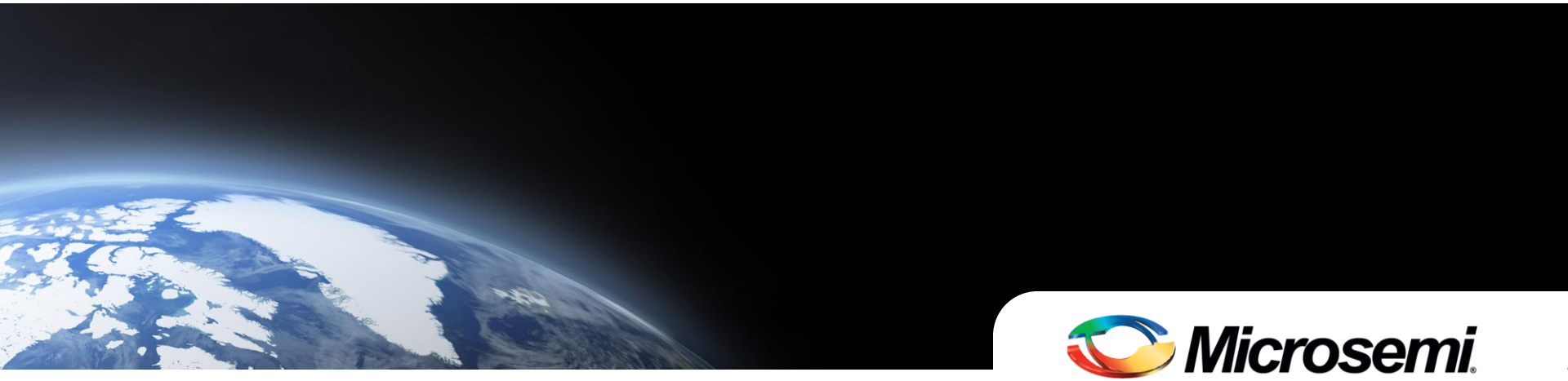
Power Matters.™



Microsemi

MACsec-aware TSN Traffic Shapers

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May 19, 2015

Relaying MAC Frames in 802.1Q

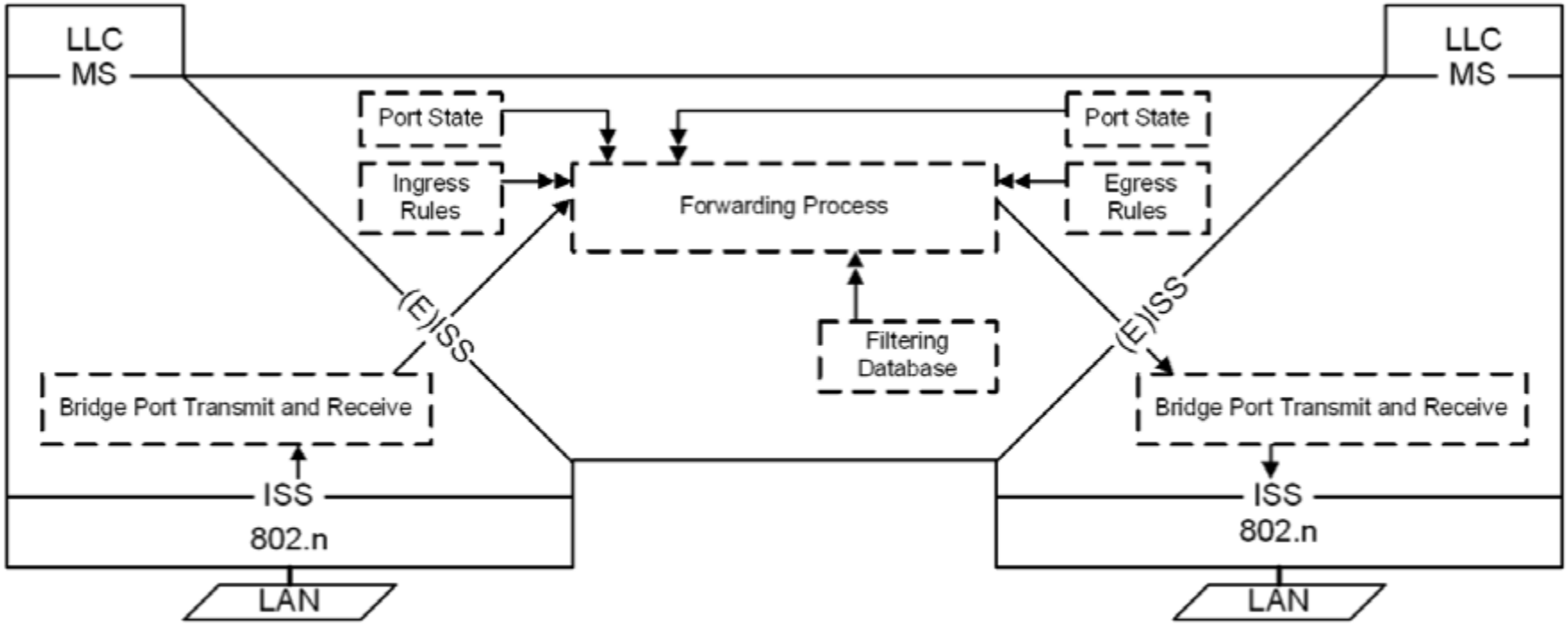


Figure 8-4—Relaying MAC frames

Location of Queues in 802.1Q

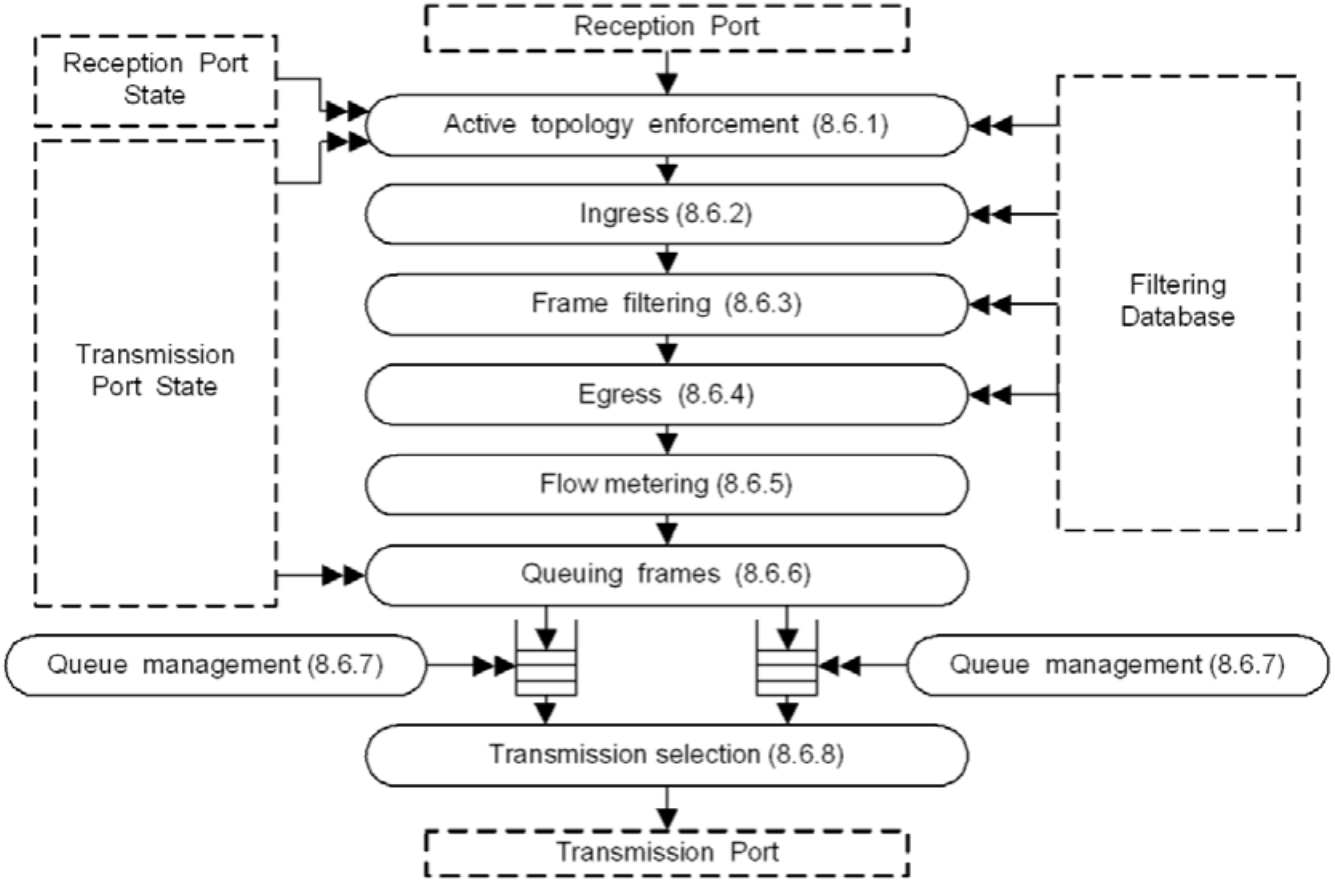


Figure 8-11—Forwarding Process functions

Where MACsec Fits in...

- From 802.1AEcg/D0.5

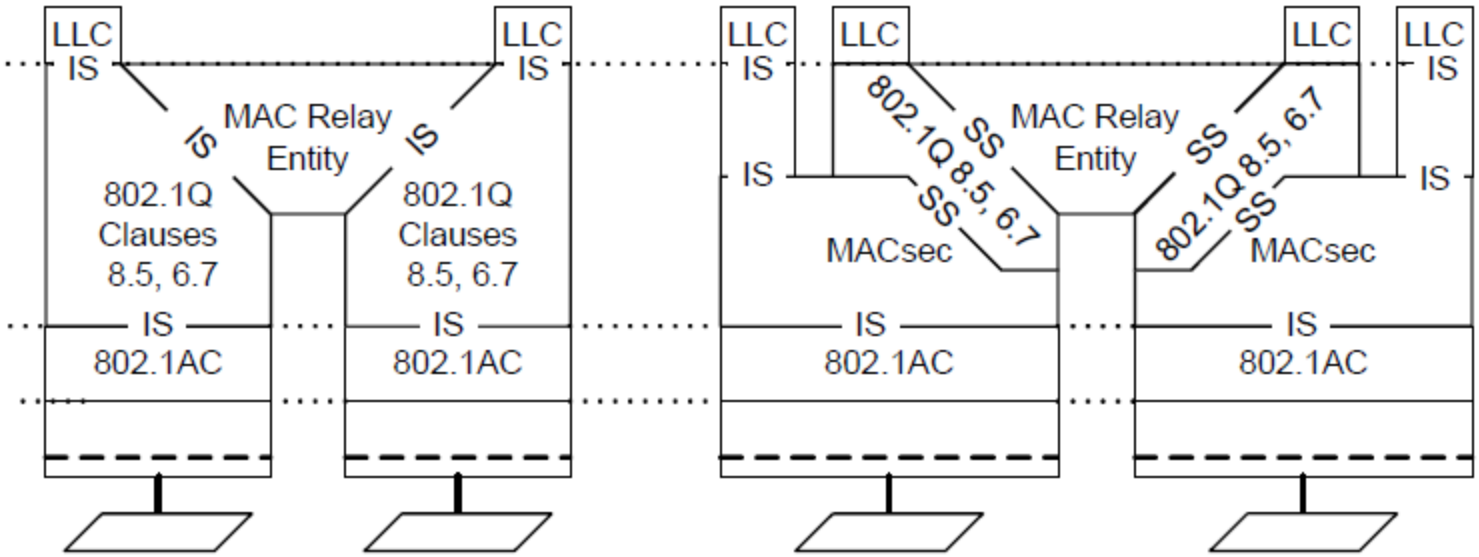


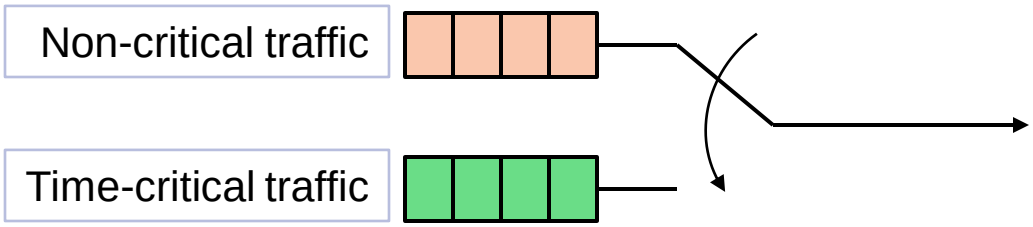
Figure 11-6—Addition of MAC Security to a VLAN-aware MAC Bridge

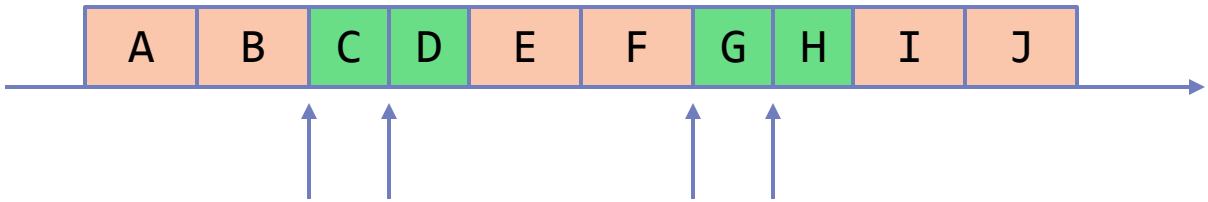
Purpose of Traffic Shapers in TSN

- A traffic shaper can be used to schedule time-sensitive traffic when interspersed with non-time-sensitive traffic
- This will help reduce the variability of the delivery time of the time-sensitive traffic and, therefore, timing jitter

Example of Traffic without Shaper

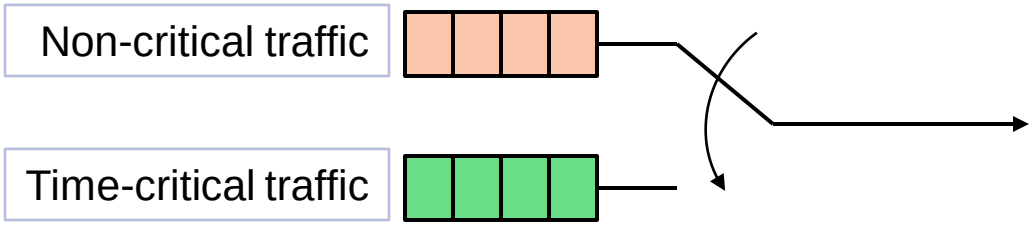
- The SOF times for Frames C & G is unpredictable and depends on the lengths of Frames B & F.

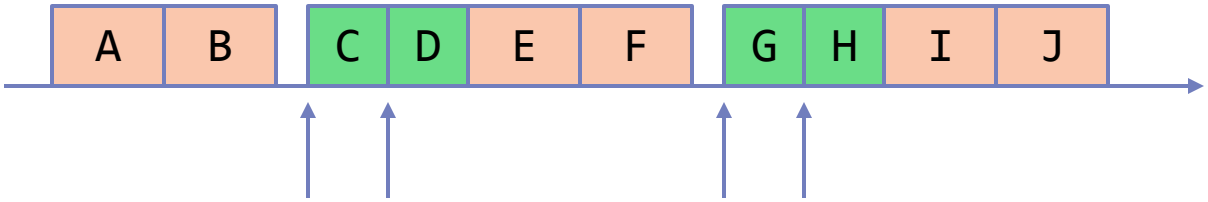




Example of Traffic with Shaper

- After adding a guard band, the SOF times for Frames C & G is now predictable and no longer depends on the lengths of Frames B & F.





Data Added by MACsec

- From 802.1AE-2006

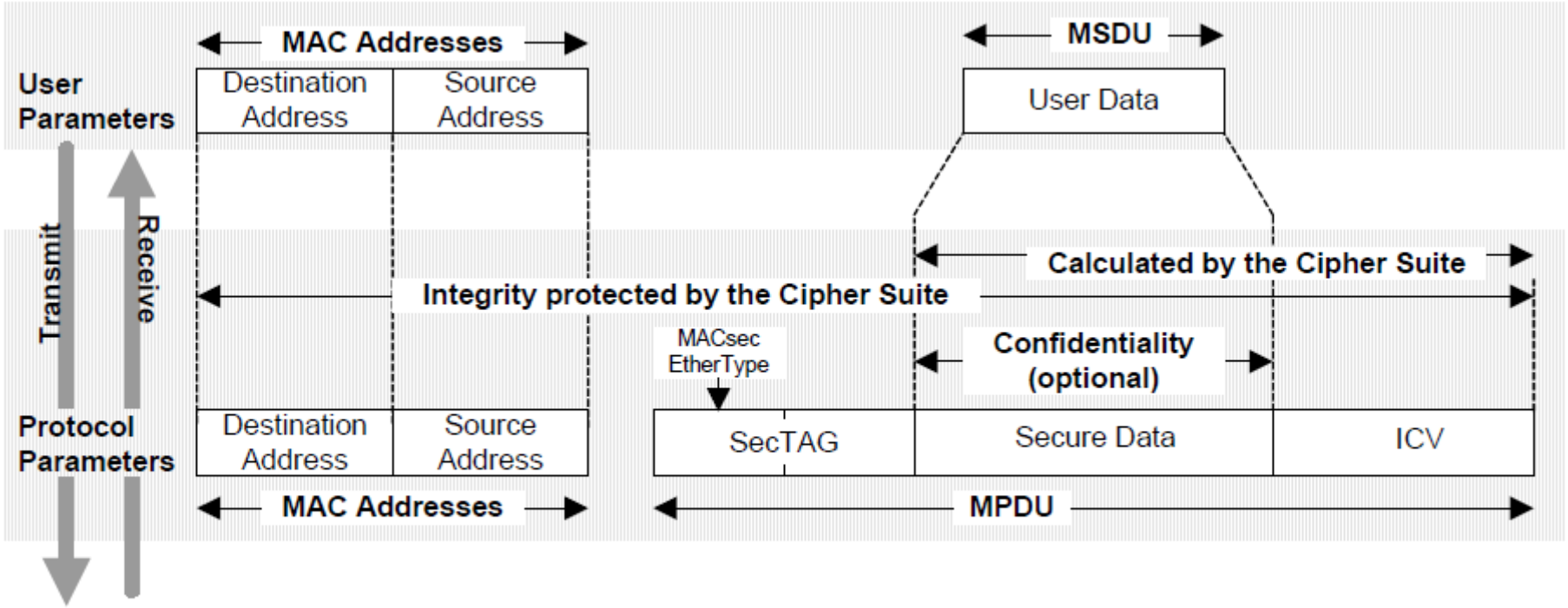
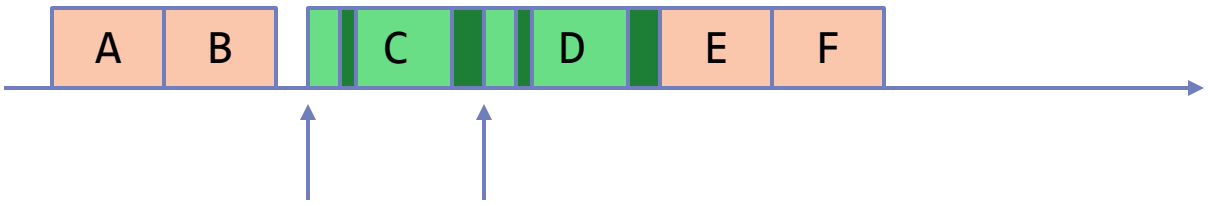


Figure 8-1—MACsec

MACsec Traffic with Shaper

- However, MACsec adds Bandwidth to the Traffic (SecTAG + ICV)
  - 24 octets if SCI is implicit
  - 32 octets if SCI is explicit



- This now makes the SOF time of Frame D different than what the scheduler expects

Conclusion

- Therefore, the TSN Traffic Shaper must be MACsec-aware. If Traffic is scheduled for the SecY Controlled Port, then the additional octets added by the MACsec transformation must be factored into the Shaping algorithm.
- If preemption is used and MACsec packets are fragmented, then the TSN Traffic Shaper must be slighter smarter, yet.
  - The first fragment contains the SecTAG (8 or 16 octets).
  - The last fragment contains the ICV (16 octets).

Proposed 802.1Qbv Sponsor Ballot Comment

- 802.1 specifies MACsec operations (encryption and frame expansion) to exist AFTER the queues and TSN shaping functions. Therefore, the TSN shaping function must be specified to account for the additional bytes later added by MACsec. This is especially critical for bump-in-the-wire MACsec implementations, such as MACsec in a PHY, where the MACsec function isn't in the same chip as the TSN shaping function.
  - This ensures any TSN-compliant shaper in a switch / NPU / ASIC will work with a MACsec PHY or EDE without requiring flow control back to the TSN shaper (which destroys TSN).
  - It's probably not necessary to specify if this is done for all frames on the port or only for frames to be encrypted. Either way will function correctly, the per-frame method of course has better performance.

Thank You!