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Interworking between PLCA enabled nodes with non-PLCA enabled nodes

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Outline

- What happens when a non-PLCA enabled node is attached to a PLCA enabled mixing segment network?
  - non-PLCA enabled nodes (from now on called “rogue” from PLCA perspective) can trigger physical collisions on the line
    - When PLCA is enabled, the PHY still detects physical collisions (see fig. 148-7/2 - TRANSMIT) which are reported to the MAC via PLS_SIGNAL.indication primitive, triggering back-offs as normal
  - Network shall still be able to operate, eventually with degraded performance, i.e.
    - All nodes shall still be able to access the media
    - PLCA improvements waived, plain CSMA/CD behavior takes precedence
  - PLCA operations resume without external intervention as soon as there are no more rogues “jamming” the PLCA mechanism.
  - Need for a way to detect this condition and notify the management layers
- In other words:
  - PLCA is CSMA/CD with improvements so it shall interwork with non-PLCA enabled nodes natively.

Problem

- Assuming that a “rogue” node is transmitting, what can actually happen?
  - The rogue transmits during another PLCA-enabled node’s transmit opportunity. Two possibilities from here:
    - a) the “robbed” node was yielding the TO (no collision)
    - b) the “robbed” node was about to transmit a packet (collision)
  - rogue transmits over a BEACON (unlikely)
    - All PLCA enabled nodes wait for a new BEACON
      - rogue detects a physical collision, PLCA enabled nodes wait for a new BEACON (not a problem)

Problem

- Case (a): rogue "steals" the TO of a PLCA enabled node which had nothing to transmit
  - all nodes receive the packet as if it was sent by the node owning the TO (not a problem, node ID is not sent on the line. Identifying the sender is the MAC's job)
  - "robbed" node receives the packet as well but does not increment the TO counter (because of YIELD)
    - not a problem for nodes with non-zero ID (would wait for a new BEACON before transmitting, anyway)
    - problem for the PLCA coordinator (ID = 0): BEACON would be sent earlier than normal.
      - Fix to FSM is required

Problem

- Case (b): both the rogue and the PLCA enabled node transmit a packet, resulting in a collision
  - MACs back-off with increased transmission attempt counter, as normal
  - At next transmit opportunity the "robbed" PHY would transmit with increased commit time (depending on random back-off time).
  - If physical collisions keep occurring (because of the rogue transmitting), at some point the MAC gives up (discards the packet) leaving PLCA stuck in COMMIT state.
    - Fix requires adding a timer to get out of COMMIT state in this case.
    - Also useful in case the MAC resets without notice.

Proposed text changes

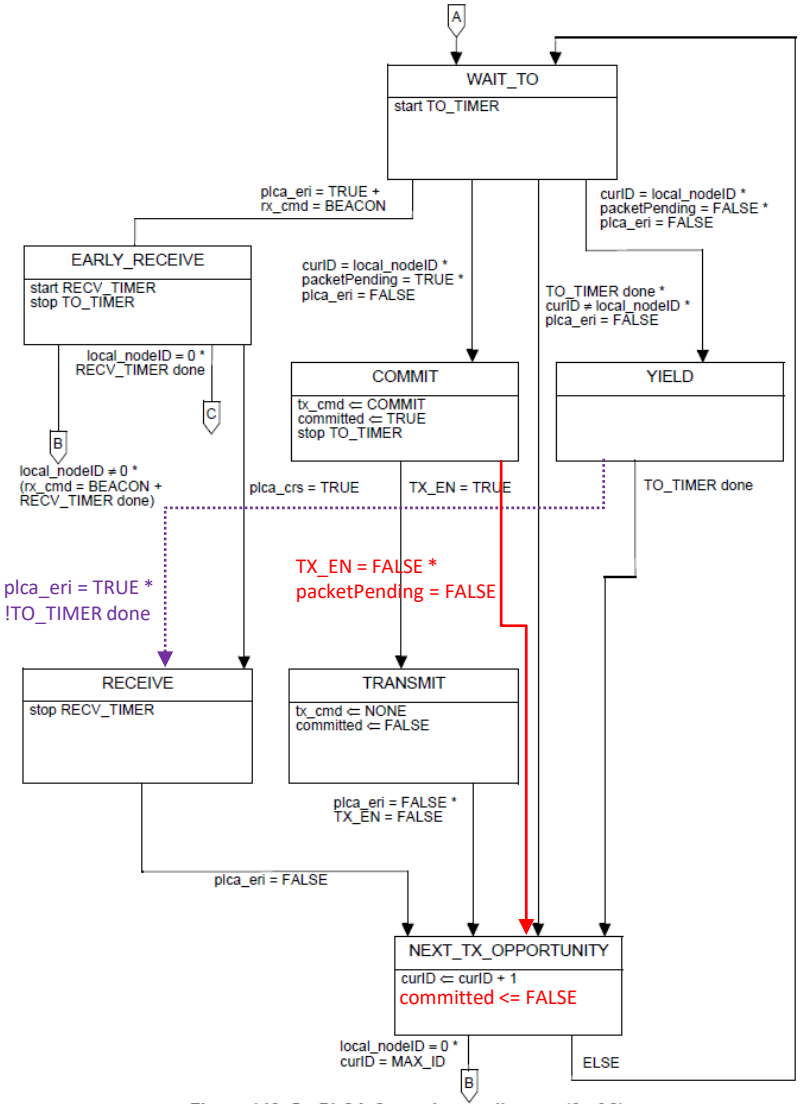

Figure 148–5—PLCA Control state diagram (2 of 2)

Add transition from YIELD to RECEIVE state with condition "plca_eri = TRUE * !TO_TIMER done"

Add transition from COMMIT to NEXT_TX_OPPORTUNITY state with condition "TX_EN = FALSE * packetPending = FALSE"

Add "committed <= FALSE" in NEXT_TX_OPPORTUNITY state box

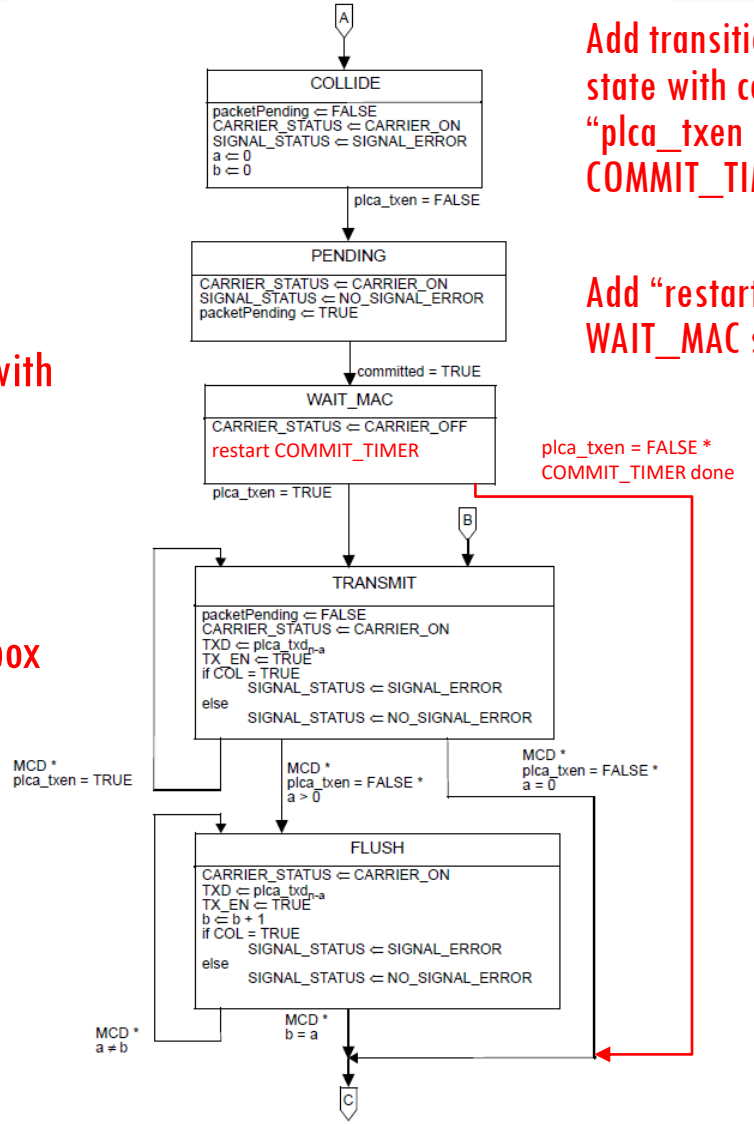

Figure 148–7—PLCA DATA state diagram (2 of 2)

Add transition from WAIT_MAC to C state with condition "plca_txen = FALSE * COMMIT_TIMER done"

Add "restart COMMIT_TIMER" in WAIT_MAC state box

Proposed text changes

- 148.4.6.4 Timers
  - COMMIT_TIMER
    - Defines the maximum time the PLCA Data state machine is allowed to stay in WAIT_MAC state. Duration: 192 bit times
- 45.2.3
  - Add register 3.2294 “10BASE-T1S PCS Diagnostic 2”
  - Add register description

Bit(s)	Name	Description	R/W
3.2294.15:0	PhysicalColCnt	16 bit field counting the number of physical collisions occurred since last read of this register.	RO - SC

  - PhysicalColCnt
    - Shall report the number of physical collisions (i.e. excluding the ones triggered by the optional PLCA RS) occurred since last time register 3.2294 was read.

Conclusions

- PLCA enabled nodes are expected to interwork with non PLCA enabled nodes on the same mixing segment network
  - When all nodes support and enable PLCA, performance is improved as expected
  - Otherwise the network behaves just as in normal CSMA/CD mode
- Bugs were found in current specifications that in some corner cases could lead to interworking problems in presence of physical collisions:
  - PLCA coordinator could send a BEACON earlier when yielding the transmit opportunity
  - PLCA could get stuck in COMMIT/WAIT_MAC states if MAC perform too many transmission attempts (because of physical collisions) and discards the packet
- Proposals to fix the bugs were shown
  - Addition of a diagnostic register to report physical collisions is proposed as well

THANK YOU!