Beyond 100G

Joint ITU-T / IEEE Workshop-
The Future of Ethernet Transport

Geneva, Switzerland
28 May 2010

Agenda

Introduction	John D'Ambrosia	Force10 Networks, Chair, IEEE P802.3ba TF
Part I		
• **Data Centers**	Vijay Vusirikala	Google
• **Internet Exchanges**	Henk Steenman	AMS-IX
• **Carriers**	Martin Carroll	Verizon
• **Scaling the P802.3ba and G.709 Architectures**	Steve Trowbridge	Alcatel-Lucent WP3/15 Chairman
• **25/28G Electrical Signaling**	Adam Healey	LSI
Part 2		
• **Optical client side technologies - integration, feasible rate**	Jon Anderson	Opnext
• **Optical line side technologies**	Pete Anslow	Ciena
• **Economic Aspects of the Next Speed**	Chris Cole	Finisar
• **Introduction to Discussion**	John D'Ambrosia	
Discussion	EVERYONE!	

FORCE10

The Next Rate

An Introduction

John D'Ambrosia
Chair, IEEE P802.3ba Task Force
Director, Ethernet-based Standards, CTO Office

May 28, 2010

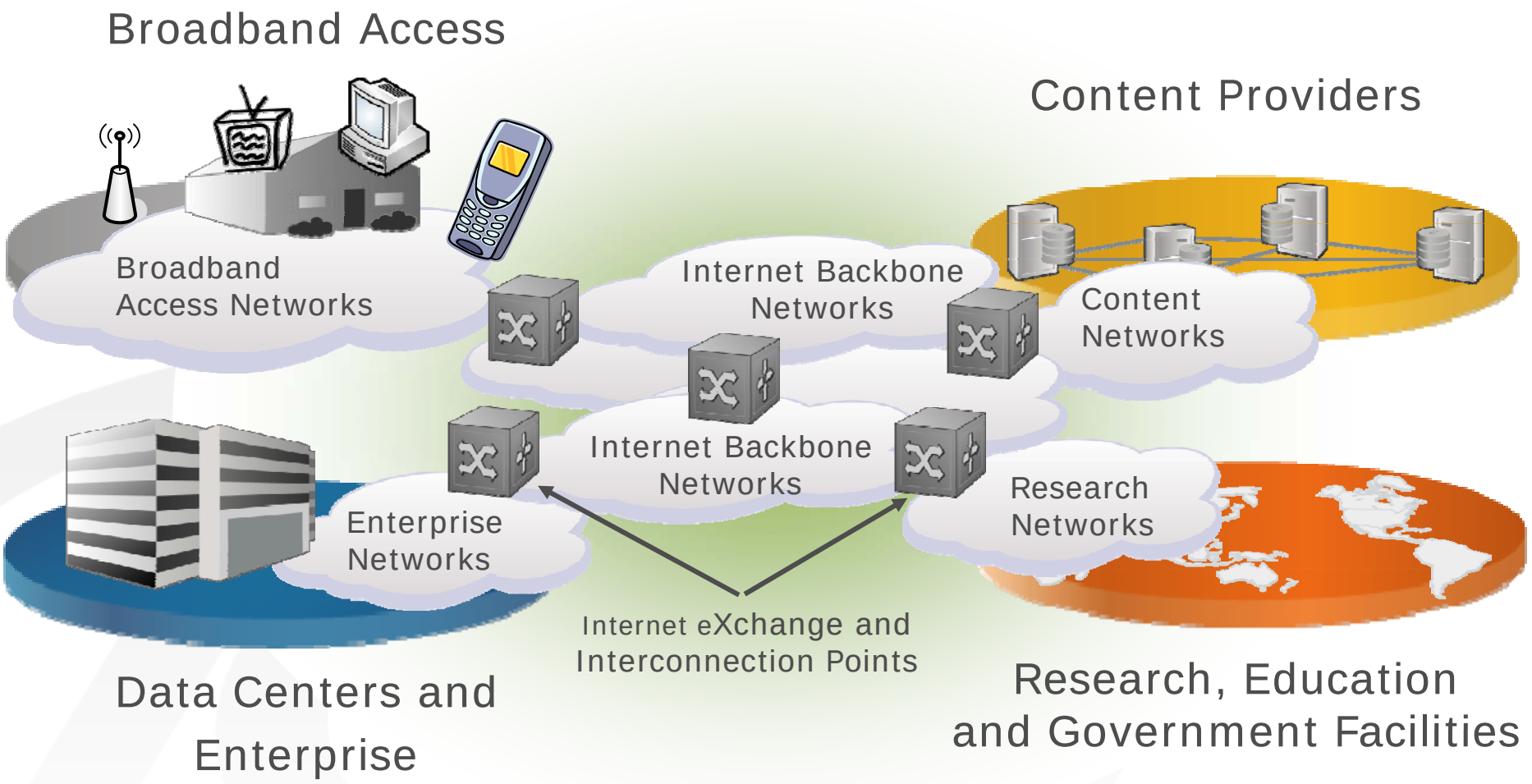
Regarding the Views Expressed

- 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.

ethernet alliance member

The Ethernet Ecosystem



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 (125m OM4 MMF)	√	√
40GBASE-LR4 **100GBASE-LR4**	At least 10km SMF	√	√
100GBASE-ER4	At least 40km SMF		√

Potential Projects - Growing the 40GbE / 100GbE Family

	Description	40GbE	100GbE
Chip-to-Chip / Module	10 x 10 Gb/s > 4 x 25 Gb/s		✓
Backplane	10 x 10 Gb/s > 4 x 25 Gb/s?		✓
Twin-axial	10 x 10 Gb/s > 4 x 25 Gb/s?		✓
Twisted Pair	Focus on Data Center Applications (< 100m?)	✓	✓
Multi-mode Fibre	Reduced width or lambda ? Longer reach?	✓	✓
Single-mode Fibre	Single Lambda? Longer reach?	IEEE P802.3bg ✓	✓
Energy Efficiency	Apply to electrical and optical aspects?	✓	✓
Chip-to-Chip / Module	Serial 40 Gb/s?	✓	

Key ITU-T 100G Standardization Milestones

Date	Milestone
Feb 2007	First proposal for adding ODU4 to hierarchy to transport 100G Ethernet
Dec 2008	G.709 Am. 3 – stabilize ODU4 bit rate and format, mappings of clients and tributaries to be specified later
Sep 2009	G.709 revision – ODU4 tributary and client mappings (non-normative for 40/100GE), multi-lane format for OTU3, OTU4 G.707 Am. 2, multi-lane format for STM-256 G.783 Am. 2, equipment functions for multi-lane STM-256 G.695 revision, C4S1-2D1 application code for multi-lane OTU3, STM-256 using 40GBASE-LR4 optics G.959.1 revision, 4I1-9D1F & 4L1-9C1F application codes for multi-lane OTU4 over 100GBASE-LR4/ER4 optics

Conttributed per Steve Trowbridge

Key ITU-T 100G Standardization Milestones

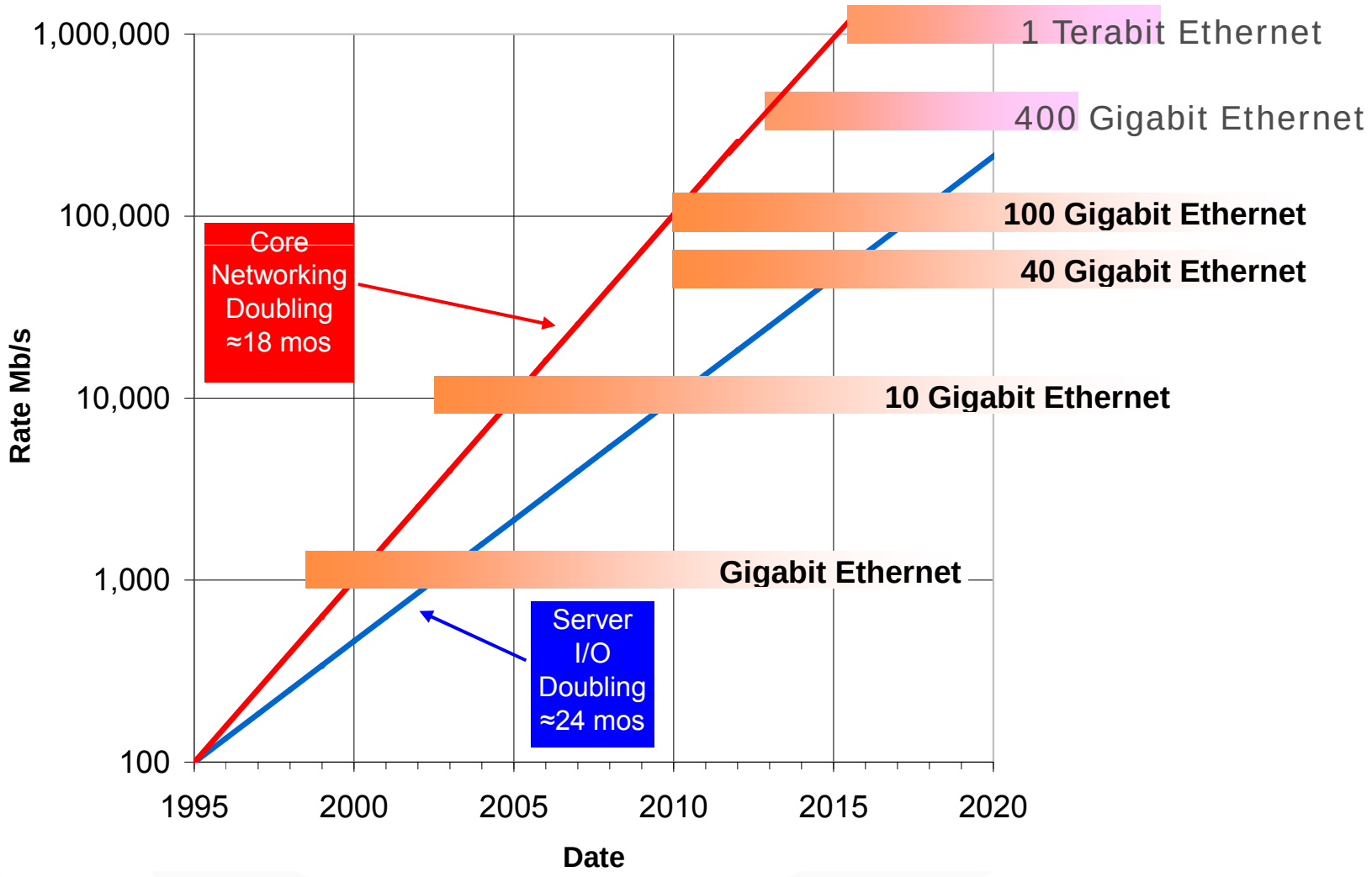
Date	Milestone
June 2010	G.709 Am. 1 – Normative specifications with payload type codepoint assignments for 40GBASE-R into OPU3, 100GBASE-R into OPU4
	G.798 revision – OTN Equipment functions supporting ODU4, GMP and TTT mappings for 40/100GBASE-R
	G.695 Amendment – Adjust C4S1-2D1 optical budgets to match final P802.3ba 40GBASE-LR4 specifications
	G.874 revision – Management of updated OTN including ODU4, 40/100GE mappings

Conttributed per Steve Trowbridge

Developing an IEEE Standard

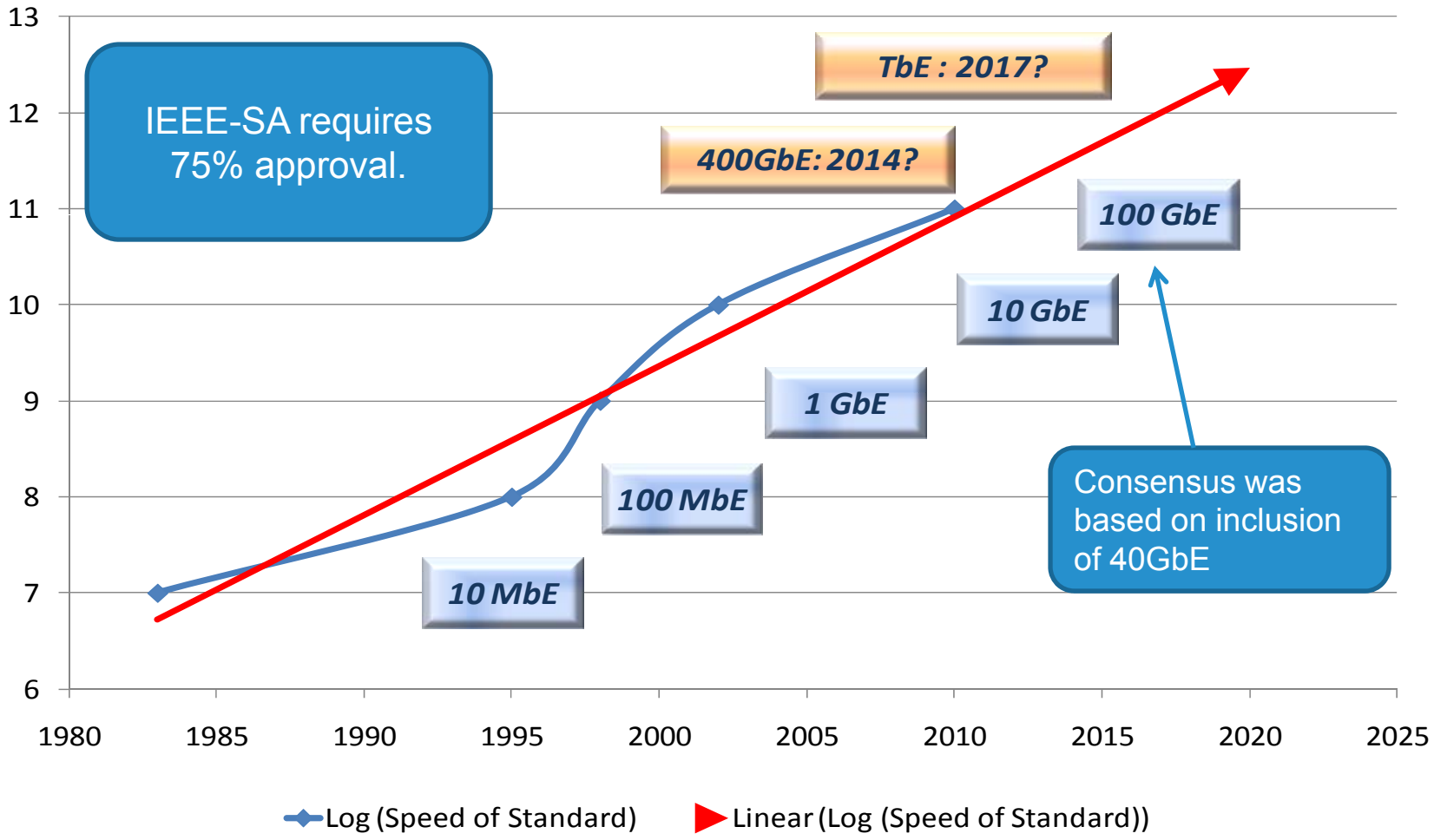
Pending Approvals by Respected Body

Bandwidth Projections

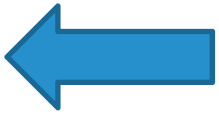
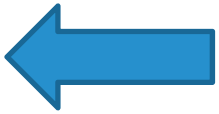
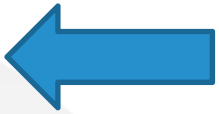


Based on IEEE 802.3 HSSG "Tutorial", 11/2007

Industry Consensus Drives Development



The IEEE 802 “5 Criteria”

- Broad Market Potential 
- Distinct Identity
- Compatibility
- Technical Feasibility 
- Economic Feasibility 

The areas the industry needs to explore…

The Basic Questions…..

- Market Need?
  - Application Space?
  - Rate?
  - Reach?
  - Economics?
  - When?
- Technical Hurdles?
  - Architecture?
  - Electrical Signaling?
  - Optical Signaling?
- The Challenge to the Market
  - Higher Density / Lower Cost 40G / 100G Solutions?
  - The Next Speed?