PHY timers for 1000BASE-T Energy Efficient Ethernet

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Key constraints from “SLAVE initiates wake” case

- $T_P = (T_{TCP} + T_M + T_{RCP}) = (T_{TDP} + T_M + T_{RDP})$
- $T_{WSR}(M) = T_{WSR}(S) \geq 2T_P$
- $T_{TWTS}(M) + T_{RWTS}(S) = T_{TWTS}(S) + T_{RWTS}(M) = T_W - 2T_P$
- $T_{TWTS}(S) = T_W - 2T_P + T_{RWTS}(M) = T_{SZ}$
- $\underbrace{(T_{SA} + T_{SCR})}_{\text{Controlled locally}} + \underbrace{(T_{TA} + T_{MZ} + T_{RCVR})}_{\text{Controlled by link partner}} \leq \underbrace{T_W - 3T_P - T_M}_{\text{12,816 ns (per currently assumed values)}}$

Timing parameter summary (values in ns)

Parameter	grimwood_01_0309	healey_02_0309	Other	Maximum
T_{SA}	500	500		500
T_{SCR}	3500	5500		5500
T_{TA}	700	700	900*	900
T_{MZ}	5000	5000		5000
T_{RCVR}	2500	1116		2500
Total	12200	12816		14400
Margin	616	0		(1584)

- T_{SCR} and T_{RCVR} are not defined in the current draft, but limits will be implied by wake time shrinkage constraints
- Increase in T_{TA} is derived from the observation that, given a maximum (1400 ns) value of lpi_waketx_timer and the upper bound on T_{SA}, T_{TA} could actually be up to 900 ns (the draft imposes the cap of 700 ns)
- Simply taking the largest value from each column yields a 1584 ns deficit in the wake time budget
- Once these values are settled, the wake time shrinkage limits follow directly

Notes on T_{MZ}

- A minimum value of T_{MZ} is required, for instance, to prevent WAKE-related transmission from the SLAVE from overlapping with the MASTER's WAKE_TRAINING state
- $T_{MZ} \geq (T_{TA} + T_M + T_{SA}) + T_{WTX} + T_P$
- The upper bound of T_{MZ} is implementation dependent
- Currently T_{MZ} (which corresponds to lpi_wakemz_timer in the draft) is specified as a point value with no tolerance
- A tolerance should be defined with the minimum value to be based on the equation above and the upper limit based on flexibility of implementation, but likely less than the current 5000 ns allocation

Moving forward

Parameter	Maximum	Proposal
T_{SA}	500	500
T_{SCR}	5500	4616
T_{TA}	900	700
T_{MZ}	5000	5000
T_{RCVR}	2500	2500
Total	14400	13316
Margin	(1584)	(500)

- Increase the PHY wake time to 16.5 microseconds to accommodate additional margin and promote robust and interoperable PHY operation
- The minimum value of T_{MZ} must be greater than 4028 ns; propose T_{MZ} (min.) of 4250 ns

1000BASE-T wake time shrinkage values

PHY type		Default $T_{W\_SYS\_RES}$ (min.)	T_{W_PHY} (min.)	$T_{PHY\_SHRINK\_TX}$ (max.)	$T_{PHY\_SHRINK\_RX}$ (max.)	Default $T_{W\_SYS\_RX}$ (min.)
1000BASE-T	MASTER	16.50 µs	16.50 µs	5.00 µs	2.50 µs	1.76 µs
	SLAVE			12.24 µs	9.74 µs	

- In addition…
- Change the period of lpi_wakemz_timer to be between 4.25 and 5.00 µs …
- Change the period of lpi_wake_timer to not exceed 16.5 µs …
- …and update Table 78-4 accordingly

On the topic of T_{W_PHY}

- Per the earlier discussion, there may be some confusion surrounding the definition of T_{W_PHY} (min.)
- This may readily be addressed by a footnote to the table referenced to this column
- "T_{W_PHY} is a parameter employed by the system which corresponds to the behavior of the PHY. A wake time of a compliant PHY may not exceed T_{W_PHY} (min.)"

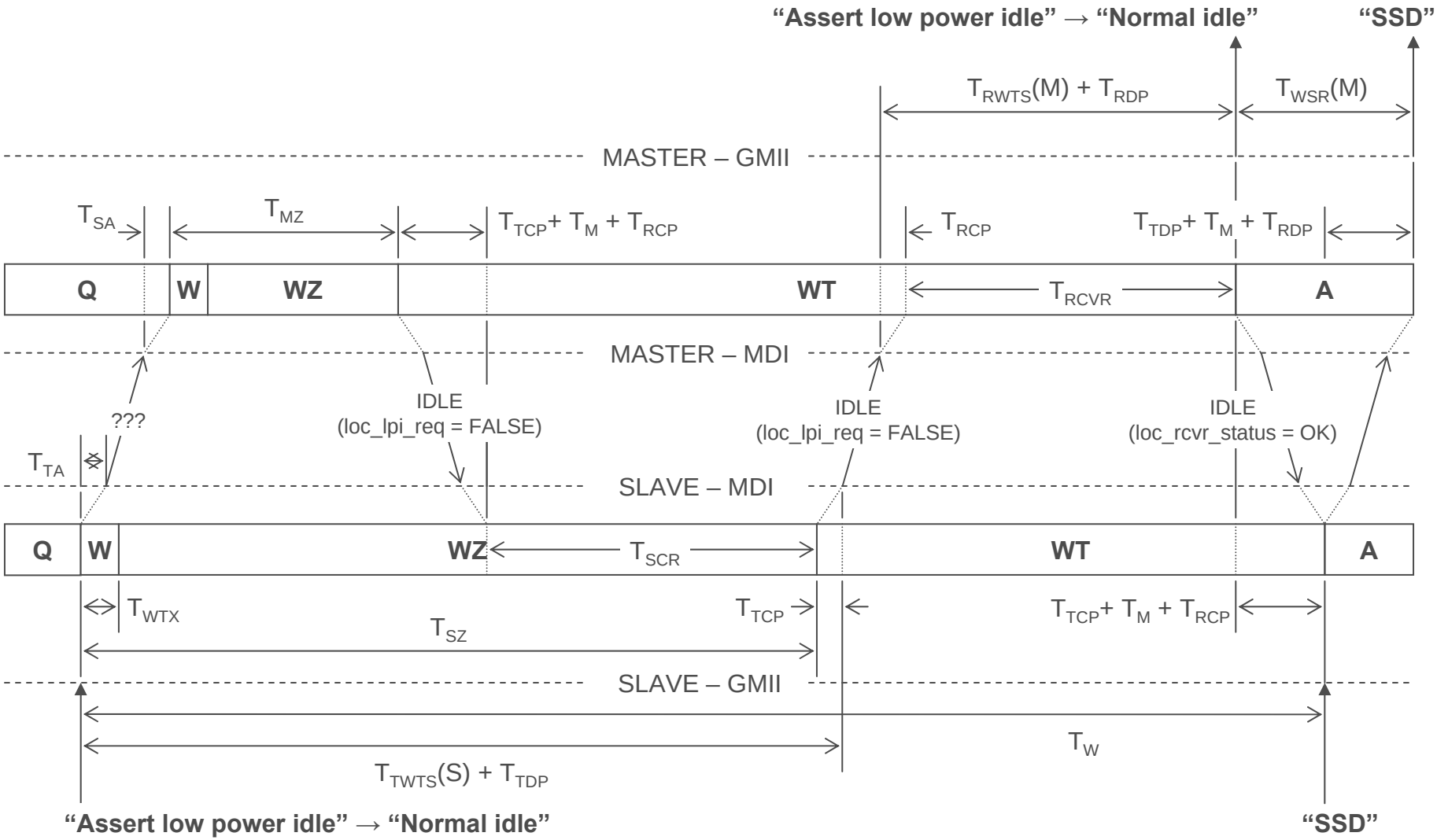
Motion

- The IEEE P802.3az Task Force adopts the recommendations in healey_03_0309.pdf slides 7 and 8.
  - Technical (≥ 75%)
  - Moved: A. Healey
  - Second: M. Chadha

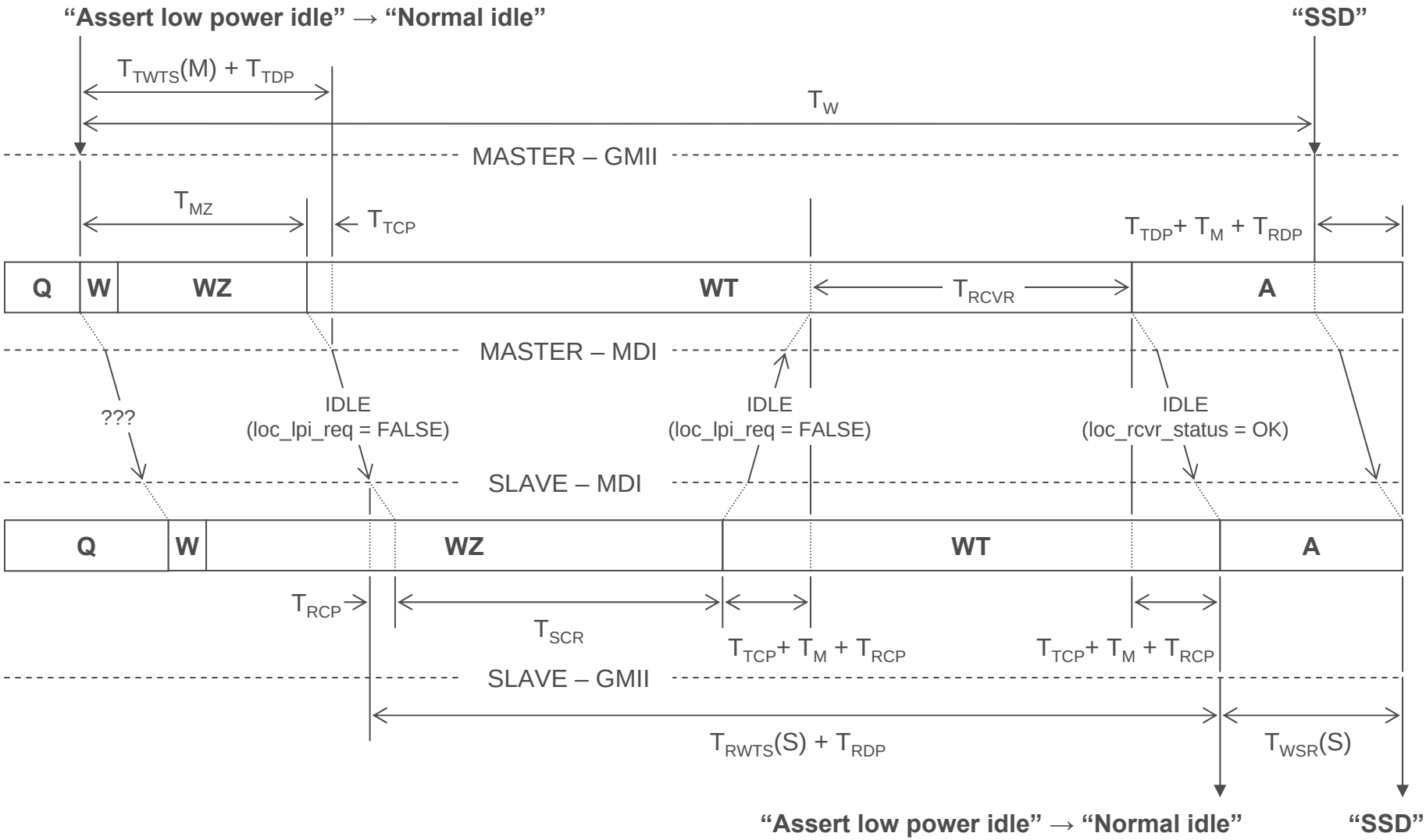
- Y: 12, N: 0, A: 1
- Motion Passes

Back-up slides

SLAVE initiates wake



MASTER initiates wake



Equations

- $T_{SZ} \leq (T_{TA} + T_M + T_{SA}) + T_{MZ} + (T_{TCP} + T_M + T_{RCP}) + T_{SCR}$
- $T_{TWTS}(M) \leq T_{MZ} + (T_{TCP} - T_{TDP})$
- $T_{TWTS}(S) \leq T_{SZ} + (T_{TCP} - T_{TDP})$
- $T_{RWTS}(M) \leq T_{RCVR} + (T_{RCP} - T_{RDP})$
- $T_{RWTS}(S) \leq T_{RCP} + T_{SCR} + 2(T_{TCP} + T_M + T_{RCP}) + T_{RCVR} - T_{RDP}$
  $\leq T_W - T_{TWTS}(M) - T_{WSR}(M) = T_{TWTS}(S) - T_{TWTS}(M) + T_{RWTS}(M)$