Security Level:

P2P Ethernet Access

A short review and next steps

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What will be covered

- **Pertinent clauses and their outlines**
- **Clause 114 (25GBASE-LR/ER) table by table**
- **What's next**
- **Timelines and Deadlines**

P2P by Clause

- **Clause 56. Introduction to Ethernet for subscriber access networks**
  - Figure 56–1—Architectural positioning of EFM: P2P Topologies
  - 56.1.1 Summary of P2P sublayers
- **58. PMD sublayer and medium, type 100BASE-LX10 and 100BASE-BX10**
  - About 36 pages
- **59. PMD sublayer and medium, type 1000BASE-LX10 and 1000BASE-BX10**
  - About 29 pages
- **66. Extensions of the 10 Gb/s RS, 100BASE-X & 1000BASE-X PHY for unidirectional transport**
  - About 11 pages
- **Other applicable clauses**
  - 52. PMD sublayer and baseband medium, type 10GBASE-S/L/E (about 43 pages)
  - 114. PMD sublayer and medium, types 25GBASE-LR/ER (about 19 pages)

PHY	Rate (b/s)	Fibers	Wavelength (nm)	Coding	Reach (km)	min Insertion Loss (dB)
100BASE-LX	100M	2	1310	8B10B	10	6
100BASE-BX	100M	1	1550D/1310U	8B10B	10	5.5 - 6
1000BASE-LX*	1G	2	1310	8B10B	10	6
1000BASE-BX	1G	1	1490D/1310U	8B10B	10	5.5 - 6

* Defined for both SMF and MMF

Clause 59 1000BASE-LX/BX outline

(Selectively compressed)

Clause 52 10GBASE-S/L/E outline

52.1 Overview
52.1.1 PMD sublayer service interface
52.2 Delay constraints
52.3 PMD MDIO function mapping
52.4 PMD functional specs
52.4.1 PMD block diagram
52.4.2 PMD Transmit function
52.4.3 PMD Receive function
52.4.4 PMD Signal Detect function
52.4.5 PMD_reset function
52.4.6 PMD_fault function
52.4.7 PMD_global_transmit_disable function
52.4.8 PMD_transmit_fault function
52.4.9 PMD_receive_fault function
52.5 PMD-MDI optical specs 10GBASE-S
52.5.1 10GBASE-S transmitter optical specs
52.5.2 10GBASE-S receive optical specs
52.5.3 10GBASE-S link power budgets (info).
52.6 PMD-MDI optical specs 10GBASE-L
52.7 PMD-MDI optical specs 10GBASE-E
52.8 Jitter specs for 10GBASE-R / W
52.8.1 Sinusoidal jitter for receiver conformance test
52.9 Optical measurement requirements
52.9.1 Test patterns.
52.9.2 λ0, spectral width, & SMSR measurements
52.9.3 Average optical power measurements
52.9.4 Extinction ratio measurements
52.9.5 OMA test procedure
52.9.6 RINxOMA measuring procedure
52.9.7 Transmitter optical waveform.
52.9.8 Receiver sensitivity measurements
52.9.9 Stressed receiver conformance test
52.9.10 Tx and dispersion penalty measurement
52.9.11 Measurement Rx3 dB elec upper cutoff freq
52.10 Environmental specs.
52.10.1 General safety
52.10.2 Laser safety
52.10.3 Installation
52.11 Environment
52.11.1 Electromagnetic emission
52.11.2 Temperature, humidity, and handling
52.12 PMD labeling requirements
52.13 Fiber optic cabling model
52.14 Characteristics of the fiber optic cabling (channel)
52.14.1 Optical fiber and cable
52.14.2 Optical fiber connection.
52.14.3 10GBASE-E attenuator management
52.14.4 Medium Dependent Interface (MDI) requirements
52.15 PICS

(Selectively compressed)

Clause 114 25GBASE-LR/ER outline

114.1 Overview
114.1.1 Bit error ratio
114.2 PMD service interface
(105.4) (25GMII) Service interface dpec
114.3 Delay constraints.
114.4 PMD MDIO function mapping.
114.5 PMD functional specs
114.5.1 PMD block diagram
114.5.2 PMD transmit function
114.5.3 PMD receive function.
114.5.4 PMD global signal detect function
114.5.5 PMD reset function.
114.5.6 PMD global tx disable function (optional)
114.5.7 PMD fault function (optional)
114.5.8 PMD transmit fault function (optional)
114.5.9 PMD receive fault function (optional)
114.6 PMD-MDI optical specs for 25GBASE-LR/ER
114.6.1 25GBASE-LR/ER transmitter optical specs
114.6.2 25GBASE-LR/ER receive optical specs
114.6.3 25GBASE-LR/ER link power budgets (ill)

114.7 Def of optical params and mea methods
114.7.1 Test patterns for optical parameters
114.7.2 Wavelength and (SMSR)
114.7.3 Average optical power
114.7.4 Optical Modulation Amplitude (OMA)
114.7.5 Transmitter and dispersion penalty (TDP)
114.7.5.1 Reference transmitter requirements
114.7.5.2 Channel requirements
114.7.5.3 Reference receiver requirements
114.7.5.4 Test procedure.
114.7.6 Extinction ratio
114.7.7 Relative Intensity Noise (RIN20OMA).
114.7.8 Transmitter optical waveform (transmit eye)
114.7.9 Receiver sensitivity.
114.7.10 Stressed receiver sensitivity
114.8 Safety, installation, environment, and labeling
(112.8) Safety, installation, environment, and labeling
114.9 Fiber optic cabling model
114.10 Char of the fiber optic cabling (channel)
(88.11.1) Optical fiber cable.
(88.11.2) Optical fiber connection
114.11 Req for iop between 25GBASE-LR/ER.
114.12 PICS

(Selectively compressed)

An outline to consider

KEY:
Text common to 52, 59 & 114
Text common to 2 of 52, 59, & 114
Proposed xRef

XX.1 Overview
XX.2 PMD sublayer service interface
(105.4/46.1.7) 25GMII/XGMII service interface spec
XX.3 Delay constraints
XX.4 PMD MDIO function mapping
XX.5 PMD functional specs
XX.5.1 PMD block diagram
XX.5.2 PMD transmit function
XX.5.3 PMD receive function
XX.5.4 PMD signal detect function
XX.5.5 (59/114) PMD_reset function
XX.5.6 (59/114) PMD_fault function
XX.5.7 (59/114) PMD_global_tx_disable function
XX.5.8 (59/114) PMD_transmit_fault function
XX.5.9 (59/114) PMD_receive_fault function
XX.6 PMD to MDI optical specs
XX.6.1 PMD transmitter optical specs
XX.6.2 PMD receiver optical specs
XX.6.3 (59/114) PMD link power budgets (informative)
XX.7 {52/59) PMD to MDI optical specs
XX.7.2 (52/59) PMD transmit optical specs
XX.7.1 (52/59) Receiver optical specs
XX.8 (52,59) Jitter specs
XX.9 Def of optical param & mea. methods.
XX.9.1 Test patterns
XX.9.2 λ0, spectral width, & SMSR measurements
XX.9.3 Average optical power measurements
XX.9.4 Extinction ratio measurements
XX.9.5 Optical modulation amplitude (OMA) test procedure
XX.9.6 RIN optical modulation amplitude
XX.9.7 Transmitter and dispersion penalty (TDP)
XX.9.8 Receive sensitivity measurements
XX.9.9 Stressed receiver conformance test
XX.9.10 (52,59) Mea of the rx 3 dB elel upper cutoff freq
XX.10 Safety, installation, environment, and labeling.
(112.8.x/52.10.x)General & Laser safety, Installation , Environment, Electromagnetic emission, Temperature, humidity, and handling, PMD labeling requirements
XX.11 Fiber optic cabling model
XX.12 Characteristics of the fiber optic cabling
(88.11.x/51.14.x)Optical fiber cable/connection, Connection iol, Max discrete reflectance
XX.12.5 (52,59) Medium Dependent Interface (MDI)
XX.13 PICS

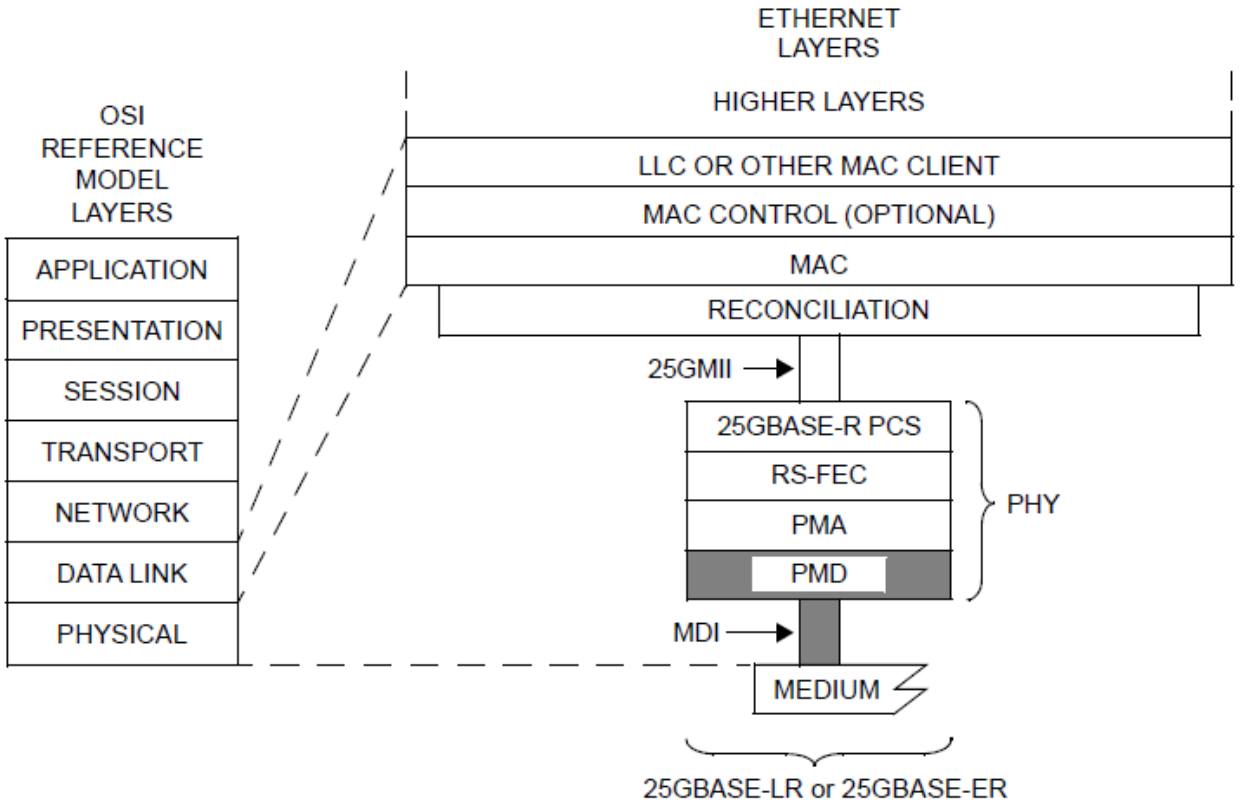
Overview

Table 114–1—Physical Layer clauses associated with the 25GBASE-LR and 25GBASE-ER PMDs

Associated clause	25GBASE-LR	25GBASE-ER
106—RS	Required	Required
106—25GMII[a]	Optional	Optional
107—PCS for 25GBASE-R	Required	Required
108—RS-FEC[b]	Required	Required
109—PMA for 25GBASE-R	Required	Required
109A—25GAUI C2C	Optional	Optional
109B—25GAUI C2M	Optional	Optional
78—Energy Efficient Ethernet	Optional	Optional

[a]The 25GMII is an optional interface. However, if the 25GMII is not implemented, a conforming implementation must behave functionally as though the RS and 25GMII were present.
[b]The option to bypass the Clause 108 RS-FEC correction function is not supported.

Architecture



25GMII = 25 GIGABIT MEDIA INDEPENDENT INTERFACE
LLC = LOGICAL LINK CONTROL
MAC = MEDIA ACCESS CONTROL
MDI = MEDIUM DEPENDENT INTERFACE
PCS = PHYSICAL CODING SUBLAYER
PHY = PHYSICAL LAYER DEVICE
PMA = PHYSICAL MEDIUM ATTACHMENT
PMD = PHYSICAL MEDIUM DEPENDENT
RS-FEC = REED-SOLOMON FORWARD ERROR CORRECTION
LR = PMD FOR SINGLE-MODE FIBER - 10 km
ER = PMD FOR SINGLE-MODE FIBER - 40 km

Figure 114–1—25GBASE-LR and 25GBASE-ER PMDs relationship to the ISO/IEC Open Systems Interconnection (OSI) reference model and the IEEE 802.3 Ethernet model

Block diagram

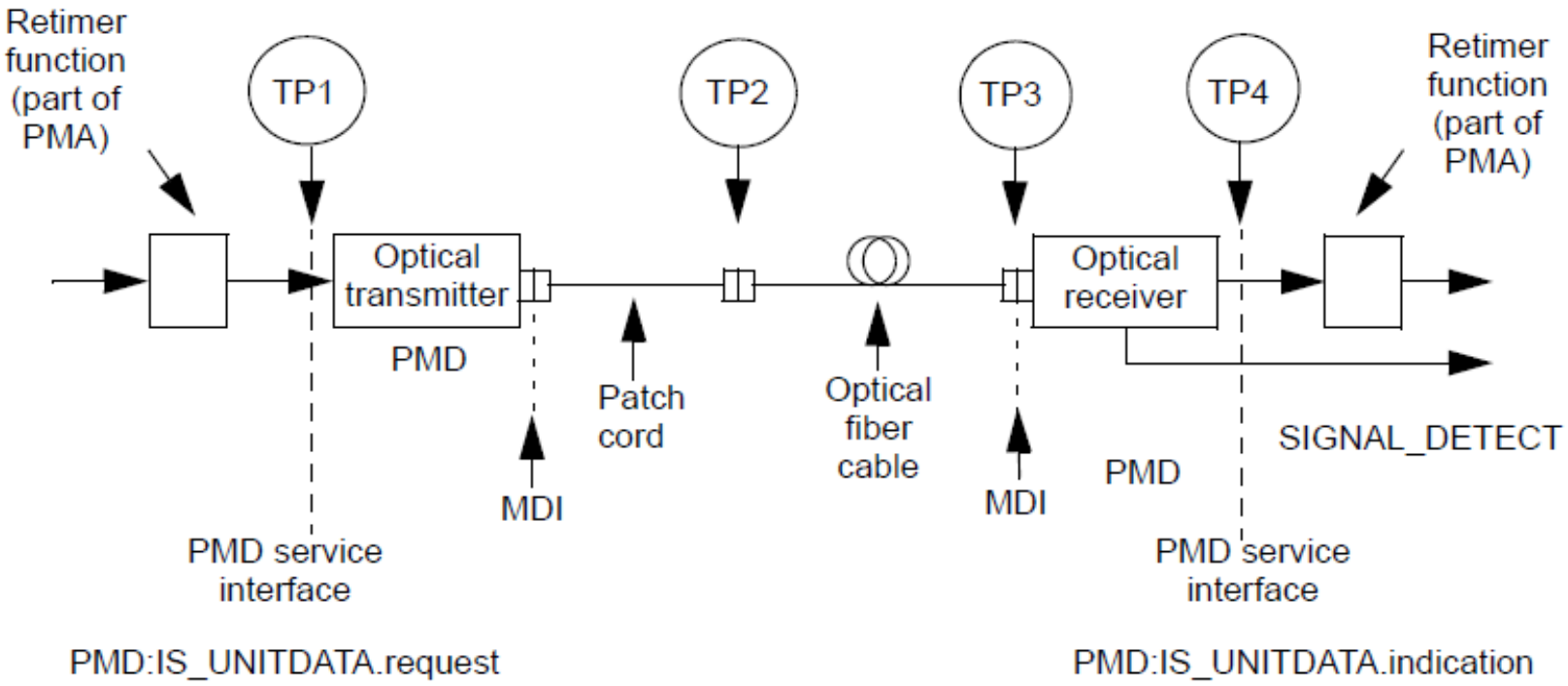


Figure 114–2—Block diagram for 25GBASE-LR and 25GBASE-ER transmit/receive paths

Variable mapping & operating ranges

Table 114–2—MDIO/PMD control variable mapping

MDIO control variable	PMA/PMD register name	Register/bit number	PMD control variable
Reset	PMA/PMD control 1 register	1.0.15	PMD_reset
Global PMD transmit disable	PMD transmit disable register	1.9.0	PMD_global_transmit_disable

Table 114–3—MDIO/PMD status variable mapping

MDIO status variable	PMA/PMD register name	Register/ bit number	PMD status variable
Fault	PMA/PMD status 1 register		
Transmit fault	PMA/PMD status 2 register		
Receive fault	PMA/PMD status 2 register		
Global PMD receive signal detect	PMD receive signal detect registe		

Table 114–5—25GBASE-LR and 25GBASE-ER operating ranges

PMD type	Required operating range[a]
25GBASE-LR	2 m to 10 km
25GBASE-ER	2 m to 30 km
	2 m to 40 km[b]

[a]The RS-FEC correction function may not be bypassed for any operating distance.
[b]Links longer than 30 km for the same link power budget are considered engineered links. Attenuation for such links needs to be less than the worst case specified for IEC 60793-2-50 type B1.1, type B1.3, or type B6_a single-mode fiber.

Tx Spec

Table 114–6—25GBASE-LR and 25GBASE-ER transmit characteristics

Description	25GBASE-LR	25GBASE-ER	Unit
Signaling rate (range)	25.78125 ± 100 ppm		GBd
Center wavelength (range)	1295 to 1325	1295 to 1310	nm
Side-mode suppression ratio (SMSR), (min)	30		dB
Average launch power (max)	2	6	dBm
Average launch power[a] (min)	–7	–3	dBm
Optical Modulation Amplitude (OMA), (max)	2.2	6	dBm
Optical Modulation Amplitude (OMA)[b], (min)	–4	0	dBm
Launch power in OMA minus TDP (min)	–5	–1	dBm
Transmitter and dispersion penalty (TDP), (max)	2.7	2.7	dB
Average launch power of OFF transmitter (max)	–20		dBm
Extinction ratio (min)	3	4	dB
$RIN_{20}OMA$ (max)	–130		dB/Hz
Optical return loss tolerance (max)	20		dB
Transmitter reflectance[c] (max)	–26		dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3} Hit ratio 5×10^{-5} hits per sample.	{0.31, 0.4, 0.45, 0.34, 0.38, 0.4}		

[a]Average launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
[b]Even if the TDP < 1 dB, the OMA (min) must exceed this value.
[c]Transmitter reflectance is defined looking into the transmitter.

Rx Spec

Table 114–7—25GBASE-LR and 25GBASE-ER receive characteristics

Description	25GBASE-LR	25GBASE-ER	Unit
Signaling rate (range)	25.78125 ± 100 ppm		GBd
Center wavelength (range)	1295 to 1325		nm
Damage threshold[a] (min)	3	–3	dBm
Average receive power (max)	2	–4	dBm
Average receive power[b] (min)	–13.3	–21	dBm
Receive power (OMA), (max)	2.2	–4	dBm
Receiver reflectance (max)	–26		dB
Receiver sensitivity (OMA)[c], (max)	–12	–19	dBm
Stressed receiver sensitivity (OMA)[d], (max)	–9.5	–16.5	dBm
Conditions of stressed receiver sensitivity test			
Stressed eye closure[e]	2.5	2.5	dB
Stressed eye J2 Jitter[e]	0.27	0.27	UI
Stressed eye J4 Jitter[e]	0.39	0.39	UI
SRS eye mask definition {X1, X2, X3, Y1, Y2, Y3} Hit ratio 5×10^{-5} hits per sample.	{0.31, 0.4, 0.45, 0.34, 0.38, 0.4}		

[a]The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.

[b]Average receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

[c]Receiver sensitivity (OMA), (max) is informative.

[d]Measured with conformance test signal at TP3 (see 114.7.10) for the BER specified in 114.1.1.

[e]Stressed eye closure, stressed eye J2 Jitter, and stressed eye J4 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Link budgets

Table 114–8—25GBASE-LR and 25GBASE-ER illustrative link power budgets

Parameter	25GBASE-LR	25GBASE-ER		Unit
Power budget (for maximum TDP)	9.7	20.7		dB
Operating distance	10	30	40[a]	km
Channel insertion loss	6.3[b]	15[b]	See 114.9[a]	dB
Maximum discrete reflectance	See 114.10	See 114.10		dB
Allocation for penalties[c] (for maximum TDP)	3.4	20.7 minus maximum channel insertion loss per Table 114–12		dB
Additional insertion loss allowed	0	Maximum channel insertion loss per Table 114–12 minus 15	0	dB

[a]Links longer than 30 km are considered engineered links. Attenuation for such links needs to be less than the worst case for cables containing IEC 60793-2-50 type B1.1, type B1.3, or type B6_a single-mode cabled optical fiber.
[b]The channel insertion loss is calculated using the maximum distance specified in Table 114–5 and fiber attenuation of 0.43 dB/km at 1295 nm plus an allocation for connection and splice loss given in 88.11.2.1.
[c]Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

Channel characteristics

Table 114–11—Fiber optic cabling (channel) characteristics

Description	25GBASE-LR	25GBASE-ER		Unit
Operating distance (max)	10	30	40	km
Channel insertion loss[a, b] (max)	6.3	See Table 114–12		dB
Channel insertion loss (min)	0	10[c]		dB
Positive dispersion[b] (max)	22.6	27.6	36.8	ps/nm
Negative dispersion[b] (min)	–27.9	–83.7	–111.6	ps/nm
DGD_max[d]	8	10.3	10.3	ps
Optical return loss (min)	21	21	21	dB

[a]These channel insertion loss values include cable, connectors, and splices.
[b]Over the wavelength range 129[illegible]
25GBASE-ER.
[c]Channel insertion loss (min) may [illegible]
[d]DGD_max is the maximum differ[illegible]

Table 114–14—Channel insertion loss requirements for interoperation

Direction	Min loss	Max loss	Unit
25GBASE-LR transmitter to 25GBASE-ER receiver	6.2	13.3	dB
25GBASE-ER transmitter to 25GBASE-LR receiver	4	10.3	dB

What is needed?

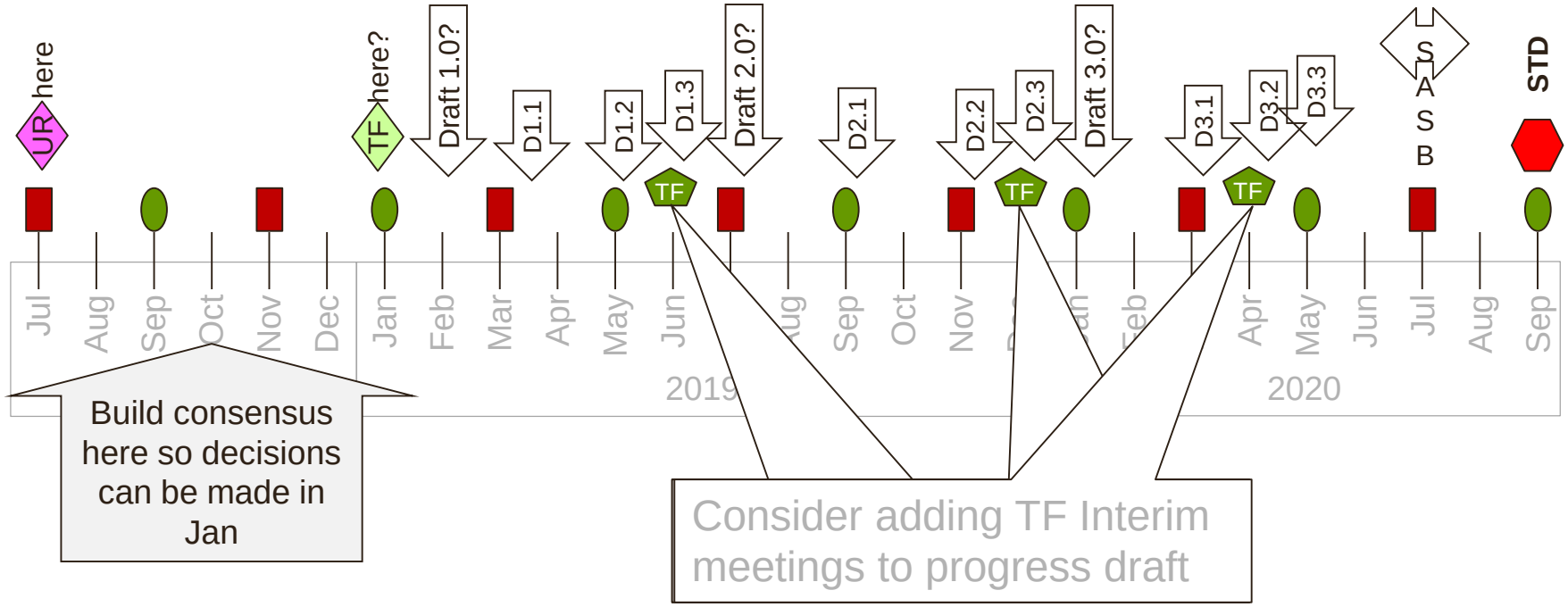
- **Adaptation for 10 Gb/s based on**
  - Clause 44. Introduction to 10 Gb/s baseband network,
  - Clause 48. Physical Coding Sublayer (PCS) and Physical Medium Attachment (PMA) sublayer, type 10GBASE-X, and
  - Clause 49. Physical Coding Sublayer (PCS) for 64B/66B, type 10GBASE-R
    - Could also consider 256B/257B encoding based on 91.5.2.5
  - Clause 52. PMD sublayer and baseband medium type 10GBASE-S/L/E
- **Adaptation for 25 Gb/s based on**
  - Clause 105. Introduction to 25 Gb/s networks.
  - Clause 106. Reconciliation Sublayer (RS) and Media Independent Interface (25GMII) for 25 Gb/s operation, and
  - Clause 107. Physical Coding Sublayer (PCS) for 64B/66B, type 25GBASE-R
    - Do we want to consider Nx25G-EPON PCS instead?
  - Clause 88. PMD sublayer and medium, type 100GBASE-LR4 and 100GBASE-ER4
    <OR>
    Clause 114. PMD sublayer and medium, types 25GBASE-LR/ER
- **Basic PMD choices**
  - Select wavelength plan(s) (1270 nm / 1350 nm ?)
  - Select optical budgets (one for 10 km, another for 20 km at each rate?)
  - Select optional FEC (or maybe same optical budget with & without FEC)?

Misc Thoughts

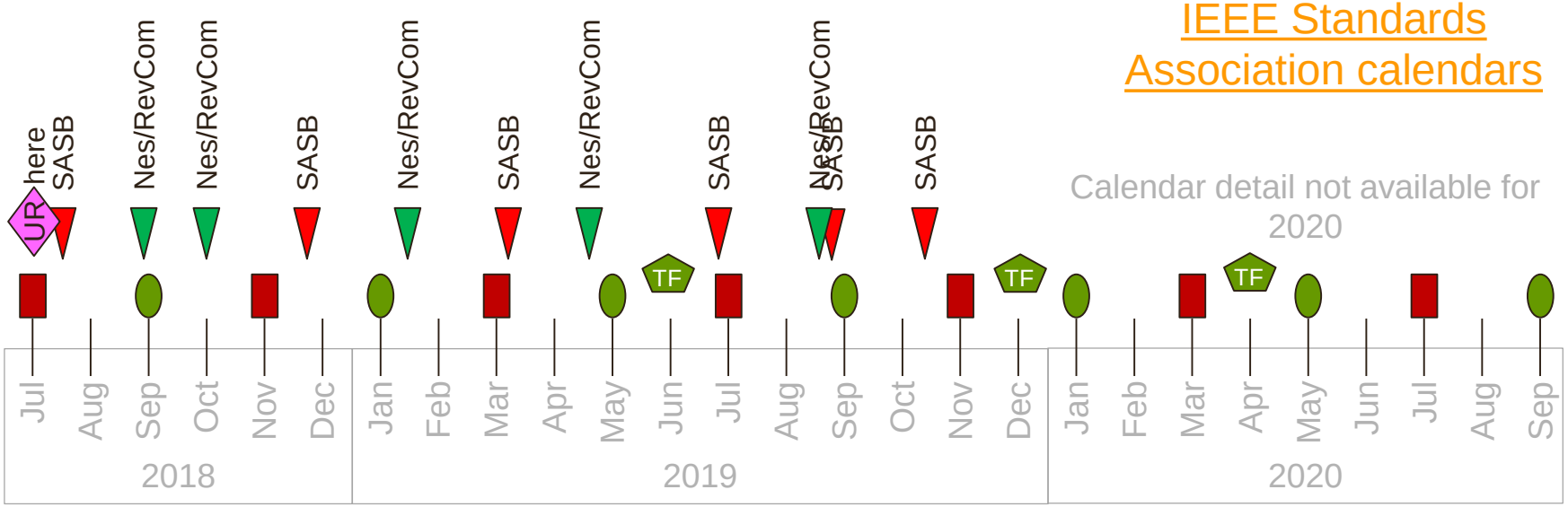
- **Possible distractions to be avoided**
  - MMF versions
  - 2 fiber (100BASE-LX / 1000BASE-LX like) versions

- **How can we accelerate the process?**
  - Use the time between now and Jan (when we hopefully become a Task Force) to achieve consensus on big ticket items
    - Wavelengths
    - Optical Budgets
    - FEC / no FEC
    - Line code
    - …
  - Reference existing text whenever possible
  - Agree on an aggressive timeline
    - Allow for Task Force interim meetings to close out comments
    - Be aware of submittal deadlines

How fast can we run?



Important calendar dates



[IEEE Standards Association calendars]

Calendar detail not available for 2020

Group	Start	Days	Type
SASB	12-Jun-18	3	
802.3 WG	9-Jul-18	4	P
SASB	27-Jul-18	-	Tel
NesCom/RevCom	6-Sep-18	-	Tel
802.3 WG	10-Sep-18	5	I
NesCom/RevCom	15-Oct-18	-	Tel
802.3 WG	15-Nov-18	4	P
SASB	3-Dec-18	3	

Group	Start	Days	Type
802.3 WG	14-Jan-19	5	I
NesCom/RevCom	28-Jan-19	-	Tel
802.3 WG	14-Mar-19	4	P
SASB	19-Mar-19	3	
NesCom/RevCom	2-May-19	-	Tel
802.3 WG	20-May-19	5	I
SASB	13-Jul-19	-	Tel
802.3 WG	18-Jul-19	4	P
NesCom/RevCom	4-Sep-19	-	Tel
SASB	5-Sep-19	-	Tel
802.3 WG	9-Sep-19	5	I
SASB	5-Nov-19	3	
802.3 WG	14-Nov-19	4	P

NesCom/RevCom Submittal Deadlines:
27-Jul-18
6-Sep-18
15-Oct-18
18-Dec-18
8-Feb-19
22-Mar-19
3-May-19
26-Jul-19
17-Sep-19

Deadlines that must be met

Action	Days	Rule explaination
Draft PAR, CSD responses, and Objectives submittal to WG	(30)	No requirement in rules but generaly included in 30 day meeting announcement
Draft PAR and CSD responses submittal to EC	30	30 Days in advance of plenary meeting where draft PAR and CSD responses will be considered
PAR submittal to NesCom and SASB	40/50	40 days, 50 days for last meeting of year, submittal can occur before WG/EC approval
Initial Task Force Ballot period and Recirculation	-	There are no rules or requirement for Task Force review, no requirement to have one
Draft Working Group ballot request preview	10	The draft has to pre-submitted to the WG 10 days prior to the request for approval to proceed to WG ballot
Initial Working Group Ballot period	30	
Working Group Recirculation Ballot period	15	
Sponsor Ballot Group formation period	30	
Mandatory editorial Coordination (MEC)	30	Has to be performed on a draft before it proceeds to Sponsor ballot, worst case time, generally a lot quicker
Draft submittal for Sponsor Ballot (after WG/EC approval)	5	Worst case time, generally a lot quicker
Initial Sponsor Ballot period	30	
Draft submittal for Sponsor Recirculation Ballot	5	Worst case time, generally a lot quicker
Sponsor Recirculation Ballot period	15	
Draft final submittal to RevCom and SASB (after WG/EC approval)	40/50	40 days, 50 days for last meeting of year, submittal can occur before EC approval, also conditional approval

Thank you

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BACK-UP

Overview

Table 59–1—Classification of 1000BASE-LX10 and 1000BASE-BX10 PMDs

Description	1000BASE-LX10		1000BASE-BX10-D	1000BASE-BX10-U	Unit
Fiber type[a]	B1.1, B1.3 SMF	50, 62.5 µm MMF	B1.1, B1.3 SMF		
Number of fibers	2	2	1		
Typical transmit direction	N/A		Downstream	Upstream	
Nominal transmit wavelength	1310	1310	1490	1310	nm
Minimum range	0.5 m to 10 km	0.5 m to 550 m[b]	0.5 m to 10 km		
Maximum channel insertion loss[c]	6.0	2.4	5.5	6.0	dB

[a]Per IEC 60793-2.
[b]See Table 59–16 for fiber and cable characteristics.
[c]At the nominal operating wavelength

Architecture

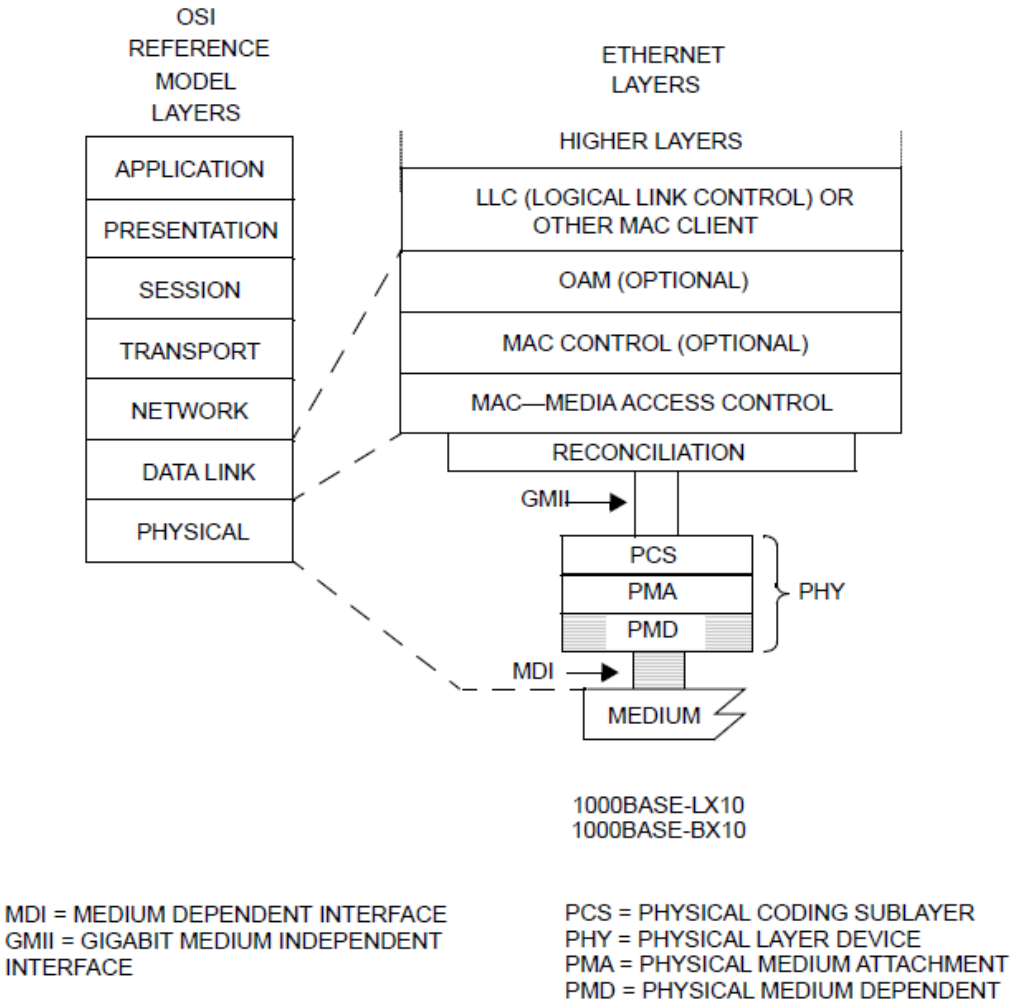

Figure 59–1—1000BASE-LX10 and 1000BASE-BX10 PMDs relationship to the ISO/IEC Open Systems Interconnection (OSI) reference model and the IEEE 802.3 Ethernet model

Block Diagram

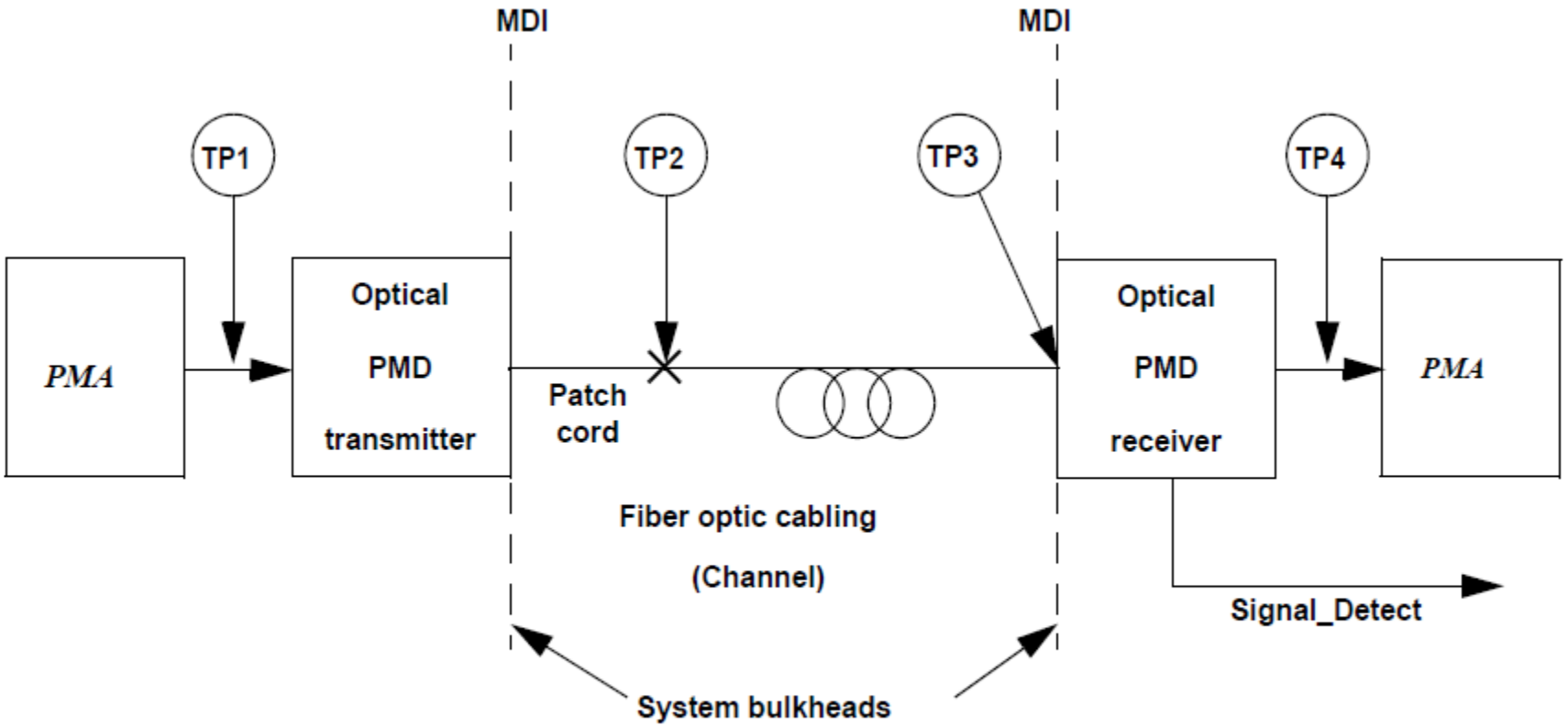

Figure 59–2—1000BASE-X block diagram

BX10 Tx

RMS spectral width (max) from Table 59-4 is 3.5 nm

Table 59–4—1000BASE-LX10 spec

Center wavelength	RMS spectral wid (max)[a]
nm	nm
1260	2.09
1270	2.52
1280	3.13
1286	3.50
1290	
1297	
1329	
1340	
1343	
1350	3.06
1360	2.58
1480 to 1500	0.88

[a]These limits for the 1000BASE-LX10 transmitter wavelengths may be found by interpolation.

Table 59–6—1000BASE-BX10-D and 1000BASE-BX10-U transmit characteristics

Description	1000BASE-BX10-D	1000BASE-BX10-U	Unit
Nominal transmitter type[a]	Longwave Laser		
Signaling speed (range)	1.25 ± 100 ppm		GBd
Operating wavelength range[b]	1480 to 1500	1260 to 1360	nm
RMS spectral width (max)	See Table 59–4		nm
Average launch power (max)	–3		dBm
Average launch power (min)	–9		dBm
Average launch power of OFF transmitter (max)	–45		dBm
Extinction ratio (min)	6		dB
$RIN_{12}OMA$ (max)	–113		dB/Hz
Optical return loss tolerance (max)	12		dB
Launch OMA	–8.2 (151)		dBm (μW)
Transmitter eye mask definition {X1, X2, Y1, Y2, Y3}	0.22, 0.375, 0.20, 0.20, 0.30		UI
Transmitter reflectance (max)	–10	–6	dB
Transmitter and dispersion penalty, TDP (max)	3.3		dB
Decision timing offsets for transmitter and dispersion penalty (min)	± 80		ps

[a]The nominal device type is not intended to be a requirement on the source type, and any device meeting the transmitter characteristics specified may be substituted for the nominal device type.

[b]The great majority of the transmitted spectrum must fall within the operating wavelength range. The allowable range of central wavelengths is narrower than the operating wavelength range by the actual RMS spectral width at each extreme.

BX10 Rx

Also see

Table 59–10—1000BASE-LX10 and 1000BASE-BX10 jitter budget on SMF (informative)

Table 59–10—1000BASE-LX10 and 100

	To
Reference point	**UI**
TP1	0.240
TP1 to TP2	0.334
TP2	0.481
TP2 to TP3	0.119
TP3	0.510
TP3 to TP4	0.332
TP4	0.749

Table 59–7—1000BASE-BX10-D and 1000BASE-BX10-U receive characteristics

Description	1000BASE-BX10-D	1000BASE-BX10-U	Unit
Signaling speed (range)	1.25 ± 100 ppm		GBd
Wavelength (range)	1260 to 1360	1480 to 1500	nm
Bit error ratio (max)	10^{-12}		
Average receive power (max)	–3		dBm
Receive sensitivity (max)	–19.5		dBm
Receiver sensitivity as OMA (max)	–18.7 (13.4)		dBm (µW)
Receiver reflectance (max)	–12		dB
Stressed receive sensitivity (max)[a]	–15.4		dBm
Stressed receiver sensitivity as OMA (max)	–14.6 (35)		dBm (µW)
Vertical eye-closure penalty (min)[b]	2.6		dB
Receive electrical 3 dB upper cutoff frequency (max)	1500		MHz
Signal detect threshold (min)	–45		dBm
Stressed eye jitter (min)	0.3		UI pk-pk
Jitter corner frequency	637		kHz
Sinusoidal jitter limits for stressed receiver conformance test (min, max)	0.05, 0.15		UI

[a]The stressed receiver sensitivity is optional.
[b]Vertical eye closure penalty and jitter specifications are test conditions for measuring stressed receiver sensitivity. They are not required characteristics of the receiver.

Channel Penalties

Table 59–8—Illustrative 1000BASE-LX10 and 1000BASE-BX10 channel and penalties

PMD type	1000BASE-LX10		1000BASE-BX10-D	1000BASE-BX10-U	Unit
Fiber type	B1.1, B1.3 SMF	50μm, 62.5μm MMF	B1.1, B1.3 SMF		
Measurement wavelength for fiber	1310	1300	1550	1310	nm
Nominal distance	10	0.55	10		km
Available power budget	10.5	8.5	10.5		dB
Maximum channel insertion loss[a]	6.0	2.4	5.5	6.0	dB
Allocation for penalties[b]	4.5	6.1	5.0	4.5	dB

[a]The maximum channel insertion loss is based on the cable attenuation at the target distance and nominal measurement wavelength. The channel insertion loss also includes the loss for connectors, splices and other passive components.

[b]The allocation for penalties is the difference between the available power budget and the channel insertion loss; insertion loss difference between nominal and worse case operating wavelength is considered a penalty.

OPTIONAL STRAW POLLS

Straw Poll

I would support downstream center wavelength of about:

1. **1270** _____
2. **1290** _____
3. **1310** _____
4. **1320** _____
5. **1330** _____
6. **1340** _____
7. **1350** _____
8. **Other** _____
9. **Don’t know**_____

(Chicago rules)

Straw Poll

I would support upstream center wavelength of about:

1. **1270** _____
2. **1290** _____
3. **1310** _____
4. **1320** _____
5. **1330** _____
6. **1340** _____
7. **1350** _____
8. **Other** _____
9. **Don’t know**_____

(Chicago rules)