DELAYS AND DELAY VARIATION IN AN ETHERNET FRONTHAUL NETWORK

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This presentation updates
http://www.ieee802.org/1/files/public/docs2015/cm-farkas-delay-pdv-1215-v01.pdf

GOAL

- Assumptions
  - Only frame preemption is used out of the TSN tools (no 802.1Qbv)
    - Express: CPRI traffic
    - Preemptable: all the rest of the traffic
  - CPRI flows are allowed to race each other at every hop
  - Playout buffer is used for outbound traffic at the edge bridge in order to cope with Frame Delay Variation (FDV)
    - Note: It is FLR (Frame Delay Variation) for a switched Ethernet transport network. Packet Delay Variation (PDV) is a generic term for packet networks. CPRI also has a (TDM-)frame structure, which is referred to as “CPRI frame”
- This presentation investigates the calculation possibilities of delay and FDV in the Ethernet transport network for frames of CPRI flows

EFFECTS OF FRAME PREEMPTION

- Worst case delay: 124 Bytes
  - The serving time of 124 Bytes is the worst case delay that an express frame carrying CPRI traffic can suffer in a bridge due to preempting background traffic
  - It is 114.4 ns for 10 Gbps outbound link, it is 11.44 ns for 100 Gbps link
  - Details: http://www.ieee802.org/1/files/public/docs2015/cm-farkas-applicability-of-bu-and-bv-1115-v02.pdf
- Best case is 0, if no need to preempt
- Therefore, frame preemption delay causes FDV
- The per hop frame preemption delays are accumulated
- FDV due to frame preemption can be calculated

$$FDV_{preemtion} = \sum_{j} t_j^{124B}$$

i.e. by summing the service time of 124 Bytes for the outbound link of each hop *j*

- Frame preemption may cause 572 ns FDV in a 5-hop diameter network comprising 10 Gbps links

DELAY

- Delay calculation per CPRI flow:
  - Propagation delay: on passed link (inc. serialization); depends on link length (5usec/km)
  - Bridging delay: on passed bridge; depends on bridge implementation (non-blocking!)
    Note: no queuing delay for CPRI
  - Racing delay: racing event may occur at an egress port; depends on relative arrival time of racing frames and their size
    Note: racing can be treated as a special queuing delay.
  - Playout buffer delay: re-shaper/de-FDV buffer; depends on configuration (T_{buffer})

$$Delay_{tr} = \sum_i d_{link\_i} + \sum_j d_{sw\_j} + \sum_r d_r + T_{buffer}$$

propagation | bridging | racing | playout

Assumptions (propagation, bridging):
- Symmetric up/down
- Static value
- Change only
  - if network topology or nodes changed
  - rerouting (skew)

Racing:
- # of racing may differ up/down

FRAME DELAY VARIATION (FDV)

- FDV calculation per CPRI flow:
  - Propagation: no FDV caused by a point-to-point link
  - Bridging: implementation specific (non-blocking bridge is assumed)
    Note: no queuing FDV for time critical traffic. If TSN function(s) cause FDV it should be added for a given solution.
  - Racing: depends on solution characteristics
    Note: Racing can be treated as a factor causing special queuing FDV.
  - Playout: can eliminate FDV partly / entirely

$$FDV_{tr}^{max} = 0 + \sum_j FDV_{sw_j}^{max} + \sum_j t_j^{124B} + \sum_r FDV_r^{max} - T_{de-FDV}$$

propagation | bridging | racing | playout

- depends on bridge implementation (↑ bridging)

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