

USB4 1.0 ENGINEERING CHANGE NOTICE FORM

Title: Packet Forwarding Jitter
Applied to: USB4 Specification Version 1.0

Brief description of the functional changes:

Defines the jitter of the delay when a Tunneled Packet is forwarded from an Ingress to an Egress Adapter.

Benefits as a result of the changes:

The overall maximum jitter of a Tunneled Packet along a Path can be calculated to support DP OUT Adapter buffer calculation.

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:

None

An analysis of the hardware implications:

None.

An analysis of the software implications:

None

An analysis of the compliance testing implications:

A test should be added to the Protocol CTS.

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Actual Change

(a). Section 5.3 Quality of Service (QOS)

5.3.4 Packet Forwarding Delay Jitter

When a Router routes a Tunneled Packet along a Path, from an Ingress Adapter to an Egress Adapter, it generates Packet Forwarding Delay (PFD) Jitter. The PFD is the delay between the time when the last bit of a Tunneled Packet is received at the Ingress Adapter to the time when the first bit of the Tunneled Packet is sent by the Egress Adapter. The PFD Jitter is the difference between the maximum and the minimum PFD between two Adapters along a Path in a Router. The PFD Jitter in a Router shall be no more than $t_{\text{TunneledPacketJitter}}$.

Note: PFD Jitter does not include the additional delay due to another Transport Layer Packet or Ordered Set having priority in being transmitted. It also does not include the delay in transmission due to insufficient flow control credits.

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(b). Table 5-13

Table 5-13. Transport Layer Timing Parameters

Parameter	Description	Min	Max	Units
<u>tTunneledPacketJitter</u>	<u>The maximum PFD jitter of Tunneled Packets in a Router.</u>	<u>--</u>	<u>100</u>	<u>ns</u>

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(c). Section 10.5.4.2 Accumulation Cycles

- USB4 Delay Jitter – the Jitter cause by delays over the USB4 Fabric.
 - The following can create delays at the Egress Adapter for each Hop:
 - Time Sync Packets.
 - Credit Grant Packets.
 - Control Packets.
 - Other Tunneled Packets (on both same priority and lower priority Paths).
 - Packet forwarding jitter within a Router.

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- Worst case Accumulating Cycles = (DP IN Jitter) + (USB4 Delay Jitter)
= (17MTPs) + $\left[\left((5 \text{ Hops} * 2 * 260 \text{ Bytes} * 8) * \text{USB4 UI} \right) / \text{HBR3 UI} \right] + (6 \text{ Hops} * \text{tTunneledPacketJitter} / \text{HBR3 UI})$
= (1088) + $\left[(20800 \text{ Bits} * 0.1\text{ns} / 1.23\text{ns}) + (6 * 100\text{ns} / 1.23\text{ns}) \right] = \underline{2780-3268}$ Link Symbol Cycles