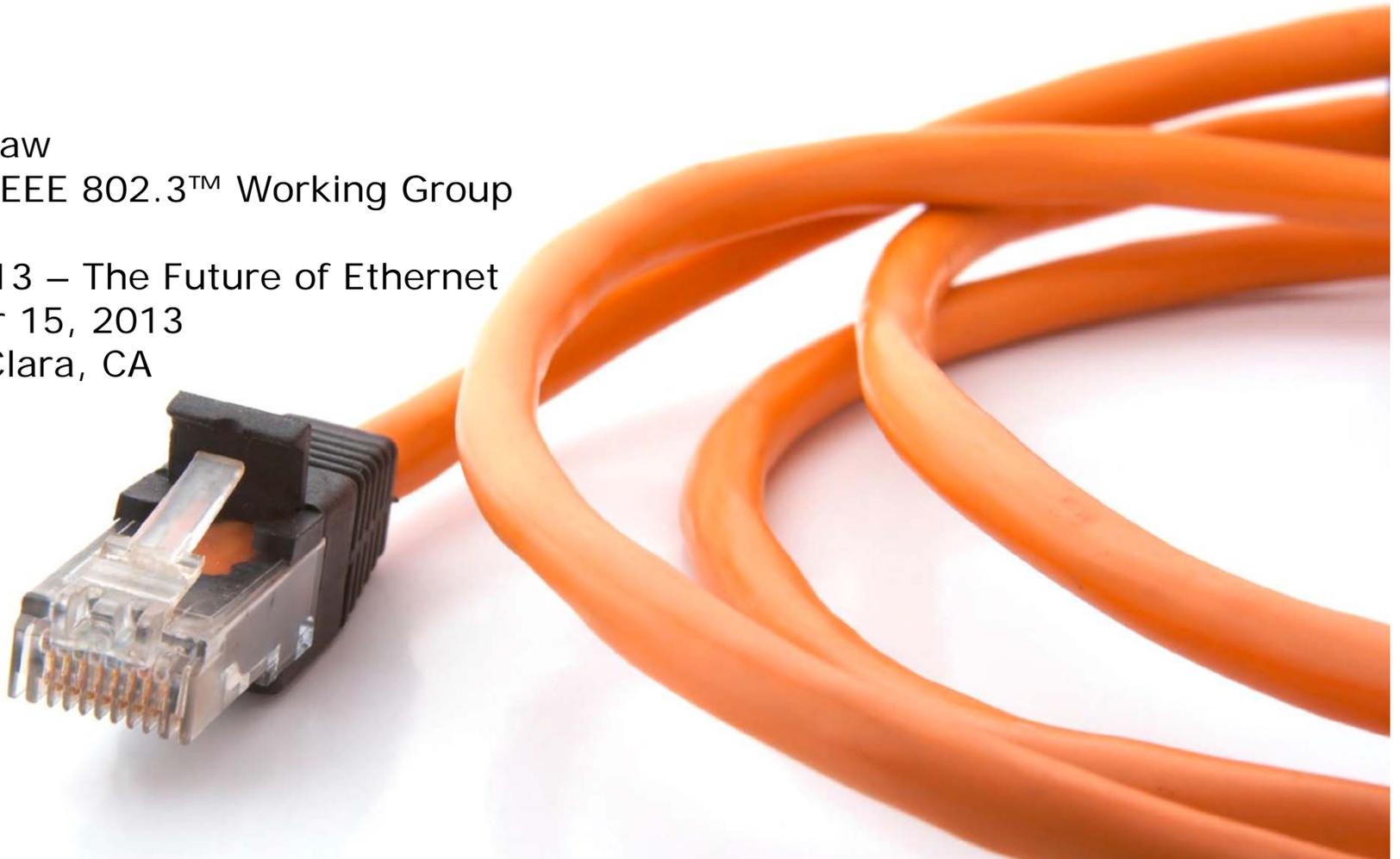


Market Driven Ethernet Innovation

David Law
Chair, IEEE 802.3™ Working Group

TEF 2013 – The Future of Ethernet
October 15, 2013
Santa Clara, CA



Before I Share my Opinion...

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 of IEEE.

<http://standards.ieee.org/ipr/disclaimers.html>

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The modern paradigm for standards

IEEE 802.3 Ethernet Standard

The Open Ethernet Standard

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Standards Drive Innovation in Today's World



Standards open up new markets faster

Standards make markets bigger

Standards enable faster product development

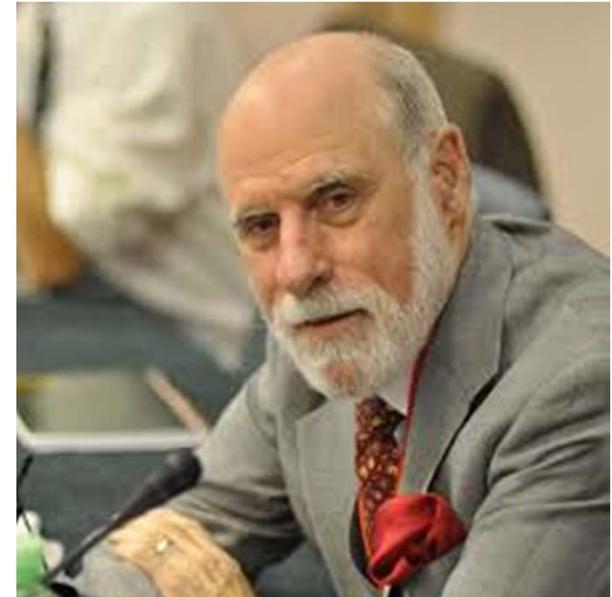
A borderless standards model benefits all

Standards are integral to the mission of IEEE



Standards – The Foundation For Innovation

“People often take the view that standardization is the enemy of creativity. But I think that standards help make creativity possible - by allowing for the establishment of an infrastructure, which then leads to enormous entrepreneurialism, creativity, and competitiveness.”



Vint Cerf, TCP/IP co-developer

http://en.wikipedia.org/wiki/Vint_Cerf

OpenStand: The Paradigm



- IEEE, IAB, IETF, Internet Society and W3C documented a **set of principles** for a modern or market-driven paradigm of global, open and bottom-up standards
- In this paradigm, economics of **global markets** and societal needs, fueled by technological innovation, drive global deployment of consensual, bottom-up standards to help ensure strong integration, interoperability and increased synergies along the innovation chain across national and regional boundaries
- It embraces communities that are grounded in universal openness; leverages and builds upon knowledge for innovation; and produces standards in a process that is **open to the society** of world experts without restrictions



OpenStand: The Principles



1. **Respectful cooperation** between standards organizations, whereby each respects the autonomy, integrity, processes and intellectual property rules of the others
2. **Adherence** to the fundamental parameters of standards development, including: due process, broad consensus, transparency, balance and universal openness
3. **Collective empowerment** to strive to develop standards that are chosen and defined based on technical merit, as judged by the contributed expertise of an open and global experts community; provide global interoperability, scalability, stability, and resiliency; enable global competition; serve as building blocks for further innovation; and contribute to the creation of benefit for humanity
4. **Availability** of standards specifications made globally accessible to all for implementation and deployment; the proponents of this paradigm have defined procedures to develop specifications that can be implemented under fair terms, ensuring thus a broad affordability of the outcome of the standardization process (openness of input and output)
5. **Voluntary adoption** of the standards by the market; their success is determined by the market

OpenStand: The Initiative



- Multi-faceted, multi-dimensional
- Strives to gain global awareness and recognition for standards and standards development processes based on the core principles
- Embraces technical innovation via methods that ensure direct, open participation and that produce standards without borders and without limits
- Advocates for increased openness and inclusivity
- Encourages global cooperation and openness for innovation, market growth and the advancement of technology for the global benefit of humanity
- Entities and individuals can:
 - Show support for and commitment to the principles
 - Promote the value of open standards and open standards development processes and their impact
 - Leverage the principles and paradigm in discussions, negotiations and relationships as essential tools for technology advancement to address global issues and to help ensure universal growth and social progress

An Open Invitation



We invite you to engage with us in Open Standards

For more information:

open-stand.org

standards.ieee.org

Video:

http://www.youtube.com/watch?v=_4qQ4qA9xeE&feature=youtu.be

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The modern paradigm for standards

IEEE 802.3 Ethernet Standard

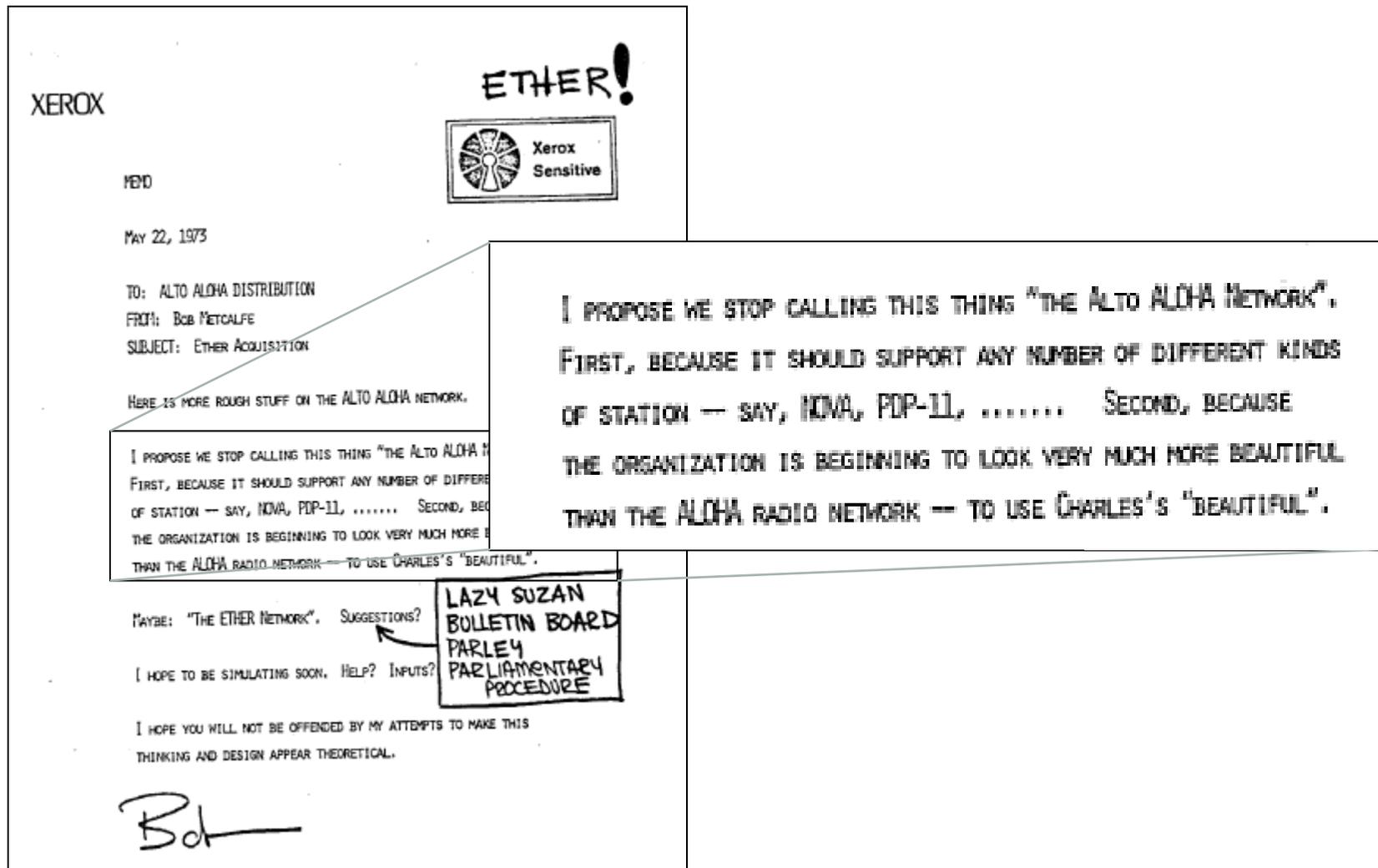
The Open Ethernet Standard

IEEE 802.3 Ethernet projects

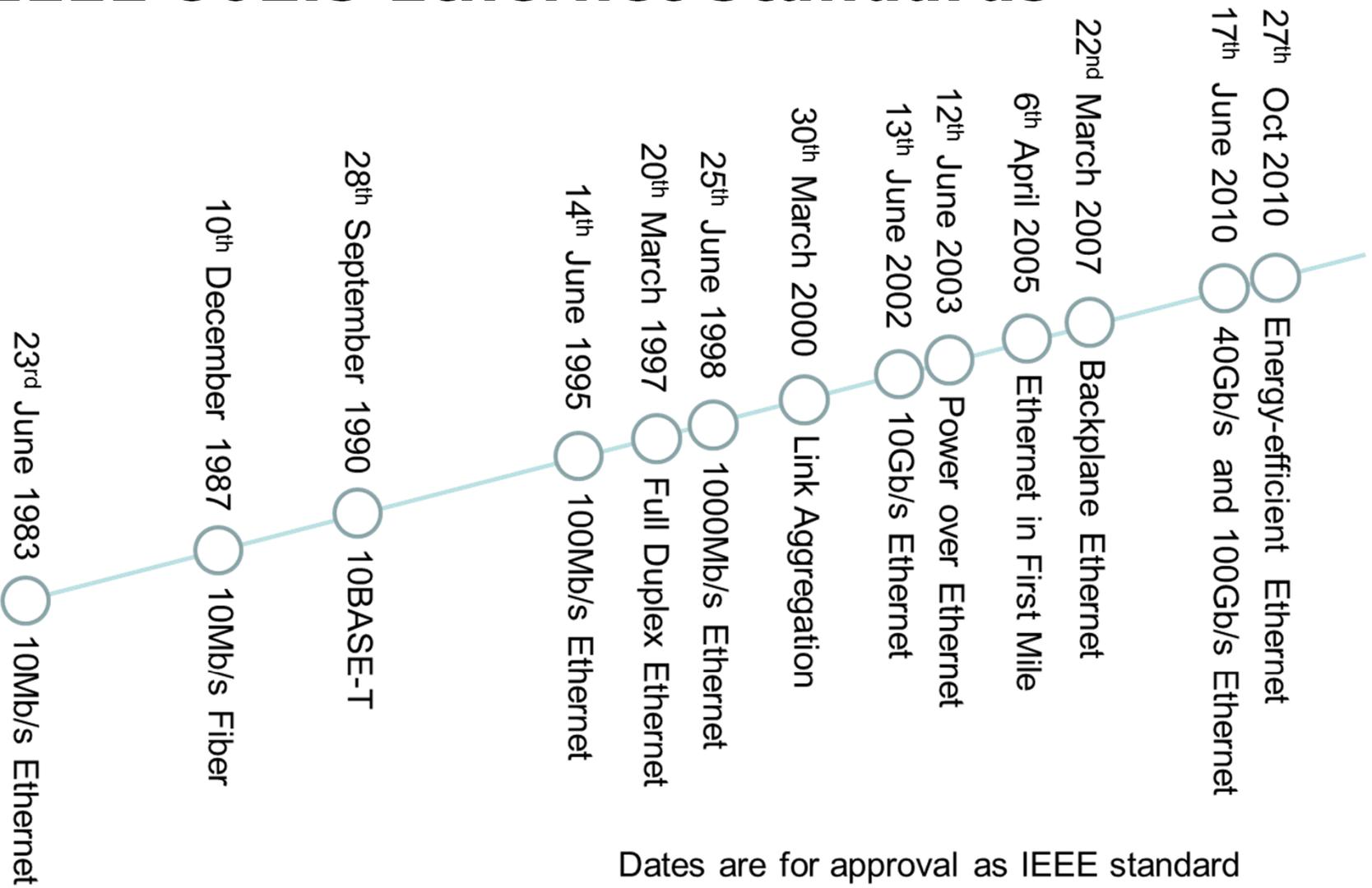
Current and proposed IEEE 802.3 projects

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The Open Ethernet Standard

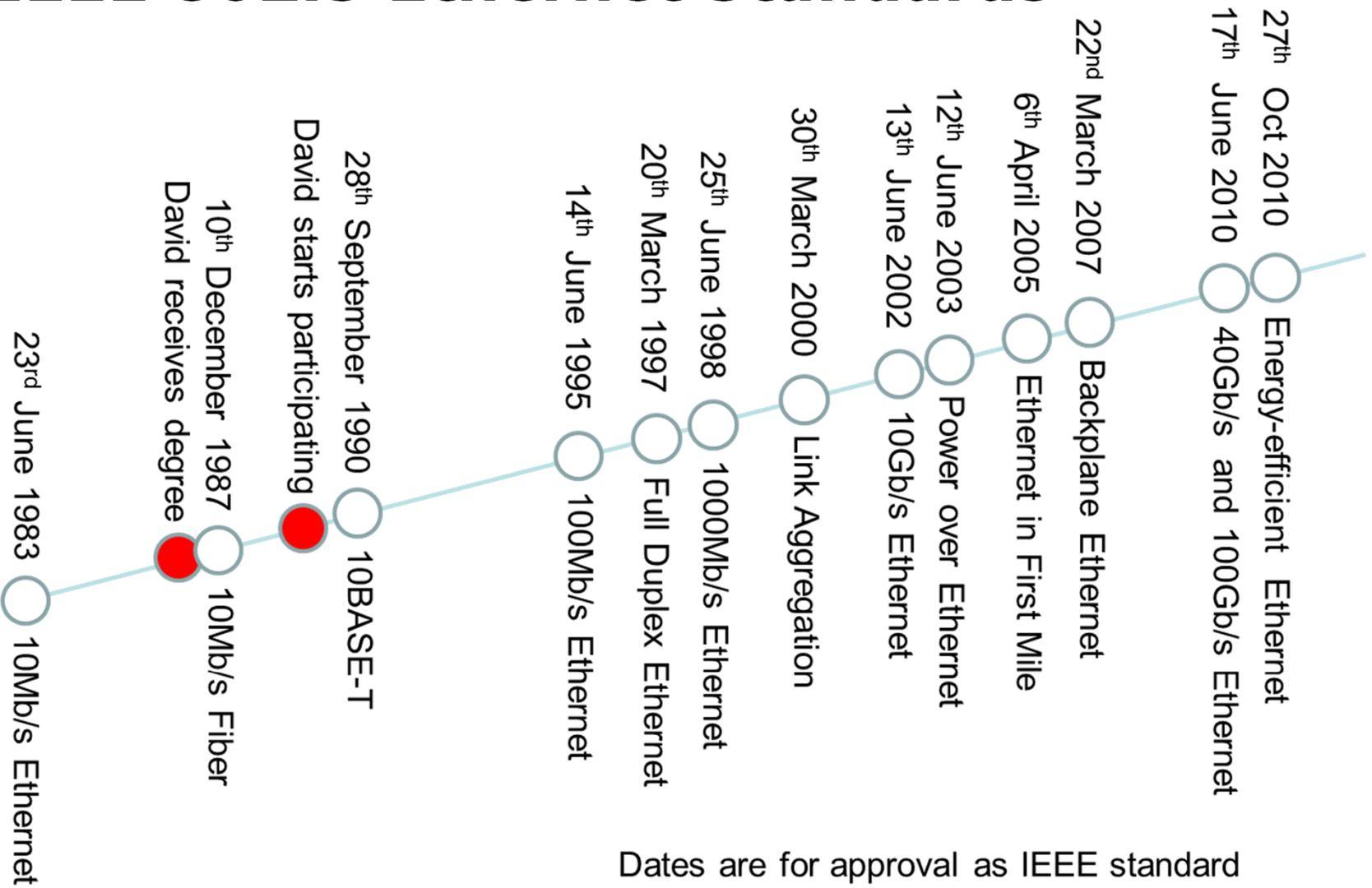


30 Years of IEEE 802.3 Ethernet Standards



Dates are for approval as IEEE standard

30 Years of IEEE 802.3 Ethernet Standards



Dates are for approval as IEEE standard

Global Standards for Global Markets

- Globally deployed Internet standards
 - OASIS – Applications
 - W3C – Browsers
 - IETF – Routing Protocols
 - IEEE – Networking



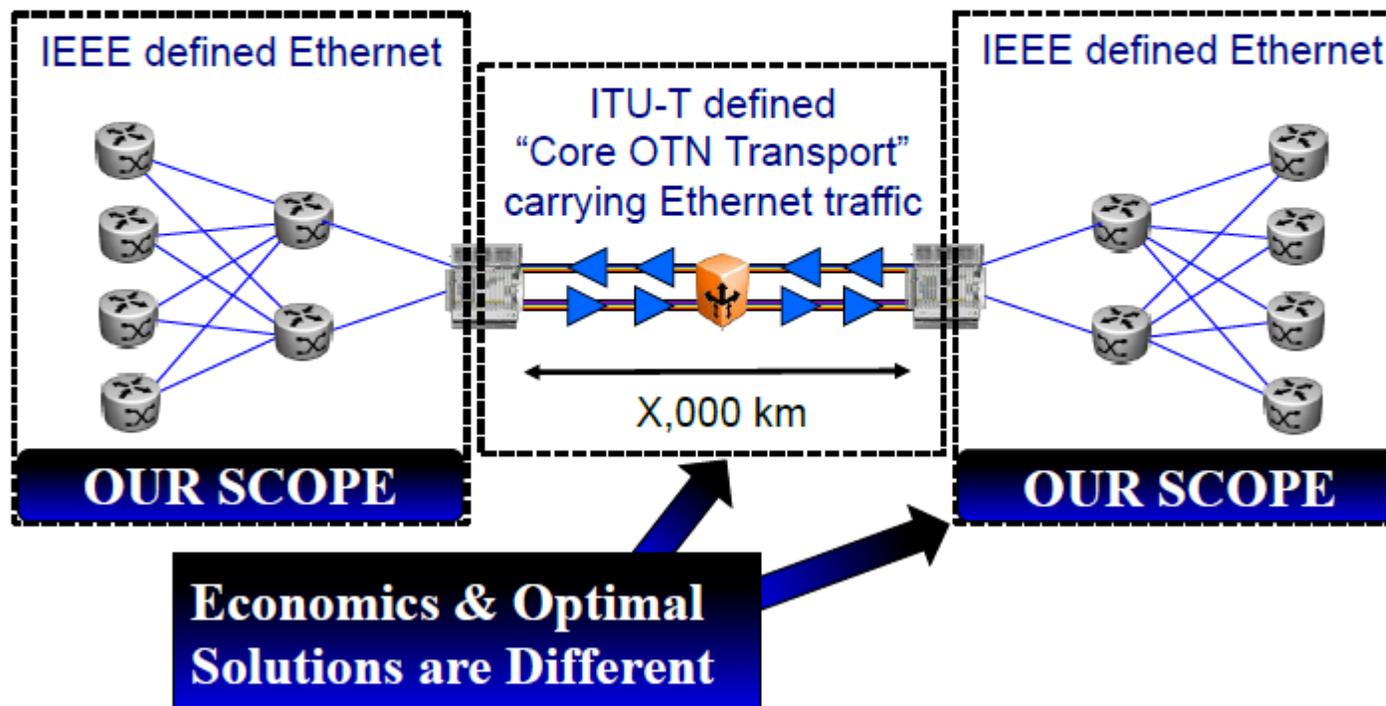
Symbiotic Relationships

Just one example of many

At highest rates Ethernet is becoming dominant traffic for client- and line-side

- “Core OTN Transport” is defined by the ITU-T

Interdependent problems, but not interchangeable solutions



Source: IEEE 802.3™ 400Gb/s Call-for-interest consensus presentation, March 19th 2013
http://www.ieee802.org/3/400GSG/public/mar13/CFI_01_0313.pdf

Symbiotic relationships

Some more examples of many

- Structured cabling
 - ISO/IEC JTC1 SC25 WG3
 - TIA TR42
- Optical Interworking Forum (OIF)
- Metro Ethernet Forum (MEF)
- IEEE 1904.1 Service Interoperability in Ethernet Passive Optical Networks (SIEPON)

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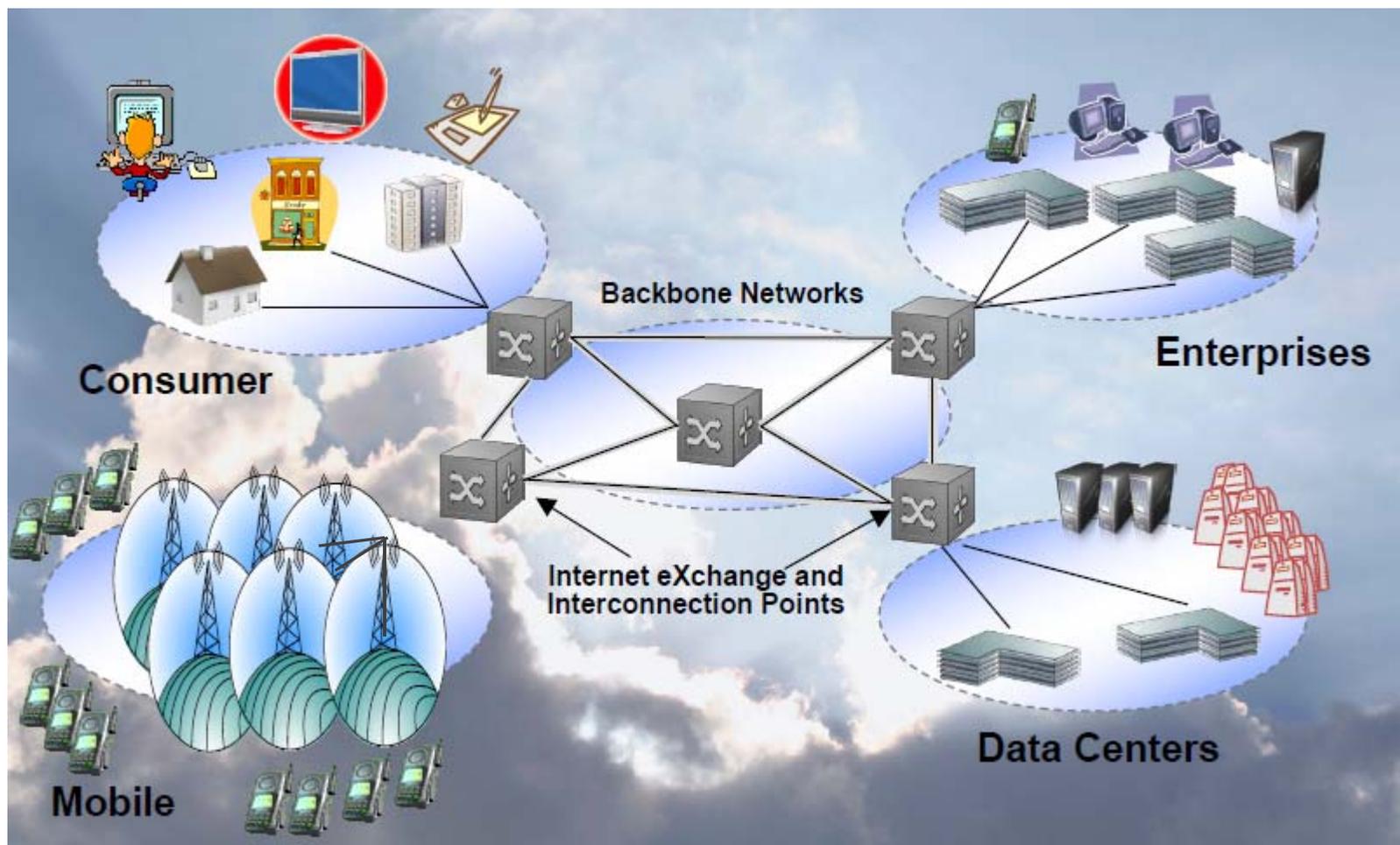
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The Ethernet Eco-System Today



Source: IEEE 802.3™ 400Gb/s Call-for-interest consensus presentation, March 19th 2013
http://www.ieee802.org/3/400GSG/public/mar13/CFI_01_0313.pdf

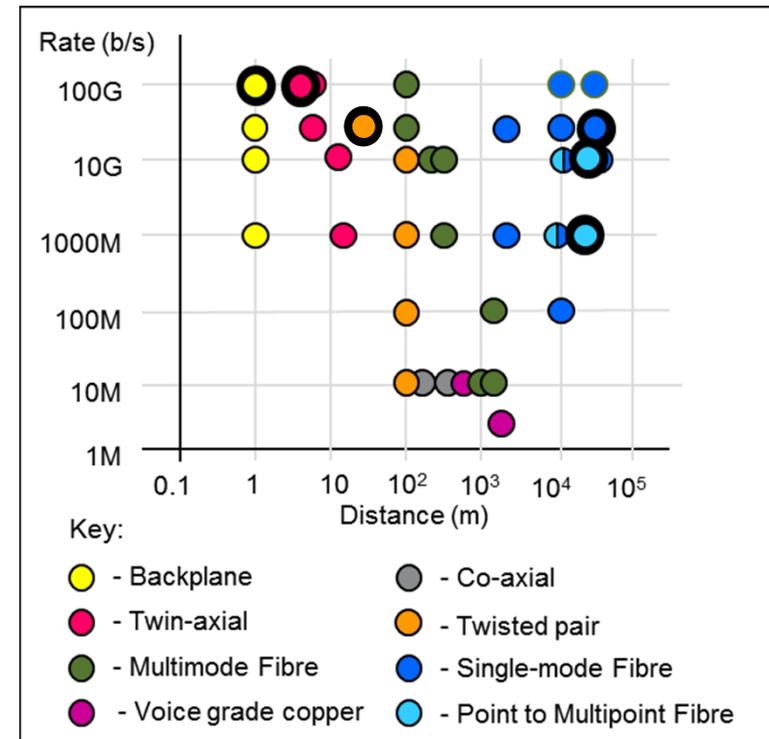
IEEE Std 802.3.1-2013 Ethernet MIBs

- IETF developed SMIv2 (SNMP) format Ethernet MIB modules
 - The IETF decided to stop developing these MIB modules
 - IEEE 802.3 Ethernet Working Group now does this work
- Initial standard IEEE Std 802.3.1-2011 Ethernet MIBs
- IEEE Std 802.3.1-2013 Ethernet MIBs
 - Update of the IEEE Std 802.3.1-2011 MIB standard
 - Add support for the various recent amendments
 - GDMO MIB specification deprecated by this revision
- On publication IEEE Std 802.3 and MIB match
 - For the first time in many years

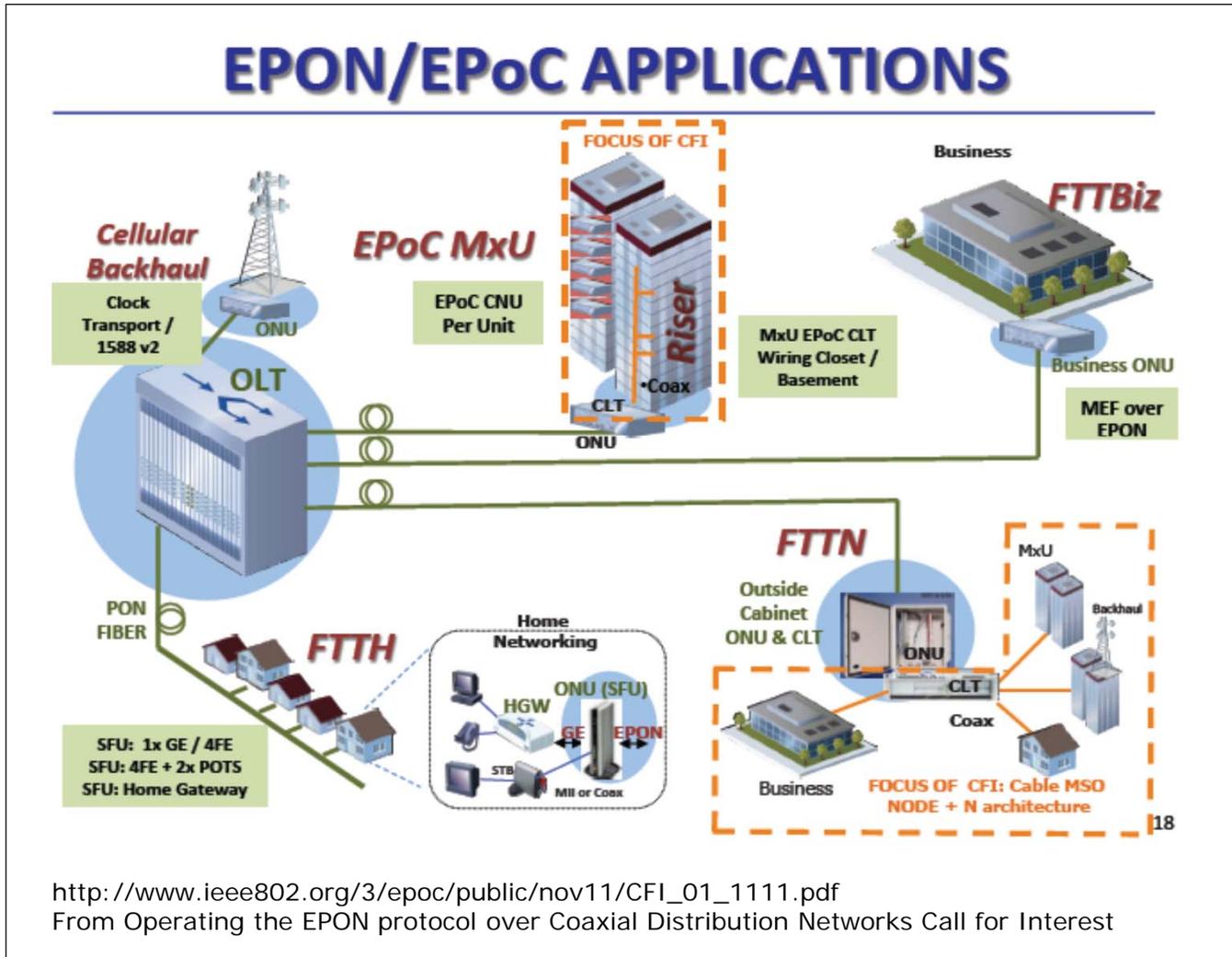
IEEE 802.3 projects

EPON, 40Gb/s and 100Gb/s PHYs

PHY Type	Data rate	Distance	Media
IEEE Std 802.3bk-2013 Extended EPON			
1000BASE-PX30	1Gb/s symmetric	20 km 1:32 typ	One single-mode Point to Multipoint 
1000BASE-PX40	1Gb/s symmetric	20 km 1:64 typ	
10GBASE-PR40	10Gb/s symmetric	20 km 1:64 typ	
10/1GBASE-PRX40	10Gb/s dn 1Gb/s up	20 km 1:64 typ	
IEEE P802.3bj 100Gb/s Copper and Backplane			
100GBASE-CR4	100Gb/s	5m	Copper cable assembly 
100GBASE-KR4	100Gb/s	Chanel based	Backplane 
100GBASE-KP4	100Gb/s		Backplane 
IEEE P802.3bm 40 Gb/s and 100 Gb/s Operation Over Fiber Optic Cables			
40GBASE-ER4	40Gb/s	40km	Single-mode 
100GBASE-SR4	100Gb/s	100m	4 Lane multimode 
IEEE P802.3bq 40GBASE-T			
40GBASE-T	40Gb/s	30m	Twisted pair 

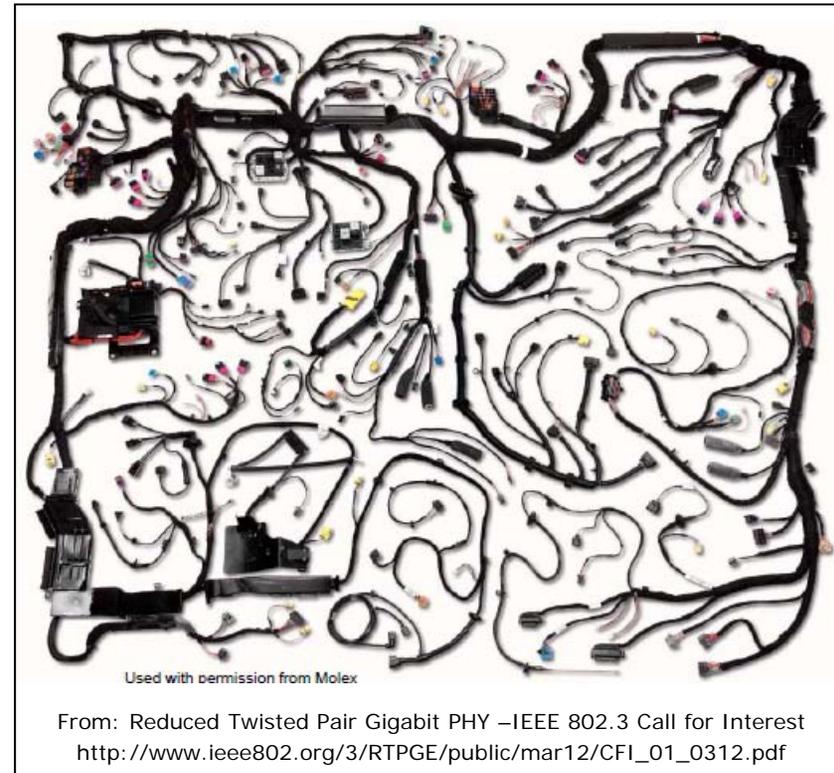


IEEE P802.3bn EPON Protocol over Coax (EPoC)



IEEE P802.3bp Reduced Twisted Pair Gigabit Ethernet (RTPGE)

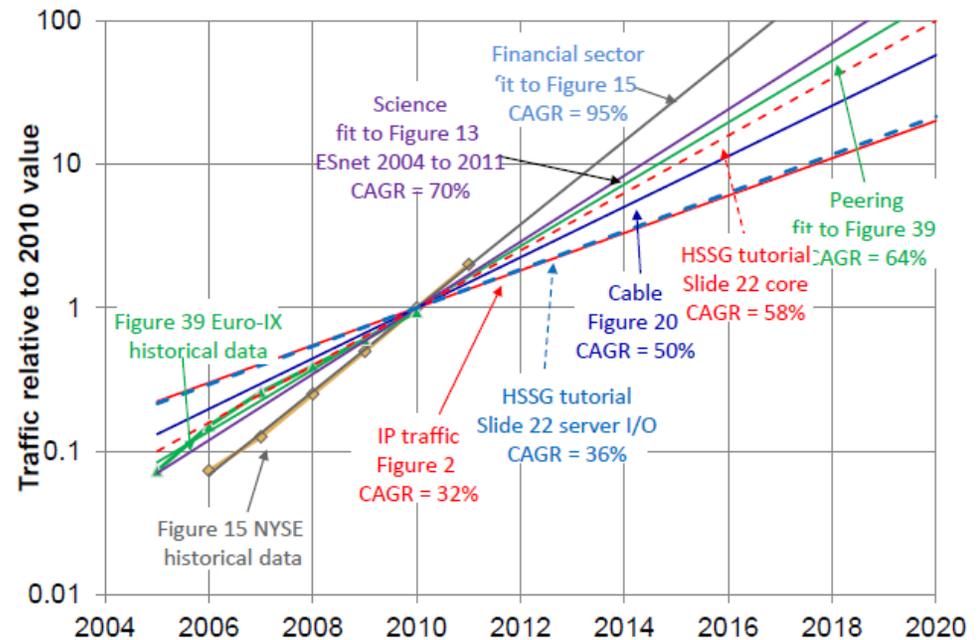
- Some objectives
 - Support 1 Gb/s operation in automotive & industrial environments (e.g. EMC, temperature).
 - Define the performance characteristics of an automotive link segment and a PHY to support point-to-point operation over this link segment with less than three twisted pairs supporting up to four inline connectors using balanced copper cabling for at least 15m for the automotive link segment.



Findings IEEE 802.3 Industry Connections Ethernet Bandwidth Assessment Ad Hoc

http://www.ieee802.org/3/ad_hoc/bwa/BWA_Report.pdf

- Report published in July 2012
- Higher growth rates
 - Financial and data intensive science
 - CAGR = 95% and 70%
- Mid growth rate
 - Peering
 - CAGR = 64%
- Lower growth rates
 - Cable users and IP traffic
 - CAGR = 50% and 32%

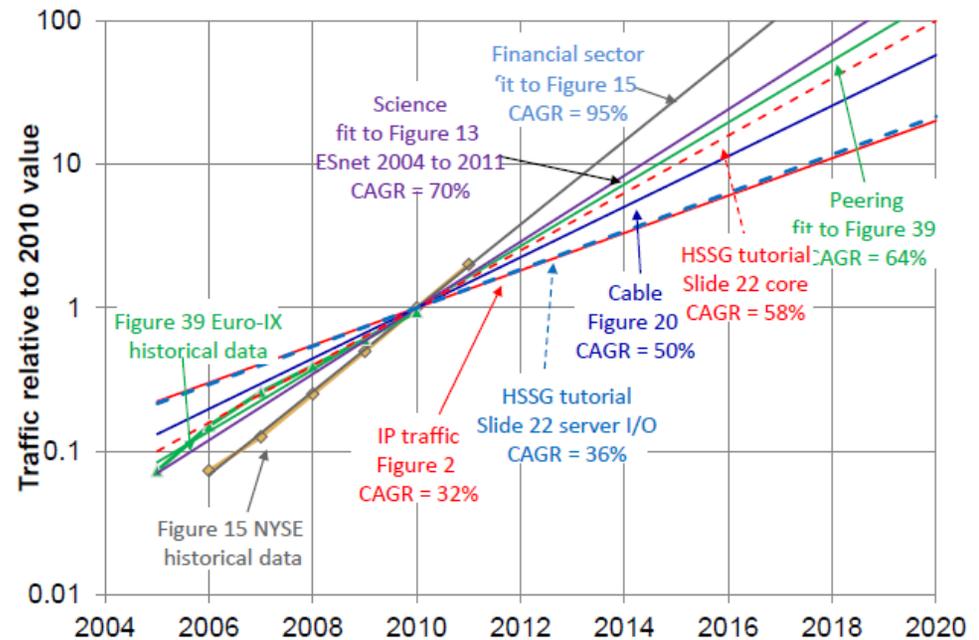


Findings IEEE 802.3 Industry Connections Ethernet Bandwidth Assessment Ad Hoc

http://www.ieee802.org/3/ad_hoc/bwa/BWA_Report.pdf

■ Summary

- Bandwidth growth rates used by IEEE 802.3 High Speed Study Group remain valid
- Core networking
 - Doubling every 18 Months (CAGR = 58%)
- Computing networking
 - Doubling ever 24 months (CAGR = 41%)
- 1Tb/s Ethernet
 - In core in the second half of decade



400Gb/s Study Group

Some interesting facts and forecasts

- **Facebook Facts:***
 - Dec 2006 – 12 Million Users
 - Dec 2010 – 608 Million Users
 - Oct 2012 – Over 1 Billion Users
- **Forecast May 30, 2012****
 - By 2016 – 1.2 million video minutes traveling Internet every second
 - “Fixed” video users: 0.792B (2011) to 1.5B (2016)
 - “Mobile” video users – fastest growing mobile service, 0.271B (2011) to 1.6B (2016)
 - Desktop videoconferencing users – 26.4M (2011) to 218.9M (2016)
- **Forecast Feb 2013 *****
 - Mobile video to represent 66% of all mobile data traffic by 2017
- **YouTube Statistics ******
 - Every minute - 72 hours of video are uploaded
 - Each month 4 billion hours of video are watched
 - 25% of global views come from mobile devices
 - Traffic from mobile devices tripled in 2011
- **Netflix**
 - Oct 28, 2011 – “Netflix represents 32.7% of North America’s peak web traffic”

• * Facebook Newsroom, Timeline, <http://newsroom.fb.com/Timeline>.

• ** May 30, Press Release, “2012, Cisco VNI Forecast,” <http://newsroom.cisco.com/press-release-content?articleId=888280>.

• *** Visual Networking Index , Cisco, http://www.cisco.com/en/US/netsol/ns827/networking_solutions_sub_solution.html#-forecast, Feb, 2013.

• **** Youtube Statistics, http://www.youtube.com/t/press_statistics, data obtained Feb 15, 2013.

• ***** Techspot – “Netflix represents 32.7% of North America’s peak Web traffic, Oct 28, 2011, <http://www.techspot.com/news/46048-netflix-represents-327-of-north-americas-peak-web-traffic.html>.

Source: 400Gb/s Call-for-interest consensus presentation, March 19th 2013
http://www.ieee802.org/3/400GSG/public/mar13/CFI_01_0313.pdf

Other IEEE 802.3 Study Groups

- Distinguished Minimum Latency Traffic Study Group
 - Latency to initiate the transmission of an express frame shall be less than two times the minimum packet size plus IPG
- 4-Pair PoE Study Group
 - Support for 49W at the PD
 - Support for 10GBASE-T
- 1-Pair Power over Data Lines (PoDL) Study Group
 - Power distribution over a single twisted pair link segment
 - Support voltage and current levels for the automotive, transportation, and industrial control industries.
 - Support fast-startup operation

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Conclusions

From DC to 400Gb/s

- Ethernet is the ubiquitous wired connectivity
 - < 0.01m to 1,000s of kilometres
 - 10Mb/s to 100Gb/s
 - Backplane to fibre (and everything in between)
 - Energy-efficient Ethernet
 - Power over Ethernet
- New speeds, media, features and applications
 - 400Gb/s
 - EPOC
 - Automotive
 - Industrial control

Thank you