45 Management Data Input/Output (MDIO) Interface

Need to make reference to registers in 97.6.3 or alternatively put them in Clause 45.

97 Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer, Physical Medium Dependent (PMD) sublayer, and baseband medium, type 1000BASE-T1

97.6 Operations, Administration, and Maintenance (OAM)

The 1000BASE-T1 PCS level Operations, Administration, and Maintenance (OAM) provides an optional mechanisms useful for monitoring link operation such as exchanging PHY link health status and message exchange. The OAM information is exchanged in-band between two PHYs without using any of the normal data bandwidth. The OAM is strictly between two 1000BASE-T1 PHYs on the physical layer. Passing OAM information to other layers is outside the scope of this standard.

OAM is operational as long as both PHYs implement this mechanism and link is up. It continues to be operational during low power idle albeit the information is transferred at a slower rate during the refresh cycle.

The 1000BASE-T1 RS frame has a 9-bit reserved field as described in clause 97.3.2.2.11. This 9-bit is used to exchange OAM frames. The implementation of OAM frame exchange function is optional. However, if 1000BASE-T1 EEE is implemented, then the OAM frame exchange function must be implemented to exchange at minimum the link partner health status.

For the remainder of this sub clause, the term OAM is specific to the 1000BASE-T1 PCS level OAM.

97.6.1 Definitions

OAM frame – A frame consisting of 12 byte of data with 12 parity bits

OAM symbol – A 9-bit symbol consisting of one data byte plus a parity bit. 12 OAM symbols makes up an OAM frame.

OAM field – The 9-bit reserved field in each RS frame as described in clause 97.3.2.2.11 or in each refresh cycle as described in clause TBD (need to insert into EEE section).

OAM message – A message contains a 4 bit message number plus 8 bytes of message data embedded in an OAM frame. The same OAM message can be repeated on multiple OAM frames.

97.6.2 Functional specifications

97.6.2.1 OAM Frame Structure

Each OAM frame is made up of 12 bytes of data and 12 parity bits. Each symbol consists of 8 bits of data and one parity bit. The parity bit value for symbol 0 should be such that the sum of the number of 1s in the nine bits is even. The parity bit value for symbols 1 to 11 should be such that the sum of the number of 1s in the nine bits is odd.

One OAM frame symbol is placed in the 9-bit OAM field in each RS frame during normal operation. One OAM frame symbol is placed in the 9-bit OAM field in each refresh cycle during low power idle. The 12 OAM frame symbols are consecutively inserted into 12 consecutive RS frames and/or refresh cycles. Once the 12 symbols of the current OAM frame are inserted, the 12 symbols of the next OAM frame are inserted. This process is continuous without any break in the insertion of OAM frame symbols.

Bit 0 of each OAM frame symbol is the first bit transmitted in the 9-bit OAM field. Symbol 0 is the first symbol transmitted in each OAM frame.

The OAM frame boundary can be found at the receiver by determining the symbol parity. Symbol 0 has even parity while all other symbols have odd parity.

If OAM is not implemented then the 9-bit OAM field shall be set to all 0s. If the link partner does not implement OAM, the 9-bit OAM field will remain static and the symbol parity will not change.

	D8	D7	D6	D5	D4	D3	D2	D1	D0
Symbol 0	Even Parity	Reserved	Reserved	Reserved	Reserved	PingRx	PingTx	SNR<1>	SNR<0>
Symbol 1	Odd Parity	Valid	Toggle	Ack	TogAck	Message_Number<3:0>			
Symbol 2	Odd Parity	Message<0><7:0>							
Symbol 3	Odd Parity	Message<1><7:0>							
Symbol 4	Odd Parity	Message<2><7:0>							
Symbol 5	Odd Parity	Message<3><7:0>							
Symbol 6	Odd Parity	Message<4><7:0>							
Symbol 7	Odd Parity	Message<5><7:0>							
Symbol 8	Odd Parity	Message<6><7:0>							
Symbol 9	Odd Parity	Message<7><7:0>							
Symbol 10	Odd Parity	CRC16 First bit							
Symbol 11	Odd Parity	Final bit CRC16							

Figure 97-X – OAM Frame

97.6.2.2 OAM Frame Data

The OAM frame data is shown in Figure 97-X. OAM<x><y> refers to symbol x, bit y of the frame. Reserved fields shall be set to 0.

97.6.2.2.1 Ping RX

The Ping RX is indicated in OAM<0><3>.
This bit is set by the PHY to the same value as the Ping TX bit received from the link partner.

97.6.2.2.2 Ping TX

The Ping TX is indicated in OAM<0><2>.
This bit is set by the PHY to for the link partner to echo on Ping RX.

97.6.2.2.3 PHY Health

The PHY Health (SNR<1:0>) is indicated in OAM<0><1:0>.
This status is set by the PHY to indicate the status of the receiver. The definitions of good, marginal, when to request idles, and when to request retrain are implementation dependent.

00 – PHY link is dying and will drop link and re-link within 2 to 4 ms after the end of the current OAM frame.
01 – LPI refresh insufficient for maintain PHY SNR. Request link partner to exit LPI and send idles (used only when EEE is enabled).
10 – PHY SNR is marginal.
11 – PHY SNR is good.

97.6.2.2.4 OAM Message Valid

The OAM message valid (Valid) is indicated in OAM<1><7>.

0 – Current OAM frame does not contain a valid OAM message.
1 – Current OAM frame contains a valid OAM message.

97.6.2.2.5 OAM Message Toggle

The OAM message toggle (Toggle) is indicated in OAM<1><6>.
The toggle bit is used to ensure proper OAM message synchronization between the PHY and the link partner. The toggle bit in the current OAM message is set to the opposite value of the toggle bit in the previously OAM message only if link partner acknowledge the OAM message is received. This allows one OAM message to be delineated from a second OAM message since the same OAM message may be repeated over multiple OAM frame. This bit is valid only if Valid is set to 1.

97.6.2.2.6 OAM Message Acknowledge

The OAM message Acknowledge (Ack) is indicated in OAM<1><5>.
Ack is set by the PHY to let the link partner know that the OAM message sent by the link partner is successfully received as defined in clause 97.6.2.3 and the PHY is ready to accept a new OAM message. An OAM message is defined to be Message_Number<3:0> and Message<7:0><7:0>.

0 – No Acknowledge
1 – Acknowledge

97.6.2.2.7 OAM Message Toggle Acknowledge

The OAM message Toggle Acknowledge (TogAck) is indicated in OAM<1><4>.
TogAck is set by the PHY to let the link partner know which the OAM message is being acknowledged. TogAck takes the value of Toggle bit of the OAM message being acknowledged. This bit is valid only if Ack is set to 1.

97.6.2.2.8 OAM Message Number

The OAM message number is indicated in OAM<1><3:0>.
This field is user defined but is recommended that it be used to indicate the meaning of the 8 byte message that follows. If used this way, up to 16 different 8 byte messages can be exchanged.

The message number is user defined and its definition is outside the scope of this standard.

97.6.2.2.9 OAM Message Data

The OAM message data is indicated in OAM<9:2><7:0>.
The 8 byte message data is user defined and its definition is outside the scope of this standard.

Ack is set by the PHY to let the link partner know that the OAM frame sent by the link partner is successfully received as defined
The OAM frame byte is the lower 8 bits of the 9-bit OAM symbol. Twelve bytes form the OAM data. The first 10 bytes

97.6.2.2.10 CRC 16

The CRC16 is indicated in OAM<11:10><7:0>.
The CRC16 implements the polynomial $(x+1)(x^{15}+x+1)$ of the previous 10 bytes. The CRC16 shall produce the same result as the implementation shown in Figure 97-Y. The 16 delay elements S0,..., S15, shall be initialized to zero. Afterwards OEM<9:0><7:0> presented in their transmitted order as described in clause 97.6.2.1 are used to compute the CRC16 with the switch connected, which is setting CRC gen in Figure 97-Y. Note that the parity bit is not used in the CRC16 calculation. After all the 10 bytes have been processed, the switch is disconnected (setting CRC out) and the 16 values stored in the delay elements are transmitted in the order illustrated, first S15, followed by S14, and so on, until the final value S0. S15 is indicated in OAM<10><0> and S0 is indicated in OAM<11><7>.

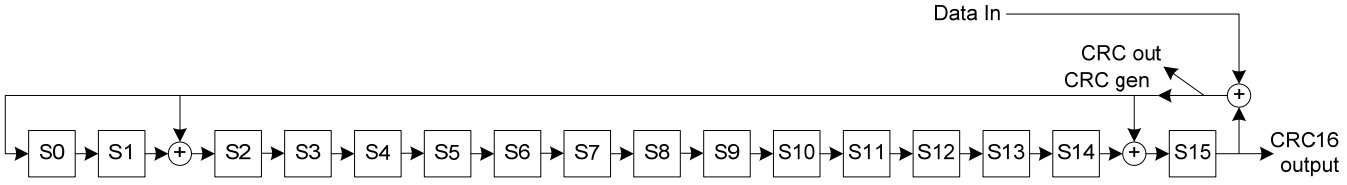

Figure 97-Y – OAM CRC 16

97.6.2.3 OAM Frame Acceptance Criteria

All fields of the OAM frame shall be rejected and the OAM frame ignored if any of the following occurs.
1) Incorrect parity on any of the 12 symbols
2) Incorrect CRC16
3) Uncorrectable RS frame on any of the 12 symbols.

Otherwise all fields shall be accepted.

The fields shall retain their value and not updated when a rejected OAM frame is received.

97.6.2.4 PHY Health Indicator

The PHY current health is sent to the link partner on a per OAM frame basis using the SNR<1:0> bits as described in clause 97.6.2.2.1. It lets the link partner have an early indication of potential problems that may cause the PHY to drop link or have high error rates.

If EEE is implemented there may be a case where a PHY's receiver can no longer keep good SNR based on quiet/refresh cycles. Instead of dropping link, the PHY can attempt to recover by forcing the link partner to exit LPI in its egress direction so that the PHY can receive normal activity to recover. This is done by transmitting SNR<1:0> with a value of 01.

If a PHY receives SNR<1:0> set to 01 by its link partner, then it cannot enter into LPI in the egress direction. If the PHY is already in LPI then the PHY must immediately exit LPI. The rules of exiting and entering LPI are discussed in clause TBD.

97.6.2.5 Ping

The PingTx bit is set based on the value in mr_tx_ping. The PingRx bit is set based on the latest PingTx received from the link partner. The value in rm_rx_ping is set based on the received PingRx from the link partner. The user can determine that the link partner OAM is operating properly by togging mr_tx_ping and observing mr_rx_ping matches after a short delay.

The Ping bits are updated on a per OAM frame basis.

97.6.2.6 OAM Message Exchange

Unlike the PHY health indicator and the ping function which operates on a per OAM frame basis, the OAM message exchange operates on a per OAM message basis which will occur over many OAM frames. The OAM message exchange mechanism allows a management entity attached to a PHY and its peer attached to the link partner to asynchronously pass OAM messages and verify its delivery.

The OAM message is first written into the OAM transmit registers in the PHY. The OAM message is then read out of the OAM transmit registers atomically and transmitted to the link partner. After the link partner receives the OAM message it transfers it into the link partner's OAM receive registers and also sends an acknowledge back to the PHY indicating that the next OAM message can be transmitted. One OAM message can be loaded into the OAM transmit registers while another OAM message is being transmitted by the PHY to the link partner while yet another OAM message is being read out at the link partner's OAM receive registers. The exchange of OAM messages are occurring concurrently and bi-directionally.

The transfers between the management entities can be done asynchronously. On the transmit side mr_tx_valid = 0 indicates that the next OAM message can be written into the OAM transmit registers. Once the registers are written the management entity sets mr_tx_valid to 1 to indicate that the OAM transmit registers contains a valid OAM message. Once the message is read out atomically, the state machine clears the mr_tx_valid to 0 to indicate that the registers are ready to accept the next OAM message.

On the receive side mr_rx_lp_valid indicates that valid OAM message can be read from the OAM receive registers. Once these registers are read, the mr_rx_lp_valid should be cleared to 0 to indicate that the registers are ready to receive the next OAM message. If mr_rx_lp_valid is not cleared then the OAM message transfer will eventually stall since the sender cannot send new OAM messages if the receiver does not acknowledge that a OAM message has been transferred into the OAM receive registers.

The management entities can asynchronously read mr_tx_valid and mr_rx_lp_valid to know when OAM messages can be transferred in and out of the OAM registers.

The toggle bit alternates between 0 and 1 which lets the management entity determine which OAM message is being referred to. The toggle bit transitioning rules between one OAM frame to the next OAM frame are shown in Table 97-X.

Table 97-X – Toggle Bit Transition Rules

Previous Valid	Previous Toggle	Current Valid	Current Toggle	Description
0	0	0	0	No valid OAM message
0	0	0	1	Illegal transition (Error)
0	0	1	0	New OAM message starting
0	0	1	1	Illegal transition (Error)
0	1	0	0	Illegal transition (Error)
0	1	0	1	No valid OAM message
0	1	1	0	Illegal transition (Error)
0	1	1	1	New OAM message starting
1	0	0	0	Illegal transition (Error)
1	0	0	1	Received acknowledge, no new OAM message to send
1	0	1	0	Repeating current OAM message, waiting for link partner's acknowledge
1	0	1	1	Previous OAM message ending, new OAM message starting
1	1	0	0	Received acknowledge, no new OAM message to send
1	1	0	1	Illegal transition (Error)
1	1	1	0	Previous OAM message ending, new OAM message starting
1	1	1	1	Repeating current OAM message, waiting for link partner's acknowledge

97.6.3 OAM Register Requirements

The management interface is used to communicate OAM information to the management entity.MMD3 of the Clause 45 Management Data Input/Output(MDIO) interface shall be provided as the logical interface to access the device registers for OAM and other management purposes. The Clause 45 MDIO electrical interface is optional. Where no physical embodiment of the MDIO exists, provision of an equivalent mechanism to access the registers is recommended. Table 97-–Y provides the mapping of state diagram variables to management registers.

Table 97-Y – State Variables to OAM Register Mapping

State diagram variable	Name	Register mapping
mr_tx_valid	OAM Message Valid	3.TBD0.15
mr_tx_toggle	Toggle Value	3.TBD0.14
mr_tx_received	OAM Message Received	3.TBD0.13
mr_tx_received_toggle	Received Message Toggle Value	3.TBD0.12
mr_tx_message_num[3:0]	Message Number	3.TBD0.11:8
mr_rx_ping	Ping Received	3.TBD0.3
mr_tx_ping	Ping Transmit	3.TBD0.2
mr_tx_SNR[1:0]	Local SNR	3.TBD0.1:0
mr_tx_message[7:0]	OAM Message 0	3.TBD1.7:0
mr_tx_message[15:8]	OAM Message 1	3.TBD1.15:8
mr_tx_message[23:16]	OAM Message 2	3.TBD2.7:0
mr_tx_message[31:24]	OAM Message 3	3.TBD2.15:8
mr_tx_message[39:32]	OAM Message 4	3.TBD3.7:0
mr_tx_message[47:40]	OAM Message 5	3.TBD3.15:8
mr_tx_message[55:48]	OAM Message 6	3.TBD4.7:0
mr_tx_message[63:56]	OAM Message 7	3.TBD4.15:8
mr_rx_lp_valid	Link Partner OAM Message Valid	3.TBD5.15
mr_rx_lp_toggle	Link Partner Toggle Value	3.TBD5.14
mr_rx_lp_message_num[3:0]	Link Partner Message Number	3.TBD5.11:8
mr_rx_lp_SNR[1:0]	Link Partner SNR	3.TBD5.1:0
mr_rx_lp_message[7:0]	Link Partner OAM Message 0	3.TBD6.7:0
mr_rx_lp_message[15:8]	Link Partner OAM Message 1	3.TBD6.15:8
mr_rx_lp_message[23:16]	Link Partner OAM Message 2	3.TBD7.7:0
mr_rx_lp_message[31:24]	Link Partner OAM Message 3	3.TBD7.15:8
mr_rx_lp_message[39:32]	Link Partner OAM Message 4	3.TBD8.7:0
mr_rx_lp_message[47:40]	Link Partner OAM Message 5	3.TBD8.15:8
mr_rx_lp_message[55:48]	Link Partner OAM Message 6	3.TBD9.7:0
mr_rx_lp_message[63:56]	Link Partner OAM Message 7	3.TBD9.15:8

97.6.3.1 OAM Transmit Register

Table 97-A – OAM Transmit Register

Bit(s)	Name	Description	R/W
3.TBD0.15	OAM Message Valid	Used to indicate message data in registers 3.TBD0.11:8, 3.TBD1, 3.TBD2, 3.TBD3, and 3.TBD4 are valid and ready to be atomically loaded. This bit shall self clear when registers are atomically loadedby the state machine. 1 = Message data in registers are valid 0 = Message data in registers are not valid	R/W, SC
3.TBD0.14	Toggle Value	Toggle value to be transmitted with message. This bit is set by the state machine and cannot be overridden by the user.	RO
3.TBD0.13	OAM Message Received	1 = OAM message reveived by link partner 0 = OAM message not received by link partner	RO
3.TBD0.12	Received Message Toggle Value	Toggle value of message that was received by link partner as indicated in 3.TBD0.13.	RO
3.TBD0.11:8	Message Number	User defined message number to send	R/W
3.TBD0.7:4	Reserved	Set to 0s	R/W
3.TBD0.3	Ping Received	Received PingTx value from latest good OAM frame received	RO
3.TBD0.2	Ping Transmit	Ping value to send to link partner	R/W
3.TBD0.1:0	Local SNR	00 – PHY link is dying and will drop link and re-link within 2 to 4 ms after the end of the current OAM frame. 01 – LPI refresh insufficient for maintain PHY SNR. Request link partner to exit LPI and send idles (used only when EEE is enabled). 10 – PHY SNR is marginal. 11 – PHY SNR is good.	RO

Editors Note: Need to add some subsection text to describe the registers

97.6.3.2 OAM Message Registers

Table 97-B – OAM Message Register

Bit(s)	Name	Description	R/W
3.TBD1.15:8	OAM Message 1	Message byte 1. LSB transmitted first.	R/W
3.TBD1.7:0	OAM Message 0	Message byte 0. LSB transmitted first.	R/W
3.TBD2.15:8	OAM Message 3	Message byte 3. LSB transmitted first.	R/W
3.TBD2.7:0	OAM Message 2	Message byte 2. LSB transmitted first.	R/W
3.TBD3.15:8	OAM Message 5	Message byte 5. LSB transmitted first.	R/W
3.TBD3.7:0	OAM Message 4	Message byte 4. LSB transmitted first.	R/W
3.TBD4.15:8	OAM Message 7	Message byte 7. LSB transmitted first.	R/W
3.TBD4.7:0	OAM Message 6	Message byte 6. LSB transmitted first.	R/W

Editors Note: Need to add some subsection text to describe the registers

97.6.3.3 OAM Receive Register

Table 97-C – OAM Receive Register

Bit(s)	Name	Description	R/W
3.TBD5.15	Link Partner OAM Message Valid	Used to indicate message data in registers 3.TBD5.11:8, 3.TBD6, 3.TBD7, 3.TBD8, and 3.TBD9 are valid and ready to be atomically loaded. This bit shall self clear when registers 3.TBD9 is read. 1 = Message data in registers are valid 0 = Message data in registers are not valid	RO, SC
3.TBD5.14	Link Partner Toggle Value	Toggle value received with message.	RO
3.TBD5.13:12	Reserved	Reserved - 0s	RO
3.TBD5.11:8	Link Partner Message Number	Message number from link partner	RO
3.TBD5.7:2	Reserved	Reserved - 0s	RO
3.TBD5.1:0	Link Partner SNR	00 – PHY link is dying and will drop link and re-link within 2 to 4 ms after the end of the current OAM frame. 01 – LPI refresh insufficient for maintain PHY SNR. Request link partner to exit LPI and send idles (used only when EEE is enabled). 10 – PHY SNR is marginal. 11 – PHY SNR is good.	RO

Editors Note: Need to add some subsection text to describe the registers

97.6.3.4 Link Partner OAM Message Registers

Table 97-D – Link Partner OAM Message Register

Bit(s)	Name	Description	R/W
3.TBD6.15:8	Link Partner OAM Message 1	Message byte 1. LSB transmitted first.	RO
3.TBD6.7:0	Link Partner OAM Message 0	Message byte 0. LSB transmitted first.	RO
3.TBD7.15:8	Link Partner OAM Message 3	Message byte 3. LSB transmitted first.	RO
3.TBD7.7:0	Link Partner OAM Message 2	Message byte 2. LSB transmitted first.	RO
3.TBD8.15:8	Link Partner OAM Message 5	Message byte 5. LSB transmitted first.	RO
3.TBD8.7:0	Link Partner OAM Message 4	Message byte 4. LSB transmitted first.	RO
3.TBD9.15:8	Link Partner OAM Message 7	Message byte 7. LSB transmitted first.	RO
3.TBD9.7:0	Link Partner OAM Message 6	Message byte 6. LSB transmitted first.	RO

Editors Note: Need to add some subsection text to describe the registers

97.6.4 Detailed functions and State Diagrams

97.6.4.1 State Diagram Variables

Editors Note: The variables listed below are the obvious ones. More will be added when we flesh out the state machine

link_status
Status of the underlying medium.

Values: FAIL – Underlying receive channel is not intact.
OK – Underlying receive channel is intact and enabled.

mr_rx_lp_message[63:0]
Eight byte OAM message from the link partner. The value in this variable is valid only when mr_rx_lp_valid is 1.

mr_rx_lp_message_num[3:0]
Four bit message number from the link partner. The value in this variable is valid only when mr_rx_lp_valid is 1.

mr_rx_lp_SNR[1:0]
Link partner health status.

Values: 00 – PHY link is dying and will drop link and re-link within 2 to 4 ms after the end of the current OAM frame.
01 – LPI refresh insufficient for maintain PHY SNR. Request link partner to exit LPI and send idles (used only when EEE is enabled).
10 – PHY SNR is marginal.
11 – PHY SNR is good.

The threshold for the status is implementation dependent.

mr_rx_lp_toggle
The toggle bit value associated with the eight byte OAM message from the link partner.

Values: The toggle bit alternates between 0 and 1.

mr_rx_lp_valid
Indicates whether OAM message in mr_rx_lp_message[63:0], mr_rx_lp_message_num[3:0] and the toggle bit in mr_rx_lp_toggle is valid or not. This variable should be cleared when mr_rx_lp_message[63:48] is read and is not explicitly shown in the state machine. The clearing of this variable indicates to the state machine that the OAM message is read by the user and the state machine can proceed to load in the next OAM message.

Values: 0 – Invalid
1 – Valid

mr_rx_ping
Echoed ping value from the link partner.

Values: The value can be 0 or 1.

mr_tx_message[63:0]
Eight byte OAM message transmit by the PHY. The value in this variable is valid only when mr_tx_valid is 1.

mr_tx_message_num[3:0]
Four bit message number transmit by the PHY. The value in this variable is valid only when mr_tx_valid is 1.

mr_tx_ping
Ping value transmit by the PHY.

Values: The value can be 0 or 1.

mr_tx_received

Indicates whether the most recently transmitted OAM message with a toggle bit value of mr_tx_received_toggle was received, read, and acknowledged by the link partner.

Values: 0 – OAM message not received and read by the link partner
1 – OAM message received by the link partner

mr_tx_received_toggle

Toggle bit value of the OAM message that was received, read, and most recently acknowledged by the link partner. This bit is valid only if mr_tx_received is 1.

Values: The value can be 0 or 1.

mr_tx_SNR[1:0]

Status register indicating PHY health status.

Values: 00 – PHY link is dying and will drop link and re-link within 2 to 4 ms after the end of the current OAM frame.
01 – LPI refresh insufficient for maintain PHY SNR. Request link partner to exit LPI and send idles (used only when EEE is enabled).
10 – PHY SNR is marginal.
11 – PHY SNR is good.

The threshold for the status is implementation dependent.

mr_tx_toggle

The toggle bit value associated with the eight byte OAM message transmit by the PHY.
The value is automatically set by the state machine and cannot be set by the user. This bit should be read and recorded prior to setting mr_tx_valid to 1.

Values: The toggle bit alternates between 0 and 1.

mr_tx_valid

Indicates whether OAM message in mr_tx_message[63:0] and mr_rx_lp_message_num[3:0] is valid or not. This register will be cleared by the state machine to indicate whether the next OAM message can be written into the registers.

Values: 0 – Invalid
1 – Valid

SNR[1:0]

PHY health status.

Values: 00 – PHY link is dying and will drop link and re-link within 2 to 4 ms after the end of the current OAM frame.
01 – LPI refresh insufficient for maintain PHY SNR. Request link partner to exit LPI and send idles (used only when EEE is enabled).
10 – PHY SNR is marginal.
11 – PHY SNR is good.

The how this status is generated and the threshold for the status is implementation dependent.

reset

Reset

Values: false – OAM circuit not in reset
true – OAM circuit is in reset

rx_boundary

This variable is set to true whenever the receive data stream reaches the end of a Reed Solomon frames during normal operation, or at the end of a received refresh cycle during low power idle operation. This variable is set to false at other times.

Values: false – receive stream not at a boundary end
true – receive stream at a boundary end

rx_oam_field<8:0>
Nine bit OAM symbol extracted from a received Reed Solomon frame during normal operation, or from a received refresh cycle during low power idle operation.

rx_oam<11 to 0><8:0>
Raw 12 symbol OAM frame received from the link partner.

tx_boundary
This variable is set to true whenever the transmit data stream reaches the start of a Reed Solomon frames during normal operation, or at the start of a transmit refresh cycle during low power idle operation. This variable is set to false at other times.

Values: false – transmit stream not at a boundary end
true – transmit stream at a boundary end

tx_oam_field<8:0>
Nine bit OAM symbol inserted into a transmitted Reed Solomon frame during normal operation, or into a trnsmitted refresh cycle during low power idle operation.

tx_oam<11 to 0><8:0>
Raw 12 symbol OAM frame transmitted from the PHY.

97.6.4.2 State Diagram Counters

Editors Note: The counters listed below are the obvious ones. More may be added when we flesh out the state machine

rx_cnt
OAM frame receive symbol count

Values: The value can be any integer from 0 to 12 inclusive.

tx_cnt
OAM frame transmit symbol count

Values: The value can be any integer from 0 to 12 inclusive.

97.6.4.3 State Diagram Functions

Editors Note: The functions listed below are the obvious ones. More may be added when we flesh out the state machine

CRC16(10 bytes)
This function outputs a 16 bit CRC value using 10 byte input as defined in clause 97.6.2.2.10.

CRC16_Check(12 bytes)
This function checks whether the 12 byte frame has the correct CRC16 as defined in clause 97.6.2.2.10.

Values: BAD – CRC16 check is bad
GOOD – CRC16 check is good

Parity(12 bytes)
This function outputs 12 parity bits, one for each of the 12 input bytes. An even parity bit is output for the first byte, and odd parity bits are output for each of the remaining 11 bytes.

Parity_Check(9-bit symbol)
This function calculates the bit parity of the 9 bit symbol.

Values: Even – Symbol has even parity
Odd – Symbol has odd parity

97.6.4.4 State Diagrams

Editors Note: The transmit and receive state diagrams will be worked on once the general outline of the OAM mechanics is approved as baseline as this will require some effort to develop.

Figure 97 – P - Transmit State Diagram

Figure 97 – Q - Receive State Diagram