10 Mb/s Single Twisted Pair Ethernet
10BASE-T1L Auto-Negotiation Timing Changes

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Timing Values

- 10BASE-T1L uses low speed (LSM) Auto-Negotiation.
- The current timer values in D3.0 are based on a maximum link segment length of 1589 m assuming a NVP of 0.6, thus leading to a maximum link segment delay time of t_{dly} = 8834 ns (see 146.7.1.3).
- The intention is to add some margin for the maximum link segment length to support up to 2000 m.
- This will increase the link segment delay time to **t_{dly} = 11111 ns**.

- The current low speed mode Auto-Negotiation also does not take the dispersion of the signal over the link segment into account.
- The minimum "blind_timer" duration is exactly two times the link segment delay time t_{dly} and does not provide some additional time before re-enabling the receiver to allow for signal dispersion on the link segment.
- To add some margin for dispersion, the intention is to adapt the timing to allow for a additional dispersion of maximum 2 bit times.

- The intended modifications for the Clause 98 LSM Auto-Negotiation timers are seen on the next page.

- Additionally the **failure_timer** of the speed selection state diagram in Figure 98-11 is intended to be increased from 150 ms ± 1 ms to **250 ms ± 1 ms** to allow the management entity more time to load the needed data over a slow MDIO in case these pages are not preloaded into the PHY (this will result in a minimum worst-case time for AN telegram exchange of about 98 ms including the initial synchronization using random back-off timers).

Timing Values

- The following table shows possible timer values for a 625 kBit/s communication (a bit time is $t_{bit} = 1600$ ns, the maximum link segment delay time is $t_{dly} = 11111$ ns, blue are the numbers, which have changed or are new compared to the D3.0 draft):

Timer	Min	Max	Unit	Remarks
blind_timer	25422	28622	ns	$2 \times t_{dly} + 2 \times t_{bit} \rightarrow 2 \times t_{dly} + 4 \times t_{bit}$
break_link_timer	8000	8133	µs	Time to disable PHY and release the bidirectional data lines for auto-negotiation.
clock_detect_max_timer	1680	2000	ns	5 – 25 % more than time T2 (t_{bit})
clock_detect_min_timer	1200	1520	ns	5 – 25 % less than time T2 (t_{bit})
data_detect_max_timer	880	1200	ns	10 – 50 % more than time T3 (t_{bit} / 2)
data_detect_min_timer	400	720	ns	10 – 50 % less than time T3 (t_{bit} / 2)
interval_timer	799.96	800.04	ns	800 ns ± 0.005 % (t_{bit} / 2)
link_fail_inhibit_timer [10BASE_T1L]	3030	3090	ms	3060 ms ± 30 ms (3030 ms is the maximum time for link training of a 10BASE-T1L PHY)
page_test_max_timer	128000	131200	ns	80 $t_{bit} \rightarrow$ 82 t_{bit} (a nominal DME frame is 78 bit long)
receive_DME_timer	153422	156622	ns	page_test_max_timer + $2 \times t_{dly} + 2 \times t_{bit}$
rx_wait_timer	320 (D3.0: 300)	360 (D3.0: 340)	µs	Time after which at least a new DME frame has to be received before going into receive IDLE state (time to handle the half-duplex state diagram plus headroom).
silent_timer	28622	31822	ns	$2 \times t_{dly} + 4 \times t_{bit} \rightarrow 2 \times t_{dly} + 6 \times t_{bit}$

- backoff_timer:

  If T[4] bit is 1, the duration is (153422 ns to 156622 ns) + (random integer from 0 to 15) x (28622 ns to 31822 ns).

  (this is equal to: receive_DME_timer + (random integer from 0 to 15) x silent_timer)

  If T[4] bit is 0, the duration is (168533 ns to 171733 ns) + (random integer from 0 to 15) x (28622 ns to 31822 ns).

  (this is equal to: receive_DME_timer + $t_{dly} + t_{bit}$ + 3 t_{bit} / 2 + (random integer from 0 to 15) x silent_timer)

Changes to the Draft D3.0

- P75, L30: Change text for backoff_timer_[LSM] duration to:

  If T[4] bit is 1, the duration is (153422 ns to 156622 ns) + (random integer from 0 to 15) x (28622 ns to 31822 ns).

  If T[4] bit is 0, the duration is (168533 ns to 171733 ns) + (random integer from 0 to 15) x (28622 ns to 31822 ns).

- P75, L39: Change timer duration for blind_timer to: 25422 ns to 28622 ns
- P76, L22: Change timer duration for receive_DME_timer_[LSM] to: 153422 ns to 156622 ns
- P76, L26: Change timer duration for rx_wait_timer_[LSM] to: 320 μs to 360 μs
- P76, L30: Change timer duration for silent_timer_[LSM] to: 28622 ns to 31822 ns
- P82, L3: Change timer duration for failure_timer to: 250 ms ± 1 ms

Thank You