

USB4 2.0 ENGINEERING CHANGE NOTICE FORM

Title: LFPS Handshake on CLx Exit Flow
Applied to: USB4 Specification Version 2.0

Brief description of the functional changes:

Changing the condition to stop sending LFPS to make sure we have either a full two-way handshake or enough time to detect the LFPS. This document includes also the change required in the Re-timer spec.

Benefits as a result of the changes:

A more robust solution that can overcome problems in timing handshakes and match the behaviors in the eco-system.

An assessment of the impact to the existing revision and systems that currently conform to the USB specification:
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Need to verify that Routers can comply, if not, a waiver will be given and a interoperability solution should be implemented.

An analysis of the hardware implications:
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Routers and Re-timers will be required to implement an optional condition (that was mandatory in the first USB4 Version 2 spec) or a new timer.

An analysis of the software implications:
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None

An analysis of the compliance testing implications:
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Waivers will be given for implementations that followed the spec before the change.

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Actual Change

(a). 4.2.1.6.2.2 Entry to State

To Text:

When the Receiver Port detects CL_OFF Ordered Sets with the *Index* field set to 0t on Lane 0, it shall:

- De-activate RS-FEC decoding. The detection of CL_OFF shall not require RS-FEC decoding.
- Shut down all of its enabled receivers.
- Enable LFPS detection tEnterLFPS2 time after receiving the first CL_OFF Ordered set on the Lane 0 receiver.
- If the Receiver Port is already in CL0s (TX) state:
 - If the Initiating Port sent CL_OFF Ordered Sets with the *CLx State* field set to 2t and when the Receiver Port entered CL0s (TX) state it transmitted CL_OFF Ordered Sets with the *CLx State* field set to 2t, it shall transition to CL2 state.
 - Otherwise it shall transition to CL1 state.
- Else, it shall transition to CL0s (RX) state.

Entry time to a CLx state is tEnterLFPS3.

Note: the maximal entry time to a CLx state can be up to the maximal value of tEnterLFPS3

(b). 4.2.1.6.5.4 Gen 4 Exit Flow from CL1 or CL2 State

To Text:

A USB4 Port may initiate exit from CL1 or CL2 state due to an internal objection or detection of one or more LFPS cycles on its Lane 0 receiver. When initiating exit from CL1 or CL2 state, a USB4 Port shall:

1. Send a Low Frequency Periodic Signaling (LFPS) burst on Lane 0 until all the following two conditions are met:
 - The receiver detected LFPS.
 - After the receiver detected LFPS, the transmitter sent at least 16 LFPS cycles.

If exit was initiated by detecting LFPS, the Port ~~may shall~~ apply at least one of the third condition following conditions:

- The receiver no longer detects LFPS.
- tEnterLFPS3 time passed since the Port shut down its transmitter

If the Port is in CL0s (RX) and detected LFPS on its receiver while entering CL1 or CL2 by transmitting CL OFF, it shall behave as if the exit from CL1/2 was initiated by detecting LFPS even if it has an internal objection.

The Port shall stop sending LFPS within tStopLFPS2 time after the conditions above are met.

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If the exit from CL1 or CL2 was initiated by detecting LFPS on the Lane 0 receiver, the Port shall transmit the LFPS on the Lane 0 transmitter within tWarmupCL1 or tWarmupCL2 respectively.

(c). Table 4-72 - Logical Layer Timing Parameters

To Text:

Parameter	Description	Min	Max	Units
<u>tEnterLFPS3</u>	<u>Time between shutting down the transmitter to the last LFPS sent on CL1/2 exit flow</u>	<u>18</u>	<u>25</u>	<u>us</u>
tWarmUpCL1	When exiting CL1 state, time between receiving the first LFPS cycle and sending the first LFPS.	--	<u>2140</u>	μs

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Change in Re-timer specification:

(d). 4.2.4.3.2.2 CL1/CL2 Exit

To Text:

When a Re-timer detects an LFPS burst on the Lane 0 receiver of its port, the Re-timer shall:

1. Transmit LFPS on the corresponding transmitter (e.g. Port A). A Cable Re-timer shall send the first LFPS within $t_{CLxForwardLFPS}$ time after the first LFPS cycle on the receiver. The transmitters shall stop sending LFPS $t_{StopLFPS2}$ time after all the following are true:
 - The Re-timer detected LFPS on Lane 0 receiver of the corresponding Port (e.g., Port A).
 - The Re-timer transmitted at least 16 LFPS cycles after detecting LFPS on the corresponding Port's receiver (e.g., Port A).
 - $t_{EnterLFPS3}$ time passed since the Re-timer shut down the corresponding transmitter.
2. Transmit LFPS on the Adapter's transmitter (e.g. Port B). The first LFPS shall be sent within $t_{WarmUpCLx}$ time after the first LFPS cycle on the receiver. The transmitter shall send at least 16 LFPS cycles. The transmitter shall stop transmitting LFPS $t_{StopLFPS2}$ after at least one of the following conditions is met: starting LFPS transmission.
 - $t_{EnterLFPS3}$ time passed since the Re-timer shut down the Adapter's transmitter (e.g. Port B)
 - The Adapter's receiver (e.g. Port B) is not detecting LFPS