Impacts on latency

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Main issues identified

- Legacy traffic interference
- CBSA caused delays
- Queueing/Ordering effects

…and some combinations ?

Legacy traffic interference

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- Problem Statement
  - Non-preemptive nature of Ethernet
  - Frames can be long with 1500 octets payload
    (means approx. latency **125µs** @FE, 12,5µs @GE)

➔ Possible Solutions
  - Interruption mechanism for long frames
    ➔some changes in IEEE802.3 (and others?) needed
  - Transmit acceptable peaces of information
    ➔restrict max frame size at a link
    ➔fragmentation at egress and reassembly at ingress

Architectural consideration

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- Short fragments is a LAN(link) property
  ➔ bridged LAN property possible but some issues
- Fragmentation on egress
  Reassembly on ingress
- Short frame requirement leads to
  ➔ 92 Octet data size of a fragmentation element
- Improvement latency by a factor of 10
- Average overhead <20%, peak 30% for legacy traffic
- Can be handled outside MAC in bridge or end device
- Fragmentation expedite any type of high priority traffic

Example fragmentation

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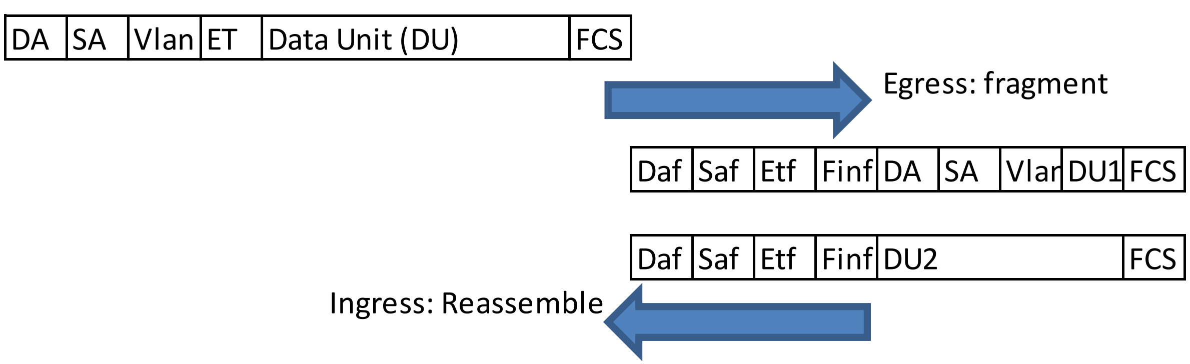
- Higher layers are not affected
- LAN technology not affected
- Some rules avoiding additional overhead:
  - Min Frame size: if residual fragment <46
    upgrade last fragment to 46 and reduce last but one
  - A look ahead policy can reduce latency
    can be activatited after target port selection of stream



CBSA caused delays

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- Problem Statement
  - Streams come from different sources at the same time
  - Last stream can be delayed for almost **one cycle**
  - Occurs with each data rate and each stream load
    e.g. FE 80% and GE 20% load causes similiar delays!

➔ Possible Solution

  ➔ Avoid shaping effects in non-overload situations (burst all streams) work with positive credit

  ➔ Handle a sequence of streams like a single stream

  ➔ Do shaping only if more than bandwith is exhausted for n cycles

  ➔ Drop stream elements if stream exhaust bandwith

Burst all streams

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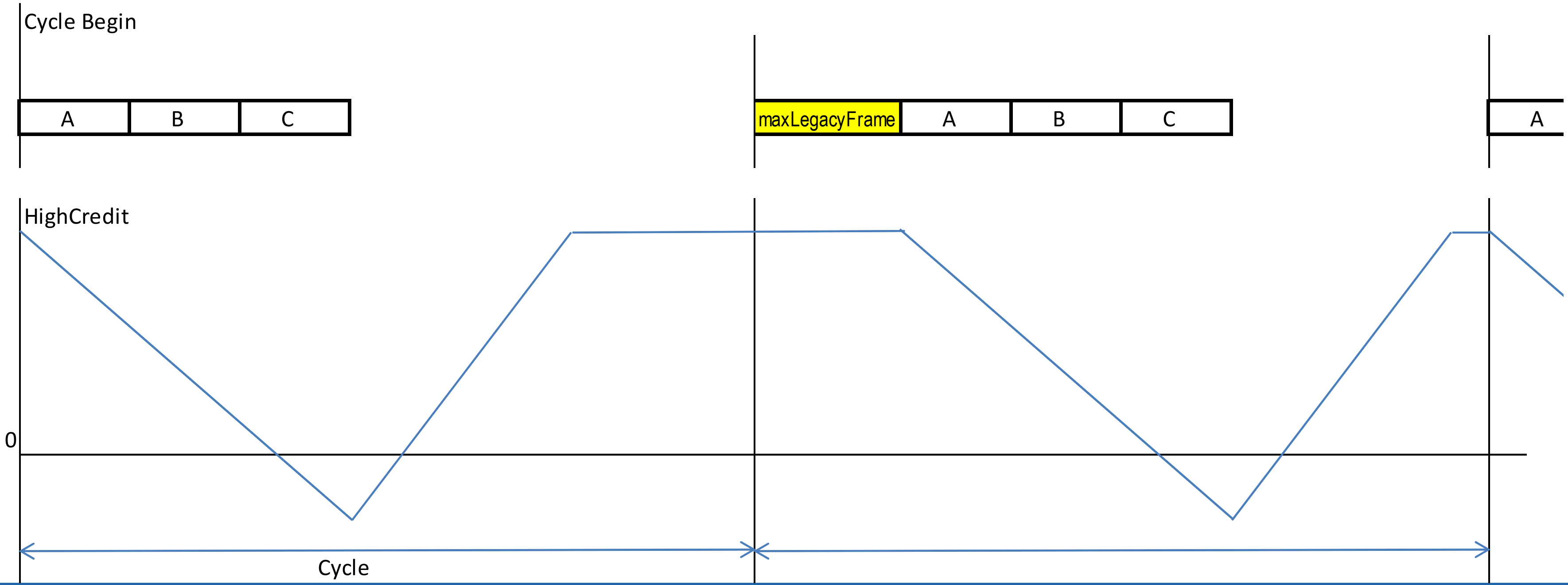
- All streams shall be send at cycle start
- Positive credit on idle
- Idle slope reach high credit before cycle begin (even with interference)



Queueing effects

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- Problem Statement
  - Streams come from different sources
  - Each stream on each port goes to a different target port on different bridges
  - The last stream element of each ingress port goes to the same egress port

→ Possible Solutions
  - → Send selection depends upon ordering
  - → Ordering Algorithm:
    - → Rearrangement of late frames
    - → Neighbor can switch/set desired arrival order
  - → Giving priorities in advance (per bridge?)

Ordering of streams

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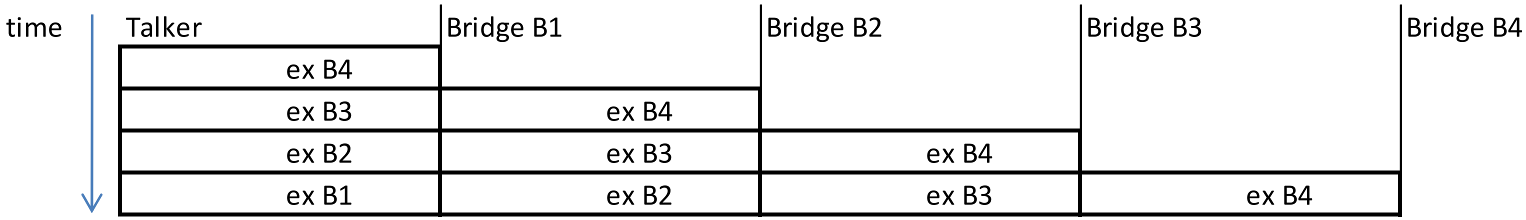
- Latency should determine the order
- Example shows a talker with several different listener
- Situation aplies to all structures
- Performance improvement factor 2
- This rule helps for cascaded hierarchial communication
- This shows that transmission time and bandwith must not necessarily be added (slipstream effect)



More complex structures

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- Multiple sources and destinations show a different picture
- Path length is all the same
- Send Order in bridges 1 to 5 shall be different:
  - Bridge1: 21, 31, 41, 51
  - Bridge2: 32, 42, 52, 12
  - Bridge3: 43, 53, 13, 23
  - Bridge4: 54, 14, 24, 34
  - Bridge5: 15, 25, 35, 45