Optical Parameters – Baseline Proposal Status

Tom Issenhuth,
John D’Ambrosia

Status of Optical Parameters Baseline

- This presentation is not intended for debate of the parameters or values but to capture the current state of the baseline proposal
- The key progression of the baseline:
  - Initial proposal and adoption of parameters (excluding values)
    - Stassar_3ct_02_0719 via Vienna motion 5
    - Reafirmed via motion 4 from April 2, 2020 interim teleconference
  - Proposed update to parameters, no adoption: stassar_3cw_01_200423
  - Proposed update and adoption of some parameters and values : sluyski_3cw_02_200507
    - Motion #1 from 5/7 TF Interim Teleconference: Adopt updating the parameter list on slides 4 to 6 of stassar_3ct_02_0719 with the parameter list and values specified on slides 11 – 14 of sluyski_3cw_02_200507
- It was noted that the status of the baseline needed to be updated
- The following observations were made during the update:
  - Sluyski_3cw_02_200507 drew from stassar_3cw_01_200423 not stassar_3ct_02_0719
  - Some parameters were modified or added
  - Parameters adopted that did not have values adopted are TBD
  - The progession of the parameters and associated values is shown in backup
  - Proposed parameters for further study per sluyski_3cw_02_200507 are included

Updated Baseline – 400GBASE-ZR Transmit Characteristics

Table 156–8—400GBASE-ZR transmit characteristics

Description	Value	Unit
Signaling rate (range)	59.84375 +/– 20ppm	GBd
Modulation format	DP-16QAM	—
Minimum channel spacing	75	GHz
Average channel output power (max)	–6	dBm
Average channel output power (min)	–10	dBm
Nominal center frequency	The frequency in Table 156–6 corresponding to the variable Tx_optical_channel_index	THz
Maximum spectral excursion	TBD	GHz
Minimum side mode suppression ratio	TBD	dB
Laser linewidth (max)	500	kHz
Offset between the carrier and the nominal center frequency (max)	1.8	GHz
Power difference between X-Y polarizations (max)	1.5	dB
Skew between the X-Y polarizations (max)	5	ps
Maximum error vector magnitude	TBD	%
DC I-Q offset (mean), [per polarization]	TBD	dB
Transmitter Inband OSNR(193.6)[a] (min)	–34	dB (0.1nm)
Average launch power of OFF transmitter (max)	–20	dBm
Optical return loss tolerance[b] (max)	–24	dBm
Transmitter reflectance[c] (max)	–20	dB

[a]This parameter is not necessary to support amplified DWDM links up to at least 80 km of single-mode fiber, but has been added to allow operation on unamplified links.
[b]Maximum light power (relative in decibel w.r.t Tx output) reflected back to transmitter while still meeting performance requirements.
[c]Optical power ratio of the reflected light of Tx output port back to fiber network vs. the external incident light into the Tx output port.

- Other items (not adopted) proposed for further study
  - Spectra excursion (min)
  - Laser relative intensity noise (avg)
  - Laser relative intensity noise (max)
  - Instantaneous I/Q offset (Dither)
  - Tx Clock Phase Noise
  - Output power with Tx disabled
  - Transmitter back reflectance tolerance

Updated Baseline – 400GBASE-ZR Receive Characteristics

Table 156–9—400GBASE-ZR receive characteristics

Description	Value	Unit
Signaling rate (range)	59.84375 +/– 20ppm	GBd
Modulation format	DP-16QAM	—
Nominal center frequency	The frequency in Table 156–6 corresponding to the variable Rx_optical_channel_index	THz
Average input power (max)	0	dBm
Average input power (min)	–12	dBm
Minimum mean input power [unamplified]	TBD	dBm
Minimum OSNR(193.6) [amplified]	TBD	dB (0.1 nm)
Minimum OSNR(193.6) [unamplified][a]	TBD	dB (0.1 nm)
Receiver OSNR (193.6)[b] (min)	26	dB (0.1 nm)
Optical return loss (min) / Reflectance of receiver input (max)	20	dB

[a]This parameter is not necessary to support amplified DWDM links up to at least 80 km of single-mode fiber, but has been added to allow operation on unamplified links.

[b]Minimum value of OSNR (referred to 0.1 nm noise bandwidth @ 193.6) that can be tolerated while maintaining the maximum BER below the CFEC threshold. This must be met for all powers between the maximum and minimum mean input power with a transmitter with worst-case values of: transmitter optical return loss, receiver connector degradations and measurement tolerances.

- Other items (not adopted) proposed for further study
  - Damage Threshold
  - PMD Tolerance

Updated Baseline – 400GBASE-ZR Black Link Characteristics

Table 156–10—400GBASE-ZR black link characteristics

Description	Value	Unit
Channel spacing (min)	75	GHz
Maximum ripple	TBD	dB
Maximum optical path OSNR penalty	TBD	dB
Chromatic dispersion (max)	2000	ps/nm
Chromatic dispersion (min)	0	ps/nm
Optical return loss at TP2 (min)	24	dB

Description	Value	Unit
Differential group delay, (DGD)[a] (max)	28	ps
Discrete reflectance between TP2 and TP3 (max)	–27	dB
Polarization dependent loss[b] (max)	2.0	dB
Polarization rotation speed (max)	50	krad/s
Maximum inter-channel crosstalk at TP3	TBD	dB
Maximum interferometric crosstalk at TP3	TBD	dB

[a]Differential Group Delay (DGD) is the time difference at reception between the fractions of a pulse that were transmitted in the two principal states of polarization of an optical signal. DGD_max is the maximum differential group delay that the system must tolerate.
[b]Does not include transmitter polarization imbalance.

- Other items (not adopted) proposed for further study
  - Black link transfer function with a well defined TX spectrum

Thanks!

Backup Slides!

Transmitter Specifications

		Note: the Sluyski presentation incorrectly states the adpoted parameters were per stassar_3ct_02_0719 but they were from Stassar-01-042320 and never adopted					
Parameters adopted on slides 4 to 6 of stassar_3ct_02_0719 via Vienna motion 5		**Updated parameters proposed on Stassar-01-200423 and Sluyski-02-200507**			**Parameters and values adopted on slides 11 to 14 of Sluyski-02-200507 via motion 1 on 05/07/20 Interim Teleconference Meeting**	Adopted Value	Adopted Unit
		Signaling rate (range) - GBd		Parameter added in 802.3ct D1.0	Signaling rate (range)	59.84375 +/- 20ppm	GBd
		Modulation format —		Parameter added in 802.3ct D1.0	Modulation format —	DP-16QAM	
		Minimum channel spacing - GHz		Parameter added in 802.3ct D1.0	Minimum channel spacing	75	GHz
Maximum mean channel output power - dBm		Average channel output power (max) - dBm		Wording changed in 802.3ct D1.0	Average channel output power (max)	-6	dBm
Minimum mean channel output power - dBm		Average channel output power (min) - dBm		Wording changed in 802.3ct D1.0	Average channel output power (min)	-10	dBm
Minimum central frequency - THz		Nominal center frequency - THz		Wording changed in 802.3ct D1.0	Nominal center frequency	Per Table 156.xx	THz
Maximum central frequency - THz		Nominal center frequency - THz		Minimum and maximum combined			
Maximum laser linewidth - kHz		Laser linewidth (max) - kHz		Wording changed in 802.3ct D1.0	Laser linewidth (max)	500	KHz
Maximum offset between the carrier and the nominal central frequency - GHz		Offset between the carrier and the nominal center frequency (max) - GHz		Wording changed in 802.3ct D1.0	Offset between the carrier and the nominal center frequency (max) GHz	1.8	GHz
Maximum power difference between polarizations - dB		Power difference between polarizations (max) - dB		Wording changed in 802.3ct D1.0 with additional modifications	Power difference between X-Y polarizations (max)	1.5	dB
Maximum skew between the two polarizations - ps		Skew between the two polarizations (max) - ps		Wording changed in 802.3ct D1.0 with additional modifications	Skew between the X-Y polarizations (max)	5	ps
Maximum I-Q offset - dB		I-Q offset (max) - dB		Wording changed in 802.3ct D1.0 with additional modifications	DC I-Q offset (mean), [per polarization]	TBD	dB
Minimum Transmitter OSNR(193.6) - dB		Transmitter OSNR(193.6) (min) - dB		Wording changed	Transmitter Inband OSNR (193.6) (min)	-34	dB (0.1nm)
		Average launch power of OFF transmitter (max) - dBm		Parameter added in 802.3ct D1.0	Average launch power of OFF transmitter (max) dBm	-20	dBm
				Parameter added	Optical return loss tolerance (max)	-24	dBm
		Transmitter reflectance (max) - dB		Parameter added in 802.3ct D1.0	Transmitter reflectance (max)	-20	dB
Defined Parameters still TBD							
Maximum spectral excursion - GHz		Spectral excursion (max) - GHz					
Minimum side mode suppression ratio - dB		Side-mode suppression ratio (SMSR), (min) - dB					
Maximum error vector magnitude - %		Error vector magnitude (max) - %					
Items for further study as proposed on slide 17 of Sluyski-02-200507							
		Spectra Excursion (min)					
		Laser relative intensity noise (avg)					
		Laser relative intensity noise (max)					
		Instantaneous I/Q offset (Dither)					
		Tx Clock Phase Noise					
		Output power with Tx disabled					
		Transmitter back reflectance tolerance					

Receiver Specifications

		Note: the Sluyski presentation incorrectly states the adpoted parameters listed were per stassar_3ct_02_0719 but they were from Stassar-01-042320 and never adopted					
Parameters adopted on slides 4 to 6 of stassar_3ct_02_0719 via Vienna motion 5		**Updated parameters proposed on Stassar-01-200423 and Sluyski-02-200507**			**Parameters and values adopted on slides 11 to 14 of Sluyski-02-200507 via motion 1 on 05/07/20 Interim Teleconference Meeting**	Adopted Value	Adopted Unit
		Signaling rate (range) - GBd		Parameter added in 802.3ct D1.0	Signaling rate (range)	59.84375 +/- 20ppm	GBd
		Modulation format —		Parameter added in 802.3ct D1.0	Modulation format —	DP-16QAM	
		Nominal center frequency - THz		Parameter added in 802.3ct D1.0	Nominal center frequency	Per Table 156.xx	THz
Maximum mean input power - dBm		Maximum average input power - dBm		Wording changed	Average input power (max)	0	dBm
Minimum mean input power [amplified] - dBm		Minimum average input power [amplified] - dBm		Wording changed	Average input power (min)	-12	dBm
Receiver OSNR tolerance(193.6) - dB (0.1 nm)		Receiver OSNR tolerance(193.6) - dB (0.1 nm)		Wording changed	Receiver OSNR tolerance(193.6) (min)	26	dB (0.1nm)
Maximum reflectance of receiver - dB		Maximum reflectance of receiver - dB		Wording changed	Optical return loss (min) / reflectance of receiver input (max)	20	dB
Defined Parameters still TBD							
Minimum mean input power [unamplified] - dBm		Minimum average input power [unamplified] - dBm					
Minimum OSNR(193.6) [amplified] - dB (0.1 nm)		Minimum OSNR(193.6) [amplified] - dB (0.1 nm)					
Minimum OSNR(193.6) [unamplified] - dB (0.1 nm)		Minimum OSNR(193.6) [unamplified] - dB (0.1 nm)					
Items for further study as proposed on slide 17 of Sluyski-02-200507							
		Damage threshold - dBm		Parameter added in 802.3ct D1.0			
		PMD Tolerance					

Black Link Specifications

		Note: the Sluyski presentation incorrectly states the adpoted parameters listed were per stassar_3ct_02_0719 but they were from Stassar-01-042320 and never adopted					
Parameters adopted on slides 4 to 6 of stassar_3ct_02_0719 via Vienna motion 5		**Updated parameters proposed on Stassar-01-200423 and Sluyski-02-200507**			**Parameters and values adopted on slides 11 to 14 of Sluyski-02-200507 via motion 1 on 05/07/20 Interim Teleconference Meeting**	Adopted Value	Adopted Unit
				Parameter added	Channel Spacing (min)	75	GHz
Maximum (residual) chromatic dispersion - ps/nm		Maximum chromatic dispersion - ps/nm		Wording changed	Chromatic dispersion (max)	2000	ps/nm
Minimum (residual) chromatic dispersion - ps/nm		Minimum chromatic dispersion - ps/nm		Wording changed	Chromatic dispersion (min)	0	ps/nm
Minimum optical return loss at TP2 - dB		Minimum optical return loss at TP2 - dB		Wording changed	Optical return loss at TP2 (min)	24	dB
Maximum differential group delay - ps		Maximum differential group delay, DGD_max - ps		Wording changed	Differential group delay, (DGD) (max)	28	ps
Maximum discrete reflectance between TP2 and TP3 - dB				Parameter removed in 802.3ct D1.3	Discrete reflectance between TP2 and TP3 (max)	-27	dB
Maximum polarization dependent loss - dB		Maximum polarization dependent loss - dB		Wording changed	Polarization dependent loss (max)	2.0	dB
Maximum polarization rotation speed - krad/s		Maximum polarization rotation speed - krad/s		Wording changed	Polarization rotation speed (max)	50	krad/s
Defined Parameters still TBD							
Maximum ripple - dB		Maximum ripple - dB					
Maximum inter-channel crosstalk at TP3 - dB		Maximum inter-channel crosstalk at TP3 - dB					
Maximum interferometric crosstalk at TP3 - dB		Maximum interferometric crosstalk at TP3 - dB					
Maximum optical path OSNR penalty - dB		Maximum optical path OSNR penalty - dB					
Items for further study as proposed on slide 17 of Sluyski-02-200507							
		Black link transfer function with a well defined TX spectrum					
		Fiber dispersion slope (min) (S_0) - ps/nm^2.km		Parameter added in 802.3ct D1.0			