*Contributors Note: In this contribution **megenta text** is used to highlight specific items the reader may wish to discuss or will need updating when included in the draft (e.g., change font to external link, add Xref, etc.). If not discussed these will be incorporated in the draft as baseline (assuming an appropriate motion is passed).*

Insert new clauses and corresponding annexes as follows:

157. Introduction to 10 Gb/s, 25 Gb/s, and 50 Gb/s Ethernet Bidirectional PHYs

157.1 Overview

157.1.1 Scope

This clause describes the general requirements for 10 Gb/s, 25 Gb/s, and 50 Gb/s Ethernet Bidirectional Physical Layer entities (PHYs). Within this clause this family of PHYs are collectively referred to as Multi-Gigabit Ethernet BiDi PHYs. These PHYs are divided into two variants based on the direction of transmission; Optical Line Terminal (OLT) PHYs transmit in the downstream direction and Optical Network Unit (ONU) PHYs transmit in the upstream direction.

All Multi-Gigabit Ethernet BiDi PHYs specified herein use the IEEE 802.3 MAC sublayer operating at a data rate of 10 Gb/s, 25 Gb/s, or 50 Gb/s as appropriate and are defined for full duplex operation only.

The Multi-Gigabit Ethernet BiDi PHYs, shown in Table 157–1, provide a frame loss ratio of less than 6.2×10^{-10} for 64-octet frames with minimum interpacket gap.

157.1.2 Relationship of Multi-Gigabit Ethernet BiDi PHYs to the ISO OSI reference model

The Multi-Gigabit Ethernet BiDi PHYs couple to the IEEE 802.3 MAC. The relationships among the IEEE 802.3 Multi-Gigabit Ethernet BiDi Physical Medium Attachment (PMA), Physical Medium Attachment (PMA), forward error correction (FEC), and Physical Coding Sublayer (PCS) sublayers and the IEEE 802.3 MAC, with respect to the ISO Open System Interconnection (OSI) reference model are shown in Figure 157–1.

While this specification defines interfaces in terms of bits, octets, and frames, implementations may choose other data-path widths for implementation convenience. Exceptions to implementation choices are specified in 44.1.3 (for 10 Gb/s), 105.1.2 (for 25 Gb/s), and 131.1.2 (for 50 Gb/s) apply. In addition to these exceptions the MDI specifications for Multi-Gigabit Ethernet BiDi PHYs are as follows:

a) for 10 Gb/s PHYs see Clause 158,
b) for 25 Gb/s PHYs see Clause 159, and
c) for 50 Gb/s PHYs see Clause 160.

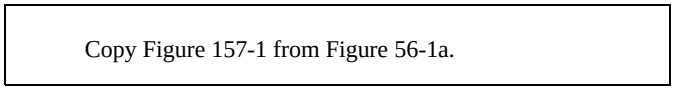

Figure 157–1—Architectural positioning of Multi-Gigabit Ethernet BiDi PHYs

157.1.3 Nomenclature

Within this clause the Multi-Gigabit Ethernet Bidi PHY device use the following nomenclature.

rrGBASE-BRx-d
Where:
rr refers to the PHY rate in Gb/s; 10, 25, or 50.
x refers to the PHY reach; 10 (10 km), 20 (20 km), or 40 (40 km).
d refers to the transmit direction of the PHY; D = downstrean, U = upstream.

The term xMII is used to generically refer to the family of Media Independent Interfaces (MII) including the GMII, 25GMII, or 50GMII.

All Multi-Gigabit Ethernet BiDi PHYs are listed in Table 157–1.

Table 157–1—Multi-Gigabit Ethernet BiDi PHYs

Name	Description
10G-BASE-BR10-D	10 Gb/s OLT PHY using 10GBASE-R encoding over one single-mode fiber, with reach up to at least 10 km (see Clause 158).
10G-BASE-BR20-D	10 Gb/s OLT PHY using 10GBASE-R encoding over one single-mode fiber, with reach up to at least 20 km (see Clause 158).
10G-BASE-BR40-D	10 Gb/s OLT PHY using 10GBASE-R encoding over one single-mode fiber, with reach up to at least 40 km (see Clause 158).
10G-BASE-BR10-U	10 Gb/s ONU PHY using 10GBASE-R encoding over one single-mode fiber, with reach up to at least 10 km (see Clause 158).
10G-BASE-BR20-U	10 Gb/s ONU PHY using 10GBASE-R encoding over one single-mode fiber, with reach up to at least 20 km (see Clause 158).
10G-BASE-BR40-U	10 Gb/s ONU PHY using 10GBASE-R encoding over one single-mode fiber, with reach up to at least 40 km (see Clause 158).
25G-BASE-BR10-D	25 Gb/s OLT PHY using 25GBASE-R encoding over one single-mode fiber, with reach up to at least 10 km (see Clause 159).
25G-BASE-BR20-D	25 Gb/s OLT PHY using 25GBASE-R encoding over one single-mode fiber, with reach up to at least 20 km (see Clause 159).
25G-BASE-BR40-D	25 Gb/s OLT PHY using 25GBASE-R encoding over one single-mode fiber, with reach up to at least 40 km (see Clause 159).
25G-BASE-BR10-U	25 Gb/s ONU PHY using 25GBASE-R encoding over one single-mode fiber, with reach up to at least 10 km (see Clause 159).
25G-BASE-BR20-U	25 Gb/s ONU PHY using 25GBASE-R encoding over one single-mode fiber, with reach up to at least 20 km (see Clause 159).
25G-BASE-BR40-U	25 Gb/s ONU PHY using 25GBASE-R encoding over one single-mode fiber, with reach up to at least 40 km (see Clause 159).
50G-BASE-BR10-D	50 Gb/s OLT PHY using 50GBASE-R encoding over one single-mode fiber, with reach up to at least 10 km (see Clause 160).

Table 157–1—Multi-Gigabit Ethernet BiDi PHYs *(continued)*

Name	Description
50G-BASE-BR20-D	50 Gb/s OLT PHY using 50GBASE-R encoding over one single-mode fiber, with reach up to at least 20 km (see Clause 160).
50G-BASE-BR40-D	50 Gb/s OLT PHY using 50GBASE-R encoding over one single-mode fiber, with reach up to at least 40 km (see Clause 160).
50G-BASE-BR10-U	50 Gb/s ONU PHY using 50GBASE-R encoding over one single-mode fiber, with reach up to at least 10 km (see Clause 160).
50G-BASE-BR20-U	50 Gb/s ONU PHY using 50GBASE-R encoding over one single-mode fiber, with reach up to at least 20 km (see Clause 160).
50G-BASE-BR40-U	50 Gb/s ONU PHY using 50GBASE-R encoding over one single-mode fiber, with reach up to at least 40 km (see Clause 160).

157.1.4 Physical Layer signaling systems

This standard specifies a family of Physical Layer implementations. Table 157–2, Table 157–3, and Table 157–4 specify the correlation between PHY types and specific clauses for the PCS, FEC, PMA and PMD. Implementations conforming to one or more PHY types must meet the requirements of the corresponding clauses.

Editor's Note: I've specified Clause 51 PMA below, we may want to consider Cl 83 PMA however that is a multi-lane PMA and may require more exceptions. I assumed Cl 74 FEC. These tables should be place so as to avoid breaking the page.

Table 157–2—Nomenclature and clause correlation, 10G-BASE-BRx

Nomenclature	Clause									
	46		49	74	78	51	78	158		
	RS	GMII	64B/66B PCS	FEC	EEE	Serial PMA	EEE	10 Gb/s PMD		
								10 km	20 km	40 km
10G-BASE-BR10-D	M	O	M	O	O	M	O	M		
10G-BASE-BR20-D	M	O	M	O	O	M	O		M	
10G-BASE-BR40-D	M	O	M	M	O	M	O			M
10G-BASE-BR10-U	M	O	M	O	O	M	O	M		
10G-BASE-BR20-U	M	O	M	O	O	M	O		M	
10G-BASE-BR40-U	M	O	M	M	O	M	O			M

Table 157–3—Nomenclature and clause correlation, 25G-BASE-BRx

Nomenclature	Clause/Annex											
	74	78	106		107	108	109	109 A	109 B	159		
										25 Gb/s PMD		
	BASE-R FEC	EEE	RS	25GMII	25GBASE-R PCS	25GBASE-R FEC	PMA	25GAUI C2C	25GAUI C2M	10 km	20 km	40 km
25G-BASE-BR10-D	??	O	M	O	M	O	M	O	O	M		
25G-BASE-BR20-D	??	O	M	O	M	M	M	O	O		M	
25G-BASE-BR40-D	??	O	M	O	M	M	M	O	O			M
25G-BASE-BR10-U	??	O	M	O	M	O	M	O	O	M		
25G-BASE-BR20-U	??	O	M	O	M	M	M	O	O		M	
25G-BASE-BR40-U	??	O	M	O	M	M	M	O	O			M

Table 157–4—Nomenclature and clause correlation, 50G-BASE-BRx

Nomenclature	Clause/Annex														
	78	132		133	134	135	135B	135C	135D	135E	135F	135G	160		
													50 Gb/s PMD		
	EEE	RS	50GMII	50GBASE-R PCS	50GBASE-R FEC	PMA	50GAUI C2C	50GAUI C2M	50GAUI-2 C2C	50GAUI-2 C2M	50GAUI-1 C2C	50GAUI-1 C2m	10 km	20 km	40 km
50G-BASE-BR10-D	O	M	O	M	M	M	O	O	O	O	O	O	M		
50G-BASE-BR20-D	O	M	O	M	M	M	O	O	O	O	O	O		M	
50G-BASE-BR40-D	O	M	O	M	M	M	O	O	O	O	O	O			M
50G-BASE-BR10-U	O	M	O	M	M	M	O	O	O	O	O	O	M		
50G-BASE-BR20-U	O	M	O	M	M	M	O	O	O	O	O	O		M	
50G-BASE-BR40-U	O	M	O	M	M	M	O	O	O	O	O	O			M

157.2 Summary of Multi-Gigabit Ethernet BiDi syblayers

157.2.1 Reconciliation Sublayer (RS) and Media Independent Interface (XGMII, 25GMII, and 50GMII)

The RS provides a mapping between the signals provided at the xMII and the MAC/PLS service definition.

The xMII provides a logical interconnection between the MAC sublayer and Physical Layer entities (PHY). The xMII may be physically instantiated or can logically connect layers within a device. While the xMII is an optional interface, it is used extensively in this standard as a basis for functional specification and provides a common service interface for the Physical Coding Sublayer (PCS).

The specific RS and xMII specified for a given Multi-Gigabit Ethernet Bidi PHY is given in Table 157–2, Table 157–3, or Table 157–4.

157.2.2 Physical Coding Sublayer (PCS)

The PCS performs encoding of data from the MII to 64B/66B code blocks and transfers the encoded data to the PMA or FEC sub-layer and performs decoding of 64B/66B blocks from the PMA or FEC sub-layer and transfers the decoded data to the MII. The specific PCS specified for a given Multi-Gigabit Ethernet Bidi PHY is given in Table 157–2, Table 157–3, or Table 157–4.

157.2.3 Forward Error Correction (FEC) sublayer

An FEC sublayer is available for all Multi-Gigabit BiDi PHYs. The FEC sublayer can be placed in between the PCS and PMA sublayers or between two PMA sublayers. The specific FEC specified for a given Multi-Gigabit Ethernet Bidi PHY is given in Table 157–2, Table 157–3, or Table 157–4.

157.2.4 Physical Medium Attachment (PMA) sublayer

The PMA sublayer provides a medium-independent means for the PCS or FEC sub-layers to support the use of a range of physical media. The PMA performs the mapping of transmit and receive data streams between the PCS or FEC and PMA via the PMA service interface and mapping of transmit and receive data streams between the PMA and PMD via the PMD service interface.

The PMA performs retiming of the received data stream when appropriate, optionally provides data loopback at the PMA or PMD service interface, and optionally provides test-pattern generation and checking. The PMA also may provide an observable electrical interface for the 25GAUI or 50GAUI chip-to-chip (C2C) or chip-to-module (C2M).

The specific PMA specified for a given Multi-Gigabit Ethernet Bidi PHY is given in Table 157–2, Table 157–3, or Table 157–4.

157.2.5 Physical Medium Dependent (PMD) sublayer

The PMD sublayer is responsible for interfacing to the transmission medium. The MDI connects the PMD to the medium and is defined in the associated PMD clause. The specific PMD specified for a given Multi-Gigabit Ethernet Bidi PHY is given in Table 157–2, Table 157–3, or Table 157–4.

157.2.6 Management interface (MDIO/MDC)

The optional MDIO/MDC management interface (Clause 45) provides an interconnection between MDIO Manageable Devices (MMDs) and Station Management (STA) entities.

157.2.7 Management

Managed objects, attributes, and actions are defined for all Multi-Gigabit Ethernet BiDi PHYcomponents. These items are defined in Clause 30.

157.3 Service interface specification method and notation

The service interface specification for Multi-Gigabit Ethernet BiDi Physical Layers is as per the definition in 1.2.2.

The 10GBASE-BRx PHYs use the inter-sublayer service interfaces specified in 49.2.2.

The 25GBASE-BRx PHYs use the inter-sublayer service interfaces specified in 105.4.

The 50GBASE-BRx PHYs use the inter-sublayer service interfaces specified in 131.3.

157.4 Delay constraints

Predictable operation of the MAC Control PAUSE operation (Clause 31, Annex 31B) demands that there be an upper bound on the propagation delays through the network. This implies that MAC, MAC Control sublayer, and PHY implementers must conform to certain delay maxima, and that network planners and administrators conform to constraints regarding the cable topology and concatenation of devices.

The maximum delay for 10GBASE-BRx PHYs sublayers are specified in 44.3.

The maximum delay for 25GBASE-BRx PHYs sublayers are specified in 105.5.

The maximum delay for 50GBASE-BRx PHYs sublayers are specified in 131.4.

157.5 State diagrams

State diagrams take precedence over text.

The conventions of 1.2 are adopted, along with the extensions listed in 21.5.

Multiple states of a function that have a transition to a common state utilizing different qualifiers (for example, multiple exit conditions to an IDLE or WAIT state) may be indicated by a shared arrow. An exit transition arrow must connect to the shared arrow, and the qualifier must be met prior to termination of the transition arrow on the shared arrow. The shared arrow has no qualifier.

157.6 Silent Start

<<<From Draft 0.2>>>

157.7 Protocol implementation conformance statement (PICS) proforma

The supplier of a protocol implementation that is claimed to conform to any part of IEEE Std 802.3, Clause 45, Clause 73, Clause 74, Clause 106 through Clause 112, Clause 114, Clause 158 through Clause 160, and related annexes demonstrates compliance by completing a protocol implementation conformance statement (PICS) proforma.

A completed PICS proforma is the PICS for the implementation in question. The PICS is a statement of which capabilities and options of the protocol have been implemented. A PICS is included at the end of each clause as appropriate. Each of the Multi-Gigabit Ethernet BiDi PICS conforms to the same notation and conventions used in 21.6.