GE Aerospace

Minimum Frame Size Filter for PSFP

Need and Proposal

Mar 11rd 2026

Abdul Jabbar
GE Aerospace

Purpose/Agenda

1. Background on Per-Stream Filtering and Policing (PSFP)
2. Use case for minimum SDU size filtering
3. Proposal to add minimum SDU size filtering to PSFP

Background: Per-stream classification and metering as per 802.1Q-2022, 8.6.5.2

- Each received frame is associated with a stream filter
- Stream filter specifies maximum SDU size filtering
- If the SDU size of a frame exceeds the value of the associated stream filter's Maximum SDU size parameter, the frame is discarded and that stream filter's NotPassingSDUCount is incremented.
- Thus per-stream max SDU size filtering of frames prevents against faults that lead to head-of-the-line blocking and enables an engineered network with tight latency bounds
- 802.1Q does not support a per-stream min SDU size filtering.
- 802.3/Ethernet frames has an overall minimum frame size requirement of 64 Bytes

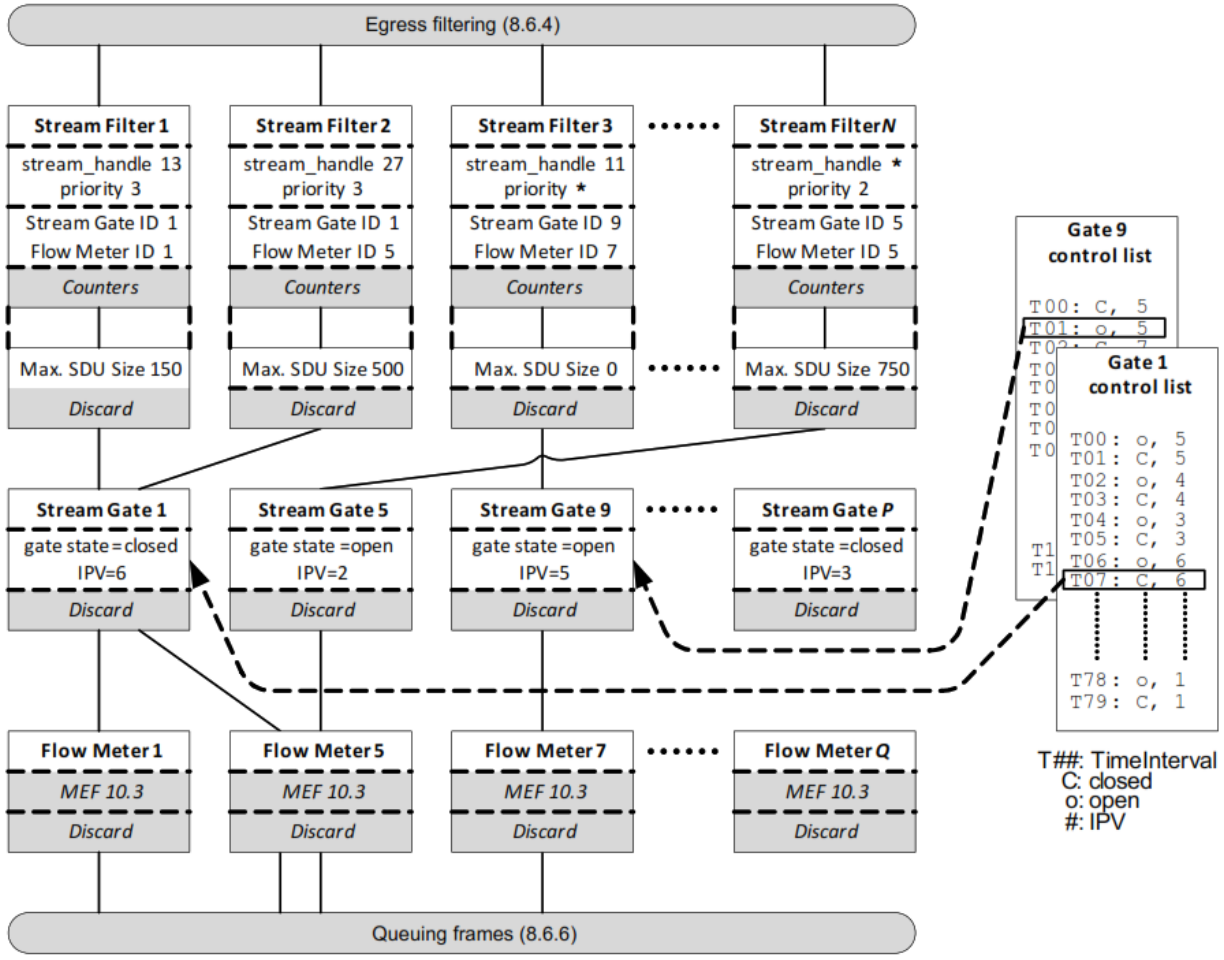
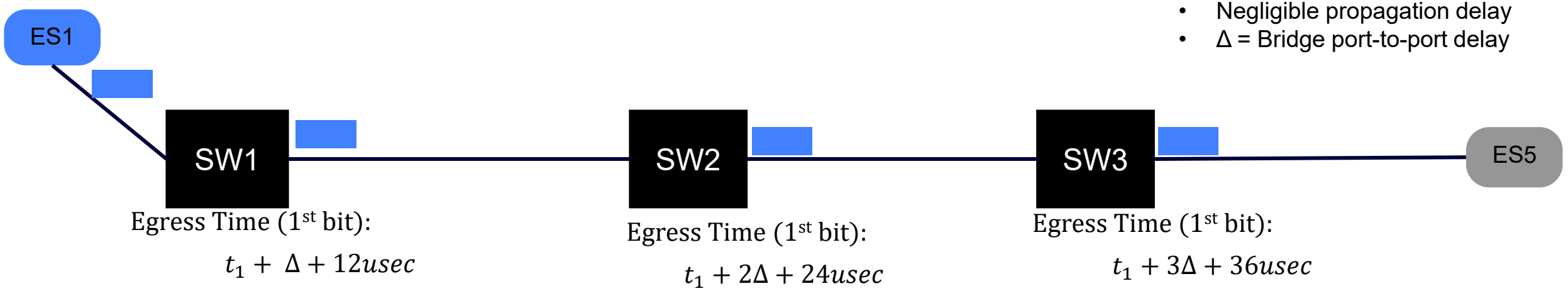


Figure 8-14—Per-stream classification for PSFP

Scheduled Traffic: Single Stream Scenario-1

Simplifying assumptions

- Identical end stations
- Identical Bridges
- Identical link lengths
- Store and Forward Bridging
- Fixed port_to_port delay
- 1 Gbps Link Speed
- Negligible propagation delay
- Δ = Bridge port-to-port delay



Stream Info:

SDU=1500 Bytes

MaxSDUSize = 1500 Bytes

TransmitOffset = t_1

Max SDU Filter = PASS

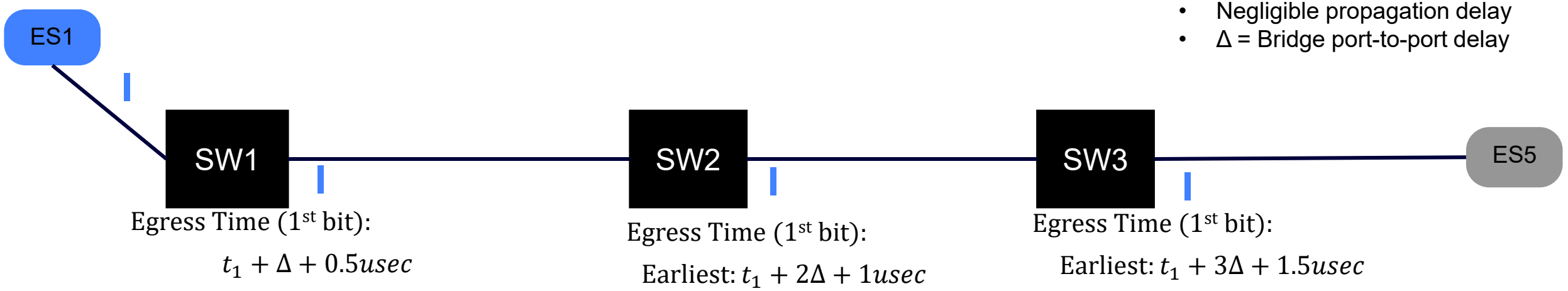
Observations:

1. Stream is specified with MaxSDUSize of 1500 Bytes according to DataFrameSpecification (46.2.3.4)
2. CNC calculates a TransmitOffset (t_1) for this stream and provides it to the ES1 (via CUC or otherwise). CNC also calculates the scheduled of the stream through the network as well PSFP stream gates
3. ES1 transmits 1500 Byte frames at transmitOffset of t_1 (first bit hits the wire at t_1)
4. All subsequent bridges forward the stream and egress ports have a corresponding transmit window allocated for this stream in their GCL. The corresponding queue/gate is open when the frame arrives at the egress port
5. All subsequent bridges also have a PSFP filter for MaxSDUSize of 1500B and stream gate that corresponds to the expected arrival window at each hop (accounting for uncertainties in clock/timing)

Scheduled Traffic : Single Stream Scenario-2

Simplifying assumptions

- Identical end stations
- Identical Bridges
- Identical link lengths
- Store and Forward Bridging
- Fixed port_to_port delay
- 1 Gbps Link Speed
- Negligible propagation delay
- Δ = Bridge port-to-port delay



Stream Info:

SDU=64 Bytes

MaxSDUSize = 1500 Bytes

TransmitOffset = t_1

Max SDU Filter = PASS

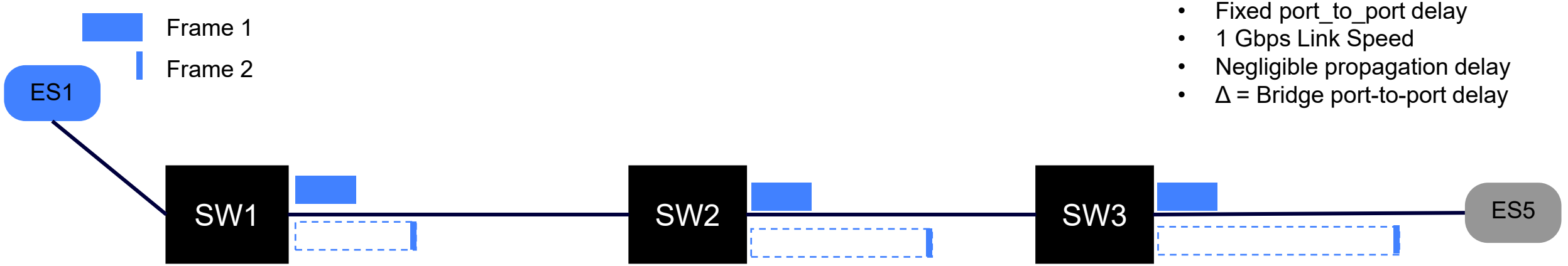
Observations:

1. Stream is specified with MaxSDUSize of 1500 Bytes according to DataFrameSpecification (46.2.3.4)
2. CNC calculates a TransmitOffset (t_1) for this stream and provides it to the ES1 (via CUC or otherwise). CNC also calculates the scheduled of the stream through the network as well PSFP stream gates
3. Application generates much smaller sized data. ES1 transmits a 64 Byte frames at transmitOffset of t_1 64 Bytes is a valid for a stream that has MaxFrameSize of 1500 Bytes (as per 802.1Q, 46.2.3.5.3)
4. The 64 Byte frame traverses the store and forward network much faster than 1500 byte frames. When the network is configured for 1500 Byte frames, the frame arrives much too early at subsequent hops. This results in both PSFP and Scheduling issues (see next slide)

Scheduled Traffic : Single Stream Scenario-3

Simplifying assumptions

- Identical end stations
- Identical Bridges
- Identical link lengths
- Store and Forward Bridging
- Fixed port_to_port delay
- 1 Gbps Link Speed
- Negligible propagation delay
- Δ = Bridge port-to-port delay



Egress Time (1st bit):

Earliest: $t_1 + \Delta + 0.5usec$

Latest: $t_1 + \Delta + 12usec$

Egress Time (1st bit):

Earliest: $t_1 + 2\Delta + 1usec$

Latest: $t_1 + 2\Delta + 24usec$

Egress Time (1st bit):

Earliest: $t_1 + 3\Delta + 1.5usec$

Latest: $t_1 + 3\Delta + 36usec$

Stream Info:

SDU=64 to 1500 Bytes

MaxSDUSize = 1500 Bytes

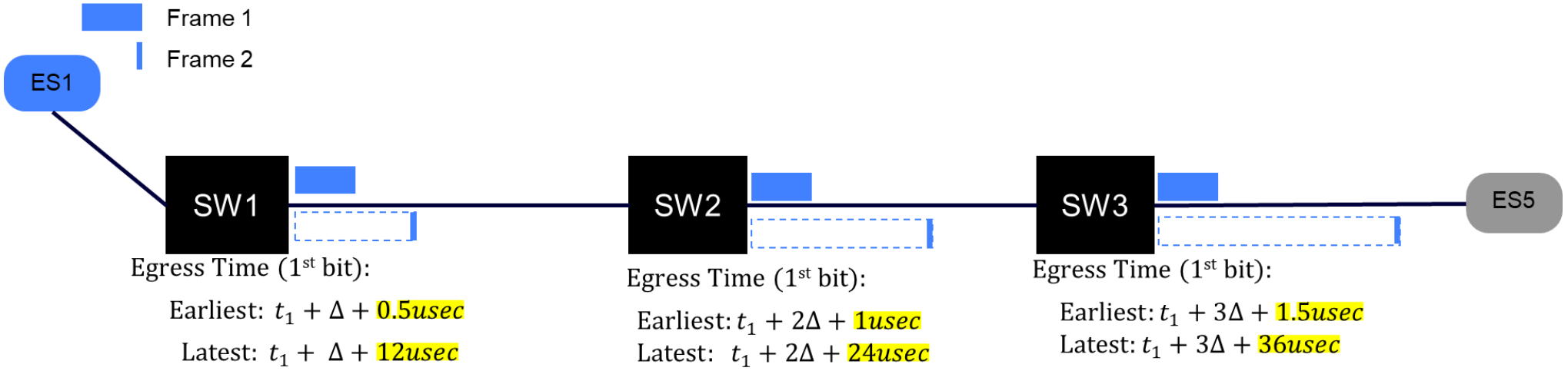
TransmitOffset = t_1

Max SDU Filter = PASS

Observations:

1. Stream is specified with MaxSDUSize of 1500 Bytes according to DataFrameSpecification (46.2.3.4)
2. CNC calculates a TransmitOffset (t_1) for this stream and provides it to the ES1 (via CUC or otherwise). CNC also calculates the scheduled of the stream through the network as well PSFP stream gates (assuming 1500 framsize)
3. ES1 transmits 1500-byte and 64-byte frames, which are both valid with MaxSDUSize of 1500 Bytes
4. 64 Byte (or frames smaller than MaxSDUSize) frames traverse much faster and disrupt the scheduled transmissions of other streams in the network (taking up scheduled slots allocated to other streams). Leads to variable congestion delay, re-ordering for frames, and potential PSPF violation of other streams.
5. Depending on the size of the smaller frame and the slop in stream gate schedules, these smaller frames eventually violate their PSFP stream gates and are dropped.

Options to address variable frame sizes



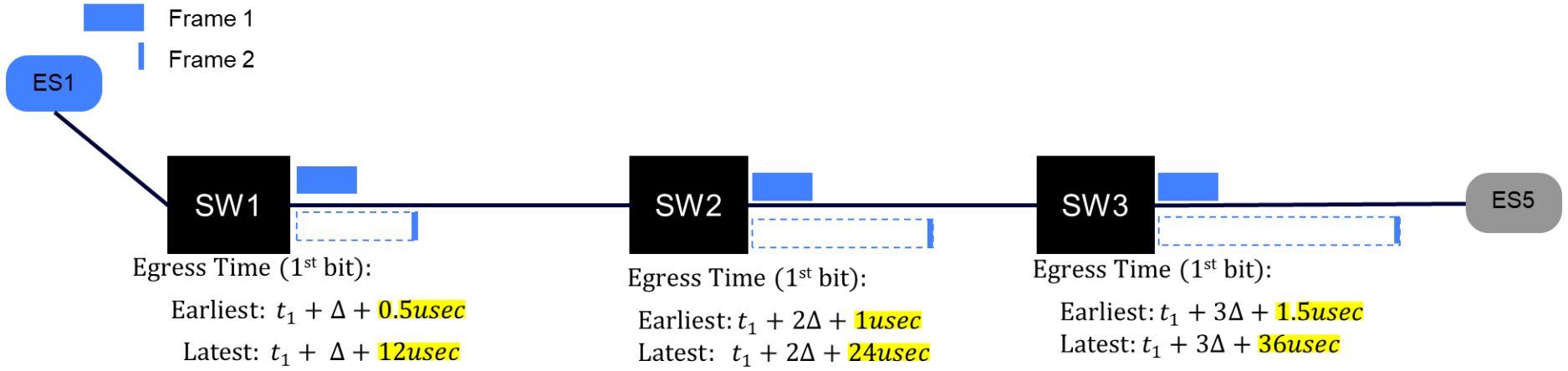
Workarounds Considered #1:

Design for wider transmit windows: CNC allocates increasingly large transmit windows along with corresponding PSFP stream gates at each hop. This will allow for full range of 64 Bytes to MaxSDUSize frames in that stream

Issues:

1. Potential (valid) transmit window grows at each hop. CNC must take this into account when scheduling other flows through the switches. Significant impact on bandwidth utilization: 100% growth per stream per hop (2x at 1 hop, 3x at 2 hops, 4x at 3 hops). Eventually leads to infeasibility
2. Valid stream gate must also grow at each hop. Increasing PSFP stream gate open duration at each hop results in larger bounds on guaranteed latency and jitter.
3. There is no other parameter for the application, end station, CUC, CNC to indicate a smaller range of SDUSize

Options to address variable frame sizes



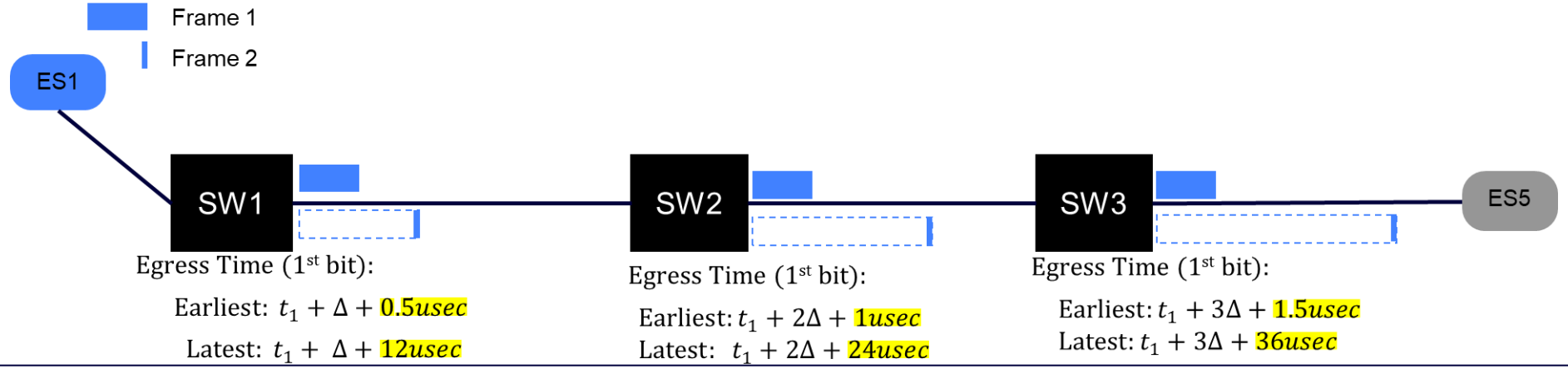
Workarounds Considered #2:

Treat MaxSDUSize as "actual" SDUSize: Network gets scheduled for MaxSDUSize. PSFP stream gates expect arrival times based on max frame size transmissions. This will catch "faulty" smaller frames and discard them.

Issues:

- On the first hop, the smaller frames still fits in the PSFP window and could disrupt other streams in that queue, including out of order frames
- Removes the ability to support normal variation in frame sizes (say 1200 to 1400 Bytes).
- Due to time error (based on PTP syn), PSFP stream gates are typically wider than frame duration on the wire. Using PSFP stream gates as an alternative to SDU size filtering is not recommended
- A "best practice" of specifying a MaxSDUSize close to the actual application frame size is NOT fault tolerant. A single faulty stream can disrupt the network. PSPF is meant to prevent this type of fault.

Proposal: MinSDUSize filtering



- Each received frame is associated with a stream filter. Stream filter specifies maximum SDU size ***and minimum SDU size*** filtering
- If the SDU size of a frame exceeds the value of the associated stream filter's Maximum SDU size parameter, the frame is discarded and that stream filter's NotPassingSDUCount is incremented.
- **If the SDU size of a frame is less than the value of the associated stream filter's Minimum SDU size parameter, the frame is discarded and that stream filter's NotPassingSDUCount is incremented.**
- Potential transmit window still grows at each hop, but at a rate determined by the difference between MaxSDUSize and MinSDUSize. CNC takes this into account and allocates increased transmit durations and corresponding stream gates.
- With managed objects MaxSDUSize can be set to the same value as MinSDUSize. If MaxSDUSize=MinSDUSize, only fixed size frames are allowed for that stream. The network allocates fixed sized transmit windows and stream gates along the transmit path. This use case applies to engineered networks in aerospace and potentially in automotive and industrial automation.
- Enables fault tolerance, wherein faulty sized frames are detected, filtered, and dropped **without any impact** on other streams in the network

Summary

1. Per Stream Filtering and Policing (PSFP) is essential for a deterministic network with bounded latency
2. PSFP supports MaxSDUSize filtering to prevent head-of-the-line blocking and congestion delays from faulty streams
3. PSFP does not do MinSDUSize filtering. 802.3 enforces a 64 Byte minimum frame size.
4. Without MinSDUSize filtering, enhancements for scheduled traffic are not effective.
5. We propose a MinSDUSize filtering option for Stream Filters to 802.1Q 8.6.5.3
6. Questions/Discussion:
   a. Is it a maintenance item or an amendment?
   b. If amendment, is the next step a motion to develop a PAR?


GE Aerospace