Optical link budget compatibility

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Compatibility objective

What does:

Provide optical compatibility with existing carrier 40Gb/s client interfaces (e.g., OTU3/STM-256/OC-768/40G POS)

(one of the objectives under discussion) actually mean?

OTU3/STM-256 applications

- The two ITU Recommendations that define optical budgets for OTU3/STM-256 applications are [G.693] and [G.959.1]
- OC-768 optical budgets are defined in [T1.105.06] which just points to G.693

- G.693 “Optical interfaces for intra-office systems”
  - VSR2000-3R1 OTU3/STM-256 with 2 km reach at 1310 nm
  - VSR2000-3R2 OTU3/STM-256 with 2 km reach at 1550 nm

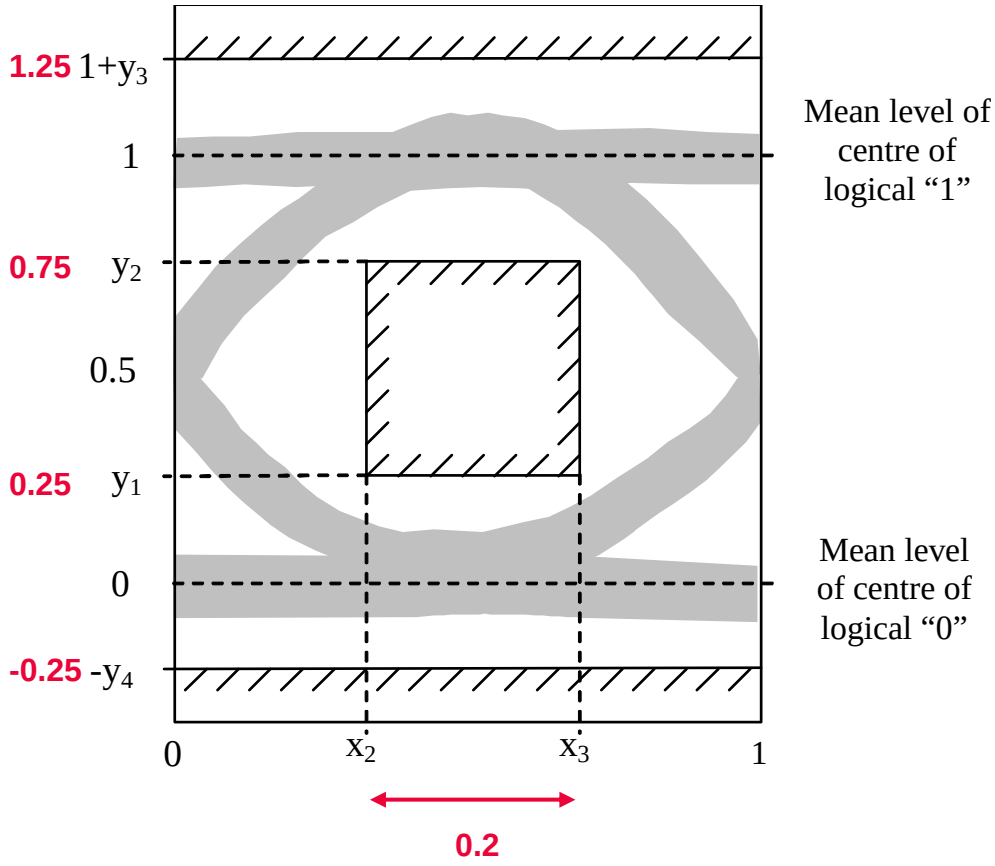
- G.959.1 “Optical transport network physical layer interfaces”
  - P1I1-3D1 OTU3/STM-256 with 10 km reach at 1310 nm

- Of these, VSR2000-3R2 is the only one known to have been deployed in carrier networks.

VSR2000-3R2 budget

Parameter	Unit	Value
Format	-	40G NRZ
Wavelength range	nm	1530 to 1565
Max mean Tx output power	dBm	+3
Min mean Tx output power	dBm	0
Min side mode suppression ratio	dB	35
Min extinction ratio	dB	8.2
Eye mask	-	See next slide
Max path attenuation	dB	4
Min path attenuation	dB	0
Max chromatic dispersion at 1565 nm	ps/nm	38
Max chromatic dispersion at 1530 nm	ps/nm	34
Max DGD	ps	7.5
Max return loss of cable plant at Tx	dB	24
Max discrete reflection in cable plant	dB	-27
Receiver sensitivity (1E-12 BER)	dBm	-6
Min receiver overload	dBm	+3
Max optical path penalty	dB	2
Max reflectance of receiver	dB	-27

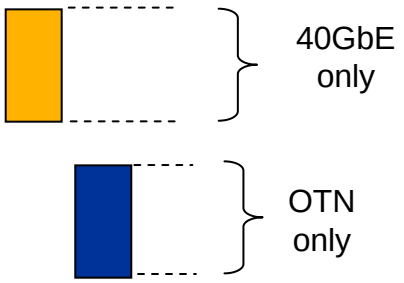
VSR2000-3R2 eye mask



Optical compatibility implications

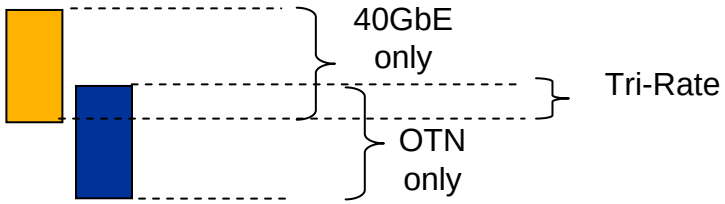
- The aim is to create a new 40GbE interface spec that enables a single device (called tri-rate here) to also be able to support the VSR2000-3R2 interface
- Format 40G NRZ
  - Making a tri-rate device that supports both serial and multi-lane or multiple modulation formats is not practical so new 40 GbE needs to be serial NRZ
- Max / min mean Tx power +3 to 0 dBm
  - Either, the new 40GbE spec could be within +3 to 0 dBm
  - or, the new 40GbE spec could allow higher or lower and the tri-rate device has a more stringent requirement than pure Ethernet. Task Force choice.
  - A power range that does not overlap with +3 to 0 dBm at all is not an option
- Most other parameters on slide 4 can be dealt with similarly to Tx power. Wavelength and Jitter are considered on the next slides.

Optical compatibility illustration

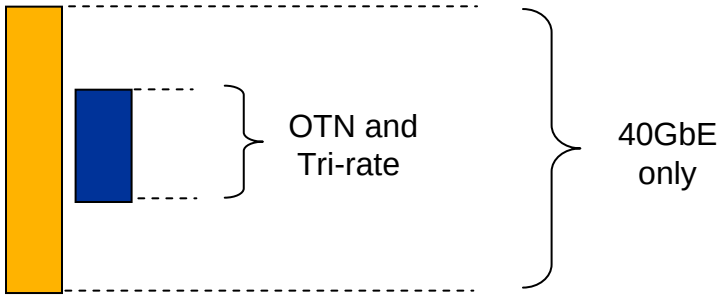


- **no overlap**
- **no optical compatibility**
- **separate ethernet and OTN optical modules**

(OTN used here to denote OTU3/STM-256/OC-768)



- **some overlap**
- **supports optical compatibility**
- **tri-rate module is more stringent (more costly) for this parameter, than either Ethernet only or OTN only module**



- **complete overlap**
- **supports optical compatibility**
- **40GbE specs may be more relaxed than OTN**
- **40GbE only module is less stringent (less costly) for this parameter than either OTN or Tri-rate module**

Wavelength

- The wavelength range of VSR2000-3R2 is 1530 to 1565 nm
- The first version of G.693 had a note requiring it to have:
  - a minimum operating range of 1290 to 1330 nm and 1530 to 1565 nm
- The 2005 revision of G.693 increased the sensitivity requirement of VSR2000-3R2 by 1 dB and the note was revised to:
  - It will also operate in the application code VSR2000-3R1 if its operating wavelength range includes 1290-1330 nm
- Many existing VSR2000-3R2 receivers operate satisfactorily in the 1290-1330 nm range.
- Consequently, the Task Force will need to debate whether operating at 1310 nm provides sufficient compatibility with the installed base and also whether the benefits of 1310 nm (e.g. lower dispersion) outweigh the drawbacks (e.g. test gear issues).

Jitter

- Jitter requirements for OTU3 are in [G.8251]
  - Jitter tolerance, jitter generation, jitter transfer, etc. Examples are:
  - Jitter generation limit from 20kHz to 320MHz is 1.2UI ptp (for no input jitter)
  - Jitter generation limit from 16MHz to 320MHz is 0.1UI ptp
- Jitter requirements for STM-256 in [G.825 Amd 1] and [G.783 Amd 1]
  - Jitter tolerance, jitter generation, jitter transfer, etc. Examples are:
  - Jitter generation limit from 80kHz to 320MHz is 0.3UI ptp (for no input jitter)
  - Jitter generation limit from 16MHz to 320MHz is 0.15UI ptp
- Many jitter requirements for OTU3/STM-256 are only relevant when considering equipment as a whole (not just the optical module) because they depend on the quality of the clock being passed across the electrical interface. Hence if jitter requirements for the new 40GbE interface are written in line with traditional Ethernet specs this will not impact the optical compatibility. However, a tri-rate device may need a higher quality clock multiplier than an Ethernet only device.

Conclusion

“Provide optical compatibility with existing carrier 40Gb/s client interfaces (e.g., OTU3/STM-256/OC-768/40G POS)”

Does not mean that the new 40GbE specification has to be the same as the VSR2000-3R2 specification (although the Task Force could choose to make them the same).

Some differences in specification could be justified as making an Ethernet only implementation significantly lower cost than one that meets VSR2000-3R2 as long as those differences don’t prevent the implementation of a cost effective single device that meets both sets of specifications.

References

- [G.693] http://www.itu.int/rec/T-REC-G.693/en
- [G.959.1] http://www.itu.int/rec/T-REC-G.959.1/en
- [G.8251] http://www.itu.int/rec/T-REC-G.8251/en
- [G.825 Amd 1] http://www.itu.int/rec/T-REC-G.825/en
- [G.783 Amd 1] http://www.itu.int/rec/T-REC-G.783/en
- [T1.105.06] https://www.atis.org/docstore/product.aspx?id=8538

Thanks!