56. Introduction to Ethernet for subscriber access networks

56.1 Overview

Modify the second paragraph in 56.1 as shown below:

In addition, a mechanism for network Operations, Administration, and Maintenance (OAM) is included to facilitate network operation and troubleshooting. 100BASE-LX10 extends the reach of 100BASE-X to achieve 10 km over conventional single-mode two-fiber cabling. The relationships between these EFM elements and the ISO/IEC Open System Interconnection (OSI) reference model are shown in Figure 56–1 for point-to-point topologies, Figure 56–2 for 1G-EPON topologies, Figure 56–3 for 10/10G-EPON topologies, Figure 56–4 for 10/1G-EPON topologies, ~~and~~ Figure 56–5 for EPoC topologies, and Figure 56–5 for Nx25G-EPON topologies.

Modify a new Figure 56-5a after existing Figure 56-5:

Modify the last paragraph in 56.1 as shown below:

The EFM architecture is further extended in:

— ~~in~~ Clause 75 and Clause 76 by the addition of 10G–EPON,~~. 10G–EPON includes the 10/10G-EPON (10 Gb/s downstream and 10 Gb/s upstream) as well as 10/1G-EPON (10 Gb/s downstream and 1 Gb/s upstream) PONs. The EFM architecture is further extended in~~
— Clause 100, Clause 101, and Clause 102 by the addition of EPoC,
— Clause 141, Clause 142, and Clause 143 by the addition of Nx25G-EPON.~~.~~

56.1.2 Summary of P2MP sublayers

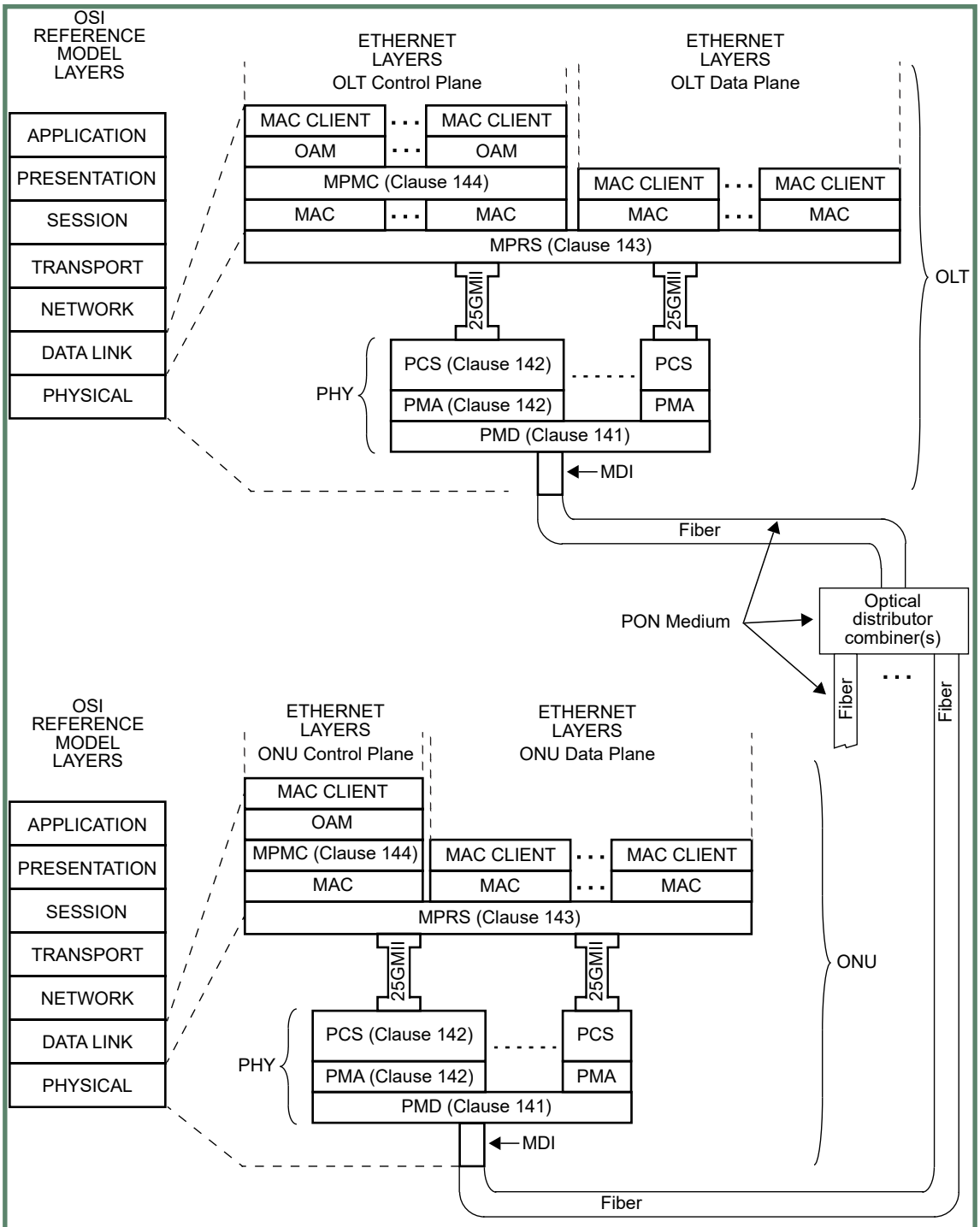
Modify the lettered list in 56.1.2 as shown below:

For P2MP optical fiber topologies, EFM supports ~~two~~the following systems:

a) PON with ~~a~~the nominal ~~bit~~MAC data rate of 1000 Mb/s in both downstream and upstream directions (1G-EPON), shared amongst the population of Optical Network Units (ONUs) attached to the P2MP topology. The P2MP PHYs use the 1000BASE-PX Physical Coding Sublayer (PCS), the Physical Medium Attachment (PMA) sublayer defined in Clause 65 and an optional forward error correction (FEC) function defined in Clause 65.

b) PON with ~~a~~the nominal ~~bit~~MAC data rate of 10 Gb/s in both the downstream and upstream directions (10/10G-EPON) as well as PON with ~~a~~the nominal ~~bit~~MAC ~~-~~data rate of 10 Gb/s in the downstream direction and 1 Gb/s in the upstream direction (10/1G-EPON), shared amongst the population of ONUs attached to the P2MP topology, and collectively referred to as 10G-EPON. The P2MP PHYs for the 10/10G-EPON use the 10GBASE-PR PCS and PMA (see ~~Clause 75~~Clause 76). The P2MP PHYs for 10/1G-EPON use the 10GBASE-PRX PCS and PMA (see Clause 76). EPONs using a nominal 10 Gb/s bit rate use a mandatory FEC function defined in Clause 76 in any direction running at the 10 Gb/s bit rate.

c) PON with the nominal MAC data rate of 25 Gb/s in the downstream direction and 10 Gb/s in the upstream direction (25/10G-EPON), 25 Gb/s in both the downstream and upstream directions (25/25G-EPON), 50 Gb/s in the downstream direction and 10 Gb/s in the upstream direction (50/10G-EPON), 50 Gb/s in the downstream direction and 25 Gb/s in the upstream direction (50/25G-EPON), and 50 Gb/s in both the downstream and upstream directions (50/50G-EPON), shared amongst the population of ONUs attached to the P2MP topology, and collectively referred to as Nx25G-EPON. The P2MP PHYs for the 25/10G-EPON and 25/25G-EPON use a single channel in each direction. The P2MP PHYs for the 50/10G-EPON and 50/25G-EPON use two channels in the downstream direction and a single channel in the upstream direction. The P2MP PHYs for the 50/



25GMII= 25 GIGABIT MEDIA INDEPENDENT INTERFACE
MDI = MEDIUM DEPENDENT INTERFACE
OAM = OPERATIONS, ADMINISTRATION & MAINTENANCE
OLT = OPTICAL LINE TERMINAL
MPRS= MULTI-POINT RECONCILIATION SUBLAYER
MPMC= MULTI-POINT MAC CONTROL
ONU = OPTICAL NETWORK UNIT
PCS = PHYSICAL CODING SUBLAYER
PHY = PHYSICAL LAYER DEVICE
PMA = PHYSICAL MEDIUM ATTACHMENT
PMD = PHYSICAL MEDIUM DEPENDENT

Figure 56–5a—Relationship of Nx25G-EPON P2MP PMD to the ISO/IEC OSI reference model and the IEEE 802.3 Ethernet model

50G-EPON uses two channels in each direction. Each PCS and PMA channel operates at 25.78125 GBd line rate in the downstream direction and 25.78125 GBd or 10.3125 GBd in the upstream direction. Each PCS channel implements a mandatory FEC function in each direction (see Clause 142).

56.1.2.1 Multipoint MAC Control Protocol (MPCP)

Modify paragraph number 1 and 2 in 56.1.2.1 as shown below:

The Multipoint MAC Control Protocol (MPCP) for 1G-EPON uses messages, state diagrams, and timers, as defined in Clause 64, to control access to a P2MP topology~~,~~; ~~while~~ Clause 77 defines the messages, state diagrams, and timers required to control access to a P2MP ODN topology in 10G-EPON; and Clause 144 defines the messages, state diagrams, and timers required to control access to a P2MP ODN topology in Nx25G-EPON. The issues related to coexistence of 1G-EPON and 10G-EPON on the same fiber plant are described in 77.4.

Every P2MP ODN topology consists of one Optical Line Terminal (OLT) plus one or more ONUs, as shown in Figure 56–2, Figure 56–3, ~~and~~ Figure 56–4, and Figure 56–5 for 1G-EPON, 10/10G-EPON ~~and~~, 10/1G-EPON, and Nx25G-EPON, respectively. One of several instances of the MPCP in the OLT communicates with the instance of the MPCP in the ONU. A pair of MPCPs that communicate between the OLT and ONU are a distinct and associated pair.

56.1.2.2 Reconciliation Sublayer (RS) and media independent interfaces

Modify paragraph number 1 and 4 in 56.1.2.2 as shown below:

The Clause 22 RS and MII, Clause 35 RS and GMII, and Clause 46 RS and XGMII are all employed for the same purpose in EFM, that being the interconnection between the MAC sublayer and the PHY sublayers. Extensions to the Clause 35 RS for P2MP topologies are described in Clause 65, the RS for 10G-EPON P2MP topologies is described in Clause 76, the RS for Nx25G-EPON P2MP topologies is described in Clause 143, and the RS for EPoC P2MP topologies is described in Clause 101.

This is described in Clause 65 for EPON, in Clause 76 for 10G-EPON, in Clause 143 for Nx25G-EPON, and in Clause 101 for EPoC. EFM Copper links use the MII of Clause 22 operating at 100 Mb/s. This is described in 61.1.4.1.2.

56.1.3 Physical Layer signaling systems

Insert a new paragraph in 56.1.3 after the statement "All 10G-EPON PMDs are defined in Clause 75":

Additionally, EFM introduces a family of Physical Layer signaling systems which are derived from 25GBASE–R, but which include RS, PCS and PMA sublayers adapted for Nx25G-EPON, along with a mandatory FEC capability, as defined in Clause 142. All of these systems employ the PMD defined in Clause 141. The family of P2MP Physical Layer signaling systems utilizes exclusively 25GBASE-R signaling for the downstream and upstream directions, supporting the following series of PMD combinations:

a) <TBD, list of PMDs to be filled in, once we know what combinations are supported when PMD tables get filled in>.

All Nx25G-EPON PMDs are defined in Clause 141.

Modify the last paragraph in 56.1.3 as shown below, inserting a new table 56-4 and modifying existing Table 56-3 as shown below:

Table 56–2 specifies the correlation between nomenclature and clauses for P2P systems, while Table 56–2 specifies the correlation between nomenclature and clauses for optical P2MP systems, and Table 56–3 specifies the correlation between nomenclature and clauses for coaxial P2MP systems. A complete implementation conforming to one or more nomenclatures meets the requirements of the corresponding clauses.

Table 56–2—Nomenclature and clause correlation for optical P2MP systems[a]

Nomenclature	Clause															
	57	60				64	65		66	75	76	77	~~Clause 100~~ 141	~~Clause 101~~ 142	~~Clause 102~~ 143	~~Clause 103~~ 144
	OAM	1000BASE-PX10 PMD	1000BASE-PX20 PMD	1000BASE-PX30 PMD	1000BASE-PX40 PMD	P2MP MPMC	P2MP RS, PCS, PMA	FEC	1000BASE-X PCS, PMA	10/1GBASE–PRX or 10GBASE-PR PMDs	P2MP RS, PCS, PMA, FEC	10G-EPON P2MP MPMC	~~10GPASS-XR~~Nx25GBASE-PQ PMD	~~EPoC~~Nx25GBASE-PQ P2MP ~~RS,~~ PCS, PMA, FEC	~~EPoC PHY Link~~Nx25GBASE-PQ M2MP MPRS	~~EPoC~~Nx25GBASE-PQ P2MP MPMC
1000BASE-PX10-D	O	M				M	M	O	M							
1000BASE-PX10-U	O	M				M	M	O								
1000BASE-PX20-D	O		M			M	M	O	M							
1000BASE-PX20-U	O		M			M	M	O								
1000BASE-PX30-D	O			M		M	M	O	M							
1000BASE-PX30-U	O			M		M	M	O								
1000BASE-PX40-D	O				M	M	M	O	M							
1000BASE-PX40-U	O				M	M	M	O								
10/1GBASE-PRX-D1	O			M		M				M	M	M				
10/1GBASE-PRX-U1	O			M		M				M	M	M				
10/1GBASE-PRX-D2	O				M	M				M	M	M				
10/1GBASE-PRX-U2	O				M	M				M	M	M				
10/1GBASE-PRX-D3	O					M				M	M	M				
10/1GBASE-PRX-U3	O					M				M	M	M				
10/1GBASE-PRX-D4	O					M				M	M	M				
10/1GBASE-PRX-U4	O					M				M	M	M				
10GBASE-PR-D1	O									M	M	M				
10GBASE-PR-U1	O									M	M	M				
10GBASE-PR-D2	O									M	M	M				

Table 56–2—Nomenclature and clause correlation for optical P2MP systems[a] *(continued)*

Nomenclature	Clause														
	57	60				64	65		66	75	76	77	~~Clause 100~~ 141	~~Clause 101~~ 142	~~Clause 102~~ 143	~~Clause 103~~ 144
	OAM	1000BASE-PX10 PMD	1000BASE-PX20 PMD	1000BASE-PX30 PMD	1000BASE-PX40 PMD	P2MP MPMC	P2MP RS, PCS, PMA	FEC	1000BASE-X PCS, PMA	10/1GBASE–PRX or 10GBASE-PR PMDs	P2MP RS, PCS, PMA, FEC	10G-EPON P2MP MPMC	~~10GPASS-XR~~Nx25GBASE-PQ PMD	~~EPoC~~Nx25GBASE-PQ P2MP ~~RS,~~ PCS, PMA, FEC	~~EPoC PHY-Link~~Nx25GBASE-PQ M2MP MPRS	~~EPoC~~Nx25GBASE-PQ P2MP MPMC
10GBASE-PR-D3	O									M	M	M				
10GBASE-PR-U3	O									M	M	M				
10GBASE-PR-D4	O									M	M	M				
10GBASE-PR-U4	O									M	M	M				
25/10GBASE-PQ11G-U2~~10GPASS-XR-D~~	O												M	M	M	M
~~10GPASS-XR-U~~25/ 10GBASE-PQ11G-U3	O												M	M	M	M
25/10GBASE-PQ11G-D2	O												M	M	M	M
25/10GBASE-PQ11G-D3	O												M	M	M	M
25/10GBASE-PQ11X-U2	O												M	M	M	M
25/10GBASE-PQ11X-U3	O												M	M	M	M
25/10GBASE-PQ11X-D2	O												M	M	M	M
25/10GBASE-PQ11X-D3	O												M	M	M	M
25GBASE-PQ11G-U2	O												M	M	M	M
25GBASE-PQ11G-U3	O												M	M	M	M
25GBASE-PQ11G-D2	O												M	M	M	M
25GBASE-PQ11G-D3	O												M	M	M	M
25GBASE-PQ11X-U2	O												M	M	M	M
25GBASE-PQ11X-U3	O												M	M	M	M
25GBASE-PQ11X-D2	O												M	M	M	M
25GBASE-PQ11X-D3	O												M	M	M	M
50/10GBASE-PQ21G-U2	O												M	M	M	M
50/10GBASE-PQ21G-U3	O												M	M	M	M
50/10GBASE-PQ21G-D2	O												M	M	M	M

Table 56–2—Nomenclature and clause correlation for optical P2MP systems[a] *(continued)*

Nomenclature	Clause														
	57	60				64	65		66	75	76	77	~~Clause 100~~ 141	~~Clause 101~~ 142	~~Clause 102~~ 143	~~Clause 103~~ 144
	OAM	1000BASE-PX10 PMD	1000BASE-PX20 PMD	1000BASE-PX30 PMD	1000BASE-PX40 PMD	P2MP MPMC	P2MP RS, PCS, PMA	FEC	1000BASE-X PCS, PMA	10/1GBASE–PRX or 10GBASE-PR PMDs	P2MP RS, PCS, PMA, FEC	10G-EPON P2MP MPMC	~~10GPASS-XR~~Nx25GBASE-PQ PMD	~~EPoC~~Nx25GBASE-PQ P2MP ~~RS,~~ PCS, PMA, FEC	~~EPoC PHY Link~~Nx25GBASE-PQ M2MP MPRS	~~EPoC~~Nx25GBASE-PQ P2MP MPMC
50/10GBASE-PQ21G-D3	O												M	M	M	M
50/10GBASE-PQ21X-U2	O												M	M	M	M
50/10GBASE-PQ21X-U3	O												M	M	M	M
50/10GBASE-PQ21X-D2	O												M	M	M	M
50/10GBASE-PQ21X-D3	O												M	M	M	M
50/25GBASE-PQ21G-U2	O												M	M	M	M
50/25GBASE-PQ21G-U3	O												M	M	M	M
50/25GBASE-PQ21G-D2	O												M	M	M	M
50/25GBASE-PQ21G-D3	O												M	M	M	M
50/25GBASE-PQ21X-U2	O												M	M	M	M
50/25GBASE-PQ21X-U3	O												M	M	M	M
50/25GBASE-PQ21X-D2	O												M	M	M	M
50/25GBASE-PQ21X-D3	O												M	M	M	M
50GBASE-PQ22X-U2	O												M	M	M	M
50GBASE-PQ22X-U3	O												M	M	M	M
50GBASE-PQ22X-D2	O												M	M	M	M
50GBASE-PQ22X-D3	O												M	M	M	M
50GBASE-PQ22G-U2	O												M	M	M	M
50GBASE-PQ22G-U3	O												M	M	M	M
50GBASE-PQ22G-D2	O												M	M	M	M
50GBASE-PQ22G-D3	O												M	M	M	M

[a]O = Optional, M = Mandatory

Table 56–3—Nomenclature and clause correlation for coaxial P2MP systems[a]

Nomenclature	Clause 57 OAM	Clause 101 EPoC P2MP RS, PCS, PMA, FEC	Clause 102 EPoC PHY-Link	Clause 103 EPoC P2MP MPMC
10GPASS-XR-D	O	M	M	M
10GPASS-XR-U	O	M	M	M

[a]O = Optional, M = Mandatory