Technology Feasibility

25GE SMF PMD

Kohichi Tamura, Oclaro

Existing Standards Work (Electrical)

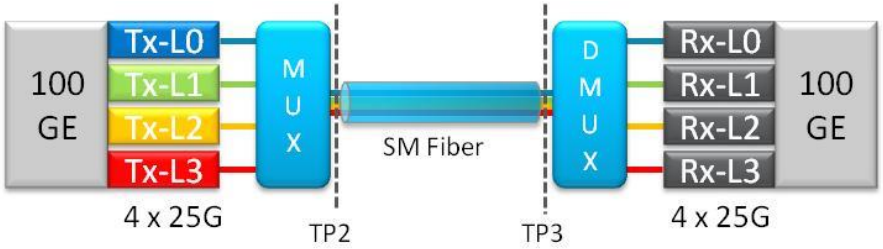
The 25GAUI chip-to-module (C2M) and 25GBASE-R RS-FEC are fully specified for 25 Gb/s operation in P802.3by.

25GAUI C2M specified in Annex 109B in P802.3by.

25GBASE-R RS-FEC specified in Clause 108 of P802.3by.

25G Leverages 100G Components

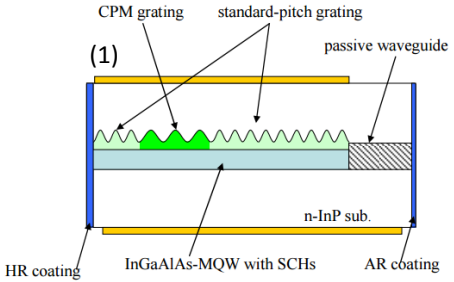
- 100GE modules are 4 lanes of 25G (4x25G)



- Key components for 25G already developed:
  - Tx: Direct modulation laser (DML)
  - Tx: Electro-absorption modulated DFB laser (EML, EA-DFB)
  - Tx: MZ modulator (SiP, InP)
  - Tx: Driver amplifiers (current and voltage)
  - Rx: PIN photodiode (PIN-PD)
  - Rx: Avalanche photodiode (APD)
  - Rx: Trans-impedance amplifier (TIA)
  - Tx/Rx: Clock-data recovery (CDR)

Many Choices Of 25G Optical Transmitter

DML

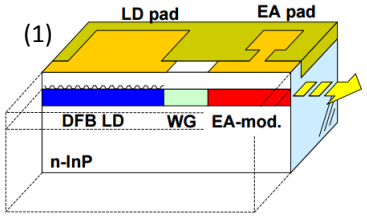


(2)

	Lane 0 (1271nm)	
	25°C	85°C
BTB	(a)	(b)
11.4km	(e)	(f)

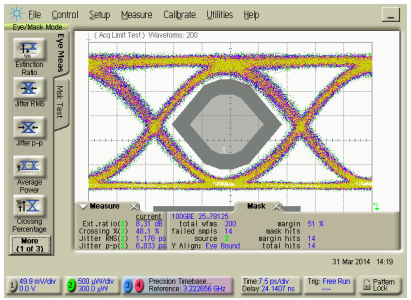
Reference:
(1) K. Nakahara et al., OFC 2013, OTh4H.3.
(2) T. Nakajima et al., OFC 2015, Th1G.6.

EML



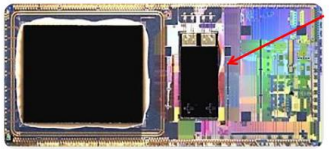
EA modulator: 100 μm
DFB laser: 400 μm

(2)

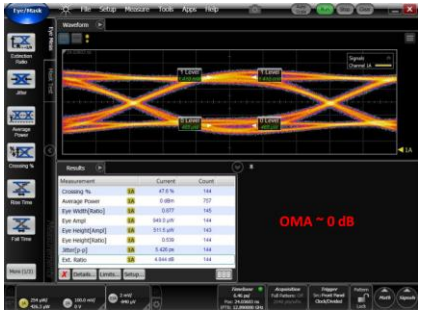


Reference:
(1) http://www.ieee802.org/3/ba/public/mar08/traverso_02_0308.pdf
(2) Oclaro internal data

SiP



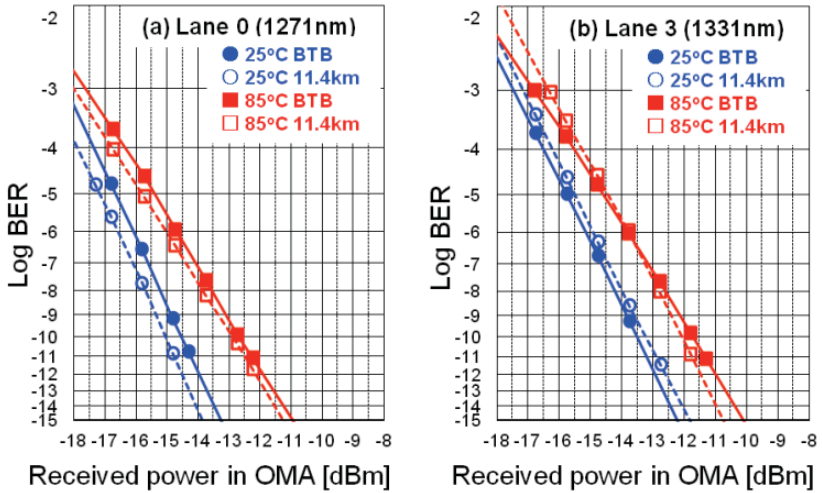
4x25 Gbps PSM4 Chipset



Reference:
http://www.ieee802.org/3/bs/public/adhoc/smf/14_10_14/welch_01_1014_smf.pdf

Long Reaches At 25G With PIN And APD Receivers

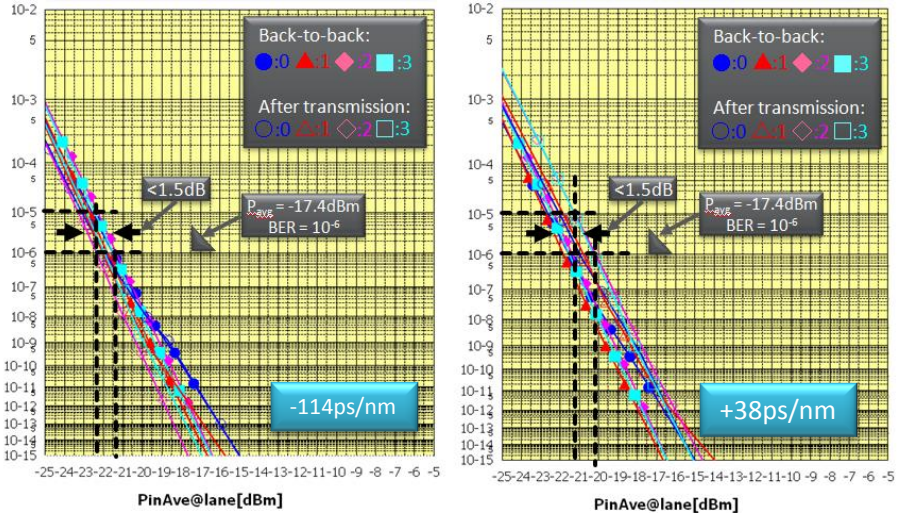
10km



- DML TOSA + PIN ROSA
- CWDM4 wavelength band

Reference:
T. Nakajima et al., OFC 2015, Th1G.6

40km



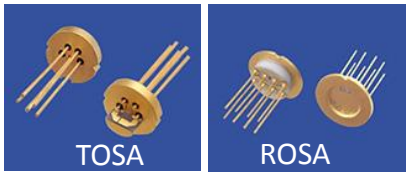
- EML TOSA + APD ROSA
- LR4 wavelength band

Reference:
Submitted to ITU-T SG15 for 4L1-9D1F G.959.1 (WD06-xx). Courtesy Finisar & Oclaro.

Low Cost Optical Packaging At 25G

25G Serial (TO-CAN)

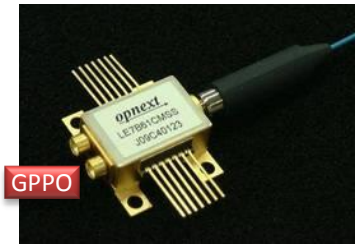
XMD-MSA TOSA
-25G TO now available
(Courtesy: Oclaro)



25G TO Headers
(Courtesy: Kyocera)

Low cost packaging up to 25G

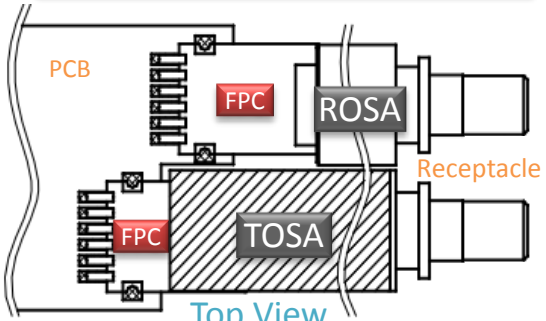
40G Serial (XLMD)



(Courtesy: Oclaro)

40G XLMD Package
(Courtesy: Kyocera)

Next Gen 40G Serial (XLMD2 - still in future)



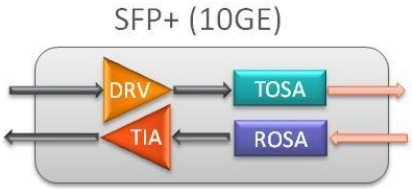
Ref: www.xlmd-msa.org

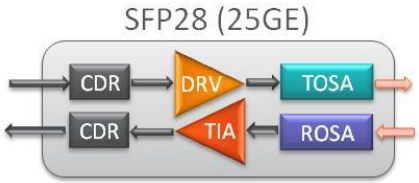
Packaging costs still high for serial 40G

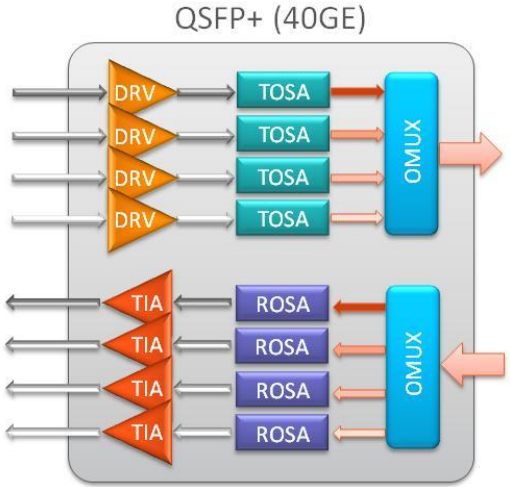
LR Module Structure Comparison

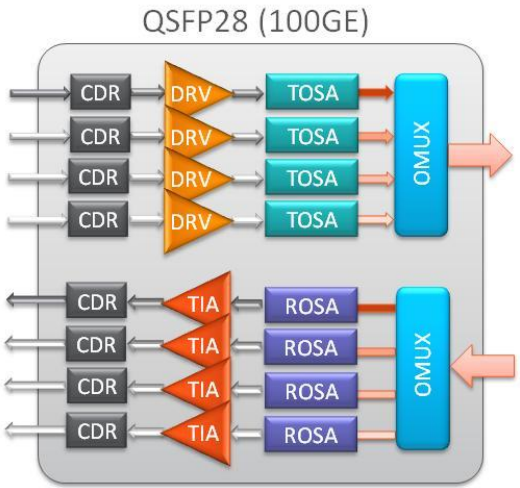
SFP

QSFP









LR Transceiver Comparison

LR Transceiver Comparison	10GE	40GE	25GE	100GE
Size	SFP+	QSFP+	SFP28	QSFP28
Modulation	NRZ	NRZ	NRZ	NRZ
Lane scheme	1 x 10G	4 x 10G	1 x 25G	4 x 25G
Power	1W	3W	~ 1W	~ 4W
mW/Gbps	100	75	~ 40	~ 40
Relative cost/Gbps (By rank:1=Lowest, 4=Highest)	1	3	2	4

Note: LR = 10km reach

Summary of 25GE SMF Technical Feasibility & Application Potential

- 25G is a proven and established technology.
- Many related applications already exist:
  - 500m: PSM4
  - 2km: CWDM4, CLR4
  - 10km: 32GFC, 100GBASE-LR4
  - 40km: 100GBASE-ER4, 100GBASE-ER4-Lite
- 25G matches native port speed of next generation ASICs.
- Single lane serial optics gives lowest cost- and power-per-Gbps
- 25G is the next higher serial rate after 10G

25GE SMF PMD

Why Now?

David Lewis, Lumentum

Why Now?

- 25GE is the best choice as the next step after 10GE for SMF transceivers
  - Single lane solutions with lower cost structure than alternative multi-lane PMDs
  - Particularly targeted at cost sensitive markets that don't yet need 40GE to 100GE speeds
- 25GE SMF is needed to complete the 25GE ecosystem
  - Twisted pair
  - PCB backplane
  - Copper cables
  - MMF
  - SMF – No standard available yet
- High volume enterprise space is looking to adopt 25GE – requires reaches > 100m
  - Standardization required now in order to enable market adoption

Straw Polls

Call-for-Interest Consensus

- Should a study group be formed for “25 Gigabit/s Ethernet PMD(s) for single mode fiber”?

- Y: N: A:

- Room count:

Participation

- I would participate in a “25 Gigabit/s Ethernet PMD(s) for single mode fiber” study group in IEEE 802.3
  - Tally:

- My company would support participation in a “25 Gigabit/s Ethernet PMD(s) for single mode fiber” study group
  - Tally:

Future Work

- Ask 802.3 at Thursday's closing meeting to form study group

- If approved:
  - 802 EC votes on Friday to approve the formation of the study group
  - First study group meeting would be during the January 2016 802.3 interim meeting (in Atlanta)

Background

To be deleted from main CFI consensus deck.

The CFI request email stated:

The IEEE 802.3by Task Force is developing standards that utilize 25 Gb/s technology for cost optimized serial solutions. As adoption of ASIC IO becomes more common across networking silicon, the opportunity to leverage low-cost serial technologies extends beyond the large scale data centers and into enterprise applications. A gap exists in the family of 25 Gb/s Ethernet PMDs which would be needed to fully address the enterprise application and the inclusion of single-mode fiber PMD(s) are needed. There is growing interest from enterprise and cloud services providers in extending 25 GE serial technology to reaches greater than 100 m for applications such as metro network access and building-to-building interconnects.

This Call For Interest is a request for the formation of a study group to 1) explore the development of new 25 Gb/s Ethernet single mode fiber PMDs, and 2) evaluate the market requirements supporting the longer-reach 25 Gb/s Ethernet interface.

Thank You!