

# Super-PON Reflections

IEEE P802.3cs, October 22, 2020  
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# Overview

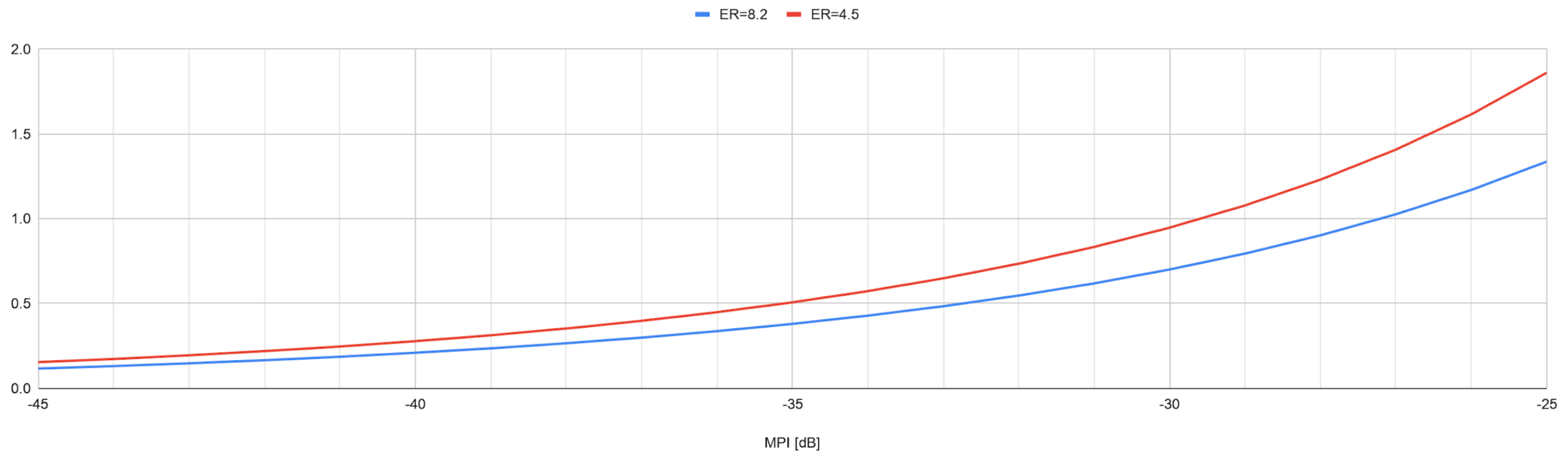
- Present penalty vs MPI
- ITU-T assumptions for XGS-PON and NG-PON2
- IEEE assumptions in 25/50G EPON (IEEE802.3ca)
- Recommendations for Super-PON (IEEE802.3cs)

# Power penalty for MPI

$$P_{MPI} (dB) = 10\log_{10} [1/(1 - \gamma)]$$

$$\gamma \cong 4(m - 1) \sqrt{MPI} \left( \frac{ER}{ER - 1} \right)$$

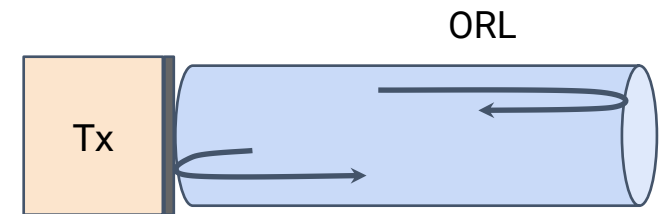
Power Pen [dB]



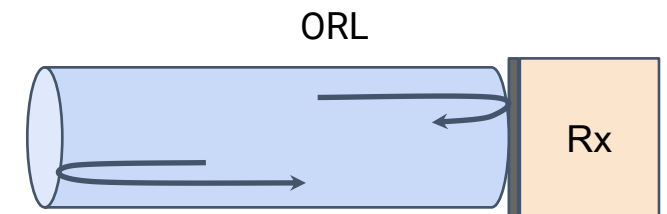
# Comparing other standards

		XGS-PON	NG-PON2 (10G)	IEEE802.3ca
Downstream	Minimum extinction ratio	8.2	8.2	8
	Maximum reflectance of equipment at S/R, measured at transmitter wavelength	N/A	N/A	-10
	Maximum reflectance of equipment at R/S, measured at receiver wavelength	-20	-20	-12
	Transmitter tolerance to reflected optical power	-15	-15	-15
	Minimum ORL of ODN (passive ODN)	32	32	15
	Upstream	Minimum extinction ratio	6	6
Maximum reflectance of equipment at R/S, measured at transmitter wavelength		-10	-6	-10
Maximum reflectance of equipment at S/R, measured at receiver wavelength		-12	-20	-12
Tolerance to reflected optical power		-15	-15	-15
Minimum ORL of ODN (passive ODN)		32	32	15

**Max NPI from Tx reflectance**



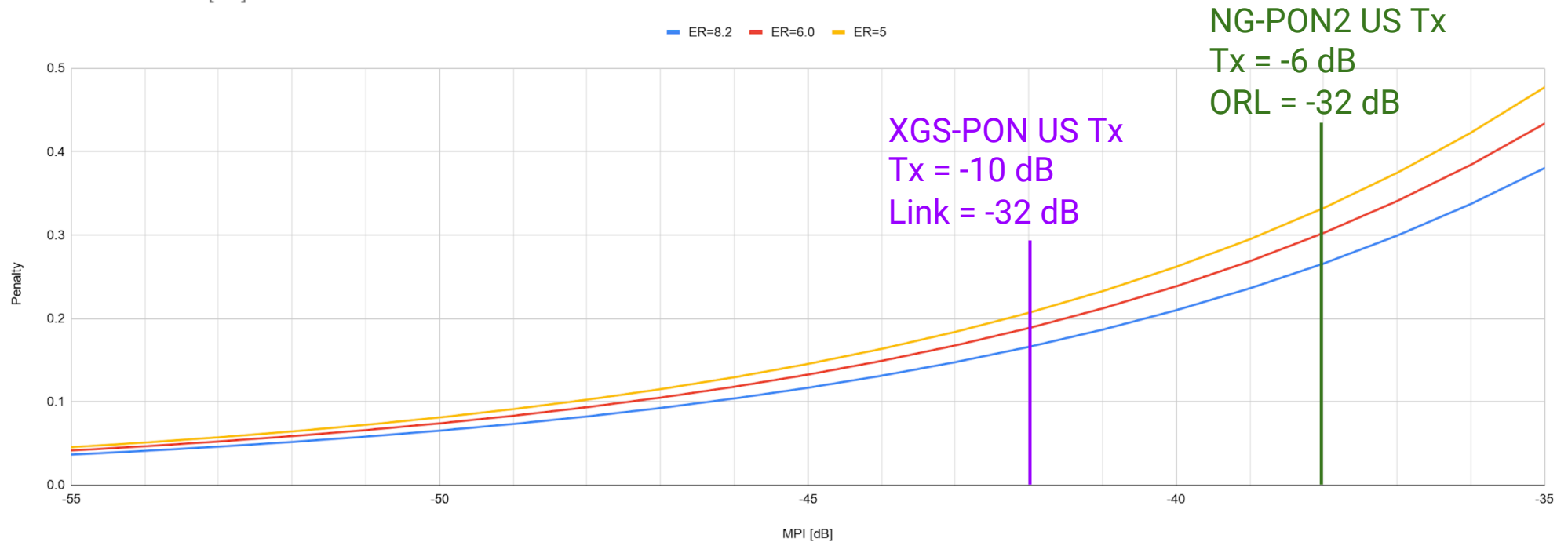
**Max NPI from Rx reflectance**



# NPI from Tx/Rx and ORL

	XGS-PON	NG-PON2 (10G)	IEEE802.3ca
NPI for DS from Tx	N/A	N/A	-25
NPI for DS from Rx	-52	-52	-27
NPI for US from Tx	-42	-38	-25
NPI for US from Rx	-44	-52	-27

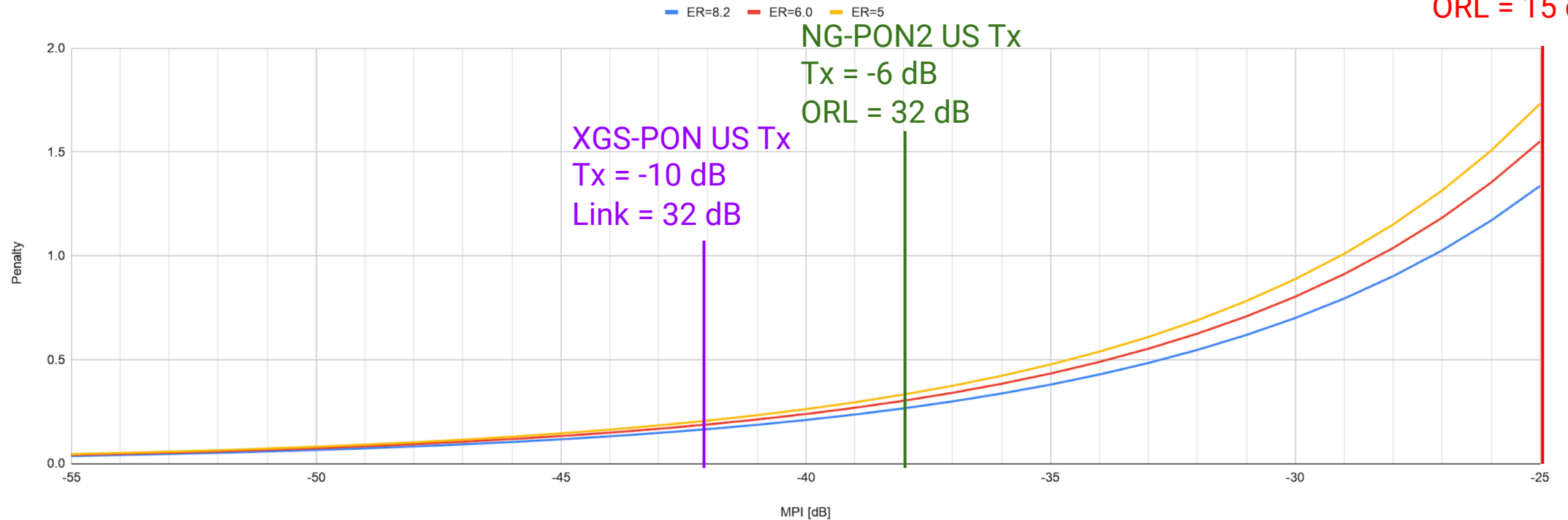
Power Pen from MPI[dB]



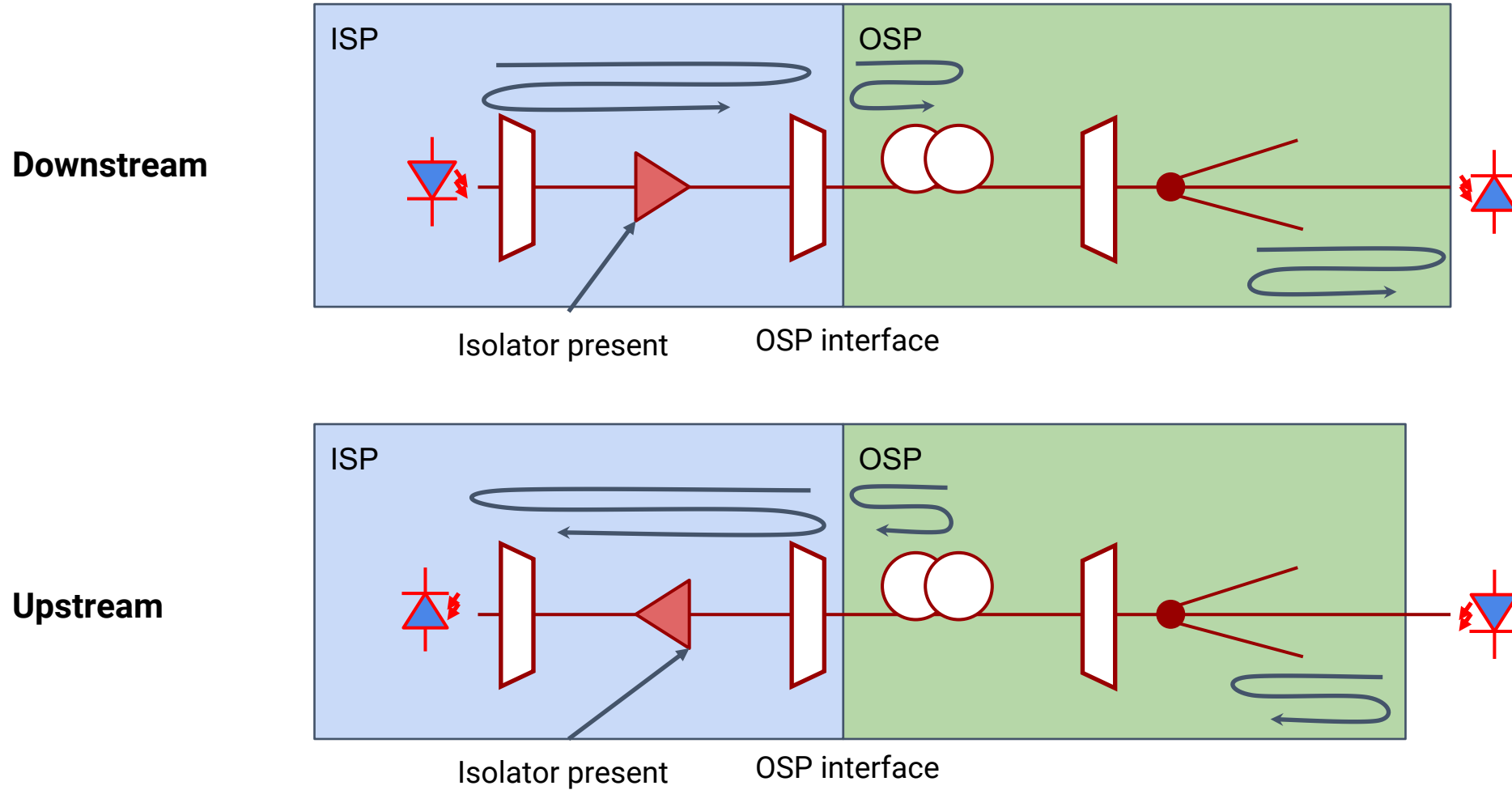
# NPI from Tx/Rx and ORL

	XGS-PON	NG-PON2 (10G)	IEEE802.3ca
NPI for DS from Tx	N/A	N/A	-25
NPI for DS from Rx	-52	-52	-27
NPI for US from Tx	-42	-38	-25
NPI for US from Rx	-44	-52	-27

Power Pen from MPI[dB]



# IEEE802.3cs reflection diagram



# Proposal for 802.3cs

		XGS-PON	NG-PON2 (10G)	IEEE802.3ca	IEEE802.3cs
Downstream	Minimum extinction ratio	8.2	8.2	8	8.2
	Maximum reflectance of equipment at S/R, measured at transmitter wavelength	N/A	N/A	-10	-10
	Maximum reflectance of equipment at R/S, measured at receiver wavelength	-20	-20	-12	-12
	Transmitter tolerance to reflected optical power	-15	-15	-15	-15
	Minimum ORL of ODN (passive ODN)	32	32	15	
	Minimum ORL of ODN (OLT to OSP interface)				42
	Minimum ORL of ODN (of OSP)				32
	Maximum reflectance at OSP interface in DS wavelength band				-20
Upstream	Minimum extinction ratio	6	6	5	6
	Maximum reflectance of equipment at R/S, measured at transmitter wavelength	-10	-6	-10	-10
	Maximum reflectance of equipment at S/R, measured at receiver wavelength	-12	-20	-12	-12
	Tolerance to reflected optical power	-15	-15	-15	-15
	Minimum ORL of ODN (passive ODN)	32	32	15	
	Minimum ORL of ODN (OLT to OSP interface)				42
	Minimum ORL of ODN (of OSP)				32
	Maximum reflectance at OSP interface in US wavelength band				-20

Parameter we cannot define using black link

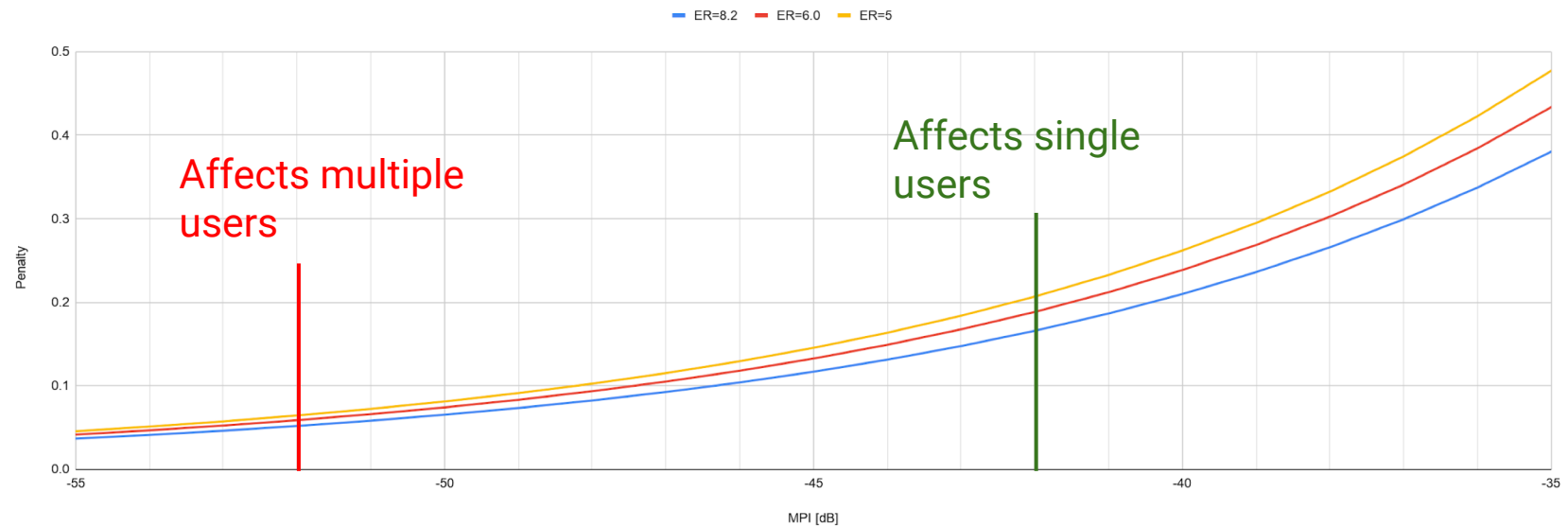
Parameter we cannot define using black link



# NPI for 802.3cs

	XGS-PON	NG-PON2 (10G)	IEEE802.3ca	IEEE802.3cs
NPI for DS from Tx (passive)	N/A	N/A	-25	
NPI for DS from Tx: OLT to OSP interface				-52
NPI for DS from Tx: OSP interface to ONU				-52
NPI for DS from Rx	-52	-52	-27	-44
NPI for US from Tx	-42	-38	-25	-42
NPI for US from Rx (passive)	-44	-52	-27	
NPI for DS from Rx: OLT to OSP interface				-54
NPI for DS from Rx: OSP interface to ONU				-52

Power Pen from MPI[dB]



# Revised table

		XGS-PON	NG-PON2 (10G)	IEEE802.3ca	IEEE802.3cs
Downstream	Minimum extinction ratio	8.2	8.2	8	8.2
	Maximum reflectance of equipment at S/R, measured at transmitter wavelength	N/A	N/A	-10	-10
	Maximum reflectance of equipment at R/S, measured at receiver wavelength	-20	-20	-12	-12
	Transmitter tolerance to reflected optical power	-15	-15	-15	-15
	Minimum ORL of ODN (passive ODN)	32	32	15	
	Minimum ORL of ODN (from OLT side)				42
	Minimum ORL of ODN (from ONU side)				32
	Maximum single reflectance of ODN				-26
Upstream	Minimum extinction ratio	6	6	5	6
	Maximum reflectance of equipment at R/S, measured at transmitter wavelength	-10	-6	-10	-10
	Maximum reflectance of equipment at S/R, measured at receiver wavelength	-12	-20	-12	-12
	Transmitter tolerance to reflected optical power	-15	-15	-15	-15
	Minimum ORL of ODN (passive ODN)	32	32	15	
	Minimum ORL of ODN (OLT to OSP interface)				42
	Minimum ORL of ODN (of OSP)				32
	Maximum single reflectance of ODN				-26

OLT parameter

ONU parameter

OLT parameter

} ODN/Black link parameters

OLT parameter

ONU parameter

OLT parameter

} ODN/Black link parameters

# OLT transmit

<b>Parameters</b>		<b>Values</b>	
<b>Parameter</b>	<b>10GBASE-SP1-Dx</b> <b>10/2.5GBASE-SP1-Dx</b>		<b>Unit</b>
Signaling speed (range)	10.3125 ± 100 ppm		GBd
Channel center frequencies	C-band 1 (downstream)		THz
Maximum spectral excursion	± 15		GHz
Maximum mean channel output power	1.5		dBm
Minimum mean channel output power	-2.5		dBm
Minimum side-mode suppression ratio (SMSR)	35		dB
Minimum channel extinction ratio	8.2		dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}		UI
Transmitter and dispersion penalty (TDP) 0 to 910 ps/nm residual CD	1.0		dB
RIN <sub>15</sub> OMA (max)	-120		dB/Hz
Average launch power of OFF transmitter (max)	-39		dBm
<b>Transmitter reflectance (max)</b>	<b>-10</b>		<b>dB</b>
Optical return loss tolerance (max)	15		dB

ONU receive

**No changes needed**

# ONU transmit

Parameters	Proposed values		Unit
	10GBASE-SP1-U <sub>x</sub>	10/2.5GBASE-SP1-U <sub>x</sub>	
Parameter			
Signaling speed (range)	10.3125 ± 100 ppm	2.578125 ± 100 ppm	GBd
Channel center frequencies	L-band 1 (upstream)		THz
Maximum spectral excursion (after turn-on time)	± 15		GHz
Maximum mean channel output power	8	4.5	dBm
Minimum mean channel output power	see eqn xx	-0.5	dBm
Minimum side-mode suppression ratio (SMSR)	38		dBm
Minimum channel extinction ratio	see eqn xx	6	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}		UI
Maximum transmitter (residual) dispersion OSNR penalty -600 to +50 ps/nm residual CD -600 to +1020 ps/nm residual CD	2.0	1.0	dB
Transmitter reflectance (max)	-10	-10	dB
Optical return loss tolerance (max)	15	15	dB
Average launch power of OFF transmitter (max)	-45		dBm
RIN <sub>15</sub> OMA (max)	-128		dB/Hz
Turn-on time (max)	512		ns
Turn-off time (max)	512		ns

# OLT receive

**No changes needed**

# Black link: OLT to ONU - Table 200-9

Parameter	10 Gb/s	Unit
Clear link passband	±15	GHz
Maximum ripple (within the clear link passband)	+2	dB
Maximum (residual) chromatic dispersion	+910	ps/nm
Minimum (residual) chromatic dispersion	0	ps/nm
Minimum optical return loss at transmitter	+20	dB
Maximum discrete reflectance between transmitter and receiver		dB
Maximum differential group delay	+12	ps
Maximum inter-channel crosstalk	0.1	dB
Maximum optical path power penalty	+1	dB
Optical return loss from OLT side	42	dB
Optical return loss from ONU side	32	dB
Maximum single reflection	-26	dB

# Black link: ONU to OLT - Table 200-10

Parameter	10 Gb/s	2.5 Gb/s	Unit
Clear link passband	±15		GHz
Maximum ripple (within the clear link passband)	+2		dB
Maximum (residual) chromatic dispersion	+50	+1020	ps/nm
Minimum (residual) chromatic dispersion	-600	-600	ps/nm
Minimum optical return loss at transmitter	+20		dB
Maximum discrete reflectance between transmitter and receiver			dB
Maximum differential group delay	+12		ps
Maximum inter-channel crosstalk	0.1		dB
Maximum optical path OSNR penalty	2	1	dB
Maximum power excursion	10	10	dB
Optical return loss from OLT side	42	42	dB
Optical return loss from ONU side	32	32	dB
Maximum single reflection	-26	-26	dB



Thank you