

#### **24.3.1.6.3 Effect of receipt**

This primitive affects operation of the PMA Link Monitor function as described in 24.3.4.4.

#### **24.3.1.7 PMA\_RXERROR.indicate**

This primitive is generated by the PMA to indicate that an error has been detected during a carrier event.

##### **24.3.1.7.1 Semantics of the service primitive**

PMA\_RXERROR.indicate (rxerror\_status)

The rxerror\_status parameter can take on one of two values: ERROR or NO\_ERROR, indicating whether the received carrier event contains a detectable error (ERROR) or not (NO\_ERROR). A carrier event is considered to be in error when it is not started by a Start-of-Stream Delimiter.

##### **24.3.1.7.2 When generated**

The PMA generates this primitive whenever a new, non-squelched carrier event is not started by a Start-of-Stream Delimiter.

##### **24.3.1.7.3 Effect of receipt**

The effect of receipt of this primitive by the client is unspecified by the PMA sublayer.

#### **24.3.2 Functional requirements**

The 100BASE-X PMA comprises the following functions:

- a) Mapping of transmit and receive code-bits between the PMA Service Interface and the PMD Service Interface;
- b) Link Monitor, which maps the PMD\_SIGNAL.indicate primitive to the PMA\_LINK.indicate primitive, indicating the availability of the underlying PMD;
- c) Carrier Detection, which generates the PMA\_CARRIER.indicate and PMA\_RXERROR.indicate primitives from inspection of received PMD signals; and
- d) Far-End Fault (optional), comprised of the Far-End Fault Generate and Far-End Fault Detect processes, which sense receive channel failures and send the Far-End Fault Indication, and sense the Far-End Fault Indication.

Figure 24-4 includes a functional block diagram of the PMA.

##### **24.3.2.1 Far-End fault**

Auto-Negotiation provides a Remote Fault capability useful for detection of asymmetric link failures; i.e., channel error conditions detected by the far-end station but not the near-end station. Since Auto-Negotiation is specified only for media supporting eight-pin modular connectors, such as used by 100BASE-TX over unshielded twisted pair, Auto-Negotiation's Remote Fault capability is unavailable to other media for which it may be functionally beneficial, such as 100BASE-TX over shielded twisted pair or 100BASE-FX. A remote fault capability for 100BASE-FX is particularly useful due to this medium's applicability over longer distances (making end-station checking inconvenient) and for backbones (in which detection of link failures can trigger redundant systems).

For these reasons, 100BASE-X provides an optional Far-End Fault facility when Auto-Negotiation cannot be used. Far-End Fault shall not be implemented for media capable of supporting Auto-Negotiation.

When no signal is being received, as indicated by the PMD's signal detect function, the Far-End Fault feature permits the station to transmit a special Far-End Fault Indication to its far-end peer. The Far-End Fault Indication is sent only when a physical error condition is sensed on the receive channel. In all other situations, including reception of the Far-End Fault Indication itself, the PMA passes through tx\_code-bit. (Note that the Far-End Fault architecture is such that IDLEs are automatically transmitted when the Far-End Fault Indication is detected. This is necessary to re-establish communication when the link is repaired.)

The Far-End Fault Indication is comprised of three or more repeating cycles, each of 84 ONEs followed by a single ZERO. This signal is sent in-band and is readily detectable but is constructed so as to not satisfy the 100BASE-X carrier sense criterion. It is therefore transparent to the PMA's client and to stations not implementing Far-End Fault.

As shown in figure 24-4, Far-End Fault is implemented through the Far-End Fault Generate, Far-End Fault Detect and the Link Monitor processes.

The Far-End Fault Generate process, which is interposed between the incoming tx\_code-bit stream and the TX process, is responsible for sensing a receive channel failure (signal\_status=OFF) and transmitting the Far-End Fault Indication in response. The transmission of the Far-End Fault Indication may start or stop at any time depending only on signal\_status.

The Far-End Fault Detect process continuously monitors rx\_code-bits from the RX process for the Far-End Fault Indication. Detection of the Far-End Fault Indication disables the station by causing the Link Monitor process to deassert link\_status, which in turn causes the station to source IDLEs. Far-End Fault detection can also be used by management functions not specified in this clause.

#### **24.3.2.2 Comparison to previous 802.3 PMAs**

Previous 802.3 PMA's perform the additional functions of SQE Test and Jabber. Neither of these functions is implemented in the 100BASE-X PMA.

SQE Test is provided in other Physical Layers to check the integrity of the Collision Detection mechanism independently of the Transmit and Receive capabilities of the Physical Layer. Since 100BASE-X effects collision detection by sensing receptions that occur during transmissions, collision detection is dependent on the health of the receive channel. By checking the ability to properly receive signals from the PMD, the Link Monitor function therefore functionally subsumes the functions previously implemented by SQE Test.

The Jabber function prevents a DTE from causing total network failure under certain classes of faults. When using mixing media (e.g., coaxial cables or passive optical star couplers), this function must naturally be implemented in the DTE. 100BASE-X requires the use of an active repeater, with one DTE or repeater attached to each port. As an implementation optimization, the Jabber function has therefore been moved to the repeater in 100BASE-X.

#### **24.3.3 State variables**

##### **24.3.3.1 Constants**

###### **FEF\_CYCLES**

The number of consecutive cycles (of FEF\_ONES ONEs and a single ZERO) necessary to indicate the Far-End Fault Indication. This value is 3.

###### **FEF\_ONES**

The number of consecutive ONEs to be transmitted for each cycle of the Far-End Fault Indication. This value is 84.

### 24.3.3.2 Variables

#### carrier\_status

The carrier\_status parameter to be communicated by the Carrier Detect process through the PMA\_CARRIER.indicate primitive. Carrier is defined as receipt of 2 noncontiguous ZEROes in 10 code-bits.

Values: ON; carrier is being received  
OFF; carrier is not being received

#### faulting

The faulting variable set by the Far-End Fault Detect process, when implemented, indicating whether or not a Far-End Fault Indication is being sensed. This variable is used by the Link Monitor process to force link\_status to FAIL. When Far-End Fault is not implemented, this variable is always FALSE.

Values: TRUE; Far-End Fault Indication is being sensed  
FALSE; Far-End Fault Indication is not being sensed

#### link\_control

The link\_control parameter as communicated by the PMA\_LINK.request primitive. When Auto-Negotiation is not implemented, the value of link\_control is always ENABLE. See clause 28 for a complete definition.

#### link\_status

The link\_status parameter as communicated by the Link Monitor process through the PMA\_LINK.indicate primitive.

Values: FAIL; the receive channel is not intact  
READY; the receive channel is intact and ready to be enabled by Auto-Negotiation  
OK; the receive channel is intact and enabled for reception

#### r\_bits [9:0]

In Carrier Detect, a vector of the 10 most recently received code-bits from the PMD RX process. r\_bits [0] is the most recently received (newest) code-bit; r\_bits [9] is the least recently received code-bit (oldest). r\_bits is an internal variable used exclusively by the Carrier Detect process.

#### rx\_code-bit

The rx\_code-bit parameter as delivered by the RX process, which operates in synchronism with the PMD\_UNITDATA.indicate primitive. rx\_code-bit is the most recently received code-bit from the PMD after conversion from NRZI.

#### rxerror\_status

The rxerror\_status parameter to be communicated by the Carrier Detect process through the PMA\_RXERROR.indicate primitive.

Values: NO\_ERROR; no error detected in the carrier event being received  
ERROR; the carrier event being received is in error

#### signal\_status

The signal\_status parameter as communicated by the PMD\_SIGNAL.indicate primitive.

Values: ON; the quality and level of the received signal is satisfactory  
OFF; the quality and level of the received signal is not satisfactory

#### tx\_code-bit\_in

In Link Fault Generate, the tx\_code-bit parameter as conveyed to the PMA from the PMA client by the PMA\_UNITDATA request.

#### tx\_code-bit\_out

In Link Fault Generate, the tx\_code-bit parameter to be passed to the TX process. Note that this is called tx\_code-bit by the TX process.

**24.3.3.3 Functions**

SHIFTLEFT (rx\_bits)

In Carrier Detect, this function shifts rx\_bits left one bit placing rx\_bits [8] in rx\_bits [9], rx\_bits [7] in rx\_bits [8] and so on until rx\_bits [1] gets rx\_bits [0].

**24.3.3.4 Timers**

stabilize\_timer

An implementation-dependent delay timer between 330  $\mu$ s and 1000  $\mu$ s, inclusive, to ensure that the link is stable.

**24.3.3.5 Counters**

num\_cycles

In Link Fault Detect, a counter containing the number of consecutive Far-End Fault cycles currently sensed. This counter gets reset on initialization or when the bit stream fails to qualify as a potential Far-End Fault Indication. It never exceeds FEF\_CYCLES.

num\_ones

This represents two separate and independent counters: In Link Fault Generate, a counter containing the number of consecutive ONES already sent during this cycle of the Far-End Fault Indication. In Link Fault Detect, a counter containing the number of consecutive ONES currently sensed; it gets reset whenever a ZERO is detected or when the bit stream fails to qualify as a potential Far-End Fault Indication. These counters never exceed FEF\_ONES.

**24.3.3.6 Messages**

PMD\_UNITDATA.indicate (rx\_nrzi-bit)

A signal sent by the PMD signifying that the next nrzi-bit is available from the medium. nrzi-bit is converted (instantaneously) to code-bit by the RX process and used by the Carrier Detect process.

5xPMD\_UNITDATA.indicates

In Carrier Detect, this shorthand notation represents repetition of the preceding state five times synchronized with five successive PMD\_UNITDATA.indicates.

PMA\_UNITDATA request (tx\_code-bit)

A signal sent by the PMA's client signifying that the next nrzi-bit is available for transmission. For this process, the tx\_code-bit parameter is interpreted as tx\_code-bit\_in.

**24.3.4 Process specifications and state diagrams****24.3.4.1 TX**

The TX process passes data from the PMA's client directly to the PMD. The PMA shall implement the TX process as follows: Upon receipt of a PMA\_UNITDATA request (tx\_code-bit), the PMA performs a conversion to NRZI format and generates a PMD\_UNITDATA request (tx\_nrzi-bit) primitive with the same logical value for the tx\_nrzi-bit parameter. Note that tx\_code-bit is equivalent to tx\_code-bit\_out of the Link Fault Generate process when implemented.

**24.3.4.2 RX**

The RX process passes data from the PMD directly to the PMA's client and to the Carrier Detect process. The PMA shall implement the RX process as follows: Upon receipt of a PMD\_UNITDATA.indicate (rx\_nrzi-bit),

the PMA performs a conversion from NRZI format and generates a PMA\_UNITDATA.indicate (rx\_code-bit) primitive with the same logical value for the rx\_code-bit parameter.

#### 24.3.4.3 Carrier detect

The PMA Carrier Detect process provides repeater clients an indication that a carrier event has been sensed and an indication if it is deemed in error. A carrier event is defined as receipt of two non-contiguous ZEROS within any 10 rx\_code-bits. A carrier event is in error if it does not start with an SSD. The Carrier Detect process performs this function by continuously monitoring the code-bits being delivered by the RX process, and checks for specific patterns which indicate non-IDLE activity and SSD bit patterns.

The Carrier Detect process collects code-bits from the PMD RX process. r\_bits [9:0] represents a sliding, 10-bit window on the code-bit sequence, with newly received code-bits from the RX process being shifted into r\_bits [0]. The process shifts the r\_bits vector to the left, inserts the newly received code-bit into position 0, and waits for the next PMD\_UNITDATA.indicate before repeating the operation. This is depicted in figure 24-13. The Carrier Detect process monitors the r\_bits vector until it detects two noncontiguous ZEROS in the incoming code-bit sequence. This signals a transition of carrier\_status from OFF to ON. Each new carrier is further examined for a leading SSD (1100010001) with rxerror\_status set to ERROR if it is not confirmed. A pattern of 10 contiguous ONES in the stream indicates a return to carrier\_status = OFF. Code-bit patterns of contiguous ONES correspond to IDLE code-groups in the PCS, per the encoding specified in 24.2.2.1.

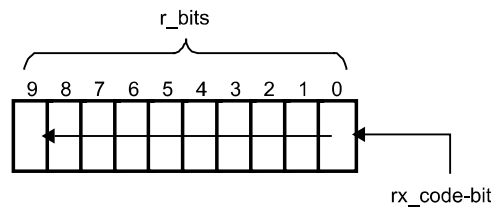


Figure 24-13—Carrier Detect reference diagram

The PMA shall, if it is supporting a repeater, implement the Carrier Detect process as depicted in figure 24-14 including compliance with the associated state variables as specified in 24.3.3.

#### 24.3.4.4 Link Monitor

The Link Monitor process is responsible for determining whether the underlying receive channel is providing reliable data. Failure of the underlying channel typically causes the PMA's client to suspend normal actions. The Link Monitor process takes advantage of the PMD sublayer's continuously signaled transmission scheme, which provides the PMA with a continuous indication of signal detection on the channel through signal\_status as communicated by the PMD\_SIGNAL.indicate primitive. It responds to control by Auto-Negotiation, when implemented, which is effected through the link\_control parameter of PMA\_SIGNAL request.

The Link Monitor process monitors signal\_status, setting link\_status to FAIL whenever signal\_status is OFF or when Auto-Negotiation sets link\_control to DISABLE. The link is deemed to be reliably operating when signal\_status has been continuously ON for a period of time. This period is implementation dependent but not less than 330 μs or greater than 1000 μs. If so qualified, Link Monitor sets link\_status to READY in order to synchronize with Auto-Negotiation, when implemented. Auto-Negotiation permits full operation by setting link\_control to ENABLE. When Auto-Negotiation is not implemented, Link Monitor operates with link\_control always set to ENABLE.

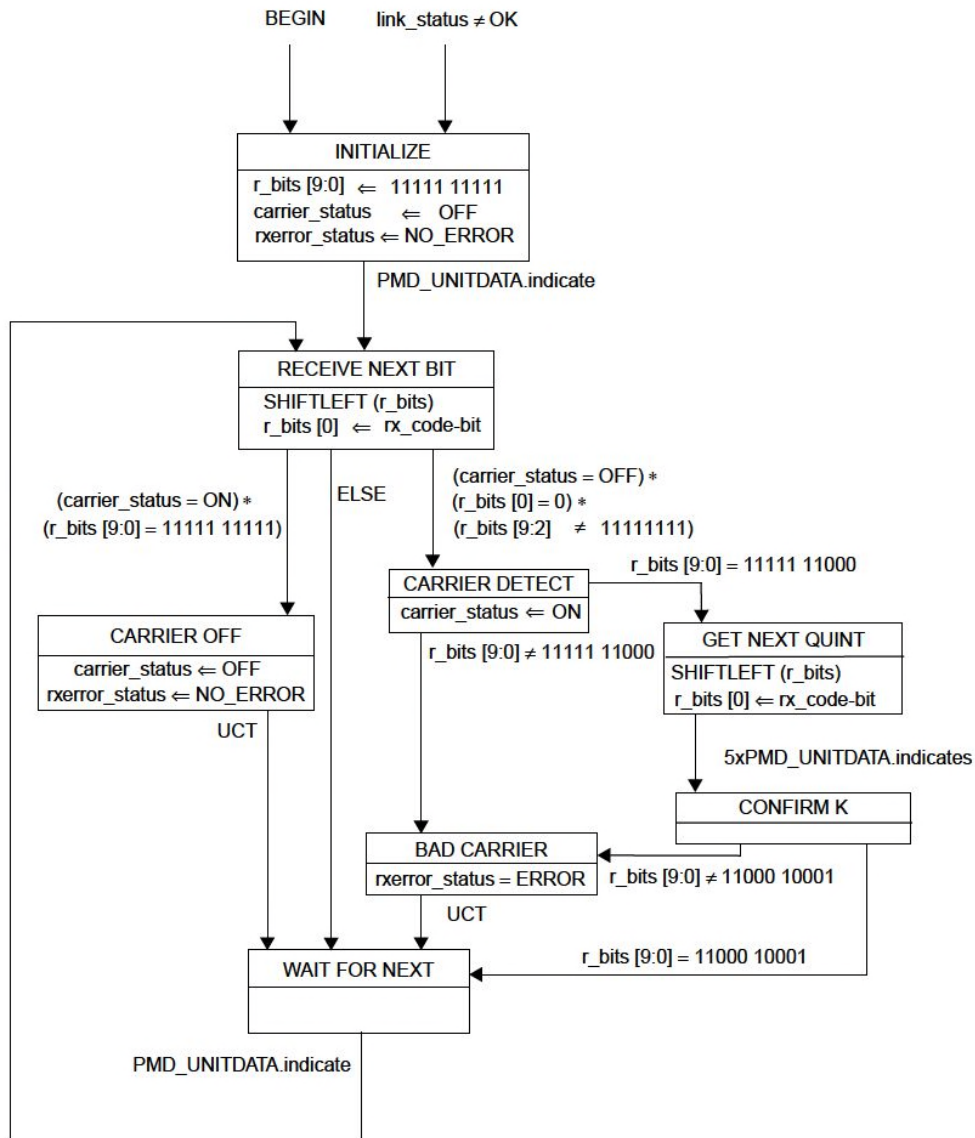
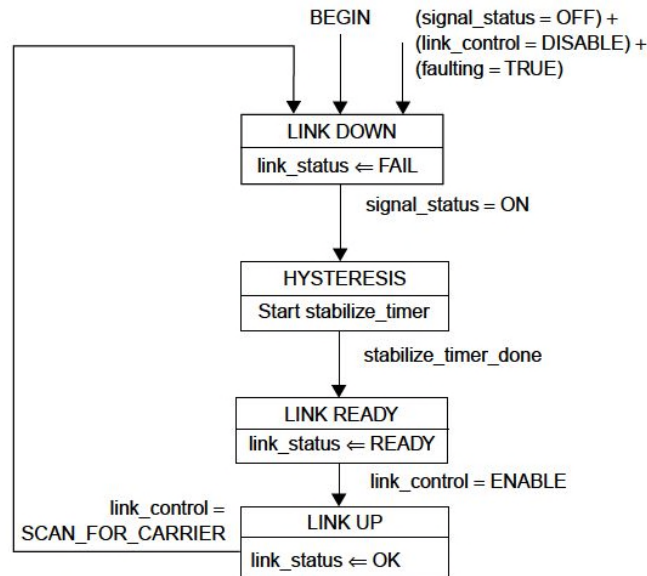


Figure 24-14—Carrier Detect state diagram

The PMA shall implement the Link Monitor process as depicted in figure 24-15 including compliance with the associated state variables as specified in 24.3.3.

**24.3.4.5 Far-End Fault Generate**

Far-End Fault Generate simply passes tx\_code-bits to the TX process when signal\_status=ON. When signal\_status=OFF, it repetitively generates each cycle of the Far-End Fault Indication until signal\_status is reasserted.



NOTE—The variables `link_control` and `link_status` are designated as `link_control [TX]` and `link_status [TX]`, respectively, by the Auto-Negotiation Arbitration state diagram (figure 28-16).

Figure 24-15—Link Monitor state diagram

If Far-End Fault is implemented, the PMA shall implement the Far-End Fault Generate process as depicted in figure 24-16 including compliance with the associated state variables as specified in 24.3.3.

#### 24.3.4.6 Far-End Fault Detect

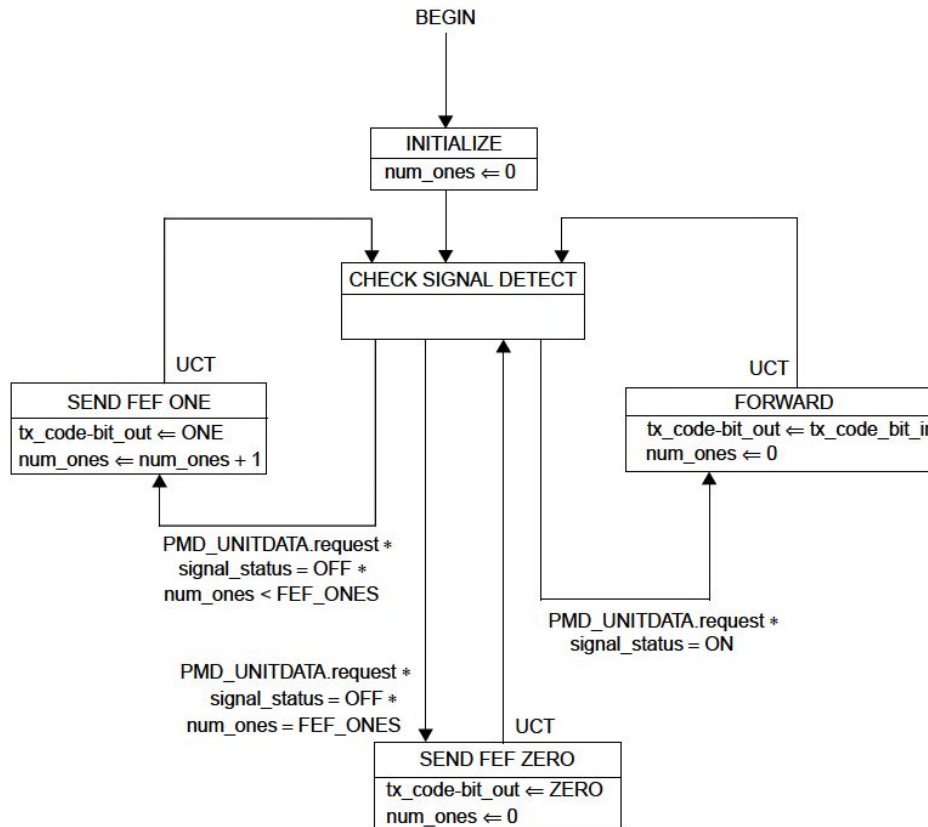
Far-End Fault Detect passively monitors the `rx_code`-bit stream from the RX process for the Far-End Fault Indication. It does so by maintaining counters for the number of consecutive ONES seen since the last ZERO (`num_ones`) and the number of cycles of 84 ONES and a single ZERO (`num_cycles`). The Far-End Fault Indication is denoted by three or more cycles, each of 84 ONES and a single ZERO. Note that the number of consecutive ONES may exceed 84 on the first cycle.

If Far-End Fault is implemented, the PMA shall implement the Far-End Fault Detect process as depicted in figure 24-17 including compliance with the associated state variables as specified in 24.3.3.

### 24.4 Physical Medium Dependent (PMD) sublayer service interface

#### 24.4.1 PMD service interface

The following specifies the services provided by the PMD. The PMD is a sublayer within 100BASE-X and may not be present in other 100BASE-T PHY specifications. PMD services are described in an abstract manner and do not imply any particular implementation. It should be noted that these services are functionally identical to those defined in the FDDI standards, such as ISO 9314-3: 1990 and ANSI X3.263: 199X, with two exceptions:



**Figure 24-16—Far-End Fault Generate state diagram**

- 100BASE-X does not include a Station Management (SMT) function; therefore the PMD-to-SMT interface defined in ISO 9314-3: 1990 and ANSI X3.263: 199X.
- 100BASE-X does not support multiple instances of a PMD in service to a single PMA; therefore, no qualifiers are needed to identify the unique PMD being referenced.

There are also *editorial* differences between the interfaces specified here and in the referenced standards, as required by the context of 100BASE-X.

The PMD Service Interface supports the exchange of nrzi-bits between PMA entities. The PMD translates the nrzi-bits to and from signals suitable for the specified medium.

The following primitives are defined:

PMD\_UNITDATA.request  
 PMD\_UNITDATA.indicate  
 PMD\_SIGNAL.indicate

#### 24.4.1.1 PMD\_UNITDATA.request

This primitive defines the transfer of data (in the form of nrzi-bits) from the PMA to the PMD.



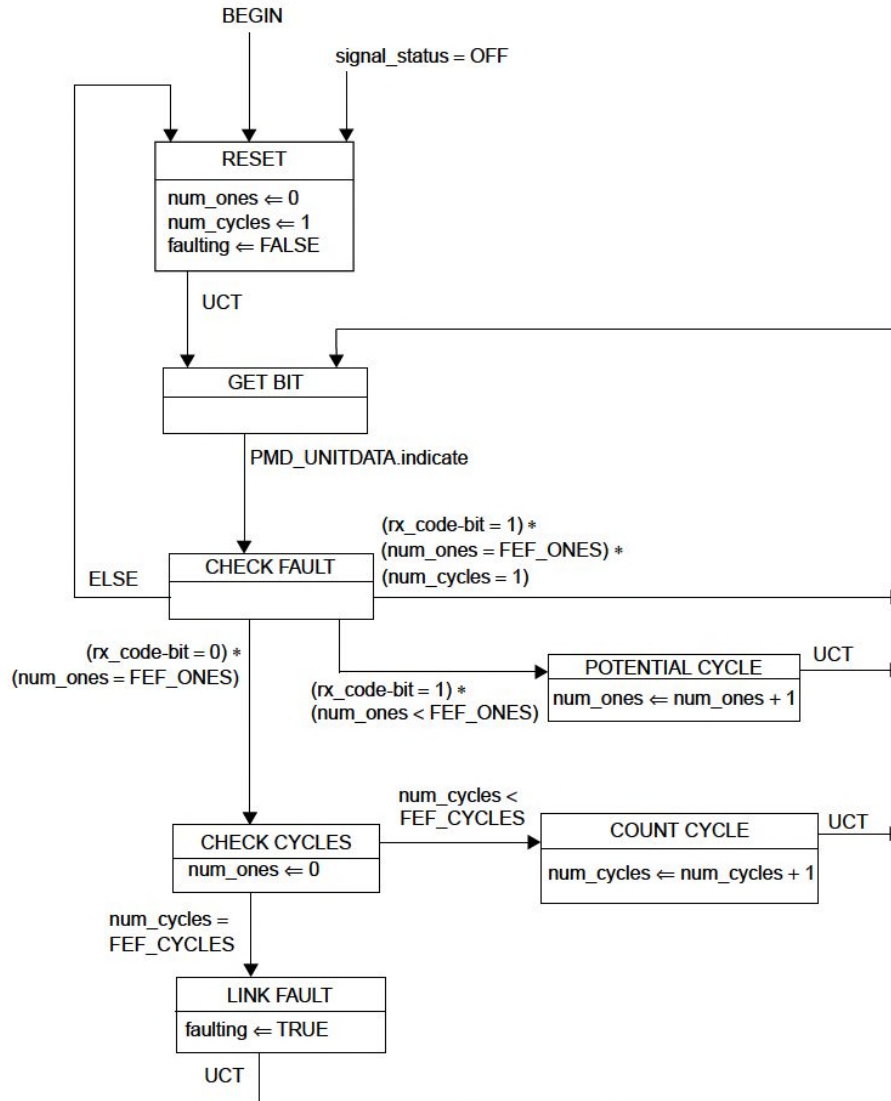


Figure 24-17—Far-End Fault Detect state diagram

**24.4.1.1.1 Semantics of the service primitive**

PMD\_UNITDATA.request (tx\_nrzi-bit)

The data conveyed by PMD\_UNITDATA request is a continuous sequence of nrzi-bits. The tx\_nrzi-bit parameter can take one of two values: ONE or ZERO.

**24.4.1.1.2 When generated**

The PMA continuously sends, at a nominal 125 Mb/s rate, the PMD the appropriate nrzi-bits for transmission on the medium.

#### **24.4.1.1.3 Effect of receipt**

Upon receipt of this primitive, the PMD converts the specified nrzi-bit into the appropriate signals on the MDI.

#### **24.4.1.2 PMD\_UNITDATA.indicate**

This primitive defines the transfer of data (in the form of nrzi-bits) from the PMD to the PMA.

##### **24.4.1.2.1 Semantics of the service primitive**

PMD\_UNITDATA.indicate (rx\_nrzi-bit)

The data conveyed by PMD\_UNITDATA.indicate is a continuous nrzi-bit sequence. The rx\_nrzi-bit parameter can take one of two values: ONE or ZERO.

##### **24.4.1.2.2 When generated**

The PMD continuously sends nrzi-bits to the PMA corresponding to the signals received from the MDI.

##### **24.4.1.2.3 Effect of receipt**

The effect of receipt of this primitive by the client is unspecified by the PMD sublayer.

#### **24.4.1.3 PMD\_SIGNAL.indicate**

This primitive is generated by the PMD to indicate the status of the signal being received from the MDI.

##### **24.4.1.3.1 Semantics of the service primitive**

PMD\_SIGNAL.indicate (signal\_status)

The signal\_status parameter can take on one of two values: ON or OFF, indicating whether the quality and level of the received signal is satisfactory (ON) or unsatisfactory (OFF). When signal\_status = OFF, then rx\_nrzi-bit is undefined, but consequent actions based on PMD\_SIGNAL.indicate, where necessary, interpret rx\_nrzi-bit as logic ZERO.

##### **24.4.1.3.2 When generated**

The PMD generates this primitive to indicate a change in the value of signal\_status.

##### **24.4.1.3.3 Effect of receipt**

The effect of receipt of this primitive by the client is unspecified by the PMD sublayer.

#### **24.4.2 Medium Dependent Interface (MDI)**

The MDI, a physical interface associated with a PMD, is comprised of an electrical or optical medium connector. The 100BASE-X MDIs, defined in subsequent clauses, are specified by reference to the appropriate FDDI PMD, such as in ISO 9314-3: 1990 and ANSI X3.263: 199X, together with minor modifications (such as connectors and pin-outs) necessary for 100BASE-X.

## 24.5 Compatibility considerations

There is no requirement for a compliant device to implement or expose any of the interfaces specified for the PCS, PMA, or PMD. However, if an exposed interface is provided to the PCS, it shall comply with the requirements for the MII, as specified in clause 22.

## 24.6 Delay constraints

Proper operation of a CSMA/CD LAN demands that there be an upper bound on the propagation delays through the network. This implies that MAC, PHY, and repeater implementors must conform to certain delay minima and maxima, and that network planners and administrators conform to constraints regarding the cable topology and concatenation of devices. MAC constraints are contained in clause 21. Topological constraints are contained in clause 29.

The reference point for all MDI measurements is the 50% point of the mid-cell transition corresponding to the reference code-bit, as measured at the MDI. Although 100BASE-TX output is scrambled, it is assumed that these measurements are made via apparatuses that appropriately account for this.

### 24.6.1 PHY delay constraints (exposed MII)

Every 100BASE-X PHY with an exposed MII shall comply with the bit delay constraints specified in table 24-2. These figures apply for all 100BASE-X PMDs.

**Table 24-2—MDI to MII delay constraints (exposed MII)**

| Sublayer measurement points | Event                                  | Min (bits) | Max (bits) | Input timing reference | Output timing reference |
|-----------------------------|--|------------|------------|------------------------|-------------------------|
| MII ⇌ MDI                   | TX_EN Sampled to MDI Output            | 6          | 14         | TX_CLK rising          | 1st bit of /J/          |
|                             | MDI input to CRS assert                |            | 20         | 1st bit of /J/         |                         |
|                             | MDI input to CRS de-assert (aligned)   | 13         | 24         | 1st bit of /T/         |                         |
|                             | MDI input to CRS de-assert (unaligned) | 13         | 24         | 1st ONE                |                         |
|                             | MDI input to COL assert                |            | 20         | 1st bit of /J/         |                         |
|                             | MDI input to COL de-assert (aligned)   | 13         | 24         | 1st bit of /T/         |                         |
|                             | MDI input to COL de-assert (unaligned) | 13         | 24         | 1st ONE                |                         |
|                             | TX_EN sampled to CRS assert            | 0          | 4          | TX_CLK rising          |                         |
|                             | TX_EN sampled to CRSde-assert          | 0          | 16         | TX_CLK rising          |                         |

### 24.6.2 DTE delay constraints (unexposed MII)

Every 100BASE-X DTE with no exposed MII shall comply with the bit delay constraints specified in table 24-3. These figures apply for all 100BASE-X PMDs.

### 24.6.3 Carrier de-assertion/assertion constraint

To ensure fair access to the network, each DTE shall, additionally, satisfy the following:

**Table 24-3—DTE delay constraints (unexposed MII)**

| Sublayer measurement points | Event   | Min (bits) | Max (bits) | Input timing reference | Output timing reference |
|-----------------------------|---|------------|------------|------------------------|-------------------------|
| MAC $\leftrightarrow$ MDI   | MAC transmit start to MDI output                              |            | 18         |                        | 1st bit of /J/          |
|                             | MDI input to MDI output (worst-case nondeferred transmit)     |            | 54         | 1st bit of /J/         | 1st bit of /J/          |
|                             | MDI input to collision detect                                 |            | 28         | 1st bit of /J/         |                         |
|                             | MDI input to MDI output = Jam (worst case collision response) |            | 54         | 1st bit of /J/         | 1st bit of jam          |

(MAX MDI to MAC Carrier De-assert Detect) – (MIN MDI to MAC Carrier Assert Detect) < 13

### 24.7 Environmental specifications

All equipment subject to this clause shall conform to the requirements of 14.7 and applicable sections of ISO/IEC 11801: 1995.

## 24.8 Protocol Implementation Conformance Statement (PICS) proforma for clause 24, Physical Coding Sublayer (PCS) and Physical Medium Attachment (PMA) sublayer, type 100BASE-X<sup>23</sup>

### 24.8.1 Introduction

The supplier of a protocol implementation that is claimed to conform to IEEE Std 802.3u-1995, Physical Coding Sublayer (PCS) and Physical Medium Attachment (PMA) sublayer, type 100BASE-X, 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.

### 24.8.2 Identification

#### 24.8.2.1 Implementation identification

|   |  |
|---|--|
| Supplier  |  |
| Contact point for enquiries about the PICS  |  |
| Implementation Name(s) and Version(s)   |  |
| Other information necessary for full identification—e.g., name(s) and version(s) for machines and/or operating systems; System Names(s)   |  |
| <p>NOTES</p> <p>1—Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirements for the identification.</p> <p>2—The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).</p> |  |

#### 24.8.2.2 Protocol summary

|  |  |
|--|--|
| Identification of protocol standard  | IEEE Std 802.3u-1995, Physical Coding Sublayer (PCS) and Physical Medium Attachment (PMA) sublayer, type 100BASE-X |
| Identification of amendments and corrigenda to this PICS proforma that have been completed as part of this PICS                                    |  |
| Have any Exception items been required?<br>(See clause 21; the answer Yes means that the implementation does not conform to IEEE Std 802.3u-1995.) | No [ ]      Yes [ ]  |
| Date of Statement  |  |

<sup>23</sup>Copyright release for PICS proformas Users of this standard may freely reproduce the PICS proforma in this annex so that it can be used for its intended purpose and may further publish the completed PICS.

**24.8.2.3 Major capabilities/options**

| Item | Feature  | Subclause | Status                     | Support | Value/Comment |
|------|--|-----------|----------------------------|---------|---------------|
| *DTE | Supports DTE without MII                         | 24.4      | O/1                        |         |               |
| *REP | Supports Repeater without MII                    | 24.4      | O/1                        |         |               |
| *MII | Supports exposed MII interface                   | 24.4      | O/1                        |         |               |
| *PCS | Implements PCS functions                         | 24.2      | REP: O<br>DTE: M<br>MII: M |         |               |
| PMA  | Implements PMA RX, TX and Link Monitor functions | 24.3      | M                          |         |               |
| *NWC | Medium capable of supporting Auto-Negotiation    |           | O                          |         | See clause 28 |
| *FEF | Implements Far-End Fault                         | 24.3.2.1  | NWC: X                     |         |               |
| NWY  | Supports Auto-Negotiation (clause 28)            |           | NWC: O                     |         | See clause 28 |

**24.8.3 PICS proforma tables for the Physical Coding Sublayer (PCS) and Physical Medium Attachment (PMA) sublayer, type 100BASE-X****24.8.3.1 General compatibility considerations**

| Item | Feature                          | Subclause | Status | Support | Value/Comment |
|------|----------------------------------|-----------|--------|---------|---------------|
| GN1  | Compliance with MII requirements | 24.4      | MII:M  |         | See clause 22 |
| GN2  | Environmental specifications     | 24.7      | M      |         |               |

**24.8.3.2 PCS functions**

| Item | Feature               | Subclause | Status | Support | Value/Comment |
|------|-----------------------|-----------|--------|---------|---------------|
| PS1  | Transmit Bits process | 24.2.3    | PCS:M  |         |               |
| PS2  | Transmit process      | 24.2.4.2  | PCS:M  |         |               |
| PS3  | Receive Bits process  | 24.2.4.3  | PCS:M  |         |               |
| PS4  | Receive process       | 24.2.4.4  | PCS:M  |         |               |
| PS5  | Carrier Sense process | 24.2.4.5  | PCS:M  |         |               |

### 24.8.3.3 PMA functions

| Item | Feature                        | Subclause | Status | Support | Value/Comment |
|------|--------------------------------|-----------|--------|---------|---------------|
| PA1  | TX process                     | 24.3.4.1  | M      |         |               |
| PA2  | RX process                     | 24.3.4.2  | M      |         |               |
| PA3  | Carrier Detect process         | 24.3.2.1  | REP: M |         |               |
| PA4  | Link Monitor process           | 24.3.4.4  | M      |         |               |
| PA5  | Far-End Fault Generate process | 24.3.4.5  | FEF: M |         |               |
| PA6  | Far-End Fault Detect process   | 24.3.4.6  | FEF: M |         |               |

### 24.8.3.4 Timing

| Item | Feature   | Subclause | Status          | Support | Value/Comment |
|------|---|-----------|-----------------|---------|---------------|
| TM1  | Support for MII signals TX_CLK and RX_CLK           | 24.2.2.3  | MII:M           |         | See clause 22 |
| TM2  | Accuracy of code-bit_timer                          | 24.2.3    | M               |         |               |
| TM3  | Compliance with PHY bit delay constraints           | 24.6.1    | MII:M<br>REP: O |         |               |
| TM4  | Compliance with DTE bit delay constraints           | 24.6.2    | DTE:M           |         |               |
| TM5  | Compliance with Carrier De-assert/Assert Constraint | 24.6.3    | DTE:M           |         |               |

## 25. Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX

### 25.1 Overview

This clause specifies the 100BASE-X PMD (including MDI) and baseband medium for twisted-pair wiring, 100BASE-TX. In order to form a complete 100BASE-TX Physical Layer it shall be integrated with the 100BASE-X PCS and PMA of clause 24, which are assumed incorporated by reference. As such, the 100BASE-TX PMD shall comply with the PMD service interface specified in 24.4.1.

### 25.2 Functional specifications

The 100BASE-TX PMD (and MDI) is specified by incorporating the FDDI TP-PMD standard, ANSI X3.263: 199X (TP-PMD), by reference, with the modifications noted below. This standard provides support for Category 5 unshielded twisted pair (UTP) and shielded twisted pair (STP). For improved legibility in this clause, ANSI X3.263: 199X (TP-PMD), will henceforth be referred to as TP-PMD.

### 25.3 General exceptions

The 100BASE-TX PMD is precisely the PMD specified as TP-PMD, with the following general modifications:

- a) The Scope and General description discussed in TP-PMD 1 and 5 relate to the use of those standards with an FDDI PHY, ISO 9314-1: 1989, and MAC, ISO 9314-2: 1989. These sections are not relevant to the use of the PMD with 100BASE-X.
- b) The Normative references, Definitions and Conventions of TP-PMD 2, 3, and 4 are used only as necessary to interpret the applicable sections of TP-PMD referenced in this clause.
- c) The PMD Service Specifications of TP-PMD 6 are replaced by those specified in 24.4.1. The 100BASE-TX PMD Service specification is a proper subset of the PMD Service Specification in TP-PMD.
- d) There are minor terminology differences between this standard and TP-PMD that do not cause ambiguity. The terminology used in 100BASE-X was chosen to be consistent with other IEEE 802 standards, rather than with FDDI. Terminology is both defined and consistent within each standard. Special note should be made of the interpretations shown in table 25-1.

**Table 25-1—Interpretation of general FDDI terms and concepts**

| FDDI term or concept              | Interpretation for 100BASE-TX          |
|-----------------------------------|--|
| bypass                            | <unused>                               |
| Connection Management (CMT)       | <no comparable entity>                 |
| frame                             | stream                                 |
| Halt Line State (HLS)             | <unused>                               |
| hybrid mode                       | <no comparable entity>                 |
| MAC (or MAC-2)                    | MAC                                    |
| Master Line State (MLS)           | <unused>                               |
| maximum frame size = 9000 symbols | maximum stream size = 3054 code-groups |
| PHY (or PHY-2)                    | PMA; i.e., PMD client                  |



**Table 25-1—Interpretation of general FDDI terms and concepts (Continued)**

| FDDI term or concept                    | Interpretation for 100BASE-TX                                       |
|---|---|
| PHY Service Data Unit (SDU)             | stream  |
| PM_SIGNAL.indication (Signal_Detect)    | PMD_SIGNAL.indicate (signal_status)                                 |
| PM_UNITDATA.indication (PM_Indication)  | PMD_UNITDATA.indicate (nrzi-bit)                                    |
| PM_UNITDATA request (PM_Request)        | PMD_UNITDATA request (nrzi-bit)                                     |
| preamble                                | inter-packet IDLEs  |
| Quiet Line State (QLS)                  | <unused>  |
| SM_PM_BYPASS request (Control_Action)   | Assume:<br>SM_PM_BYPASS request (Control_Action = Insert)           |
| SM_PM_CONTROL request (Control_Action)  | Assume:<br>SM_PM_CONTROL request (Control_Action = Transmit_Enable) |
| SM_PM_SIGNAL.indication (Signal_Detect) | <unused>  |
| Station Management (SMT)                | <no comparable entity>  |
| symbol                                  | code-group  |

## 25.4 Specific requirements and exceptions

The 100BASE-TX PMD (including MDI) and baseband medium shall comply to the requirements of TP-PMD, 7, 8, 9, 10, and 11, and normative annex A with the exceptions listed below. In TP-PMD, informative annexes B, C, E, F, G, I, and J, with exceptions listed below, provide additional information useful to PMD sublayer implementors. Where there is conflict between specification in TP-PMD and those in this standard, those of this standard shall prevail.

### 25.4.1 Change to 7.2.3.1.1, “Line state patterns”

Descrambler synchronization on the Quiet Line State (QLS), Halt Line State (HLS), and Master Line State (MLS) Line State Patterns cited in TP-PMD 7.2.3.1.1 is optional.

### 25.4.2 Change to 7.2.3.3, “Loss of synchronization”

The synchronization error triggered by PH\_Invalid as defined in TP-PMD 7.2.3.3a is not applicable.

### 25.4.3 Change to table 8-1, “Contact assignments for unshielded twisted pair”

100BASE-TX for unshielded twisted pair adopts the contact assignments of 10BASE-T. Therefore, the contact assignments shown in TP-PMD table 8-1 shall instead be as depicted in table 25-2.

### 25.4.4 Deletion of 8.3, “Station labelling”

Clause 8.3 of TP-PMD shall not be applied to 100BASE-TX.

### 25.4.5 Change to 9.1.9, “Jitter”

The jitter measurement specified in 9.1.9 of TP-PMD may be performed using scrambled IDLEs.

**Table 25-2—UTP MDI contact assignments**

| CONTACT | PHY without<br>internal crossover<br>MDI SIGNAL | PHY with<br>internal crossover<br>MDI SIGNAL |
|---------|---|--|
| 1       | Transmit +                                      | Receive +                                    |
| 2       | Transmit –                                      | Receive –                                    |
| 3       | Receive +                                       | Transmit +                                   |
| 4       |   |  |
| 5       |   |  |
| 6       | Receive –                                       | Transmit –                                   |
| 7       |   |  |
| 8       |   |  |

**25.4.6 Replacement of 11.2, “Crossover function”**

Clause 11.2 of TP-PMD is replaced with the following:

A crossover function compliant with 14.5.2 shall be implemented except that a) the signal names are those used in TP-PMD, and b) the contact assignments for STP are those shown in table 8-2 of TP-PMD. Note that compliance with 14.5.2 implies a recommendation that crossover (for both UTP and STP) be performed within repeater PHYs.

**25.4.7 Change to A.2, “DDJ test pattern for baseline wander measurements”**

The length of the test pattern specified in TP-PMD annex A.2 may be shortened to accommodate feasible 100BASE-X measurements, but shall not be shorter than 3000 code-groups.

NOTE—This pattern is to be applied to the MII. (When applied to the MAC, the nibbles within each byte are to be swapped. E.g., as delivered to the MAC, the test pattern would start, "60 c9 16 ...".)

**25.4.8 Change to annex G, “Stream cipher scrambling function”**

An example of a stream cipher scrambling implementation is shown in TP-PMD annex G. This may be modified to allow synchronization solely on the IDLE sequences between packets.

**25.4.9 Change to annex I, “Common mode cable termination”**

The contact assignments shown in TP-PMD figures I-1 and I-2 shall instead comply with those specified in table 25-2.

## 25.5 Protocol Implementation Conformance Statement (PICS) proforma for clause 25, Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX<sup>24</sup>

### 25.5.1 Introduction

The supplier of a protocol implementation that is claimed to conform to IEEE Std 802.3u-1995, Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX, 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.

### 25.5.2 Identification

#### 25.5.2.1 Implementation identification

|   |  |
|---|--|
| Supplier  |  |
| Contact point for enquiries about the PICS  |  |
| Implementation Name(s) and Version(s)   |  |
| Other information necessary for full identification—e.g., name(s) and version(s) for machines and/or operating systems; System Names(s)   |  |
| <p>NOTES</p> <p>1—Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirements for the identification.</p> <p>2—The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).</p> |  |

#### 25.5.2.2 Protocol summary

|  |   |
|--|---|
| Identification of protocol standard  | IEEE Std 802.3u-1995, Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-TX |
| Identification of amendments and corrigenda to this PICS proforma that have been completed as part of this PICS                                    |   |
| Have any Exception items been required?<br>(See clause 21; the answer Yes means that the implementation does not conform to IEEE Std 802.3u-1995.) | No [ ] Yes [ ]  |
| Date of Statement  |   |

<sup>24</sup>Copyright release for PICS proformas Users of this standard may freely reproduce the PICS proforma in this annex so that it can be used for its intended purpose and may further publish the completed PICS.

**25.5.3 Major capabilities/options**

| Item | Feature                          | Subclause | Status | Support | Value/Comment |
|------|----------------------------------|-----------|--------|---------|---------------|
| *TXU | Supports unshielded twisted pair | 25.2      | O/1    |         |               |
| TXS  | Supports shielded twisted pair   | 25.2      | O/1    |         |               |

**25.5.4 PICS proforma tables for the Physical Medium Dependent (PMD) sublayer and base-band medium, type 100BASE-TX****25.5.4.1 General compatibility considerations**

| Item | Feature                          | Subclause | Status | Support | Value/Comment |
|------|----------------------------------|-----------|--------|---------|---------------|
| GN1  | Integrates 100BASE-X PMA and PCS | 25.1      | M      |         | See clause 24 |

**25.5.4.2 PMD compliance**

| Item | Feature  | Subclause         | Status | Support | Value/Comment    |
|------|--|-------------------|--------|---------|------------------|
| PD1  | Compliance with 100BASE-X PMD Service Interface  | 25.1              | M      |         | See 24.2.3       |
| PD2  | Compliance with ANSI X3.237: 199X, 7, 8 (excluding 8.3), 9, 10, 11 and normative annex A, with listed exceptions | 25.4<br>25.4.5    | M      |         |                  |
| PD3  | Precedence over ANSI X3.237-199X   | 25.4              | M      |         |                  |
| PD4  | MDI contact assignments for unshielded twisted pair  | 25.4.4<br>25.4.10 | TXU: M |         |                  |
| PD5  | Compliance with crossover function of 14.5.2 with listed adaptations   | 25.4.7            | M      |         |                  |
| PD6  | Minimum jitter test pattern length   | 25.4.8            | M      |         | 3000 code-groups |

This is an Archive IEEE Standard. It has been superseded by a later version of this standard.

## 26. Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-FX

### 26.1 Overview

This clause specifies the 100BASE-X PMD (including MDI) and fiber optic medium for multi-mode fiber, 100BASE-FX. In order to form a complete 100BASE-FX Physical Layer it shall be integrated with the 100BASE-X PCS and PMA of clause 24, which are assumed incorporated by reference. As such, the 100BASE-FX PMD shall comply with the PMD service interface specified in 24.4.1.

### 26.2 Functional specifications

The 100BASE-FX PMD (and MDI) is specified by incorporating the FDDI PMD standard, ISO 9314-3: 1990, by reference, with the modifications noted below. This standard provides support for two optical fibers. For improved legibility in this clause, ISO 9314-3: 1990 will henceforth be referred to as fiber-PMD.

### 26.3 General exceptions

The 100BASE-FX PMD is precisely the PMD specified as fiber-PMD, with the following general modifications:

- a) The Scope and General description discussed in fiber-PMD 1 and 5 relate to the use of those standards with an FDDI PHY, ISO 9314-1: 1989, and MAC, ISO 9314-2: 1989. These clauses are not relevant to the use of the PMD with 100BASE-X.
- b) The Normative references, Definitions and Conventions of fiber-PMD 2, 3, and 4 are used only as necessary to interpret the applicable sections of fiber-PMD referenced in this clause.
- c) The PMD Service Specifications of fiber-PMD 6 are replaced by those specified in 24.4.1. The 100BASE-FX PMD Service specification is a proper subset of the PMD service specification in fiber-PMD.
- d) There are minor terminology differences between this standard and fiber-PMD that do not cause ambiguity. The terminology used in 100BASE-X was chosen to be consistent with other IEEE 802 standards, rather than with FDDI. Terminology is both defined and consistent within each standard. Special note should be made of the interpretations shown in table 26-1.

**Table 26-1—Interpretation of general FDDI terms and concepts**

| FDDI term or concept              | Interpretation for 100BASE-X           |
|-----------------------------------|--|
| bypass                            | <unused>                               |
| Connection Management (CMT)       | <no comparable entity>                 |
| frame                             | stream                                 |
| Halt Line State (HLS)             | <unused>                               |
| hybrid mode                       | <no comparable entity>                 |
| MAC (or MAC-2)                    | MAC                                    |
| Master Line State (MLS)           | <unused>                               |
| maximum frame size = 9000 symbols | maximum stream size = 3054 code-groups |

**Table 26-1—Interpretation of general FDDI terms and concepts (Continued)**

| FDDI term or concept                    | Interpretation for 100BASE-X  |
|---|---|
| PHY (or PHY-2)                          | PMA; i.e., PMD client   |
| PHY Service Data Unit (SDU)             | stream  |
| PM_SIGNAL.indication (Signal_Detect)    | PMD_SIGNAL.indicate (signal_status)                                 |
| PM_UNITDATA.indication (PM_Indication)  | PMD_UNITDATA.indicate (nrzi-bit)                                    |
| PM_UNITDATA request (PM_Request)        | PMD_UNITDATA request (nrzi-bit)                                     |
| preamble                                | inter-packet IDLEs  |
| Quiet Line State (QLS)                  | <unused>  |
| SM_PM_BYPASS request (Control_Action)   | Assume:<br>SM_PM_BYPASS request (Control_Action = Insert)           |
| SM_PM_CONTROL request (Control_Action)  | Assume:<br>SM_PM_CONTROL request (Control_Action = Transmit_Enable) |
| SM_PM_SIGNAL.indication (Signal_Detect) | <unused>  |
| Station Management (SMT)                | <no comparable entity>  |
| symbol                                  | code-group  |

## 26.4 Specific requirements and exceptions

The 100BASE-FX PMD (including MDI) and baseband medium shall conform to the requirements of fiber-PMD 8, 9, and 10. In fiber-PMD, informative annexes A through G provide additional information useful to PMD sublayer implementors. Where there is conflict between specifications in fiber-PMD and those in this standard, those of this standard shall prevail.

### 26.4.1 Medium Dependent Interface (MDI)

The 100BASE-FX medium dependent interface (MDI) shall conform to one of the following connectors. The recommended alternative is the Low Cost Fibre Optical Interface Connector.

- a) Low Cost Fibre Optical Interface Connector (commonly called the duplex SC connector) as specified in ANSI X3.237-199X, 7.1.1 through 7.3.1, inclusive.
- b) Media Interface Connector (MIC) as specified in fiber-PMD 7 and annex F. When the MIC is used, the receptacle shall be keyed as “M”.
- c) Optical Medium Connector Plug and Socket (commonly called ST connector) as specified in 15.3.2.

### 26.4.2 Crossover function

A crossover function shall be implemented in every cable-pair link. The crossover function connects the transmitter of one PHY to the receiver of the PHY at the other end of the cable-pair link. For 100BASE-FX, the crossover function is realized in the cable plant.

**26.5 Protocol Implementation Conformance Statement (PICS) proforma for clause 26, Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-FX<sup>25</sup>**

**26.5.1 Introduction**

The supplier of a protocol implementation that is claimed to conform to IEEE Std 802.3u-1995, Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-FX, 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.

**26.5.2 Identification**

**26.5.2.1 Implementation identification**

|   |  |
|---|--|
| Supplier  |  |
| Contact point for enquiries about the PICS  |  |
| Implementation Name(s) and Version(s)   |  |
| Other information necessary for full identification—e.g., name(s) and version(s) for machines and/or operating systems; System Names(s)   |  |
| <p>NOTES</p> <p>1—Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirements for the identification.</p> <p>2—The terms Name and Version should be interpreted appropriately to correspond with a supplier’s terminology (e.g., Type, Series, Model).</p> |  |

**26.5.3 Protocol summary**

|  |   |
|--|---|
| Identification of protocol standard  | IEEE Std 802.3u-1995, Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-FX |
| Identification of amendments and corrigenda to this PICS proforma that have been completed as part of this PICS  |   |
| <p>Have any Exception items been required? No <input type="checkbox"/> Yes <input type="checkbox"/></p> <p>(See clause 21; the answer Yes means that the implementation does not conform to IEEE Std 802.3u-1995.)</p> |   |
| Date of Statement  |   |

<sup>25</sup>Copyright release for PICS proformas Users of this standard may freely reproduce the PICS proforma in this annex so that it can be used for its intended purpose and may further publish the completed PICS.



### 26.5.4 Major capabilities/options

| Item | Feature   | Subclause | Status | Support | Value/Comment   |
|------|---|-----------|--------|---------|---|
| FSC  | Supports Low Cost Fibre Optical Interface Connector (duplex SC) | 26.4.2    | O/1    |         | Recommended.<br>See ANSI X3.237-199X, 7.1.1 through 7.3.1 |
| *FMC | Supports Media Interface Connector (MIC)                        | 26.4.2    | O/1    |         | See ISO 9314-3: 1990, 7 and annex F                       |
| FST  | Supports Optical Medium Connector Plug and Socket (ST)          | 26.4.2    | O/1    |         | See 15.3.2  |

### 26.5.5 PICS proforma tables for Physical Medium Dependent (PMD) sublayer and baseband medium, type 100BASE-FX

#### 26.5.5.1 General compatibility considerations

| Item | Feature                          | Subclause | Status | Support | Value/Comment |
|------|----------------------------------|-----------|--------|---------|---------------|
| GN1  | Integrates 100BASE-X PMA and PCS | 26.1      | M      |         | See clause 24 |

#### 26.5.5.2 PMD compliance

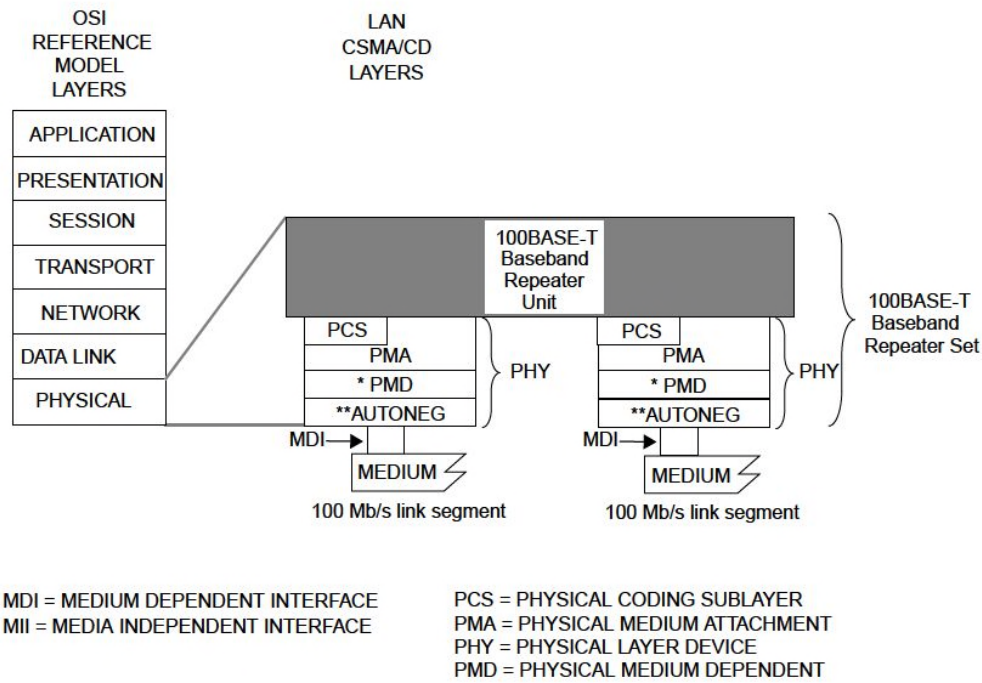
| Item | Feature   | Subclause | Status | Support | Value/Comment |
|------|---|-----------|--------|---------|---------------|
| PD1  | Compliance with 100BASE-X PMD Service Interface | 26.1      | M      |         | See 24.2.3    |
| PD2  | Compliance with ISO 9314-3: 1990 8, 9, and 10   | 26.4      | M      |         |               |
| PD3  | Precedence over ISO 9314-3: 1990                | 26.4      | M      |         |               |
| PD4  | MIC receptacle keying                           | 26.4.2    | FMC: M |         | "M"           |
| PD5  | Crossover function in cable                     | 26.4.3    | M      |         |               |

## 27. Repeater for 100 Mb/s baseband networks

### 27.1 Overview

#### 27.1.1 Scope

Clause 27 defines the functional and electrical characteristics of a repeater for use with 100BASE-T 100 Mb/s baseband networks. A repeater for any other ISO/IEC 8802-3 network type is beyond the scope of this clause. The relationship of this standard to the entire ISO/IEC 8802-3 CSMA/CD LAN standard is shown in figure 27-1. The purpose of the repeater is to provide a simple, inexpensive, and flexible means of coupling two or more segments.



\* PMD is specified for 100BASE-TX and -FX only; 100BASE-T4 does not use this layer.  
Use of MII between PCS and baseband repeater unit is optional.  
\*\* AUTONEG is optional.

Figure 27-1—100BASE-T repeater set relationship to the OSI reference model

#### 27.1.1.1 Repeater set

Repeater sets are an integral part of all 100 Mb/s baseband networks with more than two DTEs and are used to extend the physical system topology by providing a means of coupling two or more segments. Multiple repeater sets are permitted within a single collision domain to provide the maximum connection path length. Segments may be connected directly by a repeater or a pair of repeaters that are, in turn, connected by a inter-repeater link (IRL). Allowable topologies shall contain only one operative signal path between any two points on the network. A repeater set is not a station and does not count toward the overall limit of 1024 stations on a network.

A repeater set can receive, and if necessary decode, data from any segment under worst-case noise, timing, and signal amplitude conditions. It retransmits the data to all other segments attached to it with timing, amplitude, and, if necessary, coding restored. The retransmission of data occurs simultaneously with reception. If a collision occurs, the repeater set propagates the collision event throughout the network by transmitting a Jam signal. A repeater set also provides a degree of protection to a network by isolating a faulty segment's carrier activity from propagating through the network.

#### **27.1.1.2 Repeater unit**

A repeater unit is a subset of a repeater set containing all the repeater-specific components and functions, exclusive of PHY components and functions. A repeater unit connects to the PMA and, if necessary, the PCS sublayers of its PHYs.

#### **27.1.1.3 Repeater classes**

Two classes of repeater sets are defined—Class I and Class II.

Class I:

A type of repeater set specified such that in a maximum length segment topology, only one such repeater set may exist between any two DTEs within a single collision domain.

Class II:

A type of repeater set specified such that in a maximum length segment topology, only two such repeater sets may exist between any two DTEs within a single collision domain.

More complex topologies are possible in systems that do not use worst-case cable. See clause 29 for requirements.

#### **27.1.2 Application perspective**

This subclause states the broad objectives and assumptions underlying the specification defined through clause 27.

##### **27.1.2.1 Objectives**

- a) Provide physical means for coupling two or more LAN segments at the Physical Layer.
- b) Support interoperability of independently developed physical, electrical, and optical interfaces.
- c) Provide a communication channel with a mean bit error rate, at the physical service interface equivalent to that for the attached PHY.
- d) Provide for ease of installation and service.
- e) Ensure that fairness of DTE access is not compromised.
- f) Provide for low-cost networks, as related to both equipment and cabling.
- g) Make use of building wiring appropriate for the supported PHYs and telephony wiring practices.

##### **27.1.2.2 Compatibility considerations**

All implementations of the repeater set shall be compatible at the MDI. The repeater set is defined to provide compatibility among devices designed by different manufacturers. Designers are free to implement circuitry within the repeater set in an application-dependent manner provided the appropriate PHY specifications are met.