

**Fragmentation for  
reduced latency on all  
SR Classes**

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# Acknowledgements

## Reference materials:

- [new-kim+goetz-Ultra-Low-Latency-Switching-v5.pdf<sup>1</sup>](#)
- [ba-kw-stream-latency-Improvements-0311.pdf<sup>2</sup>](#)
- [ba-pannell-latency-math-0910-v4.pdf<sup>3</sup>](#)
- [ba-boiger-per-hop-class-a-wc-latency-0311.pdf<sup>4</sup>](#)

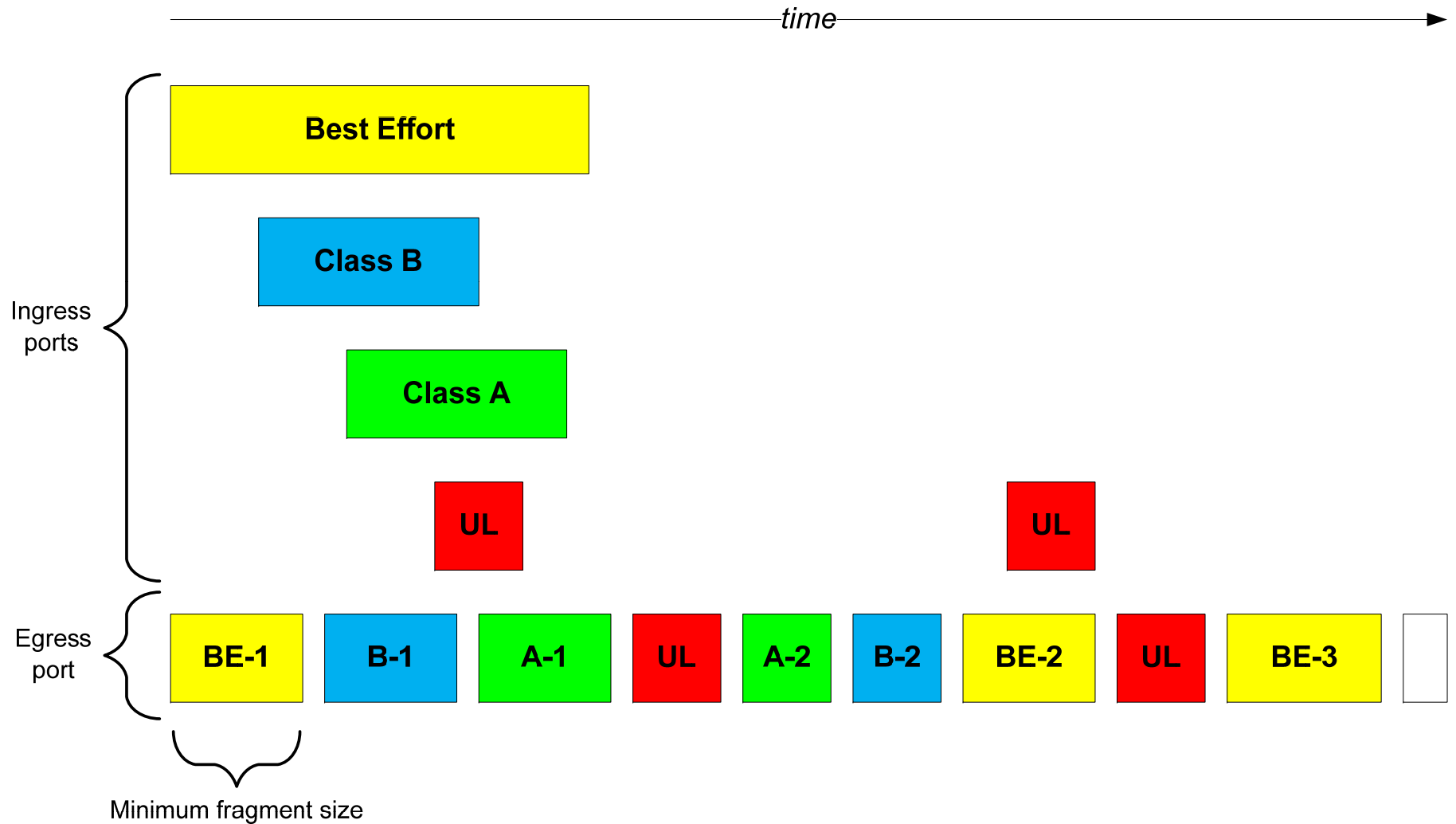
# Introduction

- Ultra-low latency<sup>1</sup> & Fragmentation<sup>1</sup> are two separate topics
- The goal of this presentation is not ultra-low latency, but to explore the benefits of fragmentation on existing AVB Classes
- Make fragmentation available to all (AVB) shapers

# Definitions

- **Interfering Traffic (IT):** frames of a lower priority which cause delays to transmission of higher priority frames.
- **Suspend-and-Resume (SaR):** Suspending transmission of a lower priority frame so a higher priority frame can be transmitted, followed by resumption of the lower priority frame. This can occur more than once to a large low priority frame.

# Multi-Class SaR



# Possible Fragmentation Marking<sup>1</sup>

- After peer Gen-2 devices agree they can do SaR (via LLDP?) they know every packet sent between them has a new 8-bit header that defines fragments
- 8-bit header contains:
  - 2 flag bits: begin, previousEnd
  - Four frag-classes requires 2-bits to identify
  - *Optional 4-bit sequence number per frag-class*

# Fragment Reassembly

- If “previousEnd” bit is set then previous frame has been completely reassembled; pass it on
  - Note: missing or damaged fragments will cause a CRC error. What do bridges do when frames have CRC errors? Toss the frame. Thus no need for sequence numbers.
- If “begin” bit is set then reset frag-class buffer pointer to beginning of buffer
- Append fragment to frag-class buffer

# Multi-Class SaR Concerns

- One Ingress buffer for each frag-class
- MACsec, etc, concerns?
- Effects on PHY/MAC/CAM?
- Will 8-bit fragmentation header work?



# Multi-Class SaR Benefits

- Jumbo Packets are back?
- Talker burst limit of two back-to-back frames<sup>4</sup>
  - Can we now define a latency formula?
- Gen-1 and Gen-2 switches can co-exist between Talkers and Listeners
  - Obviously fragmentation (and reduced latency) can only occur between Gen-2 devices
- Reduced latency for higher priority frames

# Bridge Port Latency Math with SaR<sup>3</sup>

$$\text{Max Latency} = t_{\text{Device}} + t_{\text{Interval}} + t_{\text{MaxFrameSize}} + t_{\text{Stream}} - t_{(\text{Stream}+\text{Gap})} * 1.333$$

$$t_{\text{Device}} = 5.12\mu\text{s}$$

$$t_{\text{Interval}} = 125\mu\text{s}$$

$$t_{\text{MaxFrameSize}} = 6.72\mu\text{s} \text{ (for 64 bytes + IFG + preamble), } 7.68\mu\text{s} \text{ (for 96 bytes + IFG + preamble)}$$

$$t_{\text{Stream}} = 5.12\mu\text{s} \text{ (assuming 64-byte frames)}$$

$$t_{(\text{Stream}+\text{Gap})} = 5.12\mu\text{s} + 1.6\mu\text{s}$$

$$\text{Max Latency}_{100 \text{ MB/s}} = 5.12\mu\text{s} + 125\mu\text{s} + 6.72\mu\text{s} + 5.12\mu\text{s} - ((5.12\mu\text{s} + 1.6\mu\text{s}) * 1.333) = \mathbf{133.00\mu\text{s}}$$

$$\text{Max Latency}_{1000 \text{ MB/s}} = 0.512\mu\text{s} + 125\mu\text{s} + 0.672\mu\text{s} + 0.512\mu\text{s} - ((0.512\mu\text{s} + 0.16\mu\text{s}) * 1.333) = \mathbf{125.80\mu\text{s}}$$

	100 MB/s [x7]	1000 MB/s [x7]
Without SaR	<b>249.64μs [1747μs]</b>	<b>137.46μs [962μs]</b>
With 64-byte SaR	<b>133.00μs [931μs]</b>	<b>125.80μs [881μs]</b>
With 96-byte SaR	<b>135.56μs [949μs]</b>	<b>126.06μs [882μs]</b>

# Thanks