Optical power budgets

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Operating wavelength choice

The IEEE 802.3bg Task Force must decide on the operating wavelength range for the new SMF PMD. The two obvious alternatives are around 1310nm or around 1550nm.

This contribution looks at the optical power budgets that might be applied in these two cases.

For the case of 1550nm, the known deployments use the VSR2000-3R2 budget from G.693.

For 1310 nm there is an existing ITU power budget for 10km target distance in application code P1I1-3D1 in G.959.1.

The details of these budgets are shown on the next slide.

VSR2000-3R2 and P1I1-3D1 budgets

	VSR2000-3R2	P1I1-3D1
Distance (km)	2	10
Wavelength (nm)	1530 to 1565	1307 to 1317
Pout (dBm)	+3 to 0	+4 to 0
ER (dB)	8.2	8.2
SMSR (dB)	35	35
Attenuation (dB)	4 to 0	6 to 0
Dispersion (ps/nm)	38	±16
DGD (ps)	7.5	7.5
Penalty (dB)	2	1
Overload (dBm)	+3	+4
Sensitivity (dBm)	-6	-7
Document	G.693	G.959.1

ITU-T vs IEEE style

As was discussed in anslow_02_0110.pdf in the New Orleans Study Group meeting, the serial 40GbE interface spec should enable a single tri-rate device to also be able to support the VSR2000-3R2 interface.

This means that it is expected that the majority of serial 40GbE devices will need to be tested for compliance with the ITU-T budget when they are in OTU3 or STM-256 mode.

Consequently, there seems little benefit in writing the serial 40GbE budget in terms of TDP, OMA and stressed receiver sensitivity since this will place a significant burden on the implementer of tri-rate devices.

It is therefore proposed to adopt similar specifications for the serial 40GbE budget as are used in the VSR2000-3R2 or P1I1-3D1 budgets.

Pending a decision on the transmitter wavelength range, both the 1550 and 1310nm cases are proposed in the following slides.

1550 nm 2km Tx Table

Table 89–6—40GBASE-?R transmit characteristics

Description	Value	Unit
Signaling rate (range)	41.25 ± 100 ppm	GBd
Center wavelength (range)	1530 to 1565	nm
Side-mode suppression ratio (SMSR), (min)	35	dB
Average launch power (max)	3	dBm
Average launch power (min)	0	dBm
Dispersion penalty (max)	2	dB
Average launch power of OFF transmitter (max)	–30	dBm
Extinction ratio (min)	8.2	dB
$RIN_{20}OMA$ (max)	TBD	dB/Hz
Optical return loss tolerance (max)	20	dB
Transmitter reflectance[a] (max)	–12	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{TBD}	

[a]Transmitter reflectance is defined looking into the transmitter.

1550 nm 2km Rx Table

Table 89–7—40GBASE–?R receive characteristics

Description	Value	Unit
Signaling rate (range)	41.25 ± 100 ppm	GBd
Center wavelength (range)	1530 to 1565	nm
Damage threshold[a] (min)	4	dBm
Average receive power (max)	3	dBm
Receiver reflectance (max)	–26	dB
Receiver sensitivity (average power) (max)	–6	dBm
Receiver jitter tolerance (max)	1	dB
Receiver 3 dB electrical upper cutoff frequency, each lane (max)	49	GHz

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

1550 nm 2km Budget Table

Table 89–8—40GBASE–?R illustrative link power budget

Parameter	Value	Unit
Power budget	6	dB
Operating distance	2	km
Channel insertion loss[a]	4	dB
Maximum discrete reflectance	–26	dB
Allocation for penalties[b]	2	dB
Additional insertion loss allowed	0	dB

[a]The channel insertion loss is calculated using the maximum distance specified in Table 89–5 and cabled optical fiber attenuation of TBD dB/km at TBD nm plus an allocation for connection and splice loss given in 89.10.2.1.
[b]Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

1310 nm 10km Tx Table

Table 89–6—40GBASE-LR transmit characteristics

Description	Value	Unit
Signaling rate (range)	41.25 ± 100 ppm	GBd
Center wavelength (range)	1307 to 1317	nm
Side-mode suppression ratio (SMSR), (min)	35	dB
Average launch power (max)	3	dBm
Average launch power (min)	0	dBm
Dispersion penalty (max)	1	dB
Average launch power of OFF transmitter (max)	–30	dBm
Extinction ratio (min)	8.2	dB
$RIN_{20}OMA$ (max)	TBD	dB/Hz
Optical return loss tolerance (max)	20	dB
Transmitter reflectance[a] (max)	–12	dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{TBD}	

[a]Transmitter reflectance is defined looking into the transmitter.

1310 nm 10km Rx Table

Table 89–7—40GBASE–LR receive characteristics

Description	Value	Unit
Signaling rate (range)	41.25 ± 100 ppm	GBd
Center wavelength (range)	1307 to 1317 and 1530 to 1565	nm
Damage threshold[a] (min)	4	dBm
Average receive power (max)	3	dBm
Receiver reflectance (max)	–26	dB
Receiver sensitivity (average power) (max)	–7	dBm
Receiver jitter tolerance (max)	1	dB
Receiver 3 dB electrical upper cutoff frequency, each lane (max)	49	GHz

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

1310 nm 10km Budget Table

Table 89–8—40GBASE–LR illustrative link power budget

Parameter	Value	Unit
Power budget	7	dB
Operating distance	10	km
Channel insertion loss[a]	6	dB
Maximum discrete reflectance	–26	dB
Allocation for penalties[b]	1	dB
Additional insertion loss allowed	0	dB

[a]The channel insertion loss is calculated using the maximum distance specified in Table 89–5 and cabled optical fiber attenuation of TBD dB/km at TBD nm plus an allocation for connection and splice loss given in 89.10.2.1.
[b]Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

Thanks!