Comments on EEE operation

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EEE operation is difficult to understand

- Originally specified in 802.3az-2010
- Subsequently merged into 802.3-2012
- Now being enhanced by 802.3bj
- 802.3bm (40G/100G project) has an objective to support EEE
- The main clause for EEE (Clause 78) does not give a good full high-level description of its operation
  - You have to read a lot of the other clauses to understand how signaling between the subclauses works.
- A number of comments have been submitted against draft 2.2 in an attempt to add clarity
  - This presentation aims to give a high level view of EEE operation and what enhancements are being made in 802.3bj and so aid in comment resolution.

What is Fast Wake operation?

- 802.3bj introduces EEE Fast Wake operation
- Classic (802.3az) EEE operation has been renamed Deep Sleep mode
- Characteristics of Fast Wake:
  - Compulsory for 40G/100G PHYs supporting EEE
  - No requirement for Auto-negotiation (EEE FW can be used for 802.3bm optical PHYs)
  - PHY never powers down. The only PHY requirement is for the PCS to encode and decode LPI signaling on the MII interface.

How does inter-sublayer signaling work for EEE?

- The LPI Client connects to the RS service interface. Architecturally the RS is not part of the PHY. The LPI client requests the RS to start or stop LPI signaling
- The RS communicates with the PCS by means of the MII. LPI requests are encoded on the MII signals
- The transmit PCS encodes LPI requests into special symbols which are decoded by the link partner receive PCS
- The above is true for both EEE Fast Wake and Deep Sleep modes.

Additional inter-sublayer signaling work for Deep Sleep mode

- In Deep Sleep mode the receive and transmit PCS generate a request signal each. These are passed down to the lower PHY sublayers and indicate when receive and transmit PHY functions may be powered down.
- These two EEE request signals from the PCS typically request quiet or normal operation. The Clause 49 and Clause 82 PCSs also request transmit alert operation to enable the partner device PMD to detect the end of the quiescent state.
- Additionally the Clause 49 and Clause 82 PCSs generate the RX_LPI_ACTIVE signal to indicate to the Clause 74 BASE-R FEC that it can use rapid block lock (because the link partner transmit PCS has bypassed scrambling).

XLAUI and CAUI deep sleep mode signaling

- A method is required to transport the PCS EEE request signals over the XLAUI and CAUI interfaces.
- Coding is defined in 802.3bj Clause 83 to allow LPI transmit quiet requests from the PCS to be signaled over the XLAUI and CAUI interfaces.
- The XLAUI and CAUI infer the receive quiet request from the data received from the link partner or from the RX_TX_MODE indication signal.
- The value of the RX_TX_MODE indication signal is itself inferred from the received data and is used when the EEE quiet coding has been corrupted by transcoding, FEC or bit multiplexing.

Other EEE deep sleep signals

- The receive PCS checks that the end of the quiescent state occurs at the correct time. The ENERGY_DETECT indicate signal is passed up from the PMD to the PCS for this purpose.
- 802.3bj draft 2.2 has extra primitives besides DATA, QUIET and ALERT for the transmit PCS EEE signal. These are FW, SLEEP and BYPASS.
  - These extra three primitives are unused by the lower sublayers and there is a comment against draft 2.2 to ask for their deletion. There is also a comment to add a better description of inter-sublayer signaling to Clause 78.

EEE initialization

- Two methods are used for EEE initialization
  - Auto-negotiation (AN)
  - Link Layer Discovery Protocol (LLDP)
- AN is compulsory for deep sleep mode.
- LLDP is used
  - To adjust wake up times (both for FW and deep sleep)
  - To enable EEE for PHYs that only support EEE FW
  - To switch between FW and Deep Sleep for PHYs that support both.
- This needs to be better explained in 78.3 and 78.4 and the Clause 45 AN registers. The requirements are as follows:
  1. If a PHY supports EEE deep sleep it needs to be advertised during AN
  2. If FW is supported this is indicated in the PCS EEE capability register
  3. EEE deep sleep can only be used if both PHYs resolve the capability through AN
  4. EEE FW may be used if the capability is discovered through the LLDP