

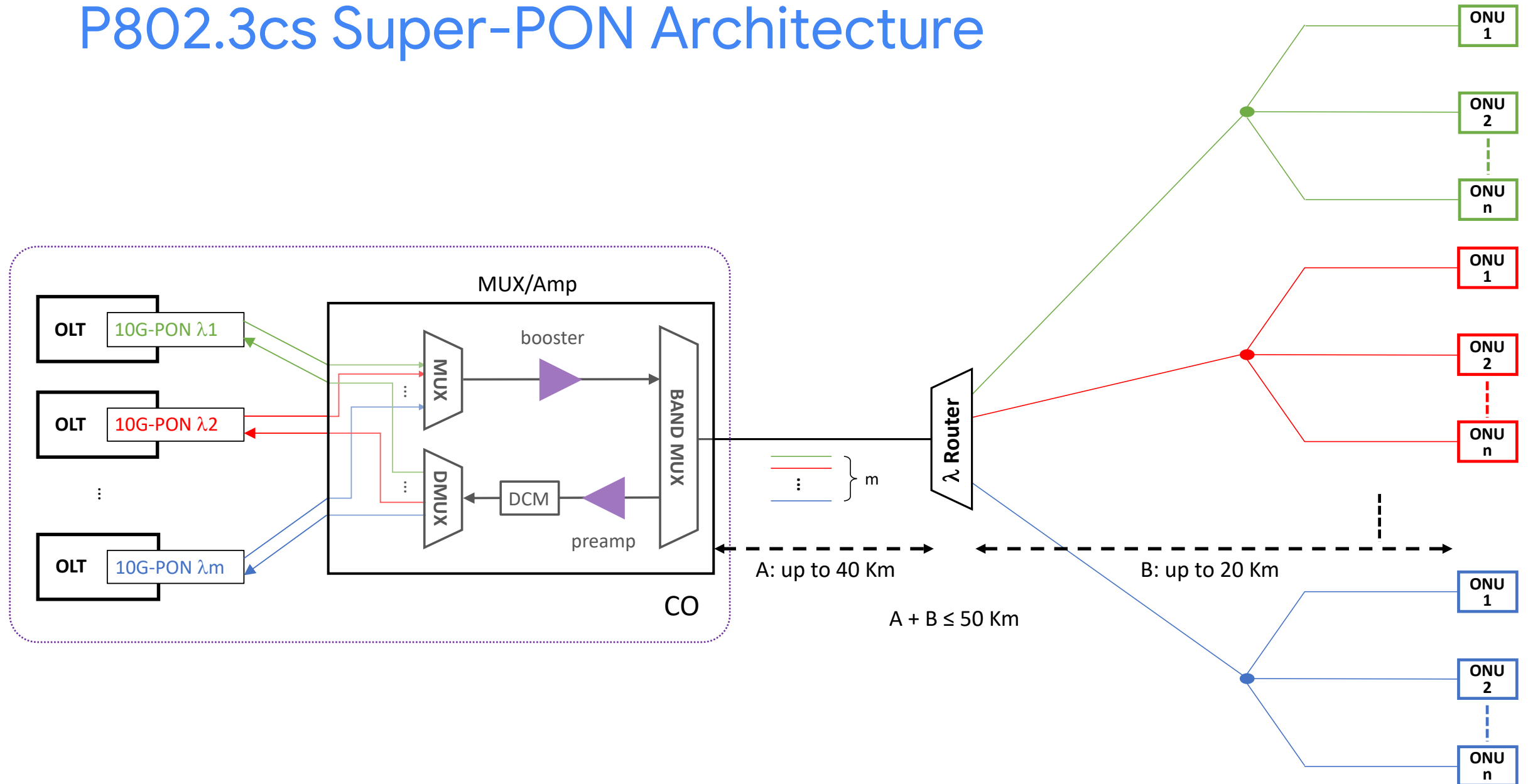
P802.3cs Black Link Parameters

IEEE P802.3cs – July 17, 2019

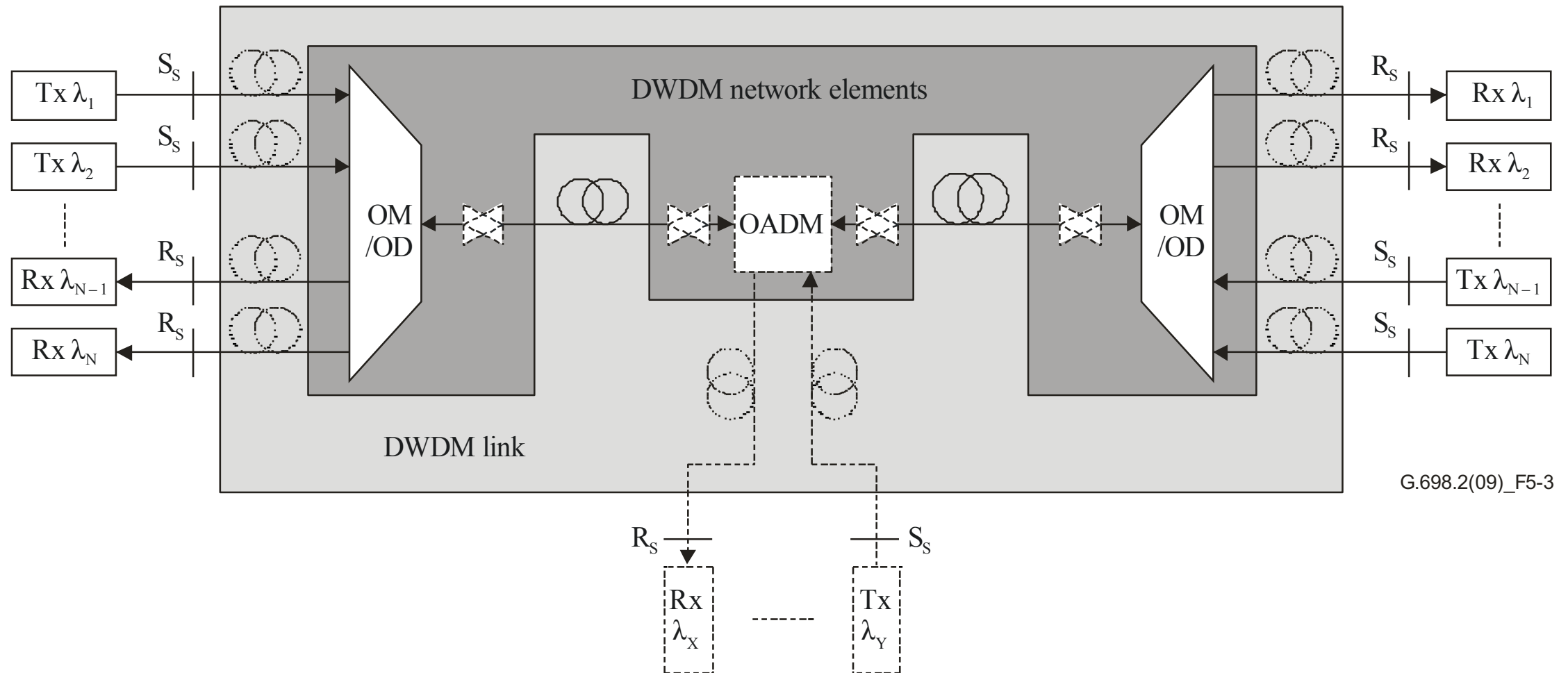
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P802.3cs Super-PON Architecture



G.698.2 Black Link Model



Parameters for Interface at point S_s

Interface at point S_s	Units
Maximum mean channel output power	dBm
Minimum mean channel output power	dBm
Minimum central frequency	THz
Maximum central frequency	THz
Maximum spectral excursion	GHz
Minimum side mode suppression ratio	dB
Minimum channel extinction ratio	dB
Eye mask	—
Maximum transmitter (residual) dispersion OSNR penalty	dB

The transmitter (residual) dispersion OSNR penalty is defined as:

Lowest OSNR at S_s with worst case (residual) dispersion – Lowest OSNR at S_s with no dispersion

Where:

- Lowest OSNR at S_s with no dispersion is the lowest OSNR that meets the maximum BER of the application from a reference receiver as defined in clause B.3 of [ITU-T G.959.1] at point S_s .
- Lowest OSNR at S_s with worst case (residual) dispersion is the lowest OSNR that meets the maximum BER of the application from a reference receiver as defined in clause B.3 of [ITU-T G.959.1] at point S_s with the chromatic dispersion (within the range specified for the application code) applied which gives the highest OSNR penalty.

NOTE – The measurement of the transmitter (residual) dispersion OSNR penalty therefore requires filtered ASE noise to be added to the signal at point S_s .

This penalty is not part of the system budget directly (since it is included as part of the optical path OSNR penalty) but rather provides an upper bound on the OSNR penalty due to dispersion alone, thereby ensuring that some of the optical path OSNR penalty is available to cover the other impairments listed.

Parameters for Interface at point R_s

Interface at point R_s	Units
Maximum mean input power	dBm
Minimum mean input power	dBm
Minimum OSNR	dB (0.1 nm)
Receiver OSNR tolerance	dB (0.1 nm)
Maximum reflectance of receiver	dB

The minimum optical signal-to-noise ratio (OSNR) is the minimum value of the ratio of the signal power in the wanted channel to the highest noise power density (referred to 0.1 nm) in the range of the central frequency plus and minus the maximum spectral excursion. For the purposes of this definition, the noise is defined to be that which would be present if the signal in the wanted channel were removed from the black link while keeping all other black link conditions the same (e.g., the gain and noise figure of all amplifiers).

This parameter places a requirement on the characteristics of the black link that the OSNR at any reference point R_s must be greater than the minimum OSNR.

The receiver OSNR tolerance is defined as the minimum value of OSNR at point R_s that can be tolerated while maintaining the maximum BER of the application. This must be met for all powers between the maximum and minimum mean input power with a transmitter with worst-case values of:

- transmitter eye mask for NRZ signal classes;
- extinction ratio for NRZ signal classes;
- optical return loss at point S_s ,
- receiver connector degradations;
- measurement tolerances.

The receiver OSNR tolerance does not have to be met in the presence of chromatic dispersion, non-linear effects, reflections from the optical path, PMD, PDL or optical crosstalk; these effects are specified separately in the allocation of maximum optical path OSNR penalty.

Reflections from the receiver back into the DWDM link are specified by the maximum permissible reflectance of the receiver measured at reference point R_s .

Parameters for the Optical Path

Optical path from point S_s to R_s	Units
Maximum ripple	dB
Maximum (residual) chromatic dispersion	ps/nm
Minimum (residual) chromatic dispersion	ps/nm
Minimum optical return loss at S_s	dB
Maximum discrete reflectance between S_s and R_s	dB
Maximum differential group delay	ps
Maximum inter-channel crosstalk	dB
Maximum interferometric crosstalk	dB
Maximum optical path OSNR penalty	dB

The optical path OSNR penalty is defined as:

$$\text{Lowest OSNR at } R_s - \text{Lowest OSNR at } S_s$$

where:

- Lowest OSNR at S_s is the lowest OSNR that meets the maximum BER of the application from a reference receiver as defined in clause B.3 of [ITU-T G.959.1] at point S_s i.e., *before* transmission through the black link.
- Lowest OSNR at R_s is the lowest OSNR that meets the maximum BER of the application from a reference receiver as defined in clause B.3 of [ITU-T G.959.1] at point R_s i.e., *after* transmission through the black link.

NOTE – The measurement of the optical path OSNR penalty therefore requires filtered ASE noise to be added to the signal at points S_s and R_s .

The effects that contribute to the optical path OSNR penalty include:

- transmitter (residual) dispersion penalty for NRZ signal classes;
- non-linear effects within the black link;
- inter-channel crosstalk;
- interferometric crosstalk;
- reflections from the optical path;
- polarization dependent loss.

The average value of the random dispersion penalties due to PMD is included in the allowed path OSNR penalty. The actual DGD that may be encountered in operation is a randomly varying fibre/cable property.

For NRZ signal classes, the transmitter/receiver combination is required to tolerate an actual DGD of 0.3-bit period with a maximum optical path OSNR penalty of 2 dB (with 50% of optical power in each principal state of polarization). For a well-designed receiver, this corresponds to an OSNR penalty of 0.2 – 0.4 dB for a DGD of 0.1-bit period.

Current P802.3cs OLT Transmitter Parameters

Parameter Name	Units
Central channel frequencies	THz
Maximum spectral excursion	GHz
Side-mode suppression ratio (SMSR) (min)	dB
Average launch power (max)	dBm
Average launch power (min)	dBm
Average launch power of OFF transmitter (max)	dBm
Extinction ratio (min)	dB
RIN ₁₅ OMA (max)	dB/Hz
Transmitter and dispersion penalty (TDP) @ 0 to 1000 ps/nm residual CD	dB
Optical return loss tolerance (max)	dB
Transmitter reflectance (max)	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	UI

From G.698.2

Interface at point S _s	Units
Maximum mean channel output power	dBm
Minimum mean channel output power	dBm
Minimum central frequency	THz
Maximum central frequency	THz
Maximum spectral excursion	GHz
Minimum side mode suppression ratio	dB
Minimum channel extinction ratio	dB
Eye mask	—
Maximum transmitter (residual) dispersion OSNR penalty	dB

Proposed P802.3cs OLT Transmitter Parameters

Interface at point S _s	Units
Maximum mean channel output power	dBm
Minimum mean channel output power	dBm
Nominal central frequency	THz
Maximum spectral excursion	GHz
Minimum side mode suppression ratio	dB
Minimum channel extinction ratio	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	UI
Maximum transmitter (residual) dispersion OSNR penalty	dB
Transmitter and dispersion power penalty (TDP) @ 0 to 1000 ps/nm residual CD	dB
RIN ₁₅ OMA (max)	dB/Hz
Extinction ratio (min)	dB
Average launch power of OFF transmitter (max)	dBm
Optical return loss tolerance (max)	dB

From G.698.2

Interface at point S _s	Units
Maximum mean channel output power	dBm
Minimum mean channel output power	dBm
Minimum central frequency	THz
Maximum central frequency	THz
Maximum spectral excursion	GHz
Minimum side mode suppression ratio	dB
Minimum channel extinction ratio	dB
Eye mask	—
Maximum transmitter (residual) dispersion OSNR penalty	dB

Current P802.3cs ONU Receiver Parameters

Parameter Name	Units
Average receive power (max)	dBm
Damage Threshold	dBm
Receiver sensitivity (max)	dBm
Receiver reflectance (max)	dB
Signal detect threshold (min)	dBm
Stressed receiver sensitivity (max)	dBm

From G.698.2

Interface at point R _s	Units
Maximum mean input power	dBm
Minimum mean input power	dBm
Minimum OSNR	dB (0.1 nm)
Receiver OSNR tolerance	dB (0.1 nm)
Maximum reflectance of receiver	dB

Proposed P802.3cs ONU Receiver Parameters

Parameter Name	Units
Maximum mean input power	dBm
Minimum mean input power	dBm
Minimum OSNR	dB (0.1 nm)
Receiver OSNR tolerance	dB (0.1 nm)
Maximum reflectance of receiver	dB
Damage Threshold	dBm
Signal detect threshold (min)	dBm

From G.698.2

Interface at point R _s	Units
Maximum mean input power	dBm
Minimum mean input power	dBm
Minimum OSNR	dB (0.1 nm)
Receiver OSNR tolerance	dB (0.1 nm)
Maximum reflectance of receiver	dB

Current P802.3cs ONU Transmitter Parameters

From G.698.2

Parameter Name	Units
Central channel frequencies	THz
Maximum spectral excursion	GHz
Side-mode suppression ratio (SMSR) (min)	dB
Average launch power (max)	dBm
Average launch power (min)	dBm
Average launch power of OFF transmitter (max)	dBm
Extinction ratio (min)	dB
RIN ₁₅ OMA (max)	dB/Hz
Maximum transmitter (residual) dispersion OSNR penalty @ -450 ps/nm residual CD @ +450 ps/nm residual CD @ +900 ps/nm residual CD	dB
Optical return loss tolerance (max)	dB
Transmitter reflectance (max)	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	UI
Turn-on time (max)	ns
Turn-off time (max)	ns

Interface at point S _s	Units
Maximum mean channel output power	dBm
Minimum mean channel output power	dBm
Minimum central frequency	THz
Maximum central frequency	THz
Maximum spectral excursion	GHz
Minimum side mode suppression ratio	dB
Minimum channel extinction ratio	dB
Eye mask	—
Maximum transmitter (residual) dispersion OSNR penalty	dB

Parameter Name	Units
Maximum mean channel output power	dBm
Minimum mean channel output power	dBm
Central channel frequencies	THz
Maximum spectral excursion	GHz
Minimum side mode suppression ratio	dB
Minimum channel extinction ratio	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	UI
Maximum transmitter (residual) dispersion OSNR penalty @ -450 ps/nm residual CD @ +450 ps/nm residual CD @ +900 ps/nm residual CD	dB
Transmitter and dispersion power penalty (TDP)	dB
Average launch power of OFF transmitter (max)	dBm
$RIN_{15}OMA$ (max)	dB/Hz
Turn-on time (max)	ns
Turn-off time (max)	ns

Proposed P802.3cs ONU Transmitter Parameters

From G.698.2

Interface at point S_s	Units
Maximum mean channel output power	dBm
Minimum mean channel output power	dBm
Minimum central frequency	THz
Maximum central frequency	THz
Maximum spectral excursion	GHz
Minimum side mode suppression ratio	dB
Minimum channel extinction ratio	dB
Eye mask	—
Maximum transmitter (residual) dispersion OSNR penalty	dB

Current P802.3cs OLT Receiver Parameters

Parameter Name	Units
Average receive power (max)	dBm
Damage Threshold	dBm
Receiver sensitivity (max)	dBm
Receiver reflectance (max)	dB
Signal detect threshold (min)	dBm
Stressed receiver sensitivity (max)	dBm
Minimum received OSNR	dB

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Interface at point R_s	Units
Maximum mean input power	dBm
Minimum mean input power	dBm
Minimum OSNR	dB (0.1 nm)
Receiver OSNR tolerance	dB (0.1 nm)
Maximum reflectance of receiver	dB

Proposed P802.3cs OLT Receiver Parameters

Parameter Name	Units
Maximum mean input power	dBm
Minimum mean input power	dBm
Minimum OSNR	dB (0.1 nm)
Receiver OSNR tolerance	dB (0.1 nm)
Maximum reflectance of receiver	dB
Damage Threshold	dBm
Signal detect threshold (min)	dBm
$T_{\text{receiver_settling}}$ (max)	ns

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Interface at point R_s	Units
Maximum mean input power	dBm
Minimum mean input power	dBm
Minimum OSNR	dB (0.1 nm)
Receiver OSNR tolerance	dB (0.1 nm)
Maximum reflectance of receiver	dB

Proposed P802.3cs Black Link Parameters

Parameter Name	Units
Maximum ripple	dB
Maximum (residual) chromatic dispersion	ps/nm
Minimum (residual) chromatic dispersion	ps/nm
Minimum optical return loss at transmitter	dB
Maximum discrete reflectance between transmitter and receiver	dB
Maximum differential group delay	ps
Maximum inter-channel crosstalk	dB
Maximum interferometric crosstalk	dB
Maximum optical path OSNR penalty	dB
Maximum optical path power penalty	dB
Max link length	km
Maximum power excursion	dB

From G.698.2

Optical path from point S_s to R_s	Units
Maximum ripple	dB
Maximum (residual) chromatic dispersion	ps/nm
Minimum (residual) chromatic dispersion	ps/nm
Minimum optical return loss at S_s	dB
Maximum discrete reflectance between S_s and R_s	dB
Maximum differential group delay	ps
Maximum inter-channel crosstalk	dB
Maximum interferometric crosstalk	dB
Maximum optical path OSNR penalty	dB

Thank you!