



CFM Configuration Guide

Application Note

CONFIDENTIAL

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1. Introduction

This document explains how to setup Connectivity Fault Management (CFM) features.

Connectivity Fault Management is defined by the IEEE 802.1ag standard. It defines protocols and practices for OAM (Operations, Administration, and Maintenance) for paths through 802.1 bridges and local area networks (LANs). IEEE 802.1ag is largely identical with ITU-T Recommendation Y.1731, which additionally addresses performance monitoring.

1.1. IEEE 802.1ag

Defines maintenance domains, their constituent maintenance points, and the managed objects required to create and administer them Defines the relationship between maintenance domains and the services offered by VLAN-aware bridges and provider bridges Describes the protocols and procedures used by maintenance points to maintain and diagnose connectivity faults within a maintenance domain;

1.2. Definitions

Maintenance Domain (MD)

Maintenance Domains are management space on a network. MDs are configured with Names and Levels, where the eight levels range from 0 to 7. A hierarchical relationship exists between domains based on levels. The larger the domain, the higher the level value. Recommended values of levels are as follows: Customer Domain: Largest (e.g., 7) Provider Domain: In between (e.g., 3) Operator Domain: Smallest (e.g., 1)

Maintenance Association (MA)

Defined as a "set of MEPs, all of which are configured with the same MAID (Maintenance Association Identifier) and MD Level, each of which is configured with a MEPID unique within that MAID and MD Level, and all of which are configured with the complete list of MEPIDs."

Maintenance association End Point (MEP)

Points at the edge of the domain, define the boundary for the domain. A MEP sends and receives CFM frames through the relay function, drops all CFM frames of its level or lower that come from the wire side.

Maintenance domain Intermediate Point (MIP)

Points internal to a domain, not at the boundary. CFM frames received from MEPs and other MIPs are cataloged and forwarded, all CFM frames at a lower level are stopped and dropped. MIPs are passive points, respond only when triggered by CFM trace route and loop-back messages.

1.3. CFM Protocols

IEEE 802.1ag Ethernet CFM (Connectivity Fault Management) protocols comprise three protocols. They are:



Continuity Check Protocol (CCP)

The Continuity Check Message (CCM) provides a means to detect connectivity failures in an MA. CCMs are multicast messages. CCMs are confined to a domain (MD). These messages are unidirectional and do not solicit a response. Each MEP transmits a periodic multicast Continuity Check Message inward towards the other MEPs.

Link Trace (LT)

Link Trace messages otherwise known as Mac Trace Route are Multicast frames that a MEP transmits to track the path (hop-by-hop) to a destination MEP which is similar in concept to User Datagram Protocol (UDP) Trace Route. Each receiving MEP sends a Trace Route Reply directly to the Originating MEP, and regenerates the Trace Route Message.

Loop-back (LB)

Loop-back messages otherwise known as MAC ping are Unicast frames that a MEP transmits, they are similar in concept to an Internet Control Message Protocol (ICMP) Echo (Ping) messages, sending Loopback to successive MIPs can determine the location of a fault. Sending a high volume of Loopback Messages can test bandwidth, reliability, or jitter of a service, which is similar to flood ping. A MEP can send a Loopback to any MEP or MIP in the service. Unlike CCMs, Loop back messages are administratively initiated and stopped.

1.4. Implementation limitations

The current implementation does not support Maintenance domain Intermediate Point (MIP), Up-MEP, Link Trace (LT), and Loop-back (LB).

2. Configuration

Global level configuration

- sender-id-tlv (default)
- interface-status-tlv include/exclude
- organization-specific-tlv include/exclude
- port-status-tlv include/exclude

MD: Maintenance Domain

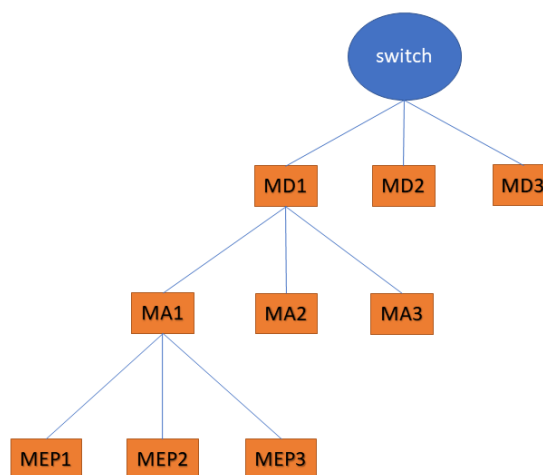
- Name
- Format
- Level
- sender-id-tlv (default)
- interface-status-tlv include/exclude
- organization-specific-tlv include/exclude
- port-status-tlv include/exclude

MA: Maintenance Association

- Name
- Format
- vlan
- continuity-check interval
- sender-id-tlv (default)
- interface-status-tlv include/exclude
- organization-specific-tlv include/exclude
- port-status-tlv include/exclude

MEP: Maintenance End Point

- mep id
- admin-state enable/disable
- continuity-check enable/disable
- up/down mep (direction)
- interface port
- remote mep
- smac
- vlan
- pcp
- alarm-level threshold
- alarm-time-absent
- alarm-time-present



An example of a full stack CFM configuration is shown below:



```
# show running-config feature cfm all-defaults
Building configuration...
cfm sender-id-tlv disable
cfm port-status-tlv disable
cfm interface-status-tlv disable
cfm organization-specific-tlv disable
!
cfm domain MyDomain
  format none
  level 3
  sender-id-tlv chassis-management
  port-status-tlv enable
  interface-status-tlv enable
  organization-specific-tlv defer
  service MyService
    format icc "ICC000MEG0000"
    type port
    continuity-check interval 100ms
    sender-id-tlv disable
    port-status-tlv defer
    interface-status-tlv defer
    organization-specific-tlv defer
  mep 301
    direction down
    interface GigabitEthernet 1/2
    vlan 100
    pcp 6
    no smac
    remote mep 300
    continuity-check
    alarm-level 1
    alarm-time-present 2500
    alarm-time-absent 10000
    admin-state disable
  !
end
```

2.1. Configuration of global parameters

The syntax for cfm global level cli command is:

```
cfm interface-status-tlv { disable | enable }
cfm organization-specific-tlv { disable | enable oui <oui> subtype <subtype> value
<value> }
cfm port-status-tlv { disable | enable }
cfm sender-id-tlv { disable | chassis | management | chassis-management }
```

Where:



interface-status-tlv be overridden	Include or exclude Interface Status TLV in CCM PDUs (may be overridden in domain and service).
organization-specific-tlv be	Include or exclude Organization-Specific TLV in PDUs (may be overridden in domain and service).
oui	The OUI on form XX-XX-XX.
subtype	Subtype value (0-255).
value	A double quoted string with length 1-63 .
port-status-tlv overridden in	Include or exclude Port Status TLV in CCM PDUs (may be overridden in domain and service).
sender-id-tlv overridden in	Default Sender ID TLV format to be used in PDUs (may be overridden in domain and service).
chassis	Enable Sender ID TLV and send Chassis ID (MAC Address).
chassis-management Address) and Management	Enable Sender ID TLV and send both Chassis ID (MAC Address (IPv4 Address).
disable	Exclude TLV from PDUs (default).
management Address).	Enable Sender ID TLV and send Management address (IPv4 Address).

An example is shown below:

```
(config)# cfm sender-id-tlv chassis-management
(config)# cfm port-status-tlv enable
(config)# cfm interface-status-tlv enable
(config)# cfm organization-specific-tlv enable oui 01-02-03 subtype 1 value "Example of oui value string."
```

2.2. Configuration of Domain parameters

The syntax for cfm domain CLI command is:

```
cfm domain <md_name>
no cfm domain { <md_name> | all }
format { none | string <name> }
interface-status-tlv { disable | enable | defer }
level <level>
organization-specific-tlv { disable | defer }
port-status-tlv { disable | enable | defer }
sender-id-tlv { disable | chassis | management | chassis-management | defer }
```

Where:



format	Change format of this domain
interface-status-tlv in this	Include or exclude Interface Status TLV in PDUs included domain or let higher level determine (may be overridden
in service)	
level	Change level (MEG-level) of this domain
organization-specific-tlv included in this	Include or exclude Organization-Specific TLV in PDUs MD or let higher level determine (may be overridden in
service)	
port-status-tlv this domain or	Include or exclude Port Status TLV in PDUs included in let higher level determine (may be overridden in service)
sender-id-tlv domain (may be	Default Sender ID TLV format to be used in PDUs in this overridden in service)

Example:

```
(config)# cfm domain MyDomain
(config-cfm-dmn)# format none
(config-cfm-dmn)# level 3
(config-cfm-dmn)# sender-id-tlv chassis-management
(config-cfm-dmn)# port-status-tlv enable
(config-cfm-dmn)# interface-status-tlv enable
(config-cfm-dmn)# organization-specific-tlv defer
```

2.3. Configuration of Service parameters

The syntax for cfm service level cli command is:

```
service <ma_name>
continuity-check interval { 3.3ms | 10ms | 100ms | 1s | 10s | 1min | 10min }
format { string <format_string> | integer <format_integer> | icc <format_icc_string>
| icc-cc <format_icc_cc_string> }
interface-status-tlv { disable | enable | defer }
mep <mepid>
no mep { <mepid> | all }
organization-specific-tlv { disable | defer }
port-status-tlv { disable | enable | defer }
sender-id-tlv { disable | chassis | management | chassis-management | defer }
type { port | vlan <vid> }
```

Where:



continuity-check	Specify the CCM interval for all MEPs in this service (MA). Default is 1s.
format	Change the format used in MAID/MEGID for this service (MA).
string	Character string (type 2). A double quoted string with 1 to 45 characters.
integer	2-octet integer (type 3), <0-65535>.
icc	ITU-T ICC-based format (type 32). Must be exactly 13 characters long
icc-cc	double quoted string.
characters long	ITU-T ICC-CC-based format (type 33). Must be exactly 15 characters long
from [A-Z].	double quoted string, and the first two characters must be from [A-Z].
interface-status-tlv in MEPs	Include or exclude Interface Status TLV in PDUs included in MEPs running in this service or let domain determine.
mep	Create or modify a Maintenance association EndPoint (MEP).
no	Negate a command or set its defaults.
organization-specific-tlv in MEPs running in	Include or exclude Organization-Specific TLV in PDUs on this service or let the domain determine.
port-status-tlv included in this	Include or exclude Port Status TLV in PDUs for MEPs service or let domain determine.
sender-id-tlv running in	Default Sender ID TLV format to be used in PDUs in MEPs this service.
service	Create or modify a Service (MA).
type	Specify whether MEPs created in this service are port or VLAN MEPs.
port	All MEPs created within this MA will be created as port MEPs (interface MEPs). There can only be one port MEP per interface.
vlan	A given port MEP may still be created with tags, if that MEP's VLAN is non-zero.
MA's	All MEPs created within this MA will created as VLAN MEPs. A given MEP may be configured with another VLAN than the primary VID, but it is impossible to have untagged VLAN MEPs.

Example:

```
(config-cfm-dmn)# service MyService
(config-cfm-dmn-svc)# format icc "ICC000MEG0000"
(config-cfm-dmn-svc)# continuity-check interval 100ms
(config-cfm-dmn-svc)# sender-id-tlv disable
(config-cfm-dmn-svc)# port-status-tlv defer
(config-cfm-dmn-svc)# interface-status-tlv defer
(config-cfm-dmn-svc)# organization-specific-tlv defer
(config-cfm-dmn-svc)# type vlan 6
```



2.4. Configuration of MEP parameters

The syntax for cfm mep level cli command is as follows

```
mep <1-8191>
admin-state { enable | disable }
alarm-level <alarm_level>
alarm-time-absent <alarm_time_absent_ms>
alarm-time-present <alarm_time_present_ms>
continuity-check
direction { up | down }
interface <port_type> <port>
mep <mepid>
no continuity-check
no remote mep { <rmepid> | all }
no smac
pcp <pcp>
remote mep <rmepid>
smac <mac>
vlan { untagged | <vid> }
```

Where:

mep	Create or modify a MEP
admin-state	Enable or disable this MEP.
alarm-level	If a defect is detected with a priority higher than this level, a
fault alarm	notification will be generated.
alarm-time-absent	The time in milliseconds that defects must be absent before a
fault alarm	notification is reset. Default is 10000 ms.
alarm-time-present	The time in milliseconds that defects must be present before a
fault alarm	notification is issued. Default is 2500 ms.
continuity-check	Enable or disable (no-form) generation of continuity-check
messages (CCMs)	
direction	Set whether this MEP is an Up- or a Down-MEP.
interface	Select an interface to configure.
mep	Create or modify a Maintenance association EndPoint (MEP).
no	Negate a command or set its defaults.
pcp	Choose PCP value in PDUs' VLAN tag. Not used if untagged.
remote	Specify the Remote MEPs that this MEP is expected to receive CCM
PDUs from.	
smac	Set a Source MAC address to be used in PDUs for this MEP. Default
to use	interface's.
vlan	VLAN commands.

Example:



```
(config-cfm-dmn-svc)# mep 301
(config-cfm-dmn-svc-mep)# direction down
(config-cfm-dmn-svc-mep)# interface GigabitEthernet 1/2
(config-cfm-dmn-svc-mep)# vlan 100
(config-cfm-dmn-svc-mep)# pcp 6
(config-cfm-dmn-svc-mep)# no smac
(config-cfm-dmn-svc-mep)# remote mep 300
(config-cfm-dmn-svc-mep)# continuity-check
(config-cfm-dmn-svc-mep)# alarm-level 1
(config-cfm-dmn-svc-mep)# alarm-time-present 2500
(config-cfm-dmn-svc-mep)# alarm-time-absent 10000
(config-cfm-dmn-svc-mep)# admin-state disable
```

2.5. Show Status

The format of the 'show cfm' CLI command is as shown below:

```
show cfm domains [domain <md_name>] [details]
show cfm services [domain <md_name>] [service <ma_name>] [details]
show cfm errors
show cfm meps [domain <md_name>] [service <ma_name>] [mep-id <mepid>] [details]
```

Where:

domains	Show CFM Domains.
services	Show CFM Services
errors	Show CFM configuration and run-time errors.
meps	Show MEPS.
details	Show detailed information.
domain	Select domain to show info for.
mep-id	Select a MEP to show info for.
service	Select a service to show info for.

Example:



```
# show cfm mep det
Defect abbreviations (alarm level in parentheses):
R (1): someRDIdefect (RDI received from at least one remote MEP)
M (2): someMACstatusDefect (received Port Status TLV != psUp or Interface Status TLV
!= isUp)
C (3): someMEPCCMdefect (valid CCM is not received within 3.5 times CCM interval
from at least one remote MEP)
E (4): errorCCMdefect (received CCM from an unknown remote MEP-ID or CCM interval
mismatch)
X (5): xconCCMdefect (received CCM with an MD/MEG level smaller than configured or
wrong MAID/MEGID (cross-connect))

Domain:                MyDomain
Service:               MyService
MEP-ID:                200
MAC Address:           00-01-c1-00-6a-42
Direction:            Down
Interface:             Gi 1/2
Continuity-check:      Enabled
presentRDI:            Yes
Type:                  Untagged Port MEP
MEP Active:            Yes
enableRMEPdefect:      False (No link on residence interface)
FNG State:             FNG_DEFECT_REPORTED (highest defect: errorCCMdefect)
Defects:               --CE-
Rx CCM PDU Count:      0
Tx CCM PDU Count:      14918
Rx Invalid CCM PDU Count: 21062
Rx CCM PDU Seq. Errors: 0
Remote MEP-ID:         201
  State:               RMEP_FAILED
  MAC Address:         00-00-00-00-00-00
  Failed/OK Time:      4 minutes and 0 seconds after boot (4 hours, 5 minutes and
2 seconds ago)
  RDI:                 0
  Port Status:         Not received (0)
  Interface Status:    Not received (0)
  Sender ID:           Not received
  Org-Specific TLV:    Not received
```

