IEEE P802.DP Features

Abdul Jabbar
GE Research

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 to provide 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

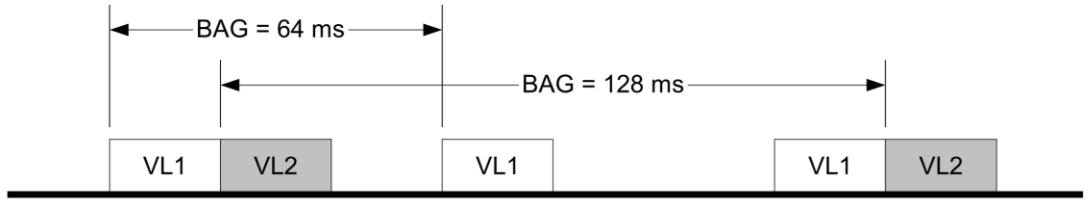
Synchronous profile to provide an ethernet based converged system

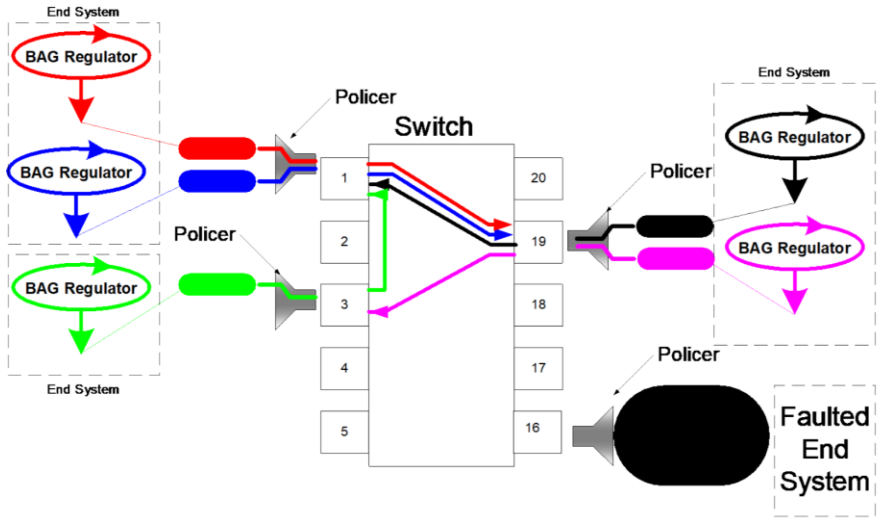
Required Functions for Aerospace Profiles

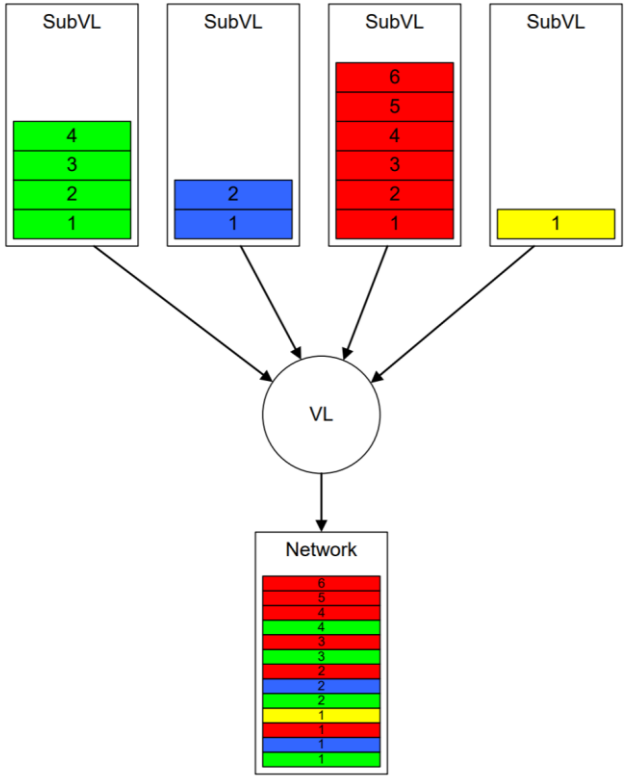
Functions	Asynchronous Profile	Synchronous Profile
Time Synchronization	None	802.1 AS – 2020
Egress Traffic Shaping	Credit Based Shaper (Qav)/ Asynchronous Traffic Shaper (Qcr)?	Credit Based Shaper (Qav)/ Asynchronous Traffic Shaper (Qcr)? Time Aware Shaper (Qbv)
Redundancy	Frame Replication and Elimination (CB) • End stations shall support FRER functions • Bridges shall/may support FRER functions	Frame Replication and Elimination (CB) • End stations shall support FRER functions • Bridges shall support FRER functions
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



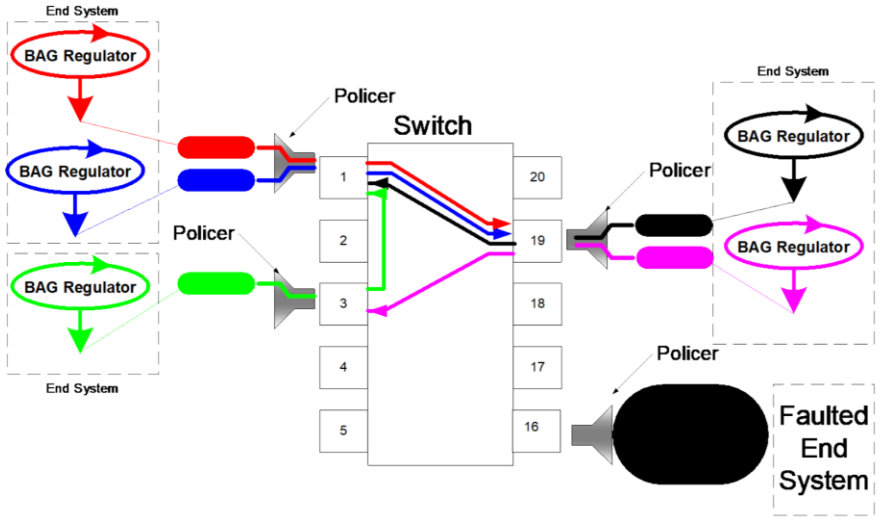




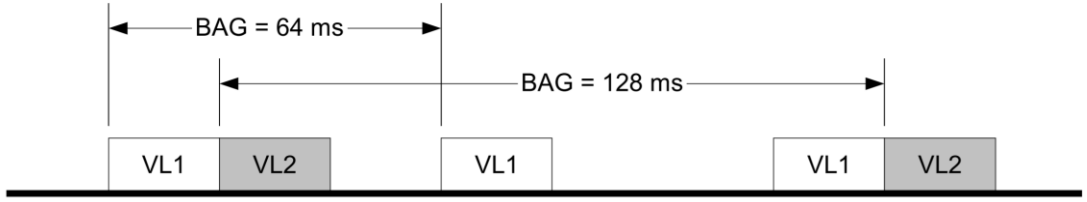
Reference: ARINC 664p7 Traffic Shaping Features by Brent Nelson

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

Traffic Shaping for Asynchronous Profile



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



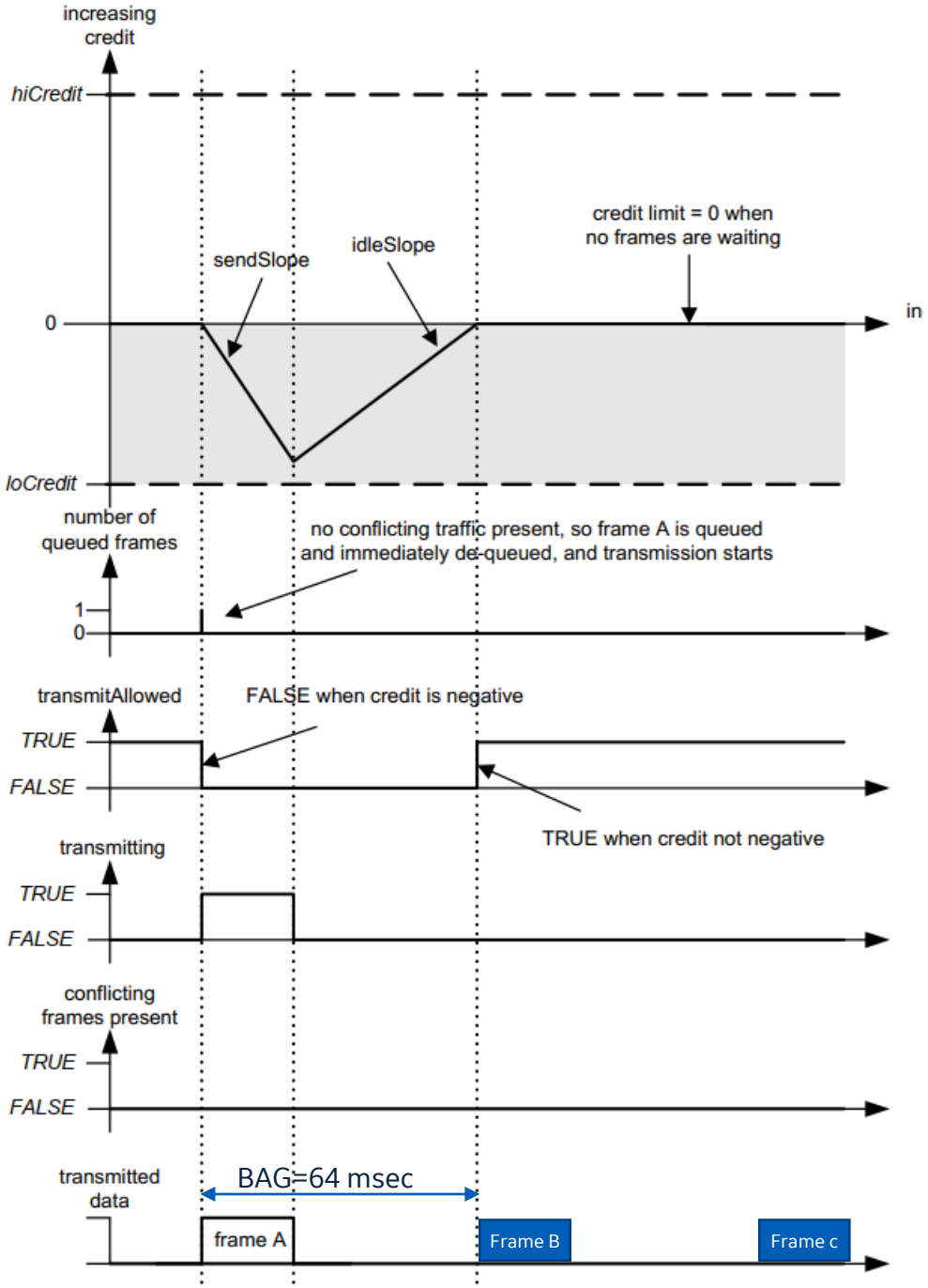
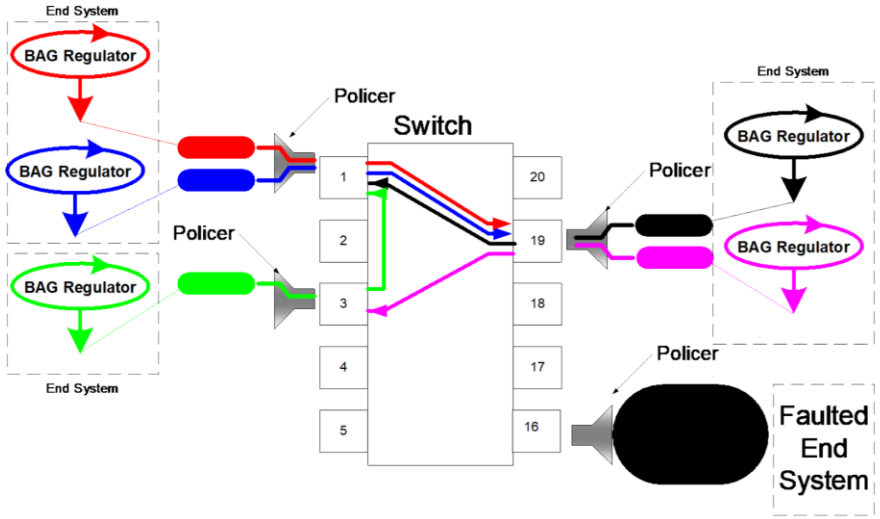
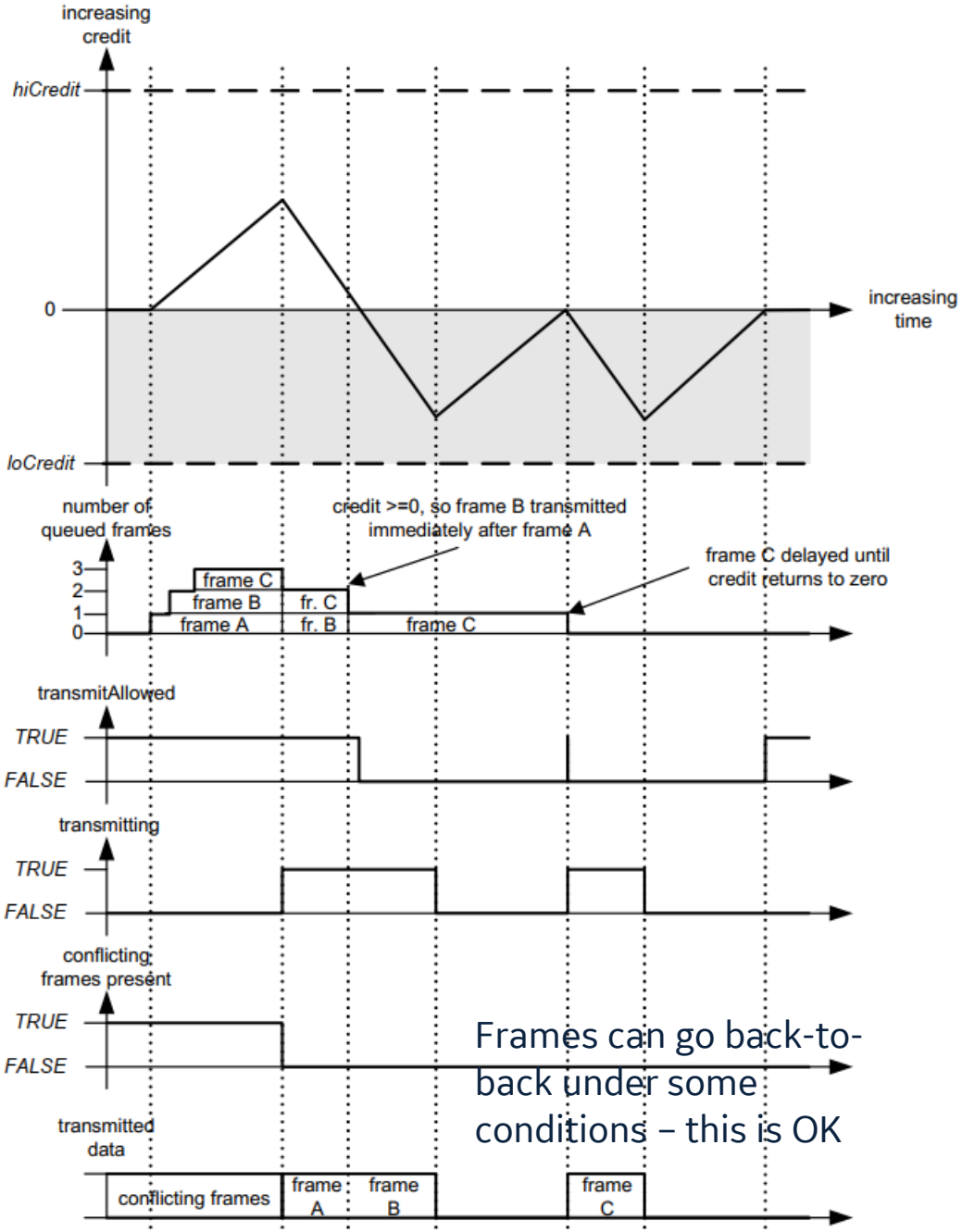


Figure L-1—Credit-based shaper operation—no conflicting traffic

Traffic Shaping for Asynchronous Profile



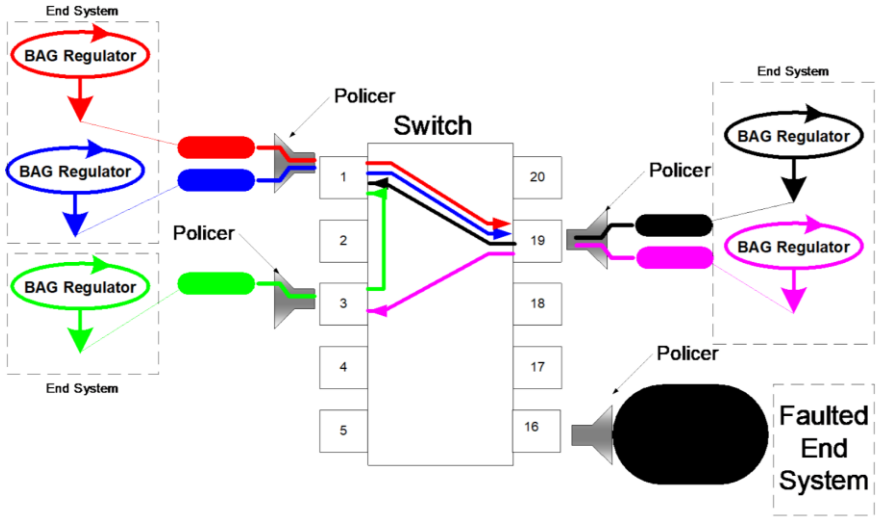
- Example of VL1 with BAG of 64 milliseconds and VL2 with BAG of 128 milliseconds

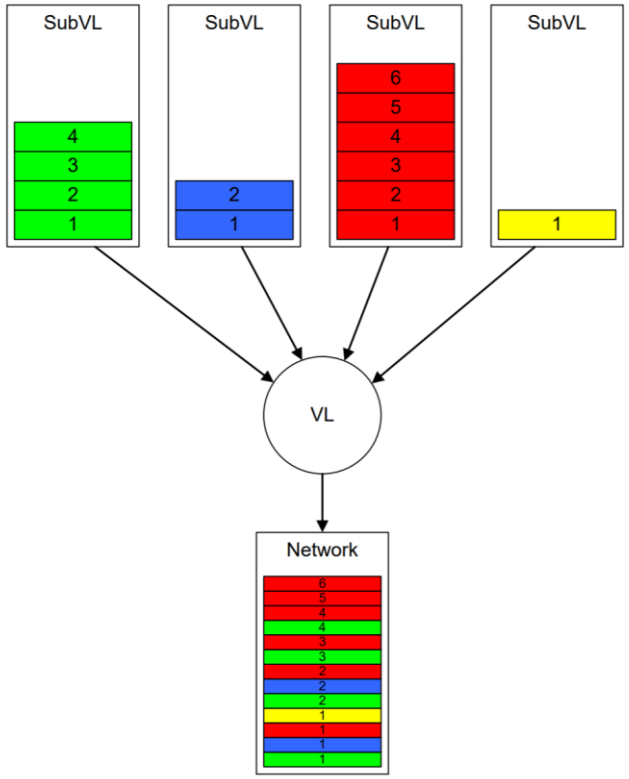


Frames can go back-to-back under some conditions – this is OK

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

Traffic Shaping for Asynchronous Profile





SubVL frames are pulled in round robin fashion in to the VL

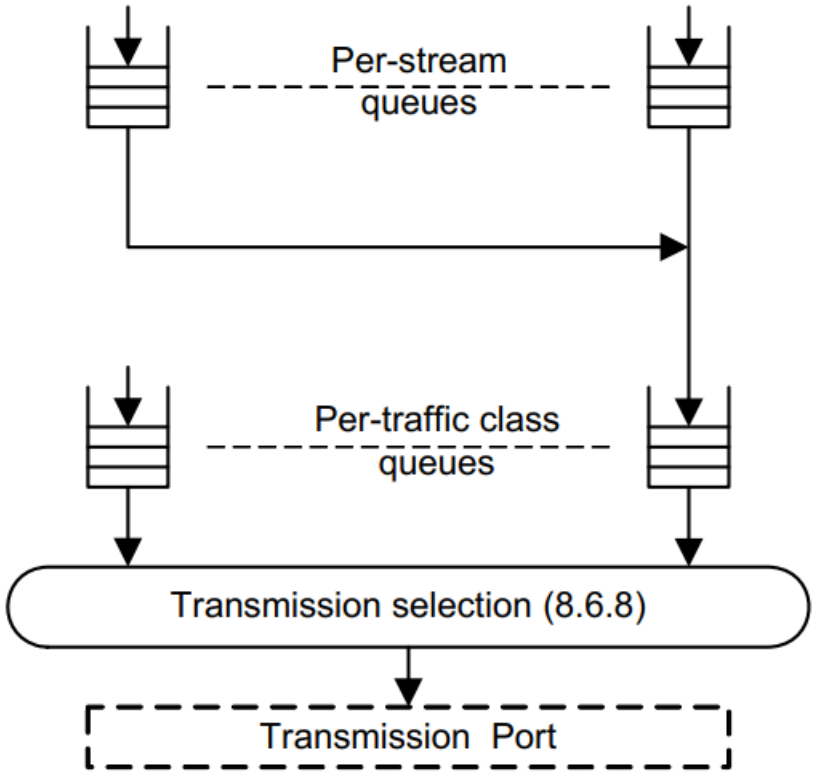


Figure 34-1—Queuing model for a Talker station

Discussion

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

Notes from Meeting:

Large end systems have 64-256 transmit Virtual Links (VL) → maps to 256 TSN streams

Each VL may have up to 4 sub VLs.

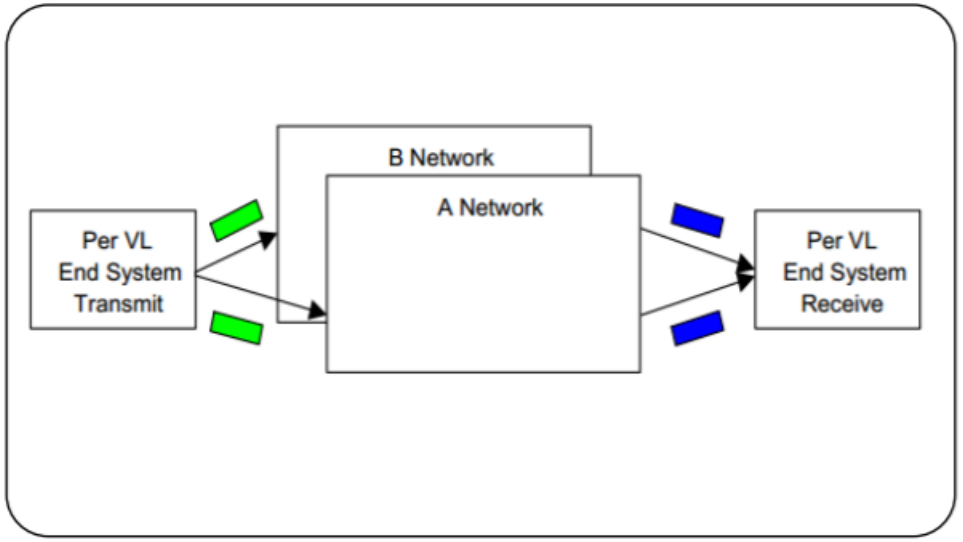
One option is to assign each VL to per-stream queue

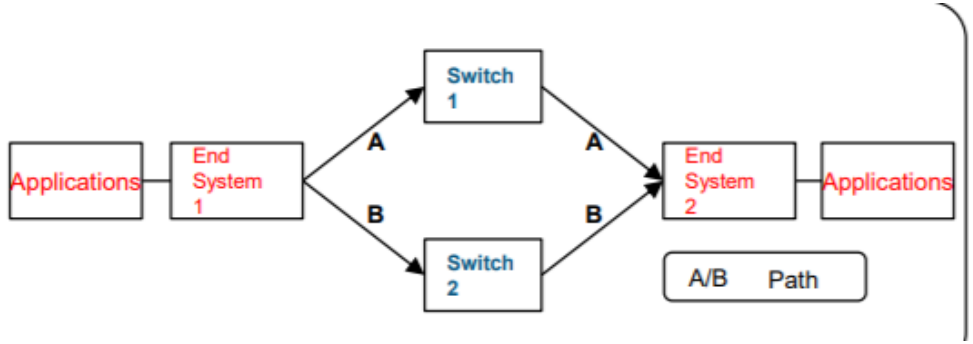
Requesting contributions from the group

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

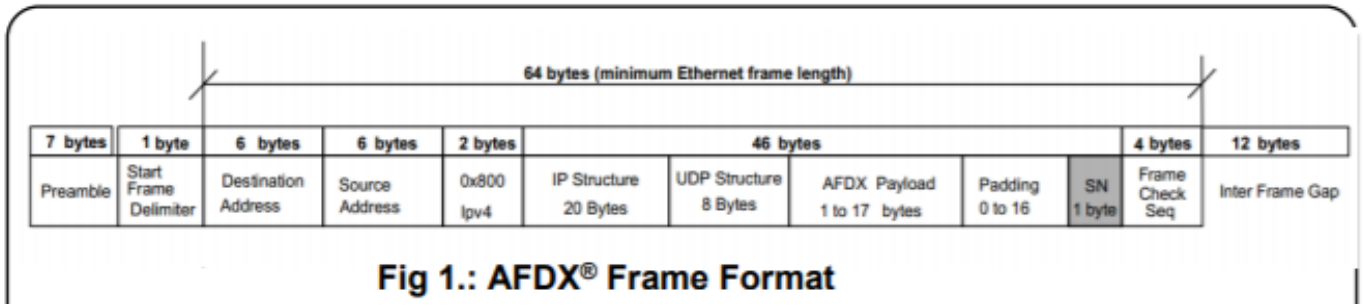


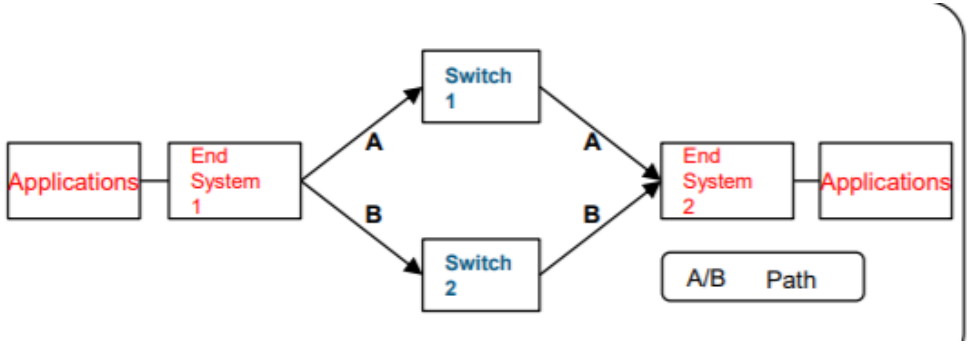
Fig 1.: AFDX® Frame Format

Does aerospace industry need this option?

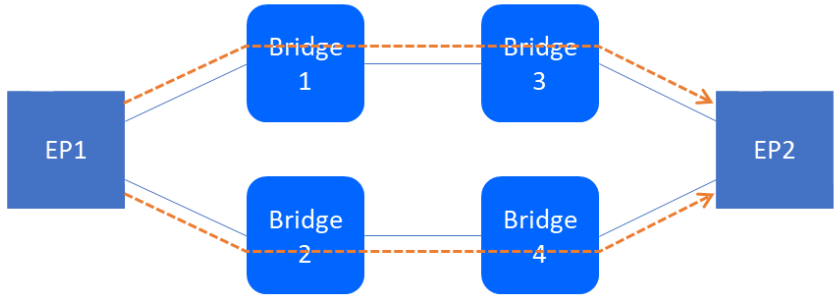
Reference: Avionics Full Duplex Ethernet and the Time Sensitive Networking Standard by Bruno Pasquier and Stefan Schneele

https://www.ieee802.org/1/files/public/docs2015/TSN-Schneele-AFDX-0515-v01.pdf

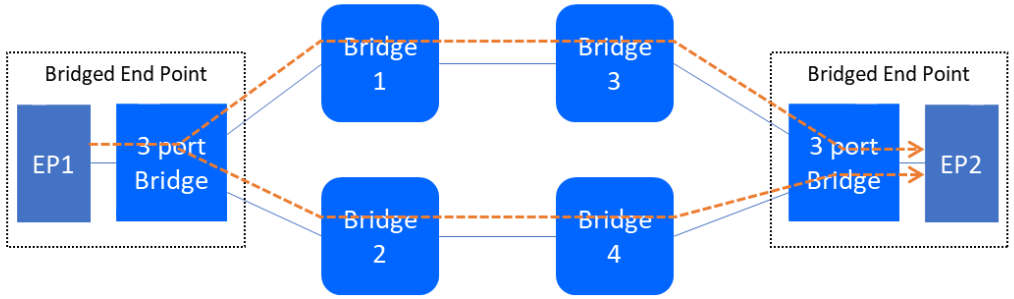
Discussion Topics: Redundancy (FRER)



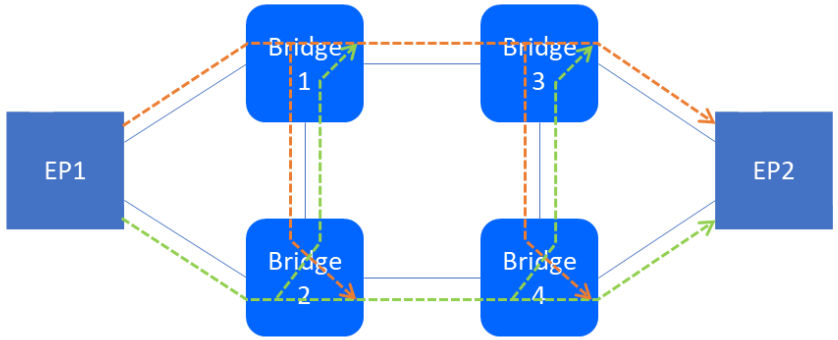
CB provides lots of redundancy variants



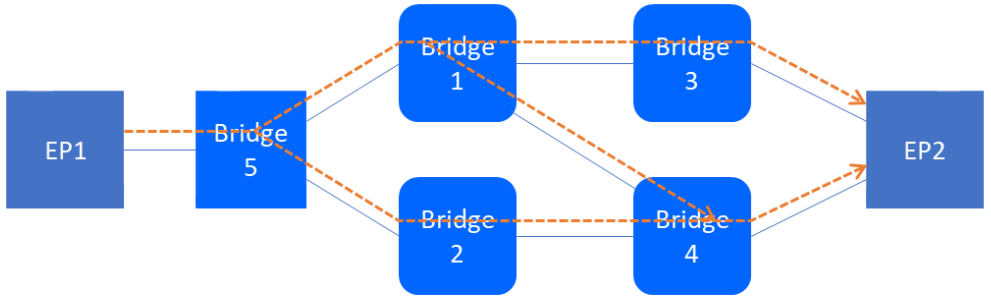
CB Capable, Dual Homed End Points using Link Aggregation



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?

Notes from meeting:

CB on bridges is desirable to enable different modes/topologies for redundancy. The added cost/complexity with requiring this feature may be “manageable”.

Need a detailed use case for forwarding both frames from a compound stream to higher layers.

It is unclear if CB is capable of sending both frames (from member streams) up to upper layer? 802.1DP may not support this feature. The user may choose to implement this behavior with two different streams (along two paths A and B).

Requesting contributions from the group