97.2 1000BASE-T1 service primitives and interfaces

1000BASE-T1 transfers data and control information across the following four service interfaces:

a) Gigabit Media Independent Interface (GMII)
b) Technology Dependent Interface
c) PMA service interface
d) Medium dependent interface (MDI)

The GMII is specified in Clause 35; the Technology Dependent Interface is specified in Clause 98. The PMA service interface is defined in 97.2.2 and the MDI is defined in TBD.

97.2.1 Technology Dependent Interface

1000BASE-T1 uses the following service primitives to exchange status indications and control signals across the Technology Dependent Interface as specified in Clause 98:

PMA_LINK.request (link_control)

PMA_LINK.indication (link_status)

97.2.1.1 PMA_LINK.request

This primitive allows the Auto-Negotiation algorithm to enable and disable operation of the PMA as specified in 98.4.2.

97.2.1.1.1 Semantics of the primitive

PMA_LINK.request (link_control)

The link_control parameter can take on one of three values: DISABLE, or ENABLE.

DISABLE	PHY processes are disabled. This allows the Auto-Negotiation algorithm to determine how to configure the link.
ENABLE	Used by Auto-Negotiation to turn control over to the PHY for data processing functions.

97.2.1.1.2 When generated

Auto-Negotiation generates this primitive to indicate a change in link_control as described in Clause 98.

97.2.1.1.3 Effect of receipt

This primitive affects operation of the PMA Link Monitor function as defined in 97.4.2.6.

97.2.1.2 PMA_LINK.indication

This primitive is generated by the PMA to indicate the status of the underlying medium as specified in 28.2.6.1. This primitive informs the PCS, PMA PHY Control function, and the Auto-Negotiation algorithm about the status of the underlying link.

97.2.1.2.1 Semantics of the primitive

PMA_LINK.indication (link_status)

The link_status parameter can take on one of two values: FAIL or OK.

FAIL	No valid link established.
OK	The Link Monitor function indicates that a valid 1000BASE-T1 link is established. Reliable reception of signals transmitted from the remote PHY is possible.

97.2.1.2.2 When generated

The PMA generates this primitive to indicate a change in link_status in compliance with the state diagram given in Figure 97–19.

97.2.1.2.3 Effect of receipt

The effect of receipt of this primitive is specified in 98.4.1.

97.2.2 PMA service interface

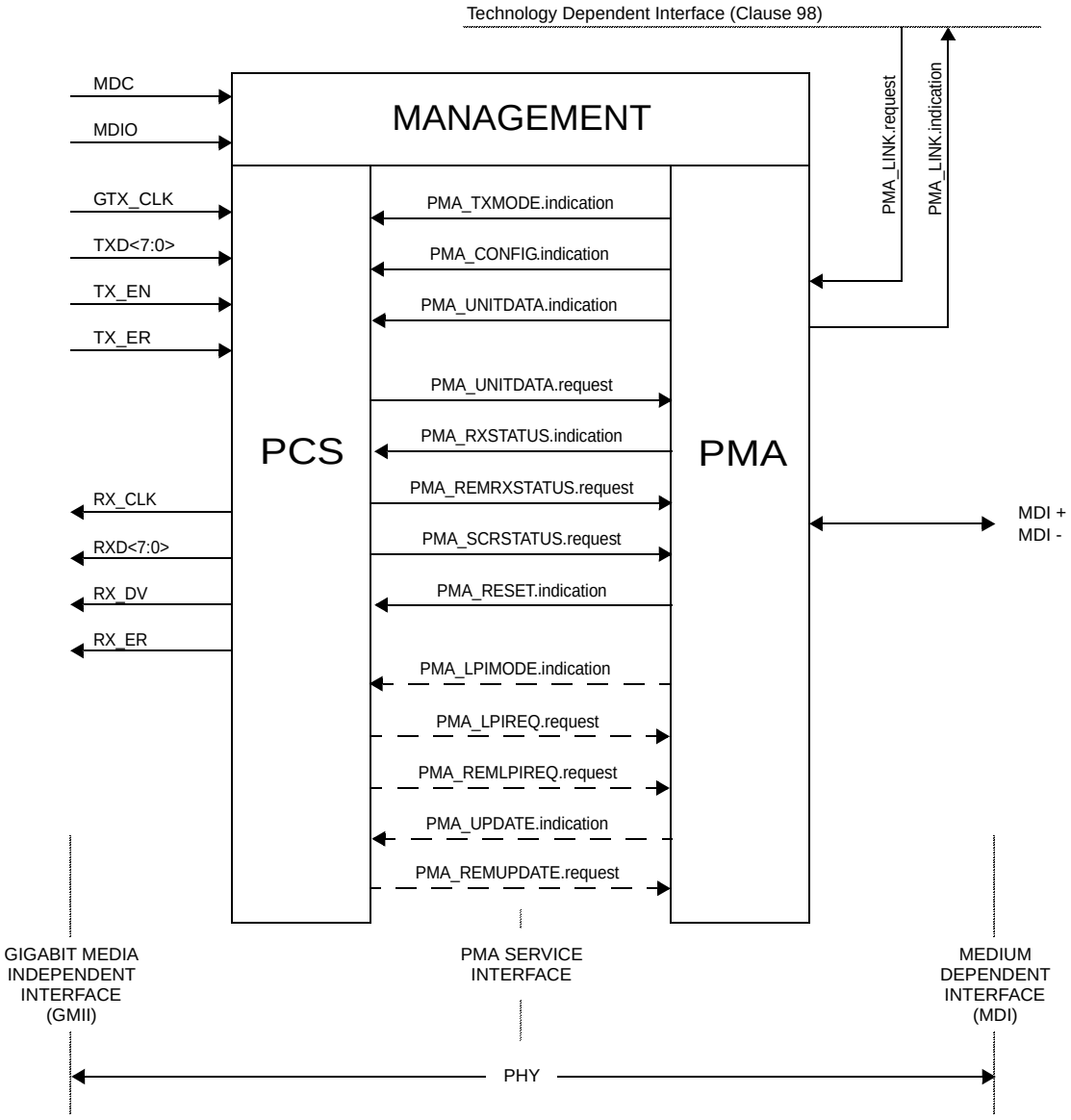
1000BASE-T1 uses the following service primitives to exchange symbol vectors, status indications, and control signals across the service interfaces:

PMA_TXMODE.indication (tx_mode)
PMA_CONFIG.indication (config)
PMA_UNITDATA.request (tx_symb)
PMA_UNITDATA.indication (rx_symb)
PMA_SCRSTATUS.request (scr_status)
PMA_PCSSTATUS.request (pcs_status)
PMA_RXSTATUS.indication (loc_rcvr_status)
PMA_REMRXSTATUS.request (rem_rcvr_status)

The use of these primitives is illustrated in Figure 97–1. Connections from the management interface (signals MDC and MDIO) to the sublayers are pervasive and are not shown in Figure 97–1.

EEE-capable PHYs additionally support the following service primitives:

PMA_PCS_RX_LPI_STATUS.request (rx_lpi_active)
PMA_PCS_TX_LPI_STATUS.request (tx_lpi_active)



NOTE—Service interface primitives shown with dashed lines are optional.

Figure 97–1—1000BASE-T service interfaces

97.2.2.1 PMA_TXMODE.indication

The transmitter in a 1000BASE-T1 link normally sends over the MDI symbols that represent a GMII data stream with framing, scrambling and encoding of data, control information, or idles.

97.2.2.1.1 Semantics of the primitive

PMA_TXMODE.indication (tx_mode)

PMA_TXMODE.indication specifies to PCS Transmit via the parameter tx_mode what sequence of code-groups the PCS should be transmitting. The parameter tx_mode can take on one of the following four values of the form:

SEND_N	This value is continuously asserted when transmission of sequences of symbols representing a GMII data stream in normal mode.
SEND_I	This value is continuously asserted when transmission of sequences of idle symbols.
SEND_T	This value is continuously asserted in case transmission of sequences of code-groups representing the training mode is to take place.
SEND_Z	This value is continuously asserted in case transmission of zeros is required.

97.2.2.1.2 When generated

The PMA PHY Control function generates PMA_TXMODE.indication messages to indicate a change in tx_mode.

97.2.2.1.3 Effect of receipt

Upon receipt of this primitive, the PCS performs its transmit function as described in 97.3.2.2.

97.2.2.2 PMA_CONFIG.indication

Each PHY in a 1000BASE-T1 link is capable of operating as a MASTER PHY and as a SLAVE PHY. MASTER-SLAVE configuration is determined during Auto-Negotiation (98). The result of this negotiation is provided to the PMA.

97.2.2.2.1 Semantics of the primitive

PMA_CONFIG.indication (config)

PMA_CONFIG.indication specifies to PCS and PMA Transmit via the parameter config whether the PHY operates as a MASTER PHY or as a SLAVE PHY. The parameter config can take on one of the following two values of the form:

MASTER	This value is continuously asserted when the PHY operates as a MASTER PHY.
SLAVE	This value is continuously asserted when the PHY operates as a SLAVE PHY.

97.2.2.2.2 When generated

PMA generates PMA_CONFIG.indication messages to indicate a change in config.

97.2.2.2.3 Effect of receipt

PCS and PMA Clock Recovery perform their functions in MASTER or SLAVE configuration according to the value assumed by the parameter config.

97.2.2.3 PMA_UNITDATA.request

This primitive defines the transfer of code-groups in the form of the tx_symb parameter from the PCS to the PMA. The code-groups are obtained in the PCS Transmit function using the encoding rules defined in 97.3.2.2 to represent GMII data and control streams or other sequences.

97.2.2.3.1 Semantics of the primitive

PMA_UNITDATA.request (tx_symb)

During transmission, the PMA_UNITDATA.request simultaneously conveys to the PMA via the parameter tx_symb the value of the symbols to be sent over the MDI. The tx_symb may take on one of the values in the set { –1, 0, 1 }

97.2.2.3.2 When generated

The PCS generates PMA_UNITDATA.request (tx_symb) synchronously with every transmit clock cycle.

97.2.2.3.3 Effect of receipt

Upon receipt of this primitive the PMA transmits on the MDI the signals corresponding to the indicated symbols after processing with optional transmit filtering and other specified PMA Transmit processing. The parameter tx_symb is also used by the PMA Receive function to process the signals received on the MDI for cancelling the echo.

97.2.2.4 PMA_UNITDATA.indication

This primitive defines the transfer of code-groups in the form of the rx_symb parameter from the PMA to the PCS.

97.2.2.4.1 Semantics of the primitive

PMA_UNITDATA.indication (rx_symb)

During reception the PMA_UNITDATA.indication simultaneously conveys to the PCS via the parameter rx_symb the values of the symbols detected on the MDI.

97.2.2.4.2 When generated

The PMA generates PMA_UNITDATA.indication (rx_symb) messages synchronously for every symbol received at the MDI. The nominal rate of the PMA_UNITDATA.indication primitive is 750 MHz, as governed by the recovered clock.

97.2.2.4.3 Effect of receipt

The effect of receipt of this primitive is unspecified.

97.2.2.5 PMA_SCRSTATUS.request

This primitive is generated by PCS Receive to communicate the status of the descrambler for the local PHY. The parameter scr_status conveys to the PMA Receive function the information that the training mode descrambler has achieved synchronization.

97.2.2.5.1 Semantics of the primitive

PMA_SCRSTATUS.request (scr_status)

The scr_status parameter can take on one of two values of the form:

OK	The training mode descrambler has achieved synchronization.
NOT_OK	The training mode descrambler is not synchronized.

97.2.2.5.2 When generated

PCS Receive generates PMA_SCRSTATUS.request messages to indicate a change in scr_status.

97.2.2.5.3 Effect of receipt

The effect of receipt of this primitive is specified in 97.4.2.4 and 97.4.2.5.

97.2.2.6 PMA_PCSSTATUS.request

This primitive is generated by PCS Receive to indicate the fully operational state of the PCS for the local PHY. The parameter pcs_status conveys to the PMA Receive function the information that the PCS is operating reliably in data mode.

97.2.2.6.1 Semantics of the primitive

PMA_PCSSTATUS.request (pcs_status)

The pcs_status parameter can take on one of two values of the form:

OK	The PCS is operating reliably in data mode.
NOT_OK	The PCS is not operating reliably in data mode.

97.2.2.6.2 When generated

PCS Receive generates PMA_PCSSTATUS.request messages to indicate a change in pcs_status.

97.2.2.6.3 Effect of receipt

The effect of receipt of this primitive is specified in 97.4.2.5.9 and 97.4.5.

97.2.2.7 PMA_RXSTATUS.indication

This primitive is generated by PMA Receive to indicate the status of the receive link at the local PHY. The parameter loc_rcvr_status conveys to the PCS Transmit, PCS Receive, PMA PHY Control function, and Link Monitor the information on whether the status of the overall receive link is satisfactory or not. Note that loc_rcvr_status is used by the PCS Receive decoding functions. The criterion for setting the parameter loc_rcvr_status is left to the implementor. It can be based, for example, on observing the mean-square error at the decision point of the receiver and detecting errors during reception of symbol stream.

97.2.2.7.1 Semantics of the primitive

PMA_RXSTATUS.indication (loc_rcvr_status)

The loc_rcvr_status parameter can take on one of two values of the form:

OK	This value is asserted and remains true during reliable operation of the receive link for the local PHY.
NOT_OK	This value is asserted whenever operation of the link for the local PHY is unreliable.

97.2.2.7.2 When generated

PMA Receive generates PMA_RXSTATUS.indication messages to indicate a change in loc_rcvr_status on the basis of signals received at the MDI.

97.2.2.7.3 Effect of receipt

The effect of receipt of this primitive is specified in Figure 97–18 and in subclauses 97.3.2.3 and 97.4.5.2.

97.2.2.8 PMA_REMRXSTATUS.request

This primitive is generated by PCS Receive to indicate the status of the receive link at the remote PHY as communicated by the remote PHY via its encoding of its loc_rcvr_status parameter. The parameter rem_rcvr_status conveys to the PMA PHY Control function the information on whether reliable operation of the remote PHY is detected or not. The criterion for setting the parameter rem_rcvr_status is left to the implementor. It can be based, for example, on asserting rem_rcvr_status is NOT_OK until loc_rcvr_status is OK and then asserting the detected value of rem_rcvr_status after proper PCS Receive decoding is achieved.

97.2.2.8.1 Semantics of the primitive

PMA_REMRXSTATUS.request (rem_rcvr_status)

The rem_rcvr_status parameter can take on one of two values of the form:

OK	The receive link for the remote PHY is operating reliably.
NOT_OK	Reliable operation of the receive link for the remote PHY is not detected.

97.2.2.8.2 When generated

The PCS generates PMA_REMRXSTATUS.request messages to indicate a change in rem_rcvr_status on the basis of signals received at the MDI.

97.2.2.8.3 Effect of receipt

The effect of receipt of this primitive is specified in Figure 97–18.

97.2.2.9 PMA_PCS_RX_LPI_STATUS.request

When the PHY supports the EEE capability this primitive is generated by the PCS receive function to indicate the status of the receive link at the local PHY. The parameter PMA_PCS_RX_LPI_STATUS.request conveys to the PCS transmit and PMA receive functions information regarding whether the receive function is in the LPI receive mode. The parameter is generated by the PCS Receive state diagram in Figure 97–11—.

97.2.2.9.1 Semantics of the primitive

PMA_PCS_RX_LPI_STATUS.request (rx_lpi_active)

The rx_lpi_active parameter can take on one of two values of the form:

TRUE	The receive function is in the LPI receive mode.
FALSE	The receive function is not in the LPI receive mode.

97.2.2.9.2 When generated

The PCS generates PMA_PCS_RX_LPI_STATUS.request messages to indicate a change in the rx_lpi_active variable as determined by the receive state diagram in Figure 97–11—.

97.2.2.9.3 Effect of receipt

The effect of receipt of this primitive is specified in 97.3.5.4.

97.2.2.10 PMA_PCS_TX_LPI_STATUS.request

When the PHY supports the EEE capability this primitive is generated by the PCS receive function to indicate the status of the transmit link at the local PHY. The parameter PMA_PCS_TX_LPI_STATUS.request conveys to the PCS transmit and PMA receive functions information regarding whether the transmit function is in the LPI transmit mode. The parameter is generated by the PCS Transmit state diagram in Figure 97–10—.

97.2.2.10.1 Semantics of the primitive

PMA_PCS_TX_LPI_STATUS.request (tx_lpi_active)

The tx_lpi_active parameter can take on one of two values of the form:

TRUE	The transmit function is in the LPI transmit mode.
FALSE	The transmit function is not in the LPI transmit mode.

97.2.2.10.2 When generated

The PCS generates PMA_PCS_TX_LPI_STATUS.request messages to indicate a change in the tx_lpi_active variable as determined by the transmit state diagram in Figure 97–10—.

97.2.2.10.3 Effect of receipt

The effect of receipt of this primitive is specified in 97.3.5.4.