Proposed Modifications to IEEE P802.3az/D0.9 Clause 40

Adam Healey, Niall Fitzgerald, Jacobo Riesco, Brian Murray
LSI Corporation

IEEE P802.3az Task Force Meeting
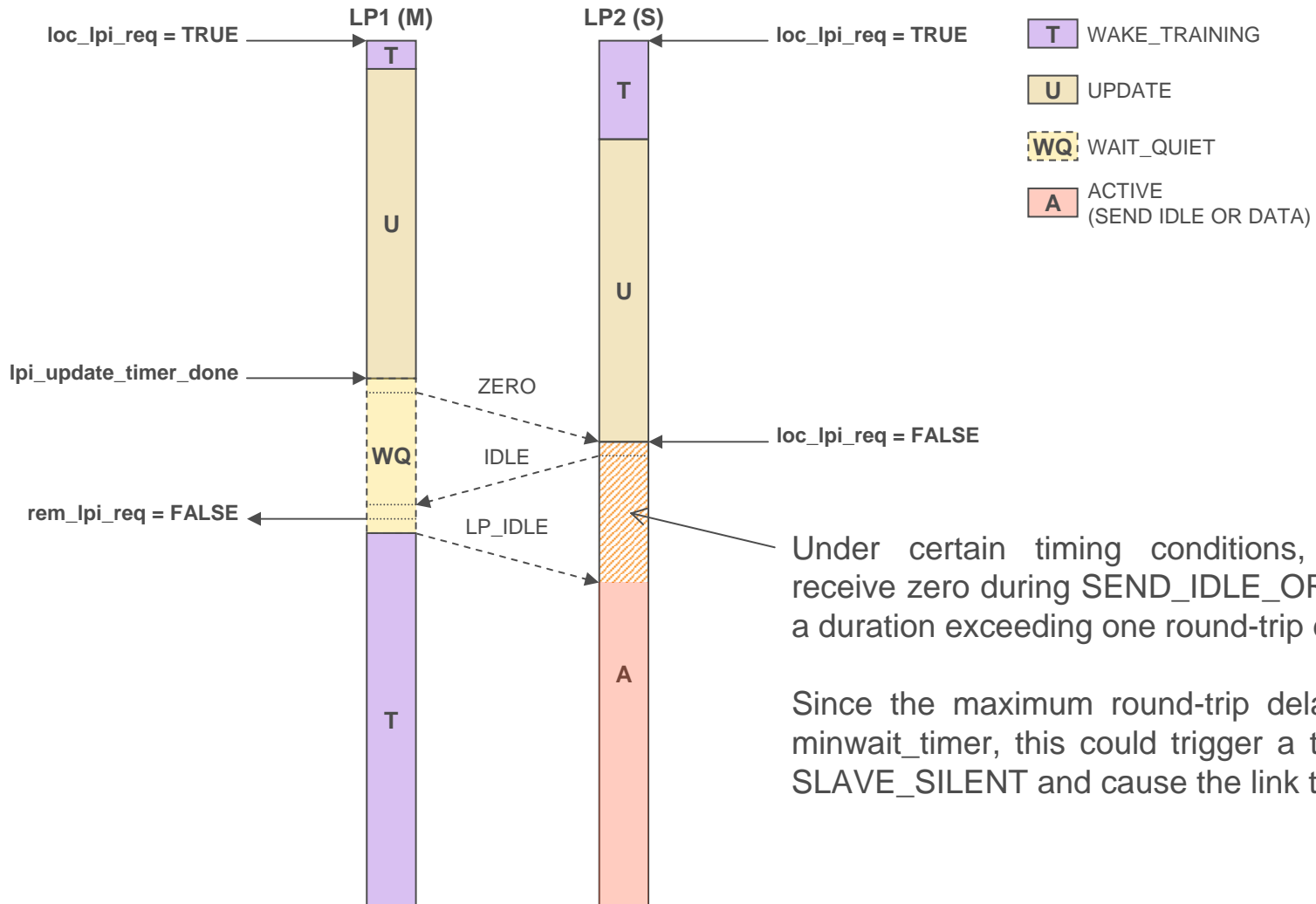**Seoul, KR**
September 2008

Motivation

- It has been pointed out* that, per the current PHY Control state diagram, there is a possibility that the local device could receive zero during SEND IDLE OR DATA when the local device de-asserts loc_lpi_req during UPDATE but the link partner transitions to WAIT_QUIET prior to receiving the notification
  - Under certain timing conditions, the duration of zero could be on the order of the round-trip delay, leading to a link restart

- It has also been pointed out* that there is a possibility that the SLAVE can bypass the WAKE_SILENT state and cause the WAKE process to fail

- Finally, it has been pointed out that the roles of SLEEP and UPDATE are similar so they may be consolidated into a single state
  - This is reinforced by the fact that lpi_sleep_timer has recently been assigned a range similar to lpi_update_timer
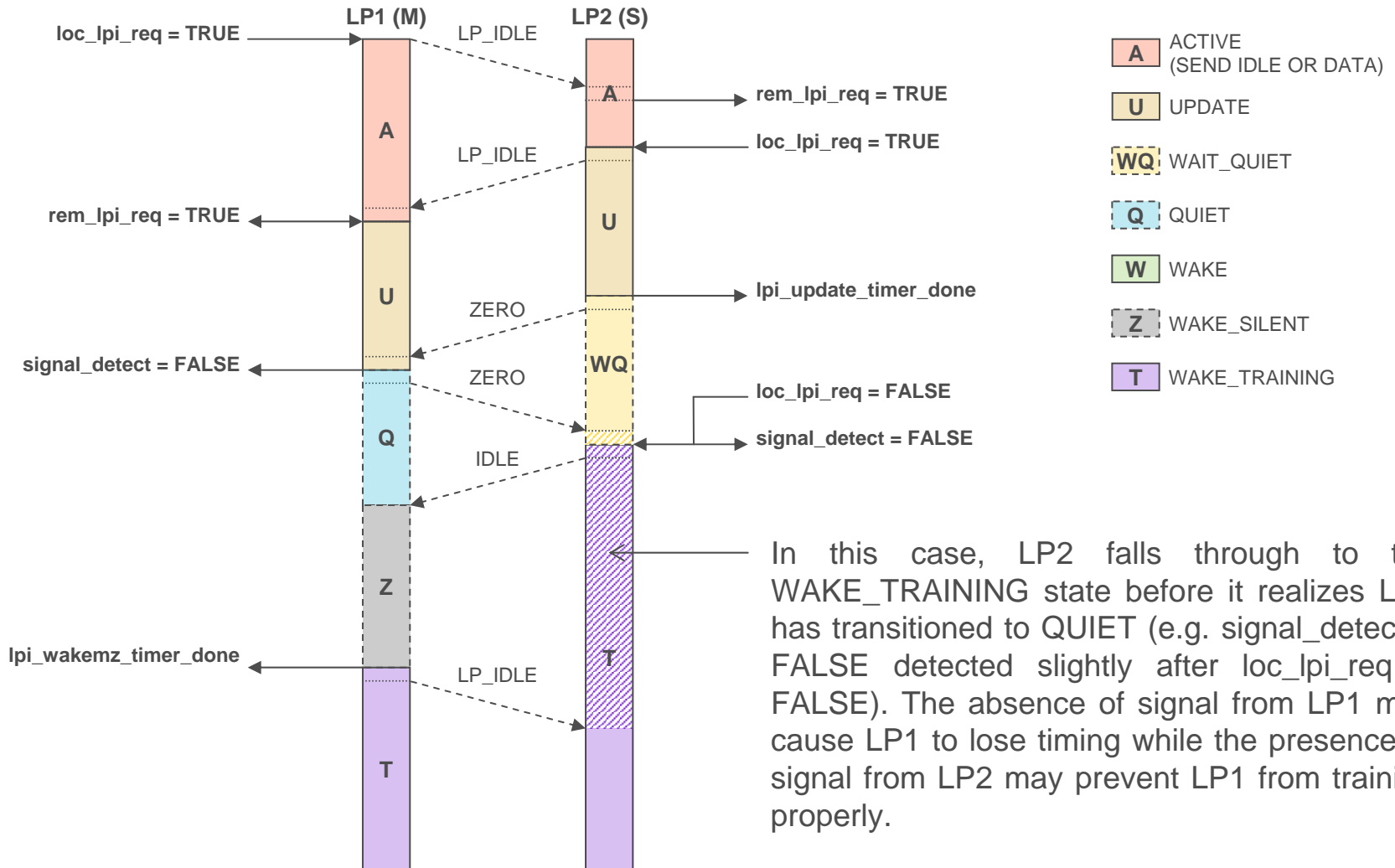
* Joseph Chou, Realtek

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Before we begin...

- State diagram transitions are not gated by a clock and it is possible to instantaneously "fall through" states

- For example, starting at UPDATE...
  - signal_detect = FALSE causes fall through to QUIET
  - loc_lpi_req = FALSE causes fall through to WAKE

- Interpreting the state machine in this way leads one to the conclusion that Case 1 in chou_01_0908.pdf is not an issue

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chou_01_0908: Case 2

loc_lpi_req = TRUE → LP1 (M)

LP2 (S) ← loc_lpi_req = TRUE

	T	WAKE_TRAINING
	U	UPDATE
	WQ	WAIT_QUIET
	A	ACTIVE (SEND IDLE OR DATA)

lpi_update_timer_done →

ZERO

loc_lpi_req = FALSE

IDLE

rem_lpi_req = FALSE ←

LP_IDLE

Under certain timing conditions, LP2 may receive zero during SEND_IDLE_OR_DATA for a duration exceeding one round-trip delay.

Since the maximum round-trip delay exceeds minwait_timer, this could trigger a transition to SLAVE_SILENT and cause the link to restart

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chou_01_0908.pdf: Case 3

In this case, LP2 falls through to the WAKE_TRAINING state before it realizes LP1 has transitioned to QUIET (e.g. signal_detect = FALSE detected slightly after loc_lpi_req = FALSE). The absence of signal from LP1 may cause LP1 to lose timing while the presence of signal from LP2 may prevent LP1 from training properly.
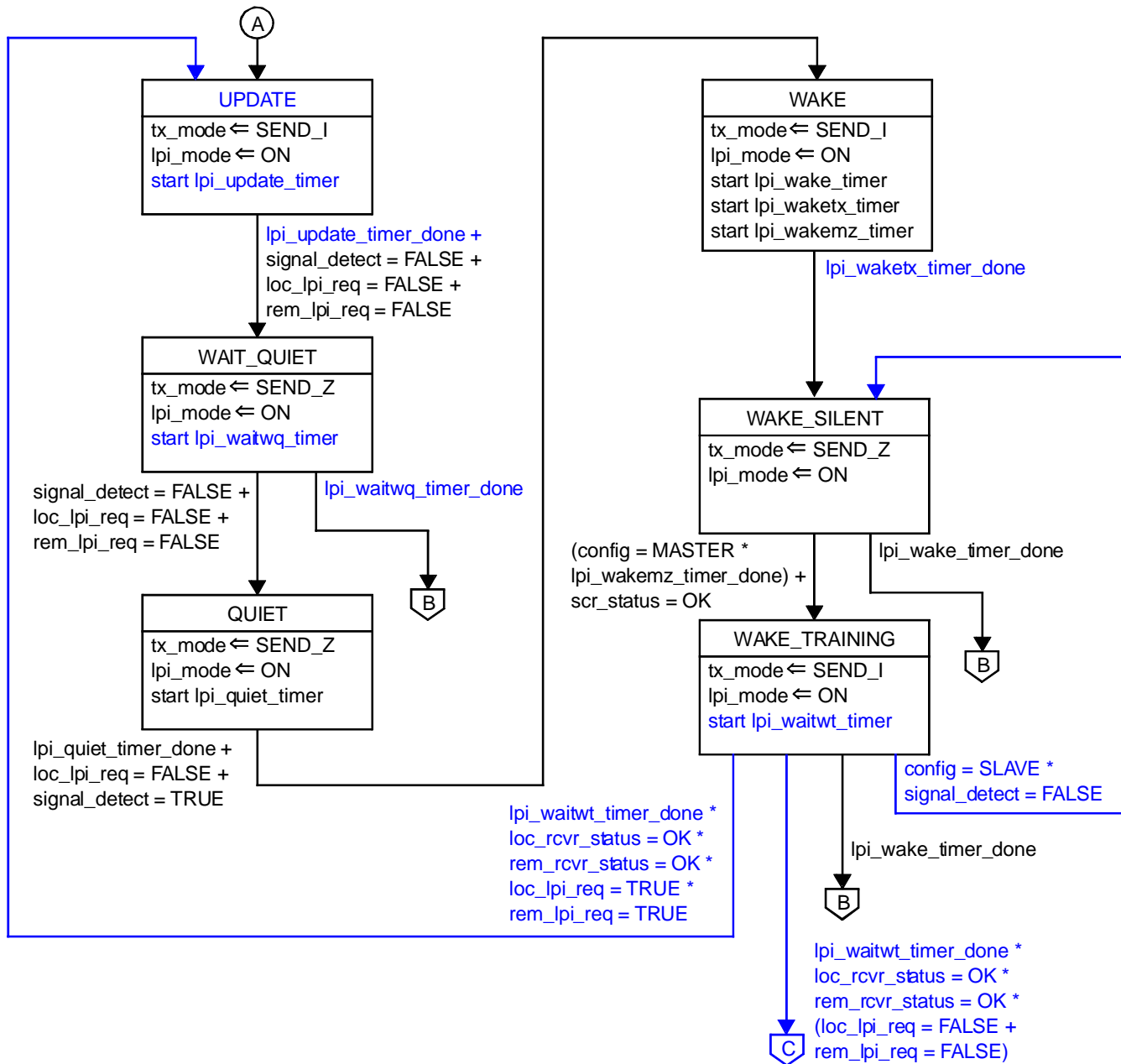
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Corrective actions

- Refer to the proposed state diagram in the next slide...

- Note – changes recommended in grimwood_01_0908.pdf included for completeness

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Supporting edits

- **40.4.2.4:** Upon activation of the low power mode, the PHY Control asserts tx_mode = SEND_I for period of time defined by ~~lpi_sleep_timer~~lpi_update_timer which allows the remote PHY to prepare for the transition to the WAIT_QUIET state. When ~~lpi_sleep_timer~~lpi_update_timer expires, PHY Control asserts tx_mode = SEND_Z and transmission ceases.

- **40.4.5.2:** Delete lpi_sleep_timer

- **40.4.5.2**: Replace lpi_wait_timer with lpi_waitwt_timer

    This timer defines the minimum time the PHY must remain in the WAKE_TRAINING state.

    Values: The condition lpi_waitwt_timer_done becomes true upon timer expiration.

    Duration: This timer shall have a period between 1.8 µs and 2.0 µs.
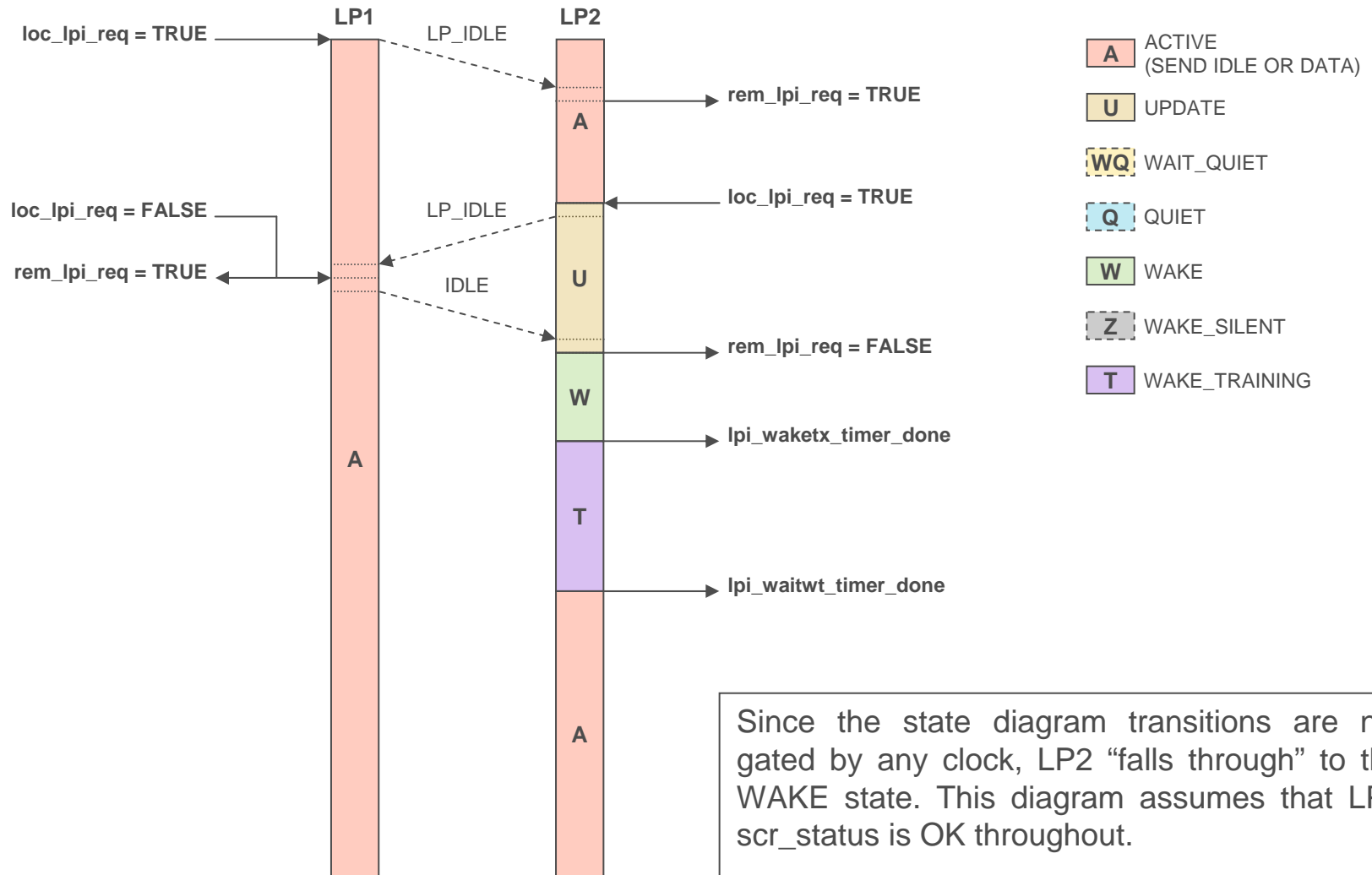
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Supporting edits (continued)

- **40.4.5.2**: Add lpi_waitwq_timer

  This timer defines the maximum time the PHY will dwell in the WAIT_QUIET state before forcing the link to restart.

 Values: The condition lpi_waitwq_timer_done becomes true upon timer expiration.

  Duration: This timer shall have a period between 4.5 μs and 5.0 μs.

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chou_01_0908.pdf: Case 1

LP1   LP_IDLE   **LP2**

loc_lpi_req = TRUE

rem_lpi_req = TRUE

A

loc_lpi_req = FALSE   LP_IDLE

loc_lpi_req = TRUE

rem_lpi_req = TRUE   IDLE

U

rem_lpi_req = FALSE

W

lpi_waketx_timer_done

T

lpi_waitwt_timer_done

A

A

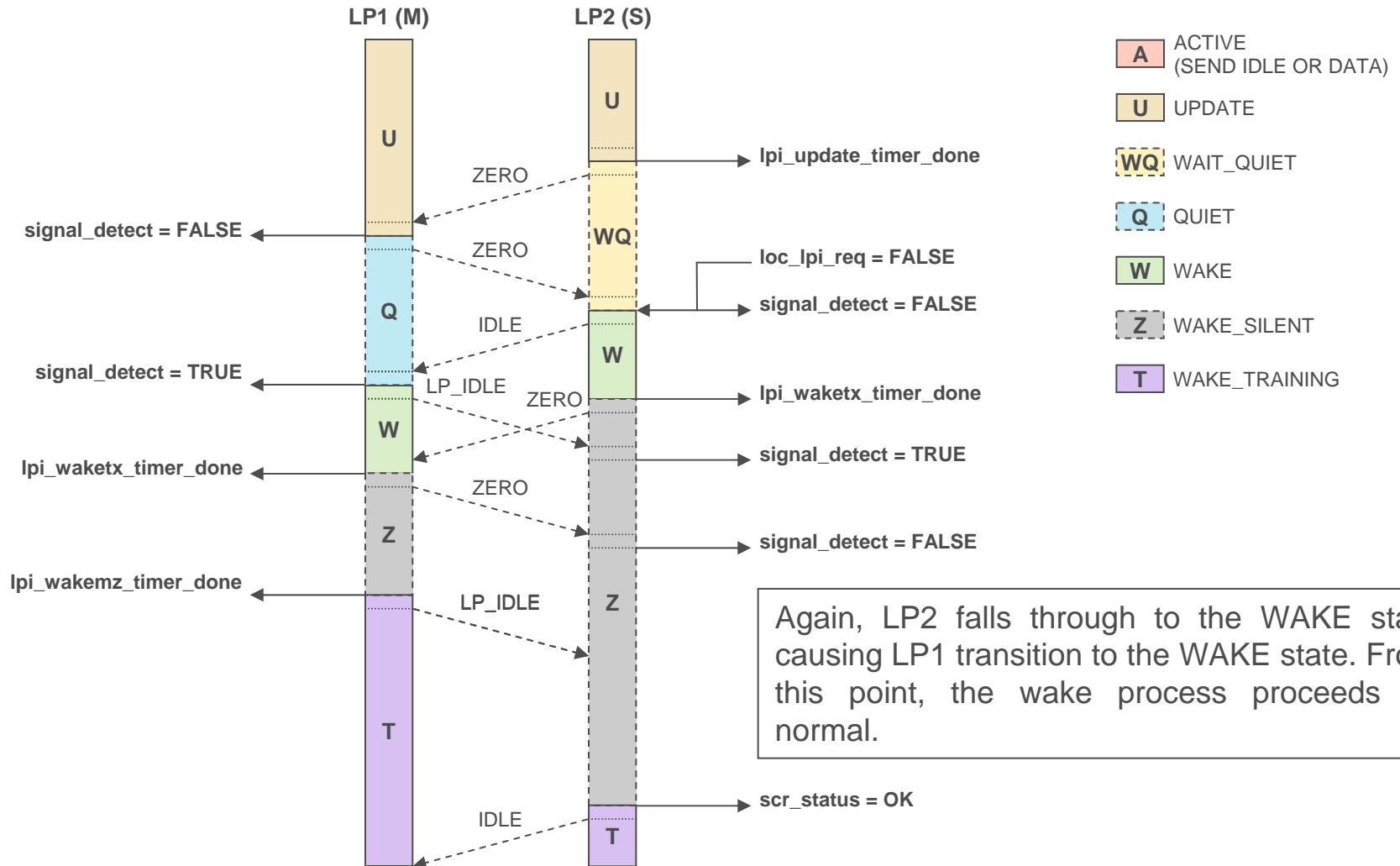|	
A	ACTIVE (SEND IDLE OR DATA)
U	UPDATE
WQ	WAIT_QUIET
Q	QUIET
W	WAKE
Z	WAKE_SILENT
T	WAKE_TRAINING

Since the state diagram transitions are not gated by any clock, LP2 "falls through" to the WAKE state. This diagram assumes that LP2 scr_status is OK throughout.

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chou_01_0908.pdf: Case 2
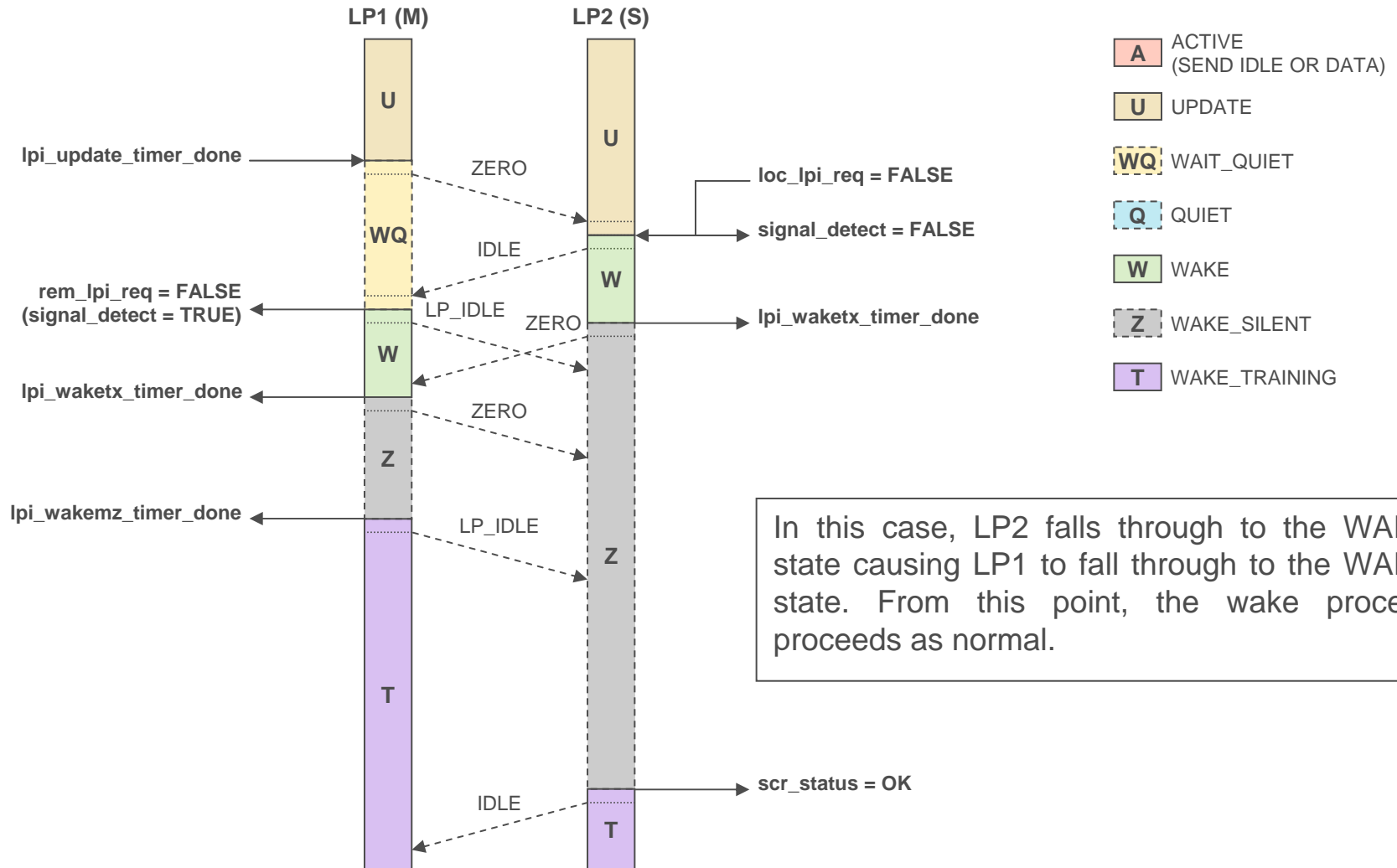
In this case, LP2 falls through to the WAKE state causing LP1 to fall through to the WAKE state. From this point, the wake process proceeds as normal.

chou_01_0908.pdf: Case 3

LP1 (M) **LP2 (S)**

U
U

ZERO — lpi_update_timer_done

WQ

signal_detect = FALSE

ZERO

Q

loc_lpi_req = FALSE

IDLE

signal_detect = FALSE

W

signal_detect = TRUE

LP_IDLE

ZERO — lpi_waketx_timer_done

W

lpi_waketx_timer_done

signal_detect = TRUE

ZERO

Z

signal_detect = FALSE

lpi_wakemz_timer_done

LP_IDLE

Z

T

scr_status = OK

IDLE

T

Legend:

A	ACTIVE (SEND IDLE OR DATA)
U	UPDATE
WQ	WAIT_QUIET
Q	QUIET
W	WAKE
Z	WAKE_SILENT
T	WAKE_TRAINING

Again, LP2 falls through to the WAKE state causing LP1 transition to the WAKE state. From this point, the wake process proceeds as normal.

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Questions?