USB 3.1 ENGINEERING CHANGE NOTICE

Title: Remove Polling.LFPS 60-µs Timer
Applied to: USB 3.1

Brief description of the functional changes proposed:

To remove the 60-us LFPS EI timer as one of the necessary exit conditions for a SSP port when switching to SS operation under certain conditions.

Benefits as a result of the proposed changes:

There exists a legacy device in the market (thumb drive) that does not comply with the spec: it does not transition to Polling.RxEQ even after it has successfully completed Polling.LFPS handshake with DFP. It will transition to Polling.RxEQ with one additional condition: after DFP enters Polling.RxEQ.
This behavior created an interop issue when interop with a SSP DFP. One of the conditions for a SSP DFP to transition to Polling.RxEQ, is to observe a 60-us timeout of LFPS EI. This is to make sure a SSP port, upon switching to SS operation, has sent enough Polling.LFPS bursts for a SS port to complete its exit handshake, AND observed through LFPS EI that its SS link partner has transitioned to Polling.RxEQ.

This proposal, although optional, will help a SSP implementation more flexible in dealing with devices that are not compliant with the spec but already deployed in the ecosystem.

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

No impact. There will be no interop issue

An analysis of the hardware implications:

Proposed changes should be applied to future implementations

An analysis of the software implications:

no

An analysis of the compliance testing implications:

New compliance test will be added to test implementations conforming to this ECR. Existing implementations will be tested under existing compliance test spec.

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Actual Change Requested

(a). From Text (and location): Section 7.5.4.3.2

- The port in SuperSpeed operation shall transition to Polling.RxEQ when the following three conditions are met:
    1. At least 16 consecutive Polling.LFPS bursts meeting the Polling.LFPS specification defined in 6.9 6.9 are sent.
    2. Two consecutive Polling.LFPS bursts are received.
    3. Four consecutive Polling.LFPS bursts are sent after receiving one Polling.LFPS burst.
- The port in SuperSpeedPlus operation shall transition to Polling.RxEQ and switch to SuperSpeed operation if the following conditions are met:
    1. No SCD1 or SCD2 is detected within the received Polling.LFPS bursts.
    2. At least four consecutive SCD1 are transmitted.
    3. Two consecutive Polling.LFPS bursts are received.
    4. One SCD1 or four consecutive Polling.LFPS bursts are transmitted after receiving one Polling.LFPS burst.
    5. No LFPS signal for more than tPollingSCDLFPSTimeout is observed.

(a). To Text (and location): Section 7.5.4.3.2

- if the port begins with SuperSpeed operation, it shall transition to Polling.RxEQ when the following two conditions are met:
    1. At least 16 consecutive Polling.LFPS bursts meeting the Polling.LFPS specification defined in 6.9 6.9 are sent.
    2. The completion of SS Polling.LFPS handshake with two consecutive Polling.LFPS bursts received and four consecutive Polling.LFPS bursts sent after receiving one Polling.LFPS burst.
- If the port begins with SuperSpeedPlus operation, it shall transition to Polling.RxEQ and switch to SuperSpeed operation if the following conditions are met:
    1. No SCD1 or SCD2 is detected within the received Polling.LFPS bursts.
    2. At least four consecutive SCD1 are transmitted.
    3. The completion of SS Polling.LFPS handshake with two consecutive Polling.LFPS bursts received and one SCD1 or four consecutive Polling.LFPS bursts transmitted after receiving one Polling.LFPS burst.
    4. Either one of the following conditions is met.
        i. No LFPS signal for more than tPollingSCDLFPSTimeout is observed. Note that this also includes, but not limited to, a scenario where a SS link partner may not recognize the Polling.LFPS bursts with varying tRepeat.
        ii. Before the tPollingSCDLFPSTimeout timer expiration, sixteen additional Polling.LFPS bursts with non-varying tRepeat are transmitted after the above three conditions are met. Note that this also includes, but not limited to, a scenario that a SS link partner may not recognize the Polling.LFPS bursts with varying tRepeat.

(b). From Text (and location): Section 7.5.4.3.1

- An upstream port in SuperSpeedPlus operation shall transmit SCD1 defined in Table 6-32. It shall perform in one of the following ways if no signature of SCD1 or SCD2 is detected within the received Polling.LFPS bursts.
    1. If it has received sixteen or more consecutive Polling.LFPS bursts and the tPollingSCDLFPSTimeout timer has not expired, it shall switch to SuperSpeed operation and transmit Polling.LFPS instead of SCD1.

       Note: This may imply that its SuperSpeed link partner is sensitive to varying tRepeat of the Polling.LFPS bursts of SCD1.
    2. If the tPollingSCDLFPSTimeout timer has expired, it shall switch to SuperSpeed operation in preparation to transition to Polling.RxEQ when all other exit conditions are met.

       Note: This may imply that its SuperSpeed link partner may enter Polling.LFPS first, and may be insensitive to varying tRepeat of SCD1 or SCD2, and has met all the exit conditions to Polling.RxEQ.
- A downstream port in SuperSpeedPlus operation shall transmit SCD1 defined in Table 6-32 if Compliance Mode is disabled. It shall perform in one of the following ways if no signature of SCD1 or SCD2 is detected within the received Polling.LFPS bursts.
    1. If it has received sixteen or more consecutive Polling.LFPS bursts and the tPollingSCDLFPSTimeout timer has not expired, it shall switch to SuperSpeed operation and transmit Polling.LFPS instead of SCD1.

       This may imply that its SuperSpeed link partner is sensitive to varying tRepeat of the Polling.LFPS bursts of SCD1.
    2. If the tPollingSCDLFPSTimeout timer has expired, it shall switch to SuperSpeed operation in preparation to transition to Polling.RxEQ when all exit conditions are met.

       Note: This may imply that its SuperSpeed link partner may enter Polling.LFPS first, and may be insensitive to varying tRepeat of SCD1 or SCD2, and has met all the exit conditions to Polling.RxEQ.

(b). To Text (and location): Section 7.5.4.3.1

- An upstream port in SuperSpeedPlus operation shall transmit SCD1 defined in Table 6-32. It shall perform in one of the following ways if no signature of SCD1 or SCD2 is detected within the received Polling.LFPS bursts.
    1. If it has received sixteen or more consecutive Polling.LFPS bursts and the tPollingSCDLFPSTimeout timer has not expired, it shall switch to SuperSpeed operation and transmit Polling.LFPS with non-varying tRepeat after four SCD1 are transmitted.

       Note: This may imply that its SuperSpeed link partner may not recognize the Polling.LFPS burst from SCD1 due to varying tRepeat.
    2. If the tPollingSCDLFPSTimeout timer has expired, it shall switch to SuperSpeed operation in preparation to transition to Polling.RxEQ when all other exit conditions are met.

       Note: This may imply that its SuperSpeed link partner may enter Polling.LFPS first, and can recognize the Polling.LFPS bursts with varying tRepeat in SCD1 or SCD2, and has met all the exit conditions to Polling.RxEQ.

- A downstream port in SuperSpeedPlus operation shall transmit SCD1 defined in Table 6-32 if Compliance Mode is disabled. It shall perform in one of the following ways if no signature of SCD1 or SCD2 is detected within the received Polling.LFPS bursts.
    1. If it has received sixteen or more consecutive Polling.LFPS bursts and the tPollingSCDLFPSTimeout timer has not expired, it shall switch to SuperSpeed operation and transmit Polling.LFPS with non-varying tRepeat after four SCD1 are transmitted..

       Note: This may include, but not limited to, a scenario that its SuperSpeed link partner may not recognize the Polling.LFPS bursts with varying tRepeat in SCD1.
    2. If the tPollingSCDLFPSTimeout timer has expired, it shall switch to SuperSpeed operation in preparation to transition to Polling.RxEQ when all exit conditions are met.

       Note: This may imply that its SuperSpeed link partner may enter Polling.LFPS first, because it can recognize the Polling.LFPS bursts with varying tRepeat in SCD1 or SCD2, and has met all the exit conditions to Polling.RxEQ.

(c). From Text (and location): Section 7.5.4.3.2

- The port in SuperSpeedPlus operation shall transition to Polling.RxEQ and switch to SuperSpeed operation if the following conditions are met:
    1. No SCD1 or SCD2 is detected within the received Polling.LFPS bursts.
    2. At least four consecutive SCD1 are transmitted.
    3. Two consecutive Polling.LFPS bursts are received.
    4. One SCD1 or four consecutive Polling.LFPS bursts are transmitted after receiving one Polling.LFPS burst.
    5. No LFPS signal for more than tPollingSCDLFPSTimeout is observed.

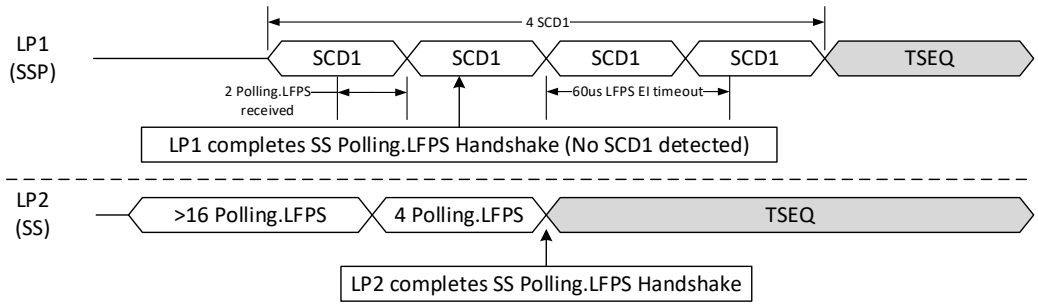
       Note: This condition implies the SuperSpeed link partner has entered Polling.RxEQ transmitting TSEQ ordered sets.

(c). To Text (and location): Section 7.5.4.3.2

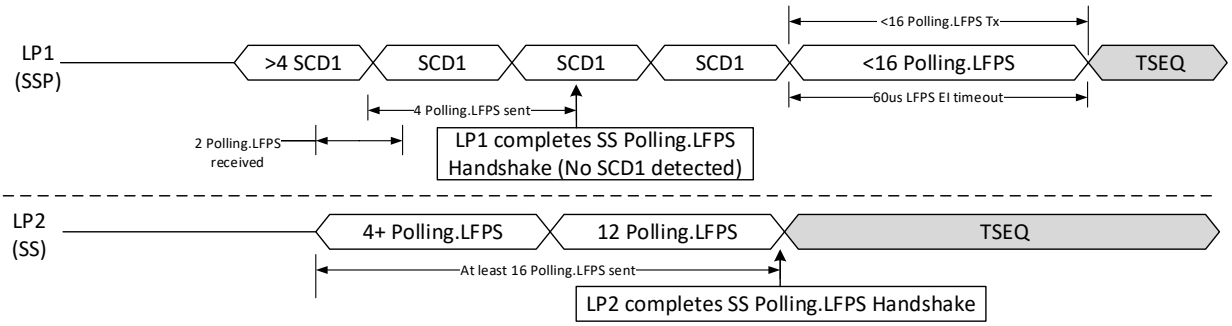
- The port in SuperSpeedPlus operation shall transition to Polling.RxEQ and switch to SuperSpeed operation if the following conditions are met. Shown in Figure 7-18 are a few example timing diagrams of a SSP port swathing to SS operations.
    1. No SCD1 or SCD2 is detected within the received Polling.LFPS bursts.
    2. At least four consecutive SCD1 are transmitted.
    3. Two consecutive Polling.LFPS bursts are received.
    4. One SCD1 or four consecutive Polling.LFPS bursts are transmitted after receiving one Polling.LFPS burst.
    5. No LFPS signal for more than tPollingSCDLFPSTimeout is observed.

       Note: This condition implies the SuperSpeed link partner has entered Polling.RxEQ transmitting TSEQ ordered sets.

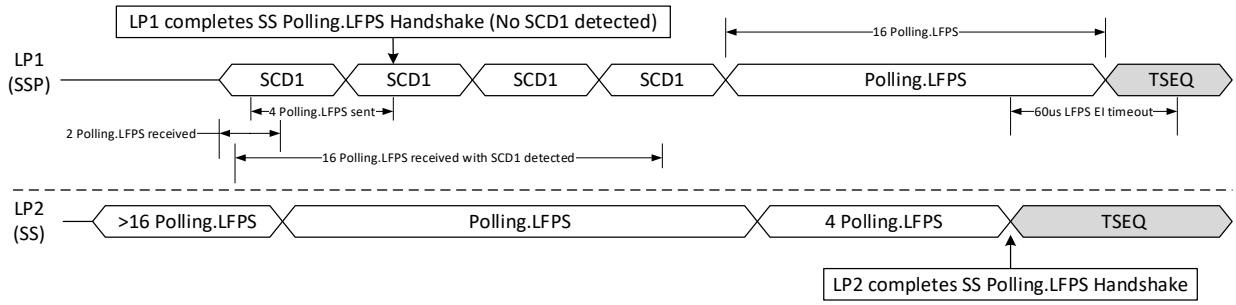
Figure 7-18. Example timing diagrams of a SSP port switching to SS operations.



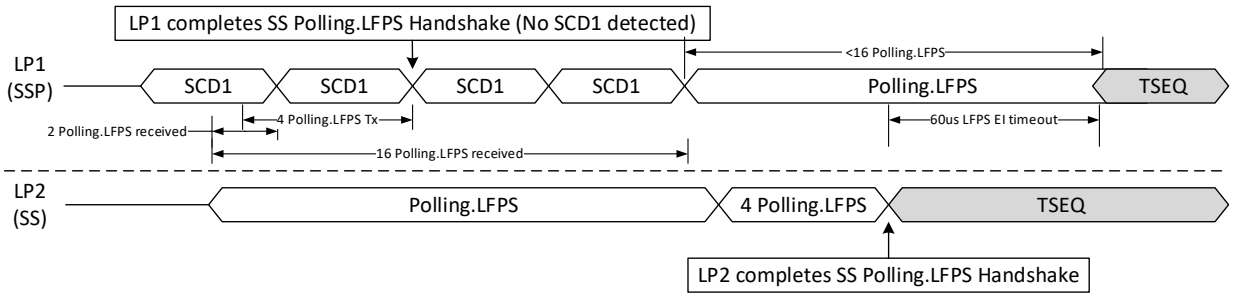
(a). Example case 1: LP2 in Polling first and able to recognize Polling.LFPS bursts in SCD1 with varying tRepeat. The last condition to be met for LP1 before exit to Polling.RxEQ is to send at least four SCD1. Note that other scenarios may exist such as the tPollingSCDLFPSTimeout timer expiration being the last condition to be met. Under this condition, if four SCD1 has transmitted and the tPollingSCDLFPSTimeout timer has not expired, LP1 will switch from SCD1 to Polling.LFPS with non-varying tRepeat.



(b). Example case 2: LP2 enters Polling after LP1 and is able to recognize Polling.LFPS bursts in SCD1 with varying tRepeat and transition to Polling.RxEQ after satisfying all the exit conditions. LP1 upon completing the SS Polling.LFPS handshake, having transmitted at least four SCD1 and found no SCD1 with the sixteen received Polling.LFPS bursts, will start transmit Polling.LFPS burst with non-varying tRepeat until the tPollingSCDLFPSTimeout timer expiration.



(c). Example case 3: LP2 enters Polling before LP1 and is not able to recognize the Polling.LFPS bursts in received SCD1. LP1 after finding no SCD1 or SCD2 within the sixteen received Polling.LFPS bursts, starts send the Polling.LFPS bursts with non-varying tRepeat, thus leading LP2 to satisfy all exit conditions. The last condition for LP1 to satisfy its exit condition to Polling.LFPS is to complete either sixteen Polling.LFPS transmission or upon the tPollingSCDLFPSTimeout timer expiration, whichever comes first. In this example, LP1 completes sixteen Polling.LFPS bursts transmission first.



(d). Example case 4: LP2 enters Polling after LP1 and is not able to recognize the Polling.LFPS bursts in received SCD1. LP1 after finding no SCD1 within sixteen Polling.LFPS bursts, starts send the Polling.LFPS bursts with non-varying tRepeat after sending four SCD1. LP2 then satisfies all exit conditions and enters Polling.RxEQ. The last condition for LP1 to satisfy its exit condition to Polling.LFPS is to complete either sixteen Polling.LFPS transmission or upon the tPollingSCDLFPSTimeout timer expiration, whichever comes first. In this example, the tPollingSCDLFPSTimeout timer expires first.

(d). From Text (and location): Section 7.5.4.4.1

Polling.LFPSPlus Requirements

- The port in SuperSpeedPlus operation shall transmit SCD2 defined in Table 6-32. If SCD2 cannot be found in 64 consecutive Polling.LFPS received, it shall transmit Polling.LFPS instead of SCD2.

  Note: This is an extreme case where a port in SuperSpeed operation transmits Polling.LFPS coinciding with SCD1 and remains in Polling.LFPS.

(d). To Text (and location): Section 7.5.4.4.1

Polling.LFPSPlus Requirements

- The port in SuperSpeedPlus operation shall transmit SCD2 defined in Table 6-32. If SCD2 cannot be found in 64 consecutive Polling.LFPS received, it shall transmit Polling.LFPS with non-varying tRepeat instead of SCD2.

  Note: This is an extreme case where a port in SuperSpeed operation transmits Polling.LFPS coinciding with SCD1 and remains in Polling.LFPS.

(e). From Text (and location): Section 7.5.4.4.2

Exit from Polling.LFPSPlus

- The port in SuperSpeedPlus operation shall transition to Polling.PortMatch if two SCD2 are transmitted after one SCD2 as defined in 6.9.4.2 6.9.4.2 is received.
- A port in SuperSpeedPlus operation shall transition to Polling.RxEQ and switch to SuperSpeed operation if the following two conditions are met:
  1. No LFPS signal for more than tPollingSCDLFPSTimeout is observed.

     Note: This condition implies the SuperSpeed link partner has entered Polling.RxEQ transmitting TSEQ ordered sets.
  2. Twenty Polling.LFPS bursts with non-varying tRepeat are transmitted, after finding no SCD2 is detected.

Note: This condition guarantees that, in the case of a port in SuperSpeedPlus operation connecting to a port in SuperSpeed operation, a port in SuperSpeed operation will receive twenty consecutive Polling.LFPS to exit from this substate if it is unable to recognize Polling.LFPS with varying tRepeat in SCD1 and SCD2, and it happens to transmit Polling.LFPS matching SCD1.

(e). To Text (and location): Section 7.5.4.4.2

Exit from Polling.LFPSPlus

- The port in SuperSpeedPlus operation shall transition to Polling.PortMatch if two SCD2 are transmitted after one SCD2 as defined in 6.9.4.2 6.9.4.2 is received.
- A port in SuperSpeedPlus operation shall transition to Polling.RxEQ and switch to SuperSpeed operation if one of the following two conditions is met. Shown in Figure 7-19 is an example timing diagram of an SSP port switching to SS operation in the substate.
    1. No LFPS signal for more than tPollingSCDLFPSTimeout is observed.

       Note: This condition implies the SuperSpeed link partner has entered Polling.RxEQ transmitting TSEQ ordered sets.
    2. Twenty Polling.LFPS bursts are transmitted, after finding no SCD2 is detected.

       Note: This condition guarantees that, in the case of a port in SuperSpeedPlus operation connecting to a port in SuperSpeed operation, a port in SuperSpeed operation will receive twenty consecutive Polling.LFPS to exit from this substate if it is unable to recognize Polling.LFPS with varying tRepeat in SCD1 and SCD2, and it happens to transmit Polling.LFPS matching SCD1.

Figure 7-19. Example timing diagram of a SSP port switching to SS operation in Polling.LFPSPlus