IEC/IEEE 60802
Loop Prevention in Required Topologies

Josef Dorr, Siemens AG

Requirements

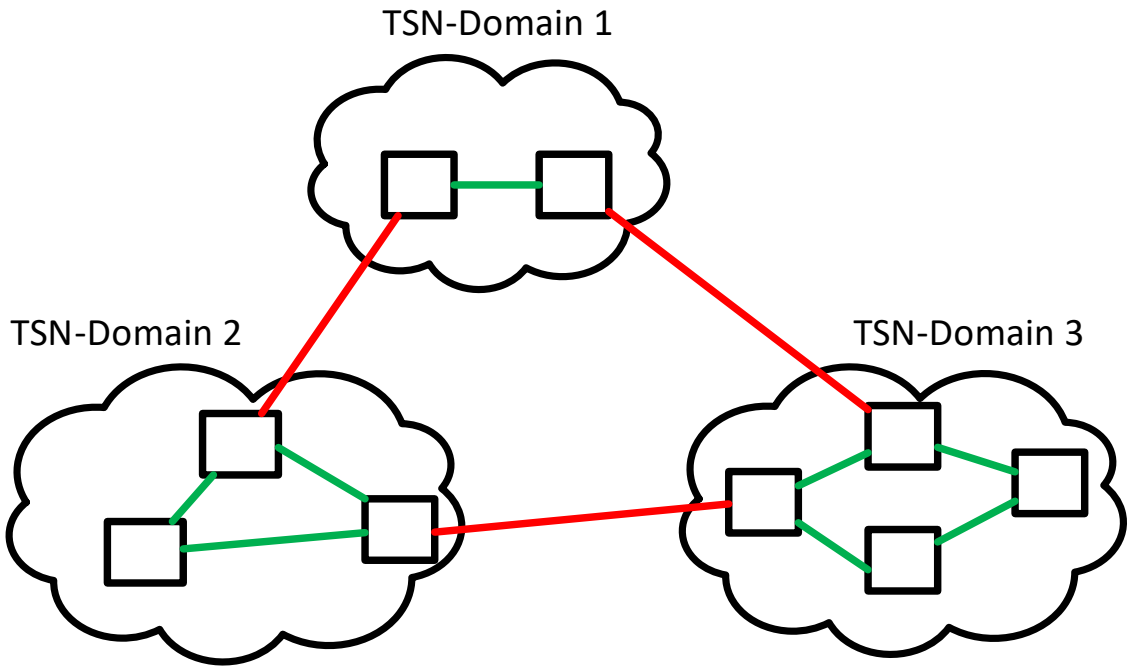
1. Topologies as described in the 60802 use cases: line, ring, star, redundant networks (e.g. redundantly interconnected rings)

2. Connectivity after network bootstrapping with automatic loop prevention
3. Connectivity to Plug and Produce with automatic loop prevention

4. Support of Stream-VLANs with (see 60802 D1.2: 6.6.1):
   - Individual FDBs,
   - Learning disabled, and
   - Discarding of frames adressed to unregistered DAs.
   - No blocked ports.

5. Support of Non-Stream-VLANs with (see 60802 D1.2: 6.6.2):
   - Shared VLAN Learning, and
   - Flooding of frames adressed to unregistered DAs.

A Topology of TSN-Domains – with loops



Loops may occur:

1. within a TSN-Domain,
2. by inter domain connections.

What are IEEE 802.1Q means to deal with these loops?

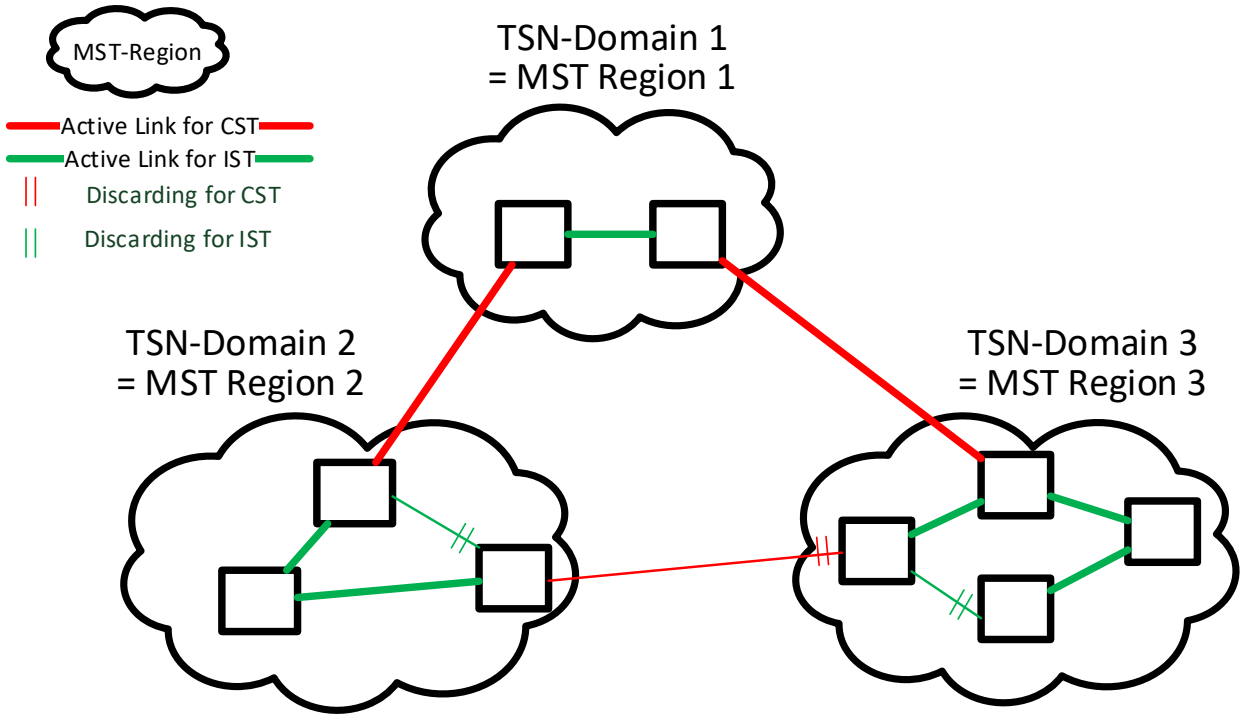
IEEE 802.1Qcc-2017: Stream reservation remote management

5.4.1.10	A VLAN-aware Bridge component implementation that conforms to the provisions of this standard for Stream reservation remote management shall … c) Support **TE-MSTID** (5.5.2). *[BUT: support for PBB-TE is not required]*
5.5.2	A C-VLAN component implementation that conforms to the provisions of this standard for **TE-MSTID** shall a) Disable learning … b) Discard frames with unregistered destination addresses …
12.32.3.1	A VLAN ID is allocated to the **TE-MSTID** in the MST Configuration Table if it is not under control of either a spanning tree protocol or IS-IS.

- TE-MSTID fulfills the requirements for Stream-VLANs.
- TE-MSTID requires support of the MST Configuration Table.

→ A TSN Domain should be a MST Region, which is described in a MST Configuration Table (identified by an MST Configuration Identifier - MCID).

A network of TSN-Domains as MST Regions
(IEEE 802.1Q-2018 3.164)



- Each TSN-Domain is also a MST Region.
- Each MST Region calculates an **Internal Spanning Tree** (IST) – default: RSTP.
- All MST Regions are connected by the **Common Spanning Tree** (CST), which is calculated by RSTP, treating each MST Region as a single Bridge.
- CST and IST together build the **Common and Internal Spanning Tree** (CIST).

→ Connectivity with loop prevention for Non-Stream traffic is provided by the RSTP based CIST.

Physical, Active and VLAN Topologies **in a 60802 TSN Domain**

See IEEE 802.1Q-2018
7. Principles of Virtual Bridged Network operation

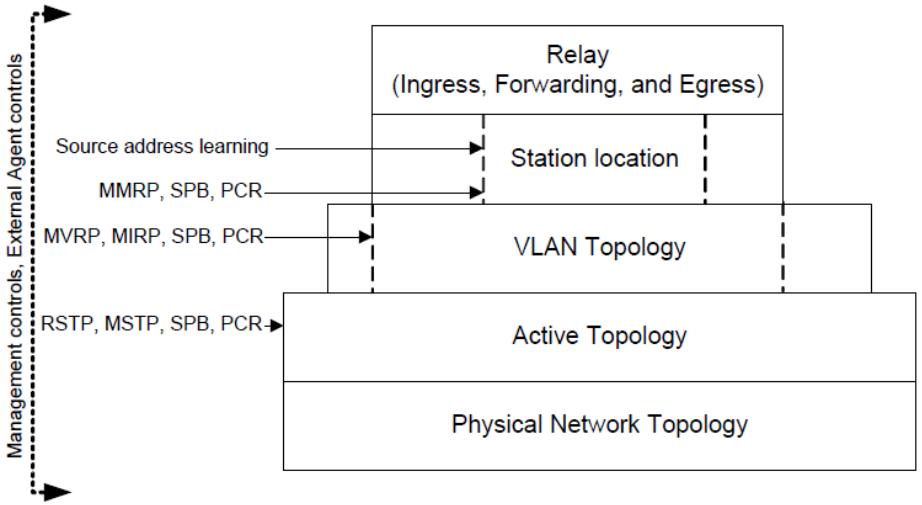
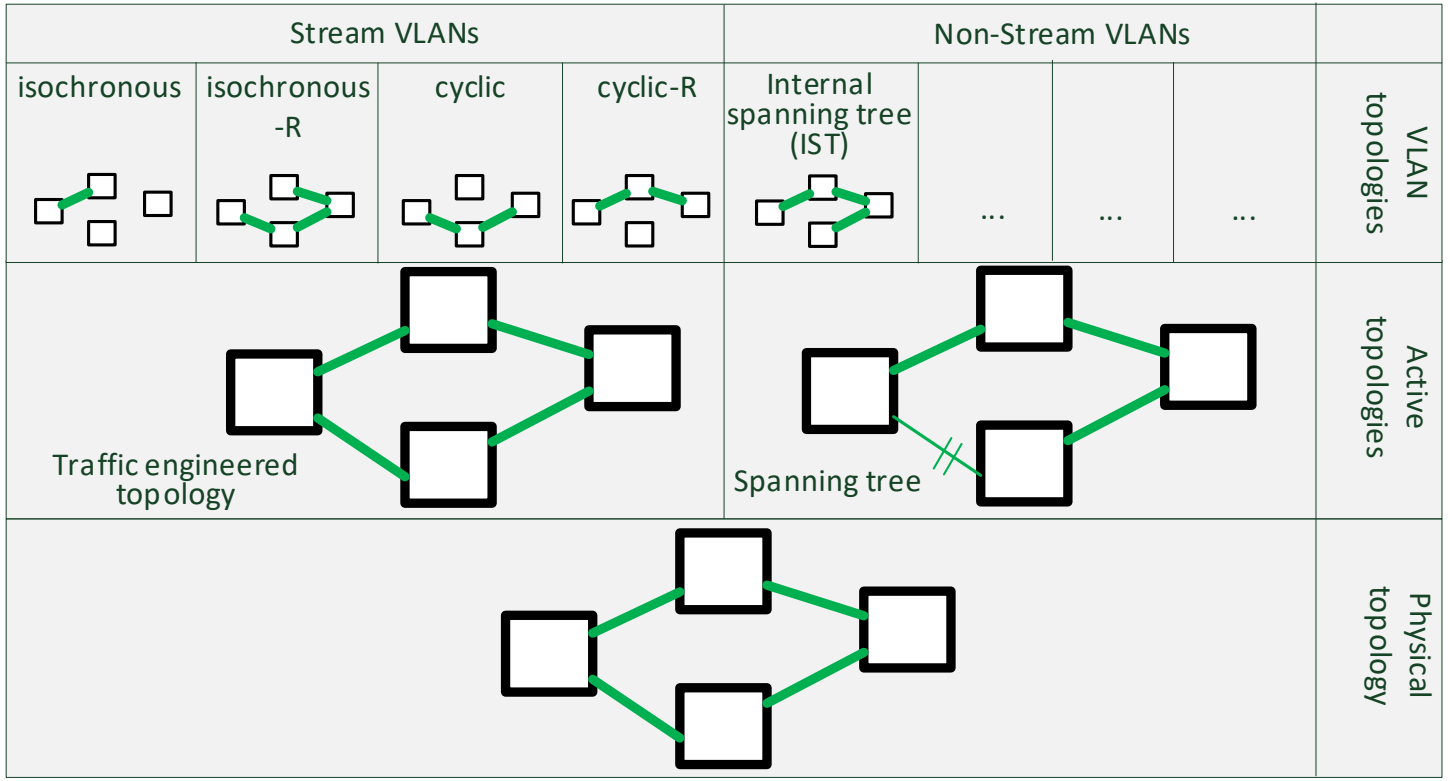
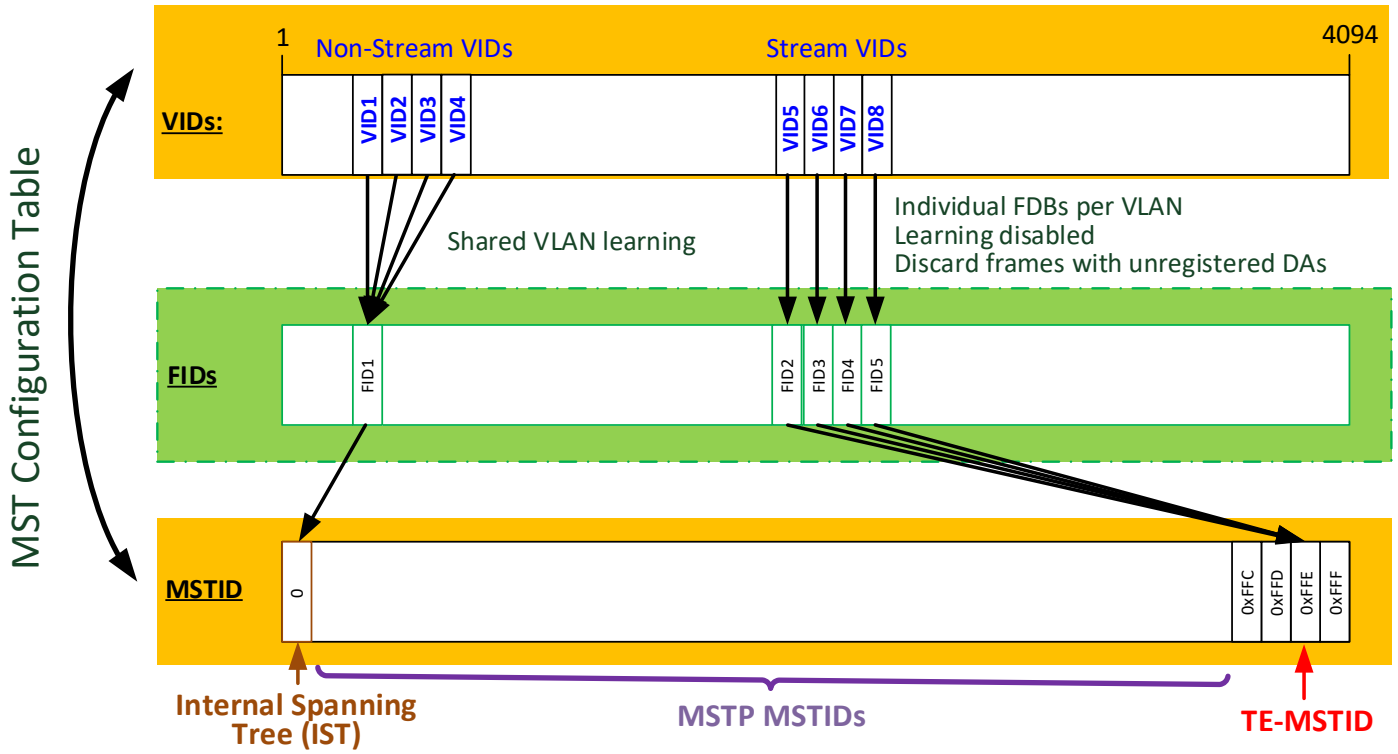


Figure 7-1—VLAN Bridging overview



IEEE802.1Q Configuration of a MST Bridge with a single Spanning Tree (IST)



See IEEE 802.1Q-2018 *8.9 MST, SPB, and ESP configuration information*

"The combination of the VID to FID allocations (8.8.8) and the FID to MSTI allocations (8.9.3) defines a mapping of VIDs to spanning trees, MSTIDs, represented by the MST Configuration Table (8.9.1)."

- All Non-Stream VIDs are assigned to the IST.
- All Stream VIDs are assigned to the TE-MSTID

→ No further MSTP support required – as long as no further active topologies are requested.

Summary and Implications

→ Support of TE-MSTID and RSTP based CIST fulfill all requirements.

- Stream connectivity is per se restricted to a TSN Domain / MST Region. Stream connectivity to other TSN Domains / MST Regions requires additional mechanisms and management -> **Inter TSN Domain Communication.**

- The Internal Spanning Tree (IST) can optionally be calculated by e.g. IEC-DLR or IEC-MRP. In this case MST Region boundary ports must support RSTP in a way so that the MST Region is treated as a single Bridge.

Profile Conformance

Bridges shall support:

- At least 8 VIDs: 4 Stream VIDs + 4 Non-Stream VIDs.
- At least 5 FIDs: 4 Steam-VID FIDs + 1 Non-Stream FID.
- MST Configuration with 2 MSTIDs:
  - TE-MSTID (0xFFE) for the Traffic Engineered Stream-VIDs,
  - IST (0) for the Non-Stream VIDs.
- RSTP:
  - for the calculation of the Common Spanning Tree (CST),
  - as default Internal Spanning Tree (IST) calculation algorithm.

$\rightarrow$ These requirements should be added to the Common Bridge Requirements 5.7.1

Questions?