G.8031 1:1 Linear Protection Switching

A view from ITU-T Q9 SG15
Contents

- Overview of G.8031 protection functions
  - The Protected Entity
  - 1-Phase APS Protocol
  - Protection Types
  - Switching Triggers
  - Bridge and Selector
  - Signaling Channel / Information
  - Switching Logic / Algorithm

- P802.1Qay: Current Preliminary Agreements

- P802.1Qay: Current Open Issues / Options

- Considerations

- Summary
The Protected Entity

- VLAN based Ethernet sub network connection (SNC)
  - G.8031 accommodates either a single VID or two different VIDs to define working and protection transport entities for protection switching
    - Two disjointed transport entities shall be used as working/protection transport entities.
  - SNC covers single link connection, subnetwork connection and trail.

W and P use different VIDs

W and P use the same VID
1-Phase APS Protocol

- Simplest APS protocol
  - Faster switching time than 2-Phase/3-Phase APS
  - But unnecessary temporal interruption may happen.
    - 2-Phase and 3-Phase APS can avoid this interruption.
    - However, it only occurs when a certain combination of events happen during a short period.
      - The number of possible combination of events are six. (LO x {FS,SF,MS}, SF-P x {FS,SF,MS})
      - The interval of two events is less than RTT/2. (RTT: Round Trip Time between two protection end points.)
    - Also duration of a temporal interruption is at most RTT which is shorter than the switching time for SF in 2-Phase APS.
Protection Types

- **1+1 Uni/Bi-directional and 1:1 Bi-directional**
  - 1:1 Uni-directional architecture is not supported.
    - State transitions become more complex than that of 1:1 bi-directional architecture.
    - However, it still requires coordination mechanisms (i.e. APS) between two protection end points.

- **Revertive / Non-revertive operation**
  - Revertive operation is useful when the working transport entity is more optimized or the protection transport entity carries best effort traffic.
  - Non-revertive operation can minimize the number of switching and service outage time.

- In addition to a switching request, **configured protection type is also signaled to the other end point** so that configuration mismatch can be detected or both end points can fall back to an interoperable state.
Switching Triggers

- Detection/Clearing of SF (Signal Fail):
  - SF: Loss of CCM, SF signal passed up from underlying (sub)layer
  - Switching is performed when hold-off timer expires after detection of SF.

- Operator’s request:
  - Lockout, Forced switch, Manual switch, Clear

- Remote request:
  - Switching request indicated in received APS information from the other side.

  Protection switching algorithm is based on priorities assigned to all triggers.
Bridge and Selector

- **1+1 Uni-/Bi-directional protection switching**
  - Permanent bridge and selective selector

- **1:1 Bi-directional protection switching**
  - Selector bridge and selective selector
    - Merging selector is not recommended because it may cause frame mis-ordering subsequent to a protection switching event.
    - Also broadcast bridge is not recommended because it may cause frame duplication subsequent to a protection switching event.
Signaling Channel / Information

- ETH-APS defined in Y.1731 is used as a signaling channel.
- Majority of OAM common fields are defined in Y.1731.
  - Version, OpCode and Flags fields are defined in Y.1731.
- APS Specific information (“APS Data” in Figure 9.10-1/Y.1731) is defined in G.8031.
  - 4 bytes APS specific information and TLV Offset value are defined in G.8031.

---

**Figure 9.10-1/Y.1731 – APS PDU format**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MEL

Configurable

Defined by Y.1731

Defined by G.8031
**Signaling Channel / Information (cont’d)**

- **APS specific information**
  - **Request/State**: the top priority global request determined by the switching logic/algorithm.
  - **Protection Type**: APS or no APS, 1:1 or 1+1, Uni- or Bi-directional, revertive or non-revertive
  - **Requested Signal**: the signal which the near end requests be carried over the protection transport entity.
  - **Bridged Signal**: the signal which the near end bridges onto the protection transport entity.

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**Prot. Type**

<table>
<thead>
<tr>
<th>Request/State</th>
<th>Requested Signal</th>
<th>Bridged Signal</th>
<th>Reserved</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 11-2/G.8031/Y.1342 – APS specific information format
Switching Logic / Algorithm

Figure 11-3/G.8031/Y.1342 – Principle of 1+1/1:1 linear protection switching algorithm
Switching Logic /Algorithm (cont’d)

- Example: During manual switching, signal fail is detected at the near end, also lockout of protection is signaled from the far end.

**Figure 11-3/G.8031/Y.1342 – Principle of 1+1/1:1 linear protection switching algorithm**
Some Observations

- G.8031 signaling information includes support for operator requests, which are processed (along with automatic requests) by the defined 1-phase switching protocol.
- Required signaling information could be carried:
  - in the CCM TLV currently under discussion in 802.1 or
  - G.8031 APS PDU
- Regardless of the signaling channel selected (i.e., APS PDU or CCM TLV), a similar switching logic/algorithmm to G.8031 will be required for PBB-TE.
G.8031 includes a set of elements/functions which together comprise a protection switching subsystem.

The switching architecture presented here appears to be compatible with the forwarding being proposed in 802.1; the APS mechanism needs to be agreed - this presentation describes the solution used in G.8031.

We believe our experience with transport systems could be of benefit to the work in 802.1 on PBB-TE.
REFERENCE
Frame mis-ordering by merging selector

- Selector bridge and merging selector

Frame mis-ordering may occur
Frame duplication by broadcast bridge

Broadcast bridge and selective selector

- Broadcast bridge and selective selector
  - Work
  - Protection
  - Manual Switch
  - Operate bridge and send APS
  - Receive APS and operate selector
  - Frame duplication may occur