Extended reach 40Gb Optical Ethernet

Call For Interest

Pete Anslow, Ciena
Matt Traverso, Cisco
Jon Anderson, Opnext

Hawaii, March 2012

Objective for this meeting

- To measure the interest in expanding the scope of the *Next Generation 100Gb Optical Ethernet* study group to include extended reach 40GbE

- We don't need to
  - Fully explore the problem
  - Debate strengths and weaknesses of solutions
  - Choose any one solution
  - Create PAR or five criteria
  - Create a standard or specification

- Anyone in the room may speak / vote
- RESPECT… give it, get it

Motivation of this Presentation

40Gb/s Ethernet is being applied to an increasing variety of applications, some of which require a longer reach than the 10km provided by 40GBASE-LR4. This Call for Interest will measure the interest in the formation of a study group (or expansion of an existing study group) to explore the market need and solutions for extended reach 40Gb/s Ethernet interfaces.

Contributors and Supporters

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Agenda

- Market need
- Technical feasibility
- Why now?
- Questions
- Straw polls

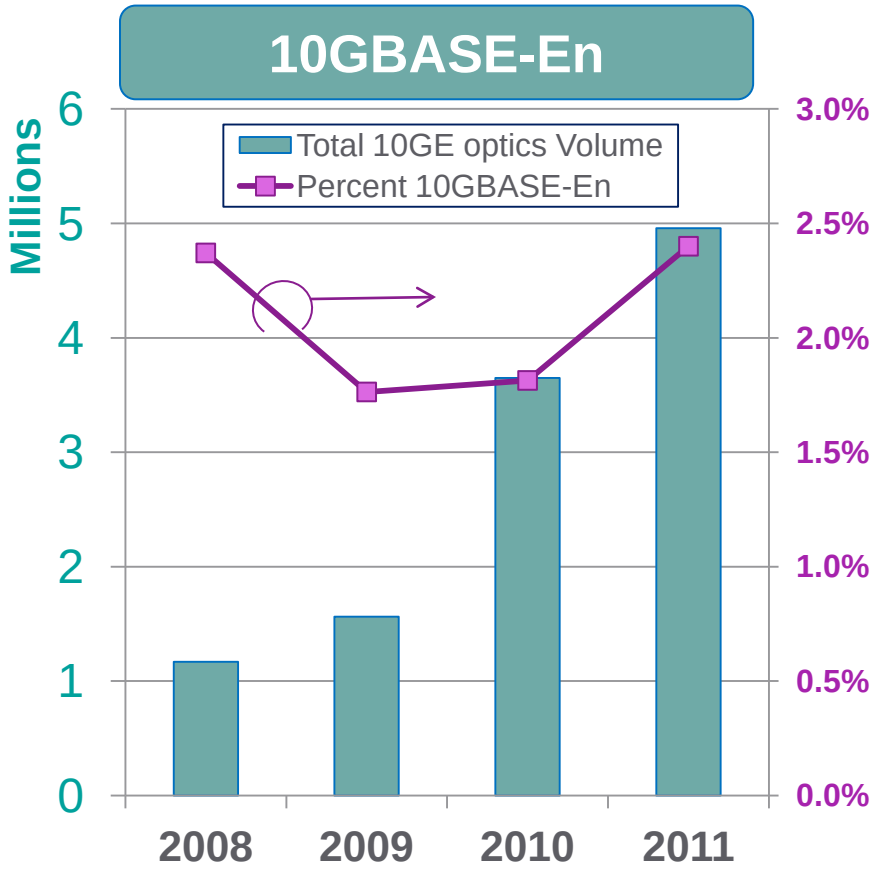
Market need

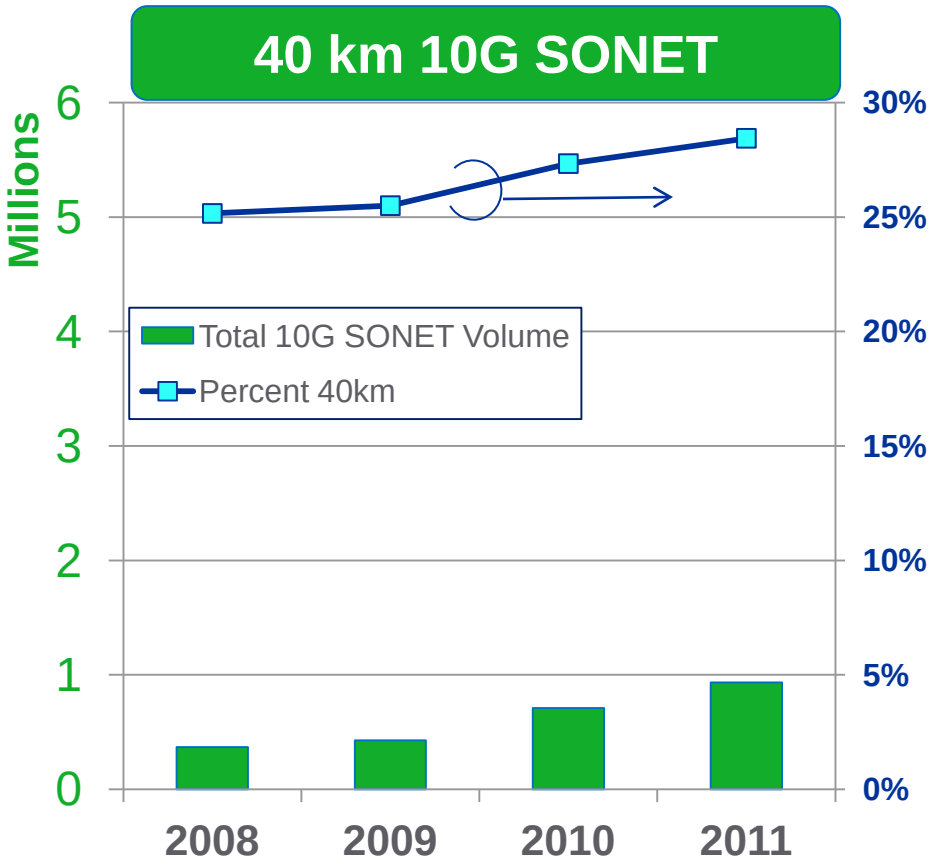
Matt Traverso, Cisco

Need for a 40km 40GBASE-R interface

- Networking need/application exists
  - 10GBASE-En – established market
  - 100GBASE-ER4 – emerging market
- For 40G connectivity at >10km limited options
  - DWDM optical transport solution: COST + Infrastructure + Low Density
  - Industry developing solutions like those in the technical feasibility section

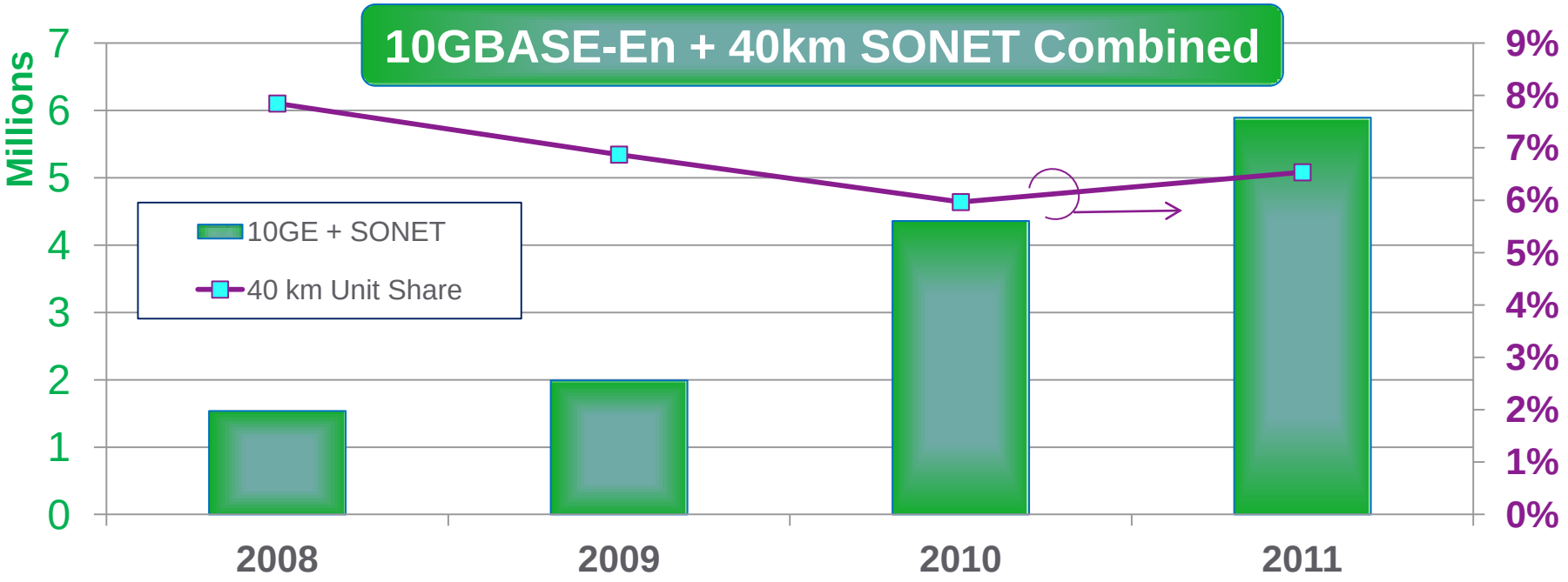
The 40km Application space exists (1)





- 10GBASE-En has been a successful Ethernet interface
- Traditional telecom applications using SONET deploy a larger percentage of 40 km links, and a slightly higher absolute value

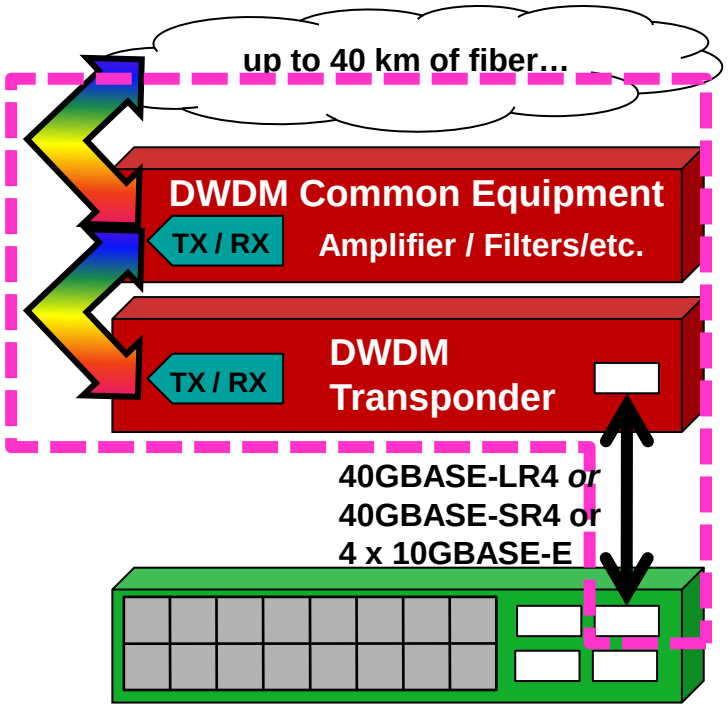
The 40km Application space exists (2)

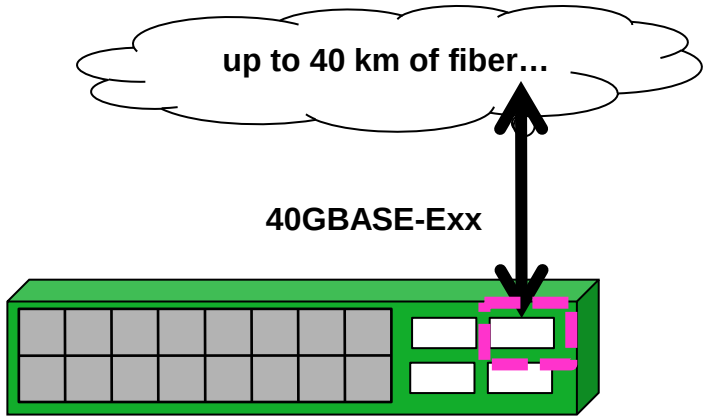


- At 40G rate, there is no established telecom 40 km point to point link
- Establishment of a 40GBASE-E PMD would address an existing application space for networking gear

Note: Data sourced from LightCounting Dec'11 Report

A 40km 40GBASE standard can simplify networks





Existing Solution – bulky & costly

- Requires sophisticated user base
- Requires additional equipment
- Optimized for ‘00s to ‘000s of km

Proposed Solution – simple…

- New PMD only
- Lack of point to point definition in telecom allows for additional Ethernet application

Technical feasibility

Jon Anderson, Opnext

Possible approach

- 10GBASE-ER in SFP+ form factor is available today from several suppliers. Optics typically employed are 1550nm EA-DFB and PIN-PD.

- Desirable to leverage 1300nm CWDM optics solutions developed for 40GBASE-LR4/C4S1-2D1 applications:
  - Available today from several suppliers;
  - Compatible for interoperability with 40GBASE-LR4 PMD;
  - Reduces ER4 cost by economies of scale.

Power budget considerations

- For achieving 40km operating distance on SMF:
  - Cable optical fiber attenuation in 1300nm range is (0.47dB/km) 18.8dB plus a couple dB for connector and splice loss; may need to consider “engineered link” with improved insertion loss;
  - Transmitter and dispersion penalty in 1300nm region is expected to be the same or similar to 40GBASE-LR4;
  - Overall, channel IL is about 12dB greater than channel IL in 40GBASE-LR4 link budget, which cannot be made up by only increased tx output power.
- Consider use of 10G APD:
  - Available today from several suppliers;
  - Rx sensitivity (OMA) typically -21dBm in 1550nm range;
  - Expect ~ 2dB responsivity degraded performance when operated in 1300nm range;
  - Overall, expect Rx sensitivity (OMA) to be in -18/-19dBm range

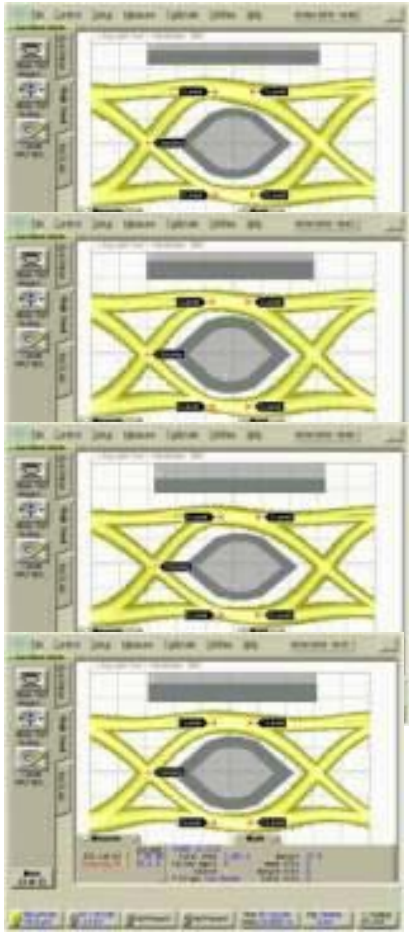
Possible link budgets

- Possible link budgets assuming 40km reach and 1300 nm operation are shown below:

	40GBASE-LR4	Vendor a 40GBASE-ER4		Vendor b 40GBASE-ER4	Vendor c 40GBASE-ER4	
Power budget (for max TDP)	9.3	20.6		22.3		
Operating distance	10	30	40	40	30	40
Maximum fiber loss per km	0.47	0.47	0.4		0.47	0.4
Optical connector loss	2	2	2			2
Channel insertion loss max	6.7	16	18	18.8		18
Channel insertion loss min	0	5.1		0	5.1	
Maximum discrete reflectance	-26	-26	-26	-26	-26	
Allocation for penalties (for max TDP)	2.6	2.6	2.6	3.5		
Additional insertion loss allowed	0	2	0			0

4x10G 40km module - example at nominal condition

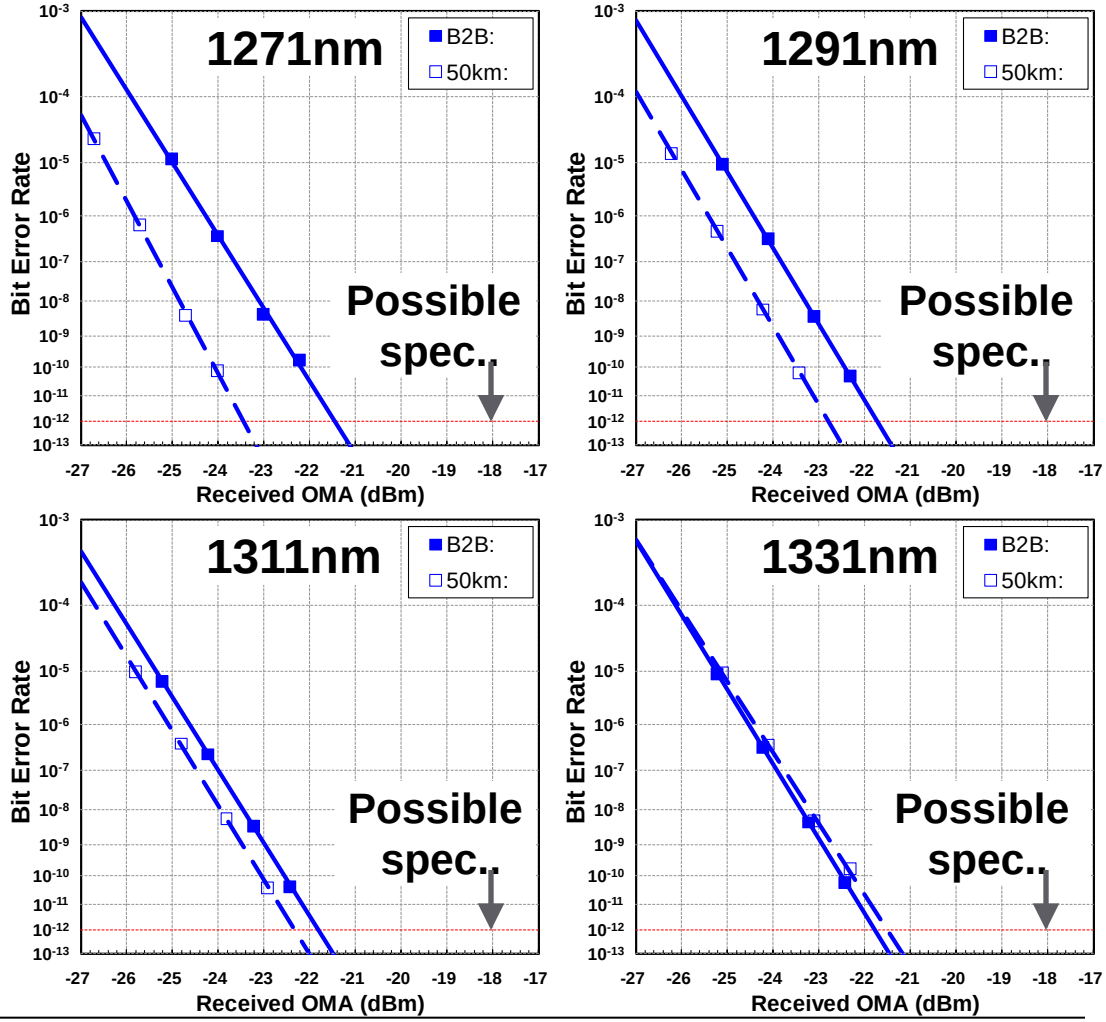
Optical waveform (10.3Gb/s)



~7dB extinction ratio

Source: Sumitomo Electric

BER curve (10.3Gb/s, B-to-B / 50kmSMF)



4x10G 40km module - receiver sensitivity deviation

Normalized module receiver sensitivity (Temperature dependency)

	Tc=0ºC	Tc=35ºC	Tc=70ºC
Normalized receiver sensitivity (OMA, B-to-B) (dBm)	-0.5	0 (nominal)	+1.0

Normalized module receiver sensitivity (Extinction ratio dependency)

	ER 5dB	ER 6dB	ER 7dB
Normalized receiver sensitivity (OMA, B-to-B) (dBm)	+0.5	0 (nominal)	-0.5

Normalized module receiver sensitivity (Data rate dependency)

	10.3Gb/s	10.75Gb/s	11.15Gb/s
Normalized receiver sensitivity (OMA, B-to-B) (dBm)	0 (nominal)	0.5	0.8

Source: Sumitomo Electric

Why now?

Why now?

- 40Gb/s Ethernet is being applied to a broader range of applications than server interconnect.
- There is a market demand for 40GbE reach greater than 10km.
- If a standard for extended reach 40GbE is not developed soon, then multiple incompatible proprietary solutions may emerge.
- Additional 100GbE optical PMDs are being studied now in the Next Generation 100Gb/s Optical Ethernet study group, so in order to avoid splitting the available resource it seems better to add consideration of additional 40GbE interfaces to this effort.

Straw poll – 100G Next Gen Optical Ethernet SG

- Atlanta, 10 November 2011

Straw Poll #4

I would support the study of an extended reach (> 10km) 40GBASE-R PMD (such as 40GBASE-ER4) within this study group

Yes 45

No 0

Abstain 10

Questions?

Straw polls

Straw polls - CFI

- Should the scope of the “Next Generation 100Gb/s Optical Ethernet” study group be expanded to include 40GbE?

Y___ N___

Straw polls - Participation

- Number of CFI Attendees

Number ___

- I would participate in 40G discussion within an expanded version of the Next Generation 100Gb/s Optical Ethernet Study Group in IEEE 802.3.

Number ___

- My company would support participation in 40G discussion within an expanded version of the Next Generation 100GbE Optical Interfaces Study Group in IEEE 802.3.

Number ___

Thanks!