

Concerning Comments On 25GBASE- LR and 25GBASE-ER Interoperation

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Outline

1. Several comments indicated that the conditions for interoperability of 25GBASE-LR and 25GBASE-ER needed clarification to ensure that the min/max specifications for OMA and average power (P_{avg}) are satisfied.
2. One possible solution is the following:
 1. For channel loss of 0 – 4 dB:
 1. Require 5 ± 1 dB attenuator when connecting 25GBASE-ER transmitter (Tx) to 25GBASE-LR receiver (Rx).
 2. Require 8 ± 1 dB attenuator when connecting 25GBASE-LR Tx to 25GBASE-ER Rx.
 2. For channel loss of 3 – 6.3 dB:
 1. Require 2 ± 1 dB attenuator when connecting 25GBASE-ER Tx to 25GBASE-LR Rx.
 2. Require 5 ± 1 dB attenuator when connecting 25GBASE-LR Tx to 25GBASE-ER Rx.

Specifications (From P802.3cc D2.0)

Table 114-6—25GBASE-LR and 25GBASE-ER transmit characteristics

Description	25GBASE-LR	25GBASE-ER	Unit
Signaling rate (range)	25.78125 ± 100 ppm		GBd
Center wavelength (range)	1295 to 1325	1295 to 1310	nm
Side-mode suppression ratio (SMSR), (min)	30		dB
Average launch power (max)	2	6	dBm
Average launch power ^a (min)	-7	-3	dBm
Optical Modulation Amplitude (OMA), (max)	2.2	6	dBm
Optical Modulation Amplitude (OMA) ^b , (min)	-4	0	dBm
Launch power in OMA minus TDP (min)	-5	-1	dBm
Transmitter and dispersion penalty (TDP), (max)	2.7	2.7	dB
Average launch power of OFF transmitter (max)	-25		dBm
Extinction ratio (min)	3.5	4	dB
RIN ₂₀ OMA (max)	-130		dB/Hz
Optical return loss tolerance (max)	20		dB
Transmitter reflectance ^c (max)	-12		dB
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3} Hit ratio 5x10 ⁻³ hits per sample.	{0.31, 0.4, 0.45, 0.34, 0.38, 0.4}		

^aAverage launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.

^bEven if the TDP < 1 dB, the OMA (min) must exceed this value.

^cTransmitter reflectance is defined looking into the transmitter.

Table 114-8—25GBASE-LR and 25GBASE-ER illustrative link power budgets

Parameter	25GBASE-LR	25GBASE-ER		Unit
Power budget (for maximum TDP)	9	20.7		dB
Operating distance	10	30	40 ^a	km
Channel insertion loss (max)	6.3 ^b	15	18	dB
Channel insertion loss (min)	0	10		dB
Maximum discrete reflectance	-26	-26		dB
Allocation for penalties ^c (for maximum TDP)	2.7	2.7		dB
Additional insertion loss allowed	0	3	0	dB

^aLinks longer than 30 km are considered engineered links. Attenuation for such links needs to be less than the worst case for B1.1, B1.3, or B6 a single-mode cabled optical fiber

^bThe channel insertion loss is calculated using the maximum distance specified in Table 114-5 for 25GBASE-LR and fiber attenuation of 0.43 dB/km at 1295 nm plus an allocation for connection and splice loss given in 88.11.2.1.

^cLink penalties are used for link budget calculations. They are not requirements and are not meant to be tested.

Table 114-7—25GBASE-LR and 25GBASE-ER receive characteristics

Description	25GBASE-LR	25GBASE-ER	Unit
Signaling rate (range)	25.78125 ± 100 ppm		GBd
Center wavelength (range)	1295 to 1325		nm
Damage threshold ^a (min)	5.5	-3	dBm
Average receive power (max)	2	-4	dBm
Average receive power ^b (min)	-13.3	-19.6 -21	dBm
Receive power (OMA), (max)	2.2	-4	dBm
Receiver reflectance (max)	-26		dB
Receiver sensitivity (OMA) ^c , (max)	-11.3	-19	dBm
Stressed receiver sensitivity (OMA) ^d , (max)	-8.8	-16.5	dBm
Conditions of stressed receiver sensitivity test			
Vertical eye closure penalty ^e	1.9	1.9	dB
Stressed eye J2 Jitter ^e	0.27	0.27	UI
Stressed eye J4 Jitter ^e	0.39	0.39	UI
SRS eye mask definition {X1, X2, X3, Y1, Y2, Y3} Hit ratio 5x10 ⁻³ hits per sample.	{0.24, 0.5, 0.5, 0.24, 0.24, 0.4}	{0.24, 0.5, 0.5, 0.24, 0.24, 0.4}	

^aThe receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.

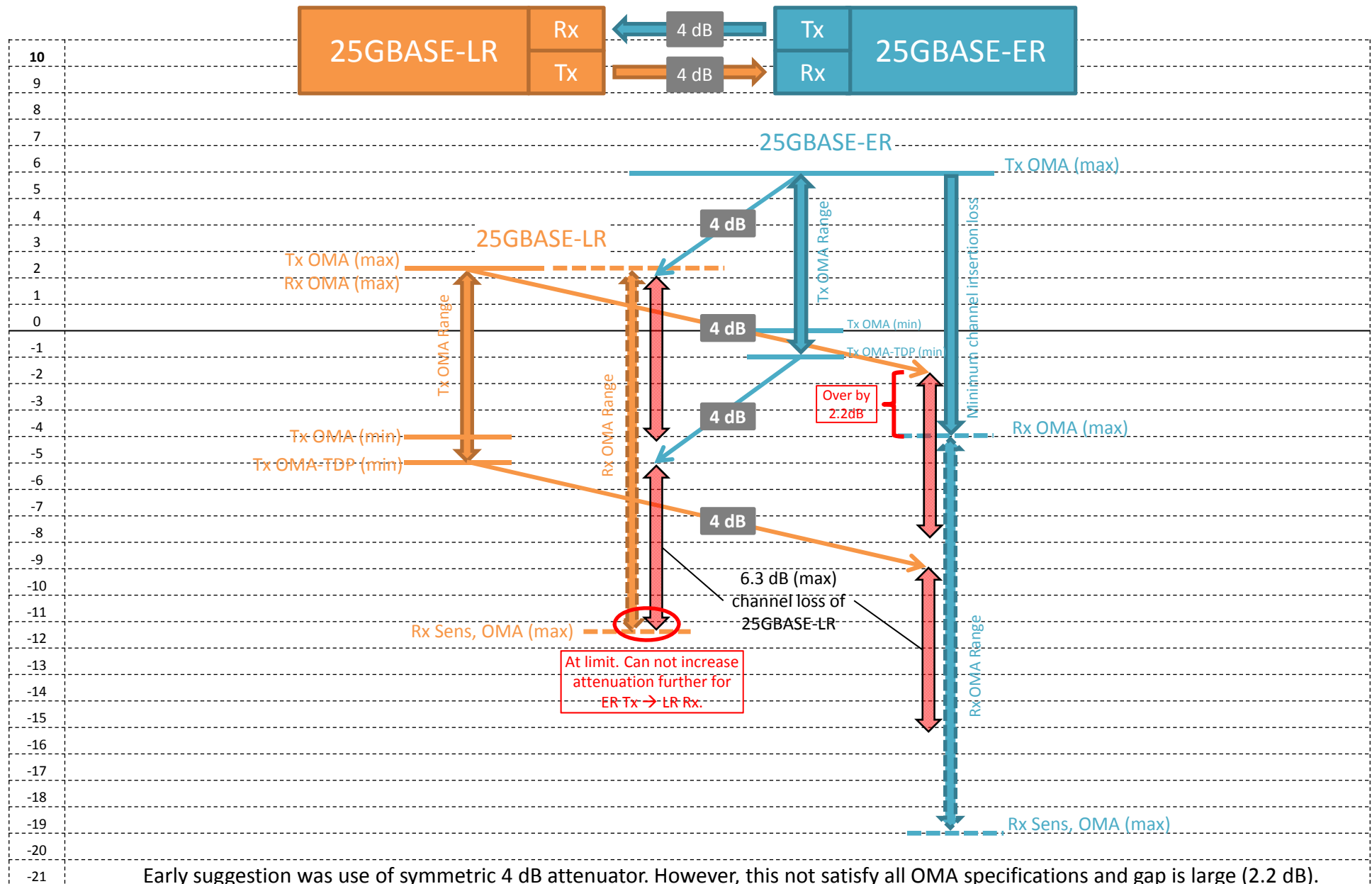
^bAverage receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

^cReceiver sensitivity (OMA), (max) is informative.

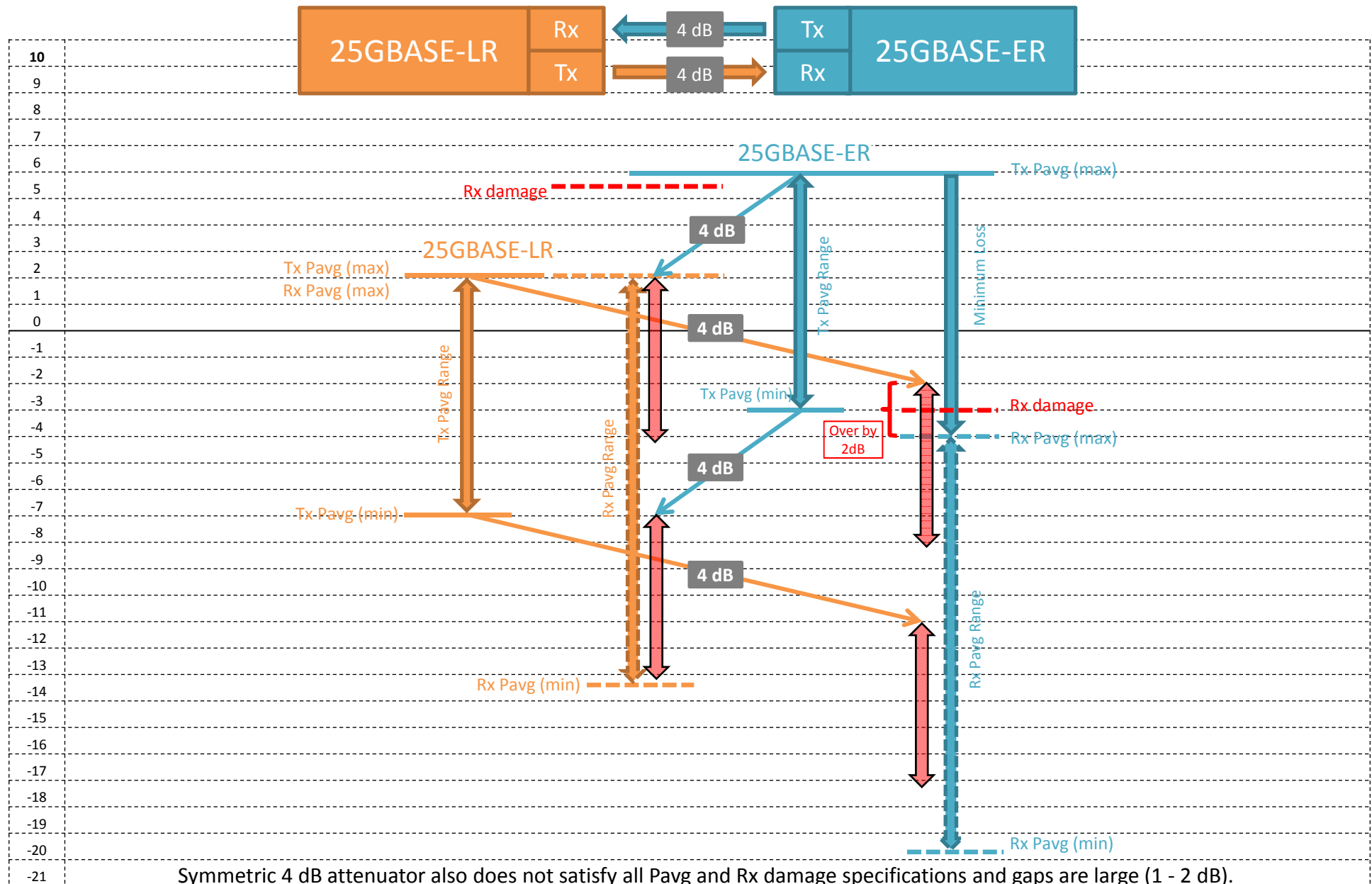
^dMeasured with conformance test signal at TP3 (see 114.7.10) for the BER specified in 114.1.1

^eVertical eye closure penalty, stressed eye J2 Jitter, and stressed eye J4 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

25GBASE-LR and 25GBASE-ER Interconnected With 4dB Attenuator – OMA

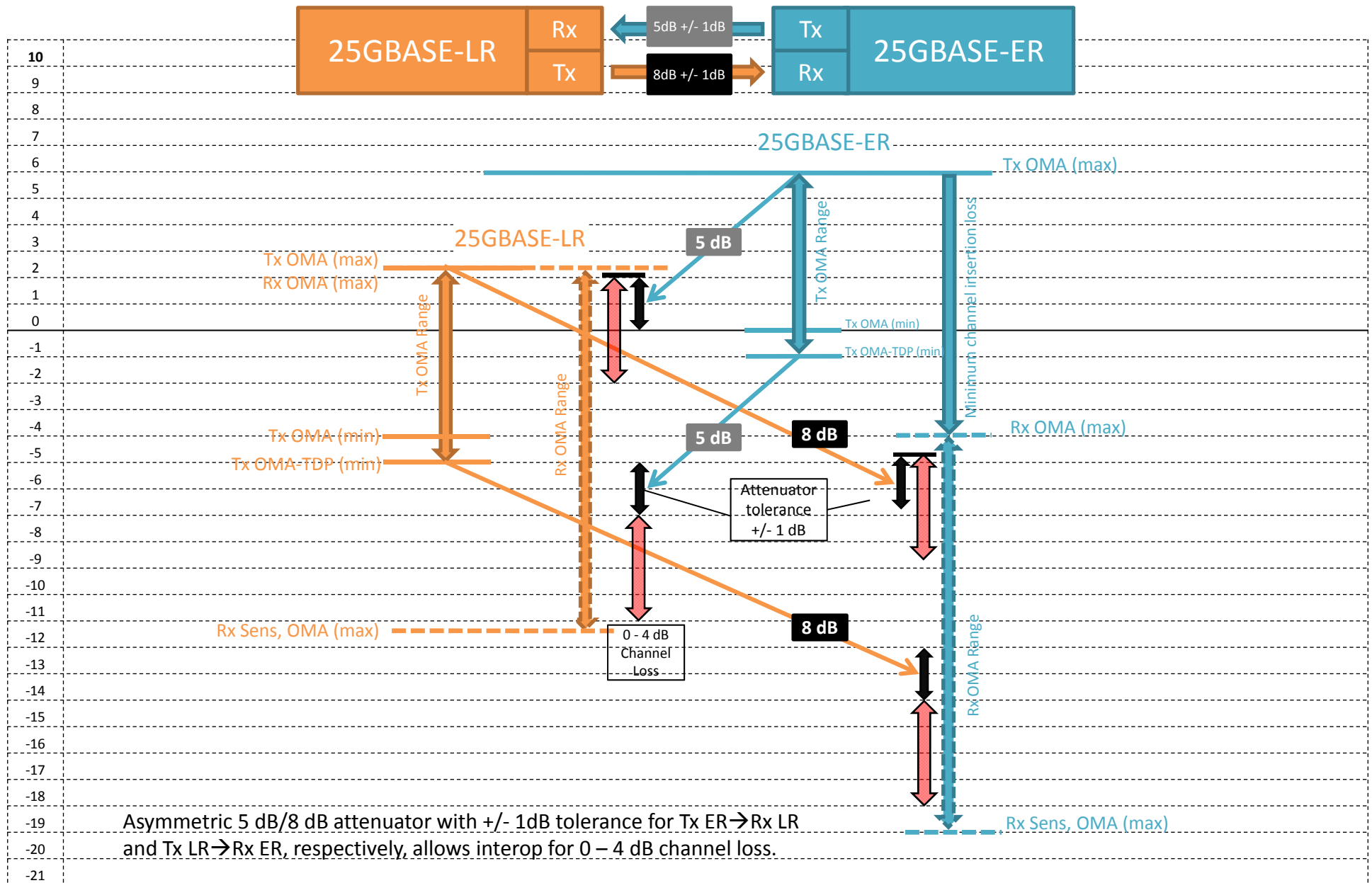


25GBASE-LR and 25GBASE-ER Interconnected With 4dB Attenuator - Pavg



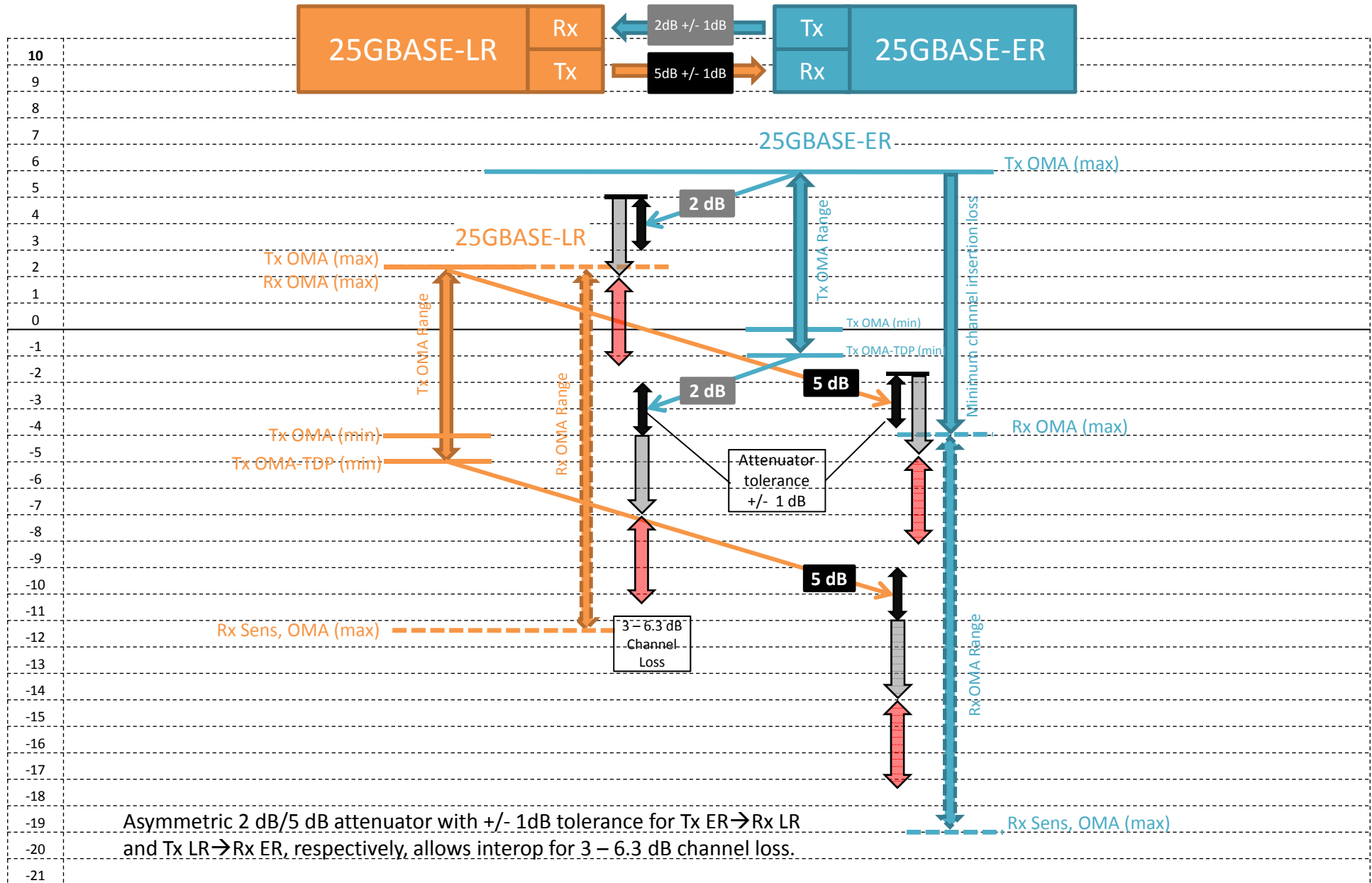
25GBASE-LR and 25GBASE-ER Interconnection Attenuator Tolerance Considerations – OMA

Channel Loss of 0-4 dB



25GBASE-LR and 25GBASE-ER Interconnection Attenuator Tolerance Considerations – OMA

Channel Loss of 3 – 6.3 dB



Summary

1. Interoperation between 25GBASE-LR and 25GBASE-ER can be achieved with asymmetric attenuators. One example of a solution is below, which requires knowledge of the channel loss.
 1. For channel loss of 0 – 4 dB:
 1. Require 5 ± 1 dB attenuator when connecting 25GBASE-ER transmitter (Tx) to 25GBASE-LR receiver (Rx).
 2. Require 8 ± 1 dB attenuator when connecting 25GBASE-LR Tx to 25GBASE-ER Rx.
 2. For channel loss of 3 – 6.3 dB:
 1. Require 2 ± 1 dB attenuator when connecting 25GBASE-ER Tx to 25GBASE-LR Rx.
 2. Require 5 ± 1 dB attenuator when connecting 25GBASE-LR Tx to 25GBASE-ER Rx.
2. Slides following this summary slide propose how the draft can be modified to accommodate the type of solutions described above. Also, adding the example in the draft should be discussed.
3. This proposal assumes the current specifications for 25GBASE-ER (i.e. per D2.0 which assumes APD receiver). If the link budget for 25GBASE-ER is shifted to allow for PIN receivers, as has been proposed elsewhere, then further consideration is needed.

Changes In D2.1 If Adopted

1. *Change the last sentence of the first paragraph of Clause 114.6 on p30 as follows (changes shown in red):*

The operating ranges for the 25GBASE-LR and 25GBASE-ER PMDs are defined in Table 114–5. A 25GBASE-LR or 25GBASE-ER compliant PMD operates on type B1.1, B1.3, or B6_a single-mode fibers according to the specifications defined in Table 114–11. A PMD that exceeds the operating range requirement while meeting all other optical specifications is considered compliant (e.g., a 25GBASE-LR PMD operating at 12.5 km meets the operating range requirement of 2 m to 10 km). **The 25GBASE-ER PMD interoperates with the 25GBASE-LR PMD provided that the channel requirements specified in Table 114-8 and Table 114-11 are met.**

Changes In D2.1 If Adopted (cont.)

2. Insert the following new columns and footnotes (shown in red) in Table 114-8.

Description	25GBASE-ER transmitter, 25GBASE-LR receiver	25GBASE-LR transmitter, 25GBASE-ER receiver	Unit
Power budget (for maximum TDP)	12.7	15.7	dB
Operating distance	10		km
Channel insertion loss (max)	10 ^d	13 ^d	dB
Channel insertion loss (min)	4 ^d	7 ^d	dB
Maximum discrete reflectance	-26		dB
Allocation for penalties (for maximum TDP)	2.7		dB
Additional insertion loss allowed	0		dB

- a. Links longer than 30 km are considered engineered links. Attenuation for such links needs to be less than the worst case for B1.1, B1.3, or B6_a single-mode cabled optical fiber
- b. The channel insertion loss is calculated using the maximum distance specified in Table 114-5 for 25GBASE-LR and fiber attenuation of 0.43 dB/km at 1295 nm plus an allocation for connection and splice loss given in 88.11.2.1.
- c. Link penalties are used for link budget calculations. They are not requirements and are not meant to be tested.
- d. These channel insertion loss values include a fixed attenuation in addition to the channel insertion loss of 25GBASE-LR. The fixed attenuation minimum value (i.e. nominal value minus tolerance) is the minimum channel insertion loss.

Changes In D2.1 If Adopted (cont.)

3. *Insert the following new columns and new footnotes (shown in red) in Table 114-12 (Note: Table 114-12 in D2.0 has the wrong numbering. It should be Table 114-11.)*

Description	25GBASE-ER transmitter, 25GBASE-LR receiver	25GBASE-LR transmitter, 25GBASE-ER receiver	Unit
Operating distance (max)	10		km
Channel insertion loss ^{a, b} (max)	10 ^d	13 ^d	dB
Channel insertion loss (min)	4 ^d	7 ^d	dB
Positive dispersion ^b (max)	22.6		ps/nm
Negative dispersion ^b (min)	-27.9		ps/nm
DGD_max ^c	8		ps
Optical return loss (min)	21		dB

a. These channel insertion loss values include cable, connectors, and splices.

b. Over the wavelength range 1295 nm to 1325 nm for 25GBASE-LR and 1295 nm to 1310 nm for 25GBASE-ER.

c. DGD_max is the maximum differential group delay that the system must tolerate.

d. *These channel insertion loss values include a fixed attenuation in addition to the channel insertion loss of 25GBASE-LR. The fixed attenuation minimum value (i.e. nominal value minus tolerance) is the minimum channel insertion loss.*