

Interop calculations – clauses 140 & 151

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IEEE P802.3cu 100 Gb/s and 400 Gb/s over SMF at 100 Gb/s per Wavelength Task Force

CLAUSE 140

Maximum loss based on SRS + channel penalties

Max loss allowed = [TxOMA(min) at max TDECQ] - [Rx SRS (max)] – channel penalties

Values in D2.1

	A		B		C	D=A-B-C	E	D-E
Transmitter	TxOMAmIn at max TDECQ	Receiver	Rx SRS	Channel	Channel penalties	Max loss allowed	Max channel insertion loss	Max attenuator
DR_Lo	1.5	FR1	-2.5	DR_Lo	0.4	3.6	3	0.6
	1.5	LR1	-4.1	DR_Lo	0.4	5.2	3	2.2
DR_Hi	1.2	FR1	-2.5	DR_Hi	0.1	3.6	3	0.6
	1.2	LR1	-4.1	DR_Hi	0.1	5.2	3	2.2
FR1_Lo	1.9	DR	-1.9	DR_Lo	0.4	3.4	3	0.4
	1.9	LR1	-4.1	FR1_Lo	0.4	5.6	4	1.6
FR1_Hi	1.8	DR	-1.9	DR_Hi	0.1	3.6	3	0.6
	1.8	LR1	-4.1	FR1_Hi	0.3	5.6	4	1.6
LR1_Lo	3.1	DR	-1.9	DR_Lo	0.4	4.6	3	1.6
	3.1	FR1	-2.5	FR1_Lo	0.4	5.2	4	1.2
LR1_Hi	3	DR	-1.9	DR_Hi	0.1	4.8	3	1.8
	3	FR1	-2.5	FR1_Hi	0.3	5.2	4	1.2

Proposed changes for D2.2

	A		B		C	D=A-B-C	E	D-E
Transmitter	TxOMAmIn at max TDECQ	Receiver	Rx SRS	Channel	Channel penalties	Max loss allowed	Max channel insertion loss	Max attenuator
DR_Lo	1.5	FR1	-2.5	DR_Lo	0.4	3.6	3	0.6
	1.5	LR1	-4.1	DR_Lo	0.4	5.2	3	2.2
DR_Hi	1.2	FR1	-2.5	DR_Hi	0.1	3.6	3	0.6
	1.2	LR1	-4.1	DR_Hi	0.1	5.2	3	2.2
FR1	1.9	DR	-1.9	DR_Lo	0.4	3.4	3	0.4
	1.9	DR	-1.9	DR_Hi	0.1	3.7	3	0.7
	1.9	LR1	-4.1	FR1	0.4	5.6	4	1.6
LR1	3.1	DR	-1.9	DR_Lo	0.4	4.6	3	1.6
	3.1	DR	-1.9	DR_Hi	0.1	4.9	3	1.9
	3.1	FR1	-2.5	FR1	0.4	5.2	4	1.2

Notes: TxOMAmIn varies with value of extinction ratio for DR transmitter and for FR1 & LR1 in D2.1. The proposed comment resolution increases the link budget by 0.1 dB for FR1 & LR1 to match the previous low extinction ratio case. This results in some minor changes to the max loss allowed for FR1 and LR1 transmitters interoperating with DR receivers over the DR channel.

Maximum loss based on received average power (min)

$$\text{Max loss allowed} = [\text{Tx Pavg (min)}] - [\text{Rx Pavg (min)}]$$

Values in D2.1

	A		B		C=A-B	D	C-D
Transmitter	Pav_min	Receiver	Rx Avg_min	Channel	Max loss allowed	Max channel insertion loss	Max attenuator
DR	-2.9	FR1	-6.9	DR	4	3	1
	-2.9	LR1	-8.3	DR	5.4	3	2.4
FR1	-2.9	DR	-5.9	DR	3	3	0
	-2.9	LR1	-8.3	FR1	5.4	4	1.4
LR1	-2	DR	-5.9	DR	3.9	3	0.9
	-2	FR1	-6.9	FR1	4.9	4	0.9

Proposed changes for D2.2

	A		B		C=A-B	D	C-D
Transmitter	Pav_min	Receiver	Rx Avg_min	Channel	Max loss allowed	Max channel insertion loss	Max attenuator
DR	-2.9	FR1	-7.1	DR	4.2	3	1.2
	-2.9	LR1	-8.2	DR	5.3	3	2.3
FR1	-3.1	DR	-5.9	DR	2.8	3	-0.2
	-3.1	LR1	-8.2	FR1	5.1	4	1.1
LR1	-1.9	DR	-5.9	DR	4	3	1
	-1.9	FR1	-7.1	FR1	5.2	4	1.2

Notes: These loss values are lower than the OMA based values for FR1 and LR1 transmitters. Although average power (min) is informative, it is used as a limit for SIGNAL_DETECT in Table 140-4.

Receive conditions	SIGNAL_DETECT value
Average optical power at TP3 \geq -15 dBm	FAIL
[[Optical power at TP3 \geq average receive power (min) Table 140-7] AND (compliant 100GBASE-R signal input)]	OK
All other conditions	Unspecified

Minimum loss based on overload

$$\text{Min loss allowed} = \max (\text{Tx Pav}(\text{max}) - \text{Rx Pav}(\text{max}), \text{Tx OMA}(\text{max}) - \text{Rx OMA}(\text{max}))$$

Values in D2.1

		A	B	A	B	C=A-B
Transmitter	Receiver	Tx Pav_max	Rx Avg_max	Tx OMA_max	Rx OMA_max	Min loss allowed
DR	FR1	4	4	4.2	4.2	0
	LR1	4	4.8	4.2	5	0
FR1	DR	4	4	4.2	4.2	0
	LR1	4	4.8	4.2	5	0
LR1	DR	4.8	4	5	4.2	0.8
	FR1	4.8	4	5	4.2	0.8

Notes: No change to these values

Proposed changes to draft

- Table 140-15 “interoperation between 100GBASE-LR1 and 100GBASE-DR”
 - For LR1 transmitter to DR receiver, change max loss from 4.1 to 4 dB
 - For DR transmitter to LR1 receiver, change max loss from 4.8 to 5.2 dB
- Table 140-16 “interoperation between 100GBASE-LR1 and 100GBASE-FR1”
 - For LR1 transmitter to FR1 receiver, no change
 - For FR1 transmitter to LR1 receiver, change max loss from 5.6 to 5.1 dB

CLAUSE 151

Maximum loss based on SRS + channel penalties

Max loss allowed = [TxOMA(min) at max TDECQ] - [Rx SRS (max)] – channel penalties

Values in D2.1

	A	B	C	D=A-B-C	E	D-E		
Transmitter	TxOM Amin at max TDECQ	Receiver	Rx SRS	Channel penalties	Max loss allowed	Max channel insertion loss	Max attenuator	
FR4_Lo	1.8	LR4-6	-4.7	FR4 Lo	0.4	6.1	4	2.1
FR4_Hi	1.7	LR4-6	-4.7	FR4 Hi	0.3	6.1	4	2.1
LR4-6_Lo	2.3	FR4	-2.6	FR4_Lo	0.4	4.5	4	0.5
LR4-6_Hi	2.2	FR4	-2.6	FR4_Hi	0.3	4.5	4	0.5

Proposed changes for D2.2

	A	B	C	D=A-B-C	E	D-E		
Transmitter	TxOM Amin at max TDECQ	Receiver	Rx SRS	Channel penalties	Max loss allowed	Max channel insertion loss	Max attenuator	
FR4	1.8	LR4-6	-4.7	FR4	0.4	6.1	4	2.1
LR4-6	2.3	FR4	-2.6	FR4	0.4	4.5	4	0.5

Notes: TxOM Amin varies with value of extinction ratio for DR transmitter and for FR4 & LR4-6 in D2.1. The proposed comment resolution increases the link budget by 0.1 dB for FR4 & LR4-6 to match the previous low extinction ratio case. This results in no change to the maximum loss allowed for interop over the FR4 channel.

Maximum loss based on received average power (min)

$$\text{Max loss allowed} = [\text{Tx Pavg (min)}] - [\text{Rx Pavg (min)}]$$

Values in D2.1

	A	B	C=A-B	D	C-D		
Transmitter	Pav_min	Receiver	Rx Avg_min	Channel	Max loss allowed	Max channel insertion loss	Max attenuator
FR4	-3.3	LR4-6	-9.1	FR4	5.8	4	1.8
LR4-6	-2.8	FR4	-7.3	FR4	4.5	4	0.5

Proposed changes for D2.2

	A	B	C=A-B	D	C-D		
Transmitter	Pav_min	Receiver	Rx Avg_min	Channel	Max loss allowed	Max channel insertion loss	Max attenuator
FR4	-3.2	LR4-6	-9	FR4	5.8	4	1.8
LR4-6	-2.7	FR4	-7.2	FR4	4.5	4	0.5

Notes: The max loss allowed is lower than the OMA based value for FR4 Tx to LR4-6 Rx. Although average power (min) is informative, it is used as a limit for SIGNAL_DETECT in Table 151-4.

Receive conditions	SIGNAL_DETECT value
For any lane; Average optical power at TP3 \geq -16 dBm	FAIL
For all lanes; [(Optical power at TP3 \geq average receive power, each lane (min) in Table 151-8 for 400GBASE-FR4 and 400GBASE-LR4-6) AND (compliant 400GBASE-R signal input)]	OK
All other conditions	Unspecified

Minimum loss based on overload

Min loss allowed = max (Tx Pav(max) – Rx Pav(max), Tx OMA(max) – Rx OMA(max))

Values in D2.1

		A	B	A	B	C=A-B
Transmitter	Receiver	Tx Pav_max	Rx Avg_max	Tx OMA_max	Rx OMA_max	Min loss allowed
FR4	LR4-6	3.5	4.2	3.7	4.4	0
LR4-6	FR4	4.2	3.5	4.4	3.7	0.7

Notes: No change to these values

Proposed changes to draft

- Table 151-16 “interoperation between 400GBASE-LR4-6 and 400GBASE-FR4”
 - For LR4-6 transmitter to FR4 receiver, no change.
 - For FR4 transmitter to LR4-6 receiver, change max loss from 6.1 to 5.8 dB

Thanks!