G.8031 1:1 Linear Protection Switching
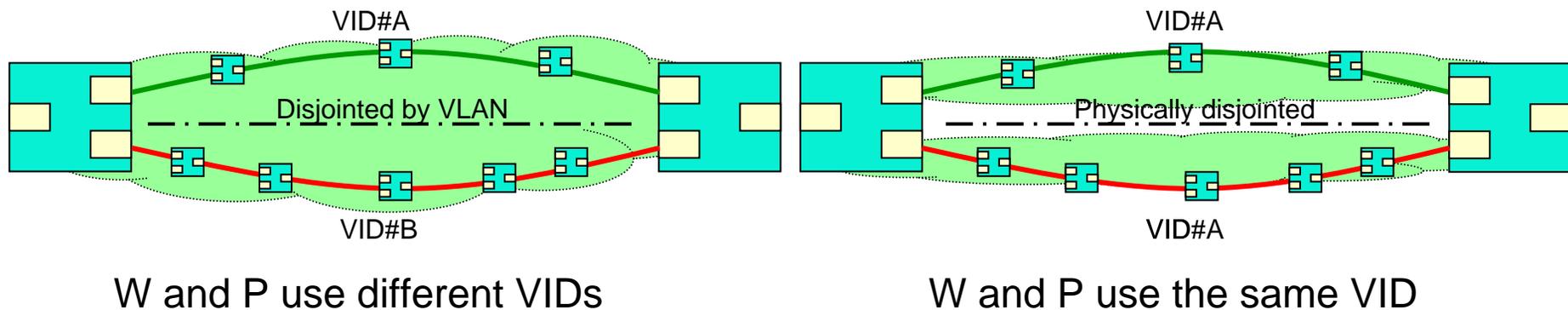
A view from ITU-T Q9 SG15

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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.

VID#A

Disjointed by VLAN

VID#B

W and P use different VIDs

VID#A

Physically disjointed

VID#A

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.

End B

End A

1-Phase

2-Phase

Only bridge is operated.

3-Phase
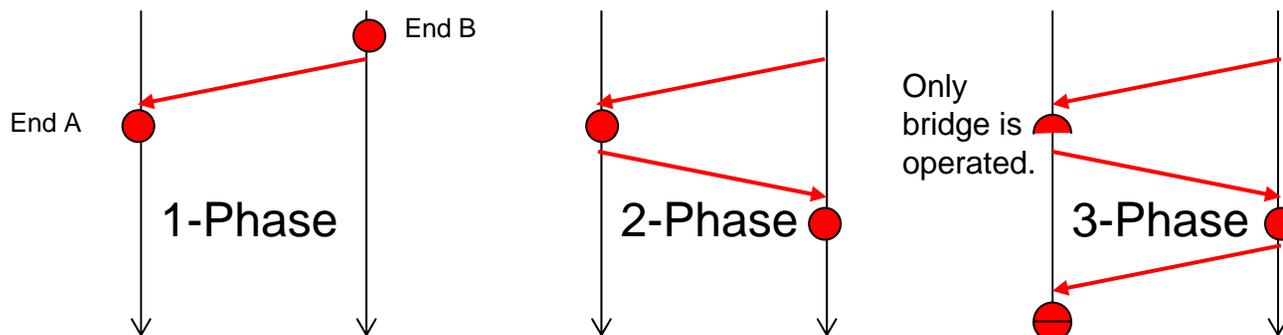
Protection Types

- 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.

| Permanent Bridge | Selector Bridge | Broadcast Bridge | Selective Selector | Merging Selector |
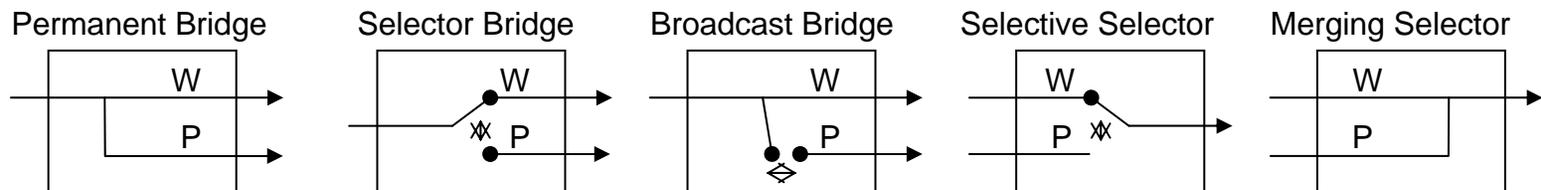
Signaling Channel / Information

- 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.
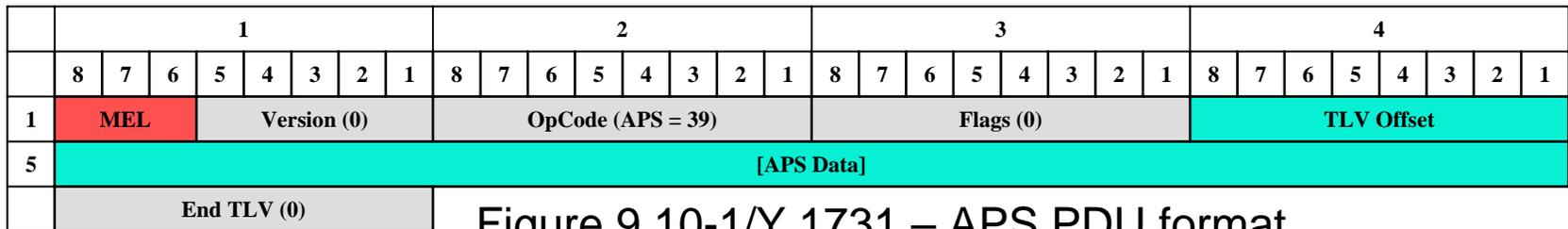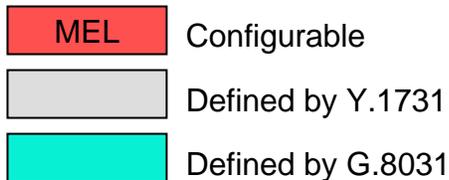
								1									2									3									4						
	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
1	MEL			Version (0)					OpCode (APS = 39)								Flags (0)								TLV Offset							
5	[APS Data]																															
	End TLV (0)																															

Figure 9.10-1/Y.1731 – APS PDU format

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.

1								2								3								4							
8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1	8	7	6	5	4	3	2	1
Request/State				Prot. Type				Requested Signal								Bridged Signal								Reserved							
				A	B	D	R																								

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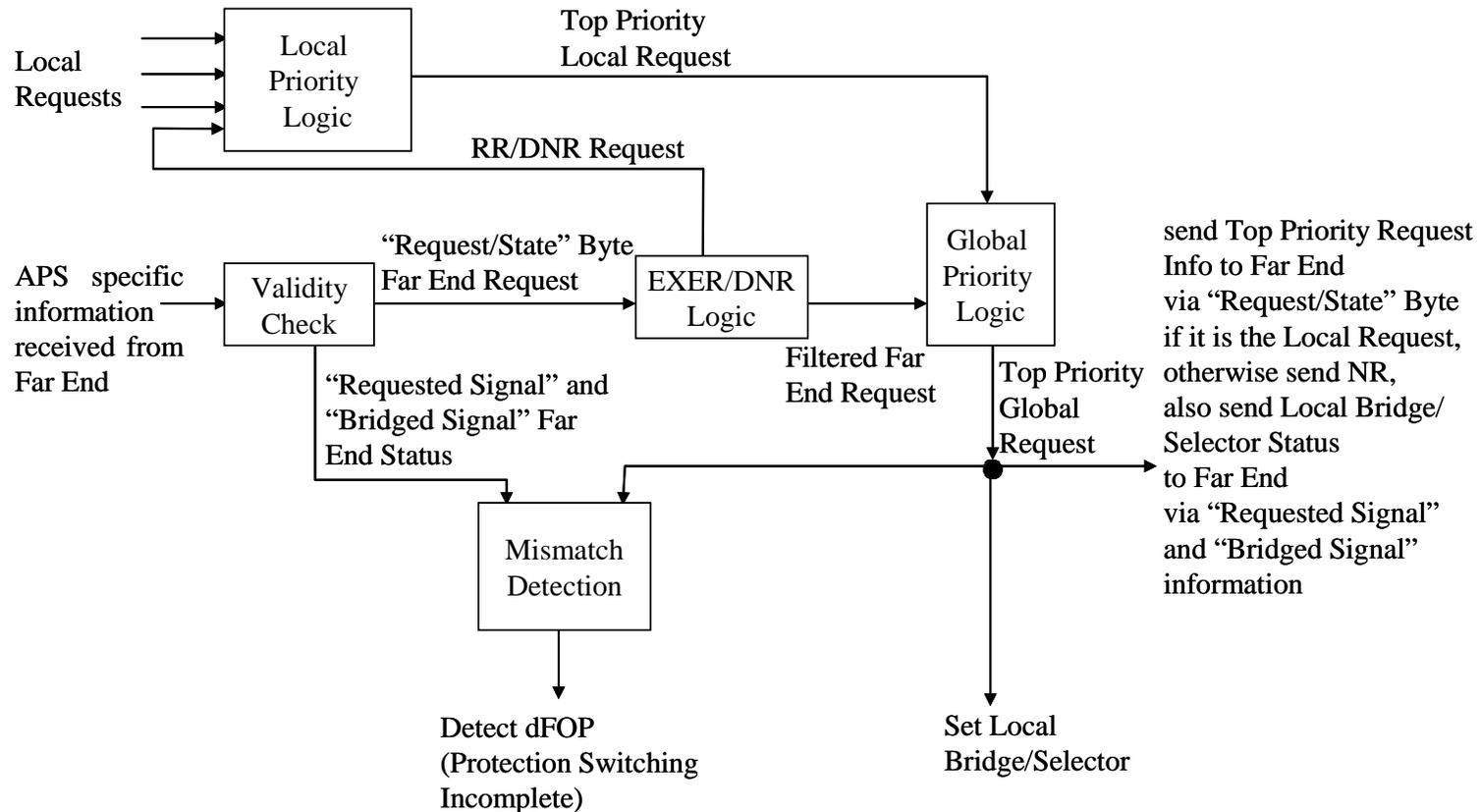
Switching Logic / Algorithm

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.
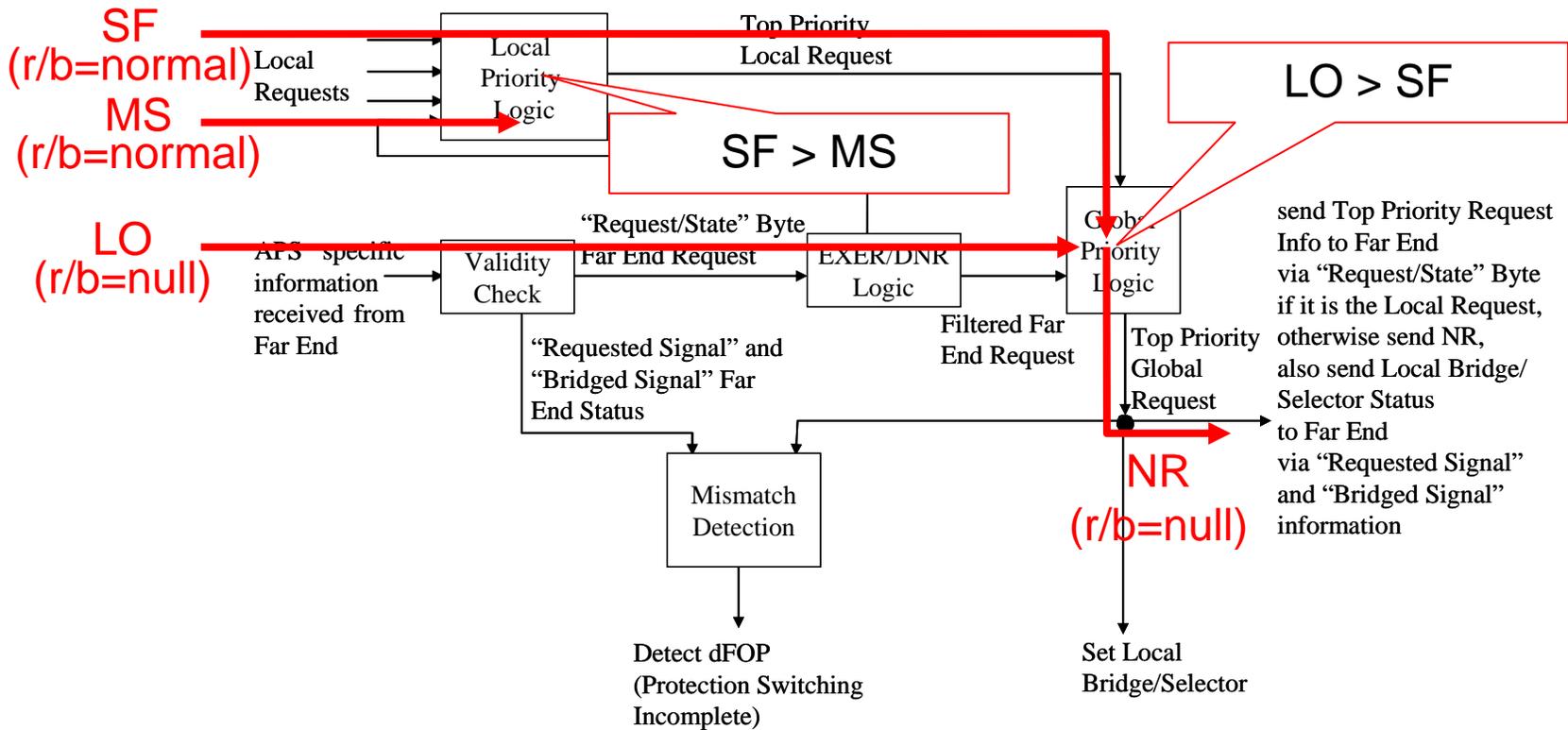

Figure 11-3/G.8031/Y.1342 – Principle of 1+1/1:1 linear protection switching algorithm

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/algorithm to G.8031 will be required for PBB-TE.

Summary

- 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**
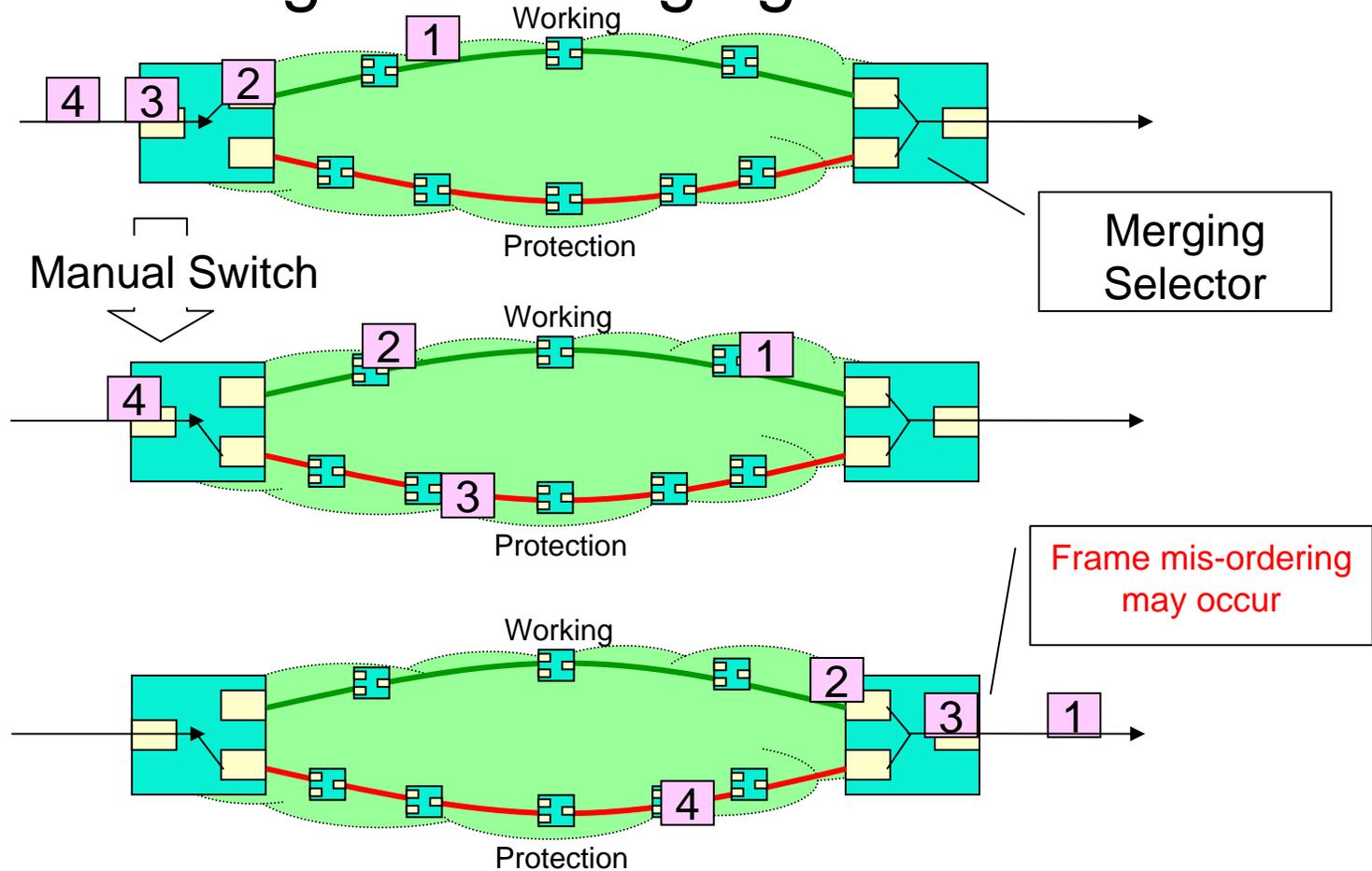
Frame duplication by broadcast bridge

- Broadcast bridge and selective selector

Broadcast Bridge

Manual Switch

Operate bridge and send APS

Receive APS and operate selector

Frame duplication may occur

Working

Protection