

Proposal for EEE in the 100BASE-T1L PCS

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Move that the IEEE P802.3dg Task Force adopt slides 3 to 7 of Murray_3dg_03a_11132024.pdf

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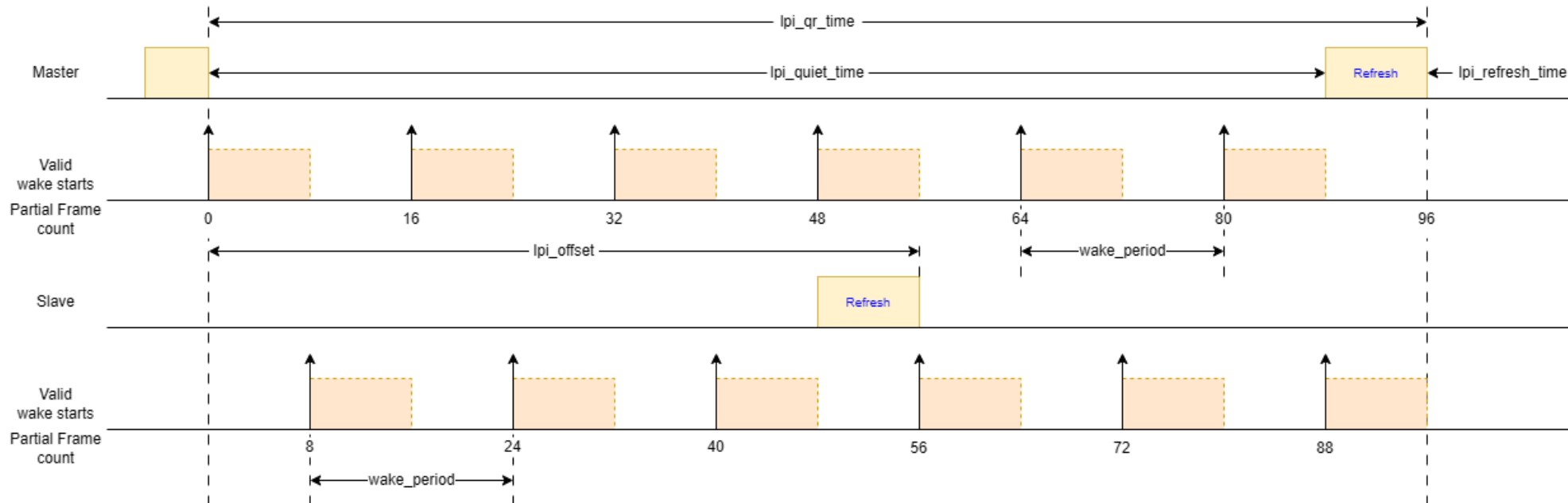
Technical (>75%)

Introduction

- ▶ This a proposal for EEE in the 100BASE-T1L PCS

Optional EEE Capability

- ▶ EEE uses the same approach as in Clauses 97, 149 & 165
- ▶ EEE abilities advertised in InfoField (EEECntrl[1:0] bits in the PHY Capability field)
 - LPI only entered when both link partners have both EEECtrl bits set
 - If EEECtrl[1] = 1 and EEECtrl[0] = 0, the PCS encoding transparently carries the LPI signalling MII to MII, but the PHY does not enter the LPI quiet-refresh cycle
 - If EEECtrl[1] = 0, LPI is encoded as a normal inter frame (Idle), and decoded as Idle (or error)
- ▶ LPI consists of alternating quiet and refresh periods
- ▶ Each direction of the link can enter and exit LPI mode independently



LPI Synchronization and Signalling

► LPI synchronization

- Quiet-refresh cycle established from the master partial frame count (PFC24)
 - Slave PHY shall synchronize its PFC24 to the master's during training

Variable	Master	Slave
tx_refresh_active	$\text{lpi_quiet_time} \leq \text{mod}(\text{PFC24}, \text{lpi_qr_time})$	$\text{lpi_offset} - \text{lpi_refresh_time} \leq \text{mod}(\text{PFC24}, \text{lpi_qr_time}) < \text{lpi_offset}$
tx_wake_start	$\text{mod}(\text{PFC24}, \text{wake_period}) = 0$	$\text{mod}(\text{PFC24}, \text{wake_period}) = \text{wake_period} / 2$

► LPI signalling

- During quiet periods, the PCS transmitter passes zero data encoded symbols to the PMA
- During the staggered out of phase refresh periods, the PCS transmitter operates as in normal mode, with PCS transmit data ($\text{TB}_n[0:7]$) set to zero
 - During normal data; LPI refresh is insufficient is sent using the auxiliary bit
 - During LPI; LPI refresh is insufficient is sent using $\text{TB}_n[0]$
- During wake-up, the PCS transmitter operates as in normal mode, with the PCS transmit data (tx_coded) containing $(8N/8N+1)$ encoded normal inter-frame symbols
 - No alert signal (same as clause 97)

LPI Timing Parameters and Wake-up Time

Parameter	Number of partial frame periods (*Values may change)	μs
lpi_offset	56	
lpi_qr_time	96	230.4
lpi_quiet_time	88	211.2
lpi_refresh_time	8	19.2
sleep	8	19.2
wake_period	16	

- Quiet time determined by the requirement to preserve timing and keep the eye open
- Refresh allows enough time to update the filter coefficients to maintain the link quality

lpi_wake_time	Wake starts before sleep is complete		Wake starts after sleep is complete	
	Partial frames	μs	Partial frames	μs
8	32	76.8	24	57.6

Auxiliary Bit - Insufficient LPI Refresh

- ▶ Only 1 auxiliary bit is available in the proposed encoding for the low latency mode and the burst error protection mode
 - This bit is only used when LPI entry is enabled and is normally zero
 - This bit will be used to indicate that LPI refresh is insufficient to maintain reliable operation of the receiver
 - When set and the link partner is in LPI, requests the link partner to exit LPI
 - When set, requests the link partner not to enter LPI