Teldat

CFM: Connectivity Fault Management

Teldat-Dm 822-I

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Chapter 1 Introduction

1.1 General overview

The **Connectivity Fault Management (CFM)** set of protocols helps detect connectivity errors easily and efficiently. Unlike other OAM procedures and methods, it allows you to verify end-to-end connections and to create managed structures based on services. It complies with TCP/IP protocol architecture and is designed to work at the network interface layer using unicast/multicast messages.

What follows is a short explanation of the elements you might find in a CFM-monitored network. To begin with, there are certain logically defined areas, called domains, that set boundaries for providers, operators and customers. These domains contain entities grouped by services that monitor network connectivity. Devices that form part of the system may contain some of these entities (as many as the number of services configured). Connectivity errors can be detected both manually, by sending loop-back messages and tracing routes, and automatically, by sending Continuity Check Messages (CCMs).

The following figure shows an example of a possible network structure. In this case, there are four monitored areas: customer domain, operator domain and two provider domains. Each provider can control its own equipment by creating monitoring entities. Customer devices are configured at the highest domain level and check connectivity with other remote devices at the same level.
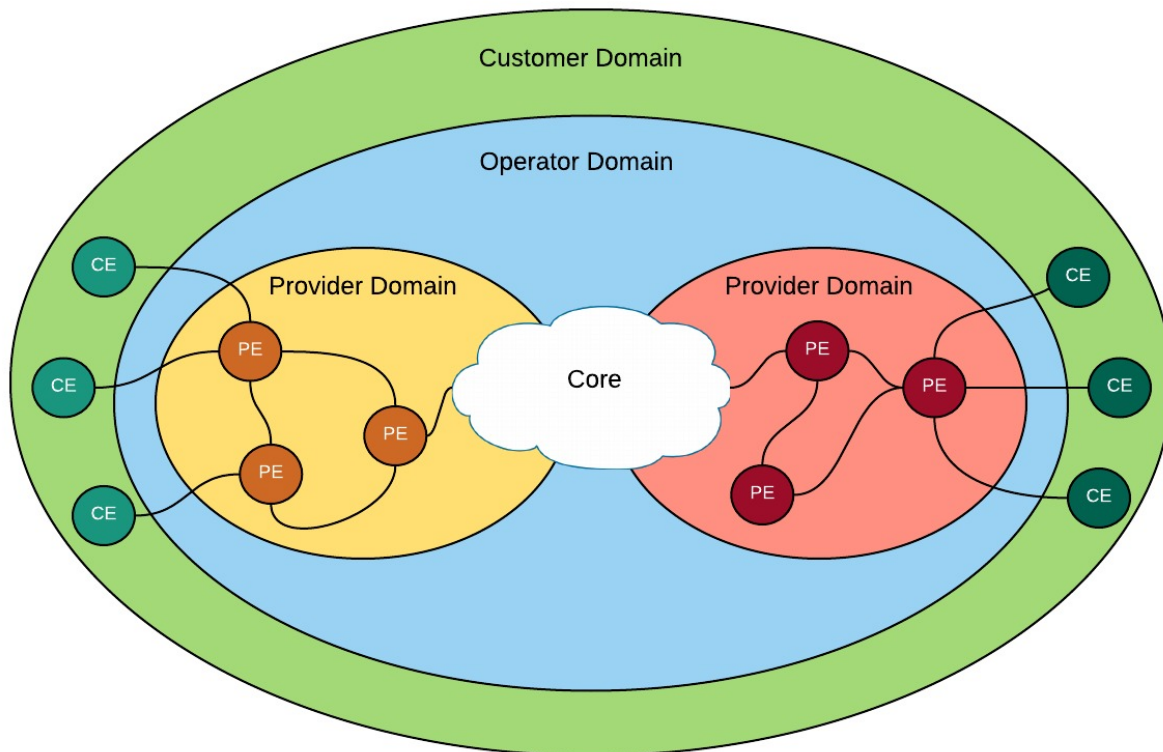
The standard defines three protocols to cover these desired functionalities:

- **Continuity Check Protocol**: this is a type of heartbeat protocol where entities periodically exchange CFM messages. This mechanism allows devices to automatically detect connectivity errors using light payload packets.

- **Link Trace Protocol**: in this protocol, an entity sends some multicast messages to track the path to a remote device. Once the message reaches its destination, the remote device sends a response message. It is conceptually similar to Trace Route.

- **Loop-Back Protocol**: in this case, the system administrator is actively responsible for verifying connectivity. One device sends unicast messages to remote devices, expecting a response similar to an echo. In addition to connectivity health, the user may obtain other interesting statistics (like jitter or bandwidth).

Previous protocols need some elements to run and interact with devices. These elements are listed and briefly described here:

- **Maintenance Domain (MD)**: this refers to the network scope under the CFM. A network is partitioned into domains, each one created at a different level. According to protocol specifications, the more outward the domain, the

higher the level. Domains can be touching or nested, but not overlapped. A maintenance domain can contain several maintenance associations (MAs) or services.

- **Maintenance Association (MA)**: this term identifies the services in an MD. Each service is transmitted separately in a different VLAN connection, resulting in one VLAN per service. An MA is made up of maintenance points (MPs).
- **Maintenance Point (MP)**: this is a managed entity defined on a specific device port. An MP can generate and receive CFM PDUs and track responses. You cannot have two equal maintenance points in the same association. An MP can be a maintenance association end point (MEP) or a maintenance intermediate point (MIP).
- **Maintenance domain Intermediate Point (MIP)**: this is not directly managed in the network. It works like an intermediate point allowing CFM protocols to run properly. An MIP does not initiate PDUs but decides whether or not to pass them through the bridge.
- **Maintenance service End Point (MEP)**: this CFM entity is the domain's end point. Residing on a device port, it represents a service provided to a customer and transmits and processes CFM messages to and from other MEPs. There are two types of MEPs, based on the direction of data flow: DOWN if the flow heads directly towards the LAN, UP if it heads towards the internal bridge.

The full description and specifications are defined by the IEEE in standard 802.1ag-2007, as an amendment of IEEE Standard for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks.

1.2 Continuity Check Protocol

Connectivity fault detection is automatically carried out by the continuity check protocol. The protocol will run looking for network errors once all relevant devices have been properly configured.

Domains have groups of elements running different services in a network. Entities (MEPs) regularly send **Continuity Check Messages (CCMs)**, allowing the network to obtain network status and descriptive information. At the same time, these senders expect to receive messages from the other entities. They will detect and report a fault /defect if they don't.

Basic service connectivity and health is monitored by a group of MEPs. The following requirements must be met in order for the group to run properly and according to specifications:

- They must have a unique MEPID identifier. An MEP will report an error if it processes a CCM that has its own ID number.
- Remote MEPs are known elements. Consequently an MEP will issue a wrong network configuration message if it processes a packet from an unknown entity.
- All MEPs must have the same transmission periodicity. Any MEP transmitting CCMs in shorter or longer time intervals (and this is spelled out in the CCM body message) will be detected and the discrepancy reported.
- MEPs may receive packets from lower levels that belong to different domains. According to protocol principles, such packets cannot pass through the bridge and reach higher domain levels. Rather, they must be processed and reported to the system administrator.
- Any CCMs received that do not comply with the format set via the specifications must be discarded.

Continuity Check does not need MIPs to forward CCMs as the entities are transparent enough for this protocol. The CCMs are forwarded by the MEPs themselves. MEPs configured at one maintenance level are MIPs at some higher level. Therefore, whenever an MEP receives a higher level packet, it forwards it through the bridge (to the other interfaces) instead of processing or discarding it.

Error reports are transmitted as SNMP traps.They contain an error description, MEPID and the network interface (to easily identify what was at fault in the network).

Chapter 2 Configuration

2.1 Basic configuration requirements

To configure the protocol in a network, first create a schema where every domain, service and maintenance point is clearly identifiable. Follow the steps below for general configuration.

- **MDs**. Devices that work at domain borders and different ports can belong to different domains. When setting domain levels, it is important to bear in mind that outward domains have higher levels. Customer domains are usually the most outward, followed by Service Provider and Operator domains.
- **MAs**. Different services coexist in the same domain. Each service in a domain has a unique name and VLANID. While there may be multiple VLANIDs, the first one configured is considered the primary VLAN. At this point, certain parameters need to be configured (such as transmission periodicity, loss-threshold, fault notifications, defect delays, etc.). Services also contain a group of MEPs sharing the same parameter values, directly or indirectly linked to each other.
- **MEPs**. The main configuration points needed to run the protocol are the MEPID, the set of remote MEPs configured in the service and the port where the MEP will be created.

The figure below attempts to clarify this structure by showing the elements present in a maintenance domain.
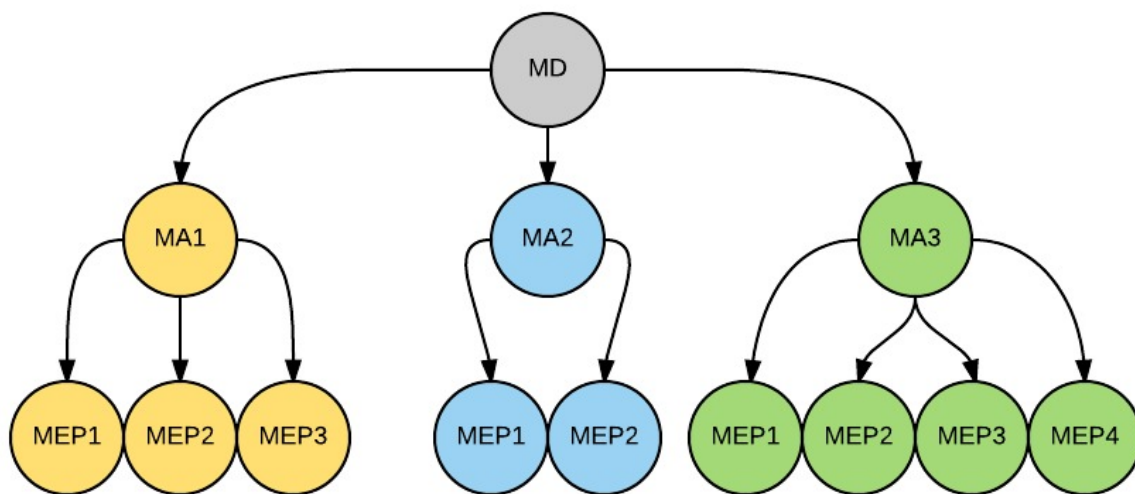
2.2 Important considerations

- For the MEPs to run, the protocol must be globally active, the relevant element must be enabled and the MEP must be configured on a particular port on a router.
- CCMs that reach a port where the protocol has not been implemented or is disabled, or where there are no MEPs capable of processing them, will pass through the bridge or be discarded (if the port is not a bridge member).
- It is possible to configure a service whose messages are created without a VLAN tag. Simply refrain from adding a VLANID.

2.3 General Configuration Menu

The commands used to configure the CFM protocol are all housed in the same menu. The first level of the configuration menu is quite simple, allowing the administrator to run or halt the protocol and to create maintenance domains.

```
Config>protocol cfm
-- CFM user configuration --
CFM config>
```

Once inside, options appear to enable protocol configuration.

Command	Function
?(HELP)	Lists the available commands or their options.

DOMAIN	Creates a new domain or access to an existing one.
ENABLE	Starts the protocol on the device.
NO	Removes a configuration parameter or restores its default value.
EXIT	Leaves the current menu.

2.3.1 ? (HELP)

Lists the available commands at the router configuration level. This command can also be used after a specific command to list the available options.

Syntax:

```
CFM config>?
```

Example:

```
CFM config>?
  domain    Defines a domain
  enable    Enables Connectivity Fault Management
  no        Negate a command or set its defaults
  exit      Exit to parent menu
```

Command history:

Release	Modification
11.00.05	The "*domain*", "*enable*", "*no*" and "*exit*" commands were introduced as of version 11.00.05.
11.01.00	The "*domain*", "*enable*", "*no*" and "*exit*" commands were introduced as of version 11.01.00.

2.3.2 DOMAIN

This command has two functions: firstly, to create a new domain from a given name (once created, the domain can be accessed by typing the same command with the set name) and, secondly, to jump straight to the maintenance service configuration menu.

Syntax:

```
CFM config>domain <domain name>
```

Example:

```
CFM config>domain myDomain
CFM-Domain myDomain config>
```

Command history:

Release	Modification
11.00.05	The "*domain*" command was introduced as of version 11.00.05.
11.01.00	The "*domain*" command was introduced as of version 11.01.00.

2.3.3 ENABLE

The protocol will be enabled globally if this command is present during the configuration phase. If it is not present, then CCMs are not generated and any such packets received are ignored.

Syntax:

```
CFM config>enable
```

Command history:

Release	Modification
11.00.05	The "*enable*" command was introduced as of version 11.00.05.
11.01.00	The "*enable*" command was introduced as of version 11.01.00.

2.3.4 NO

Removes a configuration parameter or restores its default value.

Syntax:

```
CFM config>no ?
   domain   Defines a domain
   enable   Enables Connectivity Fault Management
```

Example:

```
CFM config>no domain myDomain
```

In this example, the *myDomain* domain is removed.

Example:

```
CFM config>no enable
```

In this example, the protocol is disabled.

Command history:

Release	Modification
11.00.05	The "*no*" command was introduced as of version 11.00.05.
11.01.00	The "*no*" command was introduced as of version 11.01.00.

2.3.5 EXIT

Exits the current menu and transfers the command line to an outer level menu.

Syntax:

```
CFM config>exit
```

Example:

```
CFM config>exit
Config>
```

Command history:

Release	Modification
11.00.05	The "*exit*" command was introduced as of version 11.00.05.
11.01.00	The "*exit*" command was introduced as of version 11.01.00.

2.4 Maintenance Domain Menu

Here, you can configure maintenance domain parameters and create services belonging to a domain.

Command	Function
?(HELP)	Lists the available commands or their options.
LEVEL	Sets the domain level.
NAME-FORMAT	Selects the domain name format used in message body.
NO	Removes a configuration parameter or restores its default value.
SERVICE	Creates a new service or access to an existing one.
EXIT	Leaves the current menu.

2.4.1 ? (HELP)

Lists the available commands at the router configuration level. This command can also be used after a specific command to list the available options.

Syntax:

```
CFM-Domain myDomain config>?
```

Example:

```
CFM-Domain myDomain config>?
  level         Defines domain level
  name-format   Name format
  no            Negates a command or set its defaults
  service       Defines a service
  exit          Exit to parent menu
```

Command history:

Release	Modification
11.00.05	The "*level*", "*name-format*", "*no*", "*service*" and "*exit*" commands were introduced as of version 11.00.05.
11.01.00	The "*level*", "*name-format*", "*no*", "*service*" and "*exit*" commands were introduced as of version 11.01.00.

2.4.2 LEVEL

Sets the domain level. Valid values range from 0 to 7. If this command is not set, the default value is 0.

Syntax:

```
CFM-Domain myDomain config>level <value>
```

Example:

```
CFM-Domain myDomain config>level 5
```

Command history:

Release	Modification
11.00.05	The "*level*" command was introduced as of version 11.00.05.
11.01.00	The "*level*" command was introduced as of version 11.01.00.

2.4.3 NAME-FORMAT

CCMs include a reference to the domain to which the MEP belongs. This command chooses between different valid formats to set a value. If this command is not present, the current domain name string will be used as the default format.

Syntax:

```
CFM-Domain myDomain config>name-format { dns <domain name> | mac <MAC address> <integer value> | no-name }
```

Command history:

Release	Modification
11.00.05	The "*name-format*" command was introduced as of version 11.00.05.
11.01.00	The "*name-format*" command was introduced as of version 11.01.00.

2.4.3.1 NAME-FORMAT DNS

Sets the domain name format to a domain name-based string.

Syntax:

```
CFM-Domain myDomain config>name-format dns <domain name>
```

Example:

```
CFM-Domain myDomain config>name-format dns DOMAIN
```

Command history:

Release	Modification
11.00.05	The "*name-format dns*" command was introduced as of version 11.00.05.
11.01.00	The "*name-format dns*" command was introduced as of version 11.01.00.

2.4.3.2 NAME-FORMAT MAC

Sets the domain name format to a MAC address and integer value. A valid MAC address must be entered first, followed by a space and a two-bytes integer value.

Syntax:

```
CFM-Domain myDomain config>name-format mac <MAC address> <integer value>
```

Example:

```
CFM-Domain myDomain config>name-format mac 00-a0-26-ae-3d-7a 100
```

Command history:

Release	Modification
11.00.05	The "*name-format mac*" command was introduced as of version 11.00.05.
11.01.00	The "*name-format mac*" command was introduced as of version 11.01.00.

2.4.3.3 NAME-FORMAT NO-NAME

Deletes this name from the message body.

Syntax:

```
CFM-Domain myDomain config>name-format no-name
```

Command history:

Release	Modification
11.00.05	The "*name-format no-name*" command was introduced as of version 11.00.05.
11.01.00	The "*name-format no-name*" command was introduced as of version 11.01.00.

2.4.4 NO

Removes a configuration parameter or restores its default value.

Syntax:

```
CFM-Domain myDomain config>no ?
  level         Defines domain level
  name-format   Name format
  service       Define a service
```

Example:

```
CFM-Domain myDomain config>no level
```

This example sets the domain level at its default value.

Example:

```
CFM-Domain myDomain config>no name-format
```

In this example, the domain name string will be used as the default format.

Example:

```
CFM-Domain myDomain config>no service myService
```

In this example, the *myService* is removed.

Command history:

Release	Modification
11.00.05	The "*no*" command was introduced as of version 11.00.05.
11.01.00	The "*no*" command was introduced as of version 11.01.00.

2.4.5 SERVICE

This command has two functions: firstly, to create a new service from a given name (once created, it can by accessed by typing the same command with the setting name) and secondly, it takes the user straight to the maintenance service configuration menu.

Syntax:

```
CFM-Domain myDomain config>service <service name>
```

Example:

```
CFM-Domain myDomain config>service myService
CFM-Service myService config>
```

Command history:

Release	Modification
11.00.05	The "*service*" command was introduced as of version 11.00.05.
11.01.00	The "*service*" command was introduced as of version 11.01.00.

2.4.6 EXIT

Exits the current menu and takes the command line to an outer level menu.

Syntax:

```
CFM-Domain myDomain config>exit
```

Example:

```
CFM-Domain myDomain config>exit
CFM config>
```

Command history:

Release	Modification
11.00.05	The "*exit*" command was introduced as of version 11.00.05.
11.01.00	The "*exit*" command was introduced as of version 11.01.00.

2.5 Maintenance Service Menu

You can configure the maintenance service parameters and create local MEPs from this menu.

Command	Function
?(HELP)	Lists the available commands and their options.
ALARM	Settings related to fault notifications configuration.
CONTINUITY-CHECK	Configures packet flow parameters.
MEP	Creates a new MEP or access to an existing one.
NAME-FORMAT	Selects the service name format used in the message body.
NO	Removes a configuration parameter or restores its default value.
SENDER-ID	Adds Sender ID TLV to transmitted messages.
EXIT	Leaves the current menu.

2.5.1 ? (HELP)

Lists the commands available at the router configuration level. This command can also be used after a specific command to list the available options.

Syntax:

```
CFM-Service myService config>?
```

Example:

```
CFM-Service myService config>?
  alarm              Alarm settings
  continuity-check   Continuity check parameters
  mep                MEP identifier
  name-format        Name format
  no                 Negate a command or set its defaults
  sender-id          TLV server-id
  exit               Exit to parent menu
```

Command history:

Release	Modification
11.00.05	The "*alarm*", "*continuity-check*", "*mep*", "*name-format*", "*no*", "*sender-id*" and "*exit*" commands were introduced as of version 11.00.05.
11.01.00	The "*alarm*", "*continuity-check*", "*mep*", "*name-format*", "*no*", "*sender-id*" and "*exit*" commands were introduced as of version 11.01.00.

2.5.2 ALARM

Configures the way the Fault Notification Generator works.

Syntax:

```
CFM-Service myService config>alarm { delay <value> | min-notification-level <option> | reset <value> }
```

Command history:

Release	Modification
11.00.05	The "*alarm*" command was introduced as of version 11.00.05.
11.01.00	The "*alarm*" command was introduced as of version 11.01.00.

2.5.2.1 ALARM DELAY

When the device detects a defect on an MEP, it waits a certain time before reporting the error. This command is used to set the time delay value. Valid values range from 2.5 to 10 seconds. If this command is not set, the delay will be set to the lowest value. This time is set in milliseconds.

Syntax:

```
CFM-Service myService config>alarm delay <value>
```

Example:

```
CFM-Service myService config>alarm delay 4000
```

Command history:

Release	Modification
11.00.05	The "*alarm delay*" command was introduced as of version 11.00.05.
11.01.00	The "*alarm delay*" command was introduced as of version 11.01.00.

2.5.2.2 ALARM MIN-NOTIFICATION-LEVEL

The device can notify the system administrator when it detects a defect on an MEP. Since not all notifications are worthy of being monitored, this command allows an interval to be set. Each option sets the minimum notification level, so that the system reports incidents related to the configured notification type and higher level notifications. All notifications will be reported by default if this command is not entered during configuration.

Syntax:

```
CFM-Service myService config>alarm min-notification-level { xconCCMdefect(5) |
errorCCMdefect(4) | someRMEPCCMdefect(3) | someMACstatusDefect(2) | someRDIdefect(1)}
```

Example:

```
CFM-Service myService config>alarm min-notification-level xconCCMdefect(5)
```

Command history:

Release	Modification
11.00.05	The "*alarm min-notification level*" command was introduced as of version 11.00.05.
11.01.00	The "*alarm min-notification level*" command was introduced as of version 11.01.00.

2.5.2.3 ALARM RESET

Once the system has detected and reported an error, it will wait for normal operation. This command allows you to configure a wait time to ensure that the device is running properly again. Valid values range from 2.5 to 10 seconds. The wait time will be set to the highest value if this command is not set. This time is set in milliseconds.

Syntax:

```
CFM-Service myService config>alarm reset <value>
```

Example:

```
CFM-Service myService config>alarm reset 7000
```

Command history:

Release	Modification
11.00.05	The "*alarm reset*" command was introduced as of version 11.00.05.
11.01.00	The "*alarm reset*" command was introduced as of version 11.01.00.

2.5.3 CONTINUITY-CHECK

This command is linked to the amount of protocol messages in the system.

Syntax:

```
CFM-Service myService config>continuity-check { interval <option> | loss-threshold <value> }
```

Command history:

Release	Modification
11.00.05	The "*continuity-check*" command was introduced as of version 11.00.05.
11.01.00	The "*continuity-check*" command was introduced as of version 11.01.00.

2.5.3.1 CONTINUITY-CHECK INTERVAL

All MEPs in a service have a common feature: the periodicity of packet transmission to other remote devices in the network. If a particular MEP receives messages with a different interval in a common service, it is considered an error. Values are set by selecting an option, in accordance with the relevant specifications. The lowest values cannot be selected for configuration purposes because there is no guarantee that the protocol will work properly. All MEPs are configured with a one-minute interval when this command is absent. Important: configuring a large number of MEPs with very low intervals is not recommended because it will increase the CPU load significantly.

Syntax:

```
CFM-Service myService config>continuity-check interval { 100ms | 1s | 10s | 1m | 10m }
```

Example:

```
CFM-Service myService config>continuity-check interval 1m
```

Command history:

Release	Modification
11.00.05	The "*continuity-check interval*" command was introduced as of version 11.00.05.
11.01.00	The "*continuity-check interval*" command was introduced as of version 11.01.00.

2.5.3.2 CONTINUITY-CHECK LOSS-THRESHOLD

Each MEP can have a group of remote MEPs expecting to receive periodic messages. The local MEP will detect the absence of packet reception in the event a remote MEP stops transmitting or a connection error occurs. This command sets the number of non-received packets needed to activate the alarm. There is an internally calculated correlation between the number of lost messages and the wait time (equal to multiplying the interval and loss threshold values, plus a margin of half an interval). For example, if the loss threshold is 3 and the interval is 10 seconds, wait time will be set to 35 seconds. The loss threshold will be set to the lowest value if this command is absent.

Syntax:

```
CFM-Service SERVICE config>continuity-check loss-threshold <value>
```

Example:

```
CFM-Service SERVICE config>continuity-check loss-threshold 5
```

Command history:

Release	Modification
11.00.05	The "*continuity-check loss-threshold*" command was introduced as of version 11.00.05.
11.01.00	The "*continuity-check loss-threshold*" command was introduced as of version 11.01.00.

2.5.4 MEP

Creates a local MEP in the device or access to an existing one from this ID. The command line jumps straight to the MEP configuration menu.

Syntax:

```
CFM-Service myService config>mep mepid <value>
```

Example:

```
CFM-Service myService config>mep mepid 100
CFM-MEP 100 config>
```

Command history:

Release	Modification
11.00.05	The "*mep*" command was introduced as of version 11.00.05.
11.01.00	The "*mep*" command was introduced as of version 11.01.00.

2.5.5 NAME-FORMAT

CCMs include a reference to the domain to which the MEP belongs. This command chooses between different valid formats to set a value. The current domain name string is used as the default format if this command is not present.

Syntax:

```
CFM-Service myService config>name-format { int <value> | vid <value> | vpn-id-ieee <value> | vpn-id <value> }
```

Command history:

Release	Modification
11.00.05	The "*name-format*" command was introduced as of version 11.00.05.
11.01.00	The "*name-format*" command was introduced as of version 11.01.00.

2.5.5.1 NAME-FORMAT INT

Sets the service format name to a two-octets integer value.

Syntax:

```
CFM-Service myService config>name-format int <value>
```

Example:

```
CFM-Service myService config>name-format int 5
```

Command history:

Release	Modification
11.00.05	The "*name-format int*" command was introduced as of version 11.00.05.
11.01.00	The "*name-format int*" command was introduced as of version 11.01.00.

2.5.5.2 NAME-FORMAT VID

Sets the service format name to the primary VLAN ID.

Syntax:

```
CFM-Service myService config>name-format vid <value>
```

Example:

```
CFM-Service myService config>name-format vid 100
```

Command history:

Release	Modification
11.00.05	The "*name-format vid*" command was introduced as of version 11.00.05.
11.01.00	The "*name-format vid*" command was introduced as of version 11.01.00.

2.5.5.3 NAME-FORMAT VPN-ID-IEEE

Sets the service format name to a VPN ID, as described in RFC 2685. This input value is formatted in a hexadecimal character string made up of a group of three bytes describing the OUI and a contiguous group of four bytes identifying the VPN index.

Syntax:

```
CFM-Service myService config>name-format vpn-id-ieee <value>
```

Example:

```
CFM-Service myService config>name-format vpn-id-ieee 000a260000000f
```

Command history:

Release	Modification
11.00.05	The "*name-format vpn-id-ieee*" command was introduced as of version 11.00.05.
11.01.00	The "*name-format vpn-id-ieee*" command was introduced as of version 11.01.00.

2.5.5.4 NAME-FORMAT VPN-ID

Sets the service format name to a VPN ID as an integer value.

Syntax:

```
CFM-Service myService config>name-format vpn-id <value>
```

Example:

```
CFM-Service myService config>name-format vpn-id 15
```

Command history:

Release	Modification
11.00.05	The "*name-format vpn-id*" command was introduced as of version 11.00.05.
11.01.00	The "*name-format vpn-id*" command was introduced as of version 11.01.00.

2.5.6 NO

Removes a configuration parameter or restores its default value.

Syntax:

```
CFM-Service myService config>no ?
  alarm              Alarm settings
  continuity-check   Continuity check parameters
  mep                MEP identifier
  name-format        Name format
  sender-id          TLV sender-id incorporation
```

Example:

```
CFM-Service myService config>no mep mepid 1
```

In this example, the local MEP with ID 1 is removed.

Example:

```
CFM-Service myService config>no name-format
```

In this example, the domain name string will be used as the default format.

Command history:

Release	Modification
11.00.05	The "*no*" command was introduced as of version 11.00.05.
11.01.00	The "*no*" command was introduced as of version 11.01.00.

2.5.7 SENDER-ID

Protocol messages are able to include some TLV objects. One of them is called Sender ID, which is useful when helping identify the device. This command allows this object to be included in the messages.

Syntax:

```
CFM-Service myService config>sender-id <option>
```

Command history:

Release	Modification
11.00.05	The "*sender-id*" command was introduced as of version 11.00.05.
11.01.00	The "*sender-id*" command was introduced as of version 11.01.00.

2.5.7.1 SENDER-ID CHASSIS

Sets the Sender ID value to the Chassis ID subtype. If the device has a hostname, this will be included in the protocol messages. If not, the TLV is attached to the list anyway (with a 0 value).

Syntax:

```
CFM-Service myService config>sender-id chassis
```

Command history:

Release	Modification
11.00.05	The "*sender-id chassis*" command was introduced as of version 11.00.05.
11.01.00	The "*sender-id chassis*" command was introduced as of version 11.01.00.

2.5.8 EXIT

Exits the current menu and transfers the command line to an outer level menu.

Syntax:

```
CFM-Service myService config>exit
```

Example:

```
CFM-Service myService config>exit
CFM-Domain myDomain config>
```

Command history:

Release	Modification
11.00.05	The "*exit*" command was introduced as of version 11.00.05.
11.01.00	The "*exit*" command was introduced as of version 11.01.00.

2.6 Maintenance service End Point Menu

Here, you can configure current MEP parameters and create relatively remote MEPs.

Command	Function
?(HELP)	Lists the available commands and their options.
ENABLE	Enables protocol message generation and processing.
NETWORK	Configures the interface where the MEP is running.
NO	Removes a configuration parameter or restores its default value.
RMEP	Sets remote MEPs.
EXIT	Leaves the current menu.

2.6.1 ? (HELP)

Lists the commands available at the router configuration level. This command can also be used after a specific command to list the available options.

Syntax:

```
CFM-MEP 100 config>?
  enable     Enables CCM on MEP
  network    Configure network
  no         Negate a command or set its defaults
  rmep       Sets a remote MEP
  exit       Exit to parent menu
```

Command history:

Release	Modification
11.00.05	The "*enable*", "*network*", "*no*", "*rmep*", and "*exit*" commands were introduced as of version 11.00.05.
11.01.00	The "*enable*", "*network*", "*no*", "*rmep*", and "*exit*" commands were introduced as of version 11.01.00.

2.6.2 ENABLE

Allows protocol packets to be generated and processed in this MEP.

Syntax:

```
CFM-MEP 100 config>enable
```

Command history:

Release	Modification
11.00.05	The "*enable*" command was introduced as of version 11.00.05.
11.01.00	The "*enable*" command was introduced as of version 11.01.00.

2.6.3 NETWORK

For it to work, an MEP must be located on an interface. This command is used to configure said network. Only Ethernet or BVI interfaces and subinterfaces are capable of running this protocol. In addition, among the Ethernet interfaces, only the switches found in the Teldat M1, Atlas i60, Teldat V and Teldat iM8 models are capable of running this protocol.

Configuring an MEP on BVI interfaces/subinterfaces help track Ethernet over ATM connections.

Syntax:

```
CFM-MEP 100 config>network <interface name>
```

Example:

```
CFM-MEP 100 config>network ethernet0/1
```

```
CFM-MEP 100 config>network ethernet0/1.100
```

Command history:

Release	Modification
11.00.05	The "*network*" command was introduced as of version 11.00.05.
11.01.00	The "*network*" command was introduced as of version 11.01.00.
11.00.06	The "*network*" command applies to Teldat M1, Atlas i60 and Teldat V switches as of version 11.00.06.
11.01.02	The "*network*" command applies to Teldat M1, Atlas i60, Teldat V and Teldat iM8 switches as of version 11.01.02.
11.01.04	The "*network*" command applies to BVI interfaces and subinterfaces as of version 11.01.04.

2.6.4 NO

Removes a configuration parameter or restores its default value.

Syntax:

```
CFM-MEP 100 config>no ?
  enable     Enables CCM on MEP
  network    Configures network
  rmep       Sets a remote MEP
```

Example:

```
CFM-MEP 100 config>no enable
```

In this example, protocol message generation and processing are disabled in the local MEP with ID 100.

Example:

```
CFM-MEP 100 config>no network
```

In this example, the interface on which the local MEP with ID 100 is located is removed.

Example:

```
CFM-MEP 100 config>no rmep mepid 10
```

In this example, the local MEP with ID 100 stops controlling and monitoring the remote MEP with ID 10.

Command history:

Release	Modification
11.00.05	The "*no*" command was introduced as of version 11.00.05.
11.01.00	The "*no*" command was introduced as of version 11.01.00.

2.6.5 RMEP

Allows an MEP to detect connectivity failures in a remote MEP. The local MEP controls and monitors a remote MEP once the latter is configured. Consequently, the protocol can warn the system administrator when messages are lost. Remote MEPIDs must not be set as the local MEPID value.

Syntax:

```
CFM-MEP 100 config>rmep mepid <value>
```

Example:

```
CFM-MEP 100 config>rmep mepid 101
```

Command history:

Release	Modification
11.00.05	The "*rmep*" command was introduced as of version 11.00.05.
11.01.00	The "*rmep*" command was introduced as of version 11.01.00.

2.6.6 EXIT

Exits the current menu and transfers the command line to an outer level menu.

Syntax:

```
CFM-MEP 100 config>exit
```

Example:

```
CFM-MEP 100 config>exit
CFM-Service myService config>
```

Command history:

Release	Modification
11.00.05	The "*exit*" command was introduced as of version 11.00.05.
11.01.00	The "*exit*" command was introduced as of version 11.01.00.

Chapter 3 Monitoring

3.1 Displayed information

Once the protocol is running properly on the device, you can obtain information on what is happening to each con-figured element. You can access a monitoring menu from the general menu by performing the following steps.

```
+protocol cfm

-- CFM User Console --
CFM +
```

Information data is sorted and structured by MEPs, showing the most relevant parameters currently present in each entity.

- **MEPID**. Numerical value uniquely identifying each MEP among those configured in a single MA.
- **Type**. According to data flow direction it can be UP (to the bridge) or DOWN (to the LAN).
- **Network**. Interface on which the MEP is set.
- **MAC address**. MAC address present in CCMs as source MAC address. It identifies the interface on which the MEP is transmitting packets.
- **Status**. This field is set to ENABLED when the protocol and the current MEP are globally enabled. If it is DIS-ABLED, it means that the MEP is not running.
- **Domain**. This shows the domain and domain level where the MEP is configured.
- **Service**. This shows the service to which the MEP belongs and the VLAN used to send packets.
- **RDI**. This field can be DOWN (set to zero), if the MEP doesn't detect any defects, or UP (set to one) if an error has been detected.
- **Port state**. This field can change between two states: UP and BLOCKED. The state will always be UP if the port is not a bridge member, the service is not VLAN tagged, or the status given by Spanning Tree Protocol (STP) is for-warding. However, it is set to BLOCKED if the port is in a bridge, the service is VLAN tagged and the STP status is different from forwarding, i.e. learning, discarding...
- **Interface state**. This value refers to the interface state, which can swap between UP/DOWN.
- **enableRMEPdefect**. If this variable is ENABLED, then remote MEP state machines run normally. If the port is blocked by STP, it changes to DISABLED and state machines are immediately disabled.
- **FNG state**. This shows the current state of the Fault Notification Generator state machine.
- **FNG current defect**. This field displays which defect is currently being identified.
- **FNG last reported defect**. This shows the last defect notified by the FNG.
- **Last sent sequence number**. Sequence number set in the last transmitted message.
- **Out-of-sequence CCMs**. This variable accumulates the total number of CCMs presenting a different sequence number from the previously received message. An increase in this number indicates that some packets are being lost.
- **Remote MEPs**. Number of remote MEPs configured in the service together with this MEP.

An output example:

```
================
=== MEP Info ===
================

MEPID: 20
Type: down
Network: ethernet0/0
MAC address: 00-a0-26-20-25-e0
Status: enabled
Domain: DOMAIN_1_2 at level 1
Service: SERVICE_200 on vlan 200
RDI bit: down
Port state: up
Interface state: up
enableRMEPdefect: enabled
FNG state: reset
FNG current defect: DefNone
```

```
FNG last reported defect: DefNone
Last sent sequence number: 244
Total number of out-of-sequence received ccm: 0
Total number of remote MEPs: 1
```

Status information is provided right after data on the MEPs configured in the service. The following parameters can be observed:

- **RMEPID**. Numeric identifier of the remote maintenance association end point (MEP).
- **Sender ID**. This is an extra identifier of the remote machine where the remote MEP is running. The field may be blank if this parameter is not received.
- **Status**. This field displays the status of the current RMEP state machine. If the MEP receives remote CCMs in line with the running configuration, this value will usually be OK. FAILED will appear if the MEP receives the wrong packets (or none at all).
- **LastSeqNum**. CCM sequence number found in the last packet received.
- **LastTime**. This field shows the time (in hundreds of seconds) that has elapsed since the remote MEP state machine last entered an OK/FAILED state.

The table looks like this:

```
=================================================================================================
 RMEPID       SenderID    MAC-address    Status  LastSeqNum  RDI     Port  Interface    LastTime
=================================================================================================
     21       ROUTER_A 00-a0-26-ae-3d-7b     ok         39 down       up          up       43700
     10       ROUTER_B 00-a0-26-6c-00-15  failed       1321 down       up          up       39500
=================================================================================================
```

3.2 Monitoring commands

Describes the protocol's monitoring commands.

Command	Function
?(HELP)	Lists the available commands and their options.
LIST	Displays MEP information.
EXIT	Leaves the current menu.

3.2.1 ? (HELP)

Lists the commands that are available at the level where the router is monitored. This command can also be used after a specific command to list the available options.

Syntax:

```
CFM +?
  list    Lists MEP current information
  exit    Exit to parent menu
```

Command history:

Release	Modification
11.00.05	The "*list*" and "*exit*" commands were introduced as of version 11.00.05.
11.01.00	The "*list*" and "*exit*" commands were introduced as of version 11.01.00.

3.2.2 LIST

Displays information on local and remote MEPs. You can choose to display information on a specific MEP or on all of them.

Syntax:

```
CFM +list ?
  all      View all current MEPS
  mepid    Selects MEP by MEP ID
```

Command history:

Release	Modification
11.00.05	The "*list*" command was introduced as of version 11.00.05.
11.01.00	The "*list*" command was introduced as of version 11.01.00.

3.2.2.1 LIST ALL

Lists all configured MEPs.

Syntax:

```
CFM +list all
```

Command history:

Release	Modification
11.00.05	The "*list all*" command was introduced as of version 11.00.05.
11.01.00	The "*list all*" command was introduced as of version 11.01.00.

3.2.2.2 LIST MEPID

Lists a specific MEP.

Syntax:

```
CFM +list mepid <value>
```

Example:

```
CFM +list mepid 100
```

Command history:

Release	Modification
11.00.05	The "*list mepid*" command was introduced as of version 11.00.05.
11.01.00	The "*list mepid*" command was introduced as of version 11.01.00.

3.2.3 EXIT

Exits the current menu and transfers the command line to an outer level menu.

Syntax:

```
CFM +exit
```

Example:

```
CFM +exit
+
```

Command history:

Release	Modification
11.00.05	The "*exit*" command was introduced as of version 11.00.05.
11.01.00	The "*exit*" command was introduced as of version 11.01.00.

Chapter 4 Examples

4.1 Multi-Service Port on Customer Edge router

This example presents a scenario where several services are monitored by different MEPs on the same port. All cases are covered: primary VLAN tagged, secondary VLAN tagged and no VLAN tagged. Devices are placed at the edge of the highest maintenance domain, meaning messages should never pass through the device. MEPs must process any incoming CCM.
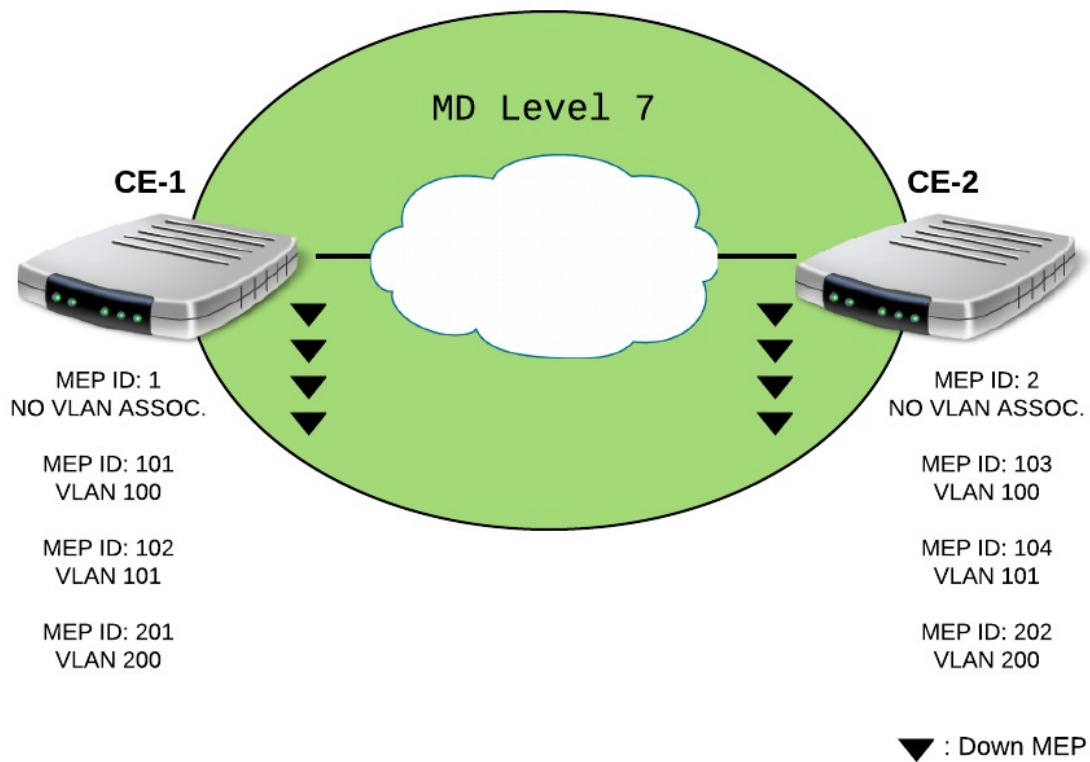
CE - 1 configuration file:

```
; Configuration for testing scenario #1
;
   add device eth-subinterface ethernet0/1 100
   add device eth-subinterface ethernet0/1 101
   add device eth-subinterface ethernet0/1 200
   set hostname CE-1
;
   network ethernet0/1
; -- Ethernet Interface User Configuration --
      ip address 192.168.214.38 255.255.252.0
;
   exit
;
   network ethernet0/1.100
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 100
;
;
   exit

   network ethernet0/1.101
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 101
```

```
;
;
   exit

   network ethernet0/1.200
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 200
;
;
   exit

   event
; -- ELS Config --
      enable trace subsystem CFM STANDARD
      enable snmp-trap event CFM.011
   exit
;
   protocol ip
; -- Internet protocol user configuration --
      route 0.0.0.0 0.0.0.0 192.168.212.2
;
      classless
   exit
;
;
   protocol snmp
; -- SNMP user configuration --
      community private1 access write-read-trap
      host 192.168.214.33 trap version v1 private1 enterprise-specific
;
      trap sending-parameters reachability-checking icmp
   exit
;
;
   protocol cfm
; -- CFM user configuration --
      enable
      domain DOMAIN_7
         level 7
         service NO_VLAN_SERVICE
            continuity-check interval 10s
            sender-id chassis
            mep mepid 1
               enable
               network ethernet0/1
               rmep mepid 2
;
            exit
;
         exit
;
         service SERVICE_100
            continuity-check interval 1m
            sender-id chassis
            mep mepid 101
               enable
               network ethernet0/1.100
               rmep mepid 103
;
            exit
;
            mep mepid 102
               enable
               network ethernet0/1.101
               rmep mepid 104
```

```
            exit
;
        exit
;
        service SERVICE_200
            continuity-check interval 1m
            mep mepid 201
                enable
                network ethernet0/1.200
                rmep mepid 202
;
            exit
;
        exit
;
    exit
;
  exit
;
  dump-command-errors
  end
```

CE - 2 configuration file:

```
; Configuration for testing scenario #1
;
  add device eth-subinterface ethernet0/1 100
  add device eth-subinterface ethernet0/1 101
  add device eth-subinterface ethernet0/1 200
  set hostname CE-2
;
  network ethernet0/1
; -- Ethernet Interface User Configuration --
     ip address 192.168.214.35 255.255.252.0
;
  exit
;
  network ethernet0/1.100
; -- Ethernet Subinterface Configuration --
;
     encapsulation dot1q 100
;
;
  exit

  network ethernet0/1.101
; -- Ethernet Subinterface Configuration --
;
     encapsulation dot1q 101
;
;
  exit

  network ethernet0/1.200
; -- Ethernet Subinterface Configuration --
;
     encapsulation dot1q 200
;
;
  exit

  event
; -- ELS Config --
     enable trace subsystem CFM STANDARD
     enable snmp-trap event CFM.011
  exit
;
  protocol ip
```
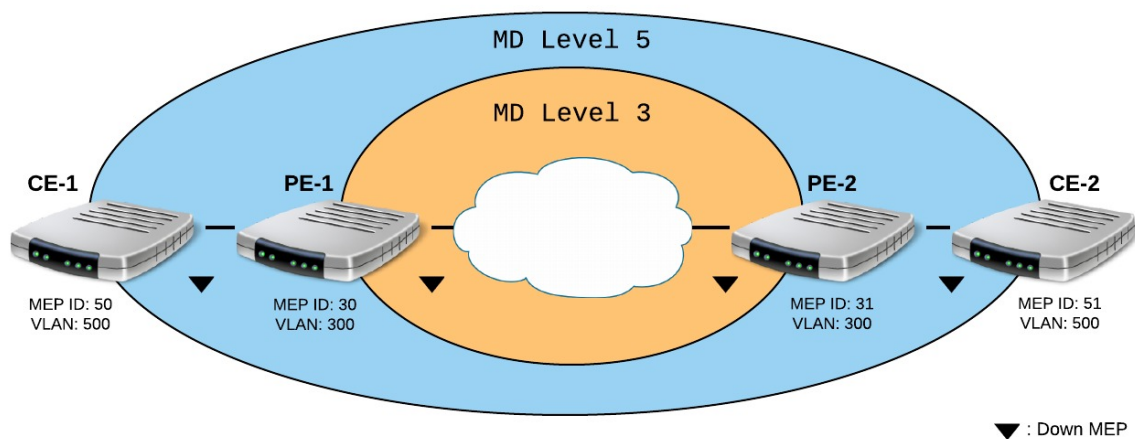
```
; -- Internet protocol user configuration --
      route 0.0.0.0 0.0.0.0 192.168.212.2
;
      classless
   exit
;
;
   protocol snmp
; -- SNMP user configuration --
      community private1 access write-read-trap
      host 192.168.214.33 trap version v1 private1 enterprise-specific
;
      trap sending-parameters reachability-checking icmp
   exit
;
;
   protocol cfm
; -- CFM user configuration --
      enable
      domain DOMAIN_7
         level 7
         service NO_VLAN_SERVICE
            continuity-check interval 10s
            sender-id chassis
            mep mepid 2
               enable
               network ethernet0/1
               rmep mepid 1
;
            exit
;
         exit
;
         service SERVICE_100
            continuity-check interval 1m
            sender-id chassis
            mep mepid 103
               enable
               network ethernet0/1.100
               rmep mepid 101
;
            exit
;
            mep mepid 104
               enable
               network ethernet0/1.101
               rmep mepid 102

            exit
;
         exit
;
         service SERVICE_200
            continuity-check interval 1m
            mep mepid 202
               enable
               network ethernet0/1.200
               rmep mepid 201
;
            exit
;
         exit
;
      exit
;
   exit
;
```

```
   dump-command-errors
   end
```

As well as showing you how to configure CFM, the above example also shows you how to enable SNMP traps to receive fault notifications. It is as easy as setting the event created for this function (number 11) as snmp-trap and adding the system administrator host IP address to the SNMP configuration menu. This trap carries the following information: MEPID, the VLANID, defect and interface.

4.2 CFM on Provider Edge router

The following example shows how the protocol works when the router is configured between two maintenance domains. In this case, the devices must be configured with a bridge in order to forward CCMs. Since MEPs can only be classified as DOWN, any messages coming from the bridge will be ignored by these entities. The bridge allows multicast messages to pass until they are processed or discarded by an MEP.

MD Level 5 / MD Level 3

CE-1   PE-1   PE-2   CE-2

MEP ID: 50   MEP ID: 30   MEP ID: 31   MEP ID: 51
VLAN: 500   VLAN: 300   VLAN: 300   VLAN: 500

▼ : Down MEP

CE - 1 configuration file:

```
; Configuration for testing scenario #2
;
   add device eth-subinterface ethernet0/1 500
   set hostname CE-1
;
   network ethernet0/1.500
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 500
;
   exit
;
   protocol cfm
; -- CFM user configuration --
      enable
      domain DOMAIN_5
         level 5
         service V500
            continuity-check interval 10s
            sender-id chassis
            mep mepid 50
               enable
               network ethernet0/1.500
               rmep mepid 51
;
            exit
;
         exit
;
      exit
;
   exit
;
```

```
      dump-command-errors
      end
```

PE - 1 configuration file (with SNMP traps):

```
; Configuration for testing scenario #2
;
   add device bvi 0
   add device eth-subinterface ethernet0/1 300
   set hostname PE-1
;
;
   network bvi0
; -- Bridge Virtual Interface configuration --
      ip address 192.168.214.40 255.255.252.0
;
   exit
;
   network ethernet0/1.300
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 300
;
   exit
;
   protocol asrt
; -- ASRT Bridge user configuration --
      bridge
      irb
      port ethernet0/1 1
      port ethernet0/0 2
      route-protocol ip
      vlan
; 802.1Q Bridge Configuration
         enable
         member port 1 vid 500
         member port 2 vid 500
      exit
;
   exit
;
;
   protocol ip
; -- Internet protocol user configuration --
      route 0.0.0.0 0.0.0.0 192.168.212.2
;
      classless
   exit
;
;
   protocol snmp
; -- SNMP user configuration --
      community private1 access write-read-trap
      host 192.168.214.33 trap version v1 private1 enterprise-specific
;
      trap sending-parameters reachability-checking icmp
   exit
;
;
   protocol cfm
; -- CFM user configuration --
      enable
      domain DOMAIN_3
         level 3
         service V300
            continuity-check interval 10s
            sender-id chassis
            mep mepid 30
```

```
                enable
                network ethernet0/1.300
                rmep mepid 31
;
            exit
;
        exit
;
    exit
;
  exit
;
  dump-command-errors
  end
```

PE - 2 configuration file:

```
; Configuration for testing scenario #2
;
  add device bvi 0
  add device eth-subinterface ethernet0/1 300
  set hostname PE-2

  network ethernet0/1.300
; -- Ethernet Subinterface Configuration --
;
    encapsulation dot1q 300
;
  exit
;
  protocol asrt
; -- ASRT Bridge user configuration --
    bridge
    irb
    port ethernet0/0 1
    port ethernet0/1 2
    route-protocol ip
    vlan
; 802.1Q Bridge Configuration
      enable
      member port 1 vid 500
      member port 2 vid 500
    exit
;
  exit
;
;
  protocol cfm
; -- CFM user configuration --
    enable
    domain DOMAIN_3
      level 3
      service V300
        continuity-check interval 10s
        sender-id chassis
        mep mepid 31
          enable
          network ethernet0/1.300
          rmep mepid 30
;
        exit
;
      exit
;
    exit
;
  exit
;
```

```
    dump-command-errors
    end
```
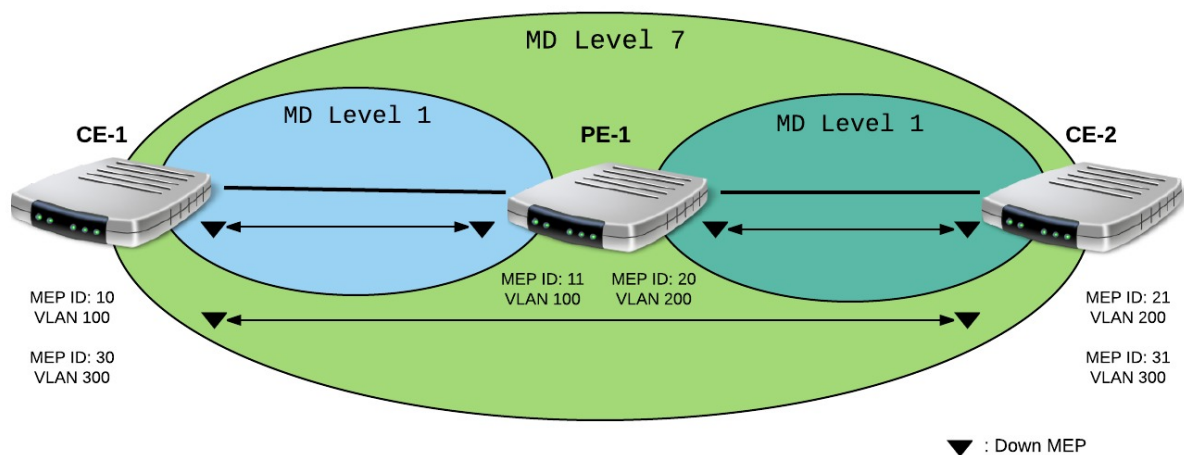
CE - 2 configuration file:

```
; Configuration for testing scenario #2
;
    add device eth-subinterface ethernet0/1 500
    set hostname CE-2
;
;
    network ethernet0/1.500
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 500
;
    exit
;
    protocol cfm
; -- CFM user configuration --
      enable
      domain DOMAIN_5
          level 5
          service V500
             continuity-check interval 10s
             sender-id chassis
             mep mepid 51
                enable
                network ethernet0/1.500
                rmep mepid 50
;
             exit
;
          exit
;
      exit
;
    exit
;
    dump-command-errors
    end
```

4.3 Checking connectivity with touching domains

The following diagram shows how to create a scenario with touching domains. This setting allows you to check back-to-back connectivity between devices without altering the rest of the configuration. It is as simple as configuring touching domains between adjacent devices at a low level. Continuity check packets are only transmitted through the physical link between them.

CE - 1 configuration file:

```
;Configuration for testing scenario #3
;
   add device eth-subinterface ethernet0/1 100
   add device eth-subinterface ethernet0/1 300
   set hostname CE-1
;
   network ethernet0/1.100
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 100
;
   exit

   network ethernet0/1.300
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 300
;
   exit

   protocol cfm
; -- CFM user configuration --
      enable
      domain DOMAIN_7
         level 7
         service SERVICE_300
            continuity-check interval 10s
            sender-id chassis
            mep mepid 30
               enable
               network ethernet0/1.300
               rmep mepid 31
;
            exit
;
         exit
;
      exit
;
      domain DOMAIN_1_1
         level 1
         service SERVICE_100
            continuity-check interval 10s
            sender-id chassis
            mep mepid 10
               enable
               network ethernet0/1.100
               rmep mepid 11
;
            exit
;
         exit
;
      exit
   exit
;
   dump-command-errors
   end
```

PE - 1 configuration file:

```
;Configuration for testing scenario #3
;
   add device bvi 0
   add device eth-subinterface ethernet0/1 100
   add device eth-subinterface ethernet0/2 200
```

```
   set hostname PE-1
;
;
   network ethernet0/1.100
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 100
;
   exit

   network ethernet0/2.200
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 200
;
   exit

   protocol asrt
; -- ASRT Bridge user configuration --
      bridge
      irb
      port ethernet0/1 1
      port ethernet0/2 2
      route-protocol ip
      vlan
; 802.1Q Bridge Configuration
         enable
         member port 1 vid 300
         member port 2 vid 300
      exit
   exit
;

   protocol cfm
; -- CFM user configuration --
      enable
      domain DOMAIN_1_1
         level 1
         service SERVICE_100
            continuity-check interval 10s
            sender-id chassis
            mep mepid 11
               enable
               network ethernet0/1.100
               rmep mepid 10
            exit
;
         exit
;
      exit

      domain DOMAIN_1_2
         level 1
         service SERVICE_200
            continuity-check interval 10s
            sender-id chassis
            mep mepid 20
               enable
               network ethernet0/2.200
               rmep mepid 21
            exit
;
         exit
;
      exit

;
```

```
   exit
;
   dump-command-errors
   end
```

CE - 2 configuration file:

```
;Configuration for testing scenario #3
;
   add device eth-subinterface ethernet0/1 200
   add device eth-subinterface ethernet0/1 300
   set hostname CE-2
;
   network ethernet0/1.200
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 200
;
   exit

   network ethernet0/1.300
; -- Ethernet Subinterface Configuration --
;
      encapsulation dot1q 300
;
   exit

   protocol cfm
; -- CFM user configuration --
      enable
      domain DOMAIN_7
         level 7
         service SERVICE_300
            continuity-check interval 10s
            sender-id chassis
            mep mepid 31
               enable
               network ethernet0/1.300
               rmep mepid 30
;
            exit
;
         exit
;
      exit
;
      domain DOMAIN_1_2
         level 1
         service SERVICE_200
            continuity-check interval 10s
            sender-id chassis
            mep mepid 21
               enable
               network ethernet0/1.200
               rmep mepid 20
;
            exit
;
         exit
;
      exit
   exit
;
   dump-command-errors
   end
```