IEEE P802.DP Features

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Objective

Further discussion on TSN Profile Features

Recap: Two Profile Approach

Asynchronous Profile

targets current Ethernet based use cases

- Asynchronous with slower cycle times (> 50 msec)
- Latency bounded with acceptable delay variation (jitter) up to latency bound
- Comfortable with rate constrained shaping
- Controlled network – no undefined traffic on the network
- Highly static – designed, analyzed, configured well ahead of operation
- Certification burden is significant – simplicity is valuable

Asynchronous profile offers an equivalent solution

Synchronous Profile

targets current non-Ethernet and future use cases

- Segmented/partitioned subsystems
- Synchronous with cycle times in the order of 1 msec. Future use cases with sub-millisecond cycle times
- Sensitive to latency (or deadline) and delay variation (jitter)
- Convergence of mixed critical traffic
- Interoperability of legacy buses on top TSN backbone
- Platform wide clock time distribution
- Potential for dynamic (re)configuration

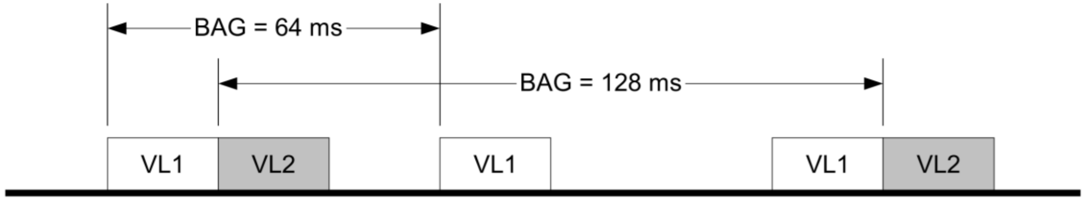
Synchronous profile provides an ethernet based converged system

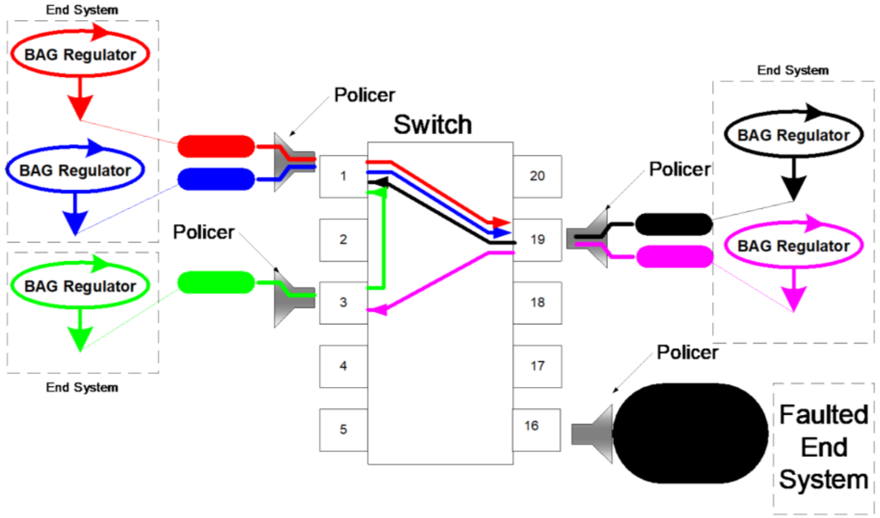
Required Functions for Aerospace Profiles

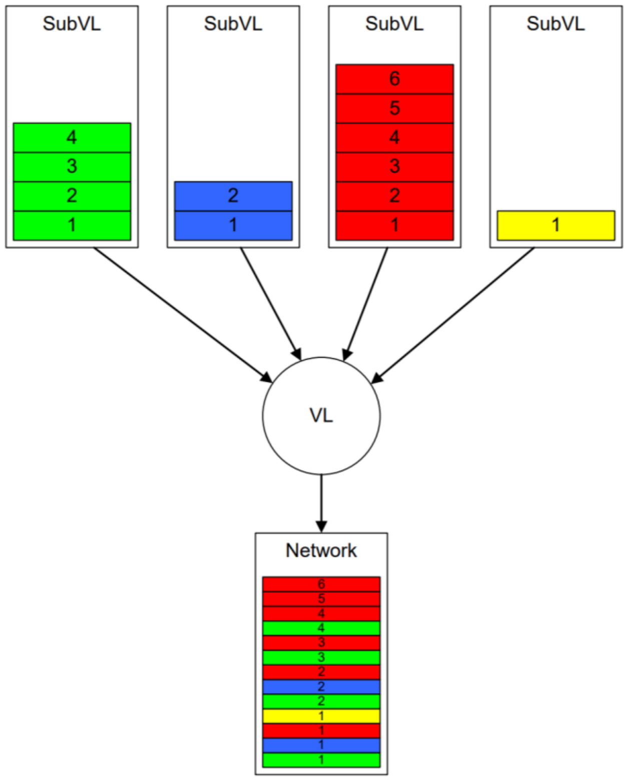
Functions	Asynchronous Profile	Synchronous Profile
Time Synchronization	None	802.1 AS – 2020
Egress Traffic Shaping	Credit Based Shaper (Qav)/ Asynchronous Traffic Shaper (Qcr)?	Credit Based Shaper (Qav)/ Asynchronous Traffic Shaper (Qcr)? Time Aware Shaper (Qbv)
Redundancy	Frame Replication and Elimination (CB)	Frame Replication and Elimination (CB)
Ingress Policing	Per-Stream Filtering and Policing (Qci)	Per-Stream Filtering and Policing (Qci)
Configuration	UNI (Qcc), Yang models (Qcw, CBcv)	UNI (Qcc), Yang models (Qcw, CBcv)
Management and Monitoring		
Forwarding		
Stream Separation		

Traffic Shaping for Asynchronous Profile

- Example of VL1 with BAG of 64 milliseconds and VL2 with BAG of 128 milliseconds



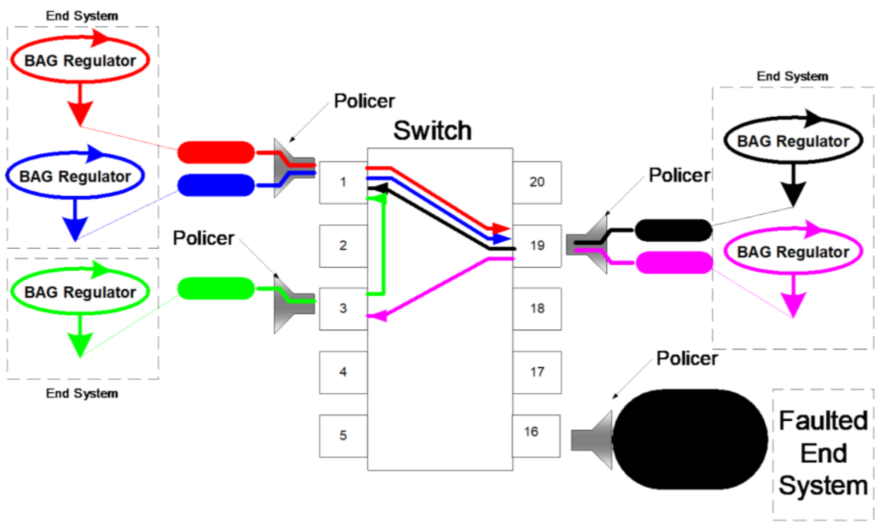




Reference: ARINC 664p7 Traffic Shaping Features by Brent Nelson

https://www.ieee802.org/1/files/public/docs2021/dp-Nelson-A664p7-Traffic-Shaping-0721-v01.pdf

Traffic Shaping for Asynchronous Profile



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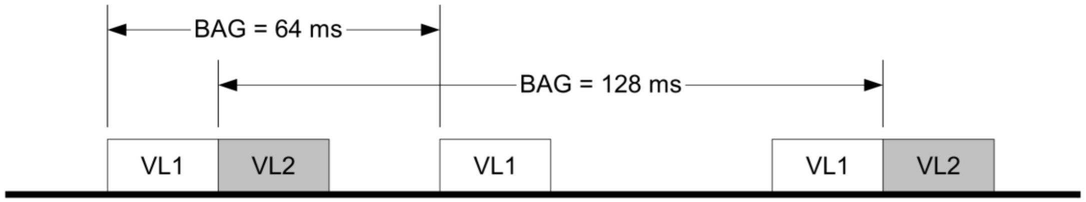


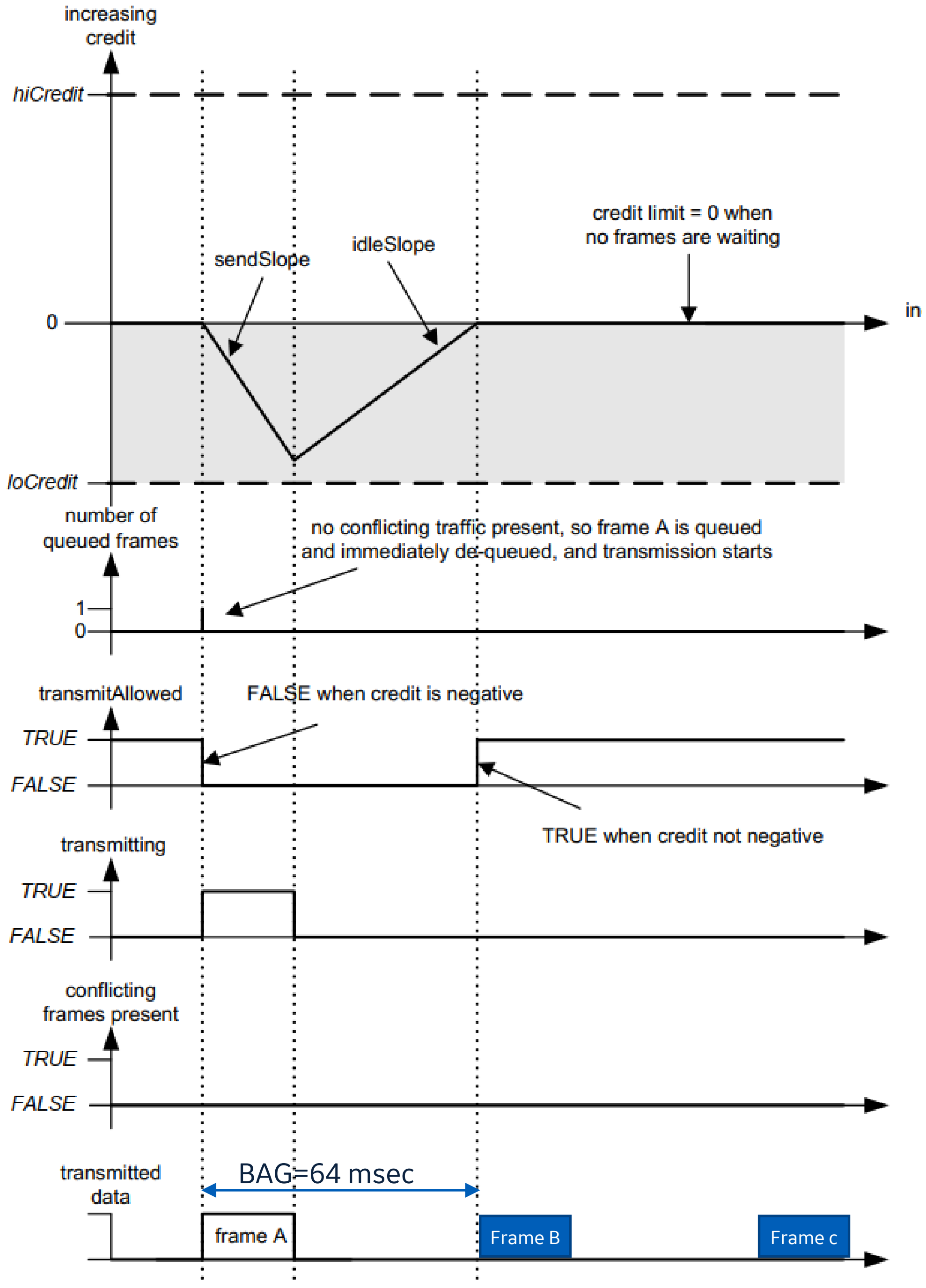
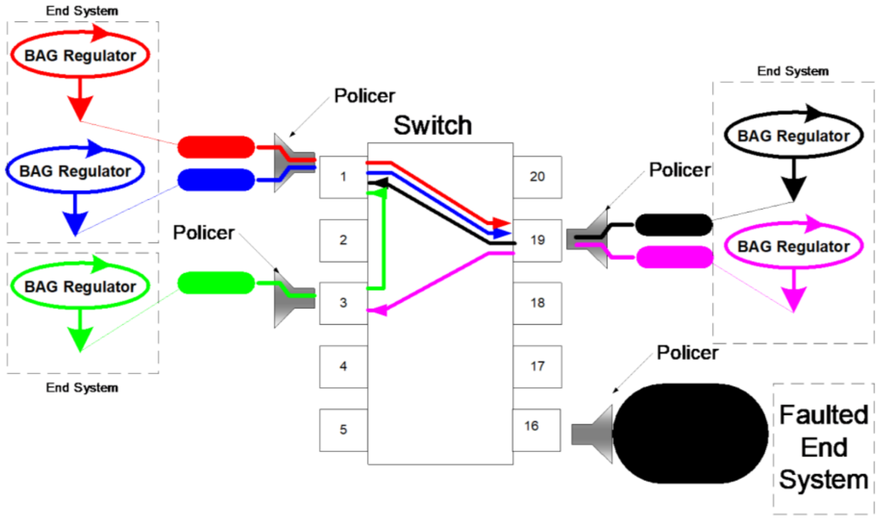


Figure L-1—Credit-based shaper operation—no conflicting traffic

Traffic Shaping for Asynchronous Profile



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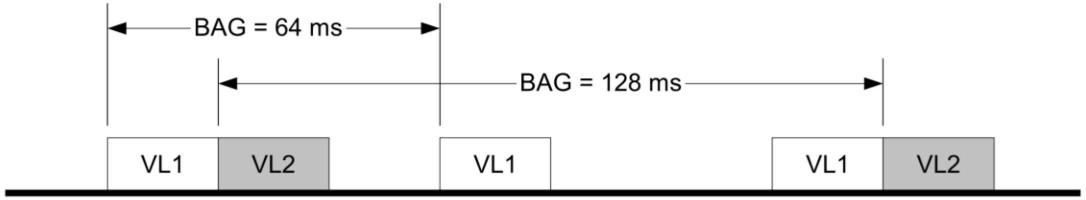


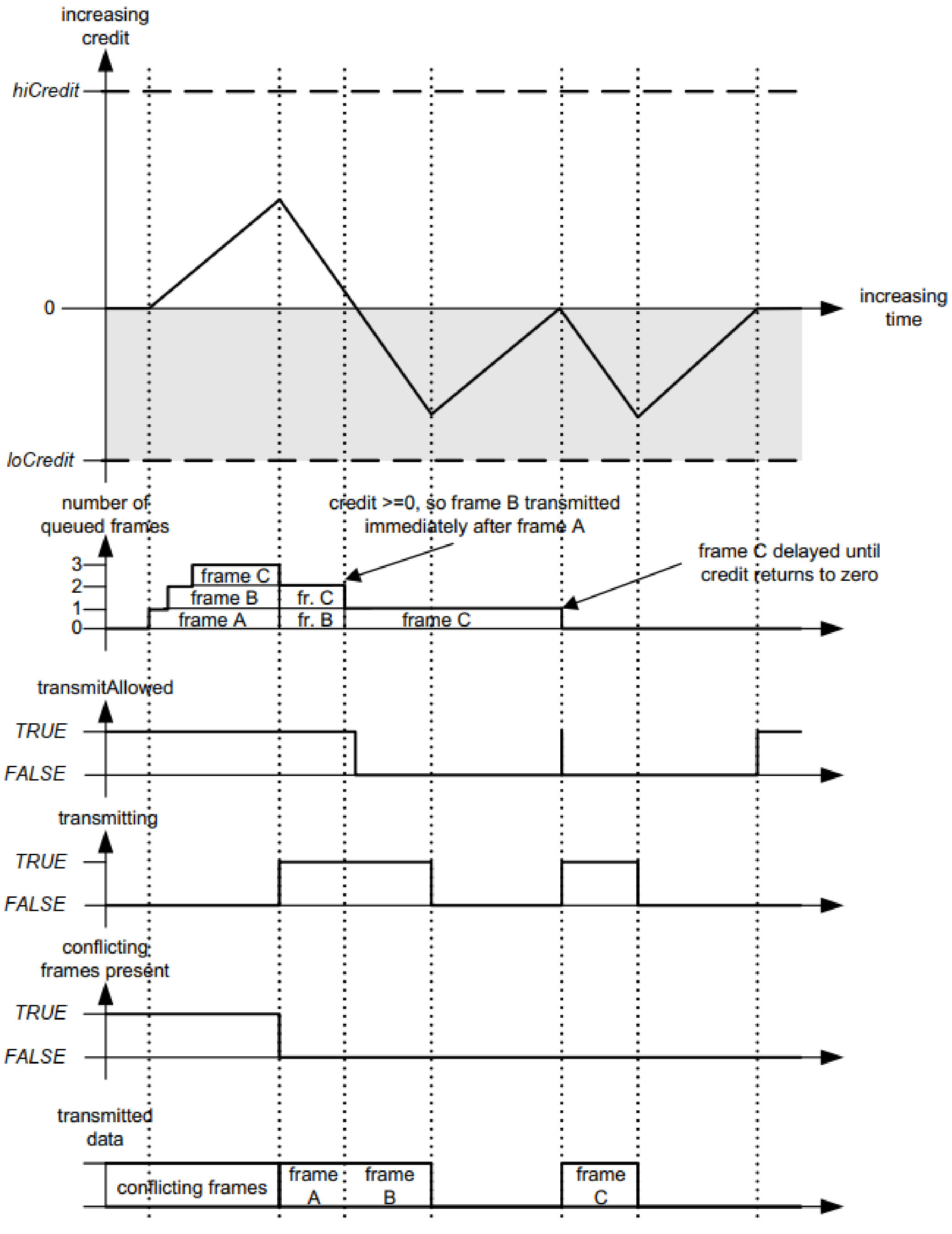
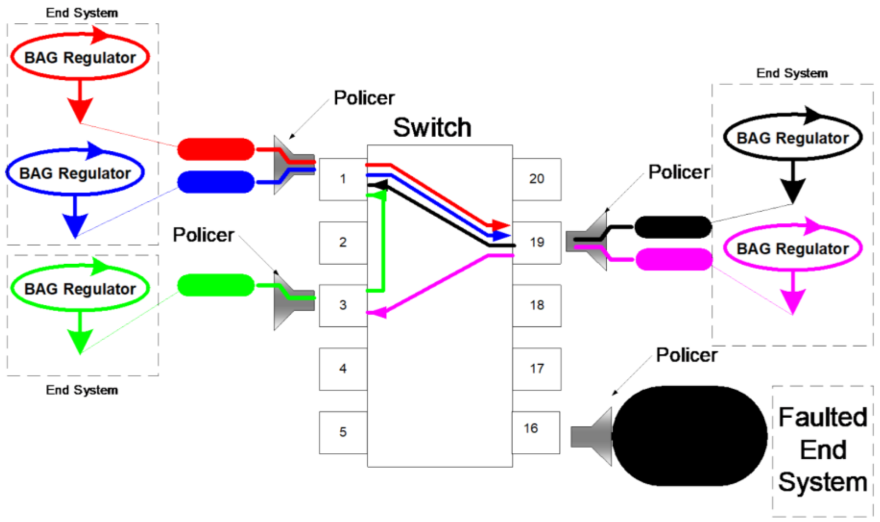
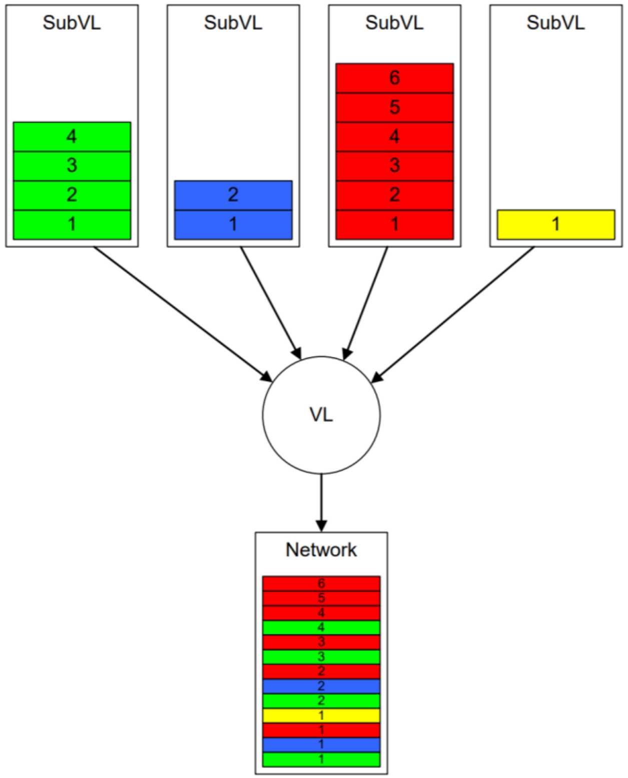


Figure L-3—Credit-based shaper operation—burst traffic

Traffic Shaping for Asynchronous Profile





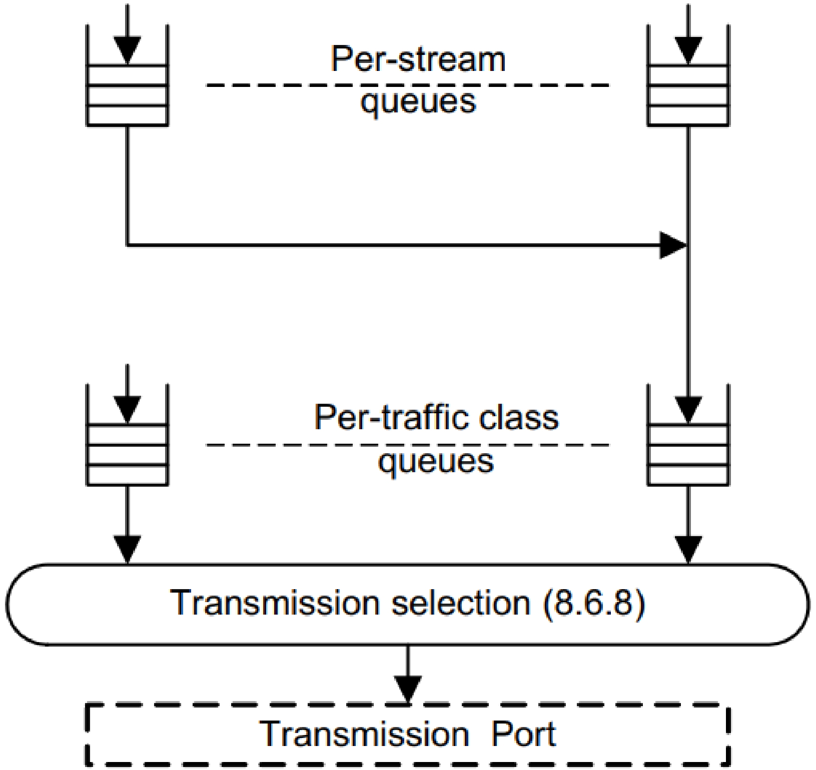


Figure 34-1—Queuing model for a Talker station

Discussion

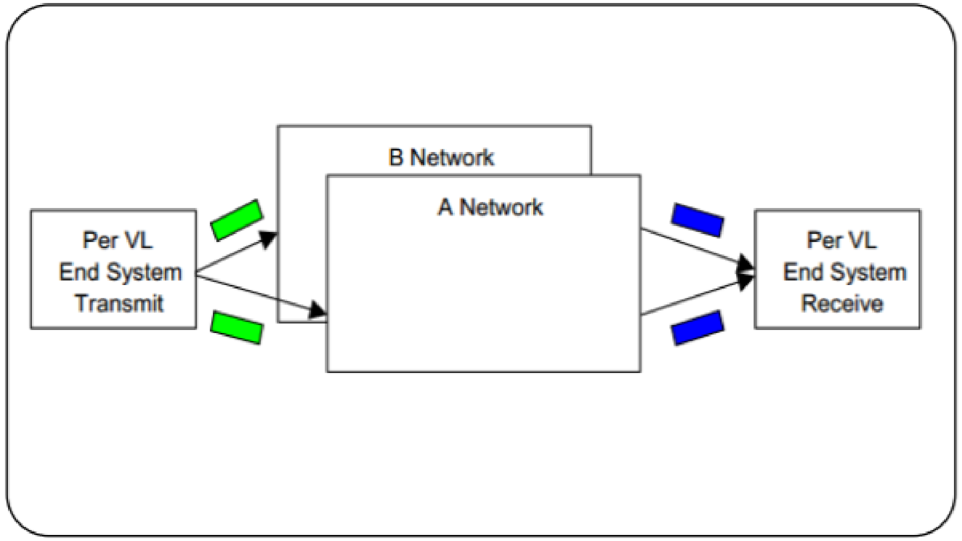
- Is Qav an appropriate replacement for current aerospace shaping solutions?
- Is Qav only needed on end stations?
- What about mixed traffic scenarios?

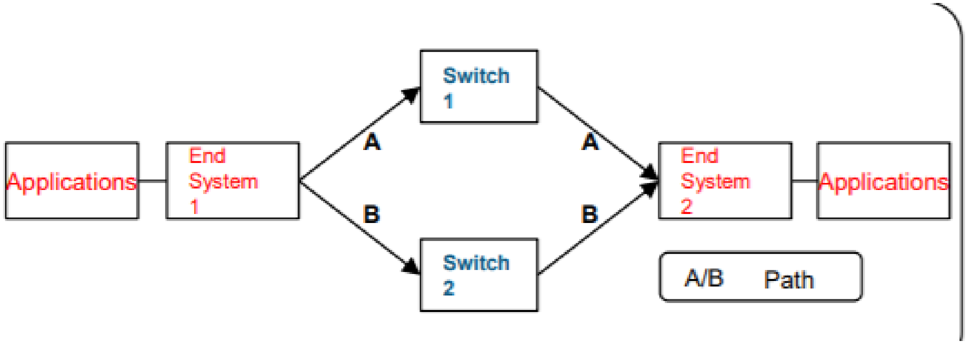
Requesting contributions from the group

Discussion Topics: Redundancy (ARINC 664)

Two independent networks A + B

- Full duplication of network
  - separate power & different routing of cables
- End-Devices handle redundancy
- Packets duplicated on device only
- Network unaware of duplication / redundancy





Reference: Avionics Full Duplex Ethernet and the Time Sensitive Networking Standard by Bruno Pasquier and Stefan Schneele
https://www.ieee802.org/1/files/public/docs2015/TSN-Schneele-AFDX-0515-v01.pdf

Discussion Topics: Redundancy (ARINC 664)

ARINC 664 P7 - Section 3.2.6.1

Use of sequence numbers for deduplication

- One-Byte sequence number suffix **per stream**
  - 0 RESET
  - 1-255 sequences
- End-Devices either use
  - "first-valid wins" and forward one packet to application (check for seq no {+0 +1 +2})
  - or forwards both packets to application

Does aerospace industry need this option?

64 bytes (minimum Ethernet frame length)

7 bytes	1 byte	6 bytes	6 bytes	2 bytes	46 bytes					4 bytes	12 bytes
Preamble	Start Frame Delimiter	Destination Address	Source Address	0x800 Ipv4	IP Structure 20 Bytes	UDP Structure 8 Bytes	AFDX Payload 1 to 17 bytes	Padding 0 to 16	SN 1 byte	Frame Check Seq	Inter Frame Gap

Fig 1.: AFDX® Frame Format

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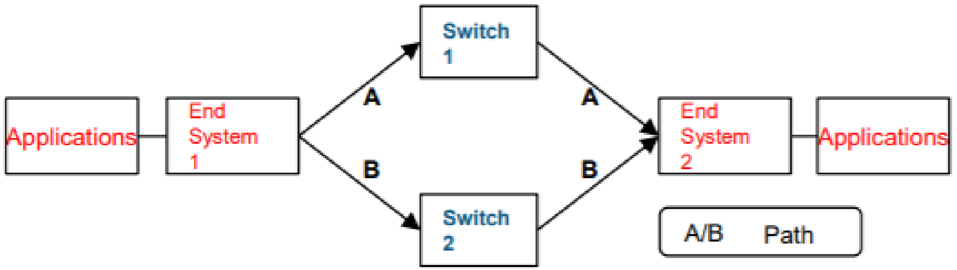
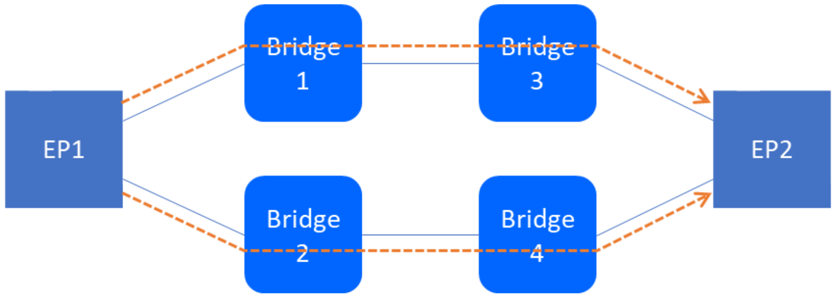
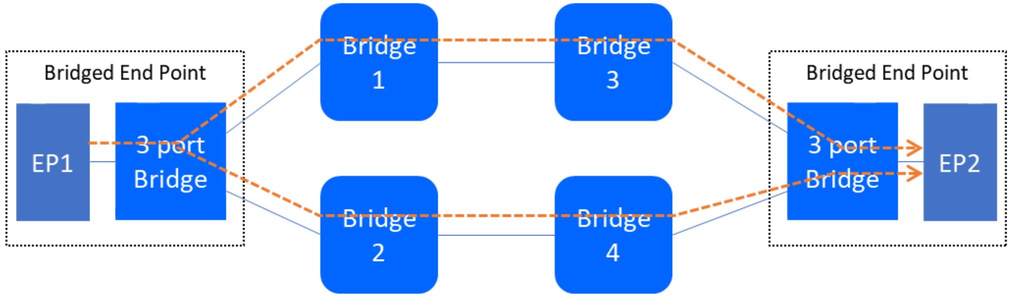
Discussion Topics: Redundancy (FRER)



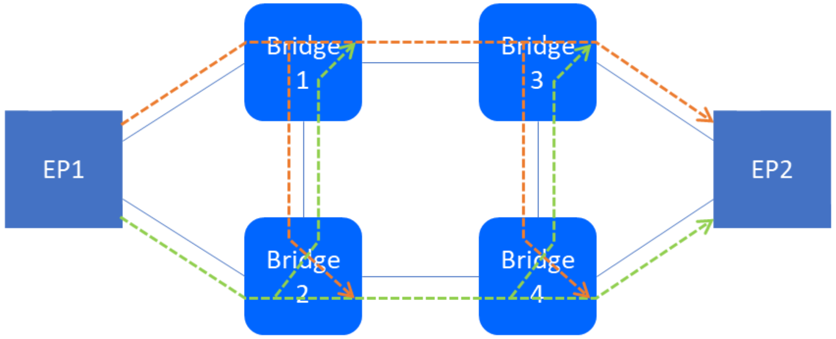
CB provides lots of redundancy variants



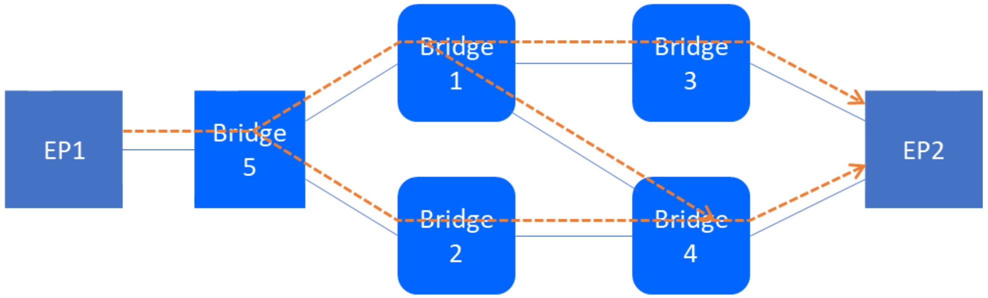
CB Capable, Dual Homed End Points using Link Aggregation



Bridged End Points. EP1 is no CB capable, EP2 is CB Capable



Ladder Redundancy: Resistant to multiple link failures



Flexible Positioning of CB functions. EP1 is not CB capable, EP2 is CB Capable

Discussion

- Is CB an appropriate network redundancy solution for aerospace applications?
- Is there a need to specify only a subset of CB redundancy patterns for DP?

Requesting contributions from the group