Finisar

Fiber Optic Solutions
for High-Speed Networks

40G Serial: wavelength & reach choices

Finisar

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Meeting IEEE PAR, 5 Criteria and Objectives

3 variants

- 1550 nm 2 km
- 1310 nm 2 km
- 1310 nm 5/10 km

What does 'compatibility' mean

- IEEE: "99%" rule of thumb
  - e.g. 99% target for 220 m link coverage during development of LRM
  - <1% failure rate, 802.3 working group requirement for Gigabit Ethernet
- Ethernet Alliance: >98%
  - Excert from Ethernet Alliance white paper "SFP+ Interoperability Demonstration White Paper" posted to www.ethernet alliance.org on September 2008*:

    "Over 98% of the 112 combinations tested interoperated error-free. After slight adjustment of the transmit PHY pre-emphasis settings which may not have been complaint to SFP+ specifications, all combinations were error-free. The lesson learned is that compliance to SFP+ specification is imperative for reliable link operation. The shorter test timeframe and short-cuts made on the first day, however, limited the scope of this interoperability test"
- Analysis of legacy module manufacturers' data indicated that ~25% of existing carrier 40 Gb/s client interfaces would not be compatible with a 1310 nm solution
- A failure rate of 25% does not meet normal IEEE performance expectations

*http://www.ethernetalliance.org/files/static_page_files/83B8AACC-C299-B906-801EE945307E8BDD/SFP+%20Interoperability%20Demonstration.pdf

1550 nm vs 1310 nm: meeting Task Force PAR

5.4 Purpose: This project will define a 40 Gb/s serial PMD that supports a link distance of at least 2 km over single-mode fiber that is optically compatible with existing carrier 40Gb/s client interfaces (OTU3/STM-256/OC-768/40G Packet over SONET (POS)), which will enable interconnection between equipment in carrier networks or as uplink interconnections from enterprises, data centers, or other network operators into carrier networks.

5.5 Need for the Project: The project is needed to provide multiple system operators and telecommunications operators with an IEEE 802.3 Ethernet 40 Gb/s serial PHY that provides optical compatibility with existing carrier 40 Gb/s client interfaces.

	1550 nm 2 km	1310 nm 2 km	1310 nm 5/10 km
Project Purpose	YES	NO	NO
Project Need	YES	NO	NO

1550 nm vs 1310 nm: meeting Task Force 5 Criteria

	1550 nm 2 km	1310 nm 2 km	1310 nm 5/10 km
Broad Market Potential	YES	YES	YES
Compatibility	YES	YES	YES
Distinct Identity One unique solution per problem (not two solutions to a problem)	YES	NO	NO
Technical Feasibility a) Demonstrated system feasibility b) Proven technology, reasonable testing c) Confidence in reliability	 a) YES b) YES c) YES	 a) Some b) Some c) Some	 a) Some b) Some c) Some
Economic Feasibility	YES	YES	YES

1550 nm vs 1310 nm: meeting Task Force Objectives (optical)

- Provide Physical Layer specification which support 40 Gb/s operation over at least 2 km on SMF
- Provide optical compatibility with existing carrier 40Gb/s client interfaces (OTU3/STM-256/OC-768/40G POS)

	1550 nm 2 km	1310 nm 2 km	1310 nm 5/10 km
2km reach objective	YES	YES	YES
Interoperable with VSR 2000-3R2	YES	NO (25% fails)	NO (>25% fails)

Relative Cost

- Parts & assembly cost differences are negligible

	1550 nm 2 km	1310 nm 2 km	1310 nm 10 km
relative EML chip cost	1.25	1	1+X
relative TOSA cost	2.75	2.5	2.5+X
relative ROSA cost	1	1	1+Y
relative module cost	25.25	25	25+X+Y

- However there is a high capex barrier and delay for jitter testing at 1310 nm, because existing test equipment works only at 1550 nm.

Qualitative spec & product development risks

	1550 nm 2 km EML	1310 nm 2 km EML	1310 nm 5/10 km EML	1310 nm 2 km DML
Optics productisation	Complete	Advanced	Advanced	Speculative
Test equipment (ITU jitter compliance)	Available	Not developed	Not developed	Not developed
Link budget specs	Known	Known	Needs review	Unknown
Field testing	Deployed	None	None	None

1550 nm vs 1310 nm: Summary

	1550 nm 2 km	1310 nm 2 km	1310 nm 5/10 km
Meets PAR	YES	NO	NO
Meets 5 Criteria	YES	NO	NO
Meets Objectives	YES	NO	NO
Development Risk	Low	Medium	Medium
2km reach objective	YES	YES	YES
Interoperable with VSR 2000-3R2	YES 100%	NO (25% fails)	NO (>25% fails)

- Only a 1550 nm solution meets all requirements with the normal levels of performance expected within IEEE
- Proposal: 802.3bg adopt 1550nm specs as shown in Anslow_03_0510