USB 3.1 ENGINEERING CHANGE NOTICE

Title: Polling LFPS
Applied to: USB_3_1r1.0_07_31_2013

Brief description of the functional changes:

To modify the operational behavior of a SSP port connecting with a SS port in the Polling.LFPS substate to achieve the following:

1. Clarify SSP behavior switching from SCD1 to Polling.LFPS
2. Relax transition conditions from Polling.LFPS to Polling.RxEQ for a SSP port to achieve minimum exit delay by not requiring additional 20 Polling.LFPS transmission if exit conditions to Polling.RxEQ are met.

Benefits as a result of the changes:

1. Clarify behavioral requirement of a SSP port when connecting to a SS port.
2. Backwards compatibility to legacy SS operation.

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

Implementation changes are expected.

An analysis of the hardware implications:

Logic only to cover behavioral changes when SSP switching to SS operation.

An analysis of the software implications:

None

An analysis of the compliance testing implications:

Corresponding changes to be expected.

Actual Change

From Text:

7.5.4.3.1 Polling.LFPS Requirements

- Upon entry, a LFPS receiver shall be enabled to receive the Polling.LFPS signals defined in Section 6.9.1.
- Upon entry, a port shall establish its LFPS operating condition within 80 µs.
- A downstream port shall disable its transition path to Compliance Mode upon PowerOn Reset or Warm Reset.
- A downstream port shall enable its transition path to Compliance Mode, if directed.
- An upstream port always has its transition path to Compliance Mode enabled upon PowerOn Reset.
- A port in SuperSpeed operation shall transmit Polling.LFPS.
- An upstream port in SuperSpeedPlus operation shall transmit SCD1 defined in Table 6-32. If no signature of SCD1 is found in sixteen consecutive Polling.LFPS received, the port shall switch to SuperSpeed operation and transmit Polling.LFPS instead of SCD1.
- A downstream port in SuperSpeedPlus operation shall transmit SCD1 defined in Table 6-32 if Compliance Mode is disabled. If no signature of SCD1 is found in sixteen consecutive Polling.LFPS received, the port shall switch to SuperSpeed operation and transmit Polling.LFPS instead of SCD1.
- A downstream port in SuperSpeedPlus operation shall transmit SCD2 if Compliance Mode is enabled.
- Note: In case a retimer is connected to the downstream port, SCD2 is used for the retimer to enable Compliance Mode. Refer to Appendix F for details.
- A port in SuperSpeedPlus operation shall implement a 60-us timer (tPollingSCDLFPSTimeout) to monitor the absence of LFPS signal after the completion of SuperSpeed Polling.LFPS handshake.
- A port in SuperSpeedPlus operation shall be ready for SuperSpeed operation if it has detected that its link partner operates at SuperSpeed.
- Note: There is no time allocated for a SuperSpeedPlus port to re-configure itself for SuperSpeed operation upon detection of its link partner operating at SuperSpeed. A SuperSpeedPlus port shall switch to SuperSpeed operation as quickly as possible for its receiver equalization training. Any time for configuration will result in receiving fewer TSEQ ordered sets from its link partner.
- A port shall disable its transition path to Compliance Mode when it has successfully completed Polling.LFPS handshake or has entered Compliance Mode.
- A 360-ms timer (tPollingLFPSTimeout) shall be started upon entry to the substate.
- The operating condition of an eSS PHY shall be established when a port is ready to exit to Polling.RxEQ.
- An eSS receiver in SuperSpeed operation may optionally be enabled to receive TSEQ ordered sets for receiver equalizer training.
- Note: The port first entering Polling.RxEQ will start transmitting TSEQ ordered sets while the other port is still in Polling.LFPS. Enabling a SuperSpeed receiver in Polling.LFPS will allow a port to start the receiver equalizer training while completing the requirement for Polling.LFPS exit handshake.

To Text:

7.5.4.3.1 Polling.LFPS Requirements

- Upon entry, a LFPS receiver shall be enabled to receive the Polling.LFPS signals defined in Section 6.9.1.
- Upon entry, a port shall establish its LFPS operating condition within 80 µs.
- A downstream port shall disable its transition path to Compliance Mode upon PowerOn Reset or Warm Reset.
- A downstream port shall enable its transition path to Compliance Mode, if directed.
- An upstream port shall always have its transition path to Compliance Mode enabled upon PowerOn Reset.
- A port in SuperSpeed operation shall transmit Polling.LFPS.
- 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 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.
     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 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 SCD2 if Compliance Mode is enabled.
  Note: In case a retimer is connected to the downstream port, SCD2 is used for the retimer to enable Compliance Mode. Refer to Appendix F for details.
- A port in SuperSpeedPlus operation shall implement a 60-us timer (tPollingSCDLFPSTimeout) to monitor the absence of LFPS signal after the completion of

SuperSpeed Polling.LFPS handshake. During this period, the port shall continue the transmission of Polling.LFPS or SCD1 until its expiration.

- A port in SuperSpeedPlus operation shall be ready for SuperSpeed operation if it has detected that its link partner operates at SuperSpeed.

  Note: There is no time allocated for a SuperSpeedPlus port to re-configure itself for SuperSpeed operation upon detection of its link partner operating at SuperSpeed. A SuperSpeedPlus port shall switch to SuperSpeed operation as quickly as possible for its receiver equalization training. Any time for configuration will result in receiving fewer TSEQ ordered sets from its link partner.
- A port shall disable its transition path to Compliance Mode when it has successfully completed Polling.LFPS handshake or has entered Compliance Mode.
- A 360-ms timer (tPollingLFPSTimeout) shall be started upon entry to the substate.
- The operating condition of an eSS PHY shall be established when a port is ready to exit to Polling.RxEQ.
- An eSS receiver in SuperSpeed operation may optionally be enabled to receive TSEQ ordered sets for receiver equalizer training.

  Note: The port first entering Polling.RxEQ will start transmitting TSEQ ordered sets while the other port is still in Polling.LFPS. Enabling a SuperSpeed receiver in Polling.LFPS will allow a port to start the receiver equalizer training while completing the requirement for Polling.LFPS exit handshake.

From Text:

7.5.4.3.2 Exit from Polling.LFPS

- 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 Section 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.LFPSPlus if two SCD1 are transmitted after one SCD1 or SCD2 as defined in Section 6.9.4.2 is received.
- The port in SuperSpeedPlus operation shall transition to Polling.RxEQ and switch to SuperSpeed operation if the following conditions are met:
  1. At least two consecutive Polling.LFPS bursts are received.
  2. Twenty Polling.LFPS bursts are transmitted, and no SCD1 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.
  3. 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.
- An upstream port shall transition to Compliance Mode upon the 360-ms timer timeout (tPollingLFPSTimeout) and the following two conditions are met:
  1. The port has never successfully completed Polling.LFPS after PowerOn Reset.
  2. The condition to transition to Polling.RxEQ or Polling.LFPSPlus is not met.

Note: If the very first attempt in Polling.LFPS handshake fails after PowerOn Reset, it implies that a passive test load may be present and compliance test should be initiated. If the very first attempt in Polling.LFPS handshake succeeds after PowerOn Reset, it implies the presence of the Enhanced SuperSpeed ports on each side of the link and no compliance test is intended. Therefore, any subsequent handshake timeout in Polling.LFPS when the link is retrained is only an indication of link training failure, not a signal to enter Compliance Mode.

- A downstream port shall transition to Compliance Mode upon the 360-ms timer timeout (tPollingLFPSTimeout) if the following three conditions are met:
  1. The Compliance Mode is enabled.
  2. The port has never successfully completed Polling.LFPS handshake after Compliance Mode is enabled.
  3. The condition to transition to Polling.RxEQ or Polling.LFPSPlus is not met.

  Note: In case Compliance mode is disabled, a downstream port may enter Rx.Detect attempting Polling.LFPS handshake again, or enter eSS.Inactive for SW intervention based on the count value of cPollingTimeout.
- A downstream port shall transition to Rx.Detect upon the 360-ms timer timeout (tPollingLFPSTimeout) if cPollingTimeout is less than two and Compliance Mode is disabled.
- A downstream port shall transition to eSS.Inactive upon the 360-ms timer timeout (tPollingLFPSTimeout) and cPollingTimeout is two.
- An upstream port of a hub shall transition to Rx.Detect upon the 360-ms timeout (tPollingLFPSTimeout) after having trained once since PowerOn Reset and the conditions to transition to Polling.RxEQ are not met.
- A peripheral device shall transition to eSS.Disabled upon the 360-ms timeout (tPollingLFPSTimeout) after having trained once since PowerOn Reset and the conditions to transition to Polling.RxEQ are not met.
- A downstream port shall transition to eSS.Disabled when directed.
- A downstream port shall transition to Rx.Detect when directed to issue Warm Reset.
- An upstream port shall transition to Rx.Detect when Warm Reset is detected.

To Text:

7.5.4.3.3 Exit from Polling.LFPS

- 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 Section 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.LFPSPlus if two SCD1 are transmitted after one SCD1 or SCD2 as defined in Section 6.9.4.2 is received.
- 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.

- An upstream port shall transition to Compliance Mode upon the 360-ms timer timeout (tPollingLFPSTimeout) and the following two conditions are met:
  1. The port has never successfully completed Polling.LFPS after PowerOn Reset.
  2. The condition to transition to Polling.RxEQ or Polling.LFPSPlus is not met.
  - Note: If the very first attempt in Polling.LFPS handshake fails after PowerOn Reset, it implies that a passive test load may be present and compliance test should be initiated. If the very first attempt in Polling.LFPS handshake succeeds after PowerOn Reset, it implies the presence of the Enhanced SuperSpeed ports on each side of the link and no compliance test is intended. Therefore, any subsequent handshake timeout in Polling.LFPS when the link is retrained is only an indication of link training failure, not a signal to enter Compliance Mode.
- A downstream port shall transition to Compliance Mode upon the 360-ms timer timeout (tPollingLFPSTimeout) if the following three conditions are met:
  1. The Compliance Mode is enabled.
  2. The port has never successfully completed Polling.LFPS handshake after Compliance Mode is enabled.
  3. The condition to transition to Polling.RxEQ or Polling.LFPSPlus is not met.

  Note: In case Compliance mode is disabled, a downstream port may enter Rx.Detect attempting Polling.LFPS handshake again, or enter eSS.Inactive for SW intervention based on the count value of cPollingTimeout.
- A downstream port shall transition to Rx.Detect upon the 360-ms timer timeout (tPollingLFPSTimeout) if cPollingTimeout is less than two and Compliance Mode is disabled.
- A downstream port shall transition to eSS.Inactive upon the 360-ms timer timeout (tPollingLFPSTimeout) and cPollingTimeout is two.
- An upstream port of a hub shall transition to Rx.Detect upon the 360-ms timeout (tPollingLFPSTimeout) after having trained once since PowerOn Reset and the conditions to transition to Polling.RxEQ are not met.
- A peripheral device shall transition to eSS.Disabled upon the 360-ms timeout (tPollingLFPSTimeout) after having trained once since PowerOn Reset and the conditions to transition to Polling.RxEQ are not met.
- A downstream port shall transition to eSS.Disabled when directed.
- A downstream port shall transition to Rx.Detect when directed to issue Warm Reset.
- An upstream port shall transition to Rx.Detect when Warm Reset is detected.