

400Gb/s 8x50G PAM4 WDM 2km SMF PMD Baseline Specifications

P802.3bs 400 Gb/s Ethernet Task Force

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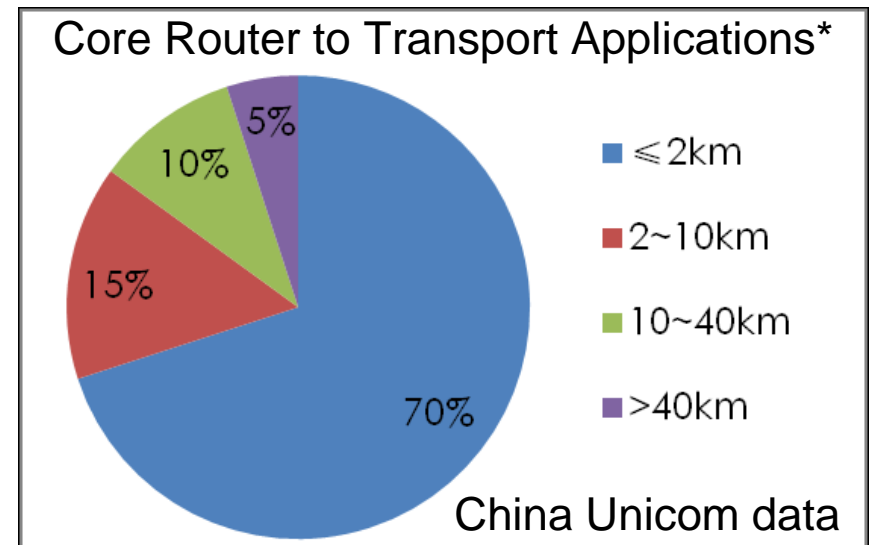
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- Jeff Twombly, Credo

Select References

- June 2015: 8x50G PAM4 2km SMF PMD Discussion
http://www.ieee802.org/3/bs/public/adhoc/smf/15_06_09/cole_01a_0615_smf.pdf
- June 2015: 8x50G PAM4 2km duplex SMF Considerations
http://www.ieee802.org/3/bs/public/adhoc/smf/15_06_09/stassar_01_0615_smf.pdf
- May 2015: 8x50G PAM4 WDM Baseline Specifications
http://www.ieee802.org/3/bs/public/15_05/cole_3bs_01a_0515.pdf
- Sept. 2014: 8x50G WDM Technology Background
http://www.ieee802.org/3/bs/public/14_09/stassar_3bs_01b_0914.pdf
- BTI
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Introduction

- 8x50G PAM4 WDM 10km specs in cole_3bs_01a_0515 were adopted for the 10km reach SMF PDM objective
http://www.ieee802.org/3/bs/public/15_05/motions_3bs_01_0515.pdf#page=10
- Adopting 8x50G PAM4 WDM 2km PMD based on existing technology will provide a cost effective solution for majority of core routing applications and result in a solid standard
- 400Gb/s Ethernet early adopters want standards based, interoperable 2km & 10km interfaces, supporting predictable development and build-out of 400Gb/s networks



* http://www.ieee802.org/3/400GSG/public/13_11/song_x_400_01a_1113.pdf#page=6

Transmit Characteristics

Description (Outer Eye)	Proposed 400GBASE-FR8	Adopted 400GBASE-LR8	Unit
Reach	2	10	km
Signaling Rate, each lane	26.6	26.6	GBd
Operating BER*	2.0E-04	2.0E-04	
Total average launch power (max)	13.2	13.2	dBm
OMA, each lane (max)	5.5	5.7	dBm
OMA, each lane (min)	0.0	0.5	dBm
Launch Power in OMA – TDP, each lane (min)	-1.0	-0.5	dBm
Transmitter and dispersion penalty, (TDP) each lane (max)	2.0	2.2	dB
Extinction ratio (ER) (min)	4.5	4.5	dB
RIN OMA (max)	TBD	TBD	dB/Hz
Optical return loss tolerance (max)	TBD	TBD	dB

* The exact operating BER will be determined by the final FEC and PMA definition

Receive Characteristics

Description (Inner Eye)	Proposed 400GBASE-FR8	<i>Adopted 400GBASE-LR8</i>	Unit
Signaling Rate, each lane	26.6	26.6	GBd
Operating BER*	2.0E-04	2.0E-04	
Receiver reflectance (max)	TBD	<i>TBD</i>	dB
Receiver Sensitivity (OMA), each lane (max)	-10.0	-11.8	dBm
Receiver 3 dB electrical upper cutoff frequency, each lane (max)	21.0	21.0	GHz
Stressed receiver sensitivity (OMA), each lane (max)	TBD	<i>TBD</i>	dBm
Conditions of stressed receiver sensitivity test	TBD	<i>TBD</i>	

* The exact operating BER will be determined by the final FEC and PMA definition

Illustrative Link Power Budgets

Parameter	Proposed 400GBASE-FR8	<i>Adopted</i> <i>400GBASE-LR8</i>	Unit
Reach	2	<i>10</i>	km
Power Budget (for maximum TDP)	11.0	<i>13.5</i>	dB
Operating Distance	2.0	<i>10.0</i>	km
Channel Insertion Loss	4.0	<i>6.3</i>	dB
Maximum Discrete Reflectance	TBD	<i>TBD</i>	dB
Allocation for Penalties* (for maximum TDP)	2.0	<i>2.2</i>	dB
Allocation for Modulation Penalties	5.0	<i>5.0</i>	dB

* Includes MPI penalty. As with all other parameters, it is subject to change in Task Force review.

WDM Lane Assignments

Lane	Center Frequency THz	Center Wavelength nm	Wavelength Range nm
L0	235.4	1273.55	1272.55 to 1274.54
L1	234.6	1277.89	1276.89 to 1278.89
L2	233.8	1282.26	1281.25 to 1283.28
L3	233.0	1286.66	1285.65 to 1287.69
L4	231.4	1295.56	1294.53 to 1296.59
L5	230.6	1300.05	1299.02 to 1301.09
L6	229.8	1304.58	1303.54 to 1305.63
L7	229.0	1309.14	1308.09 to 1310.19

Optical Margin

Description (Inner Eye)	Proposed 400GBASE-FR8	<i>Adopted 400GBASE-LR8</i>	Unit
Receiver Sensitivity (OMA), each lane, pre-DeMux (max)	-10.0	<i>-11.8</i>	dBm
DeMux Loss	3.0	<i>3.0</i>	dB
Cross-talk penalty	0.3	<i>0.3</i>	dB
Receiver Sensitivity (OMA), each lane, post-DeMux (max)	-13.3	<i>-15.1</i>	dBm
Receiver Sensitivity (OMA) single lane (typical measured)	-17	<i>-17</i>	dBm
Optical Margin	3.7	<i>1.9</i>	dB

Recommendations

- Adopt 8x50G PAM4 WDM 2km duplex SMF baseline specifications in this presentation for the P802.3bs 2km SMF PMD objective to enable cost effective solution for majority of applications that do not need 10km link budget
- Develop 2km and 10km SMF PMD specifications to interoperate at 2km reach to enable common deployment, and economies of scale through shared component volume
- Leverage strong synergy between 2km and 10km PMDs for common specification methodology and common compliance testing approach
- All baseline specification parameters will undergo further analysis and are subject to change by the Task Force

400Gb/s 8x50G PAM4 WDM 2km SMF Specs

Thank you

