(config)#interface xe20	Enter interface mode xe20.
Bridge1(config-if)#dot1ad ethertype 0x88a8	Configure xe20 as a Layer 2 port with an Ethernet Type of 0x88a8.
Bridge1(config-if)#interface xe20.1 switchport	Create a Layer 2 sub-interface xe20.1 within the physical interface xe20.
Bridge1(config-if)encapsulation dot1ad 200	Encapsulate the sub-interface with APS-channel VLAN ID 200.
Bridge1(config-if)encapsulation dot1ad 600	Encapsulate the sub-interface with data VLAN ID 600.
Bridge1(config-if)#exit	Exit interface mode xe20.
Bridge1(config)#bridge-domain 1	Enter bridge domain configure mode and configure bridge domain instance 1.
Bridge1(config-bridge-domain)#interface xe20.1	Attach the sub-interface xe20.1 to the bridge domain instance.
Bridge1(config-bridge-domain)#exit	Exit bridge domain mode.
Bridge1(config)#ethernet cfm domain-type character-string domain-name P571 level 5	Create a CFM domain with character string type, name P571, and level 5.
Bridge1(config-ether-cfm)#service ma-type string ma-name ma7	Create a CFM Maintenance Association (MA) type as a string with the name ma7.
Bridge1(config-ether-cfm-ma)#vlan 200	Add VLAN 200 to the CFM MA.

`Bridge1(config-ether-cfm-ma)#ethernet cfm mep down mpid 906 active true xe20.1`	Create a down MEP `906` for `xe20.1` interface and activate it.
`Bridge1(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable Continuity Check (CC) multicast for the MEP.
`Bridge1(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge1(config-ether-cfm-ma)#mep crosscheck mpid 905`	Configure crosscheck for the remote MEP with value `905`.
`Bridge1(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge1(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge1(config)#g8032 ring subring2`	Create a G.8032 ring named `subring2`.
`Bridge1(g8032-ring-config)#east-interface xe20.1`	Associate `xe20.1` interface as the east interface in `subring2`.
`Bridge1(g8032-ring-config)#exit`	Exit ring configure mode and return to the configure mode.
`Bridge1(config)#g8032 erp-instance erp3`	Create a G.8032 Ethernet Ring Protection (ERP) instance named `erp3`.
`Bridge1(g8032-config-switch)#ring-type sub-ring-vc`	Configure the ring type as a `sub-ring-vc`.
`Bridge1(g8032-config-switch)#ring subring2`	Associate `subring2` with the ERP instance `erp3`.
`Bridge1(g8032-config-switch)#rpl role non-owner`	Configure the node as a `non-owner` node in the ring.
`Bridge1(g8032-config-switch)#g8032-profile profile1`	Associate `profile1` with `erp3` instance.
`Bridge1(g8032-config-switch)#aps-channel level 5`	Configure the R-APS channel level as `5`.
`Bridge1(g8032-config-switch)#aps-channel vlan 200`	Configure the APS channel VLAN as `200`.
`Bridge1(g8032-config-switch)#ring-id 3`	Configure the ring ID as `3`.
`Bridge1(g8032-config-switch)#virtual-channel 100 attached-to-instance erp1`	Configure the virtual channel with VLAN `100` and attache it to ERP instance `erp1`.
`Bridge1(g8032-config-switch)#enable-tcn-propagation`	Enable Topology Change Notification (TCN) propagation.
`Bridge1(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge1(g8032-config-switch)#end`	Exit G.8032 configure mode.

Bridge4

`Bridge4#configure terminal`	Enter configure mode.
`Bridge4(config)#interface xe2`	Enter interface mode `xe2`.
`Bridge4(config-if)#dot1ad ethertype 0x88a8`	Configure `xe2` as a Layer 2 port with an Ethernet Type of `0x88a8`.
`Bridge4(config-if)#interface xe2.1 switchport`	Create a Layer 2 sub-interface `xe2.1` within the physical interface `xe2`.

`Bridge4(config-if)encapsulation dot1ad 200`	Encapsulate the sub-interface with APS-channel VLAN ID `200`.
`Bridge4(config-if)encapsulation dot1ad 600`	Encapsulate the sub-interface with data VLAN ID `600`.
`Bridge4(config-if)#exit`	Exit interface mode `xe2`.
`Bridge4(config)#bridge-domain 1`	Enter bridge domain configure mode and configure bridge domain instance `1`.
`Bridge4(config-bridge-domain)#interface xe2.1`	Attach the sub-interface `xe2.1` to the bridge domain instance.
`Bridge4(config-bridge-domain)#exit`	Exit bridge domain mode.
`Bridge4(config)#ethernet cfm domain-type character-string domain-name P271 level 5`	Create a CFM domain with character string type, name `P271`, and level `5`.
`Bridge4(config-ether-cfm)#service ma-type string ma-name ma8`	Create a CFM Maintenance Association (MA) type as a string with the name `ma8`.
`Bridge4(config-ether-cfm-ma)#vlan 200`	Add VLAN `200` to the CFM MA.
`Bridge4(config-ether-cfm-ma)#ethernet cfm mep down mpid 800 active true xe2.1`	Create a down MEP `800` for `xe2.1` interface and activate it.
`Bridge4(config-ether-cfm-ma-mep)#cc multicast state enable`	Enable Continuity Check (CC) multicast for the MEP.
`Bridge4(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode`	Exit Ethernet CFM MA-MEP mode.
`Bridge4(config-ether-cfm-ma)#mep crosscheck mpid 801`	Configure crosscheck for the remote MEP with value `801`.
`Bridge4(config-ether-cfm-ma)#exit-ether-ma-mode`	Exit Ethernet CFM MA mode.
`Bridge4(config-ether-cfm)#exit`	Exit Ethernet CFM mode and return to the configure mode.
`Bridge4(config)#g8032 ring subring2`	Create a G.8032 ring named `subring2`.
`Bridge4(g8032-ring-config)#east-interface xe2.1`	Associate `xe2.1` interface as the east interface in `subring2`.
`Bridge4(g8032-ring-config)#exit`	Exit ring configure mode and return to the configure mode.
`Bridge4(config)#g8032 erp-instance erp3`	Create a G.8032 Ethernet Ring Protection (ERP) instance named `erp3`.
`Bridge4(g8032-config-switch)#ring-type sub-ring-vc`	Configure the ring type as a `sub-ring-vc`.
`Bridge4(g8032-config-switch)#ring subring2`	Associate `subring2` with the ERP instance `erp3`.
`Bridge4(g8032-config-switch)#rpl role owner east-interface`	Configure the node as the `owner` node for the specified ERPS ring and designate the east interface as the neighbor node in the ring.
`Bridge4(g8032-config-switch)#g8032-profile profile1`	Associate `profile1` with `erp3` instance.
`Bridge4(g8032-config-switch)#aps-channel level 5`	Configure the R-APS channel level as `5`.

`Bridge4(g8032-config-switch)#aps-channel vlan 200`	Configure the APS channel VLAN as `200`.
`Bridge4(g8032-config-switch)#ring-id 3`	Configure the ring ID as `3`.
`Bridge4(g8032-config-switch)#virtual-channel 100 attached-to-instance erp1`	Configure the virtual channel with VLAN `100` and attache it to ERP instance `erp1`.
`Bridge4(g8032-config-switch)#enable-tcn-propagation`	Enable Topology Change Notification (TCN) propagation.
`Bridge4(g8032-config-switch)#commit`	Commit the candidate configuration to the running configuration
`Bridge4(g8032-config-switch)#end`	Exit G.8032 configure mode.

Validation

The following validation output displays details for the specified ERP instance using the `show g8032 erp-instance` command on Bridge5, Bridge1, and Bridge4. It describes the sub-ring type for Bridge1 and Bridge4 as virtual. Additionally, it specifies that Bridge1 is a non-owner node, while Bridge4 is the owner node for the specified ERPS ring, designating the east interface as the neighbor node in the ring.

```
Bridge5#show g8032 erp-instance
Instance          ID  State       East      state     West      state      Ring
---------------------------------------------------------------------------------
erps2             1   IDLE        xe2.1     Blocked   xe20.1    Unblocked  subring2

Bridge1#show g8032 erp-instance
Instance          ID  State       East      state     West      state      Ring
--------------------------------------------------------------------------------
erp1              1   IDLE        xe8.1     Unblocked   xe6.1    Unblocked   1
erp3              3   IDLE        xe20.1    Unblocked    -          -          subring2

Bridge4#show g8032 erp-instance
Instance          ID  State       East      state     West      state      Ring
--------------------------------------------------------------------------------
erp1              1   IDLE        xe6.1     Unblocked xe16.1    Blocked    Ring1
erp3              3   IDLE        xe2.1     Blocked    -          -        subring2

Bridge1#show g8032 erp-instance erp3
Inst Name        : erp3 (3), node-id e8:c5:7a:a8:7c:c8, Profile (1)
Description      :
Ring             : SUB-RING (VIRTUAL) (subring2), NON-OWNER, Virtual (vid 100 : r
ing_id 1)
                   Attached to (erp1),
                   tcn_propagation (1)

State            : G8032_ST_IDLE

East             : xe20.1, Unblocked, UP  , BPR (-), remote (-)

East (cfm)       : mep_id (906), cc-interval (1s), Domain (P5P71), MA (ma7)

Channel          : Level (5), vlan (200), RING_ID (2)
```

```
Bridge4#show g8032 erp-instance erp3
Inst Name        : erp3 (3), node-id b8:6a:97:25:a7:bd, Profile (1)
Description      :
Ring             : SUB-RING (VIRTUAL) (subring2), OWNER (EAST), Virtual (vid 100
: ring_id 1)
                   Attached to (erp1),
                   tcn_propagation (1)

State            : G8032_ST_IDLE

East             : xe2.1, Blocked  , UP  , BPR (-), remote (-)

East (cfm)       : mep_id (800), cc-interval (1s), Domain (P2P71), MA (ma8)

Channel          : Level (5), vlan (200), RING_ID (2)
```

Sub-ring without Virtual Channel Configuration

The following section presents a sample Ring Protection topology, demonstrating the configuration of protection switching with five bridges.

Topology

Figure 16-30 illustrates a sample Ethernet Ring Protection Switching topology. This scenario consists of one major ring, which includes Bridge1, Bridge2, Bridge3, and Bridge4, and one sub-ring involving Bridge5, Bridge1, and Bridge2.

In the major ring, RPL is enabled between Bridge 3 (the owner node) and Bridge 4 (the neighbor node) through interface xe16. The remaining devices within this major ring are non-owner nodes. For the sub-ring, RPL is enabled between Bridge 5 (the neighbor node) and Bridge 4 (the owner node) using link xe7, while the other devices in this sub-ring function as non-owner nodes.

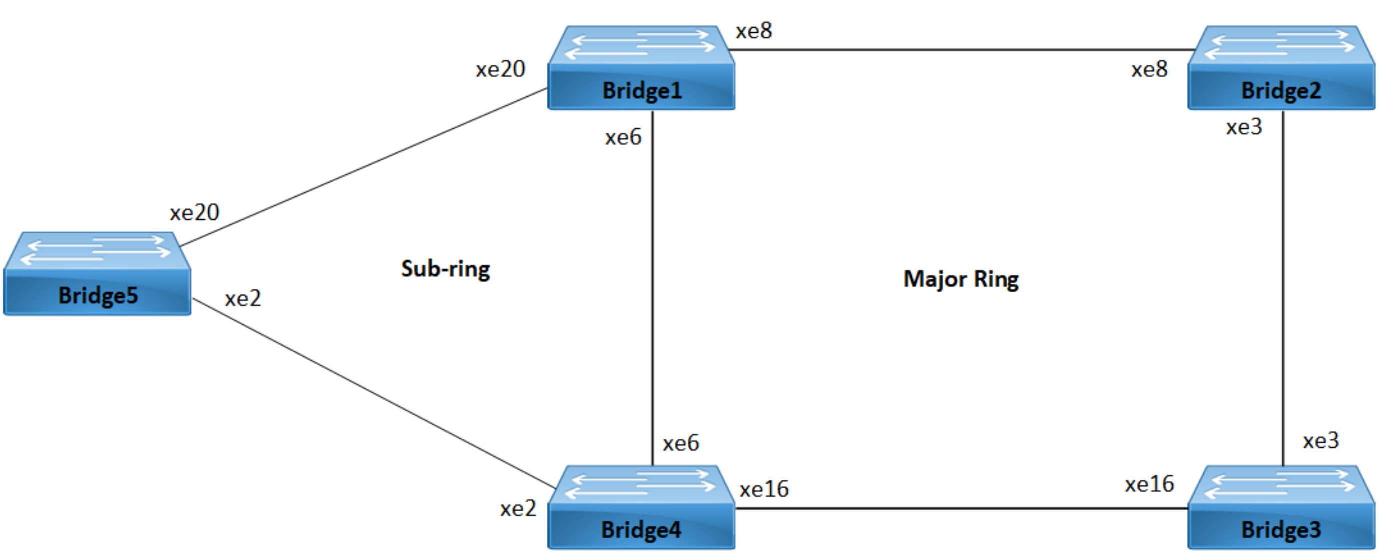


Figure 16-30: Sub-ring without Virtual Channel

Prerequisite

1. Before configuring the non-virtual channel, ensure that the major ring is configured for Bridge1, Bridge2, Bridge3, and Bridge4 following the instructions provided in the Major Ring Configuration section.
2. Repeat the same configuration steps for Bridge5, Bridge1, and Bridge4 as outlined in the Sub-ring without Virtual Channel Configuration section. Instead of using the `virtual-channel` command, configure the `non-virtual channel` command for Bridge1 and Bridge4 as shown below:

`Bridge4(g8032-config-switch)#non-virtual-channel`	Configure the non-virtual channel and attach it to ERP instance.
`Bridge4(g8032-config-switch)#enable-tcn-propagation`	Enable Topology Change Notification (TCN) propagation.
`Bridge4(g8032-config-switch)#tcn-to-instance erp1`	Attach TCN propagation to ERPS instance.

Validation

The following validation output displays details for the specified ERP instance using the `show g8032 erp-instance` command on Bridge5, Bridge1, and Bridge4. It describes the sub-ring type for Bridge1 and Bridge4 as non-virtual. Additionally, it specifies that Bridge1 is a non-owner node, while Bridge4 is the owner node for the specified ERPS ring, designating the east interface as the neighbor node in the ring.

```
Bridge5#show g8032 erp-instance
Instance         ID  State        East      state     West      state      Ring
---------------------------------------------------------------------------------------
erps2            1   IDLE         xe2.1     Blocked   xe20.1    Unblocked  subring2

Bridge1#show g8032 erp-instance
Instance         ID  State        East      state     West      state      Ring
--------------------------------------------------------------------------------------
erp1             1   IDLE         xe8.1     Unblocked   xe6.1    Unblocked   1
erp3             3   IDLE         xe20.1    Unblocked   -          -         subring2

Bridge4#show g8032 erp-instance
Instance         ID  State        East      state     West      state      Ring
--------------------------------------------------------------------------------------
-
erp1             1   IDLE         xe6.1     Unblocked xe16.1    Blocked  Ring1
erp3             3   IDLE         xe2.1     Blocked   -         -          subring2

Bridge1#show g8032 erp-instance erp3
Inst Name        : erp3 (3), node-id e8:c5:7a:a8:7c:c8, Profile (1)
Description      :
Ring             : SUB-RING (NON VIRTUAL) (subring2), NON-OWNER, tcn_propagation
(1)(erp1,)

State            : G8032_ST_IDLE

East             : xe20.1, Unblocked, UP  , BPR (-), remote (-)
```

```
East (cfm)         : mep_id (906), cc-interval (1s), Domain (P5P71), MA (ma7)

Channel            : Level (5), vlan (200), RING_ID (2)

Bridge4#show g8032 erp-instance erp3
Inst Name          : erp3 (3), node-id b8:6a:97:25:a7:bd, Profile (1)
Description        :
Ring               : SUB-RING (NON VIRTUAL) (subring2), OWNER (EAST),tcn_propagation
(1)(erp1,)

State              : G8032_ST_IDLE

East               : xe2.1, Blocked  , UP  , BPR (-), remote (-)

East (cfm)         : mep_id (800), cc-interval (1s), Domain (P2P71), MA (ma8)

Channel            : Level (5), vlan (200), RING_ID (2)
```

Implementation Examples

We explore deploying Ethernet LAN (ELAN) services using a bridge domain and leveraging ERPS to enhance network resilience and accelerate traffic switchover.

ELAN services find common applications in data centers and enterprise networks, facilitating connectivity among multiple endpoints. A bridge domain serves as a logical segment where these services are extended and managed.

Ring Topology in Data Center Network Scenario

In a data center network, multiple access switches are connected to aggregation switches forming a ring topology using bridge domains. The data center operator wants to implement fast protection switching to ensure uninterrupted connectivity for critical services in case of link or node failures.

Use Case: The data center network can achieve network resiliency by configuring ERPS over the bridge domains. In the event of a link failure on one of the ring ports, ERPS will automatically redirect traffic through the backup path, maintaining service continuity and minimizing downtime.

Campus LAN with Redundant Links Scenario

A campus LAN network is designed with redundant links between distribution switches using bridge domains. The network administrators want to implement ring protection to ensure reliable communication between buildings and minimize service disruptions in case of link failures.

Use Case: The campus LAN network can achieve seamless switchover during link failures by deploying ERPS over the bridge domains connecting the distribution switches. ERPS will detect the failure and swiftly switch traffic to the backup link, ensuring continuous connectivity for users and devices.

Industrial Automation Network Scenario

An industrial automation network uses a redundant ring topology with bridge domains to connect various industrial devices and controllers. The network operator requires a solution to achieve rapid network recovery in case of link or node failures.

Use Case: The network operator can achieve seamless switchover during link or node failures by configuring ERPS over the bridge domains in the industrial automation network. ERPS will provide fast protection switching, reducing downtime and ensuring continuous operation of critical industrial processes.

New CLI Commands

The ERPS with CFM Down-MEP over Bridge-Domain introduces the following configuration commands.

associate-ring

Use this command to configure a single ERPS instance to monitor multiple rings. All the rings associated with the `associate-ring` command must share the same parent interface as the primary ring mapped to the ERPS instance.

Note: The primary ring or instance is responsible for monitoring and managing multiple associate rings. However, it's important to note that only failures detected by the primary instance will trigger a switchover in all associated rings. Individual failures, such as link shutdowns on ring ports of associate rings, will not independently trigger failover switches in the associate rings. Instead, the primary instance must detect the failure for it to propagate to the associated rings.

Command Syntax

```
associate-ring RINGNAME
```

Parameters

`RINGNAME`	Specifies the name of the ring to associate with the ERPS instance.

Default

None

Command Mode

G.8032 configure switch mode

Applicability

This command was introduced in OcNOS version 6.4.1.

Examples

Here is a sample example of configuring a G.8032 ERP instance and associate ring in OcNOS device.

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#associate-ring ring1
OcNOS(g8032-config-switch)#end
```

hardware-profile aclif failover

Use this command to enable failover for the logical interface (LIF) resources, optimizing ERPS hardware failover ID.

Use the `no` parameter of this command to disable failover for the LIF resources.

Note: Recommend using per-interface-based Access Control List (ACL) failover on ERPS ring ports instead of a global profile.

Command Syntax

```
hardware-profile aclif failover
hardware-profile aclif no-failover
```

Parameters

None

Default

None

Command Mode

Configure mode.

Applicability

This command was introduced in OcNOS version 6.4.1.

Examples

Below are examples of configuring hardware profiles for ACL interface (aclif) with and without failover in OcNOS device.

```
OcNOS#configure terminal
OcNOS(config)#hardware-profile aclif failover

OcNOS(config)#hardware-profile aclif no-failover
```

aclif failover

Use this command to enable failover for the logical interface (LIF) resources, enhancing the LIFs hardware profile for ERPS.

Use the `no` parameter of this command to disable failover for the LIF resources, providing control over individual LIFs.

Command Syntax

```
aclif failover
aclif no-failover
```

Parameters

None

Default

None

Command Mode

Interface mode.

Applicability

This command was introduced in OcNOS version 6.4.1.

Examples

Below are sample examples of configuring ACL interface (aclif) with and without failover on interface `xe2` in OcNOS device.

```
OcNOS#configure terminal
OcNOS(config)#interface xe2
OcNOS(config)#aclif failover

OcNOS(config)#aclif no-failover
```

Revised CLI Commands

Below is the revised command for configuring ERPS with Bridge-Domain. For more details, refer G.8032 ERPS Version 2 Commands chapter in the *Carrier Ethernet Guide*.

clear g8032 erp-instance

- The command clear g8032 erp-instance is used to clear ERPS instance.
- The existing syntax now includes the newly added parameter for clearing all ERPS instance, namely `all`.

erp-instance

- The command erps-instance is used to set the ERPS-instance for the sub-interface.
- The syntax has been revised to remove the `none` parameter.

g8032 erp-instance force-switch

- The command g8032 erp-instance force-switch is used to configure administrative commands related to force switching within ERPS instances.
- The existing syntax now includes the newly added parameter to apply the command to all ERPS instances configured on the device, namely `all`.

g8032 erp-instance manual-switch

- The command g8032 erp-instance manual-switch is used to configure administrative commands related to force switching within ERPS instances.
- The existing syntax now includes the newly added parameter to apply the command to all ERPS instances configured on the device, namely `all`.

show g8032 erp-instance

- The command show g8032 erp-instance is used to display details about an ERP instance.
- The existing syntax now includes the newly added parameters to display data traffic details for ERP instances and details for a specific ERP instance, namely `data-traffic` and `summary`.

Troubleshooting

ERPS Conflict with VXLAN

In some scenarios, ERPS may encounter conflicts with VXLAN configurations, leading to issues with traffic forwarding. These conflicts primarily arise due to resource conflicts in the hardware for wide LIF data. This section provides insights into identifying and resolving such conflicts.

Issue Description

When VXLAN is used in conjunction with ERPS, traffic forwarding for xConnects configured in specific scenarios, such as Qumran2 series platform, may fail.

Conflict Details

ERPS optimizations, particularly those related to hardware failover IDs (`hw-failover-id`), can conflict with VXLAN bridge configurations and VXLAN xConnects, causing VXLAN-related functionalities to stop working as expected. The conflict arises due to resource contention in the hardware, particularly when dealing with wide LIFs data.

Proposed Solution

To address these conflicts and provide granular control over resource usage, a new CLI commands hardware-profile aclif failover and aclif failover has been introduced. This command allows users to enable or disable the `hardware-aclif-failover` feature for failover on LIFs.

Impact on ERPS

- For bridge and PB configurations, default `aclif-failover` features are available, and there is no impact on ERPS.
- For bridge-domain configurations, conflicts may arise with VXLAN on sub-interface LIFs. To resolve this, the CLI commands hardware-profile aclif failover and aclif failover must be configured on ring ports. It's important to note that enabling or configuring `aclif-failover` on ring ports for bridge-domain configurations does not result in any functional changes compared to the previous CLI settings.

Abbreviations

The following are some key abbreviations and their meanings relevant to this document:

Acronym	Description
ERPS	Ethernet Ring Protection Switching
CFM	Continuity Fault Management
ELAN	Ethernet LAN
LIF	Logical Interface
ACLIF	Access Control List Interface

Glossary

The following provides definitions for key terms used throughout this document.

Bridge Domain	A logical network segment where bridging services are extended and managed. It defines a broadcast domain in Ethernet bridging.
Bridge Ports	Physical or virtual ports/interfaces that connect devices within a bridge domain.
Network Resilience	The ability of a network to maintain service availability and performance in the face of failures or abnormal conditions.
Redundant Links	Backup or alternative network connections designed to ensure network reliability.
Distribution Switches	Network switches that aggregate traffic from access switches and connect them to core switches or routers.
Ring Topology	A network topology in which each network device is connected to exactly two other devices, forming a circular path.
Failover	The process of automatically switching to a backup or redundant system or path in case of a failure.
Downtime	The period during which a system, network, or service is unavailable or not functioning correctly.
VLAN	Virtual Local Area Network, a logical segmentation of a network to isolate traffic and improve network efficiency.
Backup Path	An alternative network path that can be used to reroute traffic in case of a failure in the primary path.
Granular Control	Fine-tuned control over specific aspects or resources within a system or network.
Resource Contention	Competition or conflict for limited resources, such as hardware resources in a network device.
Sub-Interface	A logical interface created within a physical interface to allow multiple virtual interfaces with different configurations.
Logical Interface	A virtual or logical network interface on a device.

CHAPTER 17 Ethernet in the First Mile Configuration

This chapter contains a complete sample Ethernet 802.3ah (EFM) configuration.

EFM stands for Ethernet in the First Mile and it is an Ethernet link-layer OAM, which works over direct/with ethernet repeaters point-to-point ethernet links. OAM PDUs (Protocol Data Units) uses slow protocol destination MAC address 0180.c200.0002. These frames are single-hop and can not be forwarded beyond a single hop. The transmission rate is limited to a maximum of 10 frames per second to avoid impact on normal operations. Following are the OAM features supported by EFM.

- Discovery
- Link Monitoring
- Remote Fault Detection
- Remote Loopback

Note: Ethernet OAM is a layer 2 interface feature. So switchport configuration on interface is required. Configure the OAM Mode as Active or Passive. Both switch can be configured Active-Active or Active-Passive. But Passive-Passive on both switch won't work.

Note: Remote-loopback & link monitor supported is configured by default when ethernet oam is enabled.

Note: `shut/no-shut` should be performed to bring up the interface which becomes down after dying-gasp event.

Topology

Figure 17-31 displays a sample EFM topology.

Figure 17-31: EFM Topology

Configuration

All configuration commands in the table below should be followed for each switch.

`#configure terminal`	Enter configure mode.
`(config)#interface xe3`	Enter interface mode.
`(config-if)#switchport`	Set switching characteristics on the port.
`(config-if)#ethernet oam enable`	Configure EFM on interface
`(config-if)#ethernet oam mode passive`	Configure EFM mode Passive. Default is Active
`(config-if)#ethernet oam mode active`	Configure EFM mode Active
`(config-if)# ethernet oam remote-loopback start`	Configure remote-loopback start
`(config-if)# ethernet oam remote-loopback stop`	Configure remote-loopback stop

`(config-if)#commit`	Commit the configuration
`(config-if)# exit`	Exit from interface mode

Validation

1. Verify OAM discovery

```
show ethernet oam discovery interface xe3

Local client:
-------------
  Administrative configurations:
     Mode:                                   active
     Unidirection:                           not supported
     Link monitor:                           supported(on)
     Remote Loopback:                        supported
     MIB retrieval:                          not supported
     MTU Size    :                           1518
  Operational status:
     Port status:                            operational
     Loopback status:                        no loopback
     PDU revision:                           0

Remote client:
--------------
  MAC address: 80a2.356c.21ff
  Vendor(oui): 0 0 0

  Administrative configurations:
     Mode:                                   passive
     Unidirection:                           not supported
     Link monitor:                           supported
     Remote Loopback:                        supported
     MIB retrieval:                          not supported
     MTU Size    :                           1518
```

2. Verify the Discovery State Machine Details

```
show ethernet oam xe3

Discovery State Machine Details:
--------------------------------
EFM Discovery Machine State:              Send Any
Local Parser State:                       Forward
Local Multiplexer State:                  Forward
Remote Parser State:                      Forward
Remote Multiplexer State:                 Forward

Local Client:
-------------
```

```
    Symbol Period Error:
       Window:                           100000000 Symbol(s)
       Threshold:                        1 Symbol(s)
       Last Window Symbols Errors:       0 Symbol(s)
       Total Symbols Errors:             0 Symbol(s)
       Total Symbols Errors Events:      0 Events(s)
       Relative Timestamp of the Event:  0 x 100 milliseconds

    Frame Error:
       Window:                           100 x 10 milliseconds
       Threshold:                        1 Error Frame(s)
       Last Window Frame Errors:         0 Frame(s)
       Total Frame Errors:               0 Frames(s)
       Total Frame Errors Events:        0 Events(s)
       Relative Timestamp of the Event:  0 x 100 milliseconds

    Frame Period Error:
       Window:                           10000000 Frames
       Threshold:                        1 Error Frame(s)
       Last Window Frame Errors:         0 Frame(s)
       Total Frame Errors:               0 Frames(s)
       Total Frame Period Errors Events: 0 Events(s)
       Relative Timestamp of the Event:  0 x 100 milliseconds

    Frame Seconds Error:
       Window:                           1000 x 10 milliseconds
       Threshold:                        1 Error Second(s)
       Last Window Frame Second Errors:  0 Frame(s)
       Total Frame Second Errors:        0 Frames(s)
       Total Frame Second Errors Events: 0 Events(s)
       Relative Timestamp of the Event:  0 x 100 milliseconds

Remote Client:
----------------

    Symbol Period Error:
       Window:                           0 Symbol(s)
       Threshold:                        0 Symbol(s)
       Last Window Symbols Errors:       0 Symbol(s)
       Total Symbols Errors:             0 Symbol(s)
       Total Symbols Errors Events:      0 Events(s)
       Relative Timestamp of the Event:  0 x 100 milliseconds

    Frame Error:
       Window:                           0 x 100 milliseconds
       Threshold:                        0 Error Frame(s)
       Last Window Frame Errors:         0 Frame(s)
       Total Frame Errors:               0 Frames(s)
       Total Frame Errors Events:        0 Events(s)
       Relative Timestamp of the Event:  0 x 100 milliseconds
```

```
     Frame Period Error:
        Window:                         0 Frames
        Threshold:                      0 Error Frame(s)
        Last Window Frame Errors:       0 Frame(s)
        Total Frame Errors:             0 Frames(s)
        Total Frame Period Errors Events: 0 Events(s)
        Relative Timestamp of the Event:  0 x 100 milliseconds

     Frame Seconds Error:
        Window:                         0 x 100 milliseconds
        Threshold:                      0 Error Second(s)
        Last Window Frame Second Errors:  0 Frame(s)
        Total Frame Second Errors:      0 Frames(s)
        Total Frame Second Errors Events: 0 Events(s)
        Relative Timestamp of the Event:  0 x 100 milliseconds
```

3. Verify the oam statistics

```
show ethernet oam statistics interface xe3

Counters:
----------
    Information OAMPDU Tx                  : 331
    Information OAMPDU Rx                  : 323
    Event Notification OAMPDU Tx           : 0
    Event Notification OAMPDU Rx           : 0
    Loopback Control OAMPDU Tx             : 0
    Loopback Control OAMPDU Rx             : 0
    Unsupported OAMPDU Rx                  : 0

Local event logs:
-----------------
    0 Errored Symbol Period records
    0 Errored Frame records
    0 Errored Frame Period records
    0 Errored Frame Seconds records

Remote event logs:
-----------------
    0 Errored Symbol Period records
    0 Errored Frame records
    0 Errored Frame Period records
    0 Errored Frame Seconds records
```

4. Verify the oam status

```
show ethernet oam status interface xe3

General:
```

```
-------
   Mode:                               active
   PDU max rate:                       10 packets per second
   PDU min rate:                       1 packet per 1 second
   Link timeout:                       5 seconds
   High threshold action:              no action

Link Monitoring:
----------------
     Status:                           supported(on)

     Event log size:                   20 Entries

     Symbol Period Error:
        Window:                        100 million symbols
        Low threshold:                 1 error symbol(s)
        High threshold:                none

     Frame Error:
        Window:                        100 x 10 milliseconds
        Low threshold:                 1 error frame(s)
        High threshold:                none

     Frame Period Error:
        Window:                        1000 x 100,000 frames
        Low threshold:                 1 error frame(s)
        High threshold:                none

     Frame Seconds Error:
        Window:                        1000 x 10 milliseconds
        Low threshold:                 1 error second(s)
        High threshold:                none
```

CHAPTER 18 Ethernet Test Signal Lock Configuration

ETH-TST (Ethernet Test Signal) and ETH-LCK (Ethernet Lock Signal) protocols are defined in Y.1731. ETH-TST is used to perform one-way on-demand in-service or out-of-service diagnostics tests. This includes verifying bandwidth throughput, frame loss, bit errors, etc.

ETH-LCK is used to communicate the administrative locking of a MEP and consequential interruption of data traffic forwarding towards the MEP expecting this traffic. It allows a MEP receiving frames with ETH-LCK information to differentiate between a defect condition and an administrative locking action at lower level MEP.

Topology

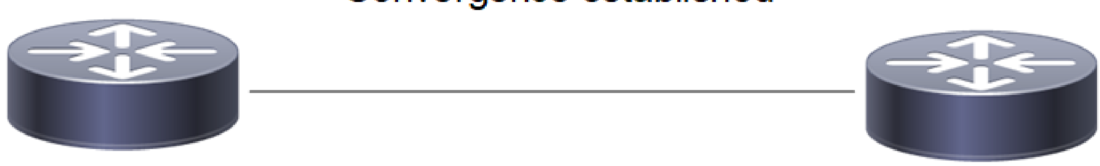


Figure 18-32: ETH Test Signal Topology

ETH-TST Configuration

Initiator/generator

`#configure terminal`	Enter configure mode.
`(config)#hardware-profile filter cfm-domain-name-str enable`	Configure Hardware profile filter.
`(config)#hardware-profile statistics ingress-acl enable`	Configure hardware profile statistics ingress-acl.
`(config)#vlan database`	Enter Vlan config mode.
`(config-vlan)#vlan 2-100 bridge 1 state enable`	Configure Vlans.
`(config-vlan)#exit`	Exit Vlan config mode.
`(config)#interface xe15`	Enter Interface config mode.
`(config-if)#switchport`	Configure Interface as switchport.
`(config-if)#bridge-group 1`	Configure bridge-group.
`(config-if)#switchport mode trunk`	Configure switchport mode as trunk.
`(config-if)#switchport trunk allowed vlan all`	Configure all vlans as part of switchport trunk.
`(config-if)#no shutdown`	Bring the interface into operation.
`(config-if)#exit`	Exit interface mode.

(config)#ethernet cfm domain-type character-string domain-name test1 level 7 mip-creation none	Enter ethernet cfm mode by specifying domain name and bridge.
(config-ether-cfm)#service ma-type string ma-name test1	Configure service ma.
(config-ether-cfm-ma)#vlan 10 bridge 1	Configure service Vlan.
(config-ether-cfm-ma)#mip-creation none	Configure mip-creation type.
(config-ether-cfm-ma)#ethernet cfm mep down mpid 200 active true xe15	Configure ethernet cfm mep.
(config-ether-cfm-ma-mep)#cc multicast state enable	Enable multicast state.
(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit Ethernet ma mep mode.
(config-ether-cfm-ma)#mep crosscheck mpid 100	Configure RMEP.
(config-ether-cfm-ma)#cc interval 5	Configure interval in ma mode.
(config-ether-cfm-ma)#exit-ether-ma-mode	Exit ma mode.
(config-ether-cfm)#exit	Exit Ethernet cfm mode.
(config)#ethernet cfm test-signal profile-name test	Configure Ethernet cfm test-signal profile.
(config-cfm-tst)#mode both	Configure test-signal mode as both(generator and receiver).
(config-cfm-tst)#frame-size 1518	Configure test-signal frame-size.
(config-cfm-tst)#cir 100 kbps cos 3 dei 1	Configure test-signal committed information rate (CIR).
(config-cfm-tst)#commit	Commit the candidate configuration to the running configuration.
(config-cfm-tst)#exit	Exit Ethernet cfm test-signal mode.

Receiver

#configure terminal	Enter configure mode.
(config)#hardware-profile filter cfm-domain-name-str enable	Configure Hardware profile filter.
(config)#hardware-profile statistics ingress-acl enable	Configure hardware profile statistics ingress-acl.
(config)#vlan database	Enter Vlan config mode.
(config-vlan)#vlan 2-100 bridge 1 state enable	Configure Vlans.
(config-vlan)#exit	Exit Vlan config mode.
(config)#interface xe15	Enter Interface config mode.
(config-if)#switchport	Configure Interface as switchport.
(config-if)#bridge-group 1	Configure bridge-group.
(config-if)#switchport mode trunk	Configure switchport mode as trunk.
(config-if)#switchport trunk allowed vlan all	Configure all vlans as part of switchport trunk.
(config-if)#no shutdown	Bring the interface into operation.
(config-if)#exit	Exit interface mode.

(config)#ethernet cfm domain-type character-string domain-name test1 level 7 mip-creation none	Enter ethernet cfm mode by specifying domain name and bridge.
(config-ether-cfm)#service ma-type string ma-name test1	Configure service ma.
(config-ether-cfm-ma)#vlan 10 bridge 1	Configure service Vlan.
(config-ether-cfm-ma)#mip-creation none	Configure mip-creation type.
(config-ether-cfm-ma)#ethernet cfm mep down mpid 100 active true xe15	Configure ethernet cfm mep.
(config-ether-cfm-ma-mep)#cc multicast state enable	Enable multicast state.
(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode	Exit Ethernet ma mep mode.
(config-ether-cfm-ma)#mep crosscheck mpid 200	Configure RMEP.
(config-ether-cfm-ma)#cc interval 3ms	Configure interval in ma mode.
(config-ether-cfm-ma)#exit-ether-ma-mode	Exit ma mode.
(config-ether-cfm)#exit	Exit Ethernet cfm mode.
(config)#ethernet cfm test-signal profile-name sample_tst	Configure Ethernet cfm test-signal profile.
(config-cfm-tst)#mode receiver	Configure test-signal mode as receiver.
(config-cfm-tst)#cir 100 kbps cos 3 dei 1	Configure test-signal CIR.
(config-cfm-tst)#commit	Commit the candidate configuration to the running configuration.
(config-cfm-tst)#exit	Exit Ethernet cfm test-signal mode.

Validation

Before the ETH-TST signal is started, convergence needs to be established. Convergence is checked as mentioned below:

```
CE1#sh ethernet cfm errors domain test1 bridge 1
Domain Name          Level     Vlan     MEPID     Defects
--------------------------------------------------------
test1                7         10       200       .....
1. defRDICCM    2. defMACstatus  3. defRemoteCCM
4. defErrorCCM  5. defXconCCM
```

After the above convergence is established with the receiver node, ETH-TST signal is started from the exec mode as mentioned below.

Generator node

```
#test-signal start-time relative 0 stop-time relative 4 tst-profile-name test domain
test1 ma test1 mep 200 target mac-address 0018.236c.5cca  bridge 1
```

Receiver node

```
#test-signal start-time relative 0 stop-time relative 4 tst-profile-name sample_tst
domain test1 ma test1 mep 100 target mac-address e8c5.7a78.712d  bridge 1
```

ETH-TST Signal initiated is checked as mentioned below :

Generator node

```
#show ethernet cfm test-signal sessions
MEP-Id  Status    StartTime             Tst-Profile       Peer MAC-Address
-------------------------------------------------------------------------------
200     Active    2019/02/15 16:32:59     test            0018.236c.5cca


#show ethernet cfm test-signal domain test1 ma test1 mep 200 bridge 1 stats gtf
 TST Session status          : In-Progress
 Elapsed Time(sec)           : 77
 MD                        : test1
 MA                          : test1
 MEP                         : 200
 Peer MAC Address            : 0018.236c.5cca
 RMEP ID                     : 100
 Start Time                    : 2019 Feb 15 16:32:59
 CIR Transmitted Packet Count      : 509767
```

Receiver Node

```
#show ethernet cfm test-signal domain test1 ma test1 mep 100 bridge 1 stats ctf
 TST Session status          : In-Progress
 Elapsed Time(sec)           : 83
 MD                          : test1
 MA                          : test1
 MEP                         : 100
 Peer MAC Address            : e8c5.7a78.712d
 RMEP ID                     : 200
 Start Time                    : 2020 Dec 16 16:34:21
 CIR Received Packet Count         : 545827
 CIR Out-of-Order Packet Count      : 0
 CIR Error Packet Count             : 0
 CIR Last Packet Sequence Number : 664967
```

ETH-LCK Configuration

Eth-Lck configuration is performed at the MEP Level as shown below :

#configure terminal	Enter configure mode
(config)# ethernet cfm domain-type character-string domain-name test1 level 7 mip-creation none	Enter ethernet cfm mode by specifying domain name and bridge.
(config-ether-cfm)#service ma-type string ma-name test1	Configure service ma
(config-ether-cfm-ma)#vlan 10 bridge 1	Configure service Vlan.
(config-ether-cfm-ma)#mip-creation none	Configure mip-creation type.
(config-ether-cfm-ma)#ethernet cfm mep down mpid 200 active true xe15	Configure ethernet cfm mep
(config-ether-cfm-ma-mep)#exit	Eth Lck configuration is performed in MEP Mode

Validation

Default state of the Ethernet cfm Lck details is as mentioned below:

```
#show ethernet cfm lck details domain test1 ma test1 mep 200 bridge 1

Maintenance Domain              : test1
Maintenance Association           : test1
MEP ID                          : 200
LCK PDU state                    : Unlocked
LCK Message Level               : 0
LCK PDU Interval                 : 1 sec
LCK PDU Priority                 : 3

(config-ether-cfm-ma-mep)#state ?
  lock    Enable adminstrative locking state
  unlock  Disable adminstrative locking state

(config-ether-cfm-ma-mep)#state lock
#show ethernet cfm lck details domain test1 ma test1 mep 200 bridge 1

Maintenance Domain              : test1
Maintenance Association           : test1
MEP ID                          : 200
LCK PDU state                 : Locked
LCK Message Level               : 0
LCK PDU Interval                 : 1 sec
LCK PDU Priority                 : 3

(config-ether-cfm-ma-mep)#message level ?
  <0-7>  Enter the level for LCK transmission

(config-ether-cfm-ma-mep)#message level 3
#show ethernet cfm lck details domain test1 ma test1 mep 200 bridge 1
Maintenance Domain              : test1
Maintenance Association           : test1
MEP ID                          : 200
LCK PDU state                    : Locked
LCK Message Level             : 3
LCK PDU Interval                  : 1 sec
LCK PDU Priority                  : 3

(config-ether-cfm-ma-mep)#interval ?
1min  PDU transmit interval is one minute
1s    PDU transmit interval is one second(default)

(config-ether-cfm-ma-mep)#interval 1min
#show ethernet cfm lck details domain test1 ma test1 mep 200 bridge 1
Maintenance Domain              : test1
Maintenance Association           : test1
MEP ID                          : 200
```

```
LCK PDU state                    : Locked
LCK Message Level               : 3
LCK PDU Interval               : 1 min
LCK PDU Priority                  : 3

(config-ether-cfm-ma-mep)#frame priority ?
<0-7>  Enter the priority for LCK transmission PDU.Default is 3

(config-ether-cfm-ma-mep)#frame priority 7
#show ethernet cfm lck details domain test1 ma test1 mep 200 bridge 1
Maintenance Domain              : test1
Maintenance Association         : test1
MEP ID                          : 200
LCK PDU state                   : Locked
LCK Message Level               : 3
LCK PDU Interval                : 1 min
LCK PDU Priority                : 7
```

CHAPTER 19 Ethernet Bandwidth Notification Configuration

This chapter contains a configuration example of Ethernet Bandwidth Notification (ETH-BN).

ETH-BN protocol is defined in ITU-T Y.1731. ETH-BN is used by a server MEP to signal the server layer link bandwidth in the transmit direction to a MEP at the client layer, for example when the server layer runs over a microwave link which has the capability to adapt its bandwidth according to the prevailing atmospheric conditions.

On receiving frames with ETH-BN information, the client layer MEP can use bandwidth information to adjust service policies, e.g., to reduce the rate of traffic being directed towards the degraded link.

A client MEP continues to receive periodic frames with ETH-BN information including currently available bandwidth until the full bandwidth is restored at server MEP. In addition, periodic frames with ETH-BN information may optionally be receive when there is no degradation or when the bandwidth degrades to 0.

OcNOS supports only ETH-BN PDU reception and received PDU is processed as per below FSM:

Note: ETH-BN transmission is not supported by OcNOS.

Note: ETH-BN session shall be initiated on pre-configured active MEP. MD, MA and MEP details shall be metadata or prerequisite for this feature.

Topology

Figure 19-33 displays a sample FSM topology.

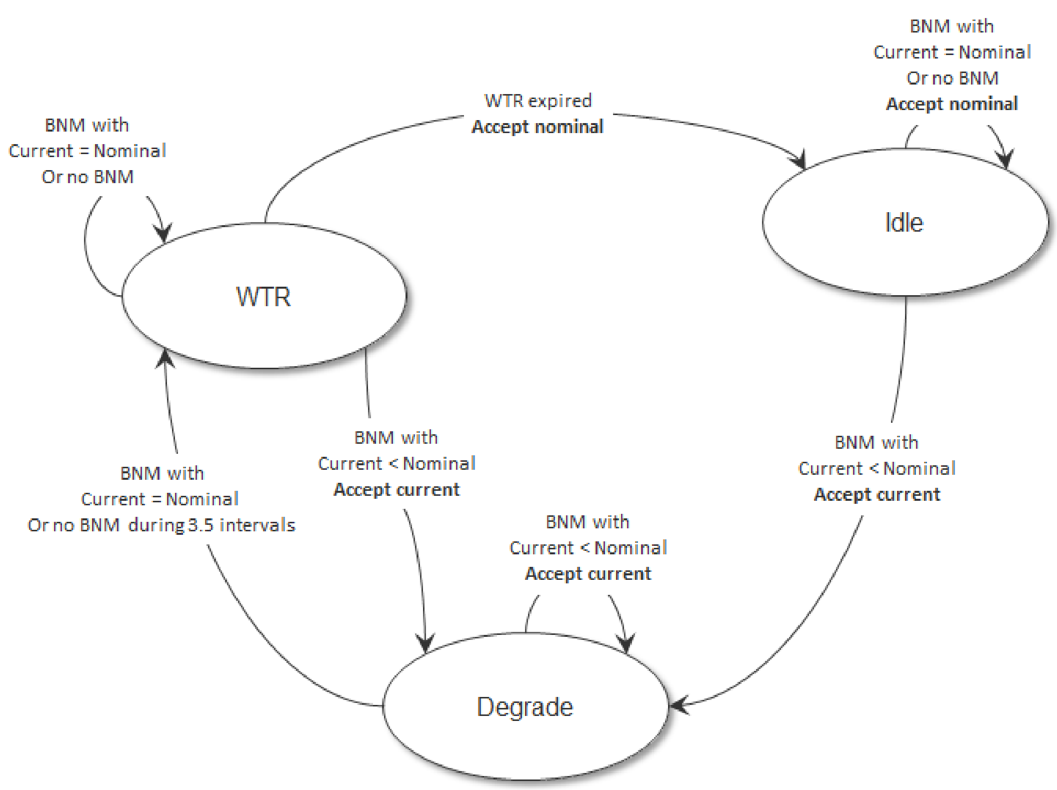


Figure 19-33: FSM Topology

Figure 19-34 displays a sample ETH-BN topology.

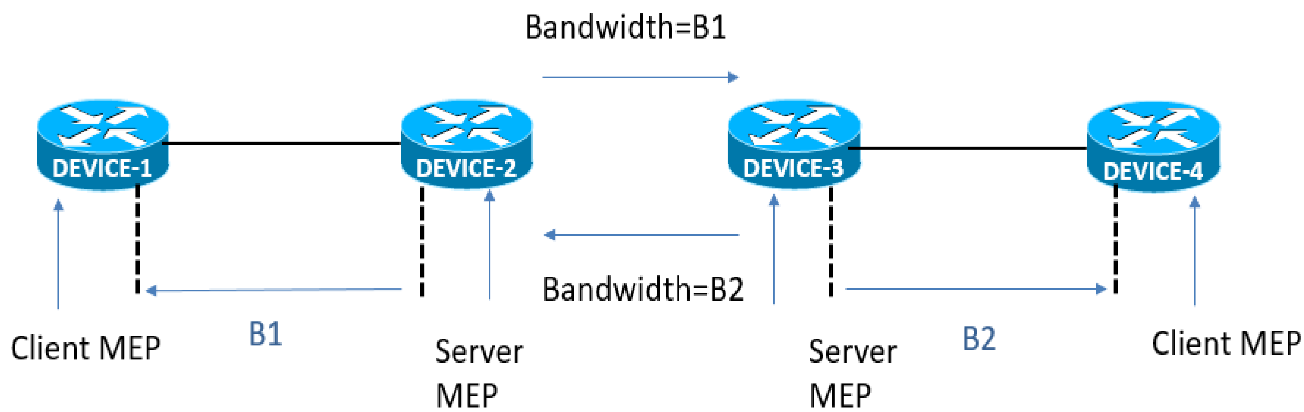


Figure 19-34: ETH-BN Topology

Prerequisite

Configure below hardware-profile commands related to CFM in configuration mode and reboot the nodes.

```
hardware-profile filter cfm-domain-name-str enable
hardware-profile statistics cfm-ccm enable (optional)
```

ETH-BN Configuration

Eth-Bn configuration is performed at the MEP Level as shown below.

`Client-mep#configure terminal`	Enter configure mode
`Client-mep(config)#bridge 1 protocol rstp vlan- bridge`	Create bridge 1 as an RSTP VLAN-aware bridge.
`Client-mep (config)#vlan database`	Entering vlan database
`Client-mep (config-vlan)#vlan 10 bridge 1 state enable`	Create VLAN 10 on bridge 1.
`Client-mep (config-vlan)#exit`	Exit vlan database
`Client-mep (config)#int ce49`	Configure interface ce49.
`Client-mep (config-if)#bridge-group 1`	Configure interface in bridge group 1.
`Client-mep (config-if)#switchport mode trunk`	Configure interface mode as trunk.
`Client-mep (config-if)#switchport trunk allowed vlan all`	Allow all VLANs on interface ce49.
`Client-mep (config-if)#exit`	Exit config mode.
`Client-mep (config)#ethernet cfm domain-type character-string domain-name 12345 level 7 mip-creation none`	Create cfm domain with type as character string and set mip creation criteria to none.
`Client-mep (config-ether-cfm)#service ma-type string ma-name 54321`	Create ma type as string and set mip creation criteria to none.
`Client-mep (config-ether-cfm-ma)#vlan 10 bridge 1`	Configure service Vlan
`Client-mep (config-ether-cfm-ma)# mip-creation none`	Configure mip-creation type.

Client-mep (config-ether-cfm-ma)#ethernet cfm mep down mpid 34 active true ce49	Create down mep for local-vid on ce49.
Client-mep (config-ether-cfm-ma-mep)#cc multicast state enable	Enable cc multicast.
Client-mep (config-ether-cfm-ma-mep)#bn receive	Enabling the eth-bn status
Client-mep (config-ether-cfm-ma-mep)#wait-to-restore-timer 50	Configure the eth-bn wait-too-restore-timer 50secs
Client-mep (config-ether-cfm-ma-mep)#exit-ether-ma- mep-mode	Exit Ethernet ma mep mode.
Client-mep (config-ether-cfm-ma)#mep crosscheck mpid 35	Enable MEP crosscheck
Client-mep (config-ether-cfm-ma)#cc interval 3ms	Enable cc interval in ms
Client-mep (config-ether-cfm-ma)#exit-ether-ma-mode	Exit ma mode.
Client-mep (config-ether-cfm)#commit	Commit the candidate configuration to the running configuration.
Client-mep (config-ether-cfm)#exit	Exit Ethernet cfm mode.

Validation

```
client-mep#show running-config cfm
!
!
ethernet cfm domain-type character-string domain-name 12345 level 7 mip-creation none
service ma-type string ma-name 54321
mip-creation none
ethernet cfm mep down mpid 34 active true ce49
bn receive
wait-to-restore-timer 50
exit-ether-ma-mep-mode
mep crosscheck mpid 35
   cc interval 3ms
exit-ether-ma-mode

!

client-mep#show ethernet cfm bn status


BNM status for interface xe26
------------------------------------

State                       : SIGNAL_PENDING
Restore Time                : 50 seconds
Total BNM Receive Count     : 2
Sender Address              : 3c2c.99d6.16a9
Elapsed time in this state: 00:01:38
```

```
Nominal Bandwidth         : 16 Mbps
Current Bandwidth         : 16 Mbps
Lowest Bandwidth          : 16 Mbps
Last BNM Received         : 2019 Mar 14 15:09:50
BNM Period                : 60 seconds
Wait-to-Restore Timer     : 45 second(s) remaining

Client-mep#show ethernet cfm bn mep  2 domain mdnam ma testtm

Ethernet BN MEP informations
------------------------------------
MA-Name : testtm
MEL : 2
Admin Status: ENABLE
Interface : ce49
VLAN : 25
Source Address     : 3c2c.99d6.16a9
Wait to Restore Timer : 50 seconds
        State                     : SIGNAL_NORMAL
        Elapsed time in this state: 00:00:01
        Last BNM Received         : 2019 Mar 14 15:09:50
        Nominal Bandwidth         : 16 Mbps
        Current Bandwidth         : 16 Mbps
        Port-ID     : -1412628480
        BNM Period : 60 seconds

Client-mep#show ethernet cfm statistics bn
MEPID   Domain     MA-Name     RX-Frames     Dropped-Frames    WR-time-left(sec)
--------------------------------------------------------------------------------
2       mdnam      testtm      2            0                 44
```

Carrier Ethernet Command Reference

CHAPTER 1 CFM and Y.1731 Commands

This chapter describes the commands used to manage the Connectivity Fault Management (CFM). CFM refers to the service OAM of Ethernet used to manage individual Layer 2 Ethernet services. The CFM protocol can discover and verify the path through 802.1 bridges and LANs. OcNOS adheres to the IEEE 802.1ag 2007 standard.

CFM includes the features required by ITU Y.1731 standard *OAM Functions and Mechanisms for Ethernet Based Networks*. This recommendation identifies the functions required to enable fault management (such as fault localization and defect detection) and performance monitoring in an Ethernet network.

abort delay-measurement

Use this command to stop the ongoing or scheduled CFM frame delay measurement session.

Command Syntax

```
abort delay-measurement mep MEPID domain DOMAIN_NAME ma MA_NAME
```

Parameters

mep	Local MEP identifier
MEPID	MEP identifier <1-8191>
domain	Specify domain.
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
ma	Specify Maintenance association name
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#abort delay-measurement mep 123 domain 12345 ma 1234
```

abort loss-measurement

Use this command to stop the ongoing CFM frame loss measurement session.

Command Syntax

```
abort loss-measurement mep MEPID domain DOMAIN_NAME ma MA_NAME
```

Parameters

`mep`	Local MEP identifier
`MEPID`	MEP identifier <1-8191>
`domain`	Specify domain.
`DOMAIN_NAME`	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
`ma`	Specify Maintenance association name
`MA_NAME`	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#abort loss-measurement mep 201 domain 12345 ma 1234
```

abort test-signal domain

Use this command to abort pre-configured test session.

Command Syntax

```
abort test-signal domain DOMAIN_NAME ma MA_NAME mep MEPID
```

Parameters

domain	Specify domain.
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
ma	Specify Maintenance association name
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it’s integer then maximum is 2-octets.
mep	Specify mep
MEPID	Enter the MEPID ranging from <1-8191>

Command Mode

Exec mode

Default

None

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
#abort test-signal domain 12345 ma 43982 mep 21
```

adaptive bandwidth disable

Use this command to disable adaptive bandwidth for ETH-BNM.

Command Syntax

```
adaptive bandwidth disable
```

Parameters

None

Default

Enabled.

Command Mode

Ethernet CFM MEP BN mode.

Applicability

This command was introduced in OcNOS version 6.5.1.

Examples

```
OcNOS(config)#ethernet cfm domain-type character-string domain-name md000
level 7 mip-creation default
OcNOS(config-ether-cfm)# service ma-type string ma-name ma289
OcNOS(config-ether-cfm-ma)#   vlan 1291 bridge 1
OcNOS(config-ether-cfm-ma)#   ethernet cfm mep down mpid 3290 active true xe2
OcNOS(config-ether-cfm-ma-mep)#     cc multicast state enable
OcNOS(config-ether-cfm-ma-mep)#bn receive
OcNOS(config-ether-cfm-ma-mep-bn)#adaptive bandwidth disable
OcNOS(config-ether-cfm-ma-mep-bn)#
```

ais interval

Use this command to set the AIS (Alarm Indication Signal) transmission interval.

Command Syntax

```
ais interval (1min|1s)
```

Parameters

`1min`	AIS transmission interval in packets per second
`1s`	AIS transmission interval in packets per minute

Default

`one-second`

Command Mode

Ethernet CFM MA MEP mode

Applicability

This command was introduced in OcNOS version 3.0.

Examples

```
#configure terminal
(config)#ethernet cfm domain-type character-string domain-name 12345 level 7
(config-ether-cfm)#service ma-type string ma-name 43982
(config-ether-cfm-ma)#ethernet cfm mep down mpid 201 active true local-vid 10 xe2
(config-ether-cfm-ma-mep)#ais interval 1m
```


ais status

Use this command to enable or disable AIS (Alarm Indication Signal) transmission and set the CFM MD level to transmit in AIS PDUs.

Command Syntax

```
ais status (enable|disable) level <0-7>
```

Parameters

`enable`	Enable AIS
`disable`	Disable AIS
`<0-7>`	CFM MD level

Default

`disable`

Command Mode

Ethernet CFM MA MEP mode

Applicability

This command was introduced in OcNOS version 3.0.

Examples

```
#configure terminal
(config)#ethernet cfm domain-type character-string domain-name 12345 level 7
(config-ether-cfm)# service ma-type string ma-name testtm
(config-ether-cfm-ma)#vlan 5 bridge 10
(config-ether-cfm-ma)#ethernet cfm mep down mpid 201 active true xe2
(config-ether-cfm-ma-mep)#ais status enable level 7
```

bins-per-fd-interval

Use this command to the set number of measurement bins per measurement interval for a two-way performance monitoring frame delay measurements on a specific MEP.

Use the no form to set number of measurement bins per measurement interval for a two-way performance monitoring frame delay measurements on a specific MEP to its default (3).

Command Syntax

```
bins-per-fd-interval <2-10>
no bins-per-fd-interval
```

Parameters

`<2-10>`	Number of frame delay bins to be created

Default

3

Command Mode

Ethernet CFM delay measurement mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)#ethernet cfm delay-measurement profile-name PROF1
(config-cfm-dm)# bins-per-fd-interval 4
```

bins-per-ifdv-interval

Use this command to set the number of measurement bins per measurement interval for an inter-frame delay for a two-way performance monitoring frame delay measurements on a specific MEP.

Use the no form to set the number of measurement bins per measurement interval for an inter-frame delay for a two-way performance monitoring frame delay measurements on a specific MEP to its default (2).

Command Syntax

```
bins-per-ifdv-interval <2-10>
no bins-per-ifdv-interval
```

Parameters

`<2-10>`	Number of inter-frame delay bins to be created

Default

2

Command Mode

Ethernet CFM delay measurement mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)#ethernet cfm delay-measurement profile-name PROF1
(config-cfm-dm)# bins-per-ifdv-interval 3
```

bin-type

Use this command to set the threshold value for a particular bin for a two-way performance monitoring frame delay measurements on a specific MEP.

Use the no form to set threshold value for a particular bin for a two-way performance monitoring frame delay measurements on a specific MEP to its default.

Command Syntax

```
bin-type frame-delay bin 2 threshold 200
no bin-type frame-delay bin 2 threshold
bin-type inter-frame-delay-variation bin 2 threshold 1000
no bin-type inter-frame-delay-variation bin 2 threshold
```

Parameters

`frame-delay` Frame delay bin type

`inter-frame-delay-variation`
Inter frame delay variation bin type

`<2-10>` Bin number for which the threshold will be changed.

`<1- 4294967295>`
Threshold value for that bin.

Default

Incremental of 5000 microseconds from bin 2, that is bin 2's threshold will be 5000, bin 3's will be 10000, bin 4 will be 15000, so on and so forth.

Command Mode

Ethernet CFM delay measurement mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)#ethernet cfm delay-measurement profile-name PROF1
(config-cfm-dm)# bin-type frame-delay bin 2 threshold 200
(config-cfm-dm)# bin-type inter-frame-delay-variation bin 2 threshold 1000
```

bn receive

Use this command to create EBN configuration and to enable/disable Eth-BN for the Mep.

Command Syntax

```
bn receive
no bn receive
```

Parameters

None

Default

ETH-BN is disabled by default

Command Mode

Ethernet CFM MEP mode

Applicability

This command was introduced in OcNOS version 5.0

Examples

```
OcNOS(config)#ethernet cfm domain-type character-string domain-name abcde
level 5
OcNOS(config-ether-cfm)#service ma-type string ma-name 7
OcNOS(config-ether-cfm-ma)#vlan 10 bridge 1
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 100 active true xe9
OcNOS(config-ether-cfm-ma-mep)#bn receive
OcNOS(config-ether-cfm-ma-mep-bn)#commit
```

bw-mapped-interface

Use this command to configure modem interface where the shapers has to be applied. When Eth-BNM and Eth-CSF PDUs are received on Out-Of-Band interface, shapper will be updated on corresponding modem interface if this CLI is configured. Use <no> version of CLI to unconfigure modem interface mapping.

Command Syntax

```
bw-mapped-interface IFNAME
no bw-mapped-interface
```

Parameters

IFNAME	Specify the interface name where bandwidth shapers can be applied

Command Mode

Ethernet CFM MEP mode

Applicability

This command was introduced in OcNOS version 5.2

Examples

```
OcNOS(config)#ethernet cfm domain-type character-string domain-name abcde
level 5
OcNOS(config-ether-cfm)#service ma-type string ma-name 7
OcNOS(config-ether-cfm-ma)#vlan 10 bridge 1
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 100 active true xe9
OcNOS(config-ether-cfm-ma-mep)# bw-mapped-interface modem1
OcNOS(config-ether-cfm-ma-mep)#commit
```

cc interval

Use this command to set the continuity checking (CC) message interval.

Command Syntax

```
cc interval  (3ms|10ms|100ms|1s|10s|1min|10min)
```

Parameters

`3ms`	3 milliseconds
`10ms`	10 milliseconds
`100ms`	100 milliseconds
`1s`	1 seconds
`1min`	1 minute
`10s`	10 seconds
`10min`	10 minutes

Note: 1min and greater not supported in QAX.

Command Mode

Ethernet CFM MA mode

Applicability

This command was introduced in OcNOS version 3.0.

Examples

```
(config)#ethernet cfm domain-type character-string domain-name 12345 level 7
(config-ether-cfm)#service ma-type string ma-name 43982
OcNOS(config-ether-cfm-ma)#vlan 10 bridge 1
(config-ether-cfm-ma)#ethernet cfm mep down mpid 2331 active true xe2
OcnOS(config-ether-cfm-ma-mep)cc interval 3ms
OcnOS(config-ether-cfm-ma-mep)#cc multicast state enable
```

cc multicast

Use this command to start or stop multicast continuity checking messages (CCMs) on a MEP.

Command Syntax

```
cc multicast state (enable|disable)
```

Parameters

`enable`	Start sending CCMs
`disable`	Stop sending CCMs

Command Mode

Ethernet CFM MA MEP mode

Applicability

This command was introduced in OcNOS version 3.0.

Examples

```
(config)#ethernet cfm domain-type character-string domain-name 12345 level 7
(config-ether-cfm)#service ma-type string ma-name 43982
(config-ether-cfm-ma)#vlan 10 bridge 1
(config-ether-cfm-ma)#ethernet cfm mep down mpid 2331 active true xe2 OcnOS(config-
ether-cfm-ma-mep)#cc multicast state enable
```

cfm snmp restart

Use this command to restart SNMP in CFM Protocol.

Command Syntax

```
cfm snmp restart
```

Parameters

None

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Examples

```
OcNOS#cfm snmp restart
```

cir

Use this command to configure a committed information rate (CIR) for an ETH test-signal in both the generator and receiver nodes. CIR is the minimum bandwidth the service provider is committed to providing its customers.

Use `no` form of this command to delete the configured CIR.

Command Syntax

```
cir <1-400000> (kbps|mbps) cos <0-7>
```

Parameters

`cir <1-400000>`	Specifies the bandwidth at which the packet exchange happens between the generator and the receiver nodes.
`cir kbps`	Specifies the unit of rate in kbps for testing the link between the generator and the receiver nodes.
`cir mbps`	Specifies the unit of rate in kbps for testing the link between the generator and the receiver nodes.
`cos <0-7>`	Specifies the COS. COS is a priority of the test signal of a specific packet.

Default

Disabled

Command Mode

Configure ETH-TEST mode

Applicability

Introduced in OcNOS version 6.6.0.

Examples

The following example shows how to configure the CIR:

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm test-signal profile-name 123
OcNOS(config-cfm-tst)#cir 100 kbps cos 2

OcNOS(config-cfm-tst)#no cir
```

clear ethernet cfm delay-measurement history

Use this command to clear the CFM frame delay measurement history statistics from CFM_MEP DB.

Command Syntax

```
clear ethernet cfm delay-measurement history mep <1-8191> domain DOMAIN_NAME ma
  MA_NAME
```

Parameters

MEPID	Local MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it’s integer then maximum is 2-octets.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#clear ethernet cfm delay-measurement history mep 123 domain no_name ma 53322
```

clear ethernet cfm dm history

Use this command to clear the CFM frame delay measurement history statistics from CFM_MEP DB.

Command Syntax

```
clear ethernet cfm dm history mep MEPID domain DOMAIN_NAME ma MA_NAME
```

Parameters

MEPID	Local MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it’s integer then maximum is 2-octets.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#clear ethernet cfm dm history mep 123 domain no_name ma 123
```

clear ethernet cfm lm history

Use this command to clear the CFM frame loss measurement history statistics.

Command Syntax

```
clear ethernet cfm lm history mep MEPID domain DOMAIN_NAME ma MA_NAME s
```

Parameters

MEPID	Local MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it’s integer then maximum is 2-octets.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#clear ethernet cfm lm history mep 201 domain 12345 ma 123
```

clear ethernet cfm loss-measurement history

Use this command to clear the CFM frame loss measurement history statistics.

Command Syntax

```
clear ethernet cfm loss-measurement history mep <1-8191> domain DOMAIN_NAME ma
  MA_NAME
```

Parameters

MEPID	Local MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#clear ethernet cfm loss-measurement history mep 201 domain 12345 ma 4327
```

clear ethernet cfm maintenance-point remote

Use this command to remove a dynamically learned RMEP.

The RMEP is relearned if rmep auto-discovery is enabled and a CCM (Continuity Checking Message) is received.

Command Syntax

```
clear ethernet cfm maintenance-points remote domain <DOMAIN-NAME>
```

Parameters

DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#clear ethernet cfm maintenance-points remote domain
```

clear ethernet cfm statistics

Use this command to clear the CFM statistics.

Command Syntax

```
clear ethernet cfm statistics
clear ethernet cfm statistics mep <MEPID> domain <DOMAIN_NAME> ma <MA_NAME>
```

Parameters

MEPID	MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
OcNOS#clear ethernet cfm statistics
```

clear ethernet cfm statistics bn

Use this command to clear the CFM Eth-BNM statistics.

Command Syntax

```
clear ethernet cfm statistics bn mep <MEPID> domain <DOMAIN_NAME> ma <MA_NAME>
```

Parameters

MEPID	MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 5.2.

Example

```
OcNOS#clear ethernet cfm statistics bn mep 123 domain 12345 ma 123
```

clear ethernet cfm statistics lck

Use this command to clear the CFM Eth-LCK statistics.

Command Syntax

```
clear ethernet cfm statistics lck mep <MEPID> domain <DOMAIN_NAME> ma <MA_NAME>
```

Parameters

MEPID	MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 6.3.0.

Example

```
OcNOS#clear ethernet cfm statistics lck mep 1 domain md001 ma ma01
```


clear ethernet cfm statistics test-signal

Use this command to clear the CFM ETH-Test receiver or generator statistics.

Command Syntax

```
clear ethernet cfm statistics test-signal domain <DOMAIN_NAME> ma <MANAME> mep
  <MEPID> stats (CTF|GTF)
```

Parameters

MEPID	MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.
CTF	ETH Test Frame Collector statistics
GTF	ETH Test Frame Generator statistics

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 6.3.0.

Example

```
OcNOS#clear ethernet cfm statistics test-signal domain md001 ma ma01 mep 1
stats gtf
OcNOS#clear ethernet cfm statistics test-signal domain md001 ma ma01 mep 2
stats ctf
```

clear ethernet cfm traceroute-cache

Use this command to clear the CFM traceroute cache entry.

Command Syntax

```
clear ethernet cfm traceroute-cache
```

Parameters

None

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#clear ethernet cfm traceroute-cache
```


csf receive

Use this command to create Eth-CSF configuration and to enable/disable Eth-CSF for the Mep.

Command Syntax

```
csf receive
no csf receive
```

Parameters

None

Default

Eth-CSF is disabled by default.

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 5.2.

Example

```
OcNOS(config)#ethernet cfm domain-type character-string domain-name abcde level 5
OcNOS(config-ether-cfm)#service ma-type string ma-name testtm
OcNOS(config-ether-cfm-ma)#vlan 5 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 201 active true xe2
OcNOS(config-ether-cfm-ma-mep)#csf receive
OcNOS(config-ether-cfm-ma-mep-csf)#commit
```

debug ethernet cfm

Use this command to enable debug for ethernet cfm .

Use `no` from of this command to disable debug for ethernet cfm

Command Syntax

```
debug ethernet cfm (all|events|rx|tx|loopback|traceroute)
no debug ethernet cfm (all|events|rx|tx|loopback|traceroute)
```

Parameters

`all`	Enable all debugs
`events`	Enable event debugs
`loopback`	Enable loopback debugs
`rx`	Enable receive debugs
`traceroute`	Enable traceroute debugs
`tx`	Enable transmit debugs

Default

None

Command Mode

Configure mode

Applicability

This command was introduced in OcNOS version 5.0 and option `all` is introduced in OcNOS version 6.3.0.

Examples

```
OcNOS(config)#debug ethernet cfm events
OcNOS(config)#debug ethernet cfm loopback
OcNOS(config)#debug ethernet cfm rx
OcNOS(config)#debug ethernet cfm tx
OcNOS(config)#debug ethernet cfm traceroute
OcNOS(config)#no debug ethernet cfm  events
OcNOS(config)#no debug ethernet cfm loopback
OcNOS(config)#no debug ethernet cfm rx
OcNOS(config)#no debug ethernet cfm tx
OcNOS(config)#no debug ethernet cfm traceroute
OcNOS(config)#debug ethernet cfm all
OcNOS(config)#no debug ethernet cfm all
```


delay-measurement type on-demand

Use this command to schedule an on-demand CFM delay measurement session.

Command Syntax

```
delay-measurement type on-demand profile-name WORD rmep (mac-address MAC|RMEPID)
  start-time (immediate|relative HH:MM:SS|absolute HH:MM:SS <1-31> MONTH <1993-
  2035>) repetition-period <6000-4294967295> mep MEPID domain DOMAIN_NAME
```

Parameters

`WORD`	Delay measurement profile name
`MAC`	Destination MAC address in HHHH.HHHH.HHHH format
`RMEPID`	Destination peer MEP identifier <1-8191>
`start-time`	Measurement session start time
`immediate`	Start immediately
`relative HH:MM:SS`	Relative time to start from the current system time
`absolute HH:MM:SS <1-31> MONTH <1993-2035>`	Scheduled date and time to start; for the month, specify the first three letters
`stop-time`	Measurement session stop time
`none`	Never stop
`relative HH:MM:SS`	Relative time to stop from the current system time
`absolute HH:MM:SS <1-31> MONTH <1993-2035>`	Scheduled date and time to stop; for the month, specify the first three letters
`<6000-4294967295>`	Repetition time in centiseconds
`MEPID`	Local MEP identifier <1-8191>
`DOMAIN_NAME`	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
`MA_NAME`	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it’s integer then maximum is 2-octets.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#delay-measurement type on-demand profile-name PROF1 rmep 101 start-time relative
00:00:03 stop-time relative 00:03:00 repetition-period 7000 mep 123 domain no_name ma
123
```

delay-measurement type proactive

Use this command to configure and start a proactive CFM delay measurement session.

Command Syntax

```
delay-measurement type proactive profile-name WORD rmep (mac-address MAC|RMEPID)
  mep MEPID domain DOMAIN_NAME ma MA_NAME
```

Parameters

WORD	Delay measurement profile name
MAC	Destination MAC address in HHHH.HHHH.HHHH format
RMEPID	Remote MEP identifier <1-8191>
MEPID	Local MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it’s integer then maximum is 2-octets.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#delay-measurement type proactive profile-name 123 rmep 101 mep 123 domain no_name ma
123
```

eir

Use this command to configure an excess information rate (EIR) for an ETH Test-Signal. EIR is the maximum bandwidth temporarily available by the service provider when the connection is less congested.

Use `no` form of this command to delete the configured EIR.

Command Syntax

```
eir <1-400000> <kbps/mbps> cos <0-7>
no eir
```

Parameters

`eir <1-400000>`	Specifies the rate
`eir kbps`	Specifies the unit of rate
`eir mbps`	Specifies the unit of rate
`cos <0-7>`	Specifies the COS

Default

Disabled

Command Mode

Configure ETH-TEST mode

Applicability

Introduced in OcNOS version 6.6.0.

Example

The following example shows how to configure the EIR:

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm test-signal profile-name 123
OcNOS(config-cfm-tst)#eir 10 mbps cos 5

OcNOS(config-cfm-tst)#no eir
```

ethernet cfm delay-measurement profile-name

Use this command to create a CFM frame delay measurement profile and enter Ethernet CFM delay measurement mode.

Use the no form of this command to remove a CFM delay measurement profile.

Command Syntax

```
ethernet cfm delay-measurement profile-name WORD
no ethernet cfm delay-measurement profile-name WORD
```

Parameters

WORD	Profile name

Command Mode

Configure mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)#ethernet cfm delay-measurement profile-name PROF1
(config-cfm-dm)#
```

ethernet cfm delay-measurement reply

Use this command to enable transmission of DMR (Delay Measurement Reply) PDUs for received DMMs (Delay Measurement Messages).

After this command is given, a delay measurement session cannot be configured to send DMMs. In that case, the device can only generate DMRs for received DMM PDUs.

Use the no form of this command to disable sending DMR PDUs. After no command is given we can thereby configure a delay measurement session to send DMMs if we need.

Command Syntax

```
ethernet cfm delay-measurement reply dmm
no ethernet cfm delay-measurement reply dmm
```

Parameters

None

Command Mode

Ethernet CFM MA MEP mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
OcNOS#configure terminal
OcNOS(config)# ethernet cfm domain-type no-name domain-name no_name level 4
OcNOS(config-ether-cfm)#service ma-type string ma-name 7
OcNOS(config-ether-cfm-ma)#vlan 10 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 100 active true xe9
OcNOS(config-ether-cfm-ma-mep)#ethernet cfm delay-measurement reply dmm
```

ethernet cfm domain-type

Use this command to create a CFM Maintenance Domain (MD) in a bridge and enter Ethernet CFM mode.

Use the `no` form of this command to remove a domain.

Note: You can create up to 15 MDs in a bridge.

Only one domain can be created without any domain name in a bridge.

A domain name of type `character-string` can only created only after the hardware-profile filter cfm-domain-name-str command is executed.

Command Syntax

```
ethernet cfm domain-type (no-name|character-string) domain-name DOMAIN_NAME level
<0-7>  mip-creation (none|default|explicit) |
no ethernet cfm domain-name DOMAIN_NAME
```

Parameters

`domain-type`	Domain type (must match service ma-type setting)
`no-name`	No MD name. The `ma-type` must be `integer` or `itu-t` carrier code (ICC) format defined by Y.1731.
`character-string`	Character string name. The `ma-type` must be string.
`DOMAIN_NAME`	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
`<0-7>`	MD level
`mip-creation`	Maintenance Intermediate Point (MIP) creation permission for this domain
`none`	No MIP can be created for this VLAN identifier
`default`	MIP can be created if no lower active level or MEP at next lower active level
`explicit`	Maintenance End Point (MEP) is needed at the next lower active level

Command Mode

Configure mode

Applicability

This command was introduced in OcNOS version 3.0.

Examples

```
OcNOS(config)#
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12347
level 7 mip-creation none
OcNOS(config-ether-cfm)#
```

ethernet cfm loss-measurement profile-name

Use this command to create a CFM frame loss measurement profile and enter Ethernet CFM loss measurement mode.

Use the `no` form of this command to remove a CFM loss measurement profile.

Command Syntax

```
ethernet cfm loss-measurement profile-name WORD
no ethernet cfm loss-measurement profile-name WORD
```

Parameters

`WORD`	Profile name

Command Mode

Configure mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)#ethernet cfm loss-measurement profile-name PROF1
(config-cfm-lm)#
```

ethernet cfm loss-measurement reply

Use this command to enable transmission of SLR (Synthetic Loss Reply) PDUs for received SLMs (Synthetic Loss Messages) and to enable transmission of LMR (Loss Measurement Reply) PDUs for received LMMs (Loss Measurement Messages).

After this command is given, a loss measurement session cannot be configured to send SLMs. In that case, the device can only generate SLRs for received SLM PDUs. The same is true for LMM/LMR also.

Use the `no` form of this command to disable sending SLR/LMR PDUs.

Command Syntax

```
ethernet cfm loss-measurement reply (slm | lmm)
no ethernet cfm loss-measurement reply (slm | lmm)
```

Parameters

`slm`	Synthetic Loss Messages
`lmm`	Loss Measurement Messages

Command Mode

Ethernet CFM MA MEP mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)# ethernet cfm domain-type no-name domain-name no_name level 4 mip-creation none
OcNOS(config-ether-cfm)#service ma-type string ma-name 7
OcNOS(config-ether-cfm-ma)#vlan 10 bridge 1
OcNOS(config-ether-cfm-ma)#mip-creation none
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 100 active true xe9
 OcNOS(config-ether-cfm-ma-mep)#ethernet cfm loss-measurement reply slm
```

ethernet cfm mep

Use this command to create a Maintenance End Point (MEP), make it active or inactive and enter Ethernet CFM MA MEP mode.

A MEP created with the `active false` option remains inactive and CFM functionality is suspended for such a MEP.

Note:

1. For a VPWS instance, only an up MEP can be created; a down MEP cannot be created for VPWS.
2. Vlan parameters is supported only for sub-interface and MA without any service.

Use the `no` form of this command to delete a MEP.

Command Syntax

```
ethernet cfm mep (down|up) mpid <1-8191> active (false|true) (IFNAME ((vlan <1-
  4094> (inner-vlan <1-4094>)|)|vpws VCNAME | evpn <1-16777215>)
```

```
no ethernet cfm mpid <1-8191>
```

Parameters

`down`	Down MEP
`up`	Up MEP
`active`	Administrative state of the MEP
`true`	Make the MEP active
`false`	Make the MEP inactive
`IFNAME`	Interface name
`vlan`	Outer vlan
`inner-vlan`	Inner vlan
`VCNAME`	Virtual circuit name
`evpn <ID>`	EVPN instance ID

Command Mode

Ethernet CFM MA mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

Physical Interface:

```
OcNOS(config)#ethernet cfm domain-type character-string domain-name md001
level 7
OcNOS(config-ether-cfm)#service ma-type string ma-name ma001
OcNoS(config-ether-cfm-ma)#vlan 11 bridge 1
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 666 active true  ge9
```

Sub-interface:

```
OcNOS(config)#ethernet cfm domain-type character-string domain-name md001
level 7
OcNOS(config-ether-cfm)#service ma-type string ma-name ma001
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 111 active true  ge9.1
vlan 100
```

ethernet cfm mip

Use this command to create a static MIP on an interface.

Use the `no` form of this command to remove a static MIP from an interface.

Command Syntax

```
ethernet cfm mip interface IFNAME
no ethernet cfm mip interface IFNAME
```

Parameters

`IFNAME`	Interface name of MIP

Command Mode

Ethernet CFM MA mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
OcNOS#con term
Enter configuration commands, one per line.  End with CNTL/Z.
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345
level 7 mip-creation default
OcNOS(config-ether-cfm)# service ma-type string ma-name ma1
OcNOS(config-ether-cfm-ma)# vlan 25 bridge 1
OcNOS(config-ether-cfm-ma)# mip-creation default
OcNOS(config-ether-cfm-ma)# ethernet cfm mip interface ge5
OcNOS(config-ether-cfm-ma)#no ethernet cfm mip interface ge5
```

ethernet cfm statistics csf

Use this command to clear the CFM Eth-CSF statistics.

Command Syntax

```
clear ethernet cfm statistics csf mep <MEPID> domain <DOMAIN_NAME> ma <MA_NAME>
```

Parameters

MEPID	MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it’s integer then maximum is 2-octets.

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 5.2.

Example

```
OcNOS#clear ethernet cfm statistics csf mep 123 domain 12345 ma 123
```

ethernet cfm test-signal profile-name

Use this command to create a test signal configuration profile associated with a specific MEP.

Use `no` form of this command to delete a test signal configuration profile.

Command Syntax

```
ethernet cfm test-signal profile-name WORD
no ethernet cfm test-signal profile-name WORD
```

Parameters

`profile-name`	Specify a profile-name
`WORD`	Specify the test signal profile name with max length of 64 characters

Command Mode

Configure mode

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
#configure terminal
(config)#ethernet cfm test-signal profile-name 123
(config-cfm-eth-tst)#

(config)#no ethernet cfm test-signal profile-name 123
```

evpn

Use this command to create a service Maintenance Association (MA), with EVPN.

Command Syntax

```
evpn <ID>
```

Parameters

`<1-16777215>`	Enter the EVPN ID. Range(1-16777215)

Command Mode

Ethernet CFM MA mode

Applicability

This command was introduced in OcNOS-SP version 6.1.0

Example

```
#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345 level 7
OcNOS(config-ether-cfm)#service ma-type string ma-name 43982
OcNOS(config-ether-cfm-ma)#evpn 100
OcNOS(config-ether-cfm-ma)#ethernet cfm mep up mpid 103 active true evpn 100
```

ethernet cfm traceroute cache

Use this command to set the cache size for traceroute output.

Use the `no` form of this command to set the cache size to its default (100).

Command Syntax

```
ethernet cfm traceroute cache size <1-4095>
no ethernet cfm traceroute cache size <1-4095>
```

Parameters

`<1-4095>`	Number of entries in cache

Default

100 entries

Command Mode

Configure mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)#ethernet cfm traceroute cache size 1
```


exit-ether-ma-mep-mode

Use this command to exit Ethernet CFM MA MEP mode and go back to Ethernet CFM MA mode.

Command Syntax

```
exit-ether-ma-mep-mode
```

Parameters

None

Command Mode

Ethernet CFM MA MEP mode

Applicability

This command was introduced in OcNOS version 3.0.

Examples

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345 level 7
OcNOS(config-ether-cfm)# service ma-type string ma-name testtm
OcNOS(config-ether-cfm-ma)#vlan 5 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 201 active true xe2
OcNOS(config-ether-cfm-ma-mep)#exit-ether-ma-mep-mode
```

exit-ether-ma-mode

Use this command to exit Ethernet CFM MA mode and go back to Ethernet CFM mode.

Command Syntax

```
exit-ether-ma-mode
```

Parameters

None

Command Mode

Ethernet CFM MA mode

Applicability

This command was introduced in OcNOS version 3.0.

Examples

```
OcNOS#configure terminal
OcnOS(config)#ethernet cfm domain-type character-string domain-name 12345 
level 7
OcNOS(config-ether-cfm)#service ma-type string ma-name testtm
OcnOS(config-ether-cfm-ma)#exit-ether-ma-mode
```

frame priority

Use this command to set/reset the PDU frame priority in the Eth-lock.

Command Syntax

```
frame priority <0-7>
no frame priority
```

Parameters

`<0-7>`	Set the PDU priority range.

Command Mode

Ethernet CFM MA MEP LCK mode

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345
level 7
OcNOS(config-ether-cfm)# service ma-type string ma-name ma1
OcNOS(config-ether-cfm-ma)# vlan 25 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 201 active true xe2
OcNOS(config-ether-cfm-ma-mep)#lck  state
OcNOS(config-ether-cfm-ma-mep-lck)#frame priority 3
```

frame-size

Use this command to configure an ETH test signal frame size which is applicable only for generator test signal mode.

Use no form of this command to delete the configured ETH test signal frame size.

Command Syntax

```
frame-size (64 | 128 | 256 | 512 | 1024 | 1280 | 1518)
no frame-size
```

Parameters

frame-size 64	Specifies the frame size of 64 bytes. This is the default value.
frame-size 128	Specifies the frame size of 128 bytes.
frame-size 256	Specifies the frame size of 256 bytes.
frame-size 512	Specifies the frame size of 512 bytes.
frame-size 1024	Specifies the frame size of 1024 bytes.
frame-size 1280	Specifies the frame size of 1280 bytes.
frame-size 1518	Specifies the frame size of 1518 bytes.

Command Mode

Configure CFM ETH test mode

Default

Enabled

Applicability

This command was introduced in OcNOS version 4.0 and command is revised to frame-size in OcNOS version 6.6.0.

Example

The following example shows how to configure an ETH test signal frame size which is applicable only for generator test signal mode:

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm test-signal profile-name 123
OcNOS(config-cfm-eth-tst)#frame-size 128

OcNOS(config-cfm-eth-tst)#no frame-size
```

hardware-profile filter cfm-domain-name-str

Use this command to enable or disable setting the CFM domain name as a character string.

Note: The `hardware-profile filter cfm-domain-name-str enable` command is only applicable for Qumran platforms and not J2C platforms.

Command Syntax

```
hardware-profile filter cfm-domain-name-str (enable|disable)
```

Parameters

`enable`	Enable CFM domain name as a character string
`disable`	Disable CFM domain name as a character string

Default

Disabled

Command Mode

Configure mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)#hardware-profile filter cfm-domain-name-str enable
```

interval

Use this command to set/reset the PDU interval for Eth-lock.

Command Syntax

```
interval (1s|1m)
no interval
```

Parameters

`1m`	Transmit interval one minute.
`1s`	Transmit interval one second

Command Mode

Ethernet CFM MA MEP LCK mode

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
OcNOS#configure terminal
```

Enter configuration commands, one per line. End with CNTL/Z.

```
OcNOS(config)#ethernet cfm domain-type character-string domain-name mdnam
level 7
OcNOS(config-ether-cfm)# service ma-type string ma-name testtm
OcNOS(config-ether-cfm-ma)#vlan 5 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 2 active true xe14
OcNOS(config-ether-cfm-ma-mep)lck state
OcNOS(config-ether-cfm-ma-mep-lck)#interval 1m
OcNOS(config-ether-cfm-ma-mep-lck)#interval 1s
```

intervals-stored

Use this command to set the number of frame loss measurement intervals to store in the history table.

Use the no form to set the number of measurement intervals to its default (32).

Command Syntax

```
intervals-stored <2-1000>
no intervals-stored
```

Parameters

`<2-1000>`	Time intervals

Default

32

Command Mode

Ethernet CFM loss measurement mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)#ethernet cfm loss-measurement profile-name PROF1
(config-cfm-lm)#intervals-stored 50
```

lck state

Use this command to enable or disable ETH-Lock PDU transmission.

Use no form to remove the command.

Command Syntax

```
lck state (unlock|lock)
no lck state
```

Parameters

unlock	Display ethernet lock PDU transmission
lock	Enable ethernet lock PDU transmission

Command Mode

Ethernet CFM MA MEP mode.

Default lock state is Unlock.

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345 
level 7
OcNOS(config-ether-cfm)# service ma-type string ma-name testtm
OcNOS(config-ether-cfm-ma)#vlan 5 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 201 active true xe2
OcNOS(config-ether-cfm-ma-mep)#lck state lock
OcNOS(config-ether-cfm-ma-mep-lck)#
```

link-level

Use this command to create a maintenance association for link-level MEPs (level 0) which do not listen on a VLAN.

Command Syntax

```
link-level  (bridge <1-32>|)
```

Parameters

`<1-32>`	Bridge id

Command Mode

Ethernet CFM MA mode

Applicability

This command was introduced in OcNOS-SP version 5.1.

Example

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345 level 0
OcNOS(config-ether-cfm)#service ma-type string ma-name ma1
OcNOS(config-ether-cfm-ma)#link-level
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 2331 active true xe2
```

loss-measurement type on-demand

Use this command to schedule an on-demand CFM loss measurement session.

Command Syntax

```
loss-measurement type on-demand profile-name WORD rmep (mac-address MAC|mep-id
  MEPID) start-time (immediate|relative HH:MM:SS|absolute HH:MM:SS <1-31> MONTH
<1993-2035>) stop-time (none|relative HH:MM:SS|absolute HH:MM:SS <1-31> MONTH
<1993-2035>) repetition-period <6000-4294967295> mep MEPID domain DOMAIN_NAME
ma MA_NAME
```

Parameters

`WORD`	Loss measurement profile name
`MAC`	Destination MAC address in HHHH.HHHH.HHHH format
`MEPID`	Remote MEP identifier <1-8191> to which to send the service OAM loss measurement frame
`start-time`	Measurement session start time
`immediate`	Start immediately
`relative HH:MM:SS`	Relative time to start from the current system time
`absolute HH:MM:SS <1-31> MONTH <1993-2035>`	Scheduled date and time to start; for the month, specify the first three letters
`stop-time`	Measurement session stop time
`none`	Never stop
`relative HH:MM:SS`	Relative time to stop from the current system time
`absolute HH:MM:SS <1-31> MONTH <1993-2035>`	Scheduled date and time to stop; for the month, specify the first three letters
`repetition-period`	Repetition time between measurement intervals
`<0-4294967295>`	Repetition time in seconds
`MEPID`	Remote MEP identifier <1-8191> to which to send the service OAM loss measurement frame
`DOMAIN_NAME`	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
`MA_NAME`	MA name

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#loss-measurement type on-demand profile-name slm rmep mac-address 0018.2323.1234
start-time immediate stop-time none repetition-period 9000 mep 201 domain 12345 ma 123
```


loss-measurement type proactive

Use this command to configure and start a proactive CFM loss measurement session.

Command Syntax

```
loss-measurement type proactive profile-name WORD rmep (mac-address MAC) mep MEPID
  domain DOMAIN_NAME ma MA_NAME
```

Parameters

WORD	Loss measurement profile name
rmep	Remote MEP
MAC	Destination MAC address in HHHH.HHHH.HHHH format
MEPID	Remote MEP identifier <1-8191> to which to send the service OAM loss measurement frame
mep	MEP
MEPID	MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	MA name

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#loss-measurement type proactive profile-name slm rmep mac-address
0018.2323.1234 mep 201 domain 12345 ma 123
```

measurement-interval

Use this command to set the measurement interval for frame loss or delay measurement session.

Use the no form of this command to set the measurement interval to its default value (15 minutes).

Command Syntax

Loss measurement:

```
measurement-interval <1-525600>
no measurement-interval
```

Delay measurement:

```
measurement-interval <1-1440>
no measurement-interval
```

Parameters

For frame loss measurement:

`<1-525600>`	Measurement interval in minutes

For frame delay measurement:

`<1-1440>`	Measurement interval in minutes

Default

15 minutes

Command Mode

Ethernet CFM loss measurement mode and Ethernet CFM delay measurement mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

Loss measurement:

```
#configure terminal
(config)#ethernet cfm loss-measurement profile-name PROF1
(config-cfm-lm)#measurement-interval 500
```

Delay measurement:

```
#configure terminal
(config)#ethernet cfm delay-measurement profile-name PROF1
(config-cfm-dm)# measurement-interval 1
```

measurement-type slm

Use this command to generate Frame Loss Message (SLM/LMM) service OAM PDUs and track replies (SLR/LMR).

The measurement-type CCM is a dual-ended frame loss method in which generated CCM PDUs carry frame loss measurement information (TxFCf, RxFCb and TxFCb).

Use the no form of this command to set the measurement type to its default value (slm).

SLM and LMM cannot be enabled at the same time. All MEPs can use either LMM or SLM for frame loss measurement.

Command Syntax

```
measurement-type (slm | lmm | ccm)
no measurement-type
```

Parameters

`slm`	SLM service PDUs are generated and SLRs is tracked for frame loss measurement.
`lmm`	LMM service PDUs are generated and LMRs is tracked for frame loss measurement.
`ccm`	CCM PDUs are used for frame loss measurement which carries frame loss measurement information.

Command Mode

Ethernet CFM loss measurement mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)#ethernet cfm loss-measurement profile-name PROF1
(config-cfm-lm)#measurement-type slm
```

mep crosscheck

Use this command to configure a remote MEP crosscheck.

Use the `no` form of this command to delete a crosscheck MEP.

Command Syntax

```
mep crosscheck mpid MEPID
no mep crosscheck mpid MEPID
```

Parameters

`MEPID`	Remote host MEP identifier <1-8191>

Command Mode

Ethernet CFM MA or MEP mode.

Applicability

This command was introduced in OcNOS version 3.0.

Example

Physical interface:

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345
level 7
OcNOS(config-ether-cfm)# service ma-type string ma-name testtm
OcNOS(config-ether-cfm-ma)#vlan 5 bridge 10
OcNOS(config-ether-cfm-ma)#mep crosscheck mpid 51
```

Sub-interface:

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name md001
level 7
OcNOS(config-ether-cfm)# service ma-type string ma-name md001
OcNOS(config-ether-cfm-ma)# ethernet cfm mep down mpid 11 active true xe1.1
vlan 10
OcNOS(config-ether-cfm-ma-mep)# cc multicast state enable
OcNOS(config-ether-cfm-ma-mep)# mep crosscheck mpid 2
```

mep lowest-priority-defect

Use this command to set the lowest-priority defect that can generate a fault alarm.

Use the `no` form of this command to set the lowest-priority defect to its default (`defMACstatus`).

Command Syntax

```
mep lowest-priority-defect
  (defRDICCM|defMACstatus|defRemoteCCM|defErrorCCM|defXconCCM)

no mep lowest-priority-defect
```

Parameters

`defRDICCM`	1 (lowest): At least one of the Remote MEP state machines is receiving valid CCMs from its remote MEP that has the Remote Defect Indication (RDI) bit set.
`defMACstatus`	2: One or more of the remote MEPs is reporting a failure in its Port Status Type-Length-Value (TLV) or Interface Status TLV: MEP Down.
`defRemoteCCM`	3: At least one of the remote MEP state machines is not receiving valid CCMs from its remote MEP.
`defErrorCCM`	4: One or more invalid CCMs has been received, and 3.5 times the CCMs' transmission interval has not yet expired.
`defXconCCM`	5: (highest): One or more cross-connect continuity check messages (CCMs) has been received, and 3.5 times at least one of those CCMs' transmission interval has not yet expired.

Default Value

defMACstatus

Command Mode

Ethernet CFM MA MEP mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345 level 7
OcNOS(config-ether-cfm)#service ma-type string ma-name testtm
OcNOS(config-ether-cfm-ma)#vlan 5 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 201 active true xe2
OcnOS(config-ether-cfm-ma-mep)#mep lowest-priority-defect defRemoteCCM
```

message level

Use this command to set the PDU MD level for Eth-lock.

Command Syntax

```
message level <0-7>
no message level
```

Parameters

`<0-7>`	Set the level of the MD PDU.

Command Mode

Ethernet CFM MA MEP LCK mode

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345
level 7
OcNOS(config-ether-cfm)# service ma-type string ma-name testtm
OcNOS(config-ether-cfm-ma)#vlan 5 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 201 active true xe2
OcNOS(config-ether-cfm-ma-mep)#lck  state
OcNOS(config-ether-cfm-ma-mep-lck)#message level 2
```

message-period

Use this command to set the interval between loss or delay measurement OAM message transmission.

Use the no form of this command to set the interval between loss or delay measurement messages to its default value (1 second).

Command Syntax

```
message-period (3ms|10ms|100ms|1s|10s)
no message-period
```

Parameters

`3ms`	3 milliseconds
`10ms`	10 milliseconds
`100ms`	100 milliseconds
`1s`	1 second
`10s`	10 seconds

Default Value

1 second

Command Mode

Ethernet CFM loss measurement mode

Ethernet CFM delay measurement mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

Loss measurement:

```
#configure terminal
(config)#ethernet cfm loss-measurement profile-name PROF1
(config-cfm-lm)#message-period 3ms
```

Delay measurement:

```
#configure terminal
(config)#ethernet cfm delay-measurement profile-name PROF1
(config-cfm-dm)#message-period 10s
```

mip-creation

Use this command for Maintenance domain Intermediate Point (MIP) creation permission for this domain.

Note: CFM MIP is not supported on Provider Bridge.

Command Syntax

```
mip-creation (none|default|explicit|defer))|
```

Parameters

`mip-creation`	Maintenance domain Intermediate Point (MIP) creation permission for this domain
`none`	No MIP can be created for this VLAN identifier
`default`	MIP can be created if no lower active level or MEP at the next lower active level
`explicit`	MEP is needed at the next lower active level
`defer`	Use the MIP creation permissions of the MD to which this MA belongs

Command Mode

Ethernet CFM MA mode

Applicability

This command was introduced in OcNOS-SP version 5.1.

Example

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345 level 7 mip-
creation none
OcNOS(config-ether-cfm)#service ma-type string ma-name 43982
OcNOS(config-ether-cfm-ma)#vlan 10 bridge 10
OcNOS(config-ether-cfm-ma)#mip-creation none
OcnOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 2331 active true xe2
```

intervals-stored

Use this command to set the number of completed measurement intervals to store in the history statistic table for a two-way performance monitoring frame delay measurements on a specific MEP.

Use the no form to set the number of completed measurement intervals to store in the history statistic table for a two-way performance monitoring frame delay measurements on a specific MEP to its default (32).

Command Syntax

```
intervals-stored <2-1000>
no intervals-stored
```

Parameters

`<2-1000>`	Number of records to store in history

Default

32

Command Mode

Ethernet CFM delay measurement mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#configure terminal
(config)#ethernet cfm delay-measurement profile-name PROF1
(config-cfm-dm)# intervals-stored 4
```

peer-port-id

Use this command to specify peer port-id for Eth-BNM. When this CLI is configured, received BNM PDU will be processed only if peer port-id value in PDU is same as configured peer-port-id. When this CLI is not configured, received BNM PDU is processed without peer port-id validation.

Use `no` form of CLI to unconfigure peer port id.

Command Syntax

```
peer-port-id <1-4294967295>
no peer-port-id
```

Parameters

`<1-4294967295>` Enter the peer port-id.Default is 0.

Command Mode

Ethernet CFM MEP BNM mode

Applicability

This command was introduced in OcNOS version 5.2.

Examples

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345 level 7 m
OcNOS(config-ether-cfm)#service ma-type string ma-name 43982
OcNOS(config-ether-cfm-ma)#vlan 10 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 2331 active true xe2
OcNOS(config-ether-cfm-ma-mep)# bn receive
OcNOS(config-ether-cfm-ma-mep-bn) peer-port-id 1234
```

ping ethernet mac

Use this command to send a loopback message for a MAC address to a remote MEP for fault verification. Use either the `domain` or the `level` parameter with the `vlan` or `bridge` parameter to target a specific device.

Command Syntax

```
ping ethernet mac MACADDRESS unicast source MEPID domain DOMAIN_NAME ma MA_NAME
```

Parameters

`MACADDRESS`	Destination MAC address in HHHH.HHHH.HHHH format
`MEPID`	Source host MEP ID <1-8191>
`DOMAIN_NAME`	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
`MA_NAME`	MA name

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Examples

```
#ping ethernet mac 0018.236e.5eb5 unicast source 201 domain 12345 ma 123
```

rmep auto-discovery

Use this command to enable or disable whether MEPs are discovered automatically based on received CCMs (Continuity Checking Messages).

On disabling RMEP auto-discovery, a previously learned RMEP is removed.

Command Syntax

```
rmep auto-discovery enable|disable
```

Parameters

`enable`	Enable automatic RMEP discovery
`disable`	Disable automatic RMEP discovery

Default

disable

Command Mode

Ethernet CFM MA or MEP mode

Applicability

This command was introduced in OcNOS version 3.0.

Examples

Physical interface:

```
OcNOS(config)#ethernet cfm domain-type character-string domain-name md002
level 7
OcNOS(config-ether-cfm)#service ma-type string ma-name ma002
Ocnos(config-ether-cfm-ma)#vlan 100 bridge 1
OcNOS(config-ether-cfm-ma-mep)#ethernet cfm mep down mpid 111 active true xe3
OcNOS(config-ether-cfm-ma-mep)#cc multicast state enable
OcNOS(config-ether-cfm-ma-mep)#rmep auto-discovery enable
```

Sub-interface:

```
OcNOS#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name md001
level 7
OcNOS(config-ether-cfm)# service ma-type string ma-name ma001
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 11 active true xe1.1
vlan 10
OcnOS(config-ether-cfm-ma-mep)#rmep auto-discovery enable
```

service ma-type

Use this command to create a service Maintenance Association (MA), and enter Ethernet CFM MA mode. This command allows creation of a maintenance association for link-level MEPs (level 0) which do not listen on a VLAN.

A VID can be associated with an MA after MA is created.

Use the `no` form of this command to remove an MA.

Command Syntax

Ethernet CFM mode

```
service ma-type (string|integer|itu-t) ma-name MA_NAME
no service ma-name MA_NAME
```

Command Mode

Ethernet CFM mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
OcNOS#con term
Enter configuration commands, one per line.  End with CNTL/Z.
OcNOS(config)#ethernet cfm domain-type character-string domain-name mdnam level 7
OcNOS(config-ether-cfm)#service ma-type string ma-name testtm
```

show ethernet cfm ais reception-status

Use this command to display information about the AIS (Alarm Indication Signal) frames received on a MEP.

Command Syntax

```
show ethernet cfm ais reception-status mep MEPID domain DOMAIN_NAME(ma-name MA_NAME
```

Parameters

MEPID	Source host MEP ID <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Maintenance association name (if type is character string maximum length of ma-name is 6. If type is integer maximum is 2-octets)
<1-32>	Bridge identifier

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm ais reception-status mep 100 domain 12345
```

show ethernet cfm bn

Use this command to display information about Eth-BNM.

Command Syntax

```
show ethernet cfm bn
```

Parameters

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 5.2.

Example

```
#show ethernet cfm bn
MEPID  Domain   MA-Name  Interface VLAN  S-Addr              Port-ID    Nominal-
BW(Mbps)  Current-BW(mbps)
-------------------------------------------------------------------------------------------
------------------------------------
100    12345    123         xe2      100      00:00:11:11:11:11    100         200
100
200    12345    124         xe1      200      00:00:11:11:11:12    200         100
300
300    12445    123         xe3      300      00:00:11:11:11:13    100         300
400
```

show ethernet cfm bn mep

Use this command to display detail information about Eth-BNM configured on MEP.

Command Syntax

```
show ethernet cfm bn mep MEPID domain DOMAIN_NAME ma MA_NAME
```

Parameters

MEPID	Source host MEP ID <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Maintenance association name (if type is character string maximum length of ma-name is 6. If type is integer maximum is 2-octets)

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 5.2.

Example

```
#show ethernet cfm bn mep 100 domain 12345 ma 123
MA-Name : 223
MEL: 4
Admin Status : Enable
Interface : xe1
VLAN : 100
Source address : 00:00:11:11:11:11
Wait to Restore timer: 200 sec
   State : SIGNAL_DEGRADED
   Elapsed time in this state : 00:00:02
   Last BNM Received : 2022 Mar 03 17:19:23
   Nominal Bandwidth : 800 Mbps
   Current Bandwidth : 600 Mbps
   Port-Id : 2
   BNM Period : 1 sec
```

show ethernet cfm csf

Use this command to display information about Eth-CSF.

Command Syntax

```
show ethernet cfm csf
```

Parameters

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 5.2.

Example

```
#show ethernet cfm csf
MEPID  Domain   MA-Name  Interface   VLAN        S-Addr
-----------------------------------------------------------------------
100    12345    123         xe2      100       00:00:11:11:11:11
200    12345    124         xe1      200       00:00:11:11:11:12
300    12445    123         xe3      300       00:00:11:11:11:13
```

show ethernet cfm csf mep

Use this command to display detail information about Eth-CSF configured on MEP.

Command Syntax

```
show ethernet cfm csf mep MEPID domain DOMAIN_NAME ma MA_NAME
```

Parameters

MEPID	Source host MEP ID <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Maintenance association name (if type is character string maximum length of ma-name is

6. If type is integer maximum is 2-octets)

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 5.2.

Example

```
#show ethernet cfm csf mep 100 domain 12345 ma 123
MA-Name : 123
MEL: 4
Admin Status : Enable
Interface : xe1
VLAN : 100
Source address : 00:00:11:11:11:11
Wait to Restore timer: 200 sec
   State : SIGNAL_DEGRADED
   Elapsed time in this state : 00:00:04
   Last CSF Received : 2022 Mar 03 17:19:23
   CSF Period : 1 sec
   CFS Type : LOS
```

show ethernet cfm delay-measurement mep

Use this command to display delay measurement statistics for a MEP both for current and history or individually.

Command Syntax

```
show ethernet cfm delay-measurement mep MEPID domain DOMAIN_NAME  (ma-name MA_NAME)
  ((current-stats|history-stats)|)
```

Parameters

`MEPID`	Local MEP identifier<1-8191>
`DOMAIN_NAME`	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
`MA_NAME`	MA name
`current-stats`	Current session DB statistics.
`history-stats`	History DB statistics.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm delay-measurement mep 123 domain no_name ma 200
MEP :   123
MA  :   200

VLANID :   10
PeerMAC Address:0000.0010.0000

CURRENT:
======================
Measurement ID : 2
Measurement Type:DMM
Elapsed time(sec):30
Start Time:2019 May 24 04:52:37
Min Frame Delay(usec):4
Max Frame Delay(usec):105
Avg Frame Delay(usec):81
Min Inter FD Variation(usec):34
Max Inter FD Variation(usec):34
Avg Inter FD Variation(usec):19

FRAME DELAY BINS
Bin NumberBin Threshold(usec)Bin Counter
```

```
==================================================
1   0   - < 49993
2   5000- <99990
3   10000- <Inf0

INTER-FRAME DELAY BINS
Bin NumberBin Threshold(usec)Bin Counter
==================================================
1   0   - < 49992
2   5000- <Inf0


HISTORY STATISTICS
======================
MD  : no_name
MA  : 200
MEP : 123
VLAN ID: 10
Measurement ID : 1
Measurement Type: DMM
Elapsed time(sec): 60
End Time: 2019 May 24 04:52:37
Min Frame Delay(usec): 56
Max Frame Delay(usec): 87
Avg Frame Delay(usec): 67 Min Inter FD Variation(usec): 1 Max Inter FD Variation(usec):
31 Avg Inter FD Variation(usec): 12

FRAME DELAY BINS
Bin NumberBin Threshold(usec)Bin Counter
==================================================
1   0   - < 49995
2   5000- <99990
3   10000- <Inf0

INTER-FRAME DELAY BINS
Bin NumberBin Threshold(usec)Bin Counter
==================================================
1   0   - < 49994
2   5000- <Inf0
```

Table 1-1 explains the output fields.

Table 1-1: show ethernet cfm dm sessions

Field	Description
MEP	Local Maintenance End Point identifier
MA	Maintenance Association name

Table 1-1: show ethernet cfm dm sessions

Field	Description
Vlan Id	Primary vlan identifier of MA
DM-Profile	delay measurement profile name
Peer MAC Address	Peer's MAC address
Measurement ID	Id of the current or history session for that particular measurement interval
Measurement Type	One way or two way DM
Elapsed time	Time still left to complete the measurement interval
Start time	Time when DM session started
Min frame delay	Minimum delay recorded
Max frame delay	Max delay recorded
Avg frame delay	Average delay calculated
Min Inter FD Variation	Minimum inter frame delay variation calculated
Max Inter FD Variation	Maximum inter frame delay variation calculated
Avg Inter FD Variation	Average inter frame delay variation calculated
FRAME DELAY BINS	Frame delay bin configuration
INTER-FRAME DELAY BINS	Inter frame delay bin configuration
Bin Number	Bin number for which the threshold and counter is configured
Bin Threshold	A bin's configured threshold value
Bin counter	The number of delays recorded in this range
RMEP Id	Peer's MEP Id
End time	The time when the Measurement Interval was completed.
MD	Maintenance domain name

show ethernet cfm delay-measurement profile

Use this command to display information about a specified delay measurement profile or all configured delay measurement profiles.

Command Syntax

```
show ethernet cfm delay-measurement profile (WORD|)
```

Parameters

WORD	Profile name.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#sh ethernet cfm delay-measurement profile dmm
Profile Name: dmm
 Measurement-type     -  DMM
 Measurement-interval -  1
 Message-period       -  10s
 Number of intervals stored -  4
 Bins per FD Interval       -  4
 Bins per IFDV Interval     -  3

       Frame Delay Bins
 Bin Number        Bin Threshold
  1                0
  2                1
  3                4

    Inter-Frame Delay Bins
 Bin Number        Bin Threshold
  1                0
  2                5000
```

Table 1-2 explains the output fields.

Table 1-2: show ethernet cfm delay-measurement profile

Field	Description
Profile Name	Loss measurement profile name
Measurement-type	DM session is one way or two way

Table 1-2: show ethernet cfm delay-measurement profile

Field	Description
Measurement-interval	See measurement-interval
message-period	See message-period
Number of intervals stored	See intervals-stored
Bins per FD Interval	See bins-per-fd-interval
Bins per IFDV Interval	See bins-per-ifdv-interval
Frame Delay Bins	Number of Frame Delay bins configured
Inter-Frame Delay Bins	Number of Inter-Frame Delay bins configured
Bin number	See bin-type
Bin threshold	See bin-type

show ethernet cfm dm sessions

Use this command to display information about the delay measurement session.

Command Syntax

```
show ethernet cfm dm sessions
```

Parameters

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm dm sessions
MEP-Id  Status  StartTime           DM-Profile   Mac-address    Repetition Period(sec)
-------------------------------------------------------------------------------------
123    Active  2019/06/01 13:14:46  123        0018.236e.5eb5     60
```

Table 1-3 explains the output fields.

Table 1-3: show ethernet cfm dm sessions

Field	Description
MEP-Id	Local Maintenance End Point identifier
Status	Inactive: if delay measurement session is not started Active: if delay measurement session is started
StartTime	Time when delay measurement session is started
DM-Profile	delay measurement profile name
Mac-address	MAC address
Repetition Period	Repetition time between measurement intervals in seconds

show ethernet cfm errors

Use this command to verify the defects present in a MEP.

Command Syntax

```
show ethernet cfm errors (domain DOMAIN_NAME)
```

Parameters

DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm errors domain 12345
Domain Name       Level     Vlan      MEPID      Defects
--------------------------------------------------------
12345              7         10        100        .....
```

Table 1-4 explains the output fields

Table 1-4: show ethernet cfm errors

Field	Description
Domain Name	Maintenance Domain name
Level	MD Level
Vlan	Vlan identifier
MEPID	Maintenance End Point identifier
Defects	Defects in current MEP

show ethernet cfm eth-bn status

Display ETH-BN status for the MEP.

Command Syntax

```
show ethernet cfm eth-bn status
```

Parameters

None

Default

NA

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 5.0

Examples

```
OcNOS#show ethernet cfm eth-bn status

BNM status for interface xe9
------------------------------------

state                      : SIGNAL_NORMAL
Hold Time                  : 60
Restore Time               : 90
Total BNM Receive Count    : 0
Sender Address             : 0000.0000.0000
Elapsed time in this state: 00:17:54
Nominal Bandwidth          : 0
Current Bandwidth          : 0
Lowest Bandwidth           : 1250000000
Last BNM Received          : NIL
BNM Period                 : 1
Hold Timer                 : Not Running
Wait-to-Restore Timer      : Not Running
OcNOS#
```

show ethernet cfm frame-lm session

Use this command to display information about the frame loss measurement session.

Command Syntax

```
show ethernet cfm frame-lm session
```

Parameters

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm frame-lm session
MEPID  Status  StartTime           Lm-profile   Mac-address    Repetition Period(sec)
-------------------------------------------------------------------------------------
201    Active  2018/10/01 00:18:46  slm        0018.236e.5eb5     60
```

Table 1-5 explains the output fields.

Table 1-5: show ethernet cfm frame-lm session

Field	Description
MEPID	Maintenance End Point identifier
Status	Inactive: if loss measurement is not in progress Active: otherwise
StartTime	When loss measurement started
Lm-profile	Loss measurement profile name
Mac-address	MAC address
Repetition Period	Repetition time between measurement intervals in seconds

show ethernet cfm lck details domain

Use this command to display a CFM lock user configuration.

Command Syntax

```
show ethernet cfm lck details domain DOMAIN_NAME ma MA_NAME mep MEPID
```

Parameters

domain	Specify domain.
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
ma	Specify Maintenance association name
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.
mep	Specify mep
MEPID	Enter the MEPID ranging from <1-8191>

Command Mode

Exec mode

Default

None

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
#show ethernet cfm lck details domain 12345 ma 200 mep 151

Maintenance Domain                : 12345
Maintenance Association           : 200
MEP ID                            : 151
LCK PDU state                     : Locked
LCK Message Level                 : 7
LCK PDU Interval                  : 1 min
LCK PDU Priority                  : 3
```

show ethernet cfm lck statistics

Use this command to display a CFM lock statistics for a MEP.

Command Syntax

```
show ethernet cfm lck statistics mep MEPID domain DOMAIN_NAME
```

Parameters

domain	Specify domain.
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
mep	Specify mep
MEPID	Enter the MEPID ranging from <1-8191>

Command Mode

Exec mode

Default

None

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
#show ethernet cfm lck statistics mep 151 domain 12345
MPID MD Name MA Name Lck State Rx Status Tx Rx
-----------------------------------------------
151  12345   200     True      False     7  0
```

show ethernet cfm loss-measurement mep

Use this command to display frame loss measurement statistics for a MEP.

Command Syntax

```
show ethernet cfm loss-measurement mep MEPID domain DOMAIN_NAME (ma-name MA_NAME)
```

Parameters

MEPID	Host MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	MA name

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm loss-measurement mep 201 domain 12345 ma 43982
MEP: 201 MA: 43982 CURRENT:
Measurement ID : 3
Measurement Type: slm
Elapsed time(sec): 51
Start Time: 2018 Nov 19 22:37:31
Near End loss: 0
Far End loss: 0
Near End accumulated loss : 0 Far End accumulated loss: 0

HISTORY:

 Measurement ID : 1
  Measurement Type            : slm
  Elapsed time(sec)           : 60
  End Time                    : 2018 Nov 19 22:36:31
  Near End loss               : 0
  Far End loss                : 0
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0

 Measurement ID : 2
  Measurement Type            : slm
  Elapsed time(sec)           : 60
  End Time                    : 2018 Nov 19 22:37:31
  Near End loss               : 0
  Far End loss                : 0
```

```
  Near End accumulated loss   : 0
  Far End accumulated loss    : 0
```

Table 1-6 explains the output fields.

Table 1-6: show ethernet cfm loss-measurement mep

Field	**Description**
MEP	Maintenance End Point identifier
MA	Maintenance Association name
CURRENT:	Current loss measurement statistics
HISTORY:	Historic loss measurement statistics
Measurement ID	Sequence number
Measurement Type	See measurement-type slm
Elapsed time	Elapsed time in seconds
Start Time	Start time
End Time	End time
Near End loss	Near end loss
Far End loss	Far end loss
Near End accumulated loss	Near end accumulated loss
Far End accumulated loss	Far end accumulated loss

show ethernet cfm loss-measurement profile

Use this command to display information about a given loss measurement profile or all loss measurement profiles.

Command Syntax

```
show ethernet cfm loss-measurement profile WORD
```

Parameters

`WORD`	Profile name.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm loss-measurement profile slm
Profile Name:slm
 measurement-type      -  slm
 measurement-interval  -  1
 intervals-stored      -  3
 message-period        -  1
```

Table 1-7 explains the output fields.

Table 1-7: show ethernet cfm loss-measurement profile

Field	Description
Profile Name	Loss measurement profile name
measurement-type	See measurement-type slm
measurement-interval	See measurement-interval
intervals-stored	See intervals-stored
message-period	See message-period

show ethernet cfm ma status

Use this command to display the connectivity status of Maintenance Associations (MAs) in a domain.

Command Syntax

```
show ethernet cfm ma status domain DOMAIN_NAME (mep <1-8191>| mep all|) (ma-name
  MA_NAME)
```

Parameters

DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
<2-4094>	VLAN identifier
mep	Host MEP
<1-8191>	Host MEP identifier
all	All host MEPs
MA_NAME	Maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm ma status domain 12345 ma 43982
MA NAME        VLAN                      STATUS
-------------------------------------------
  43982          10                      Active

#show ethernet cfm ma status domain 12345

MA NAME                         STATUS
-------------------------------
  43981                         Active
```

Table 1-8 explains the output fields.

Table 1-8: show ethernet cfm ma status

Field	Description
MA NAME	Maintenance Association name

Table 1-8: show ethernet cfm ma status (Continued)

Field	Description
VLAN	VLAN identifier
STATUS	Active: All connected MEPs in MA are receiving the CCM with no defect or alarm present Partially Active: One or more connected MEPs in MA is not receiving CCM or it is receiving CCM with defect or alarm present Not Active: None of the connected MEPS in MA are receiving CCM or it is receiving CCM with defect or alarm present

show ethernet cfm maintenance-points count

Use this command to display information about the Total CFM sessions Count on a given interface.

Command Syntax

```
show ethernet cfm maintenance-points count IFNAME
```

Parameters

IFNAME	Interface name

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 6.3.0.

Example

```
OcNOS#show ethernet cfm maintenance-points count xe6
--------------------------------------------

Total No of MIPs                 : 0
Total No of MEPs                 : 6

Total No of UP MEPs              : 0
Total No of Down MEPs            : 6
Total No of Active MEP's         : 6
Total No of UP CCM sessions      : 5
Total No of Active Test sessions : 0
Total No of Active LM sessions   : 0
Total No of Active DM sessions   : 0

New: Total No of Active MEPs             : 6

Old : Total No of Active CCM sessions  : 6
```

show ethernet cfm maintenance-points local mep

Use this command to display information about the Maintenance End Points (MEPs) on a local interface.

Command Syntax

```
show ethernet cfm maintenance-points local (mep) (interface IFNAME|)(domain
  DOMAIN_NAME)(ma-name MA_NAME)
```

Parameters

IFNAME	Interface name. This token can be used only for Down MEPs on L2 bridge.
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Maintenance association name.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm maintenance-points local mep domain 12345 ma 123
MPID Dir Lvl VLAN CC-Stat HW-Status CC-Intvl MAC-AddressDef Port MD Name
100 Dn  7   10  EnableInstalled 100 ms3c2c.99f0.b0c1 Fxe212345

#show ethernet cfm maintenance-points local mep domain 12345 ma 123
MPID Dir Lvl CC-Stat HW-Status CC-Intvl MAC-AddressDef Port MD Name

200 Up 7Enable Installed 3 ms0018.23c8.f822 Fxe15 12345
```

Table 1-9 explains the output fields.

Table 1-9: show ethernet cfm maintenance-points local mep

Field	Description
MPID	MEP identifier
Dir	Up MEP or Down MEP
Lvl	MD level
Vlan	VLAN identifier
CC-Stat	Whether continuity checking (CC) is enabled or disabled
HW-Status	Installed or pending to install in hardware
CC-Intvl	CCM Interval

Table 1-9: show ethernet cfm maintenance-points local mep

Field	Description
MAC-Address	MAC address
Def	Defect present
Port	CFM interface
MD Name	MD name

show ethernet cfm maintenance-points local mip

Use this command to display information about the Maintenance Intermediate Points (MIPs) on a local interface.

Command Syntax

```
show ethernet cfm maintenance-points local (mip) (interface IFNAME| (level <0-7>)
  (ma-name MA_NAME|))
```

Parameters

IFNAME	Interface name.
<0-7>	Maintenance level.
MA_NAME	Maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm maintenance-points local mip level 7 ma 123
Level  VID   Type  Port   MAC-Address
------------------------------------------------------
7      10    MIP   xe3   0018.23ea.da36
7      10    MIP   xe5   0018.23ea.da38
```

Table 1-10 explains the output fields.

Table 1-10: show ethernet cfm maintenance-points local mip

Field	Description
Level	MD level
VID	VLAN identifier
Type	MIP
Port	Interface name
MAC-Address	MAC address

show ethernet cfm maintenance-points remote

Use this command to display information about a remote MEP.

Command Syntax

```
show ethernet cfm maintenance-points remote (mpid MEP_ID|) (domain DOMAIN_NAME)(ma-
  name MA_NAME)
```

Parameters

MEP_ID	Remote MEP identifier <1-8191>
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	MA name

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm maintenance-points remote domain 12345
MEPIDRMEPIDLEVELVLANRx CCMRDIPEER-MACTYPE

100 200 7   10  Yes Falsea82b.b579.fd2aConfigured
```

Table 1-11 explains the output fields.

Table 1-11: show ethernet cfm maintenance-points remote

Field	Description
MEPID	MEP identifier
RMEPID	Remote MEP identifier
LEVEL	MD level
VLAN	VLAN identifier
Rx CCM	Yes if CCM receives, no if CCM doesn't receive.
RDI	Whether Remote Defect Indication (RDI) is on or off
PEER-MAC	Remote MEP mac address
TYPE	Configured or auto learned

show ethernet cfm statistics

Use this command to display CFM statistics: CCM sent and received, LBM sent and LBR received, LTM sent and LTR received.

Command Syntax

```
show ethernet cfm statistics mep MEPID domain DOMAIN_NAME ma-name MA_NAME
```

Parameters

MEPID	Host MEP identifier <1-8191>
MA_NAME	Maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show ethernet cfm statistics
Continuity Check Messages
   CCM Sent                  : 168164
   CCM Received              : 165460

Loop Back Messages
   LBM Sent                  : 5
   LBR Received(Valid)       : 5
   LBR Received(Bad msdu)    : 0
   LBR Received(Out-of-Seq): 0

Link Trace Messages
   LTM Sent                  : 1
   LTR Sent                  : 0
   LTR Received(Valid)       : 3
   LTR Received(unexpected): 0
```

Table 1-12 explains the output fields.

Table 1-12: show ethernet cfm statistics

Field	Description
Continuity Check Messages	
CCM Sent	Number of continuity check messsages (CCMs) sent

Table 1-12: show ethernet cfm statistics

Field	Description
CCM Received	Number of CCMs received
Loop Back Messages	
LBM Sent	Number of loopback messages (LBMs) sent
LBR Received(Valid)	Number of valid LBRs received
LBR Received(Bad msdu)	Number of LBRs received with bad MAC service data unit
LBR Received(Out-of-Seq)	Number of out-of-sequence LBRs received
Link Trace Messages	
LTM Sent	Number of link trace messages (LTMs) sent
LTR Received(Valid)	Number of link trace replies (LTRs) received
LTR Received(unexpected)	Number of unexpected LTRs received

show ethernet cfm statistics bn

Use this command to display CFM Eth-BNM statistics.

Command Syntax

```
show ethernet cfm statistics bn
```

Parameters

None

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 5.2.

Example

```
#show ethernet cfm statistics bn
MEPID  Domain   MA-Name   RX-Frames    Dropped-Frames    WR-time-left
----------------------------------------------------------------------
100    12334      123    10001         11 sec
200    12341      234    12000         off
300    12421      123    13000         12 sec
```

show ethernet cfm statistics csf

Use this command to display CFM Eth-CSF statistics.

Command Syntax

```
show ethernet cfm statistics csf
```

Parameters

None

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 5.2.

Example

```
#show ethernet cfm statistics csf
MEPID  Domain   MA-Name   RX-Frames    Dropped-Frames    WR-time-left
-----------------------------------------------------------------------
100    12334      123    10001         11 sec
200    12341      234    12000         off
300    12421      123    13000         12 sec
```

show ethernet cfm test-signal domain

Use this command to display ETH-Test receiver or generator statistics.

Command Syntax

```
show ethernet cfm test-signal domain DOMAIN_NAME ma MA_NAME mep MEPID  stats
  (ctf|gtf)
```

Parameters

`DOMAIN_NAME`	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
`ma`	Specify Maintenance association name
`MA_NAME`	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.
`mep`	Specify mep
`MEPID`	Enter the MEPID ranging from <1-8191>
`stats`	Display the statistics
`ctf`	Display ETH Test Frame Collector statistics
`gtf`	Display ETH Test Frame Generator statistics

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
#show ethernet cfm test-signal domain 12345 ma 43982 mep 21 stats gtf
 TST Session status           : In-Progress
 Elapsed Time(sec)            : 36
 MD                           : 12345
 MA                           : 43982
 MEP                          : 21
 Peer MAC Address             : 6cb9.c557.42d0
 RMEP ID                      : 12
 Start Time                   : 2019 Mar 01 10:23:11
 Transmitted Packet Count     : 2854713
```


show ethernet cfm test-signal profile

Use this command to display ETH-Test signal profile configuration.

Command Syntax

```
show ethernet cfm test-signal profile (WORD|)
```

Parameters

WORD	Specify the test signal profile name with max length of 64 characters

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
#show ethernet cfm test-signal profile 123
  Profile Name      : 123
  Is Receiver       : False
  Is Generator      : True
  Test-Signal Type  : In-Service
  Frame Size(bytes) : 124
  Test Pattern Type : Null-Signal-Without-CRC-32
```

show ethernet cfm test-signal sessions

Use this command to display CFM test-signal session.

Command Syntax

```
show ethernet cfm test-signal sessions
```

Parameters

None

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
OcNOS#show ethernet cfm test-signal sessions
MEP-Id  Status    StartTime             Tst-Profile       Peer MAC-Address
-------------------------------------------------------------------------------
-
```

show ethernet cfm traceroute-cache

Use this command to display the ethernet cfm traceroute cache

Command Syntax

```
show ethernet cfm traceroute-cache
```

Parameters

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
OcNOS#show ethernet cfm traceroute-cache bridge 1
 MEPID       Dest mac            Hops     Relay-action
 2           e8c5.7a91.f8c4      1        RlyHit
 2           e8c5.7a91.f8c4      1        RlyHit
```

show running-config cfm

Use this command to display CFM running configuration alone.

Command Syntax

```
show running-config cfm
```

Parameters

None

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#show running-config cfm
ethernet cfm domain-type character-string domain-name 12347 level 2 mip-
creation none
 service ma-type string ma-name 123
   vlan 10 bridge 10
   mip-creation default
   ethernet cfm mep down mpid 14 active true xe4
     lck state lock
       message level 2
       interval 1s
       frame priority 3
       exit-ether-ma-mep-lck-mode
     ethernet cfm loss-measurement reply lmm
     exit-ether-ma-mep-mode
   mep crosscheck mpid 41
   exit-ether-ma-mode
    !
```

test-signal mode

Use this command to enable an ETH test signal mode as generator or receiver or both.

Command Syntax

```
test-signal mode (generator|receiver|both)
```

Parameters

generator	The node will act as a ETH-TST frame generator
receiver	The node will act as a ETH-TST frame receiver
both	The node will act as both ETH-TST frame generator and receiver

Command Mode

Configure CFM ETH test mode

Default

The default test signal mode is receiver.

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
#configure terminal
(config)#ethernet cfm test-signal profile-name 123
(config-cfm-eth-tst)#test-signal mode generator
```

test-signal pattern-type

Use this command to configure the TLV type to be encoded in ETH-Test PDU.

Use `no` form of this command to reset the TLV pattern type to default.

Command Syntax

```
test-signal pattern-type (null-sig|null-sig-crc32|prbs|prbs-crc32)
no test-signal pattern-type
```

Parameters

`null-sig`	Specify test pattern as a Null signal without CRC-32
`null-sig-crc32`	Specify test pattern as a Null signal with CRC-32
`prbs`	Specify test pattern as a PRBS 2^31-1 without CRC-32
`prbs-crc32`	Specify test pattern as a PRBS 2^31-1 with CRC-32

Command Mode

Configure CFM ETH test mode

Default

Default TLV pattern type is Null signal.

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
#configure terminal
(config)#ethernet cfm test-signal profile-name 123
(config-cfm-eth-tst)#test-signal pattern-type null-signal

(config-cfm-eth-tst)#no test-signal pattern-type
```


test-signal start-time

Use this command to start the ETH-Test session.

Command Syntax

```
test-signal start-time (relative START-TIME | absolute START-TIME ) stop-time
  (relative STOP-TIME | absolute STOP-TIME) tst-profile-name WORD domain
  DOMAIN_NAME ma MA_NAME mep MEPID target (mac-address MAC|RMEPID)
```

Parameters

`start-time`	Specify Test session start time
`relative`	Specify Test session start time as relative
`absolute`	Specify Test session start time as absolute
`START-TIME`	Test session start time in minutes
`stop-time`	Specify Test session stop time
`STOP-TIME`	Test session stop time in minutes
`tst-profile-name`	Test session profile name
`WORD`	Specify test session profile name
`domain`	Specify domain.
`DOMAIN_NAME`	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
`ma`	Specify Maintenance association name
`MA_NAME`	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.
`mep`	Specify mep
`MEPID`	Enter the MEPID ranging from <1-8191>
`target`	Specify target
`mac-address`	Unicast destination MAC address
`MAC`	MAC address in HHHH.HHHH.HHHH format
`RMEPID`	Enter the RMEP ID ranging from 1-8191

Command Mode

Exec mode

Default

None

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
#test-signal start-time relative 0 stop-time relative 30 tst-profile-name 123
domain 12345 ma 43982 mep 21 target mac-address 6cb9.c557.42d0
```

test-signal test-type

Use this command to configure an ETH test signal test type is service interrupting or not.

Use `no` form of this command to delete the configured ETH test signal test type.

Command Syntax

```
test-signal test-type (in-service|out-of-service)
no test-signal test-type
```

Parameters

`in-service`	This indicates the ETH-Test is in-service and normal client service traffic is not interrupted
`out-of-service`	This indicates the ETH-Test is out-of-service and normal client service traffic is not disrupted

Command Mode

Configure CFM ETH test mode

Default

None

Applicability

This command was introduced in OcNOS version 4.0.

Example

```
#configure terminal
(config)#ethernet cfm test-signal profile-name 123
(config-cfm-eth-tst)#test-signal test-type in-service
(config-cfm-eth-tst)#no test-signal test-type
```


traceroute ethernet

Use this command to start traceroute messages on a remote MEP.

Command Syntax

```
traceroute ethernet MAC mepid MEPID domain DOMAIN (ma MA_NAME)
```

Parameters-

MAC	MAC address of the remote MEP or MIP in HHHH.HHHH.HHHH format.
MEPID	Host MEP identifier <1-8191>.
DOMAIN_NAME	Enter the name of the domain. Name must be of 5 characters if type is character-string otherwise no_name if domain-type is no-name1
MA_NAME	Enter maintenance association name. If ma-type is character string then maximum length of ma-name is 6 else if it's integer then maximum is 2-octets.

Command Mode

Exec mode and Privileged Exec mode

Applicability

This command was introduced in OcNOS version 3.0.

Example

```
#traceroute ethernet 0018.236e.5eb8 mepid 201 domain 12345 ma 123
MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress
action
0018.23ea.da36   1     RlyFDB                Ingress         IngOK
0018.23ea.da38   2     RlyFDB                Egress          EgrOK
0018.236e.5eb8   3     RlyHit                Ingress         IngOK

#traceroute ethernet 0018.236e.5eb8 mepid 201 domain 12345 vpws ETH-2001
MP Mac         Hops  Relay-action          Ingress/Egress  Ingress/Egress
action
0018.23ea.da36   1     RlyFDB                Ingress         IngOK
0018.23ea.da38   2     RlyFDB                Egress          EgrOK
0018.236e.5eb8   3     RlyHit                Ingress         IngOK
```

vlan

Use this command to create a service Maintenance Association (MA), with a VLAN.

Command Syntax

```
vlan VLAN_ID (bridge <1-32> | inner-vlan VLAN_ID|)
```

Parameters

`<1-32>`	Bridge id
`VLAN_ID`	Inner VLAN identifier <1-4094>

Command Mode

Ethernet CFM MA mode

Applicability

This command was introduced in OcNOS-SP version 5.1

Example

```
#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345 level 7
OcNOS(config-ether-cfm)#service ma-type string ma-name 43982
OcNOS(config-ether-cfm-ma)#vlan 10 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 2331 active true xe2
```

vpws

Use this command to create a service Maintenance Association (MA), with VPWS.

Command Syntax

```
vpws VCNAME
```

Parameters

VCNAME	Virtual circuit name with maximum length being 30

Command Mode

Ethernet CFM MA mode

Applicability

This command was introduced in OcNOS-SP version 6.1.0

Example

```
#configure terminal
OcNOS(config)#ethernet cfm domain-type character-string domain-name 12345 level 7
OcNOS(config-ether-cfm)#service ma-type string ma-name 43982
OcNOS(config-ether-cfm-ma)#vpws ETH-2001
OcNOS(config-ether-cfm-ma)#ethernet cfm mep up mpid 103 active true vpws ETH-2001
```

wait-to-restore-timer <0-86400>

Use this command to configure/unconfigure Wait-to-restore timer for Eth-BNM and Eth-CSF. For Eth-BNM, nominal bandwidth will be set after the wait-to-restore timer expiry. When this command is enabled for Eth-CSF 'DCI' state is restored after wait-to-restore timer expiry.

Command Syntax

```
wait-to-restore-timer <TIME>
no wait-to-restore-timer <TIME>
```

Parameters

TIME	Wait-to-restore-timer <0-86400>

Default

Default is 10 seconds.

Command Mode

Ethernet CFM MEP BN and CFM MEP CSF mode

Applicability

This command was introduced in OcNOS version 5.0

Examples

```
OcNOS(config)#ethernet cfm domain-type character-string domain-name abcde
level 5
OcNOS(config-ether-cfm)#service ma-type string ma-name 7
OcNOS(config-ether-cfm-ma)#vlan 10 bridge 10
OcNOS(config-ether-cfm-ma)#ethernet cfm mep down mpid 100 active true xe9
OcNOS(config-ether-cfm-ma-mep)#bn receive
OcNOS(config-ether-cfm-ma-mep-bn)#wait-to-restore-timer 90
OcNOS(config-ether-cfm-ma-mep-bn)#
```

CHAPTER 2 G8031 ELPS Commands

This chapter describes the G8031 Ethernet Linear Protection Switching (ELPS) commands.

- aps-channel level
- backup
- clear
- control-vlan
- data vlan
- debug g8031
- eps-protection-group
- exercise
- force-switch
- g8031-eps
- g8031 eps-instance
- g8031 eps-protection group
- g8031 profile
- local-freeze
- local-lockout
- lockout
- manual-switch-protection
- manual-switch-working
- mode
- protection-port
- show g8031 eps-instance
- show g8031 eps-instance <EPS_ID>
- show hsl g8031 debug
- switching mode
- timer hold-off-time
- timer wait-to-restore
- working-port

aps-channel level

Use this command to associate CFM with g8031 protection group to carry APS message.

Use the `no` form of this command to disassociate CFM from g8031 protection group.

Note: It is mandatory for Working-port MEP and Protection-Port MEP to be in different Maintenance Domain but in same Maintenance Level. Moreover, Maintenance Association Vlan-id should be same as g8031 primary-vlan id. If both the conditions are met then, g8031 protection group can be associated to using the 'level' command.

Command Syntax

```
aps-channel level <0-7>
```

Parameters

`<0-7>`	Maintainance Endpoint Level.

Command Mode

G8031 Switching Mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
(config)#g8031 eps-instance eps1
(g8031-config-eps-instance)#aps-channel level 7
```

backup

Use this command to configure backup interface (protection port) under cross-connect for bridge-domain case.

Command Syntax

```
Backup IFPBKPNAME
```

Parameters

`IFPBKPNAME`	AC Interface Backup Name.

Default

0 seconds.

Command Mode

Config Backup Crossconnect Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#cross-connect 1
(config-xc)#interface xe10.1
(config-bkp-xc)#backup xe11.1
```

clear

Use this command to perform clear operation on g8031 protection group based on instance name.

Command Syntax

```
clear g8031 eps-instance <INSTANCENAME>
```

Parameters

`<INSTANCENAME>` g8031 instance name.

Command Mode

Exec mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
# clear g8031 eps-instance eps1
```

control-vlan

Use this command to configure a contro-vlan for g8031 protection group.

Use the `no` form of this command to delete control-vlan for a g8031 protection group.

Command Syntax

```
control-vlan <2-4094>
control vlan <2-4094> inner-vlan <2-4094>
```

Parameters

`<2-4094>`	vlan id.

Command Mode

G8031 Instance Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 eps-instance eps2
(g8031-config-eps-instance)#control vlan 3
(g8031-config-eps-instance)#control vlan 3 inner-vlan 500
```

data vlan

Use this command to configure protected data vlans for g8031 protection group.

Use the `no` form of this command to delete a data vlan for g8031 protection group.

Note:

- Once mode is configured, data vlans can not be modified.
- Data vlans have to be configured individually using vlan command i.e Range of vlans not accepted with vlan command.
- This command has no impact on data-plane i.e Unprotected vlans are not blocked by g8031 working and protection-ports. It is left upto the administrator to configure only protected vlans with bridge-port configuration of working and protection g8031 ports.

Command Syntax

```
data vlan <2-4094>
no data vlan <2-4094>
```

Parameters

`<2-4094>`	vlan-id.

Command Mode

G8031 Switching Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 eps-instance eps1
(g8031-config-eps-instance)#data vlan 4-20
```

debug g8031

Use this command to debug configuration.

Command Syntax

```
debug g8031 (all|events|fsm|hal|rx|tx)
no debug g8031 (all|events|fsm|hal|rx|tx)
```

Parameters

`all`	All debugging options.
`events`	Protocol related events.
`fsm`	Instance Finite State Machine updates.
`hal`	HAL events.
`rx`	Received PDUs.
`tx`	Transmitted PDUs.

Command Mode

Exec mode.

Applicability

This command was introduced in OcNOS version 6.0.0.

Examples

```
# debug g8031 tx
# debug g8031 all
```


eps-protection-group

Use this command to map configured working/protection port under g8031 instance.

Use the `no` form of this command to unmap eps-protection group from g8031 instance.

Command Syntax

```
eps-protection-group <WORD>
no eps-protection-group
```

Parameters

`Word`	eps protection group name in string.

Command Mode

G8031 Config EPS Instance Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 eps-instance eps1
(g8031-config-eps-instance)#eps-protection-group eps1
```

exercise

Use this command to perform exercise operation on g8031 protection group based on instance name.

Use the `clear` command to clear exercise operation from g8031 protection group.

Command Syntax

```
g8031 eps-instance <INSTANCENAME> exercise
```

Parameters

`<1-32>`	g8031 instance name.

Command Mode

Exec mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
# exercise bridge 1 g8031 eps-id 10
```

force-switch

Use this command to perform force-switch on g8031 protection group based on instance name.

Use the `clear` command to clear force-switch operation from g8031 protection group.

Command Syntax

```
g8031 eps instance <INSTANCENAME> force-switch
```

Parameters

`<INSTANCENAME>` g8031instance name.

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
# g8031 eps-instance eps1 force-switch
# clear g8031 eps-instance eps1
```

g8031-eps

Use this command to map eps protection group under cross-connect were g8031 can be extended over bridge-domain.

Use the `no` form to unmap eps protection group from cross-connect.

Command Syntax

```
g8031-eps <EVCID>
no g8031-eps <EVCID>
```

Parameters

`<EVCID>`	EVC ID.

Command Mode

Config Backup Crossconnect Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#cross-connect 1
(config-xc)#interface xe10.1
(config-bkp-xc)#backup xe11.1
(config-bkp-xc)#g8031-eps eps1
```

g8031 eps-instance

Use this command to set instance-id for a particular g8031 protection group.

Use the `no` form of this command to remove instance-id for a g8031 protection group.

Command Syntax

```
g8031 eps-instance <INSTANCENAME>
```

Parameters

`<INSTANCENAME>` g8031 instance name.

Command Mode

Config Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
(config)#g8031 eps-instance eps1
```

g8031 eps-protection group

Use this command to configure working/protection port for g8031 eps protection.

Use the no form of this command to remove eps protection group.

Command Syntax

```
g8031 eps-protection group <WORD>
no g8031 eps-protection group <WORD>
```

Parameters

<WORD>	EPS protection group name in string.

Command Mode

Config Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 eps-protection group eps1
```

g8031 profile

Use this command to configure g8031 mode, switching mode and timer-status for g8031 protection group.

Use the `no` form of this command to remove profile.

Command Syntax

```
g8031 profile <WORD>
no g8031 profile <WORD>
```

Parameters

WORD	eps profile name in string.

Command Mode

Config Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 eps-instance eps1
```

local-freeze

Use this command to locally freeze the g8031 protection group.

Use the `clear` command to clear local-freeze from g8031 protection group.

Command Syntax

```
g8031 eps-instance <INSTANCENAME> local-freeze
clear g8031 eps-instance <INSTANCENAME> local-freeze
```

Parameters

`<INSTANCENAME>`	g8031 instance name.

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#g8031 eps-instance eps1 local-freeze
#clear g8031 eps-instance eps1 local-freeze
```

local-lockout

Use this command to configure local lockout for g8031 protection group.

Use the `clear` command to clear local-lockout operation from g8031 protection group.

Command Syntax

```
g8031 eps-instance <INSTANCENAME> local-lockout
clear g8031 eps-instance <INSTANCENAME> local-lockout
```

Parameters

`<INSTANCENAME>`	g8031 instance name.

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
# g8031 eps-instance eps1 local-lockout
# clear g8031 eps-instance eps1 local-lockout
```

lockout

Use this command to lockout for g8031 protection group.

Use the `clear` command to remove lockout from g8031 protection group.

Command Syntax

```
g8031 eps-instance <INSTANCENAME> lockout
```

Parameters

`<INSTANCENAME>`	g8031 instance name.

Command Mode

Exec mode

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
# g8031 eps-instance eps1 lockout
# clear g8031 eps-instance eps1
```

manual-switch-protection

Use this command to perform manual-switch for protection port.

Use the `clear` command to remove manual switch.

Command Syntax

```
g8031 eps-instance <INSTANCENAME> manual-switch-protection
```

Parameters

`<INSTANCENAME>` g8031 instance name.

Command Mode

Exec Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
# g8031 eps-instance eps1 manual-switch-protection
# clear g8031 eps-instance eps1
```

manual-switch-working

Use this command to perform manual-switch for working port.

Use the `clear` command to remove manual switch.

Command Syntax

```
g8031 eps-instance <INSTANCENAME> manual-switch-working
```

Parameters

`<INSTANCENAME>` g8031 instance name.

Command Mode

Exec Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
# g8031 eps-instance eps1 manual-switch-working
# clear g8031 eps-instance eps1
```

mode

Use this command to configure mode for g8031 protection group.

Use the `no` form of this command to mode for g8031 protection group.

Note:

- Once mode is configured, it can not be changed. Administrator has to explicitly delete and re-configure a new mode.
- In a 1+1 architecture, only unknown data traffic is sent over both the working and protected paths, while known data traffic is sent only over the learned port.

Command Syntax

```
mode (one-and-one-bidirectional| one-plus-one-bidirectional| one-plus-one-
  unidirectional)
```

Parameters

`one-and-one-bidirectional`	1:1 Bidirectional mode.
`one-plus-one-bidirectional`	1+1 Bidirectional mode.
`one-plus-one-unidirectional`	1+1 Unidirectional mode.

Command Mode

G8031 Profile Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 profile eps1
(g8031-config-profile)#mode one-and-one-bidirectional
```

protection-port

Use this command to configure a protection-port for a g8031 protection group.

Use the `no` form of this command to delete protection-port for a g8031 protection group.

Note:

- When both working and protection ports are in Signal-Failure state, Working Port is treated as Active port, and Protection group is in Signal-Failure-Protection State.
- Working and Protection Paths between two ELPS end nodes should not coincide i.e When having intermediate nodes it is required that the working path and protection path are configured via different intermediate nodes.
- Working port should be Layer-2 Physical or LAG interface. Command is also applicable for sub-interface.
- Protection port should be Layer-2 Physical or LAG interface. Command also applicable for sub-interface.

Command Syntax

```
protection-port IFNAME
no protection-port
```

Parameters

`IFNAME`	Interface name.

Command Mode

G8031 Config Protection Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 eps-protection group eps1
(g8031-config-protection)#protection-port ge10.1
```

show g8031 eps-instance

Use this command to display the status of all configured g8031 protection groups.

Command Syntax

```
show g8031 eps-instance
```

Parameters

None

Command Mode

Exec mode

Applicability

This command was introduced from OcNOS version 6.5.2.

Examples

```
#show g8031 eps-instance

EPS-Name    Id  Mode    Working-Path  State Protection-Path State Control-VLAN   CFM
-------------------------------------------------------------------------------------
eps1        1  1:1,BI xe6.1         Up    ge9.1 (A)       Up    11             Yes
eps2        1 1:1,BI ge9.2        Up     xe6.2 (A)       Up    500            Yes
```

Table 2-13 explains the output fields:

Table 2-13: show g8031 eps-instance bridge output fields

Field	Description
EPS Name	Eps instance name
ID	Protection group id
Mode	Architecture type - 1+1 or 1:1 and Directional (Uni/Bi)
Working path	Working port
Protection path	Protection port
(A)	Active Path
CFM	Working/protection MEP is configured and UP (Yes) Working/protection MEP is DOWN (No)

show g8031 eps-instance <EPS_ID>

Use this command to display the status of a particular g8031 protection group.

Command Syntax

```
show g8031 eps-instance <EPS_ID>
```

Parameters

`<EPS-ID>`	EPS instance name.

Command Mode

Exec mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
# show g8031 eps-instance eps1
Inst Name        : eps1 (1), Profile (eps1), Protection Group (eps1)

Mode & Group     : Bridge (1:1), Direction (Bi), Revertive (Yes)
                 : Working port (xe6.1, Up) Protection port (ge9.1, Up)

Current State    : Wait-To-Restore, Request signal (Normal), Active-Path(Protection)
                         dFOP State - Not in defect mode
Timer Status     : WTR (8 min 57 sec),

working_cfm      : mep_id (21), cc-interval (3ms), Domain (md001), MA (ma1)
Protection_cfm   : mep_id (11), cc-interval (3ms), Domain (md002), MA (ma2)

APS channel Info: vlan (11) Level (7)

 APS Statistics   : Tx - 18  Rx – 18
```

Table 2-14 explains the output fields:

Table 2-14: show g8031 eps-instance output fields

Field	Description
Inst Name	Protection group instance, profile and protection group name
Mode & Group	Bridge (1:1 / 1+1),Direction (Uni/Bi), switching mode (revertive/non-revertive)
Current State	No request/Signal Fail/Wait-to-Restore, Active path (Working/Protection) dFOP state (defect mode).
Timer Status	WTR/Hold-Off timers

Field	Description
Working_cfm	Working CFM MEP with mep_id, cc-interval, domain and ma
Protection-cfm	Working CFM MEP with mep_id, cc-interval, domain and ma
APS-Channel	Control vlan and APS Level
Vlan	Data vlan
APS Statistics	APS PDU TX and RX
L-APS Tx count	Number of transmitted g8031 L-APS control pkts

show hsl g8031 debug

Use this command to display debugging related information of a particular g8031 protection group.

Command Syntax

```
show hsl g8031 debug <1-32>
```

Parameters

`<1-32>`	Protection group id.

Command Mode

Exec mode

Applicability

This command was introduced before OcNOS version 5.0.

Examples

Service type: XC (Subinterface)

```
# show hsl g8031 debug 1
EPS_ID Mode   Service  Working_port    Protection_port      Active_port  Failover
------+-------+----------------+-----------------+-------------------+------------+--
1      1:1,Bi  XC      po1.2          sa1.2                Working      40000005
```

Table 2-15 explains the output fields:

Table 2-15: show hsl g8031 output fields

Field	Description
EPS ID	Protection group id
Mode	Configured g8031 mode on protection group
Service	XC(Subinterface) / L2 Bridge
Working port	Working port
Protection port	Protection port
Active Ingress	Working/Protection port
Failover	Egress failover

switching mode

Use this command to configure revertive/non-revertive switchover-type for g8031 protection group.

Use the `no` form of this command to set default switchover-type for g8031 protection group.

Command Syntax

```
switching mode (revertive | non-revertive)
no switching mode
```

Parameters

None

Default

Non-revertive.

Command Mode

G8031 Profile Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 profile eps1
(g8031-config-profile)#switching mode revertive
```

timer hold-off-time

Use this command to configure hold-off timer for g8031 protection group.

Use the `no` form of this command to set default hold-off timer value for a g8031 protection group.

Command Syntax

```
timer hold-off-time <0-10>
no timer hold-off-time
```

Parameters

`<0-10>`	Timer value in seconds.

Default

0 seconds.

Command Mode

G8031 Profile Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 profile eps1
(g8031-config-profile)#timer hold-off 2
```

timer wait-to-restore

Use this command to configure wait-to-restore timer for a g8031 protection group.

Use the `no` form of this command to set default wait-to-restore value for a g8031 protection group.

Note: This command is only applicable for revertive mode.

Command Syntax

```
timer wait-to-restore <300-720>
no timer wait-to-restore
```

Parameters

`<300-720>`	Timer value in seconds.

Default

300 seconds.

Command Mode

G8031 Profile Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 profile eps1
(g8031-config-profile)#timer wait-to-restore 360
```

working-port

Use this command to configure a working-port for a g8031 protection group.

Use the `no` form of this command delete working-port for a g8031 protection group.

Command Syntax

```
working-port IFNAME
no working-port
```

Parameters

IFNAME	Interface name.

Command Mode

G8031 Config Protection Mode.

Applicability

This command was introduced in OcNOS version 6.5.2.

Examples

```
#configure terminal
(config)#g8031 eps-protection group eps1
(g8031-config-protection)#working-port xe10
```

CHAPTER 3 G.8032 ERPS Version 2 Commands

This chapter contains the G.8032 (2012) Ethernet Ring Protection Switching (ERPS) version 2 commands.

aps-channel level

Use this command to set the maintenance entity group (MEG) level (MEL) to carry in R-APS messages.

Command Syntax

```
aps-channel level <0-7>
```

Parameters

`<0-7>`	Level.

Command Mode

G.8032 configure switch mode

Examples

Here are sample examples of configuring G.8032 ERP instance with Automatic Protection Switching (APS) channel settings in OcNOS device.

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#aps-channel level 2
OcNOS(g8032-config-switch)#end
```


aps-channel vlan

Use this command to configure APS channel VLAN-ID for the ERP instance.

Use no parameter of this command to remove APS channel VLAN-ID configuration for the ERP instance.

Command Syntax

```
aps-channel vlan <2-4094> (inner-vlan <2-4094>|)
no aps-channel vlan
```

Parameters

`<2-4094>`	VLANID
`inner-vlan`	Inner vlan
`<2-4094>`	VLANID

Command Mode

G.8032 configure switch mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#aps-channel vlan 10 inner-vlan 5
OcNOS(g8032-config-switch)#end
```


clear g8032 erp-instance

Use this command to clear ERPS instance.

This command is used at an Ethernet ring node for the following operations:

- Clearing an active local administrative command (forced switch or manual switch).
- Triggering reversion before the wait to restore (WTR) or wait to block (WTB) timer expires in the case of revertive operation.
- Triggering reversion in the case of non-revertive operation.

Command Syntax

```
clear g8032 erp-instance (INSTANCENAME | all)
```

Parameters

`INSTANCENAME`	Instance name (maximum 32 characters).
`all`	Clear all instances.

Command Mode

Exec mode.

Applicability

This command was introduced before OcNOS version 5.0 and was revised in OcNOS version 6.4.1 by adding a new parameter called `all`.

Examples

The following command clear a specific ERPS instance in the network.

```
OcNOS#clear g8032 erp-instance INST1
```

The following command clear all ERPS instance in the network.

```
OcNOS#clear g8032 erp-instance all
```

data vlan

Use this command to configure VLANs as data channels.

Use the `no` form of this command to remove VLAN configuration.

Command Syntax

```
data vlan VLAN_RANGE
no data vlan VLAN_RANGE
```

Parameters

VLAN_RANGE	Enter VLAN ID 2-4094 or list of VLAN ID's separated by commas. Eg 2 or 2,4,5 or 50,51,52 etc.

Command Mode

G.8032 configure switch mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

Here's an example of configuring G.8032 ERP instance with data VLANs 201, 202, and 203 in OcNOS device.

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#data vlan 201,202,203
OcNOS(g8032-config-switch)#end
```


debug g8032

Use this command to debug configuration.

Command Syntax

```
debug g8032 (all|tx|rx|fsm|timers|events|external|hal)
no debug g8032 (all|tx|rx|fsm|timers|events|external|hal)
```

Parameters

`all`	All debugging options
`events`	Protocol event
`external`	External CFM and NSM events
`fsm`	Instance Finite State Machine updates
`hal`	HAL events
`rx`	Received PDUs
`timers`	Protocol timer events
`tx`	Transmitted PDUs

Command Mode

Configure mode and Exec mode

Applicability

This command was introduced in OcNOS version 6.0.0.

Examples

Here's an example of enabling G.8032 debugging for both transmit (tx) and all events in OcNOS device.

```
OcNOS#configure terminal
OcNOS(config)#debug g8032 tx
OcNOS(config)#debug g8032 all
OcNOS(config)#exit
```

east-interface

Use this command to set the east port associated to the protection ring.

Command Syntax

```
east-interface IFNAME
no east-interface
```

Parameters

IFNAME	Interface name, such as xe1.

Command Mode

G8032 ring config mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

The below example demonstrates the configuration of an ERPS ring named `RING1` with the assignment of the east interface as `ce1`.

```
OcNOS#configure terminal
OcNOS(config)#g8032 ring RING1
OcNOS(g8032-ring-config)#east-interface ce1
OcNOS(g8032-ring-switch)#end
```

enable-tcn-propagation

Use this command to enable or disable TCN (topology change notification) propagation for an interconnected ring.

Command Syntax

```
enable-tcn-propagation
no enable-tcn-propagation
```

Parameters

None

Command Mode

G.8032 configure switch mode

Applicability

This command was introduced in OcNOS version 6.0.0.

Examples

In this example, the configuration for G.8032 ERP instance `instance1` includes the enabling of topology change notification (TCN) propagation.

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#enable-tcn-propagation
OcNOS(g8032-config-switch)#end
```


erps-instance

Use this command to set the ERPS-instance for the sub-interface.

Use no parameter of this command to remove the ERPS-instance configuration from the sub-interface.

Command Syntax

```
erps-instance INSTANCENAME
no erps-instance
```

Parameters

`INSTANCENAME`	Name of the ERPS instance.

Command Mode

Interface mode.

Applicability

This command was introduced in OcNOS version 6.2.0 and was revised in OcNOS version 6.4.1 by removing a parameter called `all`.

Examples

The following configurations allow the association of an ERPS instance with a sub-interface. By configuring ERPS instances on sub-interfaces, it enables protection switching for specific network segments.

```
OcNOS#configure terminal
OcNOS(config)#interface xe2.1
OcNOS(config-if)#erps-instance erp1
OcNOS(config-if)#commit
OcNOS(config-if)#end
```

g8032 erp-instance

Use this command to create an ERP instance and change to G.8032 configure switch mode.

Use the `no` form of this command to delete an ERP instance.

Command Syntax

```
g8032 erp-instance INSTANCENAME
no g8032 erp-instance INSTANCENAME
```

Parameters

INSTANCENAME	Instance name (maximum 32 characters).

Command Mode

Configure mode

Examples

The below example demonstrates the configuration of G.8032 ERP instance with the instance name `instance1`.

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#end
```

g8032 erp-instance force-switch

Use this command to configure administrative commands related to force switching within ERPS instances.

Command Syntax

```
g8032 erp-instance (INSTANCE-NAME | all) force-switch (east-interface | west-
  interface)
```

Parameters

INSTANCENAME	Instance name (maximum 32 characters).
all	Apply to all instances.
east-interface	Apply command to east interface.
west-interface	Apply command to west interface.

Command Mode

Exec mode.

Applicability

This command was introduced before OcNOS version 5.0 and was revised in OcNOS version 6.4.1 by adding a new parameter called `all`.

Examples

The following commands allows to take manual control of ERPS instances and force traffic to switch to a specific interface (east or west) as needed for network protection.

```
OcNOS#g8032 erp-instance example force-switch east-interface
OcNOS#g8032 erp-instance all force-switch west-interface
```

g8032 erp-instance manual-switch

Use this command to configure manual protection switching for specific ERPS instances or for all instances on the device.

Command Syntax

```
g8032 erp-instance (INSTANCE-NAME | all) manual-switch (east-interface | west-
  interface)
```

Parameters

`INSTANCENAME`	Instance name (maximum 32 characters).
`all`	Apply to all instances.
`east-interface`	Apply command to east interface.
`west-interface`	Apply command to west interface.

Command Mode

Exec mode.

Applicability

This command was introduced before OcNOS version 5.0 and was revised in OcNOS version 6.4.1 by adding a new parameter called `all`.

Examples

The following commands are used to configure specific ERPS instances to perform manual switching on either the west or east interface as needed.

```
OcNOS#g8032 erp-instance example manual-switch west-interface
OcNOS#g8032 erp-instance all manual-switch east-interface
```


g8032 ring

Use this command to create a ring and associate east and west interfaces with it. All ERP instances on this ring have the same east and west interfaces,

Use the `no` form of this command to delete a ring.

Command Syntax

```
g8032 ring RINGNAME
no g8032 ring RINGNAME
```

Parameters

`ring`	Ring.
`RINGNAME`	Ring name (maximum 37 characters).

Command Mode

Configure mode

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 ring ERPS123
OcNOS(config)#no g8032 ring ERPS123
OcNOS(config)#exit
```

g8032-profile

Use this command to associate the ERP instance to a profile. After configuring this command, it will take to the ERP profile configuration mode.

Command Syntax

```
g8032-profile PROFILENAME
```

Parameters

PROFILENAME	Profile name.

Command Mode

G.8032 configure switch mode

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#g8032-profile prof_1
OcNOS(g8032-profile-config)#end
```

g8032 profile

Use this command to associate the ERPS profile to an instance.

Use the `no` form of this command to delete the ERPS profile from an instance.

Command Syntax

```
g8032 profile PROFILENAME
```

Parameters

PROFILENAME	Profile name.

Command Mode

G.8032 configure switch mode

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#g8032-profile prof_1
```

non-virtual-channel

Use this command to make a sub-ring function without a virtual channel.

Use the `no` form of this command to delete a non-virtual channel.

Command Syntax

```
non-virtual-channel
no non-virtual-channel
```

Parameters

None.

Command Mode

G.8032 configure switch mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#non-virtual-channel
```

ring

Use this command to associate the ERP instance to a ring.

Command Syntax

```
ring RINGNAME
```

Parameters

RINGNAME	Ring name.

Command Mode

G.8032 configure switch mode

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#ring ring1
```

ring-id

Use this command to set the ring identifier.

Command Syntax

```
ring-id <1-239>
```

Parameters

`<1-239>`	Ring identifier.

Command Mode

G.8032 configure switch mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#ring-id 1
```

ring-type

Use this command to specify the type of the ethernet ring for this ERP instance.

Command Syntax

```
ring-type (major-ring | sub-ring | sub-ring-vc)
no ring-type
```

Parameters

`major-ring`	G.8032 major ring. In this type of rings nodes are connected in full circular topology
`sub-ring`	G.8032 sub-ring without virtual channel
`sub-ring-vc`	G.8032 sub-ring with virtual channel

Command Mode

G.8032 configure switch mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#ring-type major-ring
OcNOS(g8032-config-switch)#ring-type sub-ring-vc
```

rpl role

Use this command to set the RPL (Ring Protection Link) role of the ring node.

Command Syntax

```
rpl role ((owner | neighbor | next-neighbor)(east-interface | west-interface) |
  non-owner )
```

Parameters

`owner`	Ring node is the RPL owner.
`neighbor`	Ring node is neighbor to the RPL owner.
`next-neighbor`	Ring node is neighbor to the neighbor of the RPL owner.
`east-interface`	Role assigned to east interface.
`west-interface`	Role assigned to west interface.
`non-owner`	Ring node does not own the RPL.

Command Mode

G.8032 configure switch mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#rpl role owner east-interface
```

show g8032 erp-instance

Use this command to display details about an ERP instance.

Command Syntax

```
show g8032 erp-instance ((INSTANCENAME | data-traffic | summary)|)
```

Parameters

`INSTANCENAME`	Instance name.
`data-traffic`	Display data traffic details.
`summary`	Display summary details.

Command Mode

Exec mode.

Applicability

This command was introduced before OcNOS version 5.0 and revised in OcNOS version 6.4.1 by adding the new parameters `data-traffic` and `summary`.

Example

The below command display details about ERP instances:

```
OcNOS#show g8032 erp-instance
Instance      ID  State         East      state     West    state       Ring
-------------------------------------------------------------------------------------
phy_erp1      1   PENDING       xe24      Blocked   xe26    Unblocked    PR1
sub_erp1      2   PROTECTION    xe25      Blocked   -       -            SR1
erp3          3   PROTECTION    xe23      Blocked   -       -            SR2
br_erp1       4   PENDING       xe24.1    Blocked   xe26.1  Unblocked    BR1
```

Table 3-16 explains the output fields.

Table 3-16: show g8032 erp-instance

Field	Description
Instance	Lists the names of the ERP instances. Each instance has a unique name.
ID	Displays the ID of the ERP instance, which is a numerical identifier.
State	Indicates the current state of the ERP instance. `PENDING` state means the instance is waiting for activation, while `PROTECTION` state means it's actively providing protection.
East	Shows the interface on the east side (usually the primary side) of the ring.
State	Displays the east state of the interface, which can be `Blocked` or `Unblocked`. In the context of ERP, `Blocked` means the interface is in standby or backup mode, and `Unblocked` means it's active.
West	Shows the interface on the west side (usually the secondary side) of the ring.

Table 3-16: show g8032 erp-instance

Field	Description
State	Displays the west state of the interface,
Ring	Specifies the name or identifier of the ring associated with the ERP instance.

The below command display data traffic details for ERP instances:

```
OcNOS#show g8032 erp-instance data-traffic
Instance       ID   Data-vlan             East           West           Ring
-------------------------------------------------------------------------------------
phy_erp1       1    11-19                 xe24 (B)       xe26 (F)       PR1
sub_erp1       2    50-60                 xe25 (B)       -              SR1
br_erp1        4    bridge_domain 1       xe24.1 (B)     xe26.1 (F)     BR1
                    bridge_domain 2       xe24.2         xe26.2         BR2
```

Table 3-17 explains the output fields.

Table 3-17: show g8032 erp-instance data-traffic

Field	Description
Instance	Lists the names of the ERP instances. Each instance has a unique name.
ID	Displays the ID of the ERP instance, which is a numerical identifier.
Data-vlan	Specifies the range of VLANs associated with data traffic for each ERP instance.
East	Shows the interface on the east side (usually the primary side) of the ring that handles data traffic.
West	Shows the interface on the west side (usually the secondary side) of the ring that handles data traffic.
Ring	Specifies the name or identifier of the ring associated with the ERP instance.

The below command display details for a specific ERP instance, in this case, `erp0`:

```
OcNOS#show g8032 erp-instance erp0

Inst Name        : erp3 (3) ,node-id d0:77:ce:df:40:1b ,Profile (1)
Description      :
Ring             : SUB-RING (subring), OWNER (EAST), virtual (vlan 10, ring 2)
                   attached (-), attached to (erp1,erp2,erp3), tcn-propagation (0)

State            : G8032_ST_PROTECTION
Timer Status     : Init (0 min 4 sec), WTR (2 min 2 sec)

East             : xe25, Blocked, Down, BPR (0), remote (d0:77:ce:df:40:1e)
West             : xe24, Blocked, Down, BPR (0), remote (d0:77:ce:df:40:1f)

East (cfm)       : mep-id (1), cc-interval (10ms), domain (10), MA (finance)
West (cfm)       : mep-id (1), cc-interval (10ms), domain (10), MA (finance)

Channel          : Level (5), vlan (20), RING_ID (2)
```

```
Data Vlan        : 50-60
```

Table 3-18 explains the output fields.

Table 3-18: show g8032 erp-instance INSTANCENAME

Field	Description
Inst Name	Provides information about the ERP instance, including its name, a numerical identifier, and a unique node ID. The profile number indicates the associated ERP profile.
Description	Provides a description of the ERP instance.
Ring	Specifies details about the ring associated with the ERP instance.
State	Indicates the current state of the ERP instance.
Timer Status	Displays timer-related information.
East	Shows the interface on the east side (usually the primary side) of the ring.
West	Shows the interface on the west side (usually the secondary side) of the ring.
East(cfm)	Provides CFM-related details for the east side.
West(cfm)	Provides CFM-related details for the west side.

Channel	Provides information about the ERP channel, including:
	`ERP level`
	`VLAN associated with the channel`
	`Ring ID`

Data Vlan	Specifies the range of VLANs associated with data traffic for the ERP instance.

show g8032 profile

Use this command to display details about a profile.

Command Syntax

```
show g8032 profile PROFILENAME
```

Parameters

PROFILENAME	Profile name.

Command Mode

Exec mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#show g8032 profile profile1
Profile : profile1
=========
 Wait-To-Restore : 5 mins
 Hold Off Timer  : 0 secs
 Guard Timer     : 500 ms
 Wait-To-Block   : 5500 ms
 Protection Type : Revertive
```

show g8032 ring

Use this command to display details about a ring.

Command Syntax

```
show g8032 ring RINGNAME
```

Parameters

RINGNAME	Ring name.

Command Mode

Exec mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#show g8032 ring ring1
Ring     : ring1
==========
East     : eth1
West     : eth2
ERP Inst : inst1, inst2, inst3
```

switching mode

Use this command to set the revertive behavior of the ring node.

Command Syntax

```
switching mode (non-revertive | revertive)
```

Parameters

`revertive`	Represents revertive mode operation of a G.8032 ethernet ring.
`non-revertive`	Represents non-revertive mode operation of a G.8032 ethernet ring.

Command Mode

G.8032 profile configure mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#switching mode revertive
```

tcn-to-instance

Use this command to associate TCN instance (topology change notification) propagation for an interconnected ring when configured in non-virtual mode.

Command Syntax

```
tcn-to-instance INSTANCENANME
```

Parameters

`INSTANCENAME`	Instance name.

Command Mode

G.8032 configure switch mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#tcn-to-instance erp1
```

timer

Use this command to set timers.

Command Syntax

```
timer (wait-to-restore <1-12> | hold-off <0-10000> | guard-time <10-2000>)
```

Parameters

`wait-to-restore`	Wait-to-restore timer used to verify that a signal failure is not intermittent.
`<1-12>`	Timer value in minutes.
`hold-off`	Hold-off timer used to filter intermittent link faults.
`<0-10000>`	Timer value in a multiple of 100 milliseconds.
`guard-time`	Guard timer that blocks latent outdated messages from causing unnecessary state changes.
`<1-20000>`	Timer value in a multiple of 10 milliseconds.

Command Mode

G.8032 profile configure mode

Examples

```
OcNOS#configure terminal
OcNOS(config)#interface xe3
OcNOS(config-if)#channel-group 2 mode active
OcNOS(config-if)#ethernet cfm domain-type character-string domain-name nod12 level 7
mip-creation none
OcNOS(config-ether-cfm)#g8032 ring lagring
OcNOS(g8032-ring-config)#east-interface po1
OcNOS(g8032-ring-config)#g8032 profile profile1
OcNOS(g8032-profile-config)#timer wait-to-restore 7
OcNOS(g8032-profile-config)#timer hold-off 50
OcNOS(g8032-profile-config)#timer guard-time 300
OcNOS(g8032-profile-config)#timer guard-time 30
OcNOS(g8032-profile-config)#end
```

virtual-channel

Use this command on a sub-ring to attach it to a major instance.

Use the `no` form of this command to delete a virtual channel.

Command Syntax

```
virtual-channel (<2-4094>|) attached-to-instance INSTANCENAME
no virtual-channel
```

Parameters

`<2-4094>`	VLAN identifier.
`INSTANCENAME`	Major instance name.

Command Mode

G.8032 configure switch mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#configure terminal
OcNOS(config)#g8032 erp-instance instance1
OcNOS(g8032-config-switch)#virtual-channel 3 attached-to-instance inst1
```

west-interface

Use this command to set the west port associated to the protection ring.

Command Syntax

```
west-interface IFNAME
no west-interface
```

Parameters

IFNAME	Interface name

Command Mode

G8032 ring config mode.

Applicability

This command was introduced before OcNOS version 5.0.

Examples

```
OcNOS#configure terminal
OcNOS(config)#interface xe2
OcNOS(config-if)#g8032 ring RING1
OcNOS(g8032-ring-config)#west-interface ce1
OcNOS(g8032-ring-config)#end
```

CHAPTER 4 EFM OAM Commands

Ethernet to the First Mile (EFM) provides a minimal extension to the MAC layer Operations, Administration and Maintenance (OAM) module. EFM supplies a mechanism for monitoring link operations, such as remote fault detection and remote loopback control.

This chapter includes the following commands:

clear ethernet oam statistics interface

Use this command to reset the OAM statistics to zero.

Command Syntax

```
clear ethernet oam statistics interface <IFNAME>
```

Parameter

None

Config Mode

Exec mode

Applicability

Ethernet OAM (EFM) supported platforms

Example

```
#clear ethernet oam statistics interface xe2
```

debug ethernet oam

Use this command to set the debugging functions for OAM.

Use the `no` form of this command to disable OAM debugging.

Command Syntax

```
debug ethernet oam (event|rx|tx|all)
no debug ethernet oam (event|rx|tx|all)
```

Parameters

`event`	Enable event debugging.
`rx`	Enable RX debugging.
`tx`	Enable TX debugging.
`all`	Enable Event, RX and TX debugging

Command Mode

Exec mode and Config mode

Example

```
#debug ethernet oam event
```

ethernet oam enable

Use this command to enable or disable Ethernet OAM functionality on a port.

Use the `no` form of this command to disable Ethernet OAM functionality on a port.

Command Syntax

```
ethernet oam enable
no ethernet oam enable
```

Parameters

None

Default

Ethernet OAM is disabled.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 5.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#ethernet oam enable
```

ethernet oam link-monitor event-log-size

Use this command to set the maximum number of entries in the event log.

Command Syntax

```
ethernet oam link-monitor event-log-size <1-100>
```

Parameters

`event-log-size`	Set a log size
`<1-100>`	Set a log size

Command Mode

Interface mode

Default

The default size is 20 entries

Example

```
#configure terminal
(config)#interface eth1
(config-if)#ethernet oam link-monitor event-log-size 100
```


ethernet oam link-monitor on

Use this command to turn on link monitoring on a interface.

Use the `no` form of this command to turn link monitoring off.

Command Syntax

```
ethernet oam link-monitor on
no ethernet oam link-monitor on
```

Parameters

None

Default

When link monitor is supported, link monitoring is automatically turned on.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 5.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#ethernet oam link-monitor on
```

ethernet oam link-monitor supported

Use this command to configure link monitoring on an interface.

Use the `no` form of this command to remove support for link monitoring on an interface.

Command Syntax

```
ethernet oam link-monitor supported
no ethernet oam link-monitor supported
```

Parameters

None

Command Mode

Interface mode

Default

The default state of the link monitor is supported.

Applicability

This command was introduced in OcNOS version 5.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#ethernet oam link-monitor supported
```

ethernet oam max-rate

Use this command to set the maximum number of PDUs per second.

This command ensures that the sublayer adheres to the maximum number of OAMPDUs per second. The minimum is 1 OAMPDU per second and the maximum is 10 OAMPDUs per second.

Use the `no` form of this command to reset the maximum rate to its default.

Command Syntax

```
ethernet oam max-rate <1-10>
```

```
no ethernet oam max-rate
```

Parameter

`<1-10>`	Maximum number of PDUs per second.

Default

The default maximum rate is 10 PDUs per second.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 5.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#ethernet oam max-rate 10
```

ethernet oam min-rate

Use this command to set the minimum number of PDUs per second.

This command ensures that the sublayer adheres to the maximum number of OAMPDUs per second. The minimum is 1 OAMPDU per second and the maximum is 10 OAMPDUs per second.

Use the `no` form of this command to reset the minimum to its default.

Command Syntax

```
ethernet oam min-rate <1-10>
no ethernet oam min-rate
```

Parameter

`<1-10>`	Minimum number of PDUs per second.

Default

The default minimum rate is 1 PDU per second.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 5.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#ethernet oam min-rate 1
```

ethernet oam mode

Use this command to set data terminal equipment (DTE) to either active or passive mode.

Command Syntax

```
ethernet oam mode (active|passive)
```

Parameters

`active`	Set DTE to active mode.
`passive`	Set DTE to passive mode.

Default

The default mode for the DTE is active.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 5.0.

Example

```
#configure terminal
(config)#interface xe1
(config-if)#ethernet oam mode active

#configure terminal
(config)#interface xe1
(config-if)#ethernet oam mode passive
```

ethernet oam remote-failure

Use this command to define an action when a remote failure is detected.

Use `no` form of this command to remove an action.

Command Syntax

```
ethernet oam remote-failure {critical-event|dying-gasp|link-fault} action error-
  disable-interface
```

```
no ethernet oam remote-failure {critical-event|dying-gasp|link-fault} action error-
  disable-interface
```

Parameters

`critical-event`	Critical link event.
`dying-gasp`	Dying-gasp event.
`link-fault`	Link-fault event.
`action`	Action on a remote failure.
`error-disable-interface`	Disable the interface when a remote failure event is detected.

Default

A remote failure does not trigger any interface events by default.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 5.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#ethernet oam remote-failure critical-event action error-disable-
interface
```

ethernet oam remote-loopback (start|stop)

Use this command to start or stop remote loopback.

Command Syntax

```
ethernet oam remote-loopback start
ethernet oam remote-loopback stop
```

Parameters

start	Specify to start remote loopback.
stop	Specify to stop remote loopback.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 5.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#ethernet oam remote-loopback start

#configure terminal
(config)#interface xe1
(config-if)#ethernet oam remote-loopback stop
```

ethernet oam remote-loopback {supported|timeout}

Use this command to configure remote loopback on an interface.

Use the `no` form of this command to remove remote-loopback support from the interface.

Command Syntax

```
ethernet oam remote-loopback {supported|timeout <1-10>}
no ethernet oam remote-loopback {supported|timeout}
```

Parameters

`supported`	Configure remote loopback support.
`timeout`	Remote loopback timeout.
`<1-10>`	Number of seconds the DTE waits for the remote DTE to respond to the `ethernet oam remote-loopback start` command.

Default

The default state for remote loopback is supported. If a timeout is not set, the local DTE remains in remote loopback state until the remote DTE responds or the user stops remote loopback administratively.

Command Mode

Interface mode

Applicability

This command was introduced in OcNOS version 5.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#ethernet oam remote-loopback supported

#configure terminal
(config)#interface xe1
(config-if)#ethernet oam remote-loopback timeout 2

#configure terminal
(config)#interface xe1
(config-if)#no ethernet oam remote-loopback supported

#configure terminal
(config)#interface xe1
(config-if)#no ethernet oam remote-loopback timeout
```

ethernet oam timeout

Use this command to set the OAM timeout.

Use the `no` form of this command to reset the timeout to its default.

Command Syntax

```
ethernet oam timeout <2-30>
no ethernet oam timeout
```

Parameter

`<2-30>`	Number of seconds for the link timeout

Command Mode

Interface mode

Default

The default timeout is 5 seconds

Applicability

This command was introduced in OcNOS version 5.0.

Examples

```
#configure terminal
(config)#interface xe1
(config-if)#ethernet oam timeout 5

(config)#interface xe1
(config-if)#no ethernet oam timeout
```

show ethernet oam

Use this command to show the discovery state machine state and link event statistics on the interface.

Command Syntax

```
show ethernet oam IFNAME
```

Parameter

`IFNAME`	Specify the interface name.

Command Mode

Exec mode and Privileged Exec mode

Examples

The following sample output from this command displays the operational discovery state machine and link event statistics of the interface.

```
#show ethernet oam eth0

eth0
Discovery State Machine Details:
--------------------------------
EFM Discovery Machine State:            Send Any
Local Parser State:                     Forward
Local Multiplexer State:                Forward
Remote Parser State:                    Forward
Remote Multiplexer State:               Forward

Local Client:
-------------
     Symbol Period Error:
        Window:                         05f5e100 Symbol(s)
        Threshold:                      00 Symbol(s)
        Last Window Symbols Errors:     00 Symbol(s)
        Total Symbols Errors:           00 Symbol(s)
        Total Symbols Errors Events:    0 Events(s)
        Relative Timestamp of the Event:  0 x 100 milliseconds

     Frame Error:
        Window:                         100 x 100 milliseconds
        Threshold:                      1 Error Frame(s)
        Last Window Frame Errors:       0 Frame(s)
        Total Frame Errors:             00 Frames(s)
        Total Frame Errors Events:      0 Events(s)
        Relative Timestamp of the Event:  0 x 100 milliseconds

     Frame Period Error:
        Window:                         989680 Frames
        Threshold:                      1 Error Frame(s)
        Last Window Frame Errors:       0 Frame(s)
        Total Frame Errors:             00 Frames(s)
        Total Frame Period Errors Events: 0 Events(s)
        Relative Timestamp of the Event:  0 x 100 milliseconds
```



```
      Frame Seconds Error:
         Window:                              1000 x 100 milliseconds
         Threshold:                           1 Error Second(s)
         Last Window Frame Second Errors:     0 Frame(s)
         Total Frame Second Errors:           00 Frames(s)
         Total Frame Second Errors Events:    0 Events(s)
         Relative Timestamp of the Event:     0 x 100 milliseconds

 Remote Client:
 --------------

      Symbol Period Error:
         Window:                              00 Symbol(s)
         Threshold:                           00 Symbol(s)
         Last Window Symbols Errors:          00 Symbol(s)
         Total Symbols Errors:                00 Symbol(s)
         Total Symbols Errors Events:         0 Events(s)
         Relative Timestamp of the Event:     0 x 100 milliseconds

      Frame Error:
         Window:                              0 x 100 milliseconds
         Threshold:                           0 Error Frame(s)
         Last Window Frame Errors:            0 Frame(s)
         Total Frame Errors:                  00 Frames(s)
         Total Frame Errors Events:           0 Events(s)
         Relative Timestamp of the Event:     0 x 100 milliseconds

      Frame Period Error:
         Window:                              0 Frames
         Threshold:                           0 Error Frame(s)
         Last Window Frame Errors:            0 Frame(s)
         Total Frame Errors:                  00 Frames(s)
         Total Frame Period Errors Events:    0 Events(s)
         Relative Timestamp of the Event:     0 x 100 milliseconds
```

show ethernet oam discovery

Use this command to display the Ethernet OAM administrative and operation configuration for local and remote DTE.

Command Syntax

```
show ethernet oam discovery interface IFNAME
```

Parameter

`interface`	Specify the interface.
`IFNAME`	Specify the interface name.

Command Mode

Exec mode and Privileged Exec mode

Example

The following output displays ethernet OAM administrative and operation configurations for local and remote DTE.

```
#show ethernet oam discovery interface eth0
eth0
Local client:
-------------
  Administrative configurations:
     Mode:                               passive
     Unidirection:                       supported
     Link monitor:                       supported(on)
     Remote Loopback:                    supported
     MIB retrieval:                      not supported
     MTU Size    :                       1518
  Operational status:
     Port status:                        operational
     Loopback status:                    no loopback
     PDU revision:                       1
Remote client:
--------------
  MAC address: 0002.b3d5.93b7
  Vendor(oui): 3 0 50

  Administrative configurations:
     Mode:                               active
     Unidirection:                       supported
     Link monitor:                       supported
     Remote Loopback:                    supported
     MIB retrieval:                      not supported
     MTU Size    :                       1518
```

show ethernet oam eventlog

Use this command to display all event logs for an interface within given range.

Command Syntax

```
show ethernet oam eventlog IFNAME range-start <1-100> range-end <1-100>
```

Parameters

IFNAME	The name of the interface.
range-start	Starting range of log index.
<1-100>	Starting range of log index. This should not exceed the maximum log size.
range-end	Ending range of log index.
<1-100>	Ending range of log index. This should not exceed the maximum log size.

Command Mode

Exec mode and Privileged Exec mode

Example

The following displays an example of this command:

```
#show ethernet oam eventlog eth1 range-start 10
```

show ethernet oam statistics

Use this command to see the Ethernet OAM statistics.

Command Syntax

```
show ethernet oam statistics interface IFNAME
```

Parameter

`interface`	Specify the interface.
`IFNAME`	Specify the interface name.

Command Mode

Privileged Exec mode

Example

The following sample output from this command displays Ethernet OAM statistics for the interface named `eth0`.

```
#show ethernet oam statistics interface eth0
eth0
Counters:
---------

    Information OAMPDU Tx                    : 39
    Information OAMPDU Rx                    : 39
    Event Notification OAMPDU Tx             : 0
    Event Notification OAMPDU Rx             : 0
    Loopback Control OAMPDU Tx               : 0
    Loopback Control OAMPDU Rx               : 0
    Unsupported OAMPDU Rx                    : 0
Local event logs:
-----------------
    0 Errored Symbol Period records
    0 Errored Frame records
    0 Errored Frame Period records
    0 Errored Frame Seconds records
Remote event logs:
------------------
    0 Errored Symbol Period records
    0 Errored Frame records
    0 Errored Frame Period records
    0 Errored Frame Seconds records
```

show ethernet oam status

Use this command to display the ethernet OAM and link monitoring status of the interface.

Command Syntax

```
show ethernet oam status interface IFNAME
```

Parameter

`interface`	Specify the interface.
`IFNAME`	Specify the interface name.

Command Mode

Privileged Exec mode

Example

The following sample output displays the operational discovery state machine and link event statistics of the interface.

```
#show ethernet oam status interface eth0
eth0
General:
   Mode:                                  passive
   PDU max rate:                          10 packets per second
   PDU min rate:                          1 packet per 1 second
   Link timeout:                          5 seconds
   High threshold action:                 no action
Link Monitoring:
     Status:                              supported(on)
     Symbol Period Error:
        Window:                           100 million symbols
        Low threshold:                    0 error symbol(s)
        High threshold:                   none
     Frame Error:
        Window:                           100 x 100 milliseconds
        Low threshold:                    1 error frame(s)
        High threshold:                   none
     Frame Period Error:
        Window:                           1000 x 100,000 frames
        Low threshold:                    1 error frame(s)
        High threshold:                   none
     Frame Seconds Error:
        Window:                           1000 x 100 milliseconds
        Low threshold:                    1 error second(s)
        High threshold:                   none
```

show ethernet oam discovery brief

Use this command to list the brief overview of ethernet oam (EFM) across all the interfaces.

Command Syntax

```
show ethernet oam discovery brief
```

Parameter

None

Config Mode

Exec mode

Applicability

Ethernet OAM (EFM) supported platforms

Example

```
#show ethernet oam discovery brief

Flags :  L - Link Monitoring support M - MIB Retrieval support
R - Remote Loopback support U - Unidirectional detection support


        data is unavailable

Local Interface Remote MAC     Remote Capability  Local Capability
xe0             0000.0000.0000 Passive LR          Active LR
xe1             *              *                   Active LR
```

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