IEEE 802.1Qcx (CFM)
Data Model Overview

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IEEE 802.1 (P802.1Qcx) CFM related data model objects will be on its own branch of the hierarchy

- Facilitates utilization of CFM on devices inclusive of 802.1Q Bridges
IEEE 802.1Qcx Model
BRIDGE/COMPONENT TO CFM RELATIONSHIPS

- Introduction of a maintenance-group data node
  - Represents <MD, MA> pairing
  - Provides a “simple” reference to CFM configuration pertaining to a single MA
  - Provides a single context for managing the configuration and fault reporting of all MEPs associated with the same MA
  - Provides a single reference for MEPs sharing a common MA can significantly simplify the configuration

- The Maintenance Association Component object contains the configuration and operational information of the MA that is variable across Bridges (or across components within a Bridge) within the MD.

- For ITU-T SG15 Y.1731 modeling,
  - MEG-ID can be supported by setting the md-name-format to 'none', the ma-name-format to 'icc-format', and then fill in the ma-name with the MEG ID value.

• Bridge
  - macAddress address rw
  - str name rw
  - enum type rw
  - int number-of-ports rw
  - list* port-list ro
  - counter up-time ro

• Component
  - int32 component-id ro
  - enum component-type ro
  - macAddress address ro
  - int number-of-ports ro
  - boolean-array capabilities ro
  - boolean traffic-class-enabled rw

• Default MD Level
  - int primary-service-id rw
  - list* service-ids rw
  - ref device-ref rw
  - int md-level-mhf rw
  - enum mhf-creation rw
  - enum id-permission rw
  - bool md-status rw

• CFM Stack
  - if-ref port rw
  - int md-level rw
  - enum direction rw
  - int service-id rw
  - ref device-ref rw
  - ref maintenance-domain ro
  - ref maintenance-association ro
  - string maintenance-group ro
  - int mep-id ro
  - macAddress address ro

• Configuration Error List
  - if-ref port rw
  - int service-id rw
  - ref device-ref rw
  - enum error-type ro

• Maintenance Domain
  - int md-index rw
  - enum md-name-format rw
  - choice md-name rw
  - ref device-ref rw
  - int md-level rw
  - enum mhf-creation rw
  - enum id-permission rw
  - address fault-alarm-address rw

• Maintenance Association
  - int ma-index rw
  - enum short-ma-name-format rw
  - choice short-ma-name rw
  - enum ccm-interval rw
  - address fault-alarm-address rw
  - string maintenance-group rw

• Maintenance Association Component
  - list* service-ids rw
  - enum mhf-creation rw
  - enum id-permission rw
When a MEP is created, it will reference an **Interface** and a **maintenance-group**
- From an IEEE 802.1Q perspective, the **Interface** would be a **Bridge Port**
- Other users of this model may choose to use different **Interface** types
IEEE 802.1Qcx Model
CFM MEP OBJECT RELATIONSHIPS

• The CFM protocol session configuration and operational data attributes are associated to a MEP via a **mep-id** and **maintenance-group**
  – ITU-T SG15 Y.1731 protocols (e.g., ETH-LM, ETH-DM, ETH-SLM, etc.) can be modeled similarly
IEEE 802.1Qcx Model

CFM MIP OBJECT RELATIONSHIPS

• OPTIONAL:
  − We can support an “explicit” MIP creation model
  − The MIP is associated with an Interface (e.g., Bridge Port)
  − This mode is not an uncommon configuration practice within the industry
IEEE 802.1Qcx Model

CFM TRANSMIT COMMANDS AND NOTIFICATIONS

**TRANSMIT-LOOPBACK-MESSAGE** and **TRANSMIT-LINKTRACE-MESSAGE** commands can (also) be implemented by RPCs (Remote Procedure Calls)

<table>
<thead>
<tr>
<th>TRANSMIT-LOOPBACK()</th>
</tr>
</thead>
<tbody>
<tr>
<td>string maintenance-group rw</td>
</tr>
<tr>
<td>int mep-id rw</td>
</tr>
<tr>
<td>enum interval rw</td>
</tr>
<tr>
<td>choice target-address rw</td>
</tr>
<tr>
<td>int lbm-tx-number rw</td>
</tr>
<tr>
<td>str data rw</td>
</tr>
<tr>
<td>bool data-tlv rw</td>
</tr>
<tr>
<td>int priority rw</td>
</tr>
<tr>
<td>int dei rw</td>
</tr>
<tr>
<td>bool lbm-result-ok ro</td>
</tr>
<tr>
<td>int loopback-trans-id ro</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TRANSMIT-LINKTRACE()</th>
</tr>
</thead>
<tbody>
<tr>
<td>string maintenance-group rw</td>
</tr>
<tr>
<td>int mep-id rw</td>
</tr>
<tr>
<td>enum interval rw</td>
</tr>
<tr>
<td>choice target-address rw</td>
</tr>
<tr>
<td>int ltm-flags rw</td>
</tr>
<tr>
<td>str ltm-flags rw</td>
</tr>
<tr>
<td>bool ltm-result-ok ro</td>
</tr>
<tr>
<td>int ltm-seq-number ro</td>
</tr>
<tr>
<td>string ltm-egress-identifier ro</td>
</tr>
</tbody>
</table>

Notification (Traps/Alarms) for MEP FAULT ALARM

**MEP FAULT ALARM**

<table>
<thead>
<tr>
<th>string maintenance-group</th>
</tr>
</thead>
<tbody>
<tr>
<td>enum md-name-format</td>
</tr>
<tr>
<td>choice md-name</td>
</tr>
<tr>
<td>enum ma-name format</td>
</tr>
<tr>
<td>choice ma-name</td>
</tr>
<tr>
<td>int mep-id</td>
</tr>
<tr>
<td>enum mep-priority-defect</td>
</tr>
</tbody>
</table>
Configuration Examples

XML Representation

**NOTE:** There is much detail missing from the configuration example. The intent is to illustrate the flow of the configuration steps based upon the current proposed model structure.
Example Customer VLAN Bridge Configuration (Qcp)

- Configuration example of a **Customer VLAN Bridge** with two bridge ports

```
<bridges xc:operation="create">
  <bridge>
    <name>my-bridge</name>
    <address>01-12-23-34-45-AF</address>
    <bridge-type>customer-vlan-bridge</bridge-type>
    <component>
      <name>my-component</name>
      <id>1</id>
      <type>c-vlan-component</type>
      <address>01-12-23-34-45-56</address>
    </component>
    <bridge-vlan>
      <vlan>
        <vid>1001</vid>
        <name>vid1001</name>
      </vlan>
    </bridge-vlan>
  </bridge>
</bridges>
```

a) Bridge and associated C-VLAN Component created as a result of configuration

b) Configure VLANs supported by the Bridge
c) CVLAN Bridge Ports are created and associated with the C-VLAN Component
Example MEG ID Configuration

- Configuration example of a **Maintenance Entity Group ID (MEGID)** associated with a Bridge (*my-bridge*)

```xml
<cfm xc:operation="create">
  <bridge>my-bridge</bridge>
  <maintenance-domains>
    <maintenance-domain>
      <index>1</index>
      <name-format>none</name-format>
      <md-level>4</md-level>
      <maintenance-association>
        <index>1</index>
        <name-format>icc-format</name-format>
        <name>my-meg-id-val</name>
        <maintenance-group>maintenance-group-1</maintenance-group>
      </maintenance-association>
    </maintenance-domain>
  </maintenance-domains>
</cfm>
```
Example MAID Configuration

- Configuration example of a **Maintenance Association ID (MAID)** associated with a Bridge (*my-bridge*)

```
<cfm xc:operation="create">
  <maintenance-domains>
    <maintenance-domain>
      <index>2</index>
      <name-format>char-string</name-format>
      <name>my-domain</name>
      <md-level>4</md-level>
      <maintenance-association>
        <index>2</index>
        <name-format>char-string</name-format>
        <name>my-association</name>
        <maintenance-group>maintenance-group-2</maintenance-group>
      </maintenance-association>
    </maintenance-domain>
  </maintenance-domains>
</cfm>
```
Example MEP Creation Configuration

- Configuration example of a **Maintenance Association End Point (MEP)** on Bridge Port *(port-1)*

```xml
<cfm>
  <mep xc:operation="create">
    <port>port-1</port>
    <maintenance-group>maintenance-group-1</maintenance-group>
    <mep-id>100</mep-id>
    <direction>up</direction>
    <admin-state>true</admin-state>
  </mep>
</cfm>
```

- The MEP is associated with the maintenance-group identifier. This provides a pointer to all the maintenance-domain and maintenance-association (or in ITU-T case, the MEG ID) information to be used by this MEP.
Example Loopback Session Configuration

- Configuration example of a **Loopback Session** associated with a MEP

```xml
<cfm>
  <loopback>
    <port>port-1</port>
    <maintenance-group>maintenance-group-1</maintenance-group>
    <mep-id>100</mep-id>
    <dest-mac-address>01-AB-BC-CD-DE-EE</dest-mac-address>
    <count>3</count>
    <priority>5</priority>
    <interval>1sec</interval>
    <status>true</status>
  </loopback>
</cfm>
```
Example CCM Session Configuration

• Configuration example of a **Continuity Check Message Session** associated with a MEP

```xml
<cfm>
  <continuity-check>
    <ccm-enabled>true</ccm-enabled>
    <port>port-1</port>
    <maintenance-group>maintenance-group-1</maintenance-group>
    <mep-id>100</mep-id>
    <priority>7</priority>
    <interval>1sec</interval>
  </continuity-check>
</cfm>
```
Example MIP Configuration

- Configuration example of a **Maintenance Association Intermediate Point (MIP)** (explicit mode)

```xml
<cfm>
  <mip>
    <port>port-2</port>
    <service-type>vlan-id</service-type>
    <service-id>
      <vid>1001</vid>
    </service-id>
    <md-level>4</md-level>
  </mip>
</cfm>
```
Example MIP Configuration

- Configuration example of a **Maintenance Association Intermediate Point (MIP)** (indirect mode)

```xml
<cfm>
  <default-md-levels>
    <default-md-level>
      <component-id>1</component-id>
      <primary-service-id>
        <vid>1001</vid>
      </primary-service-id>
    </default-md-level>
  </default-md-levels>
</cfm>
```
Example Remote MEP Configuration

• Configuration example of a **Remote MEP**

```xml
<cfm>
  <mep>
    <port>port-1</port>
    <maintenance-group>maintenance-group-1</maintenance-group>
    <active-rmeps>5101</active-rmeps>
  </mep>
</cfm>
```
Example MEP Stats Retrieval Configuration

- Configuration example for retrieving MEP Stats

```xml
<rpc message-id="99">
  <get-config>
    <source>
      <running/>
    </source>
    <filter type="subtree">
      <top>
        <cfm>
          <mep>
            <port>port-1</port>
            <maintenance-group>maintenance-group-1</maintenance-group>
            <stats/>
          </mep>
        </cfm>
      </top>
    </filter>
  </get-config>
</rpc>

<rpc-reply message-id="99">
  <data>
    <top>
      <cfm>
        <mep>
          <port>port-1</port>
          <maintenance-group>maintenance-group-1</maintenance-group>
          <stats>
            <mep-ccm-sequence-errors>0</mep-ccm-sequence-errors>
            <mep-ccms-sent>0</mep-ccms-sent>
            <mep-lbr-in>0</mep-lbr-in>
            <mep-lbr-out>0</mep-lbr-out>
          </stats>
        </mep>
      </cfm>
    </top>
  </data>
</rpc-reply>
```
CFM YANG (ieee802-dot1q-cfm)
https://github.com/YangModels/yang/blob/master/standard/ieee/802.1/draft/ieee802-dot1q-cfm.yang