

## DELAYS AND PDV IN AN ETHERNET FRONTHAUL NETWORK

János Farkas and Balázs Varga janos.farkas@ericsson.com balazs.a.varga@ericsson.com

December 16, 2015

### 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 Packet Delay Variation (PDV)
  - Note: Packet Delay Variation is used for Ethernet frames as PDV is a well-known term and acronym
- This presentation investigates the calculation possibilities of delay and PDV 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 PDV
- The per hop frame preemption delays are accumulated
- > PDV due to frame preemption can be calculated

$$PDV_{preemtion} = \sum_{j} t_{j}^{124B}$$
 i.e. by summing the service time of 124 Bytes for the outbound link of each hop  $j$ 

Frame preemption may cause 572 ns PDV 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

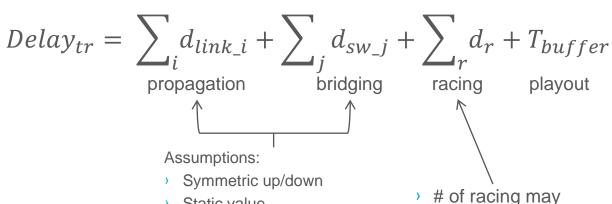
 Racing delay: racing event may occur at an egress port; depends on relative arrival

differ up/down

time of racing frames and their size

Note: racing can be treated as a special queuing delay.

 Playout buffer delay: re-shaper/de-PDV buffer; depends on configuration (T<sub>buffer</sub>)



- Static value
- Change only
  - if network topology or nodes changed
  - rerouting (skew)

### PDV



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

$$PDV_{tr}^{max} = 0 + \sum_{j} PDV_{sw_{j}}^{max} + \sum_{j} t_{j}^{124B} + \sum_{r} PDV_{r}^{max} - T_{de-PDV}$$
 propagation bridging racing playout 
$$\uparrow$$
 depends on bridge implementation



# **ERICSSON**