Consideration on the causes of accumulated latency

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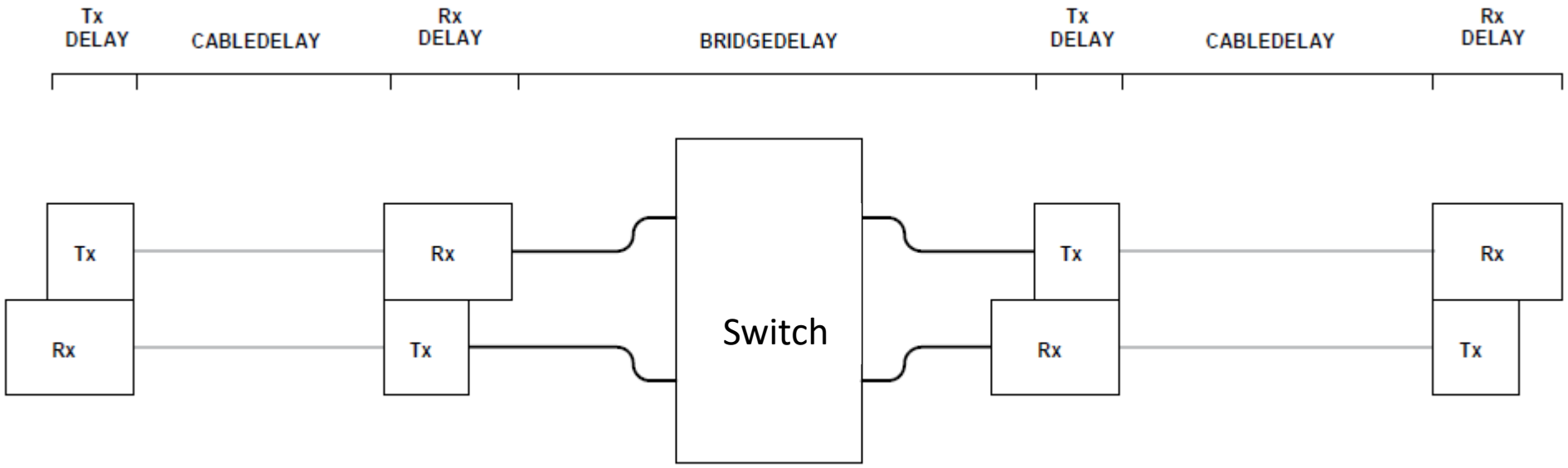
Purpose of this presentation

- **There are heavy interests in reducing accumulated latency.**
- **But it is not clear what the accumulated latency is and which part we complain most.**

- **In this presentation, we will try to clarify the notion of accumulated latency and share our further considerations.**

The timing model of an Ethernet transmission channel



- PHY Delay：the Ethernet PHYs introduce delays during receiving and transmitting that are caused by the internal processing of the data.
- Cable Delay: a typical CAT5 cable has a cable delay of 5.7 ns per meter, or approximately half a bit transmitted.
- Switch Delay: the time a message is delayed traversing through a switch.
- Tx delay, Rx delay…
- Node latency consists of phy delay, switch delay, tx delay and rx delay.

For a long line topology of many hops in industrial network, Accumulated latency is the sum of nodes' latency and cable latency.

Latency and Forwarding Delay

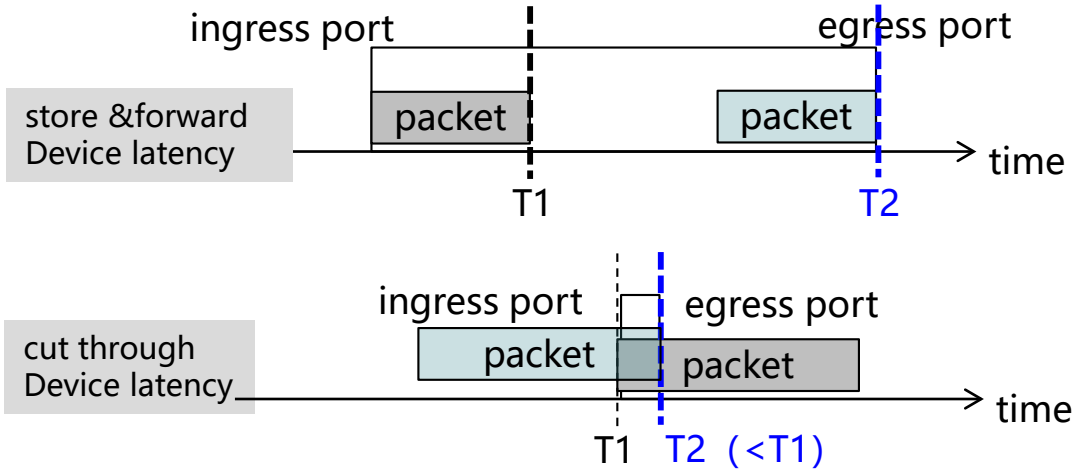
RFC1242: latency: Last in first out

3.8 **Latency**

Definition:

For store and forward devices:
The time interval starting when the last bit of the input frame reaches the input port and ending when the first bit of the output frame is seen on the output port.

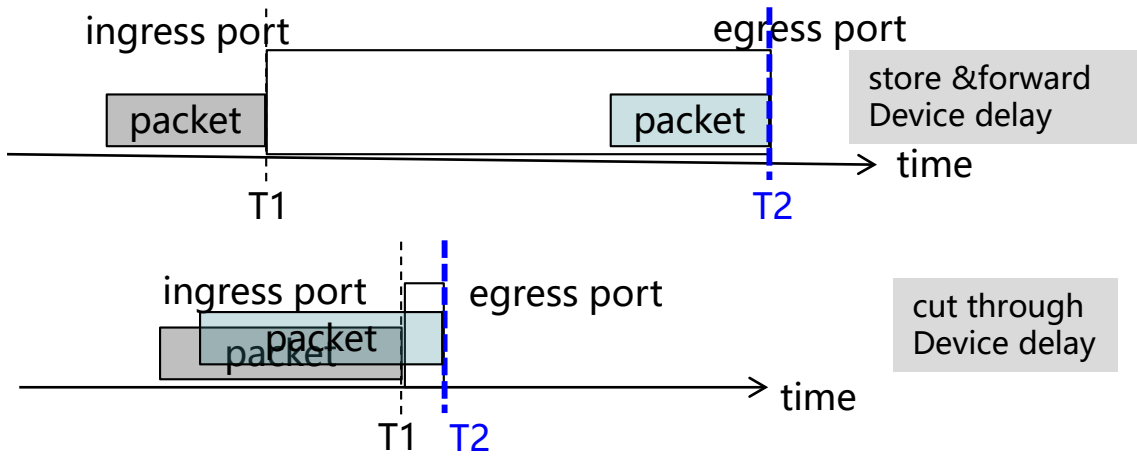
For bit forwarding devices:
The time interval starting when the end of the first bit of the input frame reaches the input port and ending when the start of the first bit of the output frame is seen on the output port.



RFC4689: forwarding delay: Last in last out

3.2.4. **Forwarding Delay**

Definition:
The time interval starting when the last bit of the input IP packet is offered to the input port of the DUT/SUT and ending when the last bit of the output IP packet is received from the output port of the DUT/SUT.



When we complain about accumulated latency, we are complaining about accumulated forwarding / switch delay.

Further considerations

new-woods-cutthroughconsiderations-0518-2017-v01.pdf

To quantify the performance of cut through, Jordon gives a formula.

- ***Switch Delay = (P+Nb) * Tb + Lu + Q***

▶ Where:

- ***Switch Delay*** is the time from receipt of SFD on the ingress port to the transmission of SFD on the egress port
- ***P*** = number of bytes in the preamble
- ***Nb*** = number of data bytes in the frame necessary to make the forwarding decision
- ***Lu*** = look-up/processing time to compute forwarding destination
- ***Q*** = internal queueing times (including MAC traversal, memory delays, etc.)
- ***Tb*** = Time necessary to transmit a byte (e.g. 80 nsec for 100 Mbit, 8 nsec for 1Gbit)

❑ Can further steps be taken to eliminate the Lu and Q?

❑ If yes, we can have constant switch delay as something like: ***Switch Delay = (P+Nb) * Tb***

The latency becomes a constant once Nb is decided.

Thank you!