



PLNOG Conference 2011: 40 GbE and 100GbE: The State of the Industry

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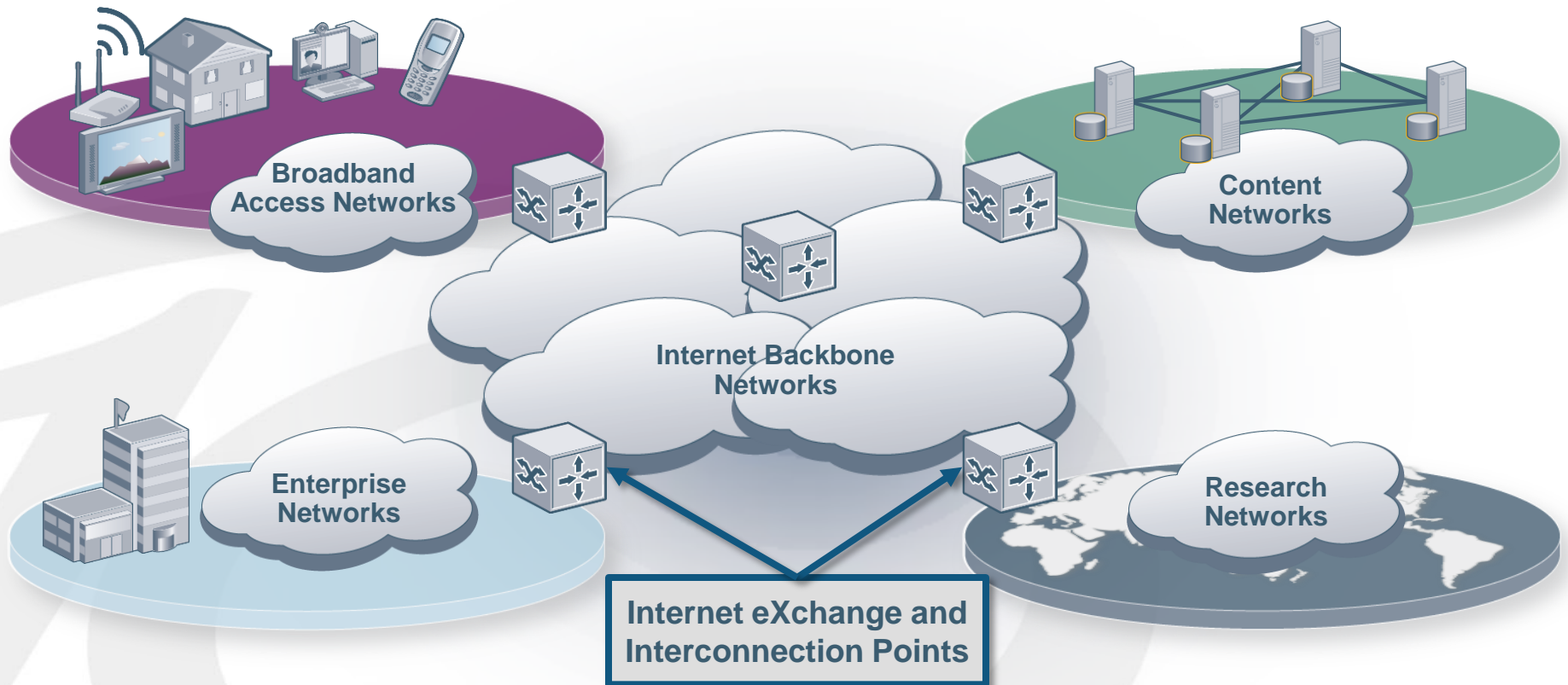
March 16, 2011

- Per IEEE-SA Standards Board Operations Manual, January 2005:
“At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position, explanation, or interpretation of the IEEE.”
- The views I am expressing on IEEE standards and related products should NOT be considered the formal position, explanation, or interpretation of the Ethernet Alliance.

The Ethernet Ecosystem

BROADBAND ACCESS

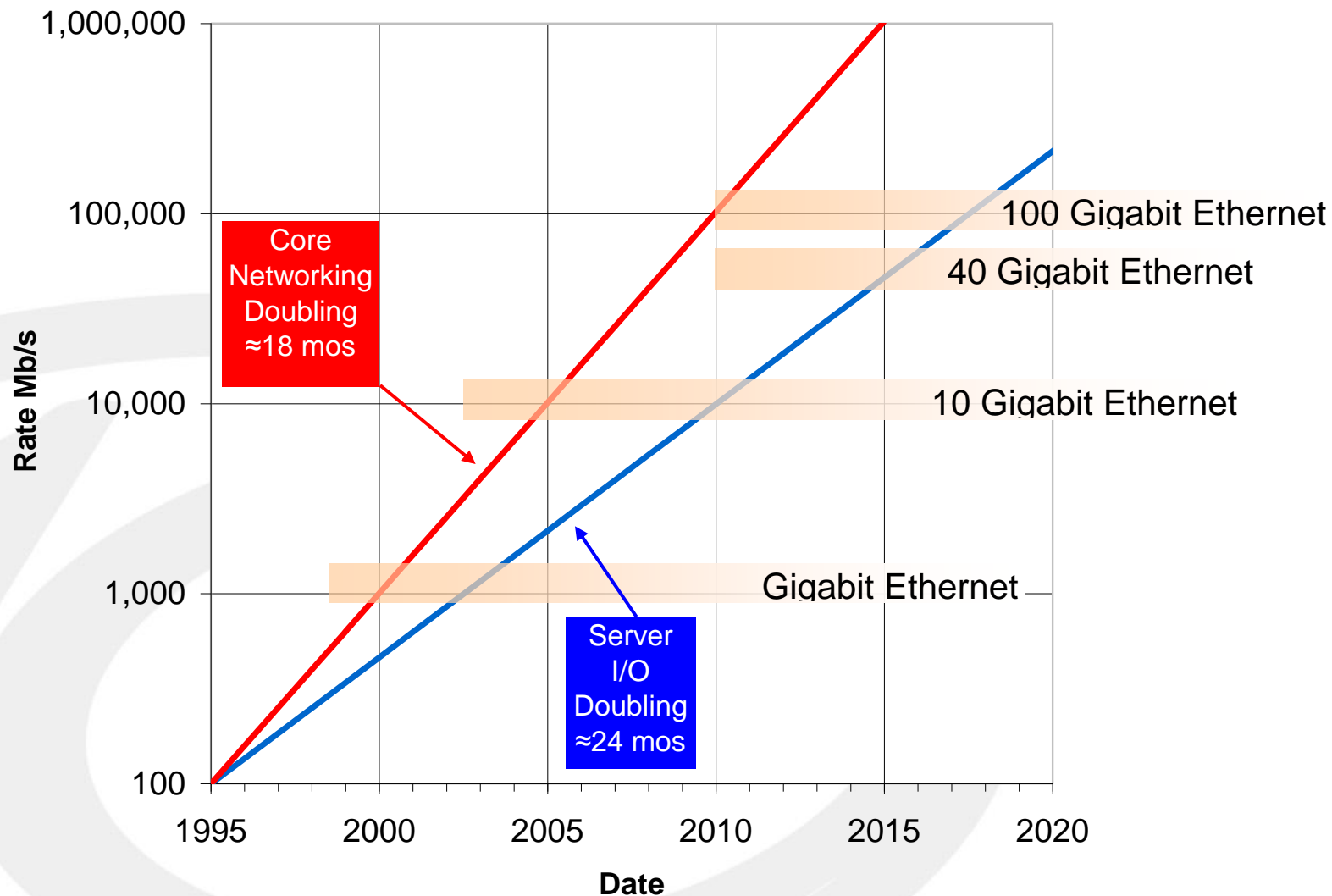
CONTENT PROVIDERS



DATA CENTERS AND ENTERPRISE

RESEARCH, EDUCATION & GOVERNMENT FACILITIES

40GbE and 100GbE: Computing and Networking

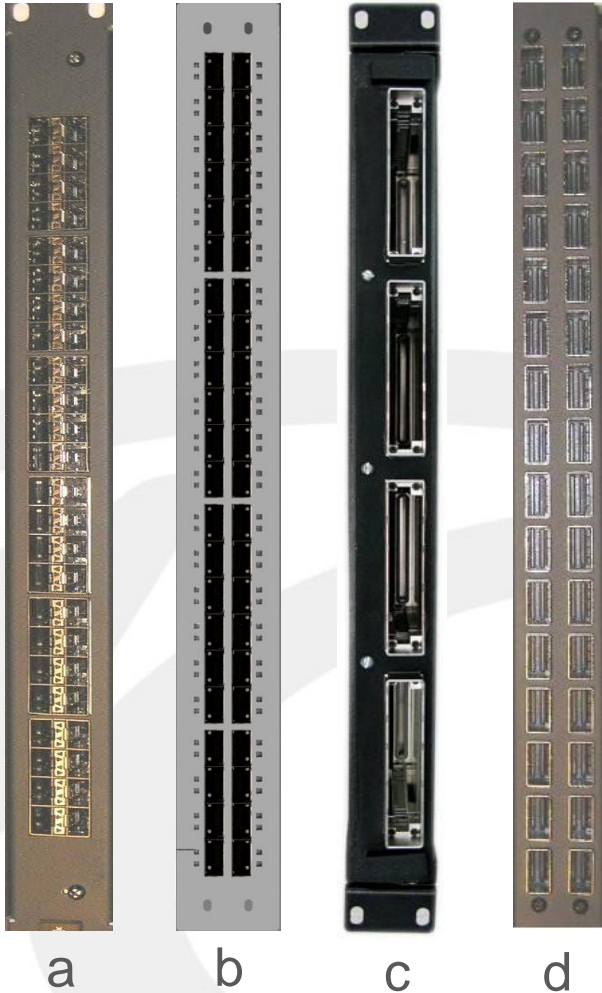


Source: HSSG Tutorial, http://www.ieee802.org/3/hssg/public/nov07/HSSG_Tutorial_1107.zip

IEEE 40Gb/s and 100Gb/s: Physical Layer Specifications

Port Type	Description	40GbE	100GbE
40GBASE-KR4	At least 1m backplane	√	
40GBASE-CR4 100GBASE-CR10	At least 7m cu (twin-ax) cable	√	√
40GBASE-SR4 100GBASE-SR10	At least 100m OM3 MMF (150m OM4 MMF)	√	√
40GBASE-FR4*	At least 2km SMF	√	
40GBASE-LR4 100GBASE-LR4	At least 10km SMF	√	√
100GBASE-ER4	At least 40km SMF		√

* Ratification anticipated on 3/31/11



Line card illustrations

- a. 48 ports SFP+ @ 10GbE = 480Gb/s
- b. 44 ports QSFP @ 40GbE = 1.76 Tb/s
- c. 4 ports CFP @ 100GbE = 400 Gb/s
- d. 32 ports CXP @ 100GbE = 3.2 Tb/s

Potential backplane bandwidth capacities

- 8 Line Cards: 3.2 Tb/s to 25.6 Tb/s
- 14 Line Cards: 5.6 Tb/s to 44.8 Tb/s

New Study Group Formed Jan 2011 to look at 100Gb/s backplane and copper cables.

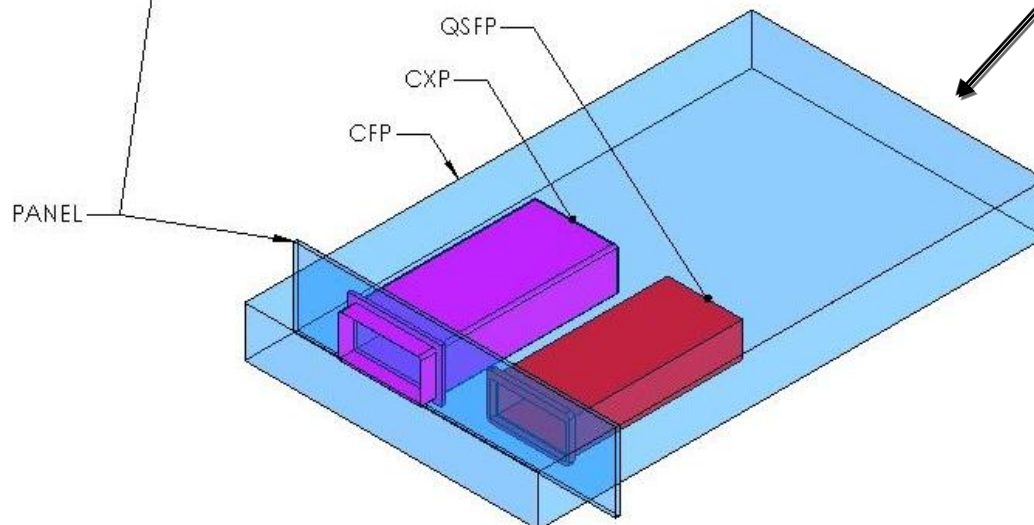
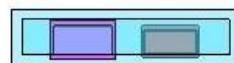
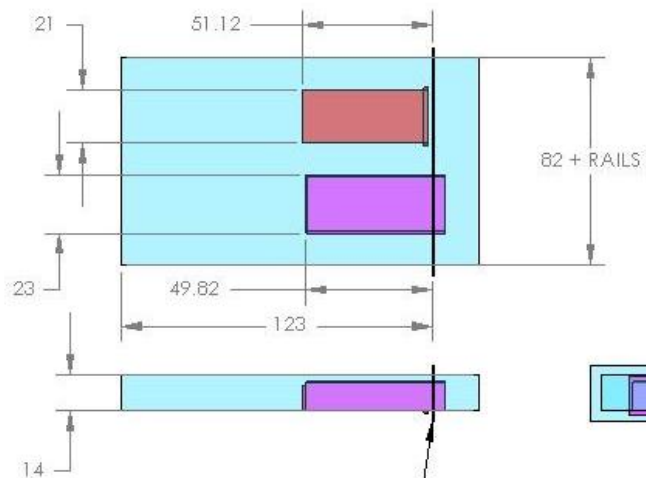
Chaired by John D'Ambrosia, Force10 Networks

Source: 100GbE Electrical Backplane/Cu Cable CFI

Looking Ahead - Growing the 40GbE / 100GbE Family

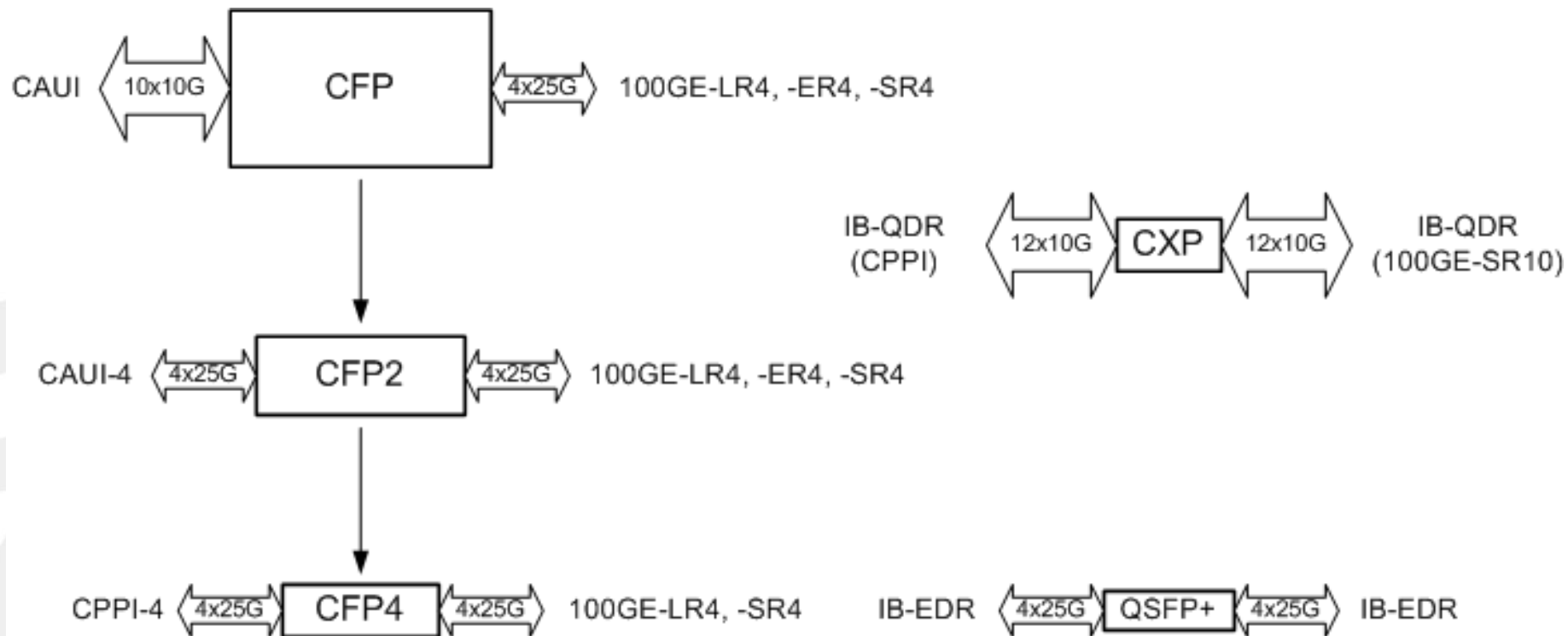
	Description	40GbE	100GbE
Backplane	4 x 25 Gb/s		CFI - Nov
Twin-axial	10 x 10 Gb/s > 4 x 25 Gb/s		New SG - Jan
Chip-to-Chip / Module	10 x 10 Gb/s > 4 x 25 Gb/s		CFI July 2011
Multi-mode Fibre	Reduced width or lambda ? Longer reach?	✓	
Single-mode Fibre	Single Lambda? Shorter reach? Longer reach?	✓	
Twisted Pair	Focus on Data Center Applications (< 100m?)	✓	✓
Energy Efficiency	Apply to electrical and optical aspects?	✓	✓

MSA Form Factors for 40GbE and 100GbE



CAUI (x10) interface connector (59.2 mm) driving module form factor

CFP MSA Roadmap



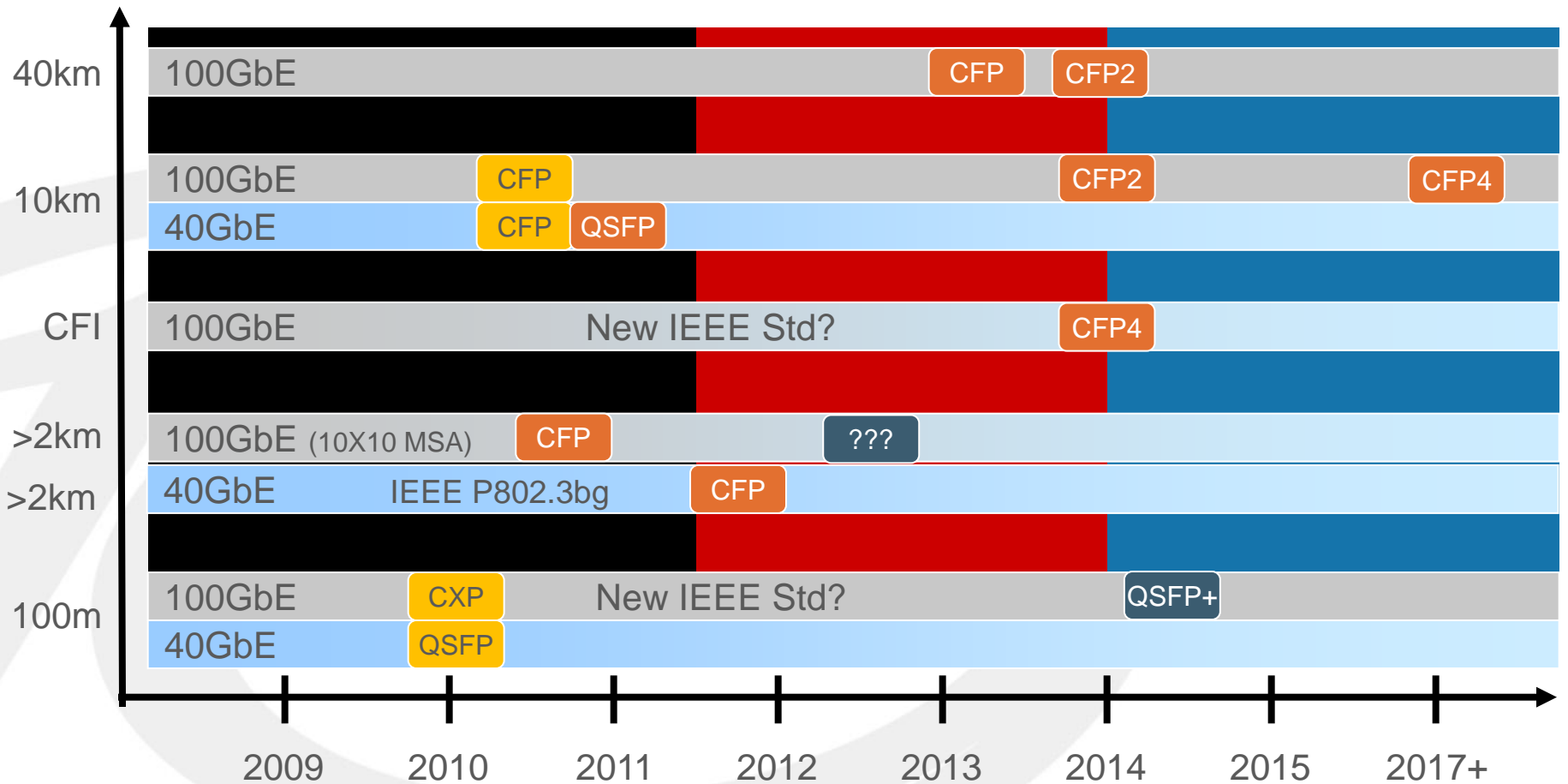
Module shapes all drawn approximately to same scale

Source: "CFP MSA 100G Roadmap and Applications"

40GbE / 100GbE Industry Technology Roadmap

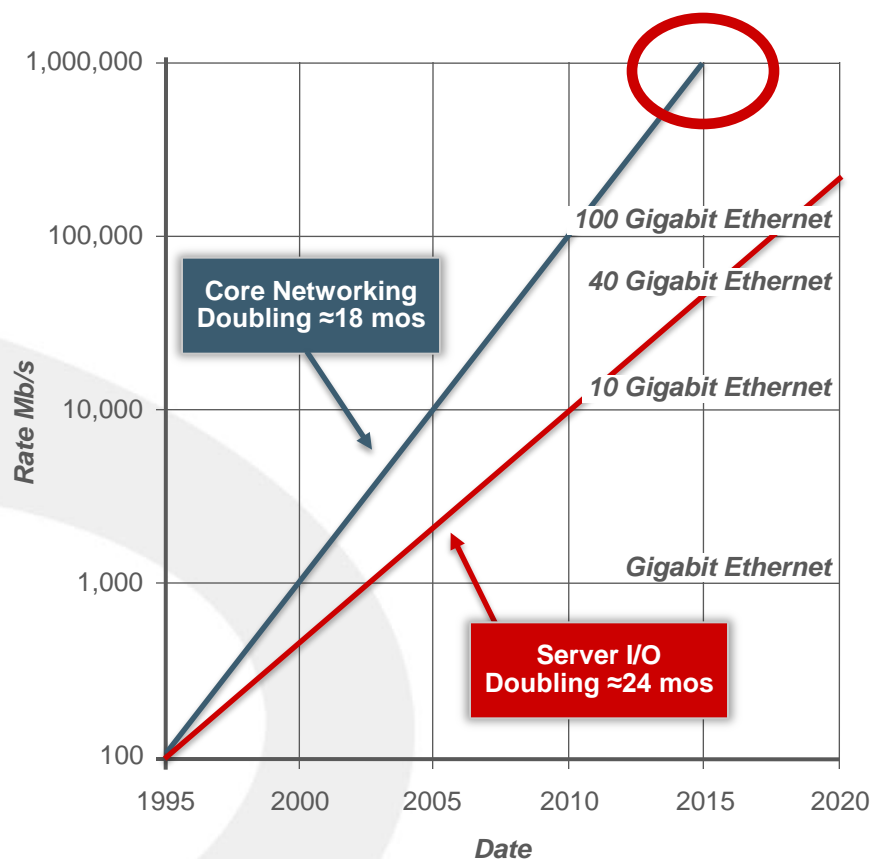


Slot Capacity	≤ 100 Gb/s	400 Gb/s	800 Gb/s - TbE
Systems	Legacy	Greenfield	
Electrical Signaling	10 Gb/s		25 Gb/s



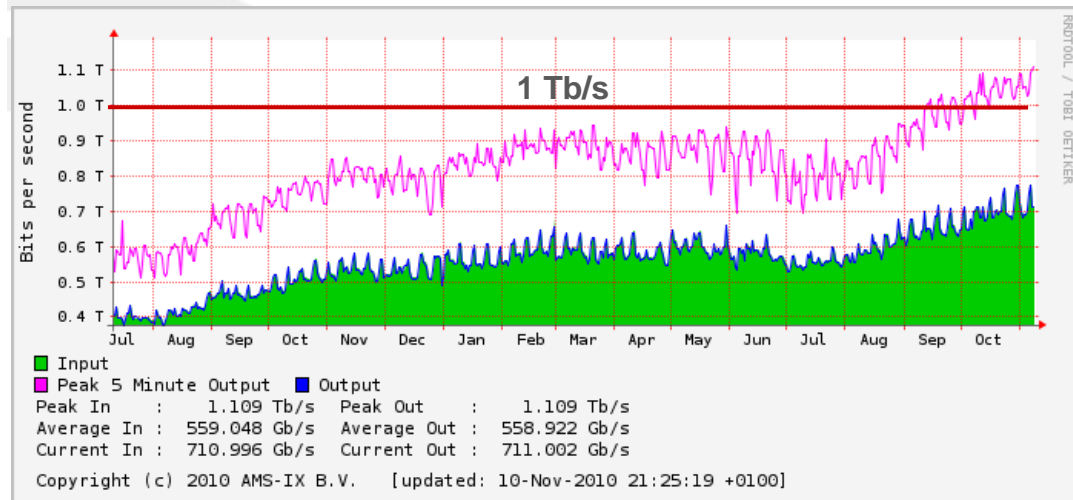
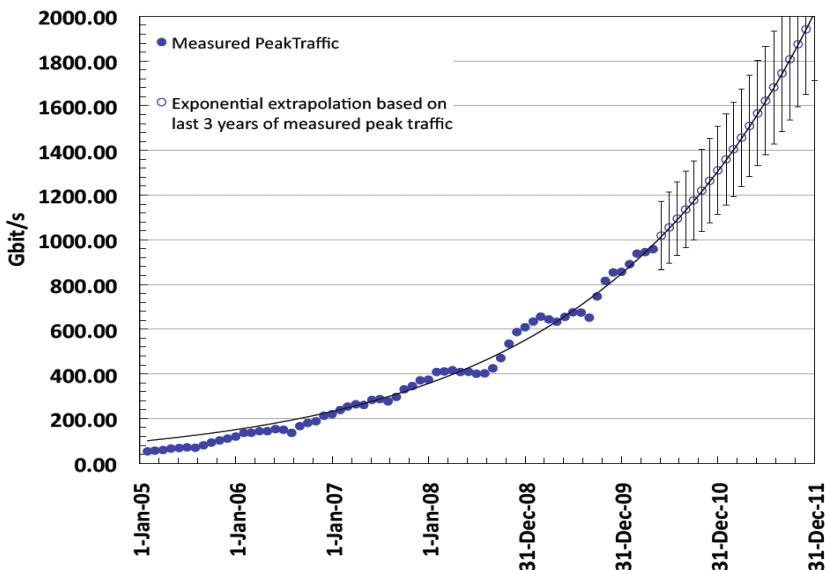
Looking Beyond 100GbE

- Industry being challenged on two fronts
 - Low cost, high density 100GbE
 - Next Rate of Ethernet
- 400GbE vs Terabit Ethernet
 - Technical Feasibility
 - Electrical Signaling
 - Optical Signaling
 - Market Need
 - Data Centers
 - Internet Exchanges
 - Carriers



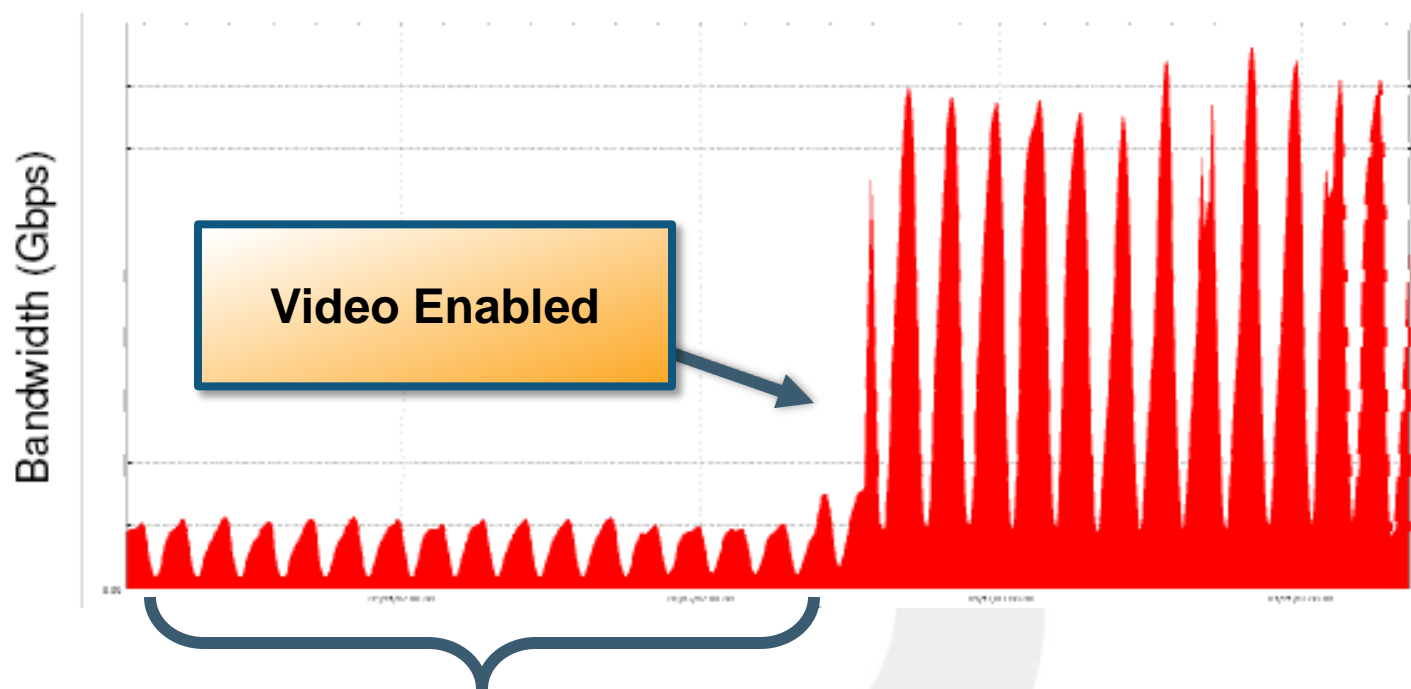
Growing bandwidth demand

- Many studies showing 40-50% annual growth in global Internet traffic
 - Atlas Internet Observatory Report, at NANOG:
<http://www.nanog.org/meetings/nanog47/abstracts.php?pt=MTQ3NSZuYW5vZzQ3&nm=nanog47>
 - MINT studies <http://www.dtc.umn.edu/mints/>
 - Bandwidth measurements from AMS-IX (Amsterdam Internet Exchange)
 - Left: peak traffic from 2005-2010
 - Right: peak and average traffic in Y2010 (Jan to Oct)



Data Provided by Henk Steenman, Amsterdam Internet Exchange (AMS-IX)

TOOTHBRUSH GRAPH



**This was a huge amount of traffic
(multiple web services, millions of users)**

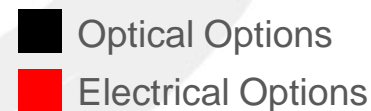
- Time Division Multiplexing
 - Let's go faster
- Modulation
 - Let's add more symbols per second
- Wavelength Division Multiplexing
 - Let's add wavelengths
- Space Division Multiplexing
 - Let's add fibres or conductors

Let's go faster!

Let's try modulation!

Add λ s

Add fibres or conductors



The Aggregate Story...

Bit rate, Gb/s	Gb/s per Lane	Number of lanes
100	10	10
	25	4
400	25	16
	40	10
	50	8
1000	25	40
	50	20

For a new higher speed - consider that a standards development effort might include these (and others):

- End users
 - Equipment Vendors
 - Chip Vendors
 - Optics Vendors
 - Cable Suppliers
 - Connector Vendors
 - Test Equipment Vendors
 - PCB Materials Vendors
 - PCB Mfg. and Assembly Vendors
 - Consultants
- In the IEEE technical decisions require $\geq 75\%$ consensus
 - Is there consensus in the industry?

Historical Perspective



The Great Debate!
↑

- Charter and Scope
 - Evaluate Ethernet bandwidth needs of the industry
 - Reference material for a future activity
 - The role of this ad hoc is to gather information, not make recommendations or create a CFI

- Webpage - http://www.ieee802.org/3/ad_hoc/bwa/index.html
- Reflector - http://www.ieee802.org/3/ad_hoc/bwa/reflector.html

- Meetings will be face-to-face and teleconferences.

- The Ad Hoc needs data. If interested in contributing contact Chair, John D’Ambrosia, Force10 Networks (jdambrosia@ieee.org)

- Everything is going Ethernet and Ethernet is going everywhere!
- New Key Initiatives
 - IEEE 802.3 100Gb/s Backplane & Cu Cable Study Group
 - IEEE 802.3 Ethernet Bandwidth Assessment Ad hoc
 - CFI Preparation – Next Generation 100GbE Optics
- CFP MSA – Next Generation Module Form Factors



THANK YOU