

148. PLCA Reconciliation Sublayer (RS)

148.1 Introduction

This clause specifies the optional ~~PHY Level~~Physical Layer Collision Avoidance (PLCA) capabilities. PLCA provides improved performance over standard CSMA/CD method in terms of throughput and latency for small multidrop networks having a limited number of nodes and high utilization.

Commented [PB1]: #589: PLCA definition

PLCA is defined for half-duplex mode of operation only. ~~MII (Clause 22) specifications are compatible with the gRS sublayer defined in 148.4.2.~~ The PLCA sublayer is specified for operation with the PHY defined in Clause 147 (10BASE-T1S).

Commented [PB2]: #599: MII compatibility
Remove ambiguous and useless text

PLCA is designed to work ~~on top of~~in conjunction with CSMA/CD and can be dynamically enabled or disabled via management interface. When disabled, the system operates as specified in Clause 22.

Commented [PB3]: #657, #284: PLCA Layer
Change text to reflect the originally intended meaning

148.2 Overview

The working principle of PLCA is that each PHY on a multidrop network is granted, ~~in turn, a single~~ transmit opportunity ~~opportunities~~ based on its assigned unique node ID (~~set by management interface~~).

Commented [PB4]: #503: Rephrase for clarity

At any time, only the PHY owning a transmit opportunity is allowed to send data over the medium, therefore avoiding physical collisions.

Transmit opportunities are generated in a round-robin fashion every time the PHY with node ID = 0 signals a BEACON on the medium, indicating the start of a new cycle. ~~This happens after each node has had a transmission opportunity. This can only happen after each PHY has been given exactly one transmit opportunity, thus ensuring media access fairness.~~

Commented [PB5]: #505: Rephrase for clarity

~~PLCA relies on the PLS_SIGNAL indication and PLS_CARRIER indication primitives to have the MAC delay transmission. PLCA relies on CSMA/CD functions to have the MAC delay a transmission~~ until a transmit opportunity is met.

Commented [PB6]: #506: Rephrase for clarity

148.3 Relationship with other IEEE standards

The relationship between the PLCA generic Reconciliation Sublayer, the ISO Open Systems Interconnection (OSI) Reference Model, and the IEEE 802.3 Ethernet Model is shown in Figure 148-1. The reconciliation sublayer (shown shaded) in Figure 148-1 connects one Clause 4 Media Access Control (MAC) layer to the PHY. Ethernet support for time synchronization protocols is defined in Clause 90. MII is defined in Clause 22.

148.4 PLCA generic Reconciliation Sublayer (gRS)

148.4.1 Introduction

This subclause specifies services provided by an extension to the Reconciliation sublayers specified in Clause 22. Within the scope of Clause 148, the term generic Reconciliation sublayer (gRS) is used to denote any IEEE 802.3 Reconciliation sublayer (RS) used to interface a MAC with any PHY supporting the PLCA capability through the MII.

148.4.1.1 Interlayer service interface

Figure 148–2 depicts the gRS interlayer service interfaces.

148.4.2 Generic Reconciliation Sublayer operation

PLCA state machines are contained in the generic RS as shown in Figure 148–3. Interaction with optional Clause 90 (Ethernet support for time synchronization protocols) is also depicted.

When PLCA functions are not supported or are disabled by the management interface (plca_en = OFF) RS operation shall conform to the MII RS definition in Clause 22.

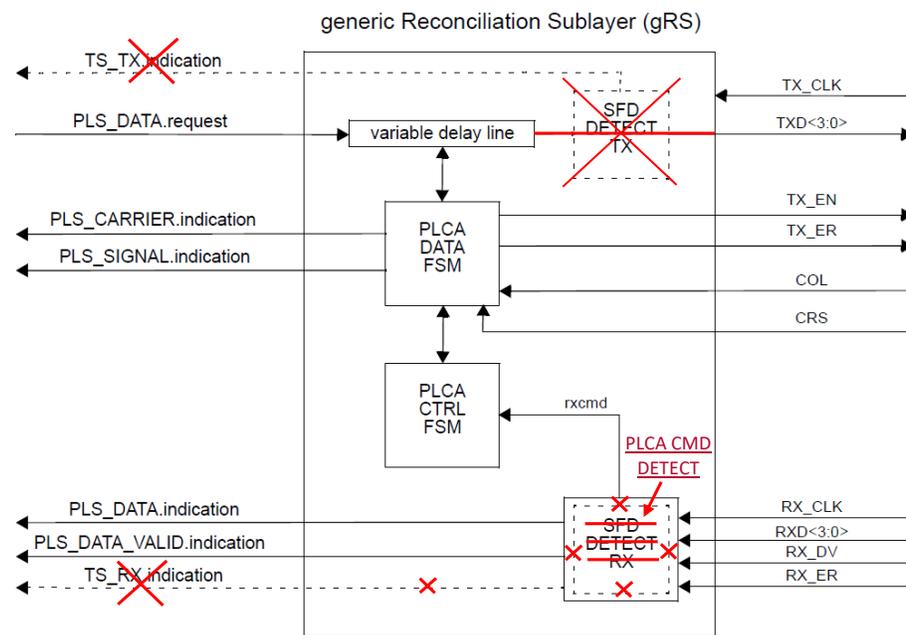


Figure 148–3—PLCA functions within the generic Reconciliation Sublayer (gRS)

148.4.2.1 Operation with TSSI

When TSSI support is also specified in the actual RS, the SFD detection of transmitted frames shall be detected after the PLCA variable delay line, as shown in Figure 148–3. This ensures the network latency measurement is not affected by the synchronization latency added by PLCA. No special attention is required for SFD detection of received frames.

Commented [PB7]: #715, #716: remove TSSI support
NOTE: in figure, remove all dashed lines

Commented [PB8]: #716: remove TSSI support

148.4.3 Mapping of MII signals to PLS service primitives and PLCA functions

The RS maps the signals provided at the MII to the PLS service primitives defined in [Clause 6](#) via the PLCA state machines, variables and functions (see 148.4.5 and 148.4.6). The PLS service primitives provided by the RS behave in exactly the same manner as defined in [Clause 6](#).

148.4.3.1 Mapping of PLS_DATA.request

When PLCA is disabled (`plca_en = OFF`) the mapping of the PLS_DATA.request primitive shall be the one specified in [22.2.1.1](#). Otherwise, the following applies.

148.4.3.1.1 Function

Maps the primitive PLS_DATA.request to PLCA state machines variables which in turn generate the MII signals TXD<3:0>, TX_EN and TX_CLK.

148.4.3.1.2 Semantic of the service primitive

PLS_DATA.request (OUTPUT_UNIT)

The OUTPUT_UNIT parameter can take one of three values: ONE, ZERO, or DATA_COMPLETE. It represents a single data bit. The values ONE and ZERO are conveyed by the PLCA variables `plca_txd<3>`, `plca_txd<2>`, `plca_txd<1>` and `plca_txd<0>` each of which conveys one bit of data while `plca_txen` is set to TRUE. The value DATA_COMPLETE is conveyed by setting the variable `plca_txen` to FALSE. MII signals TXD<3:0> and TX_EN are generated by way of the PLCA DATA State Machine specified in 148.4.6. Synchronization between the RS and the PHY is achieved by way of the TX_CLK signal.

148.4.3.1.3 When generated

The `plca_txd<3:0>` and `plca_txen` variables are assigned after every group of four PLS_DATA.request transactions from the MAC sublayer to request the PLCA functions to transmit a nibble of data when PHY transmit opportunity is met, or to signal the end of the transmission. The TX_CLK signal is generated by the PHY. The TXD<3:0> and TX_EN signals are generated by the RS according to PLCA DATA State Machine (see 148.4.6).

148.4.3.2 Mapping of PLS_DATA.indication

Map of the primitive PLS_DATA.indication shall comply with [22.2.1.2](#).

148.4.3.3 Mapping of PLS_CARRIER.indication

When PLCA is disabled (`plca_en = OFF`) the mapping of the PLS_CARRIER.indication primitive shall be the one specified in [22.2.1.3](#). Otherwise, the following applies

148.4.3.3.1 Function

Maps the primitive PLS_CARRIER.indication to the PLCA DATA State Machine.

148.4.3.3.2 Semantic of the service primitive

PLS_CARRIER.indication (CARRIER_STATUS)

The CARRIER_STATUS parameter can take one of two values: CARRIER_ON or CARRIER_OFF. For EEE capability, CARRIER_STATUS is overridden as specified in [22.2.1.3.3](#).

148.4.3.3.3 When generated

The PLS_CARRIER.indication service primitive is generated by the RS according to the PLCA DATA State Machine specified in 148.4.6.

148.4.3.4 Mapping of PLS_SIGNAL.indication

When PLCA is disabled (plca_en = OFF) the mapping of the PLS_SIGNAL.indication primitive shall be the one specified in clause 22.2.1.4. Otherwise, the following applies.

148.4.3.4.1 Function

Map the primitive PLS_SIGNAL.indication to the PLCA DATA State Machine.

148.4.3.4.2 Semantic of the service primitive

PLS_SIGNAL.indication (SIGNAL_STATUS)

The SIGNAL_STATUS parameter can take one of two values: SIGNAL_ERROR or NO_SIGNAL_ERROR.

148.4.3.4.3 When generated

SIGNAL_STATUS is generated by the PLCA DATA State Machine specified in 148.4.6.

148.4.3.5 Mapping of PLS_DATA_VALID.indication

Map of the primitive PLS_DATA_VALID.indication shall comply with clause 22.2.1.7.

148.4.3.6 Generation of TX_ER

Generation of TX_ER shall comply with clause 22.2.1.6.

148.4.3.7 Response to RX_ER indication

Response to RX_ER indication from the MII shall comply with clause 22.2.1.5.

148.4.4 Requirements for specific RS and PHY specification

Specific RS and PHY specifications that include PLCA capability shall comply with the requirements defined in this subclause.

148.4.4.1 PHY response to PLCA commands and notifications

148.4.4.1.1 BEACON request

~~BEACON function is specified in 148.4.5.1~~

~~The PLCA Control state machine generates a BEACON request by way of the tx_cmd variable as specified in 148.4.5.2. The RS conveys such the BEACON request via MII interface as defined in 22.2.2.4.~~

Upon the reception of this request, the PHY shall send a message over the media for other PHYs to decode and report to their respective RS via MII interface as specified in 22.2.2.8.

Commented [PB9]: #507: add descriptive text

Commented [PB10]: #267: remove circular reference

~~A BEACON request shall not make the PHY assert the CRS signal with the exception of signaling an early receive indication as specified in 148.4.4.1.3.~~ A BEACON request shall not make the PHY assert the RX_DV signal.

Commented [PB11]: #649, #287: CRS usage
CRS is asserted when energy is detected, including BEACON

PHY specifications are free to map the BEACON request to any suitable line coding as long as the requirement defined herein are met.

148.4.4.1.2 COMMIT request

~~COMMIT function is specified in 148.4.5.1.~~

Commented [PB12]: #507: add descriptive text

The PLCA Control state machine generates a COMMIT request by way of the tx_cmd variable as specified in 148.4.5.2. The RS conveys such request via MII interface as defined in 22.2.2.4.

~~Upon the reception of this request, the PHY shall assert the CRS signal. Upon reception of this request, the RX_DV signal shall not be asserted.~~ ~~A COMMIT request shall not make the PHY assert the RX_DV signal.~~

Commented [PB13]: #649, #287, #602: CRS usage
This is implicit in CRS definition

PHY specifications are free to map the COMMIT request to any suitable line coding as long as the requirement defined herein are met.

Commented [PB14]: #603: COMMIT mapping
Clarify that this is a requirement for PHY specs to map the COMMIT request properly.

148.4.4.1.3 Early receive indication (optional)

~~In order to minimize TO_TIMER skew across the multidrop network and improve PLCA performance, a PHY may optionally notify the RS of an early receive condition. Early receive indication is conveyed to the RS by the means of MII interface as specified in 22.2.2.8.~~

~~If supported, this notification shall occur before CRS is asserted, as soon as the PHY detects anything on the medium that might be a BEACON, COMMIT or normal data.~~

~~Notification shall terminate when either a valid BEACON, COMMIT or normal data is being received or if the condition that triggered the notifications ceases.~~

Commented [PB15]: #649, #287: CRS usage
#508, #341, #291: TO_TIMER skew
Since ERI was defined as energy detection, which is CRS behavior, no need to specify anything here

148.4.4.2 Mapping of MII signals to PLCA variables

The PLCA RS is required to decode PLCA specific signaling out of MII interface.

148.4.4.2.1 BEACON indication

When the PHY receives a BEACON, it shall indicate this information to the RS by asserting MII signals.

The RS shall react to such indication by setting the PLCA variable rx_cmd to the value BEACON. The RS shall also reset the rx_cmd variable to NONE when the BEACON indication on the MII ceases, unless a COMMIT indication is signaled in which case rx_cmd shall be set as specified in 148.4.4.2.2.

148.4.4.2.2 COMMIT indication

When the PHY receives a COMMIT from the line, it shall indicate this information to the RS by asserting MII signals.

The RS shall react to such indication by setting the PLCA variable rx_cmd to the value COMMIT. The RS shall also reset the rx_cmd variable to NONE when the COMMIT indication on the MII ceases, unless a BEACON indication is signaled in which case rx_cmd shall be set as specified in 148.4.4.2.1.

148.4.4.2.3 CARRIER indication

Since the PHY may optionally provide early receive indication by the means of CRS and COL MII signals, the `plea_crs` variable shall be set accordingly as follows:

(148-1)

148.4.4.2.4 Early receive indication

The MII signal CRS shall map to the `plea_eri` variable directly, as shown in Equation (148-2), despite the PHY supporting the early receive indication feature or not.

(148-2)

148.4.5 PLCA Control

148.4.5.1 PLCA Control State Diagram

PLCA Control state machine is responsible for synchronizing transmit opportunities across the multidrop network to avoid physical collisions.

The PLCA Control function shall conform to the PLCA Control state diagram in Figure 148-4 and Figure 148-5 and associated state variables, functions, timers and messages.

When PLCA functions are disabled (`plca_en = OFF`), the PLCA control variables are reset to their default values as shown in Figures 148-4 and 148-5 and no special signaling is conveyed to the MII through the `tx_cmd` variable.

When PLCA functions are enabled and `local_nodeID` equals zero, ~~When PLCA functions are enabled, the PHY with `local_nodeID` variable set to 0, PLCA immediately switches to RECOVER state and waits for all other PHYs to be silent for at least `RECV_BEACON_TIMER`. This prevents sending a BEACON at inappropriate time when e.g. the node with `local_nodeID = 0` resets in the middle of a PLCA cycle (i.e. when other nodes could still be sending valid data). A BEACON is then generated by such node. Then it switches to `SEND_BEACON` state, to have all other PHYs. On reception of a BEACON, all other nodes synchronize/reset their own transmit opportunity counter and related timer.~~

When PLCA functions are enabled, PHYs with nonzero `local_nodeID` wait in `RESYNC` state until a BEACON is received.

All PHYs, including the one generating the BEACON, detect the end of the BEACON condition before resetting the transmit opportunity timer/proceeding to `WAIT_TO` state, in order to minimize latency differences across the network.

After syncing is done, all PHYs have their own transmit opportunity counters (`curID`) reset and the `TO_TIMER` started. At this point the `TO_TIMER` maximum skew across all PHYs is $\square_{RXlat} + TPD$ where \square_{RXlat} is the worst case receive latency difference among all the PHYs, while `TPD` is the worst-case propagation delay time from end-to-end on the mixing segment.

On Entering `WAIT_TO` state the PHY waits for one of these possible conditions:

- 1) An early receive indication (`plea_eri = TRUE`) is signaled/CRS is asserted by the PHY through MII (see 148.4.4.1.3), indicating there's activity on the line.
- 2) The PHY asserts the CRS signal (`plea_eri = TRUE`), indicating a data reception is about to occur. `curID` becomes equal to `local_nodeID` while `packetPending` variable is `TRUE`, meaning that this PHY owns now a transmit opportunity and does have a packet to transmit

Commented [PB16]: #649, #287: CRS usage #342: may/optionally usage
Since ERI was defined as energy detection, which is CRS behavior, no need to specify anything here

Commented [PB17]: #649, #287: CRS usage
Since ERI was defined as energy detection, which is CRS behavior, no need to specify anything here

Commented [PB18]: #570: PLCA variables default values
Text is informative, the state diagrams are normative. This should help clarifying.

3. ~~Transmit opportunity counter "curID" is equal to "local_nodeID" curID becomes equal to local_nodeID while packetPending variable is FALSE, meaning that this PHY owns now a transmit opportunity but does not have a packet to transmit.~~

3) ~~TO_TIMER elapses indicating the current transmit opportunity is yielded~~

4) ~~4. TO_TIMER elapses indicating the current transmit opportunity is yielded~~

~~Condition (1) may only occur if the PHY supports the optional early receive indication as specified in 22.2.2.11 and 22.2.2.12. When this happens, it's very likely that a BEACON or a valid packet (see 1.4.312) is about to be received. However, it's also possible for the PHY to indicate a false early receive condition due to glitches and other unlikely external events. To handle such case, an optimistic scheme is used: PLCA control state machine assumes the early receive indication of the PHY to be reliable and switches to EARLY_RECEIVE state arming the RECV_TIMER and stopping the TO_TIMER (i.e. assuming BEACON or valid data to be received shortly).~~

~~If condition (1) occurs, the PHY is about to receive either a valid packet, a COMMIT request, a BEACON request or it might just be receiving a false carrier event. In any case, PLCA switches to EARLY_RECEIVE state arming the RECV_TIMER to protect against this last (unlikely) possibility.~~

~~In EARLY_RECEIVE state, PLCA is waiting for the PHY to properly decode the incoming signal and:~~

- ~~- switch to RECEIVE state if a COMMIT indication is reported or a valid packet is being decoded. RECEIVE state is then entered until the line is free (CRS deasserted).~~
- ~~- switch to RESYNC state if a BEACON is received, starting a new cycle. This can only happen to PHYs with local_nodeID != 0~~
- ~~- switch to RESYNC state also if RECV_TIMER elapses and local_nodeID != 0, meaning that a false carrier occurred and the curID variable might be out of sync. In this case the PHY skips his TO and waits for a new BEACON in order not to disrupt current cycle.~~
- ~~- switch to RECOVER state if RECV_TIMER elapses and local_nodeID = 0. In RECOVER state, since the curID variable might be out of sync, the PHY waits for all nodes to be silent for at least RECV_BEACON_TIMER before sending a new BEACON. This is required not to send a BEACON while other PHYs might still be using their TO~~

~~At this point, if the plea_crs variable is set to TRUE, the control state machine goes to RECEIVE state for actually receiving the packet. If a BEACON is detected instead, it switches to RESYNC state. In case the RECV_TIMER expires, a recovery procedure is initiated to resynchronize the (possibly) misaligned TO_TIMER and curID counter.~~

~~The recovery procedure forces the PHY with local_nodeID=0 to wait for all other PHYs to be silent for at least RECV_BEACON_TIMER before sending a new BEACON, and all other PHYs to wait for the next BEACON to be received.~~

~~When condition (2) occurs, the state machine immediately switches to RECEIVE state, stopping the TO_TIMER. This is the usual case when the early receive indication is not supported by the PHY and a packet is being received. the PHY now gets a TO having a packet to be transmitted. COMMIT state is then entered to signal other PHYs to stop their TO_TIMER and wait for a packet by the means of a COMMIT request. COMMIT state is left once the data to be transmitted is available from the MAC or the PLCA delay line.~~

~~When condition (3) occurs, PLCA Control samples the packetPending variable to detect whether the MAC is ready to send out a packet. If not, the transmit opportunity is yielded by waiting for the TO_TIMER to expire. Otherwise the transmit opportunity is committed by having the PHY issue a COMMIT request and have other PHYs stop their own TO_TIMER. This is achieved by the means of special MII signaling as specified in Table 22-1 (PLCA COMMIT request): the PHY now gets a TO without being ready to send a packet. In this case the YIELD state is entered to just skip the TO, allowing other PHYs a chance to transmit. In some rare cases (e.g. a non-PLCA enabled node transmits is connected to the network) it is possible to receive data in YIELD state. If this unlikely event happens, PLCA switch in RECEIVE state to wait until the end of the transmission and increment curID properly.~~

When condition (4) is met, another PHY has yielded its transmit opportunity, causing the `curID` variable ~~transmit opportunity counter~~ to be incremented and `TO_TIMER` to be reset.

Commented [PB19]: #510: Rephrase text for clarity
#649: CRS usage

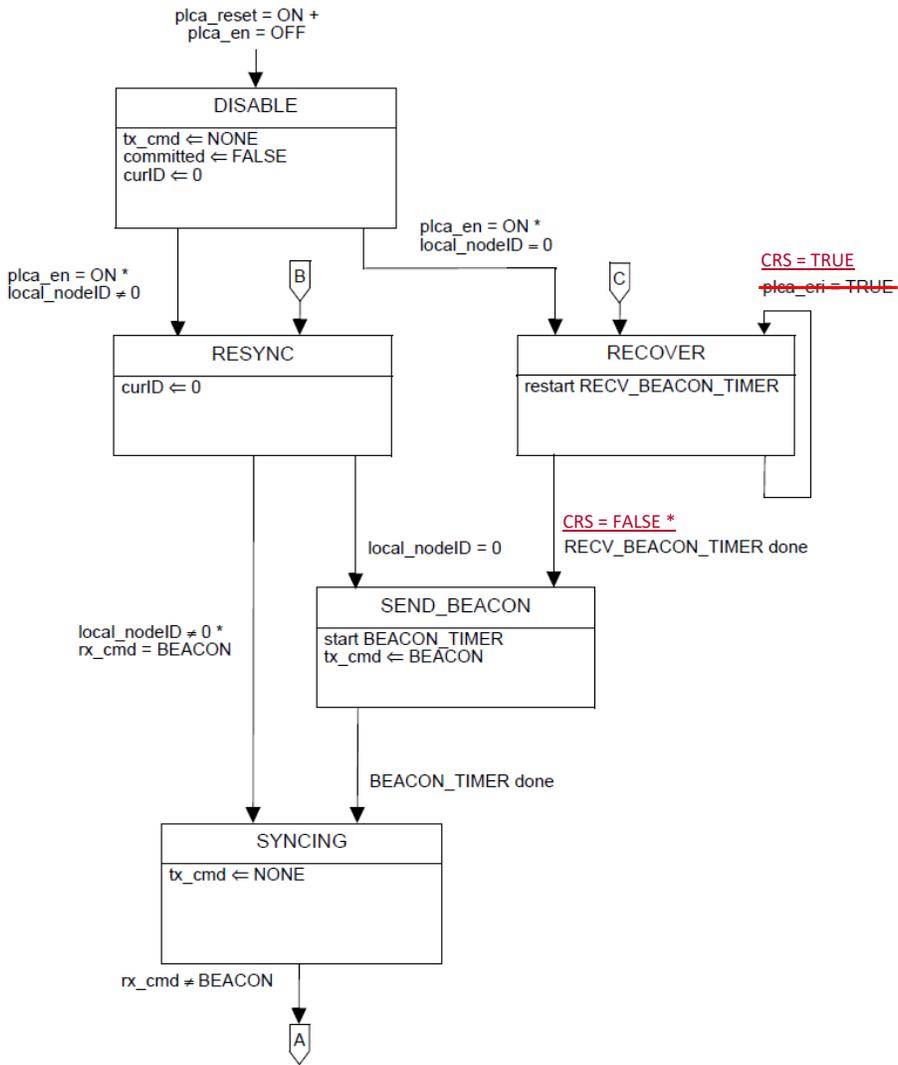


Figure 148-4—PLCA Control state diagram (1 of 2)

Commented [PB20]: #649, #287: CRS usage
replace `plca_eri` with `CRS` since now they are functionally equivalent

Commented [PB21]: #520: ambiguous exit condition
Added "`CRS = FALSE *`" to transition from **RECOVER** to **SEND_BEACON** state

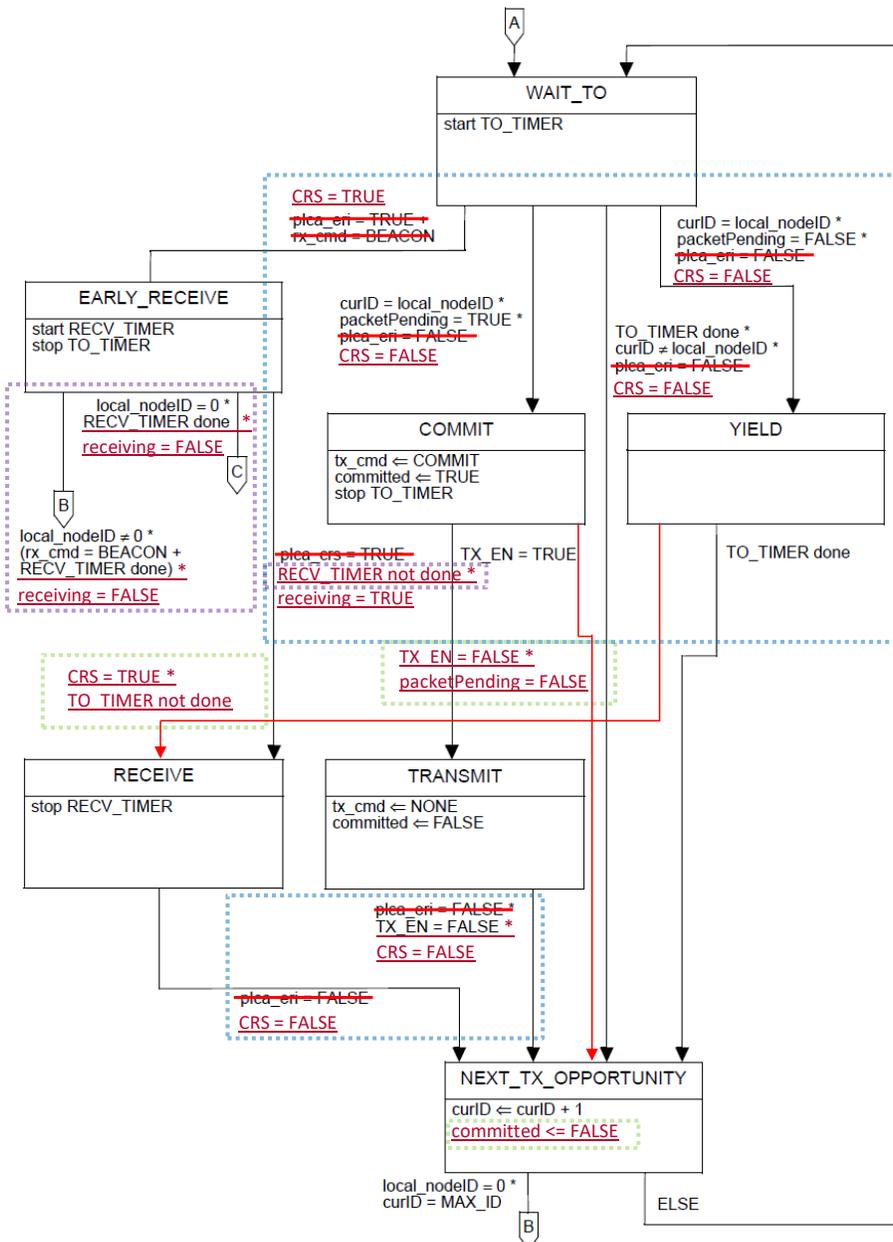


Figure 148-5—PLCA Control state diagram (2 of 2)

Commented [PB22]: #649, #287: CRS usage replace plca_eri with CRS since now they are functionally equivalent.

In transition from EARLY_RECEIVE to RECEIVE, use combination of "RX_DV asserted" OR "COMMIT received" to detect whether the signal being received is a valid packet or a COMMIT indication (which is always a precursor to a valid packet)

Changes highlighted in BLUE boxes

Commented [PB23]: #558, #557: Resolve ambiguous exit conditions

Changes highlighted in PURPLE boxes

Commented [PB24]: #551, #550: PLCA_XWORK Implement changes to have PLCA enabled nodes interoperate as expected with non PLCA-enabled nodes.

Changes highlighted in GREEN boxes

NOTE for editors: suggested to move YIELD state box to the left to avoid crossings

148.4.5.2 PLCA Control variables

plca_reset

The plca_reset signal is used to reset the optional PLCA function in the RS. This signal maps to ON when aPLCAAdminState is enabled and to OFF when aPLCAAdminState is normal, but is further qualified. When the MDIO is present, this signal is only set to ON when PLCA ability bit in MDIO register 3.2292.13 is set to a one and PLCA enable bit in MDIO register 3.2291.13 is set to a one. This signal is set to OFF when PLCA ability bit in MDIO register 3.2292.13 is set to a zero or PLCA enable bit in MDIO register 3.2291.13 is set to a zero. When MDIO is not present, the functionality of 3.2291.13 and 3.2292.13 can be provided by equivalent means.

Values: ON or OFF

plca_en

The plca_en signal controls the optional PLCA function in the RS. This signal maps to ON when aPLCAAdminState is enabled and to OFF when aPLCAAdminState is disabled. When the MDIO is present, this signal is set to ON when PLCA ability bit in MDIO register 3.2292.13 is set to a one and PLCA enable bit in MDIO register 3.2291.13 is set to a one. This signal is set to OFF when PLCA ability bit in MDIO register 3.2292.13 is set to a zero or PLCA enable bit in MDIO register 3.2291.13 is set to a zero. When MDIO is not present, the functionality of 3.2291.13 and 3.2292.13 can be provided by equivalent means.

Values: ON or OFF

~~plca_eri~~

~~Variable decoded by the RS out of MII signaling as specified in 148.4.4.2.4.
Values: TRUE or FALSE~~

~~plca_ers~~

~~Variable decoded by the RS out of MII signaling as specified in 148.4.4.2.3.
Values: TRUE or FALSE~~

CRS

The MII signal CRS.
Values: TRUE or FALSE

RX_DV

The MII signal RX_DV.
Values: TRUE or FALSE

receiving

Helper variable, defined as: $(RX_DV = TRUE) + (rx_cmd = COMMIT)$
Values: TRUE or FALSE

tx_cmd

Command to be conveyed to the PHY via MII interface. When set to NONE, no special signaling shall be conveyed. When set to BEACON or COMMIT, respective commands shall be conveyed to MII as specified in 148.4.4.1.1 and 148.4.4.1.2.
Values: NONE, BEACON or COMMIT.

rx_cmd

current PLCA command received by the PHY, signaled to the RS via MII interface. Response to

Commented [PB25]: #649, #287: CRS usage
remove unused definitions

Commented [PB26]: #649, #287: CRS usage
add definitions of new variables being used in Figures 148-4
and 148-5

rx_cmd is defined by the PLCA Control state machine.
Values: NONE, BEACON or COMMIT.

TX_EN

The MII signal TX_EN.
Values: TRUE or FALSE

local_nodeID

ID representing the PLCA transmit opportunity number assigned to the PHY. This signal maps to aPLCALocalNodeID. When MDIO is present, the local_nodeID is configured to the content of bits 3.2289.7:0. When MDIO is not present, the functionality of bits 3.2289.7:0 can be provided by equivalent means. The special value '0' is assigned to the PHY which generates BEACON signals.
Values: integer value from 0 to 255.

MAX_ID

Indicates the maximum number of PHYs that can join the multidrop network, reflecting the value of aPLCAMaxID. When MDIO is present, the MAX_ID is configured to the content of bits 3.2289.15:8. When MDIO is not present, the functionality of bits 3.2289.15:8 can be provided by equivalent means. This parameter is only meaningful for the PHY with local_nodeID = 0, otherwise it is ignored.
Values: integer number from 0 to 255

committed

Internal variable used to synchronize PLCA Control and Data functions.
It is set by PLCA Control state machine to signal that the current transmit opportunity has been committed and the PLCA DATA state machine is now allowed to convey MII data to the PHY.
Values: TRUE or FALSE

packetPending

Internal variable used to synchronize PLCA Control and Data functions.
The PLCA DATA state machine sets this variable when it detects the MAC is ready to send a packet and have PLCA Control state machine actually commit for the next available transmit opportunity.
Values TRUE or FALSE

148.4.5.3 Functions

No functions are defined for the PLCA Control state machine.

148.4.5.4 Timers

BEACON_TIMER

Times the duration of the BEACON signal.
Duration: 20 bit times.

RECV_TIMER

~~When the optional early receive indication is supported by the PHY, this~~ timer determines how much time to wait in the EARLY_RECEIVE state before performing a recovery procedure.
Duration: this timer is implementation specific and shall be greater than the PHY's total receive latency.

TO_TIMER

The transmit opportunity timer maps to aPLCATransmitOpportunityTimer. When the MDIO is present, the timer is configured to the content of bits 3.2290.15:0. When MDIO is not present, the functionality of bits 3.2290.15:0 can be provided by equivalent means. Timer value shall be long enough to allow any PHY that meets its own transmit opportunity to have the first nibble of its transmission (including the COMMIT request) to be received by all other PHYs before their own TO_TIMER expires. This includes the worst case PHY TX and RX latency and the maximum MDI to MDI propagation delay. TO_TIMER shall be set equal across the multidrop network in order for

Commented [PB27]: #649, #287: CRS usage
Remove reference to ERI

PLCA to work properly.

Duration: integer number between 1 and 65535, expressed in bit times.

RECV_BEACON_TIMER

During recovery, RECV_BEACON_TIMER times the period that all PHYs need to be silent.

Duration: The duration of this timer is controllable and should be at least $TO_TIMER * MAX_ID + BEACON_TIMER$ for reliable operations.

148.4.6 PLCA Data

148.4.6.1 PLCA Data State Diagram

PLCA Data state machine is responsible for detecting when the MAC is ready to send a packet and delay the transmission until a transmit opportunity is met.

The PLCA Data function shall conform to the PLCA Data state diagram in Figure 148–6 and Figure 148–7 and associated state variables, functions, timers and messages.

When PLCA functions are enabled, the PLCA Data state machine waits for the MAC to start a transmission or the PHY to ~~signal either an early receive indication or assert~~ carrier sense.

In the former case, the data conveyed by the MAC through the PLS_DATA.request primitive is delayed by switching to HOLD state. In the latter case, CARRIER_ON is signaled through the PLS_CARRIER.indication to have the MAC defer any new transmission, then the RECEIVE state is entered.

The MAC however, might have started a transmission right before a carrier is detected, which would normally result in a physical collision. In this case the Data state machine switches to the COLLIDE state asserting SIGNAL_STATUS = SIGNAL_ERROR via PLS_SIGNAL.indication primitive to have the MAC perform a backoff and send the packet again later, without actually forwarding any data for the PHY to transmit on the medium. This is called a logical collision.

During the HOLD state the PLCA Control state machine is notified via the packetPending variable that data is available to be transmitted and the beginning of the transmission is held in the variable delay line. At next transmit opportunity the PLCA Control state machine allows transmitting the delayed data by setting the "committed" variable to TRUE. In such case the PLCA Data state machine switches to TRANSMIT state to actually deliver the data for the PHY to encode and transmit on the medium.

The variable delay line is a small buffer that is necessary in order to avoid physical collisions by delaying transmission to the MII interface until the exclusive transmit opportunity for the node arrives. The variable delay line length is no greater than $TO_TIMER * MAX_ID + BEACON_TIMER$.

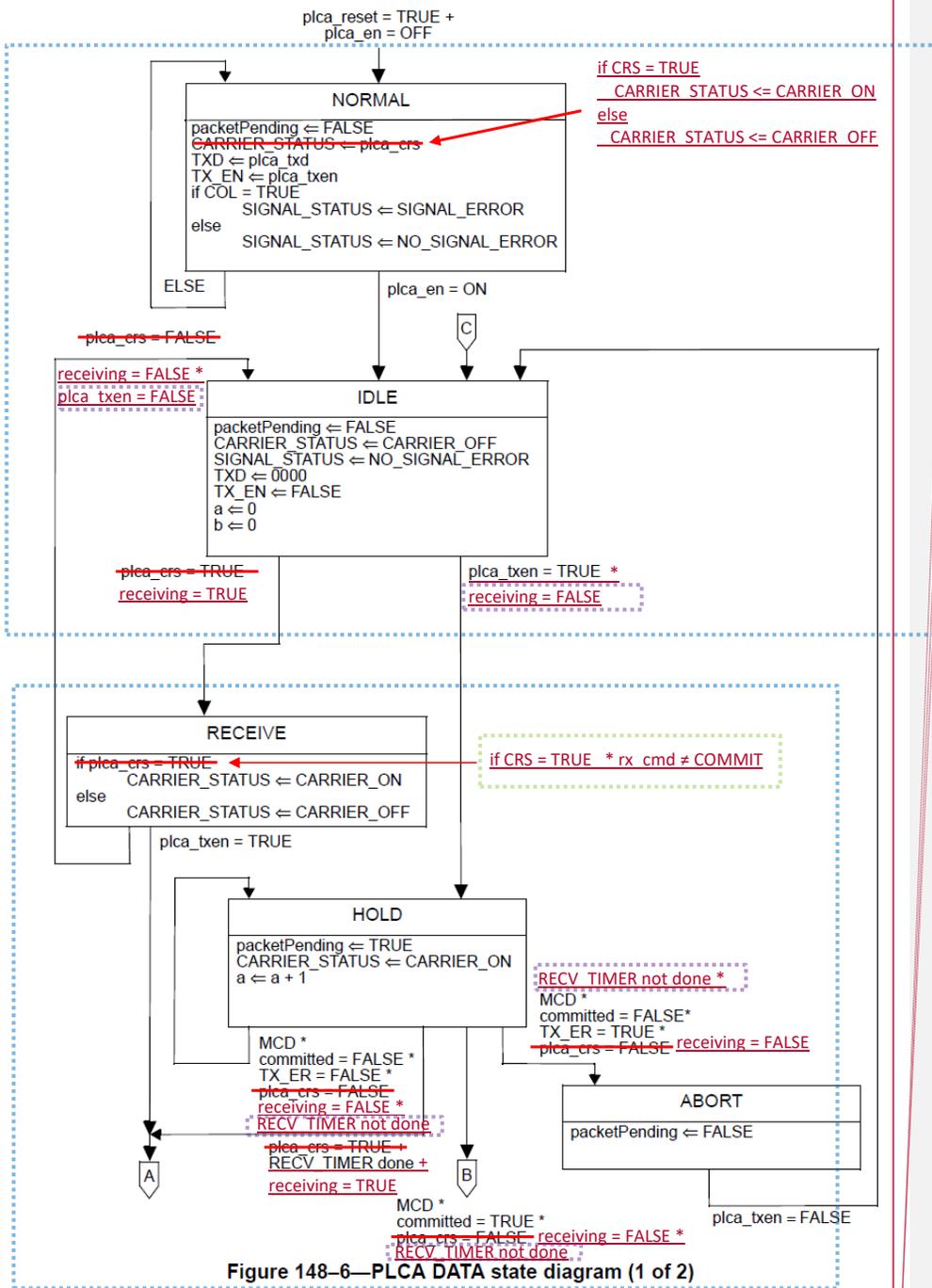
If TX_ER is asserted during the HOLD state, the PLCA Data state machine switches to ABORT state to assert packetPending = FALSE and to wait until the MAC stops sending data. The aborted packet will not be transmitted on the medium.

If another PHY starts a transmission after meeting its own transmit opportunity, delayed data cannot be held anymore and a logical collision is triggered by switching to COLLIDE state.

During the COLLIDE state, the PLCA Data state machine asserts packetPending = FALSE and CARRIER_STATUS = CARRIER_ON via the PLS_CARRIER.indication primitive. When the MAC is done sending the jam bits as described in [Clause 4](#), it waits for the next transmit opportunity by switching to PENDING state.

Commented [PB28]: #649, #287: CRS usage
Remove reference to ERI

During the PENDING state, the PLCA Data state machine asserts packetPending = TRUE and keeps CARRIER_STATUS = CARRIER_ON via the PLS_CARRIER.indication primitive to prevent the MAC to make new transmit attempts until PLCA Control state machine signals that a new transmit opportunity is met. At that point CARRIER_STATUS is set to CARRIER_OFF to have the MAC actually resend data after waiting one IPG period as described in [Clause 4](#).



Commented [PB29]: #649, #287: CRS usage replace plca_eri with CRS since now they are functionally equivalent.
 Changes highlighted in BLUE boxes

Commented [PB30]: #613: Bandwidth inequality Don't signal carrierSense to MAC during a COMMIT
 Changes highlighted in GREEN boxes

Commented [PB31]: #523, #522, #521: Ambiguous exit conditions
 Changes highlighted in PURPLE boxes

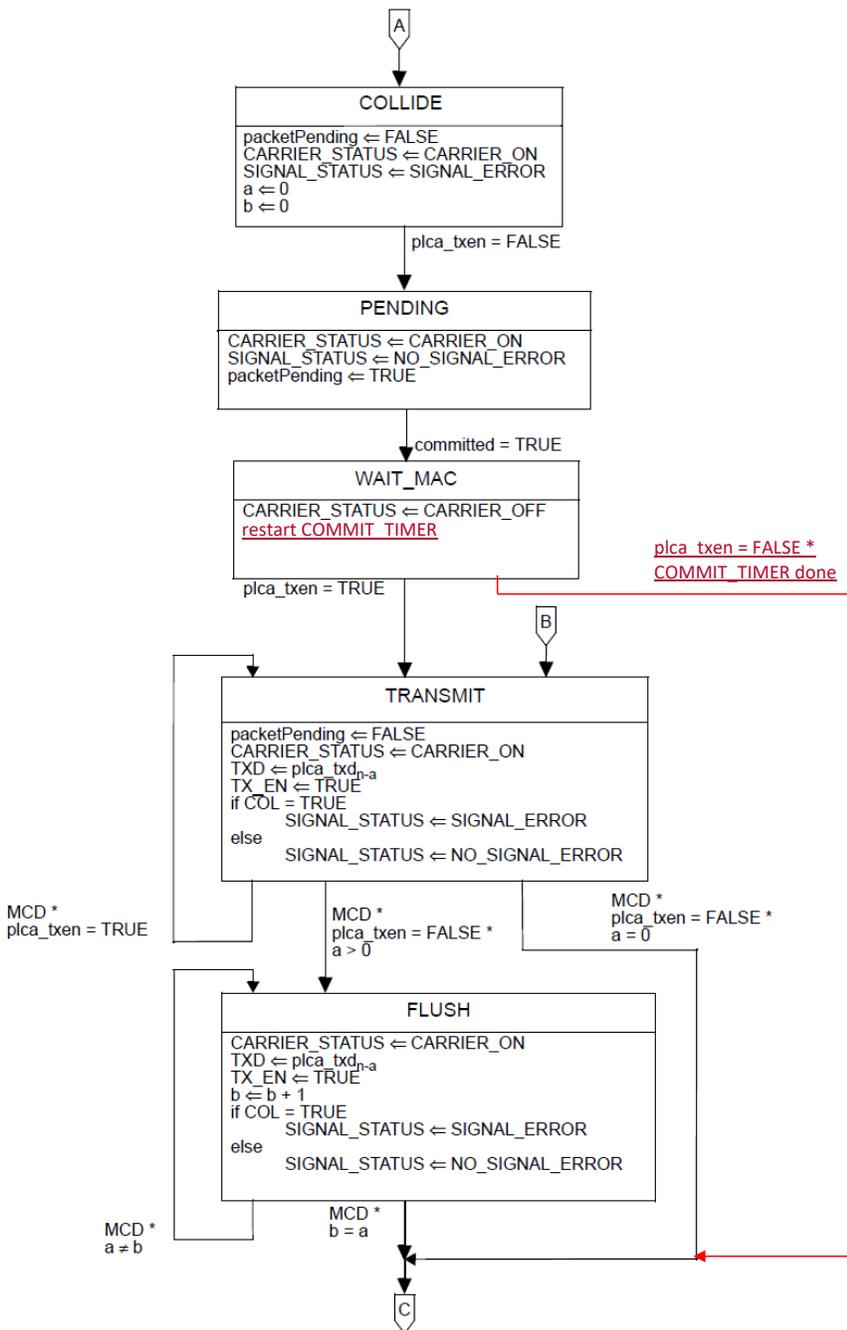


Figure 148-7—PLCA DATA state diagram (2 of 2)

Commented [PB32]: #552: PLCA_XWORK
 Implement changes to have PLCA enabled nodes
 interoperate as expected with non PLCA-enabled nodes.

148.4.6.2 PLCA Data variables

plca_reset
See 148.4.5.2.

plca_en
See 148.4.5.2.

~~plca_ers~~
See 148.4.5.2.

~~plca_txen~~
See 148.4.3.1.2

~~plca_txd~~
See 148.4.3.1.2

~~receiving~~
See 148.4.5.2.

committed
See 148.4.5.2.

packetPending
See 148.4.5.2.

CARRIER_STATUS
See 148.4.3.3.2.

SIGNAL_STATUS
See 148.4.3.4.2

TXD
The MII signals TXD<3:0>.

TX_EN
The MII signal TX_EN.

TX_ER
The MII signal TX_ER.

COL
The MII signal COL.

a
Current delay counter.

b
Flush counter.

MCD
MII Clock Done. Defined as one period of the MII clock elapsed.

148.4.6.3 Functions

No functions are defined for the PLCA Data state machine.

148.4.6.4 Timers

For the definition of RECV_TIMER see 148.4.5.4.

Commented [PB33]: #649, #287: CRS usage
remove unused definitions

Commented [PB34]: #552: PLCA_XWORK
Add missing definitions

Commented [PB35]: NOTE for editors: harmonize format

COMMIT TIMER:

Defines the maximum time the PLCA Data state machine is allowed to stay in WAIT MAC state.

Duration: 192 bit times

Commented [PB36]: #553: PLCA_XWORK
Add COMMIT timer description

148.5 Protocol implementation conformance statement (PICS) proforma for Clause 148, PLCA Reconciliation Sublayer (RS)¹

148.5.1 Introduction

The supplier of a protocol implementation that is claimed to conform to Clause 148, PLCA Reconciliation Sublayer (RS), shall complete the following protocol implementation conformance statement (PICS) proforma.

A detailed description of the symbols used in the PICS proforma, along with instructions for completing the PICS proforma, can be found in [Clause 21](#).

148.5.2 Identification

148.5.2.1 Implementation identification

Supplier ¹	
Contact point for enquiries about the PICS ¹	
Implementation Name(s) and Version(s) ^{1,3}	
Other information necessary for full identification— e.g., name(s) and version(s) for machines and/or operating systems; System Name(s) ²	
NOTE 1—Required for all implementations. NOTE 2—May be completed as appropriate in meeting the requirements for the identification. NOTE 3—The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).	

148.5.2.1

148.5.2.2 Protocol summary

Identification of protocol standard	IEEE Std 802.3xx-201x, Clause 148, PLCA Reconciliation Sublayer (RS)
Identification of amendments and corrigenda to this PICS proforma that have been completed as part of this PICS	
Have any Exception items been required? No [] Yes [] (See Clause 21 ; the answer Yes means that the implementation does not conform to IEEE Std 802.3xx-201x.)	

¹Copyright release for PICS proformas: Users of this standard may freely reproduce the PICS proforma in this subclause so that it can be used for its intended purpose and may further publish the completed PICS.

Date of Statement	
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148.5.2.2

148.5.3 Major capabilities/options

Item	Feature	Subclause	Value/Comment	Status	Support
MII	MII RS	22		O	Yes [] No []
PHY	10BASE-T1S	146		M	Yes []
TSSI	TSSI capability	90		O	Yes [] No []

148.5.3

148.5.4 PICS proforma tables for PLCA Reconciliation Sublayer (RS)

148.5.4.1 Generic Reconciliation Sublayer

Item	Feature	Subclause	Value/Comment	Status	Support
GRS1	PLCA not supported or disabled by management interface	148.4.2	Conform to MII RS definition in Clause 22	MII: M	Yes []
GRS2	SFD detection of transmitted frames	148.4.2.1	Detected after the PLCA variable delay line when TSSI is supported	TSSI: M	Yes []

148.5.4.1

148.5.4.2 Mapping of MII signals to PLS service primitives and PLCA functions

Item	Feature	Subclause	Value/Comment	Status	Support
MAP1	Mapping of PLS_DATA.request when PLCA is disabled	148.4.3.1	Specified in 22.2.1.1	MII:M	Yes []

MAP2	Mapping of PLS_DATA.indication	148.4.3.2	Specified in 22.2.1.2	MII:M	Yes []
MAP3	Mapping of PLS_CARRIER.indication when PLCA is disabled	148.4.3.3	Specified in 22.2.1.3	MII:M	Yes []
MAP4	Mapping of PLS_SIGNAL.indication when PLCA is disabled	148.4.3.4	Specified in 22.2.1.4	MII:M	Yes []
MAP5	Mapping of PLS_DATA_VALID.indication	148.4.3.5	Specified in 22.2.1.7	MII:M	Yes []
MAP6	Generation of TX_ER	148.4.3.6	Specified in 22.2.1.6	MII:M	Yes []
MAP7	Response to RX_ER indication	148.4.3.7	Specified in 22.2.1.5	MII:M	Yes []

148.5.4.2

148.5.4.3 Specific RS and PHY specification

Item	Feature	Subclause	Value/Comment	Status	Support
PLCA1	Specific RS and PHY specifications that include PLCA capability	148.4.4		M	Yes []
PLCA	Reception of BEACON request	148.4.4.1.1	See 148.4.4.1.1	MII:M	Yes []
PLCA	Reception of COMMIT request	148.4.4.1.2	See 148.4.4.1.2	M	Yes []
PLCA	Early receive indication	148.4.4.1.3	See 148.4.4.1.3	Ø	Yes [] No []

Commented [PB37]: #649, #287: CRS usage
Remove ERI

PLCA	Indicate BEACON reception	148.4.4.2.1	Indicate this information to the RS by asserting MII signals	M	Yes []
PLCA	RS reaction to BEACON indication reception	148.4.4.2.1	See 148.4.4.2.1	M	Yes []
PLCA	Indicate COMMIT reception	148.4.4.2.2	Indicate this information to the RS by asserting MII signals	M	Yes []
PLCA	RS reaction to COMMIT indication reception	148.4.4.2.2	See 148.4.4.2.2	M	Yes []
PLCA	plea_ers	148.4.4.2.3	See 148-1	M	Yes []
PLCA	plea_eri	148.4.4.2.4	See 148-2	M	Yes []

Commented [PB38]: #649, #287: CRS usage remove unused definitions

148.5.4.3

148.5.4.4 PLCA Control

Item	Feature	Subclause	Value/Comment	Status	Support
CON1	PLCA Control function	148.4.5.1	See Figure 148-4	M	Yes []
CON2	plca_reset	148.4.5.2	Set to OFF for normal RS operation	M	Yes []
CON3	plca_en	148.4.5.2	RS operation as described in Clause 22 when set to OFF	M	Yes []
CON4	tx_cmd	148.4.5.2	See 148.4.5.2	M	Yes []

CON5	BEACON_TIMER	148.4.5.4	See 148.4.5.4	M	Yes []
CON6	RECV_TIMER	148.4.5.4	Greater than the PHY's total receive latency	M	Yes []
CON7	TO_TIMER	148.4.5.4	See 148.4.5.4	M	Yes []
CON8	RECV_BEACON_TIMER	148.4.5.4	Greater than or equal to TO_TIMER * MAX_ID + BEACON_TIMER	M	Yes []

148.5.4.4

148.5.4.5 PLCA Data

Item	Feature	Subclause	Value/Comment	Status	Support
DAT1	PLCA Data function	148.4.6.1	See Figure 148-6	M	Yes []