Consideration of Burstiness in Bridged Fronthual Network

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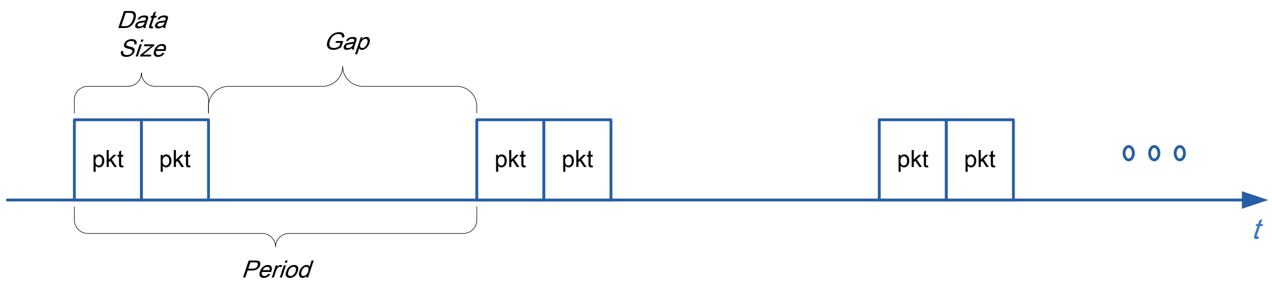
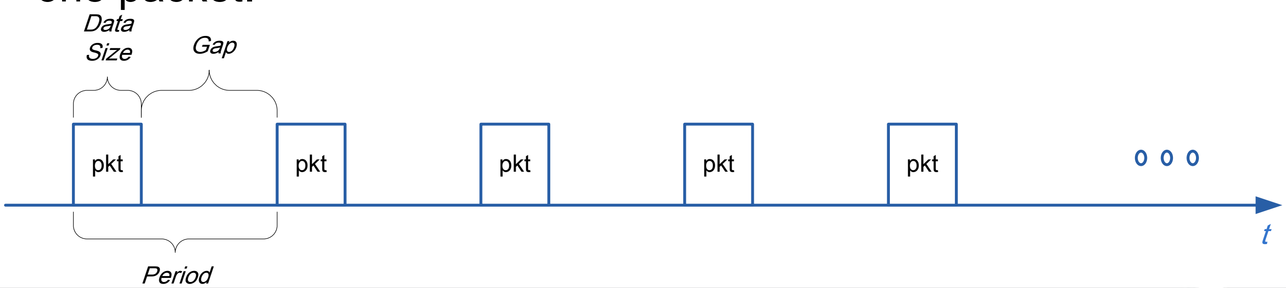
Packet Group Mode vs. Packet Gap Mode

- CPRI IQ data rate is constant, and RE/REC devices send standard Ethernet packets to bridge network, in different ways.
  - Packet Group mode. CPRI IQ data converts to multiple packets in each period, with equal gap between packet groups.

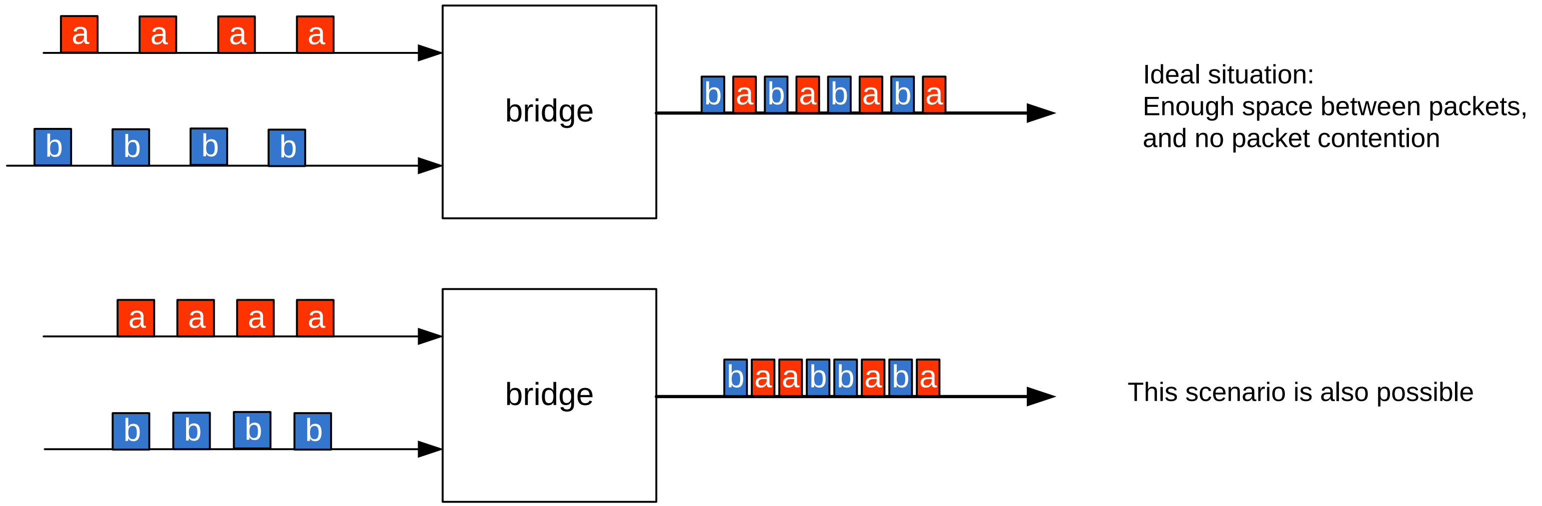


  - Packet Gap mode, is a special Packet Group mode with group size of just one packet.



Burstiness with CBR Data Stream

- Two factors introduce burstiness in bridged fronthual network.
  1. Packets received by edge port are in group, when IQ data of one period does not fit in one Ethernet frame.
  2. Bridge devices need to store and forward packets and may change packet gaps due to various reasons such as packet contention, scheduling effect etc., especially when link load is high. Burstiness will happen unless specific scheduling algorithms are used.



Question for Latency Calculation

- Current equations for each bridge latency in 802.1cm draft 0.5 and comment document is,

Equation (7-1) shows how the worst-case latency of a Bridge ($t_{MaxBridge}$) can be calculated for IQ data streams:

$$t_{MaxBridge} = t_{SF} + t_{SelfQueuing} + t_{Queuing} + t_{MaxIQFrameSize + Pre + SFD + IPG}, \quad (7\text{-}1)$$

The worst-case self-queuing delay of a Bridge Port depends on the number of IQ data flows aggregated by the given Port as shown by Equation (7-2):

$$t_{SelfQueuing} = t_{MaxIQFrameSize + Pre + SFD + IPG} \times \sum_{i=1}^{N-1} F_i, \quad (7\text{-}2) \quad *$$

In Eq 7-2, $t_{selfqueuing}$ is only related to the number of CPRI IQ data flows in contention, this implies to an assumption that each CPRI flow has exactly one packet coming at a moment, in other words, no burst ever happens. This is actually a strict requirement for bridge device.

**This equation is modified in D0.5 comment disposition, with similar idea.*

Examples

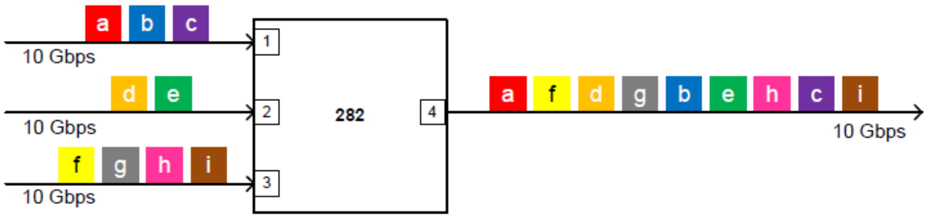
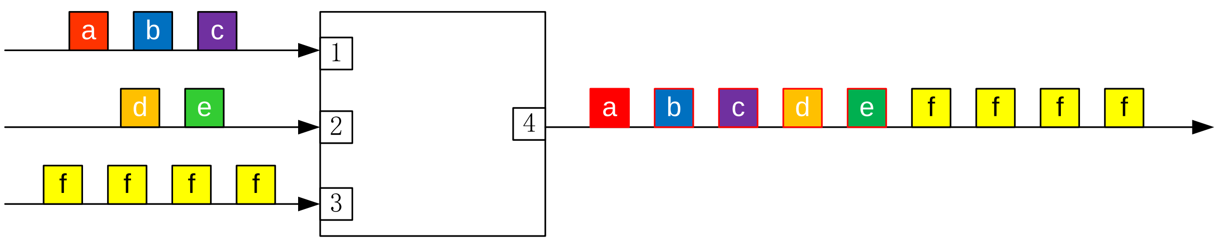


Figure B-1—Self-queuing

First example is from D0.5 Annex B, each CPRI flow has one packet coming in this scheduling cycle.



In second example, if CPRI IQ data flow *f* has 4 packets coming in burst and a credit based scheduler can arrange the output like this, assuming each port has enough credit to go. The latency of packet "*a*" is not only related to number of CPRI IQ data flows, but also burstiness of each flow.

This is the impact of burstiness on bridge latency.

Suggestion for 802.1CM Modification

- Keep Eq 7-1 as is.
- Propose to change equation 7-2 to

$$t_{self-queuing} = \sum_{i=1}^{N-1} \sum_{j=1}^{F_i} (B_j * t_{MAXIQFramSize+Pre+SFD+IPG})$$

where:

N is the number of ingress Ports receiving interfering frames carrying IQ data,

F_i is the number of IQ data flows supported by Port *i*,

B_j is burstiness of IQ data flow *j*

"The number and corresponding burstiness of the aggregated CBR IQ data flows supported by different ingress Ports (other than the reception Port of the observed flow) determine the worstcase self-queuing delay for a frame of an observed flow."

Suggestion for 802.1CM Discussion

- Need more investigation on how to reduce influence of burstiness to avoid worst case latency and jitter.
  - Simple Round Robin Scheduling?
  - Latency bounded scheduling algorithms?
  - Other ideas?
- Add proper clarification in 802.1cm that no burst exists in profile a/b
- Add another profile in 802.1cm or start new standard project to address the influence of burstiness in bridged network.

Thank you