

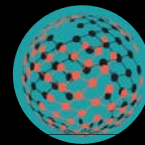


25G SMF Optics for Next Generation Enterprise / Campus / Data Centre Applications

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Alan Tipper, Semtech

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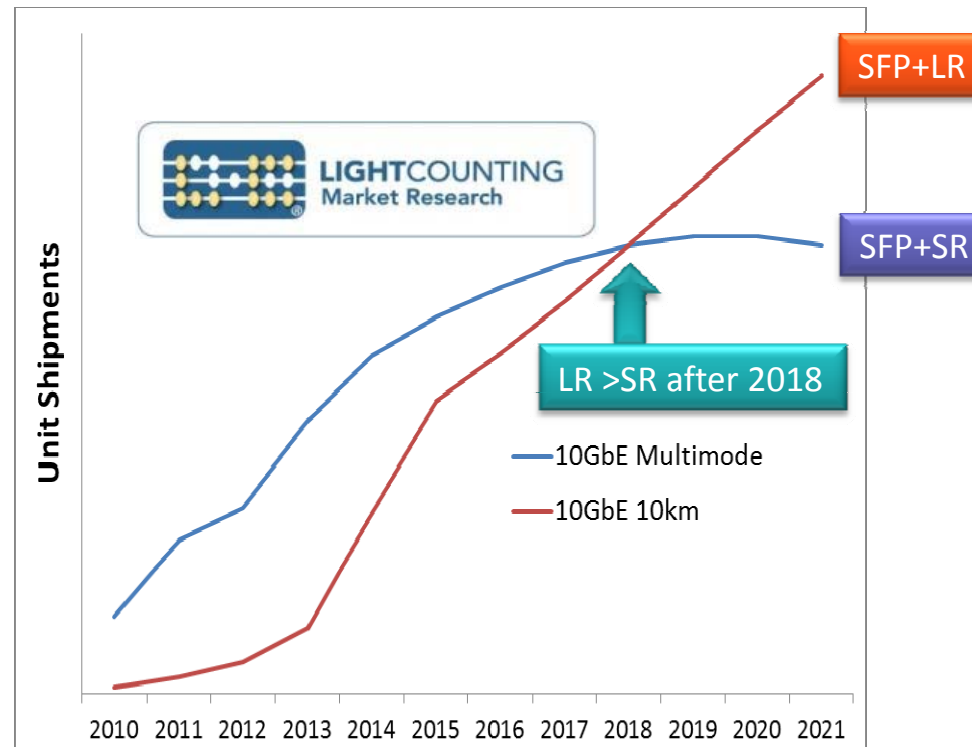
Introduction

- Background:
 1. Adding 25GE SMF objective to upcoming 50GE project was proposed during July plenary flash mob.
 - Result: Support for the standard, but most preferred different project
 2. New Industry Connection Activity (ICA) announced in August.
 - Topic: “Consider potential future projects that leverage serial electrical/optical lane signaling technologies up to 100Gb/s for use in Enterprise/Campus/Data Centre applications.”

- Purpose of this presentation:
 1. To continue discussion of 25GE SMF standard as part of ICA on Next Generation Enterprise/Campus /Data Centre applications.
 2. Seek input for starting project

Large Market Demand For SMF Transceivers

Ethernet SFP+ Module Forecast



1. Trend reflects wide range of SMF applications
2. Need for SMF standards for next gen applications

Considerations For SMF Optics For Next Gen Enterprise/Campus

1. Technologies to leverage

- 25G NRZ from 100GE (4x25G)
- 50G PAM4 from 400GE-FR8/LR8
- 100G PAM4 from 400GE-DR4

2. Serial optics

- Serial optics have lower cost and power per Gbps than parallel (WDM)

3. Match ASIC port speed

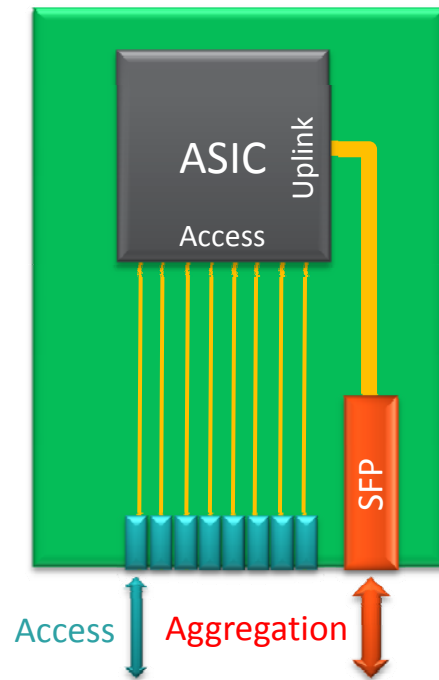
- Avoid gear boxing and optical or electrical multiplexing.
- Efficiency → lower power consumption
- Reduced components → lower cost
- SERDES going from 10G → 25G/50G

Technology Choices For Next Gen Serial SMF Transceivers

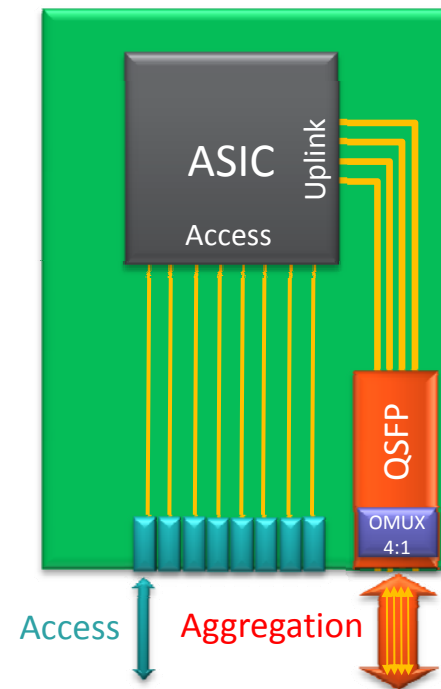
Choices	25G NRZ	50G PAM4	100G PAM4
Product availability (est.)	2015+	2017+	2018/19+?
Technology development driver (examples)	<ul style="list-style-type: none"> • 25G Ethernet • 100G Ethernet • Gen6 Fibre Channel 	<ul style="list-style-type: none"> • 50G Ethernet? • 400G Ethernet • Gen7 Fibre Channel? 	<ul style="list-style-type: none"> • 400G Ethernet
Related optical specifications	<ul style="list-style-type: none"> • 500m: PSM4 • 2km: CWDM4 • 10km: 32GFC, 100GBASE-LR4 • 25km: 100GBASE-“ER4-Lite” • 40km: 100GBASE-ER4, “ER4-Lite” 	<ul style="list-style-type: none"> • 400GBASE-FR8/LR8 • 50GE? • 64GFC? 	<ul style="list-style-type: none"> • 400GBASE-DR4
Reach (w/o FEC)	20km?	FEC necessary	FEC necessary
Reach (w/ FEC)	40km	10km?	2km?
Assessment	25G NRZ	50G PAM4	100G PAM4
Difficulty (risk)	Easy	Moderate – High	High
Pros	<ul style="list-style-type: none"> • Established technology • Wide range of applications • Matches 25G ASIC port 	<ul style="list-style-type: none"> • >4 x increase over 10Gbps • Matches 50G ASIC port 	<ul style="list-style-type: none"> • 100Gbps / λ lowest in cost and power per Gbps
Cons	<ul style="list-style-type: none"> • Only 2.5 x increase over 10Gbps 	<ul style="list-style-type: none"> • Optical PAM4 has many unknowns • Fewer applications than 25G NRZ? 	<ul style="list-style-type: none"> • High technical challenge with many unknowns • No 100G SERDES (yet...) • Limited applications?

Matching Transceiver To ASIC Port Speed

Case 1:
ASIC port speed
matches transceiver
rate



Case 2:
ASIC ports MUX'd
inside transceiver
(OMUX case)



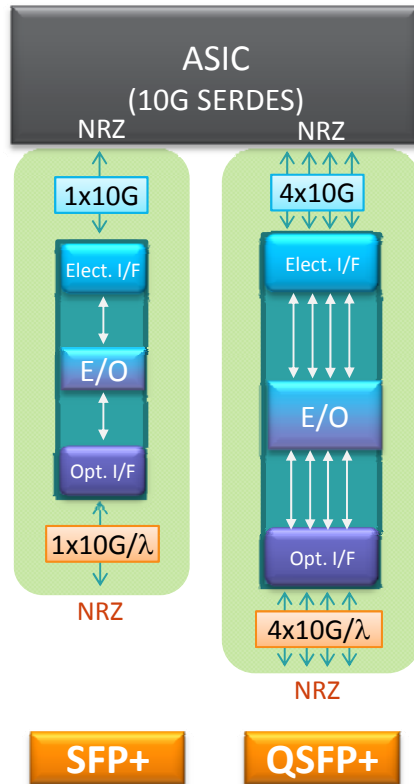
Case 1 best for enterprise/campus networks?

➤ Avoid MUX and use serial optics for lowest cost & power per Gbps

SMF Transceivers Concepts For 25G / 50G ASICs

TODAY

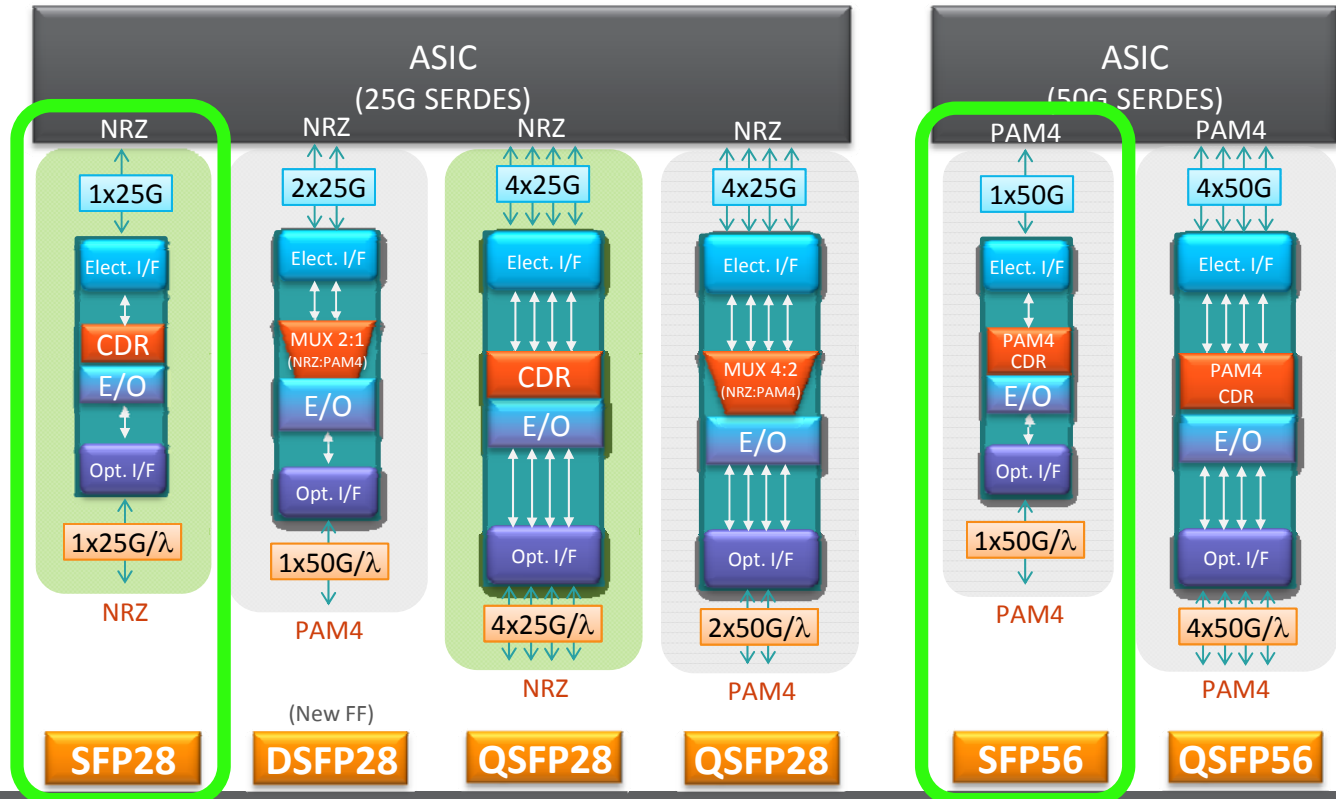
10G technology



POSSIBILITIES WITH NEXT GENERATION ASICS (NEARER TERM)

Technology building blocks:

- ASICs: 25G/NRZ or 50G/PAM4 SERDES
- CDR: 25G/NRZ and 50G/PAM4 CDRs
- MUX: 2:1MUX (2x25G/NRZ-to- 1x50G/PAM4)
- Analog E/O: 25Gbd



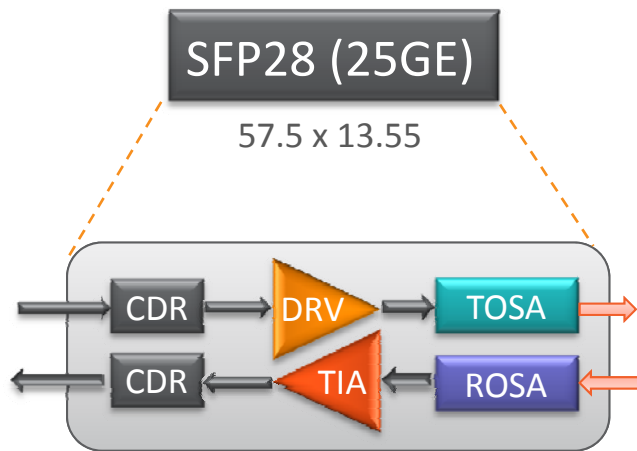
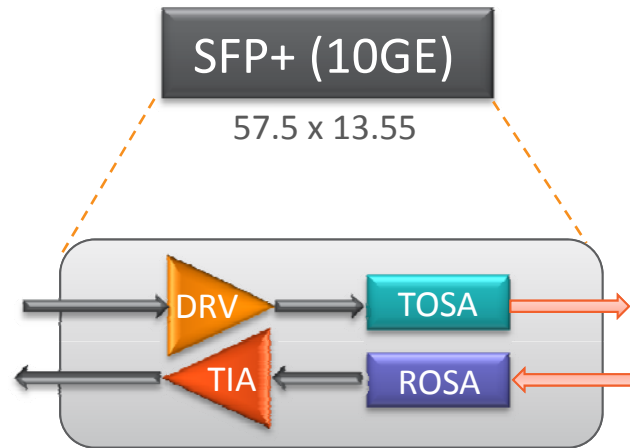
LR Transceiver Comparison

LR Transceiver Comparison	10GE	40GE	25GE?	50GE?
Size	SFP+	QSFP+	SFP28	SFP56
Modulation	NRZ	NRZ	NRZ	PAM4
Lane scheme	1 x 10G	4 x 10G	1 x 25G	1 x 50G
Power ⁽¹⁾	1W	3W	~ 1W	?
mW/Gbps	100	75	~ 40	?
Relative cost / Gbps	1	2.8-3.5 ⁽²⁾	<1.2-1.6 ⁽³⁾	?

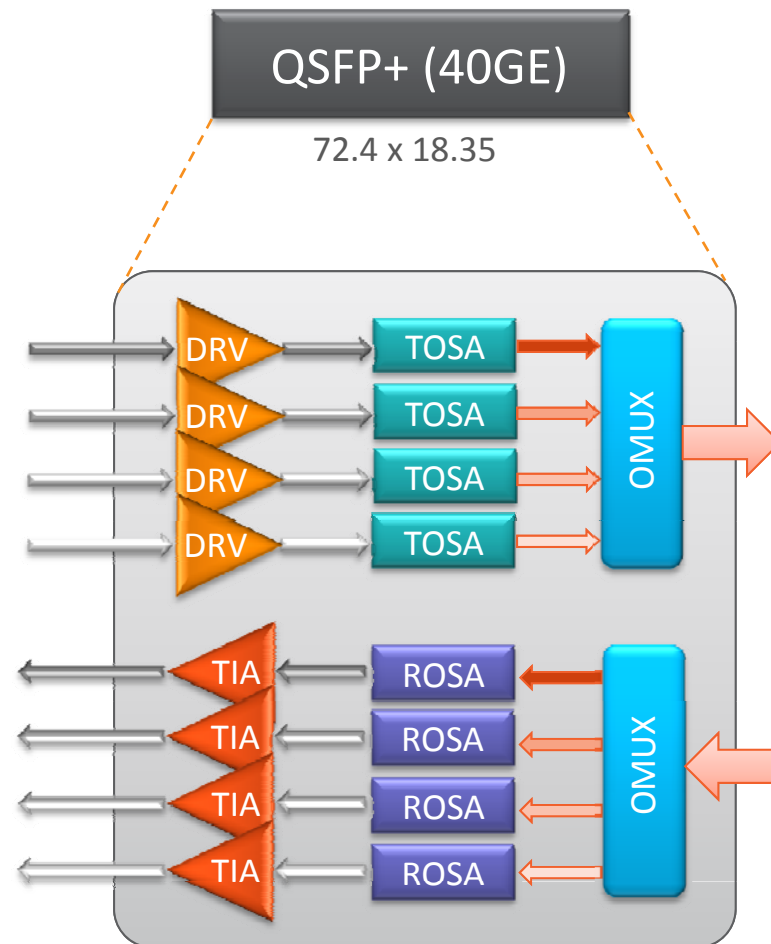
25G is incremental technology advance from 10G in packaging & silicon

- ⁽¹⁾ Assume reasonable numbers for 10km C-Temp transceivers at high volumes.
- ⁽²⁾ Based on “LightCounting Forecast Database – February 2015” numbers. SFP+LR (15.4Mpcs) and QSFP+LR4 (1.1Mpcs for 2km+10km) in 2020.
- ⁽³⁾ From Ovum Total OC Forecast for 2020 (August 2015).

LR Transceiver Comparison



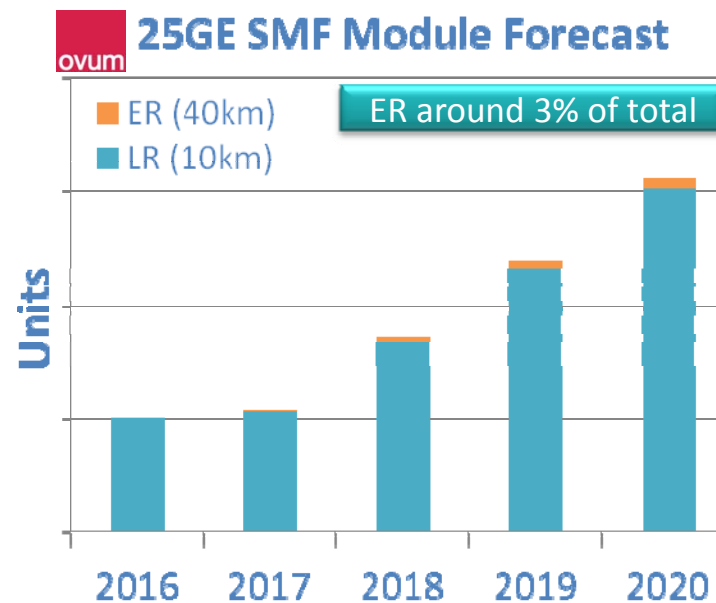
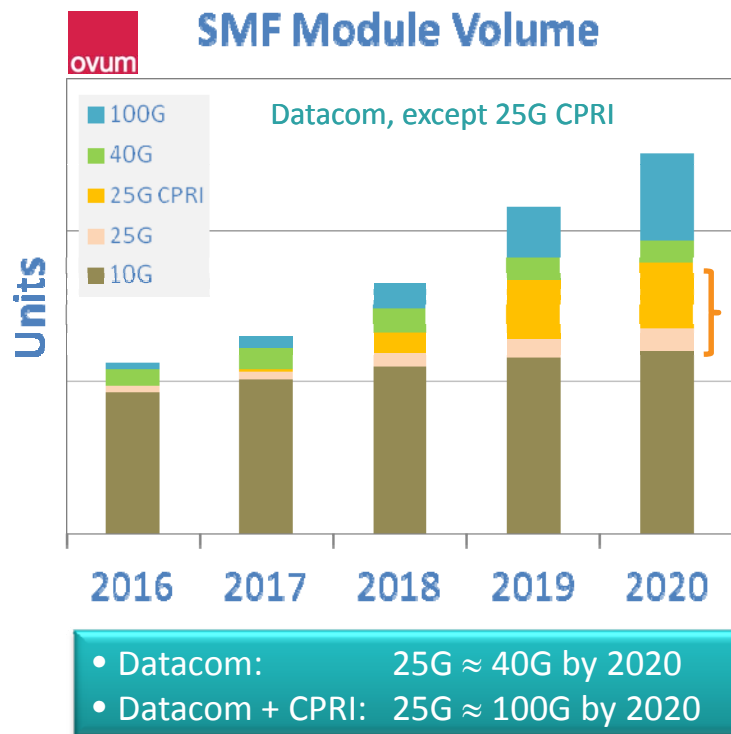
Serial optics makes 25GE lower in cost and power per Gbps.



Parallel optics & WDM makes 40GE higher in cost and power per Gbps.

Conclusion / Discussion

- 25GE is good choice as next step after 10GE for SMF transceivers
 - Suitable for cost-sensitive markets that don't need 40GE, 50GE, or 100GE
- Recent forecasts include 25G modules for datacom and wireless



Reference: Ovum "Total OC Forecast 2014-2020", Aug 2015.

Conclusion / Discussion (cont.)

3. 25GE SMF standard considerations:

1. 25GE SMF needed to complete 25G Ethernet ecosystem

PMD	Lanes	Reach	Standard
Twisted Pair	"Single"	30m	802.3bq
PCB backplane	Single	IL<35dB @ 12.9GHz	802.3by
Copper Twin Ax	Single	3m, 5m	802.3by
MMF	Single	100m	802.3by
SMF	Single	TBD	x

2. Possible objectives:

1. Objective 1: 10km (PIN Rx)

- Reference 32GFC-10km spec

2. Objective 2: 40km (APD Rx)

- Reference 100G-40km spec in ITU-T SG15 G.959.1 (App. Code 4L1-9D1F)

- Objective 3: Discuss no-FEC reaches with PIN and APD receivers?

3. Timing:

1. CFI in November 2015?

Thank You