USB 3.1 ENGINEERING CHANGE NOTICE FORM

Title: Pending HP Timer
Applied to: USB Specification Version 3.1

Brief description of the functional changes:

To address propagation delay of the cable and retimers

1. Relax Pending_HP_Timier from 3us to 10us at link and PHY layers to allow extended propagation delay of the cable and retimer when both host and device are implemented based on this ECN.
2. Add new timing requirement of tDHPResponse on new USB 3.0 and USB 3.1 SSP/SS implementations to constrain HP and LC processing time for maximum legacy compatibility.

Benefits as a result of the changes:

1. To accommodate the new connectivity models with multiple retimers up to four and 50m active cable, when both host and device have implemented this ECN.
2. To achieve best-effort legacy compatibility with multiple retiemers up to three and max 5m cable, when either a new host or device has implemented this ECN and interoperates with a legacy device or host.

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

Maximal compatibility is achieved between existing revision systems (both host and device) with three retimers (note: no legacy host and device have implemented a retimer)

1. A new host with a retimer connected to an active cable and a legacy device
2. A legacy host connected to an active cable and a new device with or without a retimer

An analysis of the hardware implications:

Any new USB3.1 and USB3.0 host or device implementations shall comply with the new ECN. This will enable future hosts and devices to support 4 retimers with extended cable reach up to 50m. This may require an IC design change for some USB3.0/3.1 gen1 host or device designs to meet the more stringent timings. There are a minimal number of USB3.1 gen2 hardware designs so the impact in here should be less.

An analysis of the software implications:

None

An analysis of the compliance testing implications:

The compliance document will need to be updated to reflect the change of the timers a new compliance procedures will be needed in order to budget timing margin for propagation delays due to cable and retimer.

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Actual Change

(a). From Text (and location): Table 7-7

Table 7-7. Transmitter Timers Summary

Timers	Timeout Value (µs)
PENDING_HP_TIMER	3

(a). To Text (and location): Table 7-7

Table 7-7. Transmitter Timers Summary

Timers	Timeout Value (µs)
PENDING_HP_TIMER	10

(b). From Text (and location): Section 7.2.4.1.13

7.2.4.1.13 Transmitter Timers

A PENDING_HP_TIMER is specified to cover the period of time from when a header packet is sent to a link partner, to when the header packet is acknowledged by a link partner. The purpose of this time limit is to allow a port to detect if the header packet acknowledgement sent by its link partner is lost or corrupted. The timeout value for the PENDING_HP_TIMER is listed in Table 7-7. The operation of the PENDING_HP_TIMER shall be based on the following rules:

(b). To Text (and location): Section 7.2.4.1.13

7.2.4.1.13 Transmitter Timers

A PENDING_HP_TIMER is specified to cover the period of time from when a header packet is sent to a link partner, to when the header packet is acknowledged by a link partner. This is measured at the connector of the HP initiator from when the last symbol of HP is transmitted to when the last symbol of the corresponding LGOOD_n or LBAD is received. The purpose of this time limit is to allow a port to detect if the header packet acknowledgement sent by its link partner is lost or corrupted. The timeout value for the PENDING_HP_TIMER is listed in Table 7-7. The operation of the PENDING_HP_TIMER shall be based on the following rules:

(c). From Text (and location): Section 7.5.6.1

7.5.6.1 U0 Requirements

- The port shall meet the transmitter specifications defined in Table 6-17.
- The port shall maintain the low-impedance receiver termination (R_{RX-DC}) defined in Table 6-21.
- The LFPS receiver shall be enabled.
- The port shall enable a 1-ms timer (tU0RecoveryTimeout) to measure the time interval between two consecutive link commands. This timer will be reset and restarted every time a link command is received.

- The port shall enable a 10-µs timer (tU0LTimeout). This timer shall be reset when the first symbol of any link command or packet is sent and restarted after the last symbol of any link command or packet is sent. This timer shall be active when the link is in logical idle.
- A downstream port shall transmit a single LDN when the 10-µs timer (tU0LTimeout) expires.
- An upstream port shall transmit a single LUP when the 10-µs timer (tU0LTimeout) expires.

(c). To Text (and location): Section 7.5.6.1

7.5.6.1 U0 Requirements

- The port shall meet the transmitter specifications defined in Table 6-17.
- The port shall maintain the low-impedance receiver termination (R_{RX-DC}) defined in Table 6-21.
- The LFPS receiver shall be enabled.
- The port shall enable a 1-ms timer (tU0RecoveryTimeout) to measure the time interval between two consecutive link commands. This timer will be reset and restarted every time a link command is received.
- The port shall enable a 10-µs timer (tU0LTimeout). This timer shall be reset when the first symbol of any link command or packet is sent and restarted after the last symbol of any link command or packet is sent. This timer shall be active when the link is in logical idle.
- A downstream port shall transmit a single LDN when the 10-µs timer (tU0LTimeout) expires.
- An upstream port shall transmit a single LUP when the 10-µs timer (tU0LTimeout) expires.
- A port shall acknowledge the received header packet with either LGOOD_n or LBAD within the HP response time (tDHPResponse). This is measured at a port's connector from when the first bit of HP is received to when the first bit of either LGOOD_n or LBAD is transmitted. If a retimer is used with the port receiving HP, the HP response time shall account for the additional delay of the retimer.
  - In SuperSpeed operation, tDHPResponse shall be less than 2540-ns.
  - In SuperSpeedPlus operation, tDHPResponse shall be less than 1610-ns.

  Note that tDHPResponse includes some worst case delay, tDPacket=2140-ns in SuperSpeed and tDPacket=910-ns in SuperSpeedPlus, when additional packets are scheduled ahead of the corresponding LGOOD_n or LBAD. It is recommended that a design respond with LGOOD_n or LBAD within 400-ns in SuperSpeed operation or 700-ns in SuperSpeedPlus operation when no packets delay the LGOOD_n or LBAD transmission. Refer to Figure E-5 of Section E.1.2.3 for details.