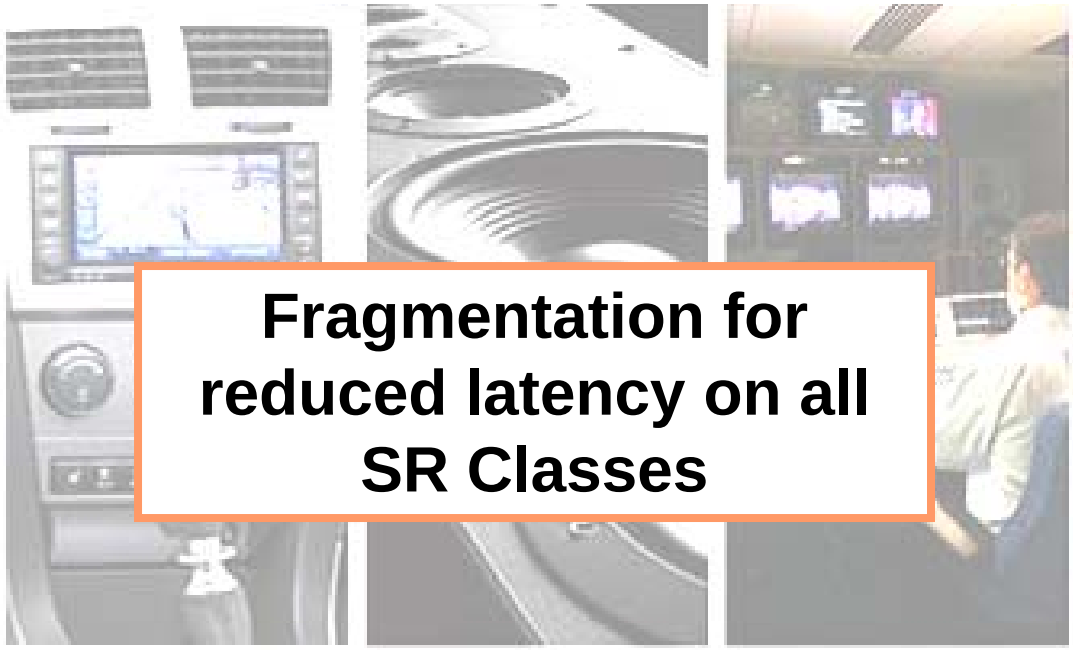

# Fragmentation for reduced latency on all SR Classes

**Craig Gunther** (craig.gunther@harman.com)

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# Acknowledgements

Reference materials:

- new-kim+goetz-Ultra-Low-Latency-Switching-v5.pdf[1]
- ba-kw-stream-latency-Improvements-0311.pdf[2]
- ba-pannell-latency-math-1110-v5.pdf[3]
- ba-boiger-per-hop-class-a-wc-latency-0311.pdf[4]

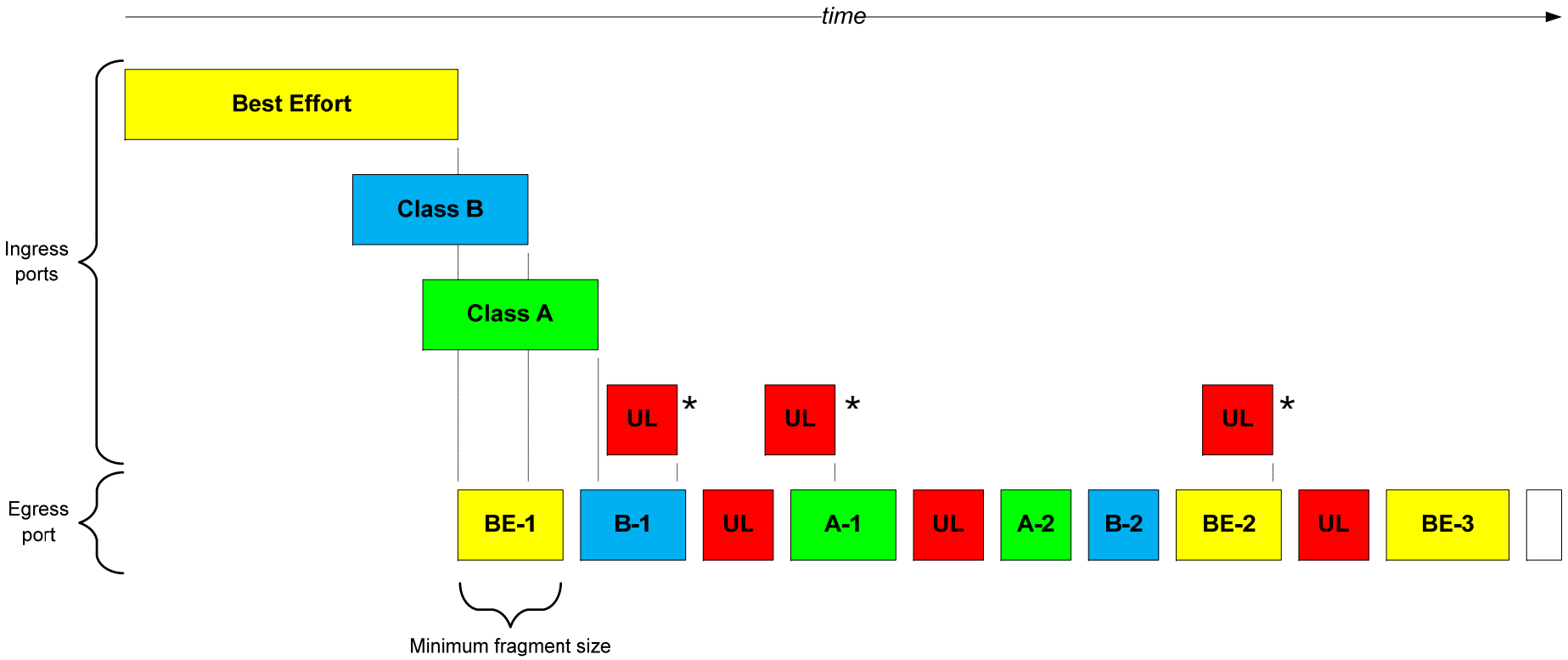
# Introduction

- Ultra-low latency[1] & Fragmentation[1] 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




*Note: This slide assumes UL frames are separate from SR Class A & B frames.

# Possible SaR Marking[1]

- 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 fragment characteristics
- 8-bit header contains:
  - 2 flag bits: begin, previousEnd
  - Four SaR-classes requires 2-bits to identify
  - 4-bit sequence number per SaR-class

# SaR Reassembly

- If “previousEnd” bit is set then previous frame has been completely reassembled; pass it on
  - Sequence numbers can be used to detect missing fragments. Note that there are only 16 sequence numbers so this can fail if there are 16 missing fragments in a row.
- If “begin” bit is set then reset SaR-class buffer pointer to beginning of buffer
- Append fragment to SaR-class buffer

# Multi-Class SaR Concerns

- One Ingress buffer for each SaR-class
  - Class A and Class B buffers are limited size
  - Best Effort buffer must support Jumbo frames
- MACsec, etc, concerns?
- Effects on PHY/MAC/CAM?
- Will 8-bit SaR header work?

# Multi-Class SaR Benefits

- Jumbo Packets are back!
- Talker burst limit of two back-to-back frames[4]
  - 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[3]

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

$t_{Device}$ = 5.12µs

$t_{Interval}$ = 125µs

$t_{MaxFrameSize}$ = 6.72µs (for 64 bytes + IFG + preamble), 7.68µs (for 96 bytes + IFG + preamble)

$t_{Stream}$ = 5.12µs (assuming 64-byte frames)

$t_{(Stream+Gap)}$ = 5.12µs + 1.6µs

Max $Latency_{100\ MB/s}$ = 5.12µs + 125µs + 6.72µs + 5.12µs - ((5.12µs + 1.6µs) * 1.333) = **133.00µs**

Max $Latency_{1000\ MB/s}$ = 0.512µs + 125µs + 0.672µs + 0.512µs - ((0.512µs + 0.16µs) * 1.333) = **125.80µs**

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

# Thanks