
IEEE 802.11
Wireless Access Method and Physical Specification

Title: **Proposed Revision to 94/068**
Section 3. - FHSS PLCP Sublayer

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Abstract

This submission contains a proposed revision of section 3 of the FH PHY working draft standard as represented by document 94/068. Every attempt was made to keep the proposed changes in this submission non-controversial. Note that even if this revision is adopted to replace section 3 of 94/068, it is still subject to detailed review and section-by-section voting by the FH PHY subgroup before presentation to the PHY group and the full 802.11 plenary. The changes fall into three categories:

- 1) Renumbering: The numbering of section 3.x is changed to 9.2.x consistent with the proposed outline modifications to 93/020 from the 802.11 editors and the proposed outline modification to 94/068.
- 2) Corrections
 - a) inconsistencies in primitive names and their usage in the state machines, timing diagrams, and related text relative to the primitive definitions in sections 2.x and 4.x.
 - b) inconsistencies between state machines, timing diagrams, and related text.
 - c) minor text errors.
- 3) Additions
 - a) definition of PLCP header including PLCP Signaling Field, PLCP_PDU Length Word, and Header Error Check.
 - c) clarification of insufficiently defined concepts and procedures.

Additions are identified by underlines; deletions by strike-thrus. Paragraph numbering changes are not marked. All other corrections are presented by a combination of deletions and additions.

9.2. FHSS Physical Layer Convergence Procedure Sublayer

9.2.1 Introduction. This section provides a convergence procedure ~~in which the~~ to map MAC PDUs ~~are mapped~~ into a framing frame format designed for FHSS radio transceivers. ~~The physical layer convergence procedure describes in how MPDUs are~~ The procedures for transmission, carrier sense, and reception are defined for both single and dual antenna diversity radios. The procedures for radios with more than two antennas are not explicitly defined but must adhere to the same constraints as the dual antenna model.

9.2.2 Physical Layer Convergence Procedure Frame Format. ~~Doc 2xx~~ The PLCP Frame Format provides for the asynchronous transfer of MAC Layer MPDU from any transmitting node to all receiving nodes within the wireless LAN. The PLCP frame format illustrated in Figure 9.2-1 consists of three parts: a PLCP Preamble, a PLCP Header, and a PLCP PDU. The PLCP Preamble provides a period of time for several receiver functions. These functions include antenna diversity, clock and data recovery and data delineation of the PLCP Header and the PLCP PDU. The PLCP Header is used to specify the length of the MPDU field and support any PLCP management information. The PLCP PDU contains the MPDU data modified by the MPDU data whitener.

~~3.3 PLCP Field Definitions~~ The PLCP packet illustrated in Figure 3-1 contains three distinct fields: PLCP Preamble, PLCP Header, and the MPDU PLCP_PDU.

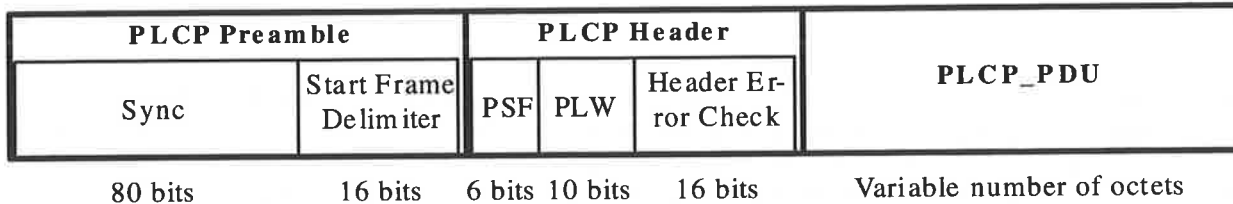


Figure 9.2-1. PLCP Frame Format

9.2.2.1 PLCP Preamble. The PLCP preamble contains two separate sub-fields; the sync field and the start frame delimiter (SFD), to allow the PHY circuitry to reach steady state demodulation and synchronization of bit clock and frame ~~epoch~~ start.

9.2.2.1.1 Sync Field. The preamble sync field is a 10-octet field containing an alternating zero-one pattern, starting with zero, to be used by the PHY sub-layer to detect a signal to receive, select an antenna if diversity is utilized, and to reach steady-state frequency offset correction and synchronization with the received packet timing.

9.2.2.1.2 Start Frame Delimiter. The start frame delimiter (SFD) consists of the 16-bit word 09AFh. The MSB of the start frame delimiter pattern follows the last bit of the sync pattern and indicates the start of the MPDU. The first bit following the frame field start frame delimiter is the first bit included in the scrambling. The start frame delimiter defines the frame timing.

9.2.2.2 PLCP Header Field Format. The PLCP Header field contains three separate sub-fields: a ~~TBD MPDU length word, a TBD PLCP signaling field, and a TBD PLCP header error~~

check/correction field a 6-bit PLCP Signaling Field (PSF), a 10-bit PLCP PDU Length Word (PLW), and a 16-bit PLCP Header Error Check (HEC) field.

3.3.2.1 PLCP Header. The MPDU length word is used by the receiving terminal to determine the last bit in the packet. The length is passed down from the MAC as a parameter within the PHY_DATA.request primitive. The length represents the TBD (octet/16-bit word) count of the MPDU packet including the HEC check field.

9.2.2.2.21 PLCP Signaling Field. The 6-bit PLCP Signaling Field (PSF) is TBD bits and indicates TBD defined in Table 9.2-1. The PSF is transmitted MSB first (bit 5) and LSB (bit 0) last.

Bit	Parameter Name	Parameter Values	Description
5	Reserved	Reserved	Reserved
4	Reserved	Reserved	Reserved
3	Reserved	Reserved	Reserved
2	Reserved	Reserved	Reserved
1	Reserved	Reserved	Reserved
0	Reserved	Reserved	Reserved

Table 9.2-1. PLCP Signaling Field Bit Descriptions

9.2.2.2.2 PLCP PDU Length Word. The PLCP PDU Length Word (PLW) is passed down from the MAC as a parameter within the PHY_DATA.request primitive in the transmitting terminal. The PLW represents the number of octets contained in the MPDU packet. Its valid states are 000h - 3FFh, representing counts of zero to 1023 bytes. The PLW is transmitted MSB first and LSB last. The PLW is used by the receiving terminal to determine the last bit in the packet.

9.2.2.2.3 PLCP Header Error Check Field. The PLCP header error check field is a 16-bit field generated by TBD method. The Header Error Check (HEC) field is a 16-bit BCH type error detection and correction field. The primitive polynomial F(x) used for the BCH calculation is as follows.

$$F(x) = x^{16} + x^{14} + x^{13} + x^{11} + x^{10} + x^9 + x^8 + x^6 + x^5 + x + 1$$

At the transmitter, the polynomial is seeded to FFFFh prior to beginning the calculation. The 16-bit remainder after performing the BCH calculation is inverted and placed in the HEC field MSB first to LSB last. At the receiver, the polynomial again is seeded to FFFFh prior to beginning the calculation. The BCH calculation is then performed on the received PLCP Header including the HEC field. If the remainder of this calculation is identically 9B6Bh, no errors were detected in the B PDU HDR. If the remainder is not 9B6Bh, an error exists. In the case of an error, the value in the remainder can be used to identify the bits that are erred for optional error correction. The 16-bit CRC for the PLCP Header can detect up to 6 random bit errors, all burst errors of length 16 or less, and all double bursts of length up to 7; other errors are not detected with probability 2^{-16} .

9.2.2.3 PLCP_PDU MPDU Data Whitener. TBD scrambling/stuffing is used to randomize the data from highly redundant patterns and to minimize the data DC bias and maximum run lengths. The scrambling/stuffing starts with the first bit of the PLCP PDU which follows the last bit of the PLCP Header. The specific method used is TBD.

9.2.3 PLCP Transmit Procedure. The PLCP transmit procedure is executed immediately upon receiving a PHY_DATA.request from the MAC layer. The CSMA/CA protocol is performed by the MAC with the PHY PLCP in the carrier sense mode.

9.2.3.1 Transmit State Machine. The PLCP transmit procedure illustrated in Figure 9.2-2 includes functions that must be performed prior to, during, and after MPDU data transmission. Before transmitting the first MPDU data bit, the PLCP shall send a PHY_TXBUSY.indicate (STATUS=busy) message to the MAC; switch the PHY PMD circuitry from receive to transmit state; turn ramp on the transmit power amplifier in the manner prescribed in Section 4 (PMD specification); and transmit the preamble sync pattern and start frame delimiter, and PLCP header. The PLCP shall generate the PLCP header as defined in Section 9.2.2.2 (PLCP Header) in sufficient time to send the bits at their designated bit slot time. The PLCP shall add the PLCP header to the start of the PLCP_PDU data. During transmission of the MPDU PLCP_PDU data, each bit of the MPDU passed down from the MAC shall be processed by the TBD scrambling/stuffing operation and a counter shall be maintained to indicate the last bit of the MPDU. The PLCP_PDU data bytes are processed and transmitted MSB first and LSB last. After the last bit of the MPDU is sent PLCP_PDU data has completed propagation through the radio and been transmitted onto the air, the PLCP shall ramp turn off the power amplifier in the manner prescribed in the PMD section and send a PHY_TXBUSY.indicate(STATUS=idle) message to the MAC layer.

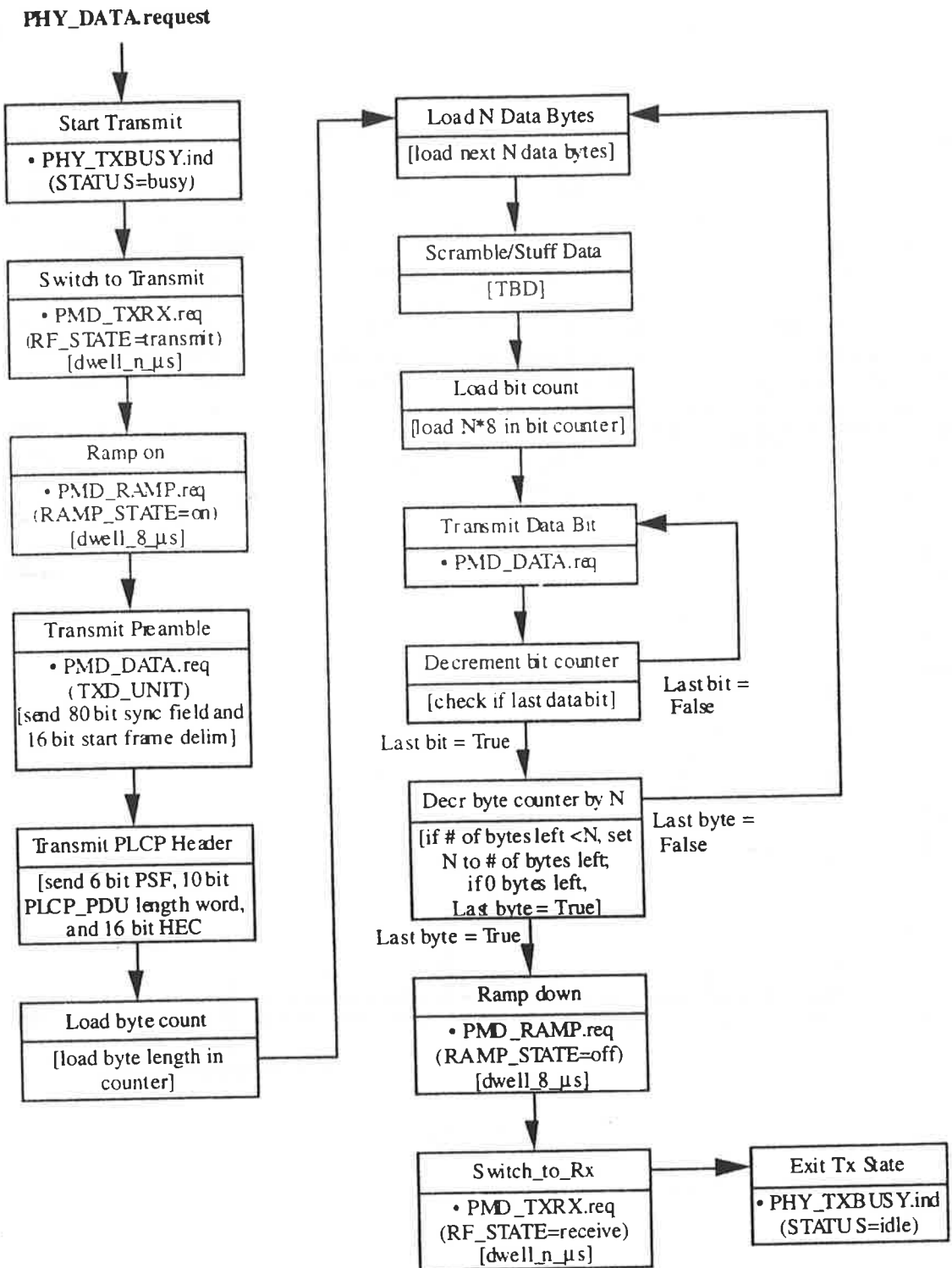


Figure 9.2-2 Transmit State Machine

9.2.3.2 Transmit State Timing. The transmit timing illustrated in Figure 9.2-3 is defined from the instant that the PHY_DATA.request is received from the MAC layer. The PLCP shall send a PHY_TXBUSY.indicate (STATUS=busy) message to the MAC within 1 μ s of receipt of the PHY_DATA.request. The PMD circuitry shall be switched from receive to transmit and settled within TBD μ s. The power amplifier shall be turned on and settled within the specified range about the final transmit power level 8 μ s after the receive to transmit switch time. The PLCP preamble shall be transmitted at 1 Mbps and be completed within 96 μ s. The scrambling/stuffing algorithm shall be enabled with the first bit following the preamble start frame delimiter. The PLCP header shall be transmitted at 1 Mbps and be completed within ~~TBD~~ bit times 32 μ s. The variable length MPDU PLCP PDU shall be transmitted at the selected data rate. Each byte of the MPDU data shall be sent with the most significant bit of each byte first and the least significant bit last. After the last bit of the MPDU PLCP PDU data has been transmitted completed propagation through the radio and been transmitted onto the air, the PLCP shall turn off the power amplifier and be less than the specified off-mode transmit power in 8 μ s. At the end of the power amplifier ramp down period, the PLCP shall send a PHY_TXBUSY.indicate(STATUS=idle) message to the MAC layer and switch the PMD circuitry from transmit to receive. Upon completion of the transmit procedure, the PLCP shall return to the PLCP carrier sense procedure.

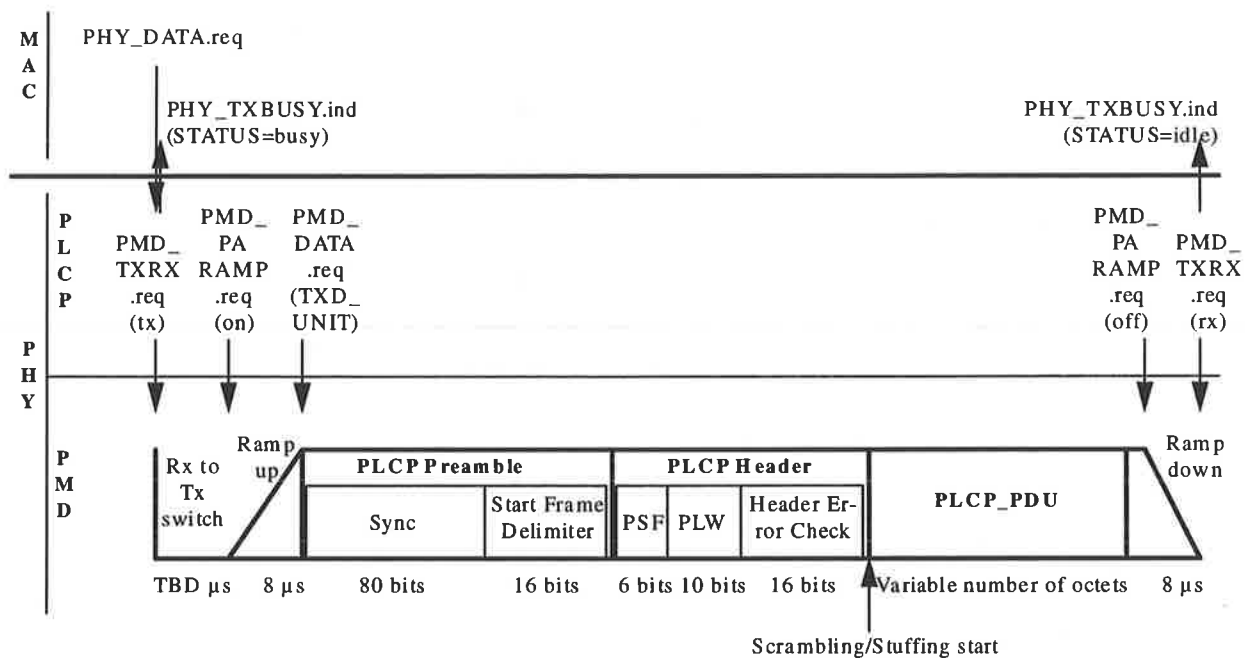


Figure 9.2-3 Transmit State Timing

9.2.4 Carrier Sense Procedure.

9.2.4.1 Carrier Sense With Diversity.

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9.2.4.1.1 Carrier Sense With Diversity State Machine.

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Figure 9.2-4 Carrier Sense with Diversity State Machine

9.2.4.1.2 Carrier Sense With Diversity State Timing.

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Figure 9.2-5 Carrier Sense with Diversity State Timing

9.2.4.2 Carrier Sense Without Diversity.

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9.2.4.2.1 Carrier Sense Without Diversity State Machine

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Figure 9.2-6 Carrier Sense without Diversity State Machine

9.2.4.2.2 Carrier Sense Without Diversity State Timing

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Figure 9.2-7 Carrier Sense without Diversity State Timing

9.2.5 PLCP Receive Procedure. The PLCP receive procedure is invoked by the PHY PLCP carrier sense procedure upon detecting a portion of a preamble followed by the start frame delimiter.

9.2.5.1 Receive State Machine. The PLCP receive procedure shown in Figure 9.2-8 includes functions that must be performed while receiving the PLCP header and the MPDU PLCP PDU data. The PLCP receive procedure begins upon detection of a complete start frame delimiter in the carrier sense procedure. The PLCP shall read in the 32-bit PLCP header and perform an error check using the header error check field. Immediately upon detection of a valid start frame delimiter, start of the PLCP receive procedure the PLCP shall send a PHY_RXBUSY.indicate(STATUS=busy) message to the MAC layer. ~~While receiving the PLCP header, the PLCP shall read the TBD length word, TBD PHY signaling field, and TBD FEC field, and perform a TBD error check/correction.~~ If the PLCP header is free or corrected of errors, the PLCP shall set a PLCP PDU byte/bit counter to indicate the last bit of the packet, receive the MPDU PLCP PDU data bits and perform the TBD descrambling/ unstuffing procedure on each MPDU PLCP PDU bit. After the last MPDU PLCP PDU bit is received, the PLCP shall send a PHY_DATA.indicate(length, data) message and a PHY_RXBUSY.indicate(STATUS=idle) message to the MAC layer. Upon completion of

receiving a packet, the PLCP shall exit the receive procedure and return to the PLCP carrier sense procedure.

If the PLCP header contains uncorrectable errors, the PLCP shall immediately set the byte/bit counter to zero, complete the receive procedure with a PHY DATA.indicate(LENGTH = 0, DATA=0, ERROR TYPE = header error check violation) and a PHY RXBUSY.indicate (STATUS=idle) to the MAC, and return to the carrier sense procedure. ~~send a PHY_RXERROR.indicate message to the MAC layer and exit the receive procedure.~~ If any other error was detected during the reception of the packet, the PLCP shall include the error type parameter in the PHY DATA.indicate message at the normal termination time as determined by the PLCP PDU byte/bit counter.

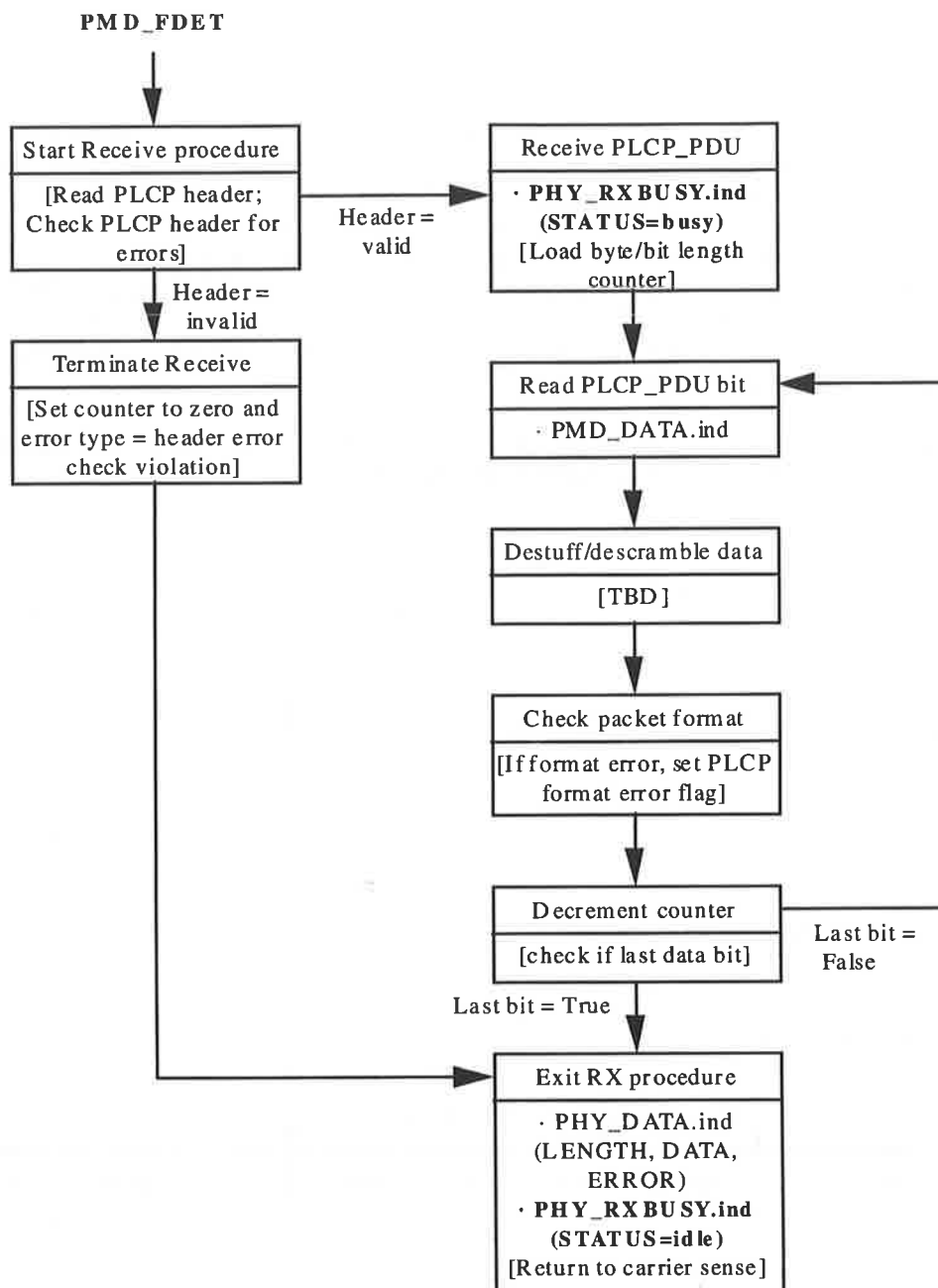


Figure 9.2-84 Receive State Machine

9.2.5.2 Receive State Timing. The receive state timing shown in Figure 9.2-9 is defined at the end of the last bit of the to begin upon detection of a complete start frame delimiter in the carrier sense procedure when the PMD_FDET is generated. The PLCP shall read in the PLCP header and generate a PHY_RXBUSY.indicate message to the MAC layer within 1 μs of receiving the last bit of a valid PLCP header. The PLCP shall read in the TBD_MPDU length indicator and TBD_PHY signaling field of the PLCP header and calculate and preload the byte/bit count in the counter within TBD 8 μs of the last bit of a valid PLCP header the length indicator. The PLCP shall read in the TBD header error check field and perform the check within TBD μs of the last bit of the error check field. The PLCP shall begin receiving the variable length MPDU PLCP PDU immediately after the end of the last bit of the PLCP header. The PLCP shall send the PHY_RXBUSY.indicate (STATUS=idle) and PHY_DATA.indicate messages within 1 μs of receiving the last PLCP PDU data bit.

If there was an uncorrectable error in the PLCP header, the PLCP shall terminate the receive procedure within 8 μs of the start of the MPDU PLCP PDU.

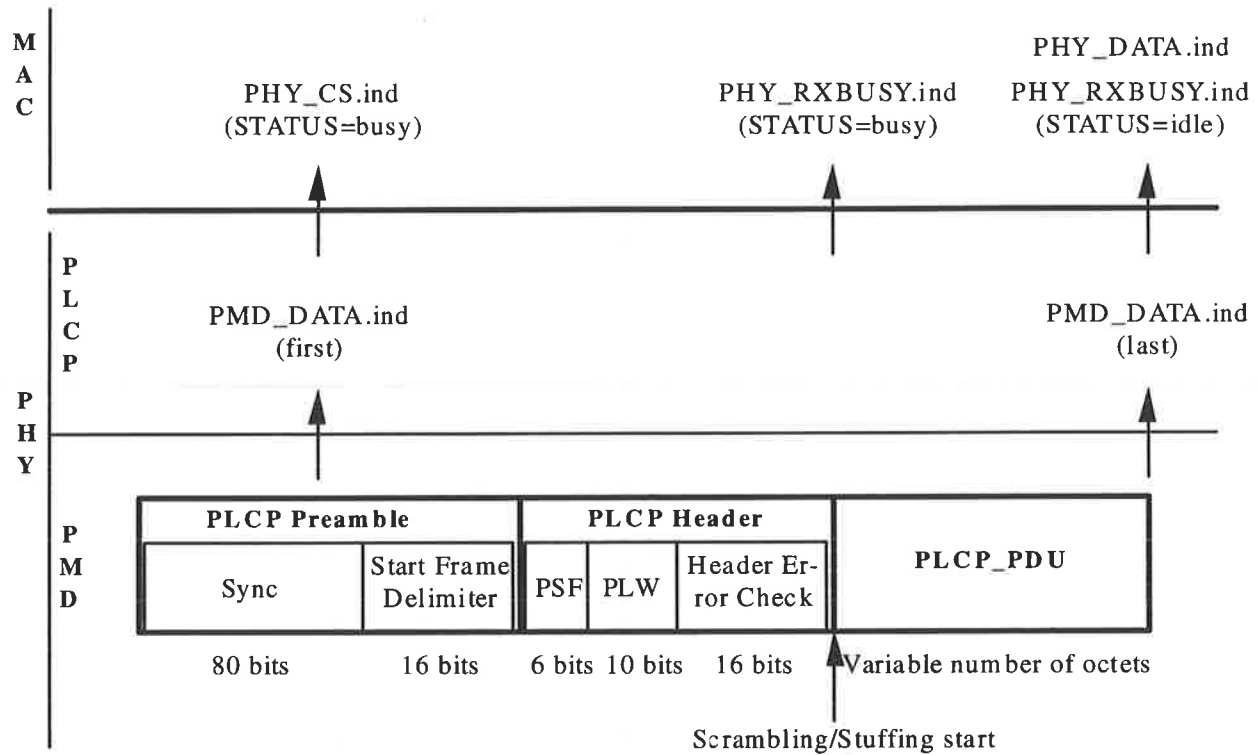


Figure 9.2-95 Receive Timing

Motion: I move to replace section 3.x (FHSS PLCP Sub-layer) of the FH PHY working draft document as documented in submission 94/068 with the contents in this submission 94/103.

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