Latency considerations

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Supporters

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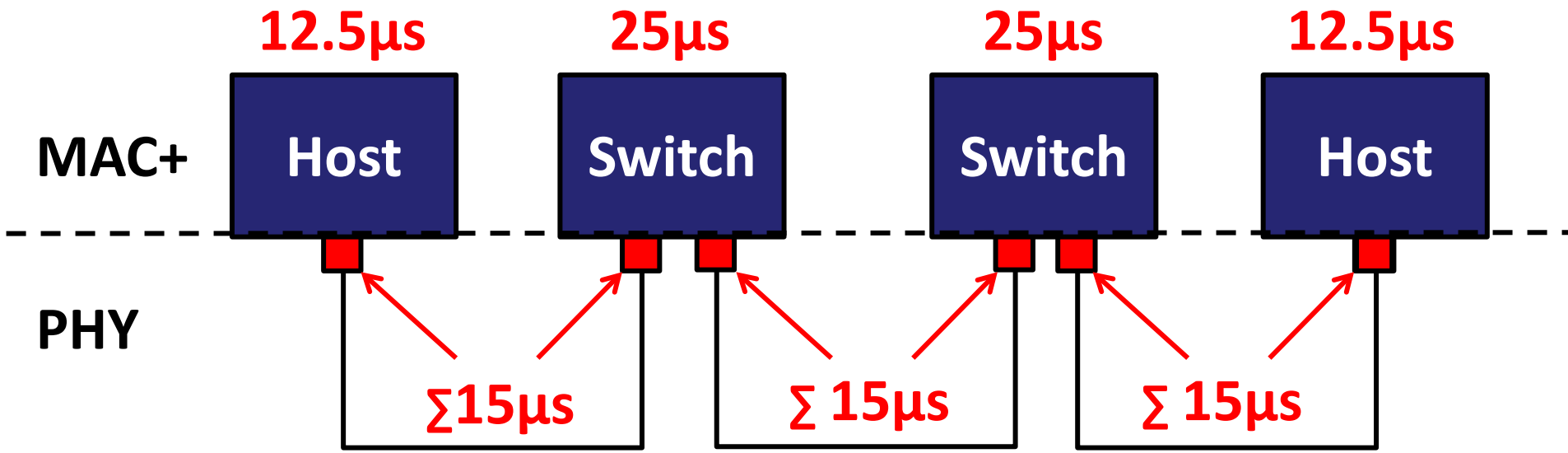
Typical Automotive Latency Requirements

- Automotive control loops require an E2E latency of the communication channel down to 1ms



- The picture shows a typical network connection which fulfills the requirements (120µs << 1000µs) even if PHY needs 15µs for FEC

Automotive Connector Requirements

- According to mechanical vibrations it is allowed for connectors to have a disconnection up to 1µs (LV214, USCAR-2)
- 1µs is what todays connectors can provide and are tested for
- If the channel is not robust enough to accept disconnections up to 1µs maybe there are mechanical designs (which maybe are more complex), alternatively, the test pass/fail criteria may need to be changed which would necessitate requalifying all existing connectors intended to be used for Ethernet

Recommendation

- FEC with additional latency of 15µs is acceptable
- Using a FEC which is robust enough to accept 1µs disconnections, would avoid requalification

Apendix

Latency definitions

- **Transmission latency**
  latency on the copper media (~5ns/m).
  Maximum is roughly 75ns = 0,075µs (@15m)
  *TranmissionLatency = Length[m]*5ns/m (estimation)*
- **Frame latency**
  latency for frame transmission (including Header & CRC = 18byte)
  *FrameLatency= (Framesize[bytes]+18)*8 / Datarate [bit/s]*
  Max. 12,144µs (@1Gbit/s; MTU=1500) or 121,44µs (@100Mbit/s; MTU=1500)
- **PHY latency**
  from x(G)MII to PMD (either up or down)
  3a. PHYlatency_down (xGMII to PMD)
  3b. PHYlatency_up (PMD to xGMII)
- **Switch latency**
  latency of the swtich (DataLink Layer, above xGMII)
- **Hop latency**
  Latency of a „hop“ in the network
  HopLatency = PHYLatency_down +FrameLatency+TransmissionLatency+PHYLatency_up
- **Network Latency**
  Latency of a network with N „hops“
  *NetworkLatency= N*HopLatency + (N-1)*SwitchLatency*

Overview 1000base-T1 stack in ISO/OSI