Description

As Ethernet technologies made their way into the Metropolitan Area Networks (MAN) and the Wide Area Networks (WAN), from the conventional enterprise level usage, they are now widely being used by service providers to provide end-to-end connectivity to customers. Such service provider networks are typically spread across large geographical areas. Additionally, the service providers themselves may be relying on certain internet backbone providers, referred to as “operators”, to provide connectivity in case the geographical area to be covered is too huge. This mode of operation makes the task of **Operations, Administration and Maintenance (OAM)** of such networks to be far more challenging, and the ability of service providers to respond to such network latency and jitter swiftly directly impacts their competitiveness.

In order to facilitate the process of measuring the delay in the network, the Ethernet OAM Delay Measurement (DM) protocol was introduced in the ITU-T Y.1731 standard.

The Eth OAM Connectivity Fault Management (CFM - 802.1ag) functionality uses special Ethernet frames with Ether Type value as 0x8902 for achieving its various functions.

Currently, Single-Ended or Two-Way Delay Measurement is supported.
The way it works is that the Transmitter generates DMM (Delay Measurement Message) PDU, records and stamps the time of transmission (txTimeF) in the DMM. The Responder, when receiving the DMM, records the receiving time (rxTimeF) and generates the DMR (Delay Measurement Reply) PDU. It then records and stamps the transmission time (txTimeB) in the DMR along with the transmission time of DMM.

When the Transmitter receives the DMR PDU, it records the receiving time (rxTimeB) and uses that timestamp along with the three timestamps available in the received DMR to calculate the statistics like Two-Way Delay using the below formula.

Two-Way Delay = (rxTimeB - txTimeF) - (txTimeB - rxTimeF)

rxTimeB and txTimeF timestamps are generated by Transmitter. txTimeB and rxTimeF timestamps are generated by Responder. Hence, the Transmitter and Responder don’t need to synchronize the clocks to make the Single-Ended or Two-Way Delay Measurement working.

Platform Compatibility

All 7500R3<X>, 7800R3<X>, DCS-7280<X>R3<X> except on systems where at least one FAP has “Revision” as “Q2c2t<X>”. To check the FAP “Revision”, run show platform fap

```
Arista#show platform fap

Switches currently in the system

   Name       Type           Device          Revision
---------- -------------- --------------- --------------
```

```
   Fap0       Jericho2       Jericho2c       Q2c2tA1
```

Feature History

Release	Update
EOS-4.28.0F	Initial introduction, support DM on Up MEPs
EOS-4.30.0F	Introduced support for DM on Down MEPs. Platform compatibility is the same as that of Up MEP except **not supported** additionally on **DCS-7280DR3A<X>** systems.
EOS-4.31.0F	Introduced support for DM on Layer 2 and Layer 3 LAG sub-interfaces patched to to pseudowires on up MEP. Introduced support for DM on Layer 2 and Layer 3 LAG sub-interfaces on Down MEP. Introduced support for DM on Layer 3 Front Panel LAG interfaces on Down MEP. For Down MEP, platform compatibility is the same as that of Up MEP except **not supported** additionally on **DCS-7280DR3A<X>** systems.
EOS-4.32.0F	Introduced support for DM on Layer 2 and Layer 3 LAG sub-interfaces on Down MEP on **DCS-7280DR3A<X>** systems. Introduced support for DM on Layer 3 Front Panel LAG interfaces on Down MEP **DCS-7280DR3A<X>** systems.
EOS-4.33.0F	Introduced support for DM on pseudowire front panel ports on Up and Down MEP.
EOS-4.33.1F	Introduced support for DM on subinterfaces with flex-encap configuration.

Configuration

Setting up the TCAM profile

We need to add the `cfm` feature to the operational PMF profile.

```
Arista(config)#hardware tcam
```

```
Arista(config-tcam)#profile <string> copy default
Arista(config-tcam-profile-<string>)#feature cfm
Arista(config-tcam-feature-cfm)#packet non-ip forwarding bridged
Arista(config-tcam-feature-cfm)#packet ipv4 forwarding bridged
Arista(config-tcam-feature-cfm)#packet ipv6 forwarding bridged
Arista(config-tcam-feature-cfm)#exit
Arista(config-tcam-profile-<string>)#exit
Arista(config-tcam)#system profile <string>
```

Setting up the MDB profile

The MDB profile needs to be changed to `balanced-xl` or ‘balanced’

```
Arista(config)#platform sand mdb profile [balanced-xl | balanced]
```

Delay Measurement configuration

Entering CFM mode

All the Delay Measurement related configurations are grouped under the CFM mode.

```
Arista(config)#cfm
Arista(config-cfm)#
```

Setting up CFM profiles

```
Arista(config-cfm)#
Arista(config-cfm)#profile <string>
Arista(config-cfm-profile-<string>)#measurement delay ?
  single-ended  Configure single-ended performance measurement
  tx-interval   Configure interval between successive frames
```

Enabling DMM transmission

This is to enable the transmission of Two-Way or Single-Ended DMM PDUs in proactive mode. Currently, only proactive mode is supported, which is also the default mode.

```
Arista(config-cfm-profile-string)#measurement delay single-ended
```

Set Transmission Interval

This is to set the transmission time interval at which DMM PDUs are transmitted. By default, 1000 milliseconds or 1 second is the time interval.

```
Arista(config-cfm-profile-string)#measurement delay tx-interval ?
  <10-600000>  Interval between successive measurement frames
```

Below is the list of supported time intervals and the corresponding commands.

10 milliseconds

```
Arista(config-cfm-profile-string)#measurement delay tx-
interval 10 milliseconds
```

100 milliseconds

```
Arista(config-cfm-profile-string)#measurement delay tx-
interval 100 milliseconds
```

1000 milliseconds (1 second)

```
Arista(config-cfm-profile-string)#measurement delay tx-
interval 1000 milliseconds
```

10000 milliseconds (10 seconds)

```
Arista(config-cfm-profile-string)#measurement delay tx-
interval 10000 milliseconds
```

60000 milliseconds (1 minute)

```
Arista(config-cfm-profile-string)#measurement delay tx-
interval 60000 milliseconds
```

600000 milliseconds (10 minutes)

```
Arista(config-cfm-profile-string)#measurement delay tx-
interval 600000 milliseconds
```

Error message in case of invalid transmission time interval

When invalid value is provided then the below error message is displayed. The invalid value here means any value not belonging to the supported time intervals mentioned above.

```
Arista(config-cfm-profile-string)#measurement delay tx-
interval 90 milliseconds
Supported tx-
interval values on this platform: 10, 100, 1000, 10000, 60000, 600000
```

Configuring Maintenance Domains (MDs)

Upto 8 MDs are supported, as per the standards.

```
Arista(config-cfm)#domain ?
  WORD  Configure a maintenance domain

Arista(config-cfm)#domain <domainName> ?
  level  Configure a maintenance domain level

Arista(config-cfm)#domain <domainName> level ?
  <0-7>  Maintenance domain level

Arista(config-cfm)#domain <domainName>  level <domainLevel>
Arista(config-cfm-md-<domainName>)#
```

Configuring Maintenance Associations (MAs)

NOTE: Currently, only the 2B integer format is supported as MA name. Support for other formats to be introduced later.

```
Arista(config-cfm-md-<domainName>)#association <maName>
```

Set direction for Maintenance End Points (MEPs)

NOTE: Both up MEPs and Down MEPs are supported.

```
Arista(config-cfm-md-<domainName>-ma-<maName>)#direction ?
  up  Set direction as Up
  down Set direction as Down
```

Attaching a CFM Profile

```
Arista(config-cfm-md-<domainName>-ma-<maName>)#profile <string>
```

Configuring Maintenance Association VLAN

```
Arista(config-cfm-md-<domainName>-ma-<maName>)#vlan <id>
```

For DM support on sub-interfaces having “unmatched” flexible encapsulation, the MA VLAN is required. This is to specify the bridging domain over which DMM packets need to be sent over.

Configuring MEPs

```
Arista(config-cfm-md-<domainName>-ma-<maName>)#end-point ?
  <1-8191>  Set local maintenance end point ID
Arista(config-cfm-md-<domainName>-ma-<maName>)#end-point <mepId>
```

Set MEP Interface

NOTE: Layer 2 and layer 3 Ethernet and LAG sub-interfaces are supported on both “up” and “down” MEP direction. Layer 3 Ethernet and LAG is supported specifically for MEP in “Down” direction.

```
Arista(config-cfm-
md-<domainName>-ma-<maName>-mep<mepId>)#interface <interfaceName>
```

Adding Remote-MEPs

Remote end-points can be added with the below command. Currently, Delay Measurement works for Point-to-Point (P2P) ETH-Connectivity. P2P means that there should be a single Remote MEP configured under a local MEP.

Even though add and range options are exposed, it must be kept in mind that only 1 remote MEP is configured under a local MEP.

NOTE: The ‘add’ keyword is optional.

```
Arista(config-cfm-md-<domainName>-ma-<maName>-mep<mepId>)#remote end-
point [add] ?
  $         list end
  <1-8191>  Remote maintenance end point ID(s) or range(s) of remote m
aintenance end point ID(s)
```

Show Commands

Delay Measurement Information

```
Arista(config)#show cfm measurement delay proactive [domain <domainNam
e> [association <maName> [end-point <mepId>] ] ] [detail]
```

Limitations

1. MEPs can only be configured on pseudowire front panel ports, L2 sub-interfaces and L3 sub-interfaces patched to pseudowires and thus Delay Measurement can work only with these interfaces.
2. Only Single-Ended or Two-Way Delay Measurement is supported.
3. Only proactive Delay Measurement is supported. On-demand Delay Measurement will be supported later.
4. Delay Measurement is only supported for Point-to-Point (P2P) ETH Connectivity. Delay Measurement for Point-to-Multipoint ETH Connectivity will be supported later.
5. Delay measurement is not supported on CFM MEP with direction “Up” on interfaces where egress sFlow is active.
6. Delay measurement is not supported on flexible encapsulation sub-interfaces with VLAN tag ranges or multiple encapsulations.

Examples

Switch1 is the Transmitter where a local UP MEP with ID=1 is configured on et1/2.1, under Domain with name as domain1 and level as 1, Association 1. This local MEP will transmit the proactive, single-ended DMM PDUs towards the remote MEP having ID=2.

Switch2 is the Responder where a local UP MEP with ID=2 (remote to Switch1) is configured on et2/1.1, under Domain with name as domain1 and level as 1, Association2. This local MEP will respond to the received DMM, towards the remote MEP having ID=1.

Transmitter

Below are the configurations required at the Transmitter side in order to enable the transmission of DMM PDUs

```
# Go to cfm mode
Switch1(config)#cfm

# Create a CFM profile with name as `dmm`
Switch1(config-cfm)#profile dmm
```

```
# Enable single-ended Delay Measurement
Switch1(config-cfm-profile-dmm)#measurement delay single-ended

# Set Time Interval as 1 second
Switch1(config-cfm-profile-dmm)#measurement delay tx-
interval 1000 milliseconds

# Configure local MEP ID=1 and remote MEP ID=2 under Domain with name
as domain1 and level as 1 and Association 1
Switch1(config-cfm)#domain domain1 level 1
Switch1(config-cfm-md-domain1)#association 1
Switch1(config-cfm-md-domain1-ma-1)#profile dmm
Switch1(config-cfm-md-domain1-ma-1)#direction up
Switch1(config-cfm-md-domain1-ma-1)#end-point 1
Switch1(config-cfm-md-domain1-ma-1-mep1)#remote end-point 2
Switch1(config-cfm-md-domain1-ma-1-mep1)#int et1/2.1
```

Responder

Below are the configurations required at the Responder side. Note that if the Responder is the Arista device then we don't need any Delay Measurement configuration. We just need to configure the local MEP (which is remote to the Transmitter) and remote MEP (which is local to the Transmitter) on the Responder device.

```
# Configure a local MEP ID=2 and remote MEP ID=1 under the Domain with
 name as domain1 and level as 1 and Association 1

Switch2(config)#cfm
Switch2(config-cfm)#domain domain1 level 1
Switch2(config-cfm-md-domain1)#association 1
Switch2(config-cfm-md-domain1-ma-1)#direction up
Switch2(config-cfm-md-domain1-ma-1)#end-point 2
Switch2(config-cfm-md-domain1-ma-1-mep2)#remote end-point 1
Switch2(config-cfm-md-domain1-ma-1-mep2)#int et2/1.1
```

Once the Responder side configurations are done, retrieve the statistics at the Transmitter device by running the below commands at the Transmitter device

```
# Get the Delay Measurement statistics
Switch1(config)#show cfm measurement delay proactive
Maintenance domain: domain1
```

```
Maintenance association: 1, Direction: up
Measurement type: proactive, TX interval: 1000 milliseconds
Maintenance end point ID: 1, Interface: Ethernet1/2.1
Remote MEP ID: 2, Status: enabled
Start time: 0:00:01 ago
Number of samples: 2
Average two-way delay: 315 usec
Average two-way delay variation: 4 usec
Best case two-way delay: 310 usec at 0:00:01 ago
Worst case two-way delay: 320 usec at 0:00:00 ago

# Get the detailed Delay Measurement statistics
# It shows the last 10 Two-Way delays
Switch1(config)#show cfm measurement delay proactive detail
Maintenance domain: domain1
Maintenance association: 1, Direction: up
Measurement type: proactive, TX interval: 1000 milliseconds
Maintenance end point ID: 1, Interface: Ethernet1/2.1
Remote MEP ID: 2, Status: enabled
Start time: 0:01:22 ago
Number of samples: 83
Average two-way delay: 320 usec
Average two-way delay variation: 20 usec
Best case two-way delay: 264 usec at 0:00:07 ago
Worst case two-way delay: 395 usec at 0:00:34 ago
   Index    Two-way Delay (usec)
---------- --------------------
       1                305.178
       2                306.878
       3                283.742
       4                349.322
       5                291.718
       6                305.607
       7                317.472
       8                264.792
       9                311.296
      10                 328.36
```

References

Ethernet OAM Connectivity Fault Management (CFM) TOI