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Configuring CFD

About CFD

Connectivity Fault Detection (CFD), which conforms to IEEE 802.1ag Connectivity Fault Management (CFM), is an end-to-end per-VLAN link layer OAM mechanism. CFD is used for link connectivity detection, fault verification, and fault location.

Basic CFD concepts

Maintenance domain

A maintenance domain (MD) defines the network or part of the network where CFD plays its role. An MD is identified by its MD name.

Maintenance association

A maintenance association (MA) is a part of an MD. You can configure multiple MAs in an MD as needed. An MA is identified by the MD name + MA name.

An MA serves the specified VLAN or no VLAN. An MA that serves a VLAN is considered to be carrying VLAN attribute. An MA that serves no VLAN is considered to be carrying no VLAN attribute.

Maintenance point

An MP is configured on a port and belongs to an MA. MPs include the following types: maintenance association end points (MEPs) and maintenance association intermediate points (MIPs).

MEPs define the boundary of the MA. Each MEP is identified by a MEP ID.

MEPs include inward-facing MEPs and outward-facing MEPs:

- An outward-facing MEP sends packets to its host port.
- An inward-facing MEP does not send packets to its host port. Rather, it sends packets to other ports on the device.

A MIP is internal to an MA. It cannot send CFD packets actively, but it can handle and respond to CFD packets. MIPs are automatically created by the device. By cooperating with MEPs, a MIP can perform a function similar to ping and traceroute.

MEP list

A MEP list is a collection of local MEPs allowed to be configured and the remote MEPs to be monitored in the same MA. It lists all the MEPs configured on different devices in the same MA. The MEPs all have unique MEP IDs. When a MEP receives from a remote device a continuity check message (CCM) carrying a MEP ID not in the MEP list of the MA, it drops the message.

The local device must send CCM messages carrying the Remote Defect Indication (RDI) flag bits. Otherwise, the peer device cannot sense certain failures. When a local MEP has not learned all remote MEPs in the MEP list, the MEPs in the MA might not carry the RDI flag bits in CCMs.

CFD levels

MD levels

To accurately locate faults, CFD introduces eight levels (from 0 to 7) to MDs. The bigger the number, the higher the level and the larger the area covered. Domains can touch or nest (if the outer domain has a higher level than the nested one) but cannot intersect or overlap.

MD levels facilitate fault location and make fault location more accurate. As shown in Figure 1, MD_A in light blue nests MD_B in dark blue. If a connectivity fault is detected at the boundary of MD_A, any of the devices in MD_A, including Device A through Device E, might fail. If a connectivity fault is also detected at the boundary of MD_B, the failure points can be any of Device B through Device D. If the devices in MD_B can operate correctly, at least Device C is operational.

Figure 1 Two nested MDs
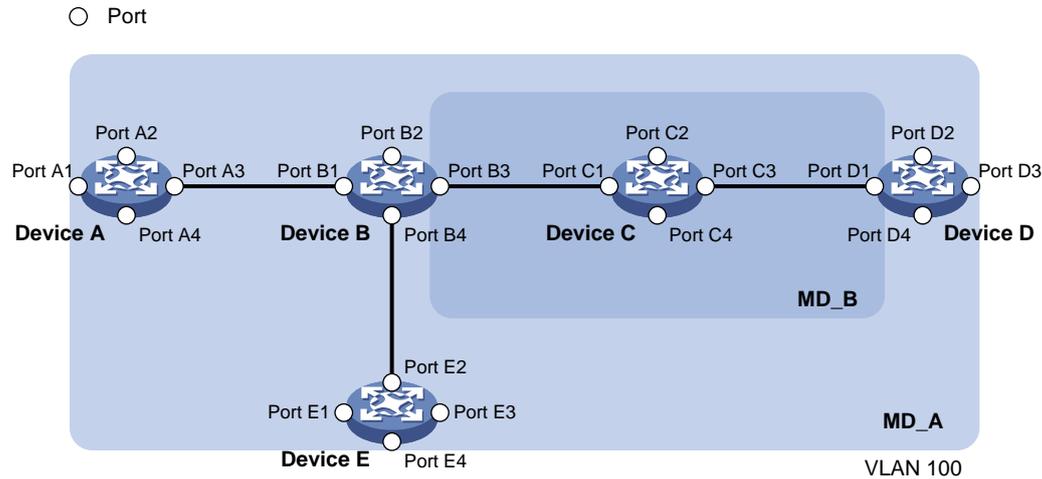
CFD exchanges messages and performs operations on a per-domain basis. By planning MDs correctly in a network, you can use CFD to rapidly locate failure points.

MA and MP levels

The level of an MA equals the level of the MD to which the MA belongs.

The level of a MEP equals the level of the MD to which the MEP belongs.

The level of a MIP is defined by its generation rule and the MD to which the MIP belongs. MIPs are generated on each port automatically according to the following MIP generation rules:

- **Default rule**—If no lower-level MIP exists on an interface, a MIP is created on the current level. A MIP can be created even if no MEP is configured on the interface.

- **Explicit rule**—If no lower-level MIP exists and a lower-level MEP exists on an interface, a MIP is created on the current level. A MIP can be created only when a lower-level MEP is created on the interface.

If a port has no MIP, the system will check the MAs in each MD (from low to high levels), and follow the procedure as described in Figure 2 to create or not to create MIPs at the current level.

Figure 2 Procedure of creating MIPs
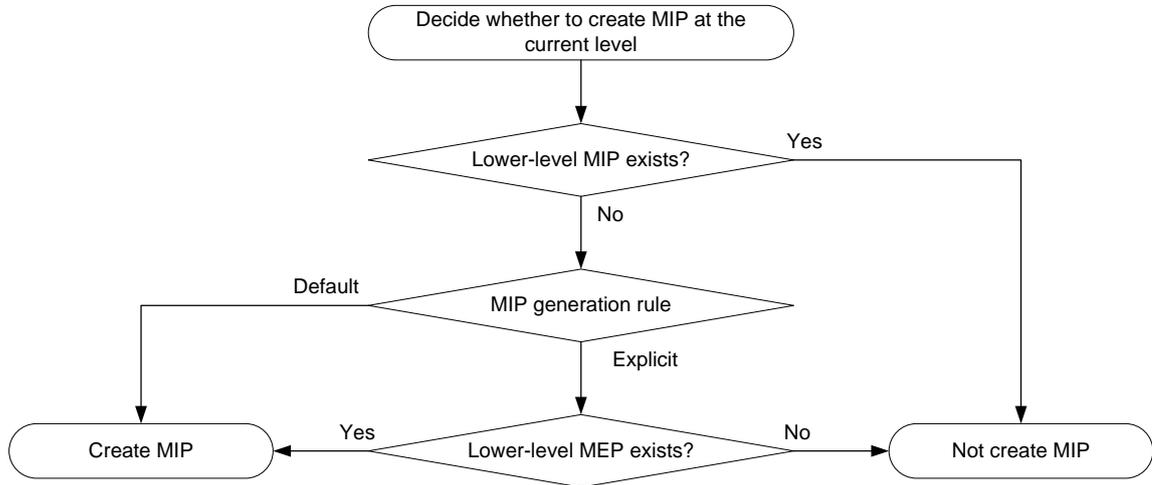
CFD grading example

Figure 3 demonstrates a grading example of the CFD module. Four levels of MDs (0, 2, 3, and 5) are designed. The bigger the number, the higher the level and the larger the area covered. MPs are configured on the ports of Device A through Device F. Port A of Device B is configured with the following MPs:

- A level 5 MIP.
- A level 3 inward-facing MEP.
- A level 2 inward-facing MEP.
- A level 0 outward-facing MEP.

Figure 3 CFD grading example
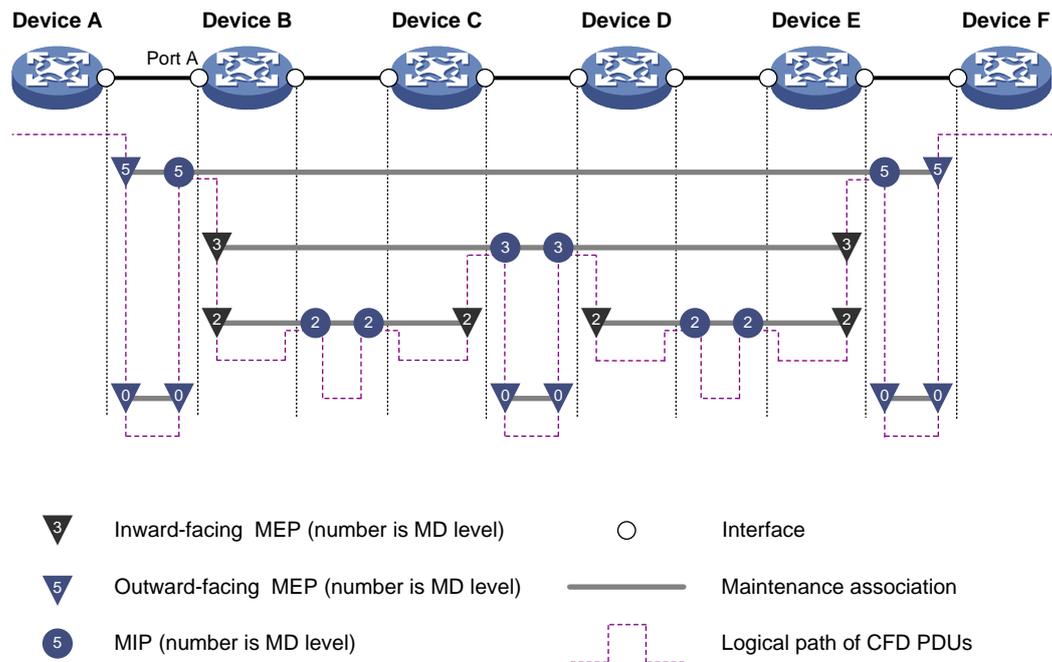
Packet processing of MPs

For an MA carrying VLAN attribute, MPs of the MA send packets only in the VLAN that the MA serves. The level of packets sent by an MP equals the level of the MD to which the MP belongs.

For an MA not carrying VLAN attribute, MPs of the MA can only be outward-facing MEPs. The level of packets sent by an outward-facing MEP equals the level of the MD to which the MEP belongs.

A MEP forwards packets at a higher level without any processing and only processes packets of its level or lower.

A MIP forwards packets of a different level without any processing and only processes packets of its level.

CFD functions

CFD functions, which are implemented through the MPs, include:

- Continuity check (CC).
- Loopback (LB).
- Linktrace (LT).
- Alarm indication signal (AIS).
- Loss measurement (LM).
- Delay measurement (DM).
- Test (TST).

Continuity check

Connectivity faults are usually caused by device faults or configuration errors. Continuity check examines the connectivity between MEPs. This function is implemented through periodic sending of CCMs by the MEPs. A CCM sent by one MEP is intended to be received by all the other MEPs in the same MA. If a MEP fails to receive the CCMs within 3.5 times the sending interval, the link is considered as faulty and a log is generated. When multiple MEPs send CCMs at the same time, the multipoint-to-multipoint link check is achieved. CCM frames are multicast frames.

Loopback

Similar to ping at the IP layer, loopback verifies the connectivity between a source device and a target device. To implement this function, the source MEP sends loopback messages (LBMs) to the target MEP. Depending on whether the source MEP can receive a loopback reply message (LBR) from the target MEP, the link state between the two can be verified.

LBM frames are multicast and unicast frames. The device can send and receive unicast LBM frames, and can receive multicast LBM frames but cannot send multicast LBM frames. LBR frames are unicast frames.

Linktrace

Linktrace is similar to traceroute. It identifies the path between the source MEP and the target MP. The source MEP sends the linktrace messages (LTMs) to the target MP. After receiving the messages, the target MP and the MIPs that the LTM frames pass send back linktrace reply messages (LTRs) to the source MEP. Based on the reply messages, the source MEP can identify the path to the target MP. LTM frames are multicast frames and LTRs are unicast frames.

AIS

The AIS function suppresses the number of error alarms reported by MEPs. If a local MEP does not receive any CCM frames from its peer MEP within 3.5 times the CCM transmission interval, it immediately starts sending AIS frames. The AIS frames are sent periodically in the opposite direction of CCM frames. When the peer MEP receives the AIS frames, it suppresses the error alarms locally, and continues to send the AIS frames. If the local MEP receives CCM frames within 3.5 times the

CCM transmission interval, it stops sending AIS frames and restores the error alarm function. AIS frames are multicast frames.

LM

The LM function measures the frame loss in a certain direction between a pair of MEPs. The source MEP sends loss measurement messages (LMMs) to the target MEP. The target MEP responds with loss measurement replies (LMRs). The source MEP calculates the number of lost frames according to the counter values of the two consecutive LMRs (the current LMR and the previous LMR). LMMs and LMRs are unicast frames.

DM

The DM function measures frame delays between two MEPs, including the following types:

- One-way frame delay measurement

  The source MEP sends a one-way delay measurement (1DM) frame, which carries the transmission time, to the target MEP. When the target MEP receives the 1DM frame, it does the following:

  o Records the reception time.

  o Calculates and records the link transmission delay and jitter (delay variation) according to the transmission time and reception time.

  1DM frames are unicast frames.

- Two-way frame delay measurement

  The source MEP sends a delay measurement message (DMM), which carries the transmission time, to the target MEP. When the target MEP receives the DMM, it responds with a delay measurement reply (DMR). The DMR carries the reception time and transmission time of the DMM and the transmission time of the DMR. When the source MEP receives the DMR, it does the following:

  o Records the DMR reception time.

  o Calculates the link transmission delay and jitter according to the DMR reception time and DMM transmission time.

  DMM frames and DMR frames are unicast frames.

TST

The TST function tests the bit errors between two MEPs. The source MEP sends a TST frame, which carries the test pattern, such as pseudo random bit sequence (PRBS) or all-zero, to the target MEP. When the target MEP receives the TST frame, it determines the bit errors by calculating and comparing the content of the TST frame. TST frames are unicast frames.

EAIS

Ethernet Alarm Indication Signal (EAIS) enables collaboration between the Ethernet port status and the AIS function. When a port on the device (not necessarily an MP) goes down, it immediately starts to send EAIS frames periodically to suppress the error alarms. When the port goes up again, it immediately stops sending EAIS frames. When the MEP receives the EAIS frames, it suppresses the error alarms locally, and continues to send the EAIS frames. If a MEP receives no EAIS frames within 3.5 times the EAIS frame transmission interval, the fault is considered cleared. The port stops sending EAIS frames and restores the error alarm function. EAIS frames are multicast frames.

Port collaboration

Port collaboration shuts down or blocks ports based on the result of link detection performed by outward-facing MEPs.

Triggering events

Port collaboration can be triggered by the following events:

- Continuity check expires.
- The CCMs with the RDI flag bits set are received.

You can specify both triggering events for an interface. Both triggering events can take effect.

Triggered actions

Port collaboration takes one of the following triggered actions:

- Blocks the port by changing its link layer protocol state to DOWN (CFD). The port cannot send or receive any data packets.
- Shuts down the port by changing its physical state to CFD DOWN. The port cannot send or receive any data packets or protocol packets.

Link recovery

If a port is blocked by CFD, it can automatically come up when the link recovers.

If a port is shut down by CFD, it cannot automatically come up when the link recovers.

- If port collaboration is triggered by continuity check expiration, you must execute the **undo shutdown** or **undo cfd port-trigger** { **cc-expire** | **rdi** } **action** command to bring up the port.
- If port collaboration is triggered by CCMs with the RDI flag bits set, you must execute the **undo cfd port-trigger** { **cc-expire** | **rdi** } **action** command to bring up the port.

Protocols and standards

- IEEE 802.1ag, *Virtual Bridged Local Area Networks Amendment 5: Connectivity Fault Management*

Restrictions and guidelines: CFD configuration

When you configure CFD, follow these restrictions and guidelines:

- Configure CC before you use the MEP ID of the remote MEP to configure other CFD functions. This restriction does not apply when you use the MAC address of the remote MEP to configure other CFD functions.
- Do not configure a Layer 2 aggregate interface as an IPP if the following conditions exist:
  - ○ The Layer 2 aggregate interface exists between an inward-facing MEP and a remote MEP.
  - ○ The MAC address of the remote MEP is used for CFD functions.

  For information about IPPs, see DRNI configuration in *Layer 2—LAN Switching Configuration Guide*.
- Typically, a port blocked by the spanning tree feature cannot receive or send CFD messages except in the following cases:
  - ○ The port is configured as an outward-facing MEP.
  - ○ The port is configured as a MIP or inward-facing MEP, which can still receive and send CFD messages except CCM messages.

  For more information about the spanning tree feature, see *Layer 2—LAN Switching Configuration Guide*.

CFD tasks at a glance

To configure CFD, perform the following tasks:

1. Configuring basic CFD settings
   a. Enabling CFD
   b. Configuring service instances
   c. Configuring MEPs
   d. Configuring MIP auto-generation rules
2. Configuring CFD functions
   a. Configuring CC
   b. (Optional.) Configuring LB
   c. (Optional.) Configuring LT
   d. (Optional.) Configuring AIS
   e. (Optional.) Configuring LM
   f. (Optional.) Configuring one-way DM
   g. (Optional.) Configuring two-way DM
   h. (Optional.) Configuring TST
3. (Optional.) Configuring EAIS
4. (Optional.) Configuring port collaboration

Prerequisites for CFD

For CFD to work correctly, design the network by performing the following tasks:

- Grade the MDs in the entire network, and define the boundary of each MD.
- Assign a name for each MD. Make sure the devices in the same MD use the same MD name.
- Define the MA in each MD according to the VLAN you want to monitor.
- Assign a name for each MA. Make sure that the devices in the same MA in the same MD use the same MA name.
- Determine the MEP list of each MA in each MD. Make sure devices in the same MA maintain the same MEP list.
- At the edges of MD and MA, MEPs must be designed at the device port. MIPs can be designed on devices or ports that are not at the edges.

Configuring basic CFD settings

Enabling CFD

1. Enter system view.
   system-view
2. Enable CFD.
   cfd enable
   By default, CFD is disabled.

Configuring service instances

About service instances

Before configuring the MEPs and MIPs, you must first configure service instances. A service instance is a set of service access points (SAPs), and belongs to an MA in an MD.

The MD and MA define the level attribute and VLAN attribute of the messages handled by the MPs in a service instance. The MPs of the MA that carries no VLAN attribute do not belong to any VLAN.

Procedure

1. Enter system view.

   system-view

2. Create an MD.

   cfd md *md-name* [**index** *index-value*] **level** *level-value* [**md-id** { **dns** *dns-name* | **mac** *mac-address subnumber* | **none** }]

3. Create a service instance.

   cfd service-instance *instance-id* **ma-id** { **icc-based** *ma-name* | **integer** *ma-num* | **string** *ma-name* | **vlan-based** [*vlan-id*] } [**ma-index** *index-value*] **md** *md-name* [**vlan** *vlan-id*]

Configuring MEPs

About MEPs

CFD is implemented through various operations on MEPs. As a MEP is configured on a service instance, the MD level and VLAN attribute of the service instance become the attribute of the MEP.

Restrictions and guidelines

- You can specify an interface as the MEP for only one of the non-VLAN-specific MAs at the same level. In addition, the MEP must be outward facing.

- If a MEP in a non-VLAN-specific MA does not receive a CCM message within 3.5 CCM intervals from a remote MEP, the local MEP sets its interface to link down state. This behavior of the local MEP facilitates fast switchover for RRPP or Smart Link.

Prerequisites

Before you configure MEPs, you must configure service instances.

Procedure

1. Enter system view.

   system-view

2. Configure a MEP list.

   cfd meplist *mep-list* **service-instance** *instance-id*

   The created MEP must be included in the configured MEP list.

3. Enter Layer 2 Ethernet interface view or Layer 2 aggregate interface view.

   interface *interface-type interface-number*

4. Create a MEP.

   cfd mep *mep-id* **service-instance** *instance-id* { **inbound** | **outbound** }

Configuring MIP auto-generation rules

About MIP auto-generation rules

As functional entities in a service instance, MIPs respond to various CFD frames, such as LTM and LBM frames. You can configure MIP auto-generation rules for the system to automatically create MIPs.

Any of the following events can cause MIPs to be created or deleted after you have configured the **cfd mip-rule** command:

- Enabling or disabling CFD.
- Creating or deleting MEPs on a port.
- Changes occur to the VLAN attribute of a port.
- The rule specified in the **cfd mip-rule** command changes.

Restrictions and guidelines

- An MA carrying no VLAN attribute is typically used to detect direct link status. The system cannot generate MIPs for such MAs.
- For an MA carrying VLAN attribute, the system does not generate MIPs if the same or a higher level MEP exists on the interface.

Procedure

1. Enter system view.

   system-view

2. Configure MIP auto-generation rules.

   cfd mip-rule { **default** | **explicit** } **service-instance** *instance-id*

   By default, no rules for generating MIPs are configured, and the system does not automatically create any MIP.

Configuring CFD functions

Configuring CC

About CC

After the CC function is configured, MEPs in an MA can periodically send CCM frames to maintain connectivity.

You must configure CC before you use the MEP ID of the remote MEP to configure other CFD functions. This restriction does not apply when you use the MAC address of the remote MEP to configure other CFD functions.

When the lifetime of a CCM frame expires, the link to the sending MEP is considered disconnected. When setting the CCM interval, use the settings described in Table 1.

Table 1 CCM interval field encoding

CCM interval field	Transmission interval	Maximum CCM lifetime
1	10/3 milliseconds	35/3 milliseconds
2	10 milliseconds	35 milliseconds
3	100 milliseconds	350 milliseconds
4	1 second	3.5 seconds

CCM interval field	Transmission interval	Maximum CCM lifetime
5	10 seconds	35 seconds
6	60 seconds	210 seconds
7	600 seconds	2100 seconds

NOTE:

- The value range for the interval field is 1 to 7. If you set the value to 1 or 2, the continuity check might work incorrectly due to hardware restrictions.
- The CCM messages with an interval field value of 1 to 3 are short-interval CCM messages. The CCM messages with an interval field value of 4 to 7 are long-interval CCM messages.

Restrictions and guidelines

When you configure the CCM interval, follow these restrictions and guidelines:

- Configure the same CCM interval field value for all MEPs in the same MA.
- After the CCM interval field is modified, the MEP must wait for another CCM interval before sending CCMs.
- If the device cannot process short-interval CCM messages, setting the CCM interval field value to smaller than 4 might cause the CC function to operate unsteadily.

Procedure

1. Enter system view.

    system-view

2. (Optional.) Set the CCM interval field.

    cfd cc interval *interval-value* **service-instance** *instance-id*

    By default, the interval field value is 4.

3. Enter Layer 2 Ethernet interface view or Layer 2 aggregate interface view.

    interface *interface-type interface-number*

4. Enable CCM sending on a MEP.

    cfd cc service-instance *instance-id* **mep** *mep-id* **enable**

    By default, CCM sending is disabled on a MEP.

5. (Optional.) Enable hardware CC on a MEP.

    a. Return to system view.

    quit

    b. Enter Layer 2 Ethernet interface view.

    interface *interface-type interface-number*

    c. Enable hardware CC on a MEP.

    cfd hardware-cc service-instance *instance-id* **remote-mep** *mep-list*

    By default, hardware CC is disabled on a MEP.

Configuring LB

To verify the link state between the local MEP and the remote MEP, execute the following command in any view:

cfd loopback service-instance *instance-id* **mep** *mep-id* { **target-mac** *mac-address* | **target-mep** *target-mep-id* } [**number** *number*]

Configuring LT

About LT

LT can trace the path between source and target MEPs, and can locate link faults by automatically sending LT messages. The two functions are implemented in the following way:

- **Tracing path**—The source MEP first sends LTM messages to the target MEP. Based on the LTR messages in response to the LTM messages, the path between the two MEPs is identified.
- **LT messages automatic sending**—If the source MEP fails to receive CCM frames from the target MEP within 3.5 times the transmission interval, it considers the link faulty. The source MEP then sends LTM frames, with the TTL field set to the maximum value 255, to the target MEP. Based on the returned LTRs, the fault source is located.

Prerequisites

Before you configure LT on a MEP in an MA carrying VLAN attribute, create the VLAN to which the MA belongs.

Procedure

1. Identify the path between a source MEP and a target MEP.

   cfd linktrace service-instance *instance-id* **mep** *mep-id* { **target-mac** *mac-address* | **target-mep** *target-mep-id* } [**ttl** *ttl-value*] [**hw-only**]

   This command is available in any view.

2. Enter system view.

   system-view

3. Enable LT messages automatic sending.

   cfd linktrace auto-detection [**size** *size-value*]

   By default, LT messages automatic sending is disabled.

Configuring AIS

About AIS

The AIS function suppresses the number of error alarms reported by MEPs.

Hardware and feature compatibility

The S6820 switch series does not support this feature.

Restrictions and guidelines

If you enable AIS, the MEPs in a service instance cannot send AIS frames in the following conditions:

- No AIS frame transmission level is configured.
- The AIS frame transmission level is lower than the MD level of the service instance.

If you enable AIS and configure an AIS frame transmission level equal to the MD level of a service instance, the MEPs in the service instance:

- Can suppress error alarms.
- Cannot send AIS frames to MDs with higher level.

Procedure

1. Enter system view.

   system-view

2. Enable AIS.

   cfd ais enable

By default, AIS is disabled.

3. Configure the AIS frame transmission level.

   cfd ais level *level-value* **service-instance** *instance-id*

   By default, the AIS frame transmission level is not configured.

   The AIS frame transmission level must be higher than the MD level of the service instance.

4. Configure the AIS frame transmission interval.

   cfd ais period *period-value* **service-instance** *instance-id*

   By default, the AIS frame transmission interval is 1 second.

Configuring LM

About LM

The LM function measures frame loss between MEPs. Frame loss statistics include the number of lost frames, the frame loss ratio, and the average number of lost frames for the source and target MEPs.

Hardware and feature compatibility

The S6820 switch series does not support this feature.

Procedure

To configure LM, execute the following command in any view:

cfd slm service-instance *instance-id* **mep** *mep-id* { **target-mac** *mac-address* | **target-mep** *target-mep-id* } [**dot1p** *dot1p-value*] [**number** *number*] [**interval** *interval*]

Configuring one-way DM

About one-way DM

The one-way DM function measures the one-way frame delay between two MEPs, and monitors and manages the link transmission performance.

Hardware and feature compatibility

The S6820 switch series does not support this feature.

Restrictions and guidelines

Follow these guidelines when you configure one-way DM on a MEP:

- One-way DM requires that the time setting at the transmitting MEP and the receiving MEP be the same. For the purpose of frame delay variation measurement, the requirement can be relaxed.
- To view the test result, use the **display cfd dm one-way history** command on the target MEP.

Procedure

To configure one-way DM, execute the following command in any view:

cfd dm one-way service-instance *instance-id* **mep** *mep-id* { **target-mac** *mac-address* | **target-mep** *target-mep-id* } [**number** *number*]

Configuring two-way DM

About two-way DM

The two-way DM function measures the two-way frame delay, average two-way frame delay, and two-way frame delay variation between two MEPs. It also monitors and manages the link transmission performance.

Hardware and feature compatibility

The S6820 switch series does not support this feature.

Procedure

To configure two-way DM, execute the following command in any view:

```
cfd dm two-way service-instance instance-id mep mep-id { target-mac
mac-address | target-mep target-mep-id } dot1p dot1p-value ] [ number
number ] [ interval interval ]
```

Configuring TST

About TST

The TST function detects bit errors on a link, and monitors and manages the link transmission performance.

Hardware and feature compatibility

The S6820 switch series does not support this feature.

Restrictions and guidelines

To view the test result, use the `display cfd tst` command on the target MEP.

Procedure

To configure TST, execute the following command in any view:

```
cfd tst service-instance instance-id mep mep-id { target-mac mac-address
| target-mep target-mep-id } [ number number ] [ length-of-test length ]
[ pattern-of-test { all-zero | prbs } [ with-crc ] ]
```

Configuring EAIS

Hardware and feature compatibility

The S6820 switch series does not support this feature.

Restrictions and guidelines

Follow these guidelines when you configure EAIS on a MEP:

- You can configure EAIS on a device that does not support or is not configured with CFD. However, EAIS must collaborate with the CFD function in the network, so you must configure CFD in the network.
- You can configure EAIS on the member port of an aggregation group, but the configuration does not take effect. If you configure EAIS on the port and then add it to an aggregation group, the EAIS configuration immediately fails to take effect. After the port leaves the aggregation group, the EAIS configuration takes effect.
- If the intersection of the configured VLANs where the EAIS frames can be transmitted and the VLANs to which the port belongs is empty, no EAIS frame is sent. If the intersection contains more than 70 VLANs and the EAIS frame transmission interval is 1 second, the CPU usage will

be too high. As a best practice, set the EAIS frame transmission interval to 60 seconds in this case.

Procedure

1. Enter system view.

    system-view

2. Enable port status-AIS collaboration.

    cfd ais-track link-status global

    By default, port status-AIS collaboration is disabled.

3. Enter Layer 2 Ethernet interface view or Layer 2 aggregate interface view.

    interface *interface-type interface-number*

4. Configure the EAIS frame transmission level.

    cfd ais-track link-status level *level-value*

    By default, the EAIS frame transmission level is not configured.

5. Configure the EAIS frame transmission interval.

    cfd ais-track link-status period *period-value*

    By default, the EAIS frame transmission interval is not configured.

6. Specify the VLANs where the EAIS frames can be transmitted.

    cfd ais-track link-status vlan *vlan-list*

    By default, the EAIS frames can only be transmitted within the default VLAN of the port.

    The EAIS frames are transmitted within the intersection of the VLANs specified with this command and the existing VLANs on the device.

Configuring port collaboration

Restrictions and guidelines

Port collaboration takes effect only on the ports with outward-facing MEPs configured.

Procedure

1. Enter system view.

    system-view

2. Enter Layer 2 Ethernet interface view or Layer 2 aggregate interface view.

    interface *interface-type interface-number*

3. Configure port collaboration.

    cfd port-trigger { **cc-expire** | **rdi** } **action** { **block** | **shutdown** }

    By default, port collaboration is not configured.

Display and maintenance commands for CFD

Execute **display** commands in any view and **reset** commands in user view.

Task	Command
Display the AIS configuration and information on the specified MEP.	**display cfd ais** [**service-instance** *instance-id* [**mep** *mep-id*]]
Display the AIS configuration and information associated with the status of the specified port.	**display cfd ais-track link-status** [**interface** *interface-type*

Task	Command
	`interface-number`]
Display the one-way DM result on the specified MEP.	`display cfd dm one-way history` [`service-instance` `instance-id` [`mep` `mep-id`]]
Display LTR information received by a MEP.	`display cfd linktrace-reply` [`service-instance` `instance-id` [`mep` `mep-id`]]
Display the content of the LTR messages received as responses to the automatically sent LTMs.	`display cfd linktrace-reply` `auto-detection` [`size` `size-value`]
Display MD configuration information.	`display cfd md`
Display the attribute and running information of the MEPs.	`display cfd mep` `mep-id` `service-instance` `instance-id`
Display MEP lists in a service instance.	`display cfd meplist` [`service-instance` `instance-id`]
Display MP information.	`display cfd mp` [`interface` `interface-type interface-number`]
Display information about a remote MEP.	`display cfd remote-mep` `service-instance` `instance-id` `mep` `mep-id`
Display service instance configuration.	`display cfd service-instance` [`instance-id`]
Display CFD status.	`display cfd status`
Display the TST result on the specified MEP.	`display cfd tst` [`service-instance` `instance-id` [`mep` `mep-id`]]
Clear the one-way DM result on the specified MEP.	`reset cfd dm one-way history` [`service-instance` `instance-id` [`mep` `mep-id`]]
Clear the TST result on the specified MEP.	`reset cfd tst` [`service-instance` `instance-id` [`mep` `mep-id`]]

CFD configuration examples

Example: Configuring CFD

Network configuration

As shown in Figure 4:

- The network comprises five devices and is divided into two MDs: MD_A (level 5) and MD_B (level 3). All ports belong to VLAN 100, and the MAs in the two MDs all serve VLAN 100. Assume that the MAC addresses of Device A through Device E are 0010-FC01-6511, 0010-FC02-6512, 0010-FC03-6513, 0010-FC04-6514, and 0010-FC05-6515, respectively.

- MD_A has three edge ports: Ten-GigabitEthernet 1/0/1 on Device A, Ten-GigabitEthernet 1/0/3 on Device D, and Ten-GigabitEthernet 1/0/4 on Device E. They are all inward-facing MEPs.

MD_B has two edge ports: Ten-GigabitEthernet 1/0/3 on Device B and Ten-GigabitEthernet 1/0/1 on Device D. They are both outward-facing MEPs.

- In MD_A, Device B is designed to have MIPs when its port is configured with low level MEPs. Port Ten-GigabitEthernet 1/0/3 is configured with MEPs of MD_B, and the MIPs of MD_A can be configured on this port. You must configure the MIP generation rule of MD_A as explicit.

- The MIPs of MD_B are designed on Device C, and are configured on all ports. You must configure the MIP generation rule as default.

- Configure CC to monitor the connectivity among all the MEPs in MD_A and MD_B. Configure LB to locate link faults, and use the AIS and EAIS functions to suppress the error alarms that are reported.

- Configure port collaboration on Ten-GigabitEthernet 1/0/3 of Device B. After the outward-facing MEP on the interface detects a link fault, the interface is shut down or blocked.

- After the status information of the entire network is obtained, use LT, LM, one-way DM, two-way DM, and TST to detect link faults.

Figure 4 Network diagram
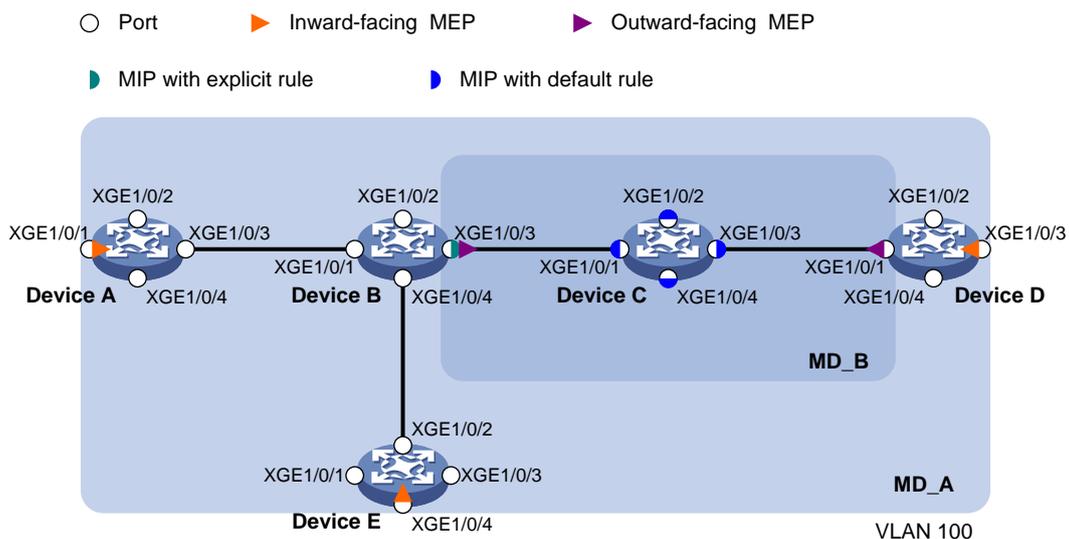
Procedure

1. Configure a VLAN and assign ports to it:
   On each device shown in Figure 4, create VLAN 100 and assign ports Ten-GigabitEthernet 1/0/1 through Ten-GigabitEthernet 1/0/4 to VLAN 100.

2. Enable CFD:
   # Enable CFD on Device A.
   ```
   <DeviceA> system-view
   [DeviceA] cfd enable
   ```
   # Configure Device B through Device E in the same way Device A is configured. (Details not shown.)

3. Configure service instances:
   # Create MD_A (level 5) on Device A, and create service instance 1 (in which the MA is identified by a VLAN and serves VLAN 100).
   ```
   [DeviceA] cfd md MD_A level 5
   [DeviceA] cfd service-instance 1 ma-id vlan-based md MD_A vlan 100
   ```
   # Configure Device E in the same way Device A is configured. (Details not shown.)

Create MD_A (level 5) on Device B, and create service instance 1 (in which the MA is identified by a VLAN and serves VLAN 100).

```
[DeviceB] cfd md MD_A level 5
[DeviceB] cfd service-instance 1 ma-id vlan-based md MD_A vlan 100
```

Create MD_B (level 3), and create service instance 2 (in which the MA is identified by a VLAN and serves VLAN 100).

```
[DeviceB] cfd md MD_B level 3
[DeviceB] cfd service-instance 2 ma-id vlan-based md MD_B vlan 100
```

Configure Device D in the same way Device B is configured. (Details not shown.)

Create MD_B (level 3) on Device C, and create service instance 2 (in which the MA is identified by a VLAN and serves VLAN 100).

```
[DeviceC] cfd md MD_B level 3
[DeviceC] cfd service-instance 2 ma-id vlan-based md MD_B vlan 100
```

4. Configure MEPs:

On Device A, configure a MEP list in service instance 1, and create inward-facing MEP 1001 in service instance 1 on Ten-GigabitEthernet 1/0/1.

```
[DeviceA] cfd meplist 1001 4002 5001 service-instance 1
[DeviceA] interface ten-gigabitethernet 1/0/1
[DeviceA-Ten-GigabitEthernet1/0/1] cfd mep 1001 service-instance 1 inbound
[DeviceA-Ten-GigabitEthernet1/0/1] quit
```

On Device B, configure a MEP list in service instances 1 and 2.

```
[DeviceB] cfd meplist 1001 4002 5001 service-instance 1
[DeviceB] cfd meplist 2001 4001 service-instance 2
```

Create outward-facing MEP 2001 in service instance 2 on Ten-GigabitEthernet 1/0/3.

```
[DeviceB] interface ten-gigabitethernet 1/0/3
[DeviceB-Ten-GigabitEthernet1/0/3] cfd mep 2001 service-instance 2 outbound
[DeviceB-Ten-GigabitEthernet1/0/3] quit
```

On Device D, configure a MEP list in service instances 1 and 2.

```
[DeviceD] cfd meplist 1001 4002 5001 service-instance 1
[DeviceD] cfd meplist 2001 4001 service-instance 2
```

Create outward-facing MEP 4001 in service instance 2 on Ten-GigabitEthernet 1/0/1.

```
[DeviceD] interface ten-gigabitethernet 1/0/1
[DeviceD-Ten-GigabitEthernet1/0/1] cfd mep 4001 service-instance 2 outbound
[DeviceD-Ten-GigabitEthernet1/0/1] quit
```

Create inward-facing MEP 4002 in service instance 1 on Ten-GigabitEthernet 1/0/3.

```
[DeviceD] interface ten-gigabitethernet 1/0/3
[DeviceD-Ten-GigabitEthernet1/0/3] cfd mep 4002 service-instance 1 inbound
[DeviceD-Ten-GigabitEthernet1/0/3] quit
```

On Device E, configure a MEP list in service instance 1.

```
[DeviceE] cfd meplist 1001 4002 5001 service-instance 1
```

Create inward-facing MEP 5001 in service instance 1 on Ten-GigabitEthernet 1/0/4.

```
[DeviceE] interface ten-gigabitethernet 1/0/4
[DeviceE-Ten-GigabitEthernet1/0/4] cfd mep 5001 service-instance 1 inbound
[DeviceE-Ten-GigabitEthernet1/0/4] quit
```

5. Configure MIPs:

Configure the MIP generation rule in service instance 1 on Device B as **explicit**.

```
[DeviceB] cfd mip-rule explicit service-instance 1
```

Configure the MIP generation rule in service instance 2 on Device C as **default**.

```
[DeviceC] cfd mip-rule default service-instance 2
```

6. Configure CC:

On Device A, enable the sending of CCM frames for MEP 1001 in service instance 1 on Ten-GigabitEthernet 1/0/1.

```
[DeviceA] interface ten-gigabitethernet 1/0/1
[DeviceA-Ten-GigabitEthernet1/0/1] cfd cc service-instance 1 mep 1001 enable
[DeviceA-Ten-GigabitEthernet1/0/1] quit
```

On Device B, enable the sending of CCM frames for MEP 2001 in service instance 2 on Ten-GigabitEthernet 1/0/3.

```
[DeviceB] interface ten-gigabitethernet 1/0/3
[DeviceB-Ten-GigabitEthernet1/0/3] cfd cc service-instance 2 mep 2001 enable
[DeviceB-Ten-GigabitEthernet1/0/3] quit
```

On Device D, enable the sending of CCM frames for MEP 4001 in service instance 2 on Ten-GigabitEthernet 1/0/1.

```
[DeviceD] interface ten-gigabitethernet 1/0/1
[DeviceD-Ten-GigabitEthernet1/0/1] cfd cc service-instance 2 mep 4001 enable
[DeviceD-Ten-GigabitEthernet1/0/1] quit
```

Enable the sending of CCM frames for MEP 4002 in service instance 1 on Ten-GigabitEthernet 1/0/3.

```
[DeviceD] interface ten-gigabitethernet 1/0/3
[DeviceD-Ten-GigabitEthernet1/0/3] cfd cc service-instance 1 mep 4002 enable
[DeviceD-Ten-GigabitEthernet1/0/3] quit
```

On Device E, enable the sending of CCM frames for MEP 5001 in service instance 1 on Ten-GigabitEthernet 1/0/4.

```
[DeviceE] interface ten-gigabitethernet 1/0/4
[DeviceE-Ten-GigabitEthernet1/0/4] cfd cc service-instance 1 mep 5001 enable
[DeviceE-Ten-GigabitEthernet1/0/4] quit
```

7. Configure AIS:

Enable AIS on Device B. Configure the AIS frame transmission level as 5 and AIS frame transmission interval as 1 second in service instance 2.

```
[DeviceB] cfd ais enable
[DeviceB] cfd ais level 5 service-instance 2
[DeviceB] cfd ais period 1 service-instance 2
```

8. Configure EAIS:

Enable port status-AIS collaboration on Device B.

```
[DeviceB] cfd ais-track link-status global
```

On Ten-GigabitEthernet 1/0/3 of Device B, configure the EAIS frame transmission level as 5 and the EAIS frame transmission interval as 60 seconds. Specify the VLANs where the EAIS frames can be transmitted as VLAN 100.

```
[DeviceB] interface ten-gigabitethernet 1/0/3
[DeviceB-Ten-GigabitEthernet1/0/3] cfd ais-track link-status level 5
[DeviceB-Ten-GigabitEthernet1/0/3] cfd ais-track link-status period 60
[DeviceB-Ten-GigabitEthernet1/0/3] cfd ais-track link-status vlan 100
[DeviceB-Ten-GigabitEthernet1/0/3] quit
```

9. Configure port collaboration on Ten-GigabitEthernet 1/0/3:

Specify the triggering event as **cc-expire** and triggered action as **shutdown** for port collaboration on the interface.

```
[DeviceB-Ten-GigabitEthernet1/0/3] cfd port-trigger cc-expire action shutdown
```

Specify the triggering event as **rdi** and triggered action as **block** for port collaboration on the interface.

```
[DeviceB-Ten-GigabitEthernet1/0/3] cfd port-trigger rdi action block
[DeviceB-Ten-GigabitEthernet1/0/3] quit
```

Verifying the configuration

1. Verify the LB function when the CC function detects a link fault:

   # Enable LB on Device A to check the status of the link between MEP 1001 and MEP 5001 in service instance 1.

   ```
   [DeviceA] cfd loopback service-instance 1 mep 1001 target-mep 5001
   Loopback to MEP 5001 with the sequence number start from 1001-43404:
   Reply from 0010-fc05-6515: sequence number=1001-43404 time=5ms
   Reply from 0010-fc05-6515: sequence number=1001-43405 time=5ms
   Reply from 0010-fc05-6515: sequence number=1001-43406 time=5ms
   Reply from 0010-fc05-6515: sequence number=1001-43407 time=5ms
   Reply from 0010-fc05-6515: sequence number=1001-43408 time=5ms
   Sent: 5        Received: 5        Lost: 0
   ```

2. Verify the LT function after the CC function obtains the status information of the entire network:

   # Identify the path between MEP 1001 and MEP 5001 in service instance 1 on Device A.

   ```
   [DeviceA] cfd linktrace service-instance 1 mep 1001 target-mep 5001
   Linktrace to MEP 5001 with the sequence number 1001-43462:
   MAC address              TTL     Last MAC        Relay action
   0010-fc05-6515           63      0010-fc02-6512  Hit
   ```

3. Verify the LM function after the CC function obtains the status information of the entire network:

   # Test the frame loss from MEP 1001 to MEP 4002 in service instance 1 on Device A.

   ```
   [DeviceA] cfd slm service-instance 1 mep 1001 target-mep 4002
   Reply from 0010-fc04-6514
   Far-end frame loss: 10    Near-end frame loss: 20
   Reply from 0010-fc04-6514
   Far-end frame loss: 40    Near-end frame loss: 40
   Reply from 0010-fc04-6514
   Far-end frame loss: 0     Near-end frame loss: 10
   Reply from 0010-fc04-6514
   Far-end frame loss: 30    Near-end frame loss: 30


   Average
   Far-end frame loss: 20    Near-end frame loss: 25
   Far-end frame loss rate: 25.00%    Near-end frame loss rate: 32.00%
   Send LMMs: 5        Received: 5        Lost: 0
   ```

4. Verify the one-way DM function after the CC function obtains the status information of the entire network:

   # Test the one-way frame delay from MEP 1001 to MEP 4002 in service instance 1 on Device A.

   ```
   [DeviceA] cfd dm one-way service-instance 1 mep 1001 target-mep 4002
   5 1DMs have been sent. Please check the result on the remote device.
   ```

   # Display the one-way DM result on MEP 4002 in service instance 1 on Device D.

   ```
   [DeviceD] display cfd dm one-way history service-instance 1 mep 4002
   Service instance: 1
   MEP ID: 4002
   Sent 1DM total number: 0
   ```

```
Received 1DM total number: 5
Frame delay: 10ms 9ms 11ms 5ms 5ms
Delay average: 8ms
Delay variation: 5ms 4ms 6ms 0ms 0ms
Variation average: 3ms
```

5. Verify the two-way DM function after the CC function obtains the status information of the entire network:

    # Test the two-way frame delay from MEP 1001 to MEP 4002 in service instance 1 on Device A.

```
[DeviceA] cfd dm two-way service-instance 1 mep 1001 target-mep 4002
Frame delay:
Reply from 0010-fc04-6514: 2406us
Reply from 0010-fc04-6514: 2215us
Reply from 0010-fc04-6514: 2112us
Reply from 0010-fc04-6514: 1812us
Reply from 0010-fc04-6514: 2249us
Average: 2158us
Frame delay variation: 191us 103us 300us 437us
Average: 257us
Packet statistics:
Sent DMMs: 5        Received: 5        Lost: 0
```

6. Verify the TST function after the CC function obtains the status information of the entire network:

    # Test the bit errors on the link from MEP 1001 to MEP 4002 in service instance 1 on Device A.

```
[DeviceA] cfd tst service-instance 1 mep 1001 target-mep 4002
5 TSTs have been sent. Please check the result on the remote device.
```

    # Display the TST result on MEP 4002 in service instance 1 on Device D.

```
[DeviceD] display cfd tst service-instance 1 mep 4002
Service instance: 1
MEP ID: 4002
Sent TST total number: 0
Received TST total number: 5
Received from 0010-fc01-6511, Bit True,  sequence number 0
Received from 0010-fc01-6511, Bit True,  sequence number 1
Received from 0010-fc01-6511, Bit True,  sequence number 2
Received from 0010-fc01-6511, Bit True,  sequence number 3
Received from 0010-fc01-6511, Bit True,  sequence number 4
```