IEEE P802.3az D1.0
Clause 55 State Diagrams
Updated

Rick Tidstrom, Broadcom

Presented by: Mike Grimwood, Broadcom

IEEE P802.3az Task Force

Dallas, November 2008

Overview

- The IEEE Draft P802.3az D1.0 state diagrams are not consistent with the defined Sleep/Quiet/Refresh and Wake signaling and do not address the need for synchronization between link partners for the purpose of Quiet and Refresh signal alignment.
  - See parnaby_01_1108.pdf for a proposal on link partner synchronization that establishes a fixed timing reference at the start-up PAM2/PAM16 boundary.

- To resolve these inconsistencies and in support of the PAM2/PAM16 synchronization proposal, this presentation proposes the following updated state diagrams:
  - PCS 64B/65B Transmit state diagram.
  - PCS 64B/65B Receive state diagram.
  - PCS LPI Transmit state diagram.
  - PMA LPI Receive state diagram.

Energy
Efficient
Ethernet

BROADCOM.
Connecting
everything®

PCS 64B/65B Transmit State Diagram New State and Transitions

- New states to be added to support Low Power Idle:
  - TX_L (Transmit Low Power Idle)
  - TX_WN (Transmit Wake Normal)
  - TX_WE (Transmit Wake Error)

- New transitions to be added to support Low Power Idle:
  - T_TYPE(tx_raw) = LI causes transition from TX_C to TX_L
  - T_TYPE(tx_raw) = LI causes transition from TX_INIT to TX_E
  - T_TYPE(tx_raw) = LI causes transition from TX_D to TX_E
  - T_TYPE(tx_raw) = LI causes transition from TX_T to TX_E
  - T_TYPE(tx_raw) = LI causes transition from TX_E to TX_E

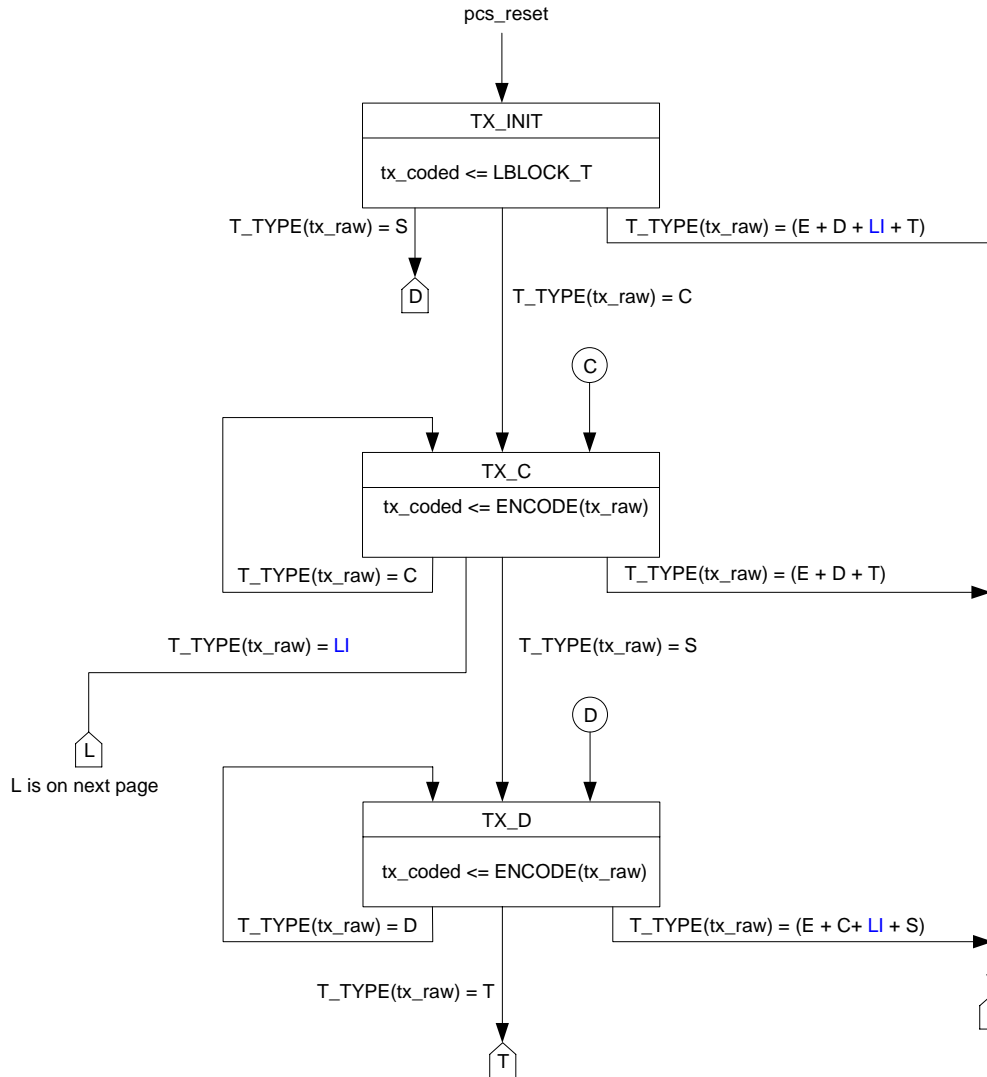Energy Efficient Ethernet

BROADCOM.
Connecting everything®

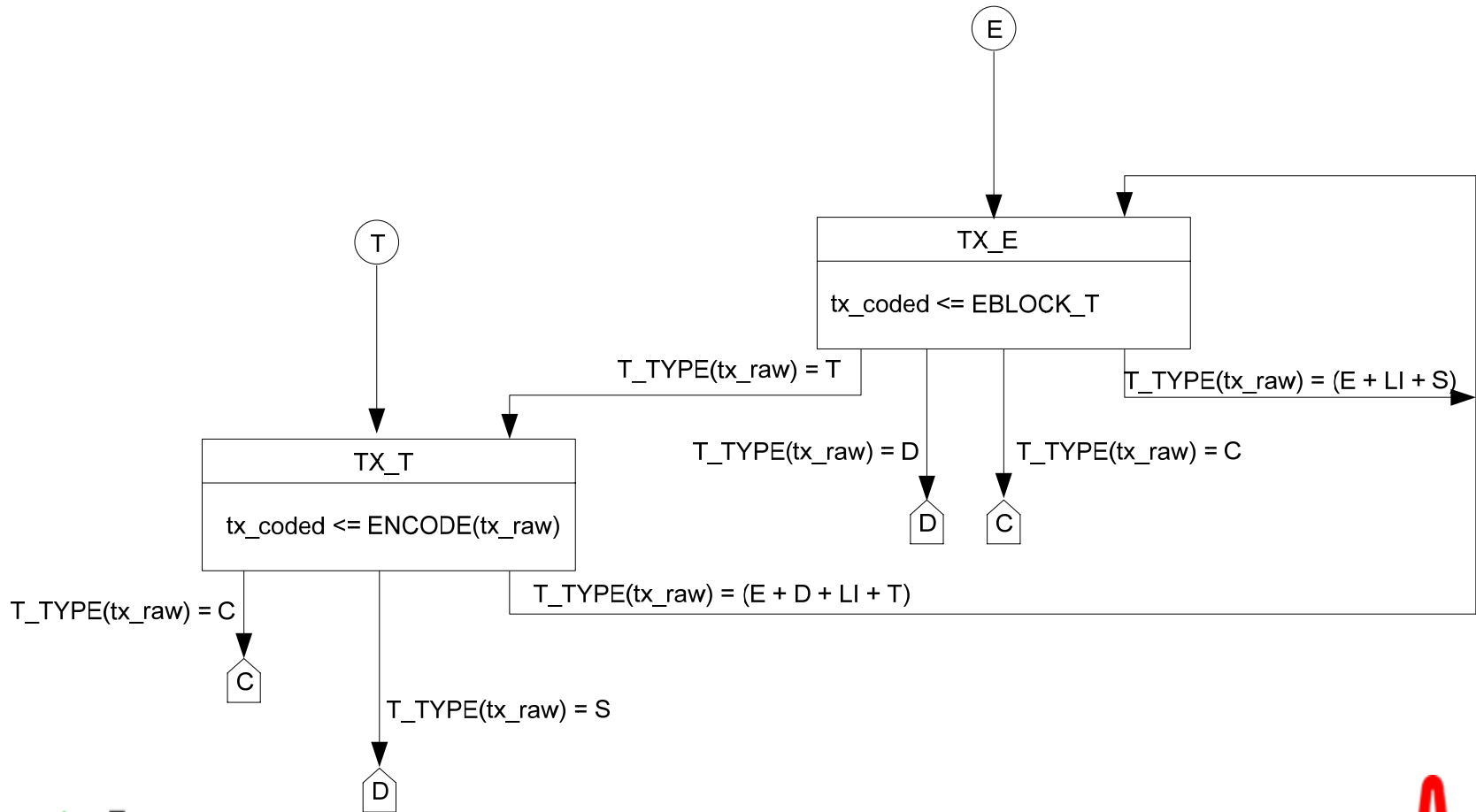# PCS 64B/65B Transmit State Diagram New Control Codes

- New 64B/65B control codes to support Low Power Idle.
    - T_TYPE(tx_raw) = LI for Low Power Idle
    - T_TYPE(tx_raw) = I for Normal Idle

- In the following state diagrams, the transition variable "C" normally refers to any control code. However, when a state has an exit transition conditioned on C that is parallel to any other exit transition using "LI" or "I", then C should be considered as any control code except for LI if it is used on any other exit transition from that state AND except for I if it is used on any other exit transition from that state.
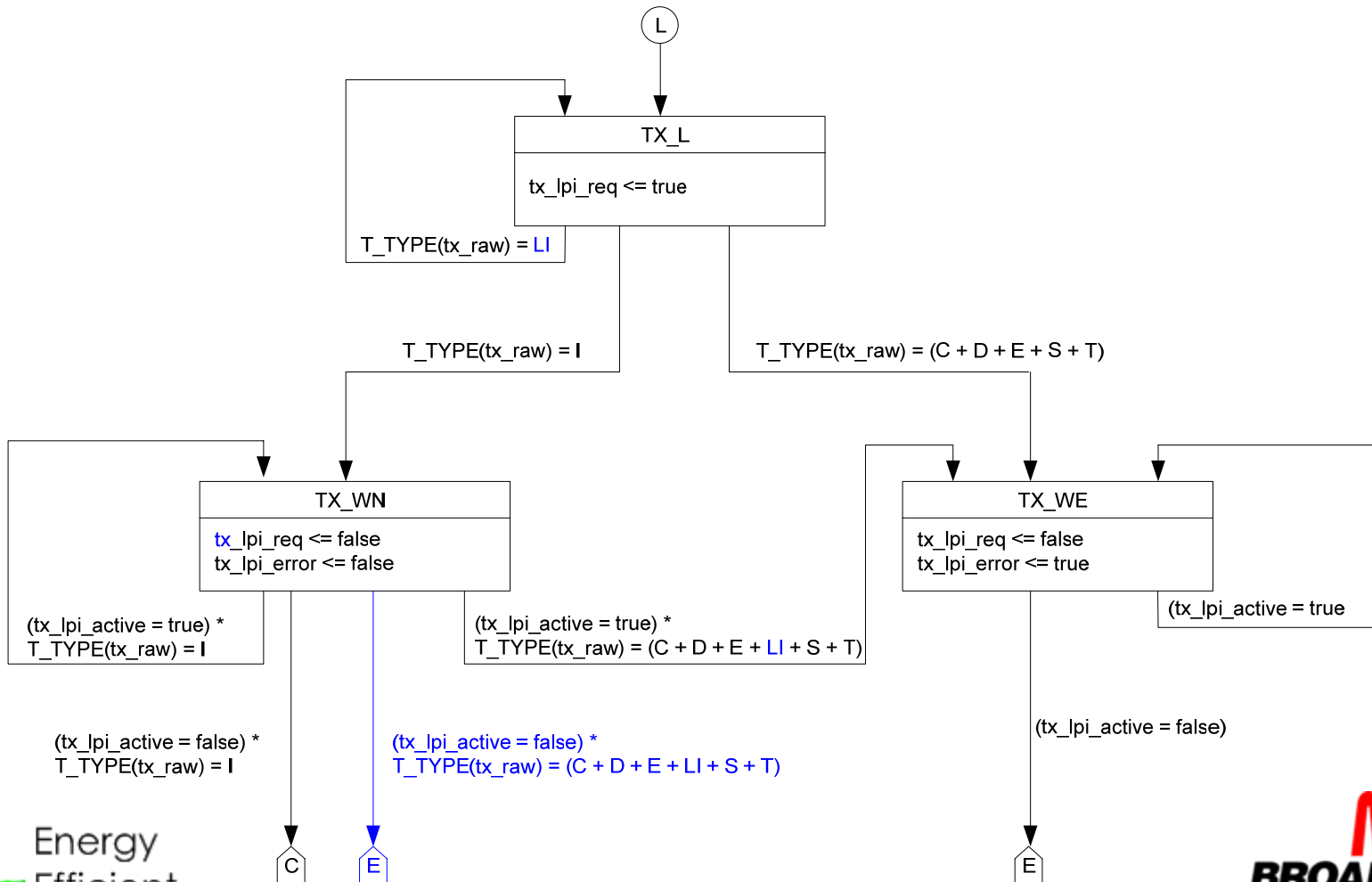
Energy Efficient Ethernet

BROADCOM.
Connecting everything®

PCS 64B/65B Transmit State Diagram (1 of 3)

pcs_reset

TX_INIT

tx_coded <= LBLOCK_T

T_TYPE(tx_raw) = S

T_TYPE(tx_raw) = (E + D + LI + T)

D

T_TYPE(tx_raw) = C

C

TX_C

tx_coded <= ENCODE(tx_raw)

T_TYPE(tx_raw) = C

T_TYPE(tx_raw) = (E + D + T)

T_TYPE(tx_raw) = LI

T_TYPE(tx_raw) = S

L

L is on next page

D

TX_D

tx_coded <= ENCODE(tx_raw)

T_TYPE(tx_raw) = D

T_TYPE(tx_raw) = (E + C+ LI + S)

T_TYPE(tx_raw) = T

E

T

Energy Efficient Ethernet

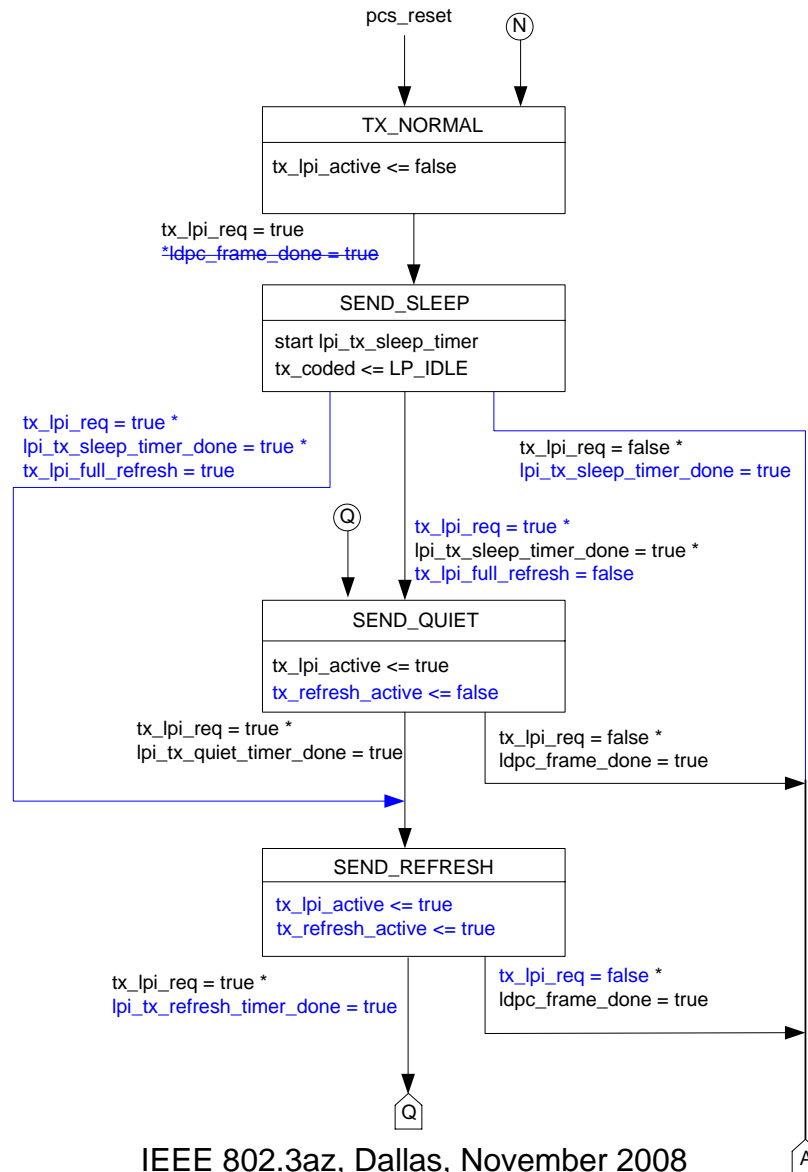IEEE 802.3az, Dallas, November 2008

BROADCOM.
Connecting everything

5

PCS LPI Transmit State Diagram

- Three new variables introduced (following parnaby_01_1108.pdf):
  - tx_lpi_full_refresh (Transmit LPI Full Refresh)
    - Is set active when (lpi_tx_mode = QUIET) * (lpi_tx_quiet_timer_done = true). It prevents partial refreshes from being transferred at the Sleep to LPI transition.
  - tx_refresh_active (Transmit Refresh Active)
    - 0 = Quiet
    - 1 = Refresh
  - tx_alert_active (Transmit Alert Active)
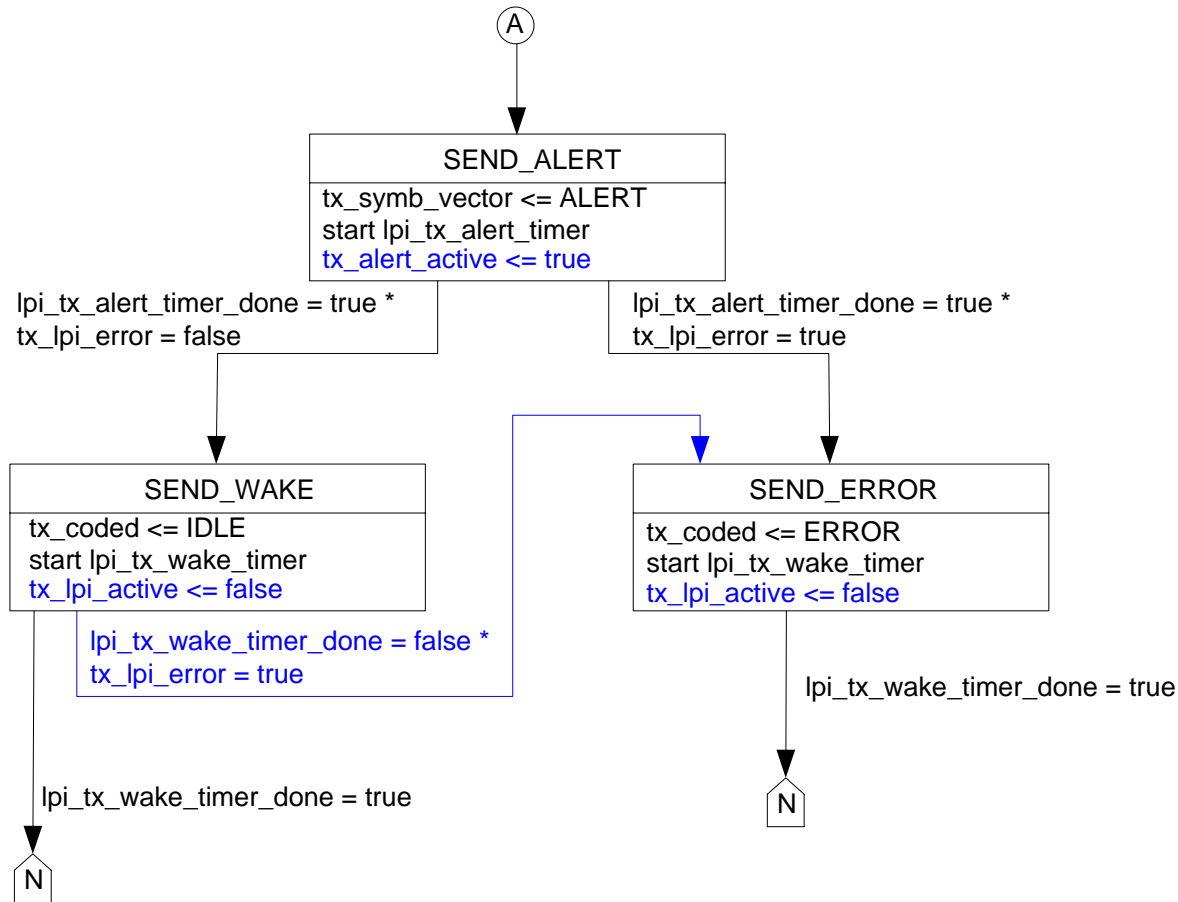
Energy
Efficient
Ethernet

BROADCOM.
Connecting
e v e r y t h i n g®

IEEE 802.3az, Dallas, November 2008

PCS LPI Transmit State Diagram (2 of 2)

PCS 64B/65B Receive State Diagram New States and Transitions

- New states to be added to support Low Power Idle:
    - RX_L (Receive Low Power Idle)
    - RX_W (Receive Wake)

- New transitions to be added to support Low Power Idle:
    - T_TYPE(rx_raw) = LI causes transition from RX_C to RX_L
    - T_TYPE(rx_raw) = LI causes transition from RX_INIT to RX_E
    - T_TYPE(rx_raw) = LI causes transition from RX_D to RX_E
    - T_TYPE(rx_raw) = LI causes transition from RX_E to RX_E

Energy Efficient Ethernet

BROADCOM.
Connecting everything

PCS 64B/65B Receive State Diagram Additional Updates

- One new variable introduced:
  - lpi_rx_wake_timer – start value is equal to number of wake frames. Used to determine if link has exited successfully from Low Power Idle.

- Transitions from RX_W
  - R_TYPE(rx_coded) = I indicates that the link is working, and the transmitter is in Wake Normal state.
  - R_TYPE(rx_coded) = E indicates that the link is working, and the transmitter is in Wake Error state.
  - lpi_rx_wake_timer_done indicates a that Wake has expired without seeing valid 65/64 blocks.

Energy
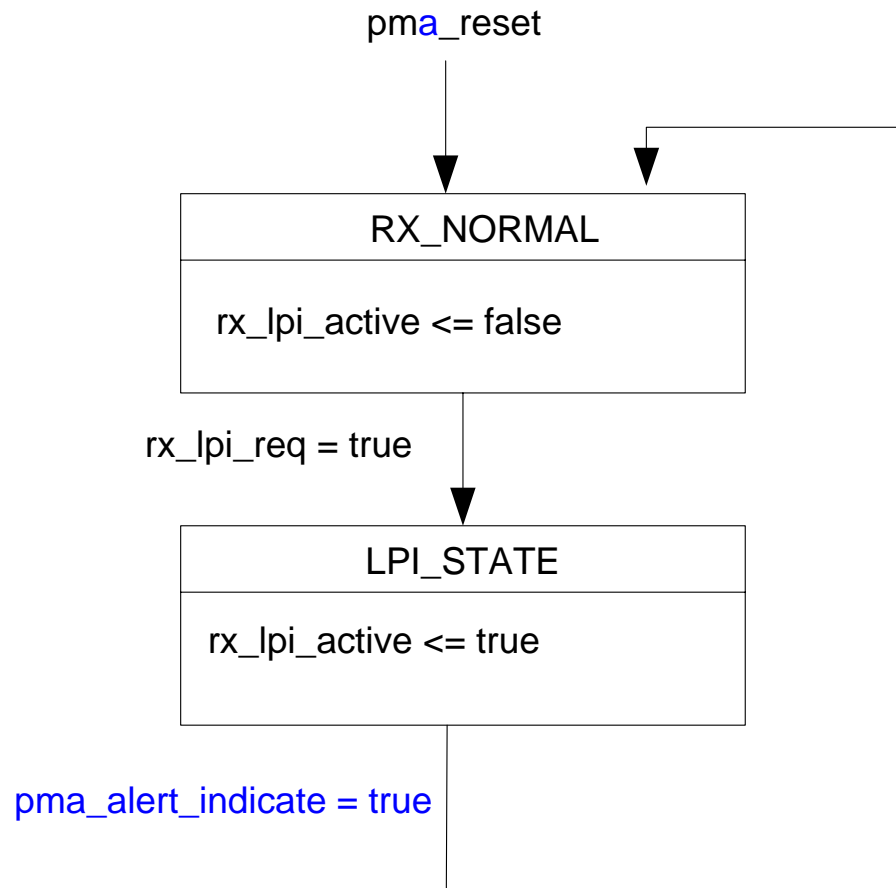Efficient
Ethernet

BROADCOM.
Connecting
everything®
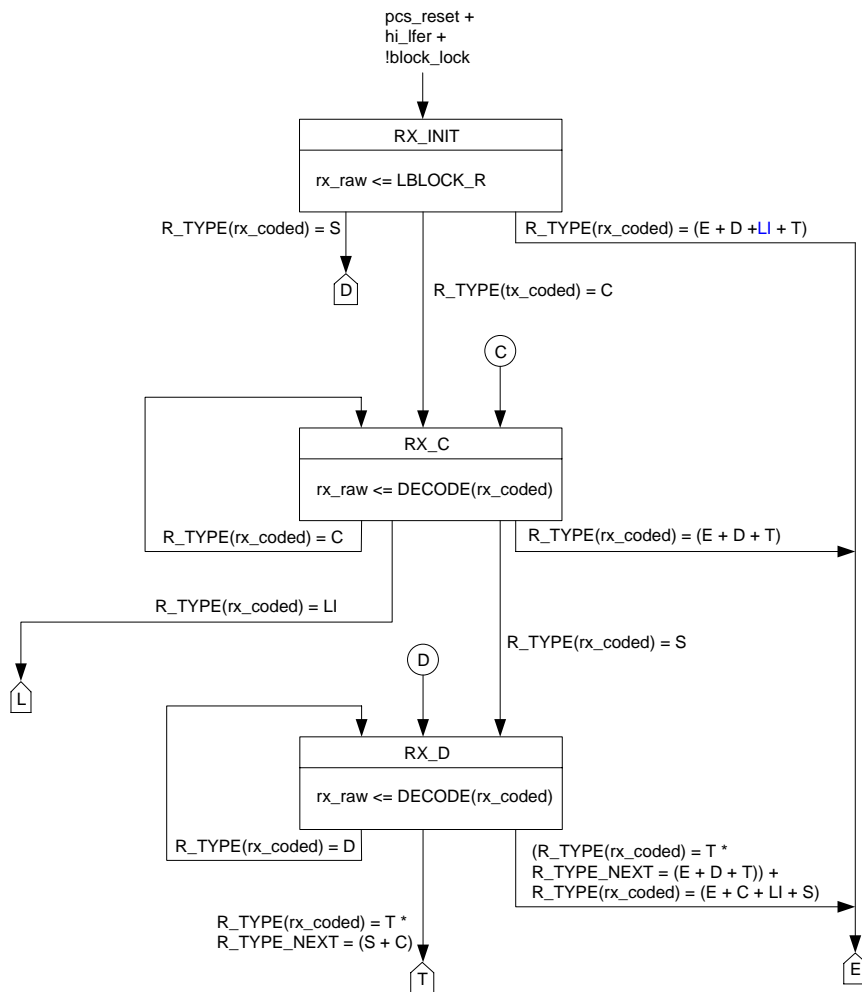
PCS 64B/65B Receive State Diagram (1 of 2)
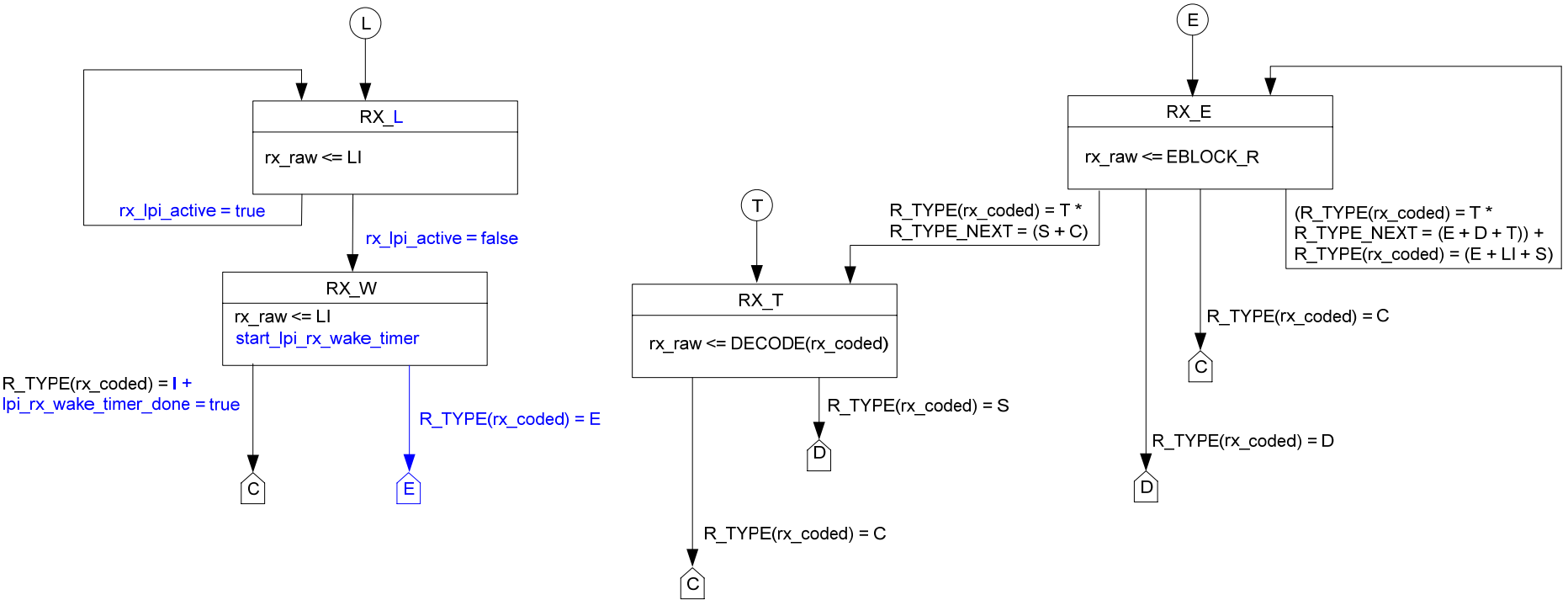
PMA LPI Receive State Diagram (1 of 1)

pma_reset

Note: State RX_WAKE not needed.

After receiving alert, RX PMA can exit from QUIET/REFRESH cycling. PCS layer handles wake timers and processing.

RX_NORMAL

rx_lpi_active <= false

rx_lpi_req = true

LPI_STATE

rx_lpi_active <= true

pma_alert_indicate = true

Energy Efficient Ethernet

BROADCOM.

Connecting everything

Summary

- Updated state diagrams proposed:
    - PCS 64B/65B Transmit.
    - PCS 64B/65B Receive.
    - PCS LPI Transmit.
    - PMA LPI Receive.

- Proposed diagrams provide consistency with existing defined signaling and the proposed PAM2/PAM16 synchronization mechanism.

Energy Efficient Ethernet

BROADCOM.
Connecting everything®

Thank you

Energy Efficient Ethernet

BROADCOM.
Connecting everything®