ETHERNET TECHNOLOGIES:
THE PURSUIT OF MULTI-VENDOR INTEROPERABILITY

Dimitris Filippou

June 7, 2019

NEXT ETHERNET ERA

ethernet alliance

Regarding the Views Expressed

The views being presented in this educational material on the respective IEEE 802.3 standards under consideration are the views of the author(s), and do NOT represent a formal position or interpretation of the respective standard by The Ethernet Alliance. This document is provided on an "AS IS," "AS AVAILABLE," and "WITH ALL FAULTS" basis, with no representations or warranties whatsoever, whether express, implied, statutory, at common law, or otherwise.

Per IEEE-SA Standards Board Bylaws, Mar 2019
"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. "

Our Mission and Priorities

We are a global community of system vendors, component suppliers and academia

- ***Our Mission***
  - Promote technologies and products based on existing and emerging IEEE 802 Ethernet standards
  - Accelerate industry adoption
  - Demonstrate multi-vendor interoperability

- ***Strategic Priorities***
  - Interoperability
  - Education

The Voice of Ethernet

What is Ethernet?

- Ethernet is an innovation brand!
- 7 Attributes
  - Native mode internet plumbing
  - High speed
  - Multi-media
  - IEEE 802.3 Standard
  - Implementations not open-sourced
  - Interoperability – Plug-n-play
  - Backwards compatibility

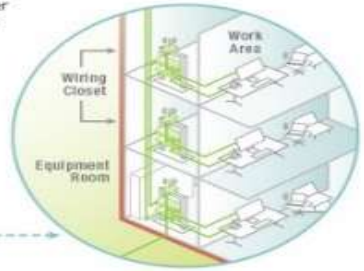
Source: Bob Metcalfe, Inventor of Ethernet

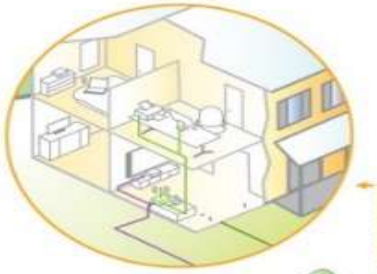
http://ethernetalliance.org/tef-2013-the-future-of-ethernet-keynote/

ENTERPRISE AND CAMPUS

Power over Ethernet is a growing Ethernet application that delivers power and data over Category cabling that has 4 twisted pairs of wires, with Cat 5 or better cabling recommended. 4-Pair PoE is being standardized to deliver over 70W of power over all 4 twisted pairs instead of the two pairs in PoE and PoE+.

PoE Types and Classes	PoE – Type 1			PoE+ – Type 2		4-Pair PoE in Standardization			
Class	0	1	2	3	4	5	6	7	8
PSE Power (W)	15.4	4	7	15.4	30	45	60	75	90
PD Power (W)	13	3.84	6.49	13	25.5	40	51	62	71
4 – Pair PoE–Type 3									
4 – Pair PoE–Type 4									





Ethernet
Telecom Network
Cable Network
CD Network

Automotive Ethernet

Ethernet is being deployed in automobiles and will become the defacto standard for automobile networks by 2020. Because of requirements for lightweight autos, Ethernet was developed to deliver data and power over a single pair of wires to distances of 15 meters at 100Mb/s and 1Gb/s.

Power Over Data Lines (PoDL)

PoDL delivers data and power to cameras, lights, entertainment systems, controls and other devices throughout the car.

Wireless Connectivity

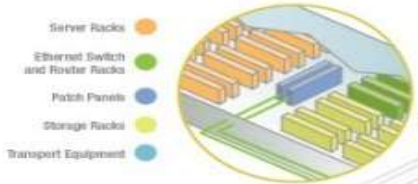
Connected cars are expected to drive increased traffic to wireless networks that result in more wireless backhaul traffic over Ethernet.

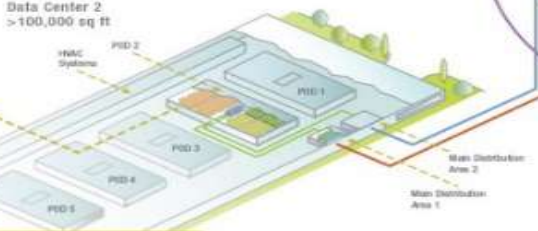
RESIDENTIAL AND CONSUMER

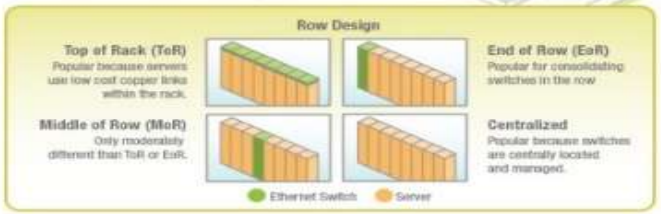
Most homes have wireless access points (WAPs) with 4 or more Ethernet ports. Smart TVs, network attached storage (NAS) and other household products come with Ethernet ports that can be used to create the smart home.

BACKBONE TO OTHER CITIES

BACKBONE TO OTHER CITIES

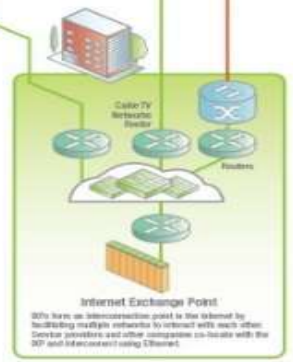


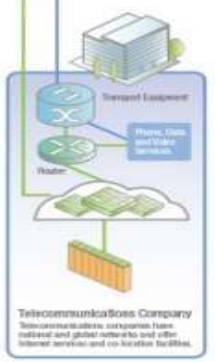


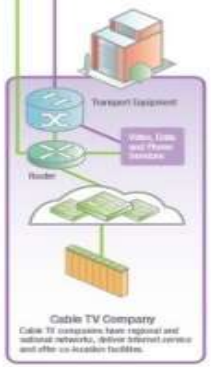


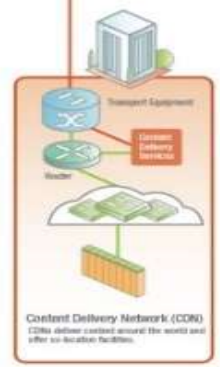
MANs

Metropolitan Area Networks (MANs) come in many varieties and deliver services to a variety of enterprises, organizations and consumers. Some MANs are based on Ethernet, but the largest MANs are based on Optical Transport Networks (OTN) technologies.









Hyperscale data centers drive amazing Ethernet volumes when hundreds of thousands of servers are connected on one site.

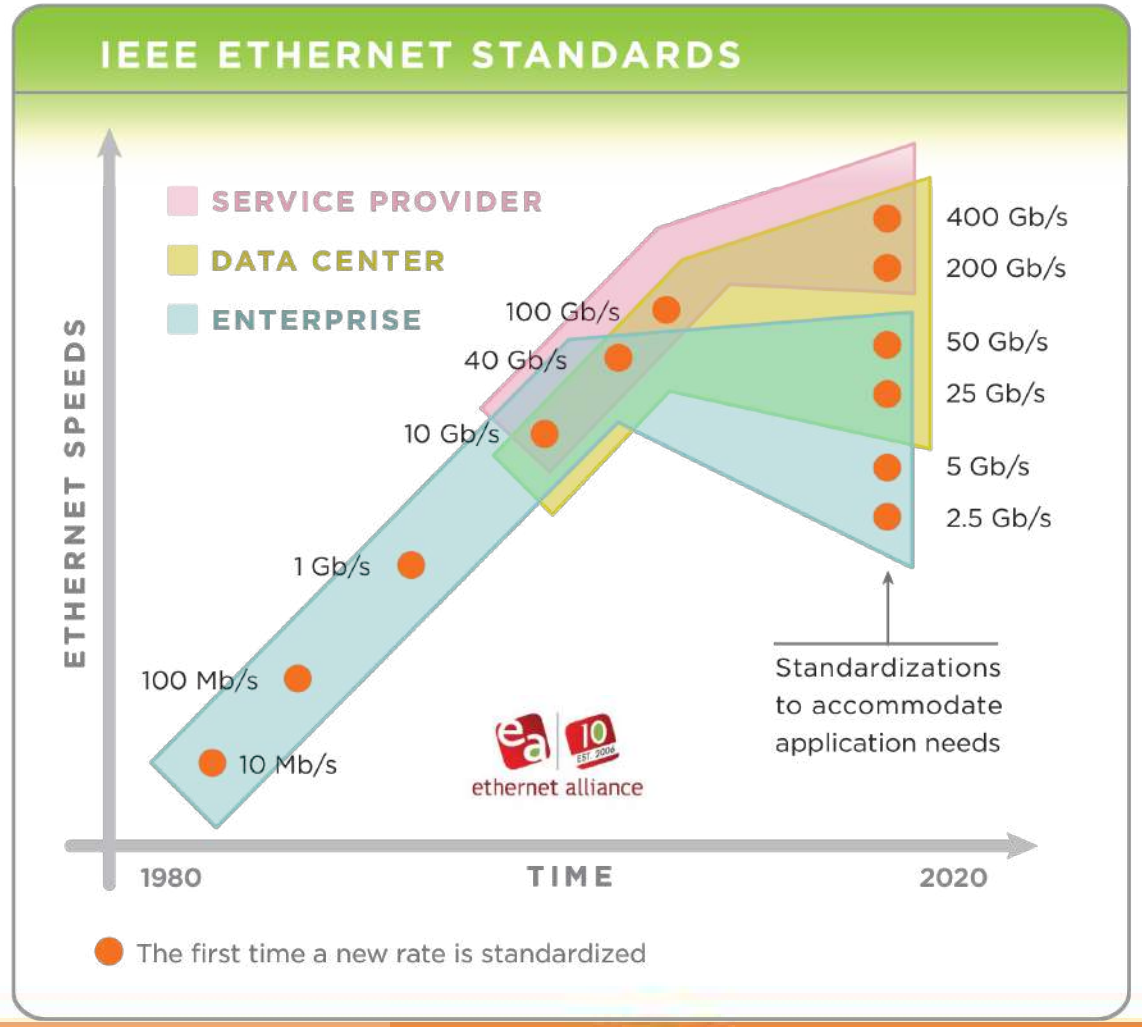
HYPERSCALE DATA CENTER

Service Providers deploy MANs and WANs to connect businesses and consumers. Some carriers deploy hyperscale data centers as well.

SERVICE PROVIDERS

NEXT ETHERNET ERA ethernet alliance

Multiple Justifications Drive Ethernet

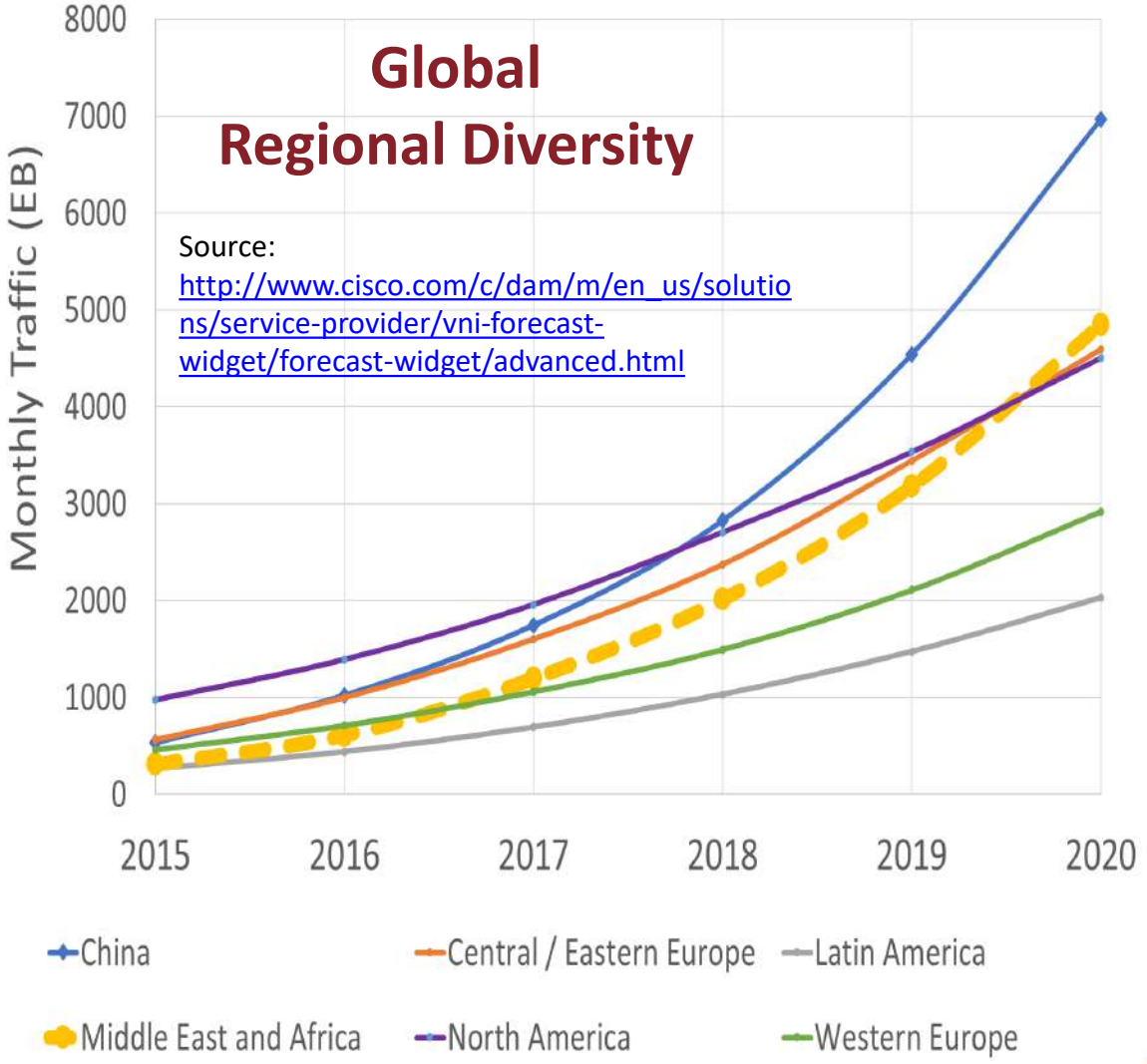


- Higher Speeds relative to application
- Various reasons justify new solutions
  - "Fatter" Pipes
  - Next Generation of Servers
  - Support of Next Gen WiFi / Re-use of existing cabling infrastructure
- The Ethernet community has responded best to customer demand

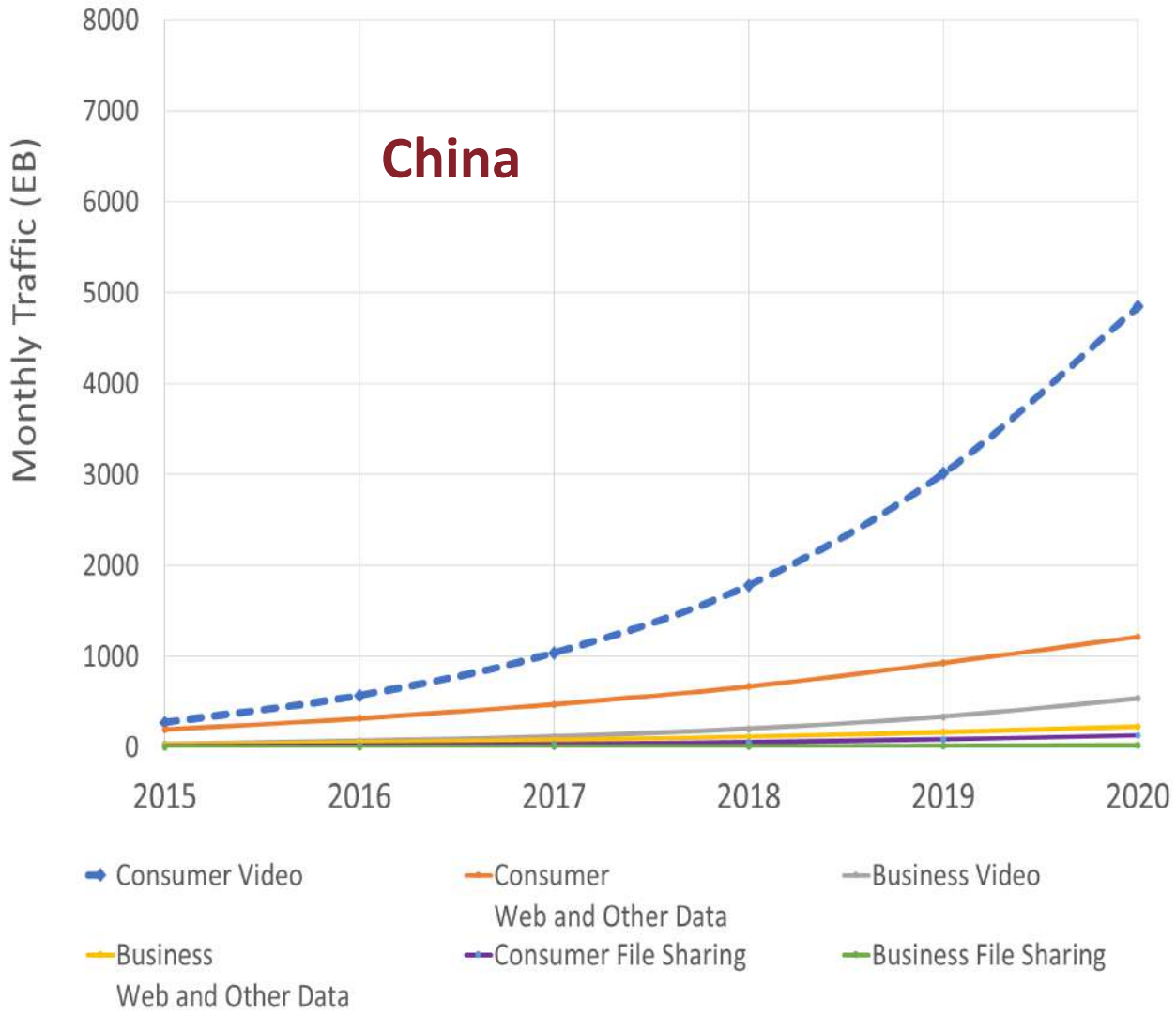
Mobile Networks Bandwidth Trends

Global Regional Diversity

Source:
http://www.cisco.com/c/dam/m/en_us/solutions/service-provider/vni-forecast-widget/forecast-widget/advanced.html



China



Emerging Applications

IoT

> 20 Billion devices by 2020

Across the Web

Automotive

400 Million Ethernet ports by 2020

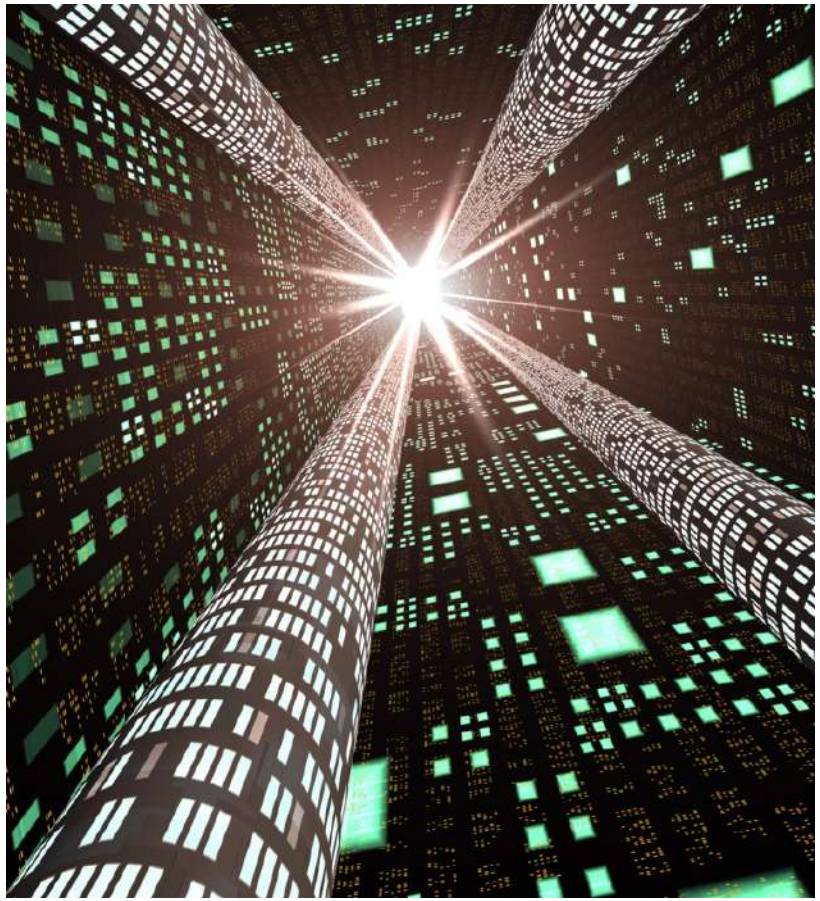
Strategy Analytics

5G

25 million subscriptions worldwide at the end of 2021

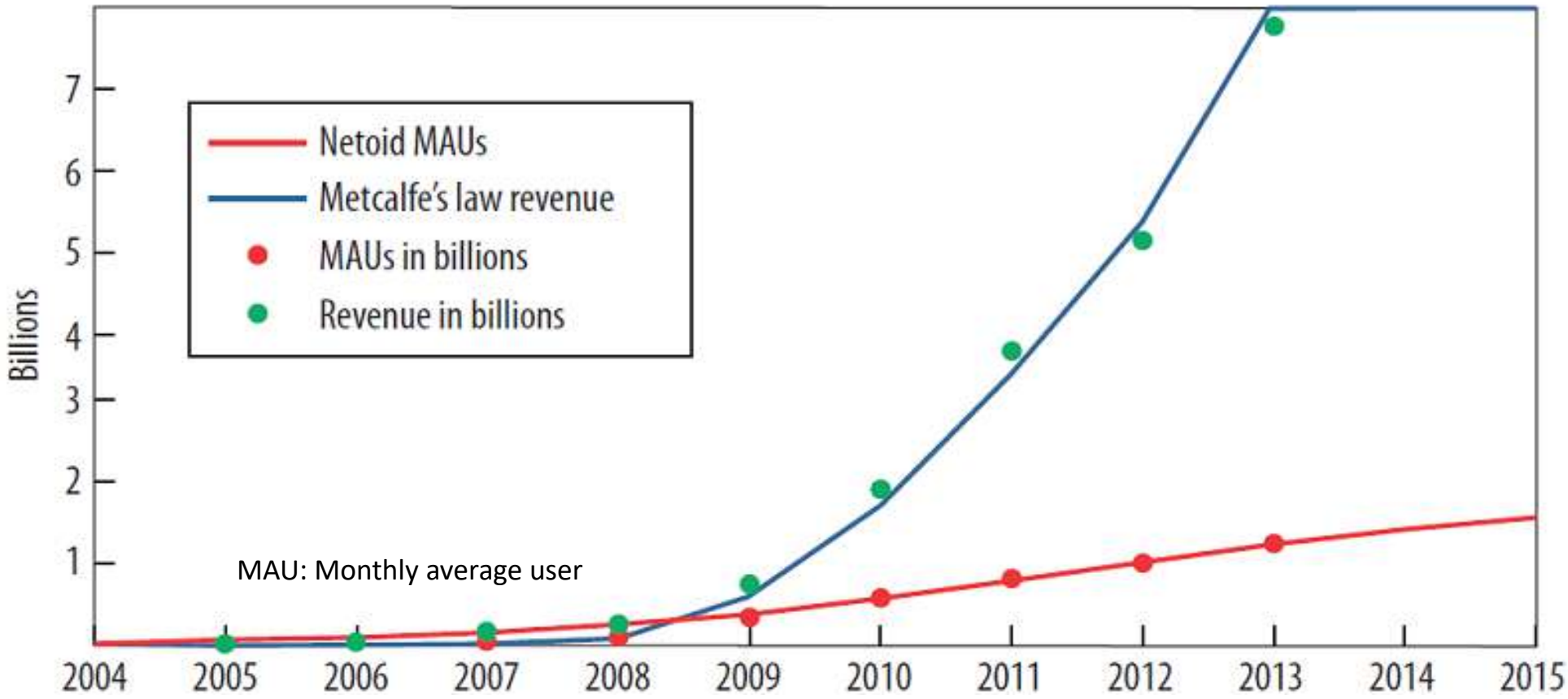
Ovum

Metcalfe's Law



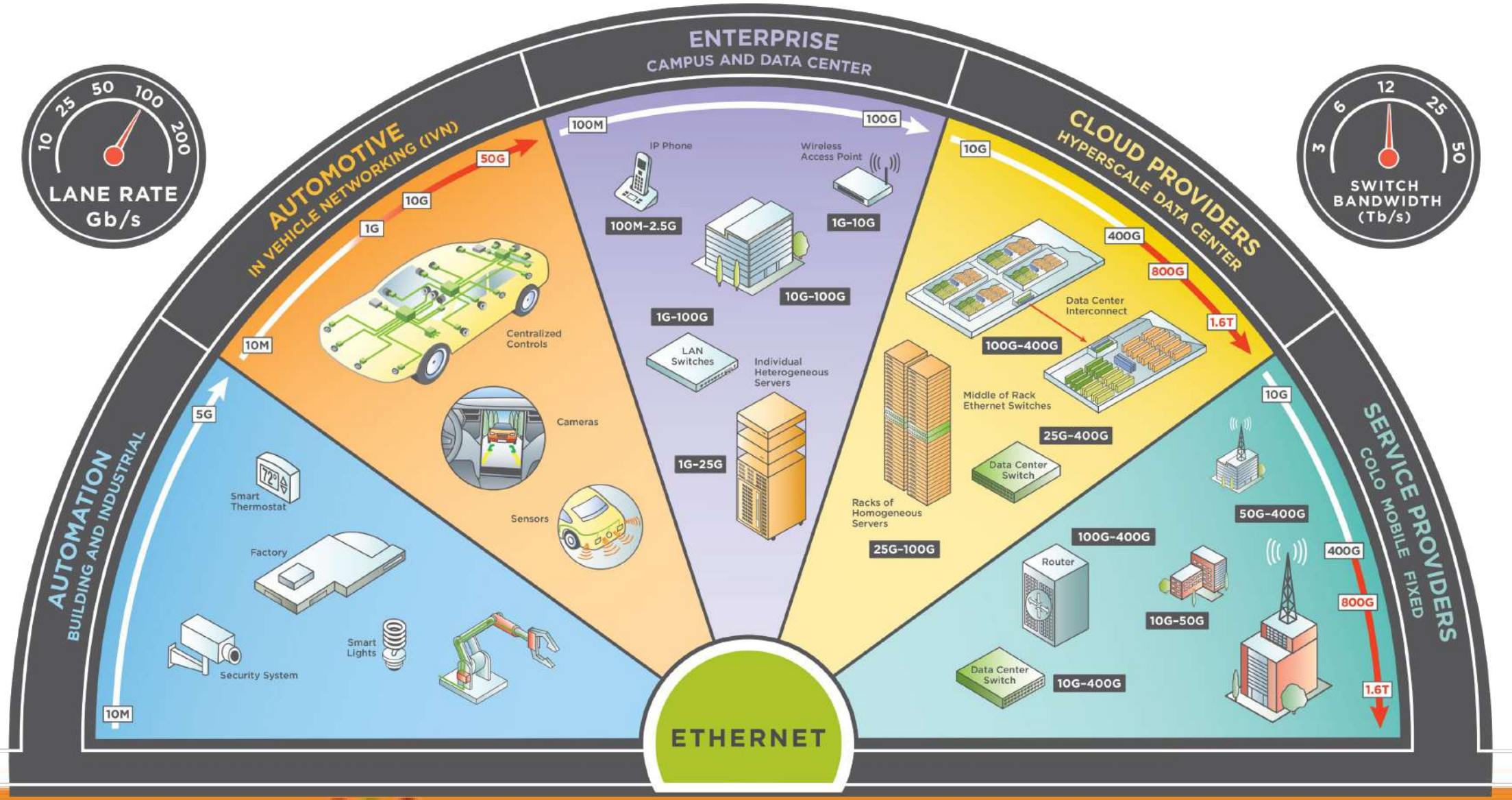
The value of a telecommunications network is proportional to the square of the number of connected users of the system.

Metcalfe's Law on Facebook Network



Used with permission from Robert Metcalfe. "Metcalfe's Law after 40 Years of Ethernet," IEEE Computer, Dec 2013.

The 2019 Ethernet Roadmap



IEEE 802.3 Standards Activity Snapshot

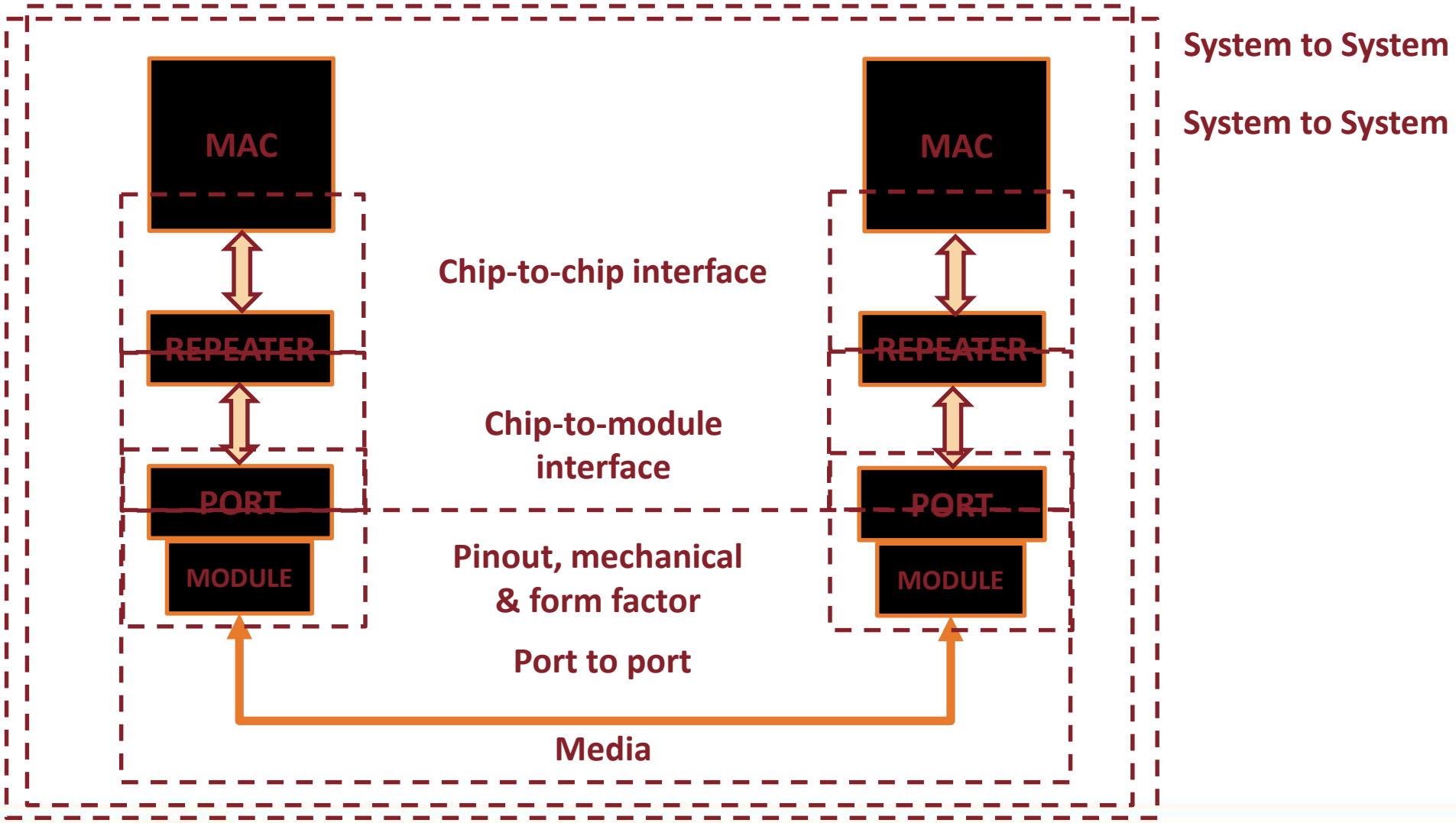
- **Recently Ratified Standards**
  - IEEE 802.3bq 25G/40G BASE-T — 2016
  - IEEE 802.3by 25GbE — 2016
  - IEEE 802.3bz 2.5G/5GBASE-T — 2016
  - IEEE 802.3bs 200GbE & 400 GbE — 2017
  - IEEE 802.3cc 25GbE SMF — 2017
  - IEEE P802.3bt DTE Power via MDI over 4-Pair (PoE) — Sept 2018
  - IEEE P802.3cb 2.5 Gb/s and 5 Gb/s Backplane — Sept 2018
  - IEEE P802.3cd 50GbE/100GbE/200GbE — Dec 2018
- **Task Forces in Process**
  - IEEE P802.3cg 10 Mb/s Single Twisted Pair Ethernet — Sept 2019
  - IEEE P802.3ck 100 Gb/s, 200 Gb/s, and 400 Gb/s Electrical Interfaces — March 2021
  - IEEE P802.3cm 400 Gb/s over Multimode Fiber — Dec 2019
  - IEEE P802.3cn 50 Gb/s, 200 Gb/s, and 400 Gb/s over Single-Mode Fiber — Jun 2020
  - IEEE P802.3cp Bidirectional 10 Gb/s, 25 Gb/s, and 50 Gb/s Optical Access PHYs — Per PAR – June2022
  - IEEE P802.3cs Increased-reach point-to-multipoint Ethernet optical subscriber access (Super-PON) — Per PAR - Sept 2022
  - IEEE P802.3ct 100 Gb/s and 400 Gb/s over DWDM Systems — Sept 2021
- **Study Groups in Process**
  - 100 Gb/s per lane Optical PHYs

OUR MISSION: DEMONSTRATE MULTIVENDOR INTEROPERABILITY

NEXT ETHERNET ERA

ethernet alliance

The Anatomy of Interoperability

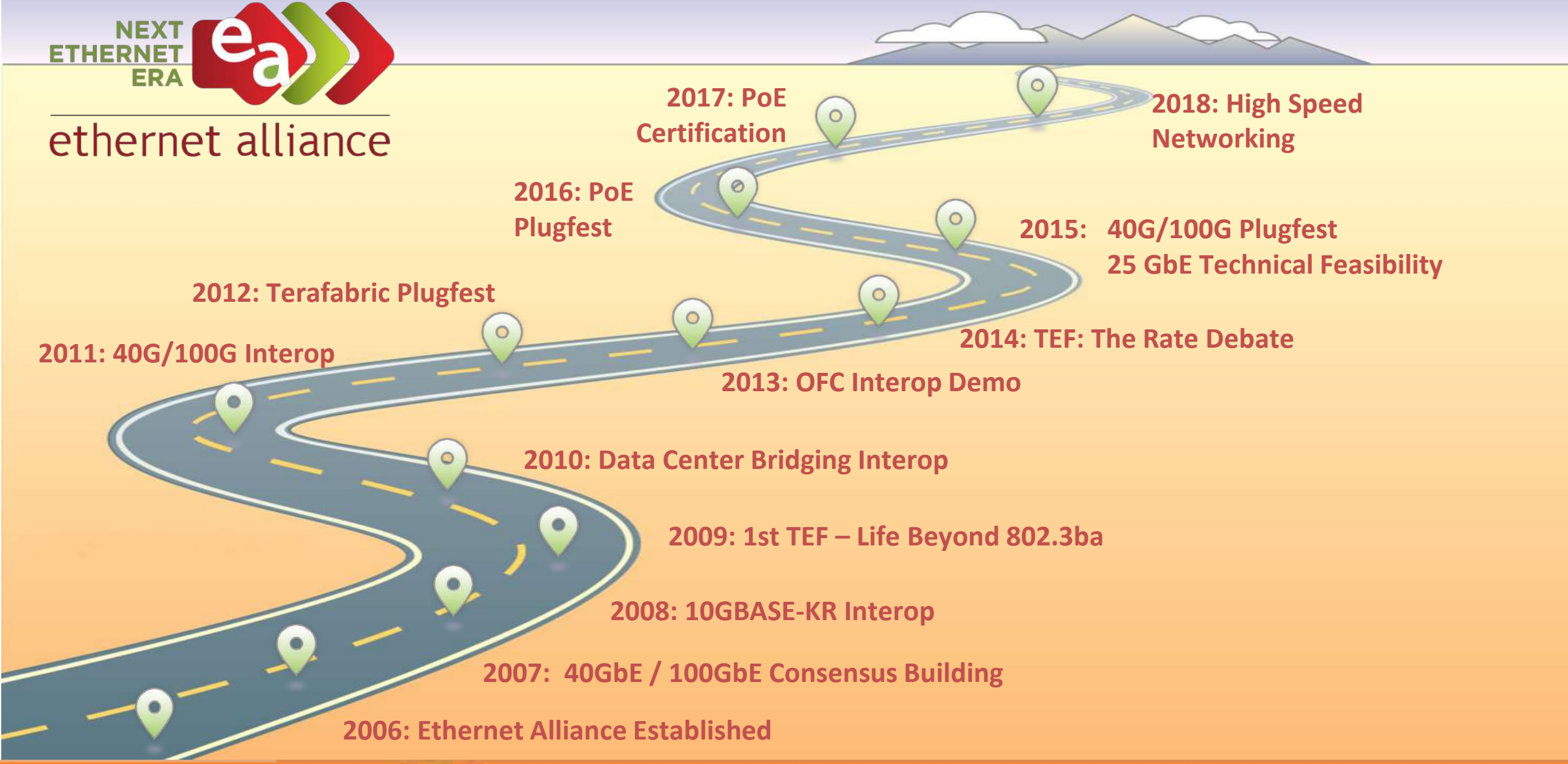


Demonstrating Multi-vendor Interoperability

- Interoperability Plugfests
- Tradeshow demonstrations
- Ethernet Alliance PoE Certification Program

NEXT ETHERNET ERA

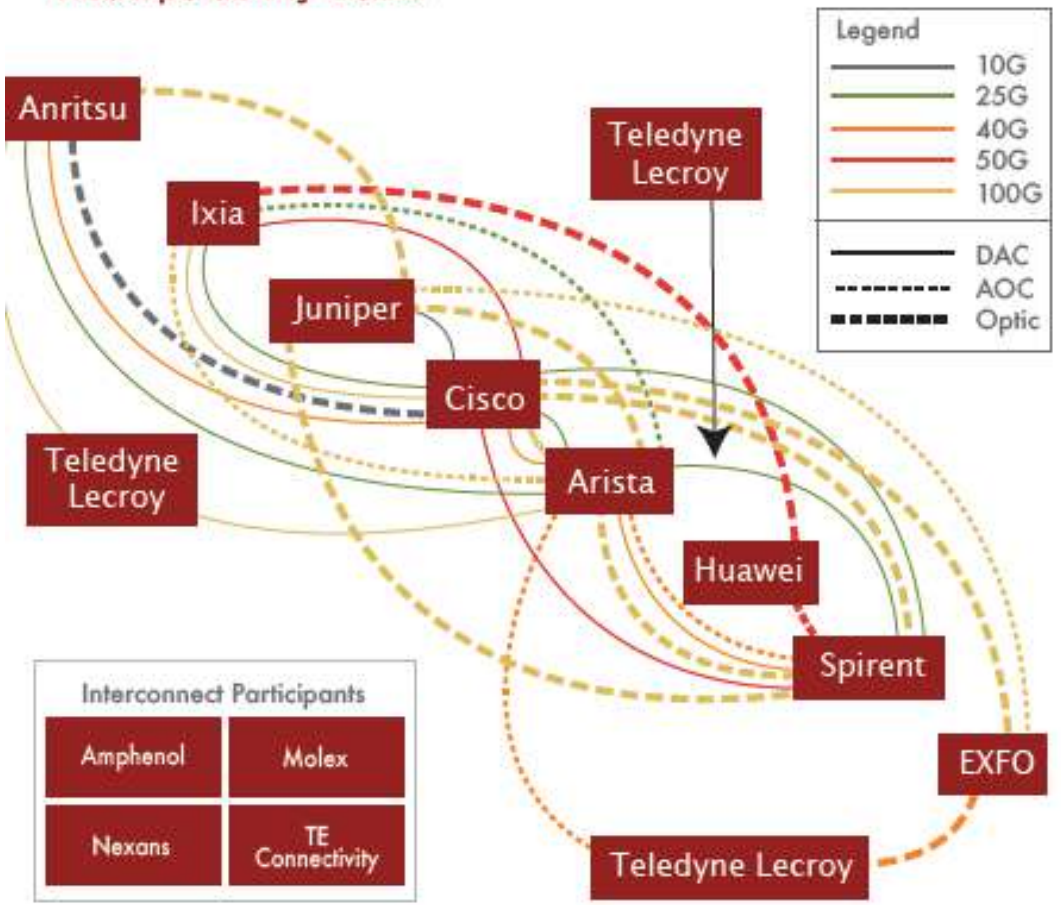
ethernet alliance



NEXT ETHERNET ERA ethernet alliance

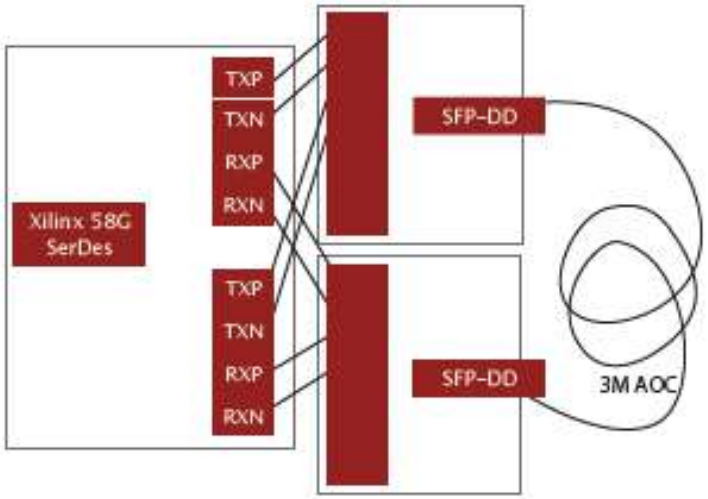
INTEROPERABILITY DEMONSTRATIONS

Ethernet Alliance 10GbE to 100GbE Interoperability Demo



SFP-DD Demonstration

2 lanes of 53 Gb/s PAM4 over 3 meters of Finisar SFP-DD AOC via Molex SFP-DD cage and paddle board



50GbE PAM4 Demo

50GbE PAM4 Generation and Analysis Demonstration

Our Investment in Multi-vendor Plugfests

- Plugfests
  - PoE (802.3af / 802.3at)
  - 2.5G / 5G / 10G BASE-T
  - 25GbE / 100 GbE
  - 100GbE
  - 4 Pair PoE
  - High Speed Networking
    - 25 / 100 GbE
    - 50/ 400 GbE

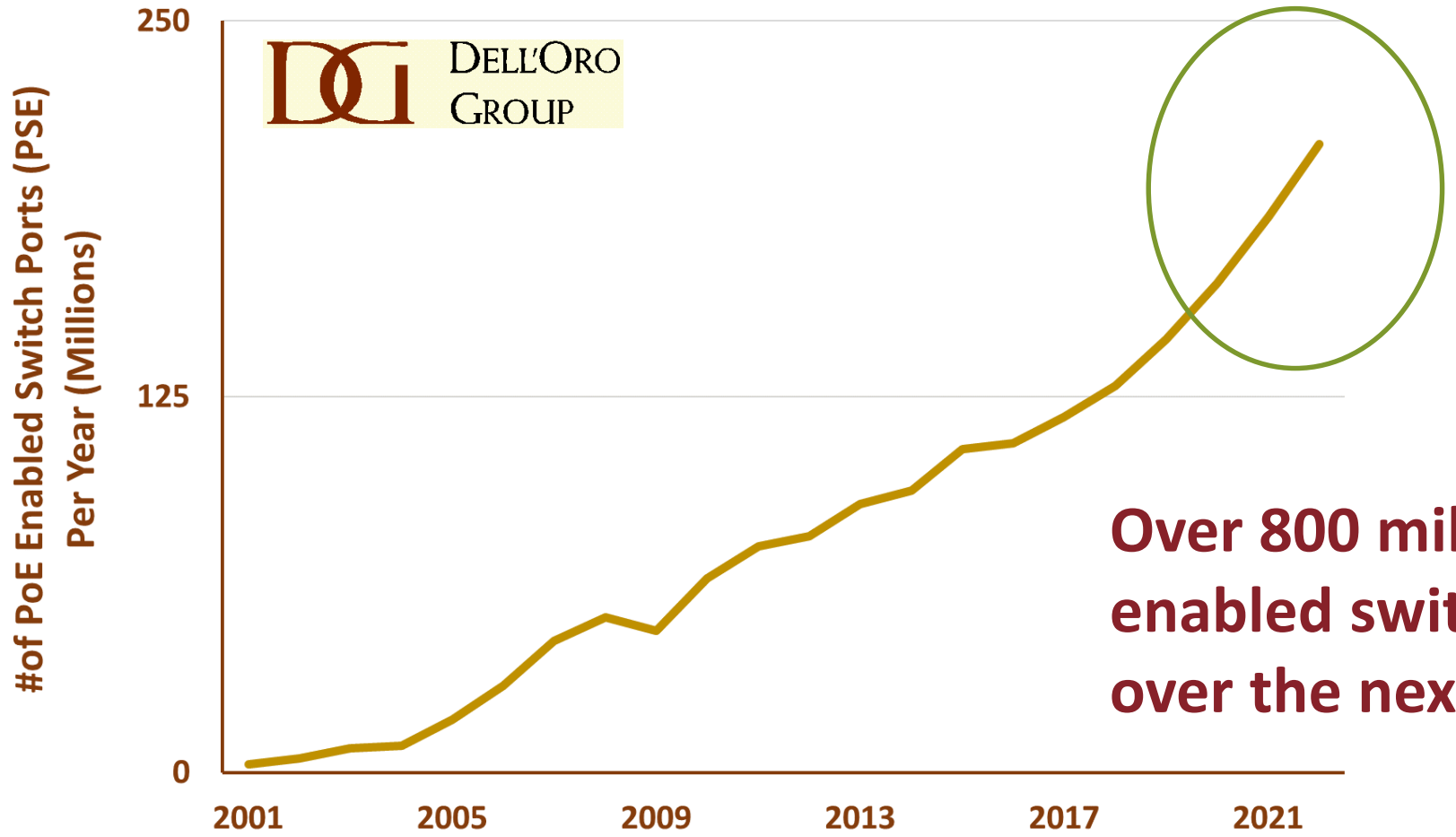
Ethernet Alliance PoE Certification Program

- Meets Ethernet Alliance Certification Test Plan
  - Gen 1: Based on IEEE Std 802.3™-2015 PoE
  - Gen 2: Based on IEEE Std 802.3™-2018 4 Pair PoE
- Confidence of interoperability between certified products
- PSE / PD Logo Distinction
- Class Number indicates maximum class supported
- Easy Interoperability: PSE Class must be greater than or equal to PD Class

PSE Class "4" Logo

PD Class "1" Logo

PoE Enabled Switch Ports Forecast



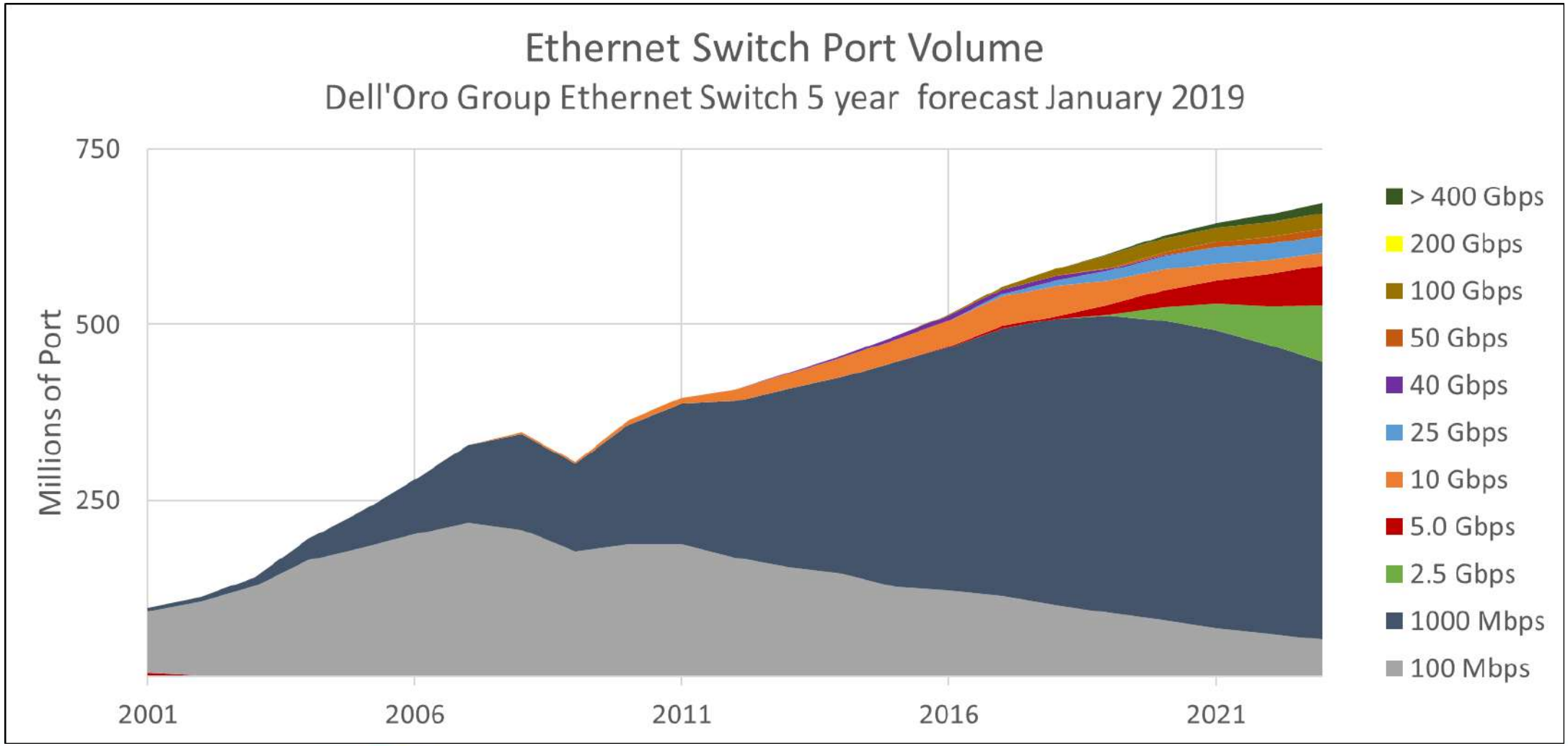
Over 800 million PoE enabled switch ports over the next 5 years!

Source: Dell'Oro Group, Feb 2018

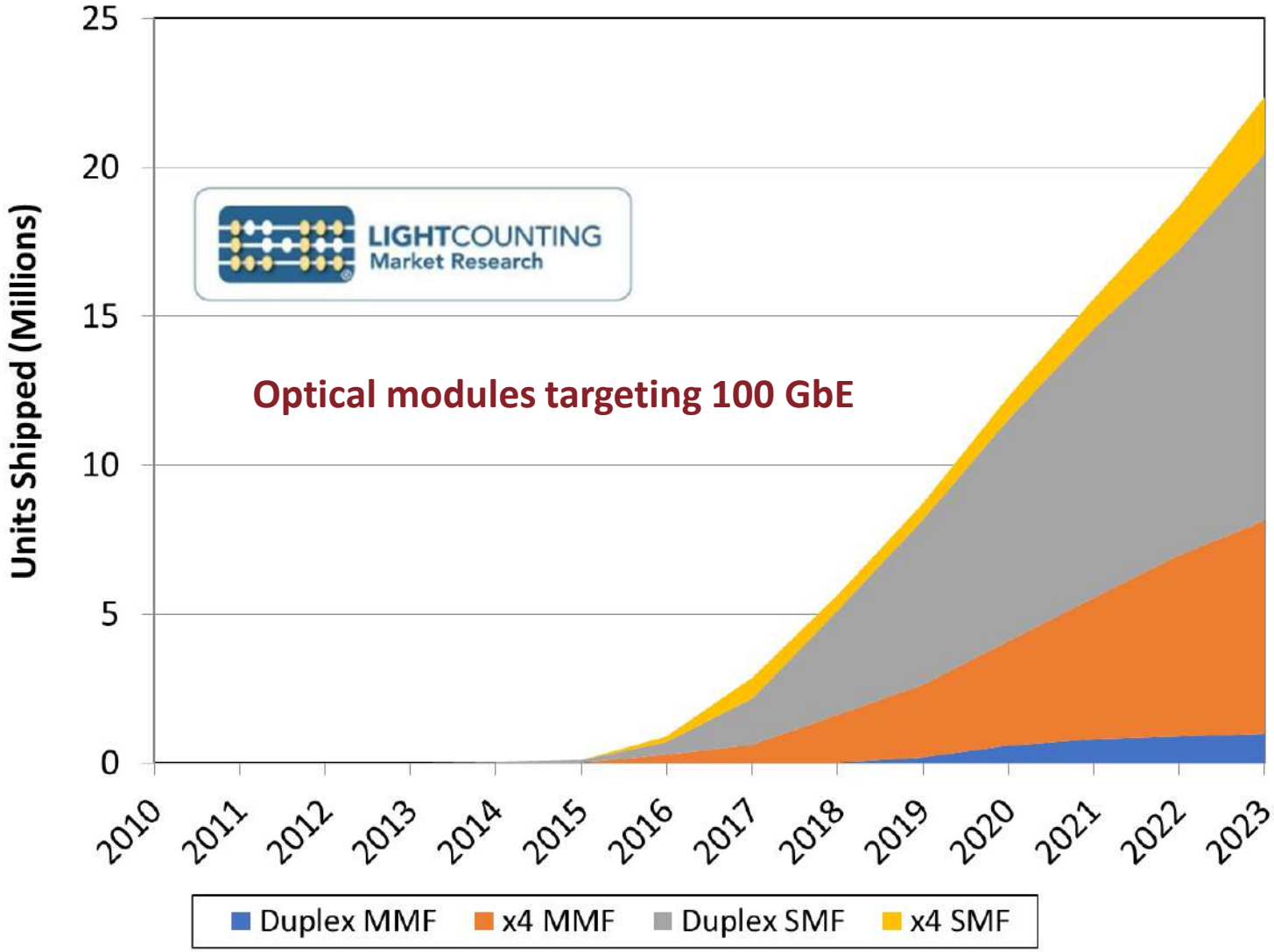
Moving Forward

- Multi-vendor Interoperability is an attribute of Ethernet
- Ethernet standards are important, but are a step on the path to wide-scale deployment
- New technologies are coming at an increasing pace
- The Ethernet Alliance leads the Ethernet industry in its investment in demonstrating multi-vendor interoperability

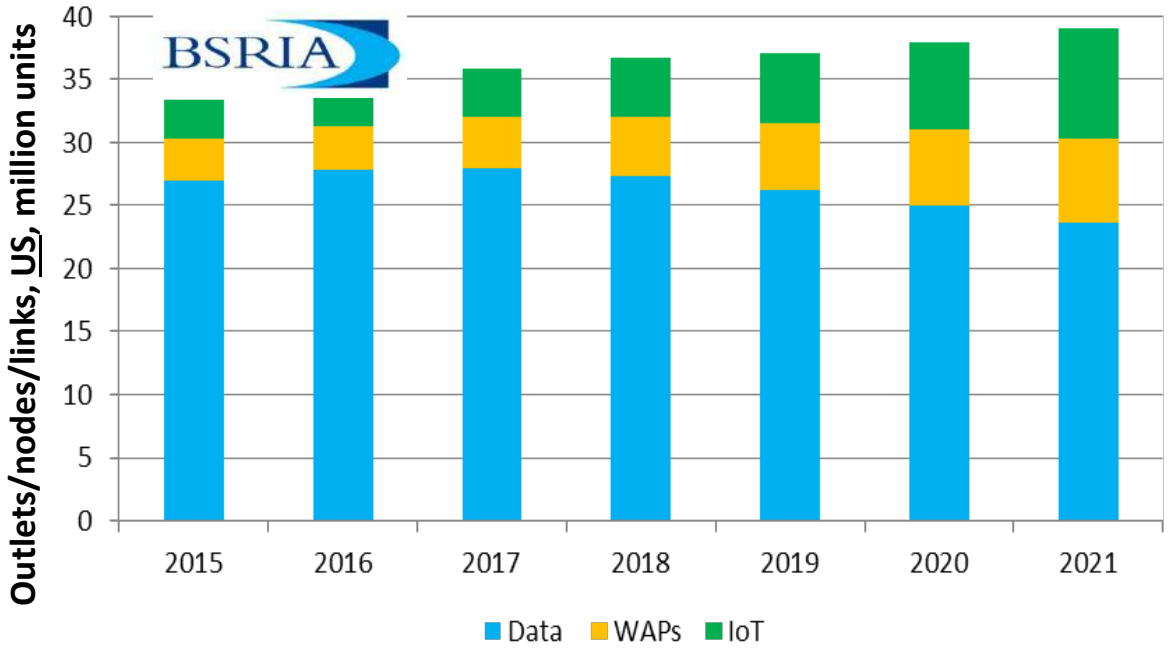
Ethernet Speed Transitions



Interoperability Can Impact Deployment

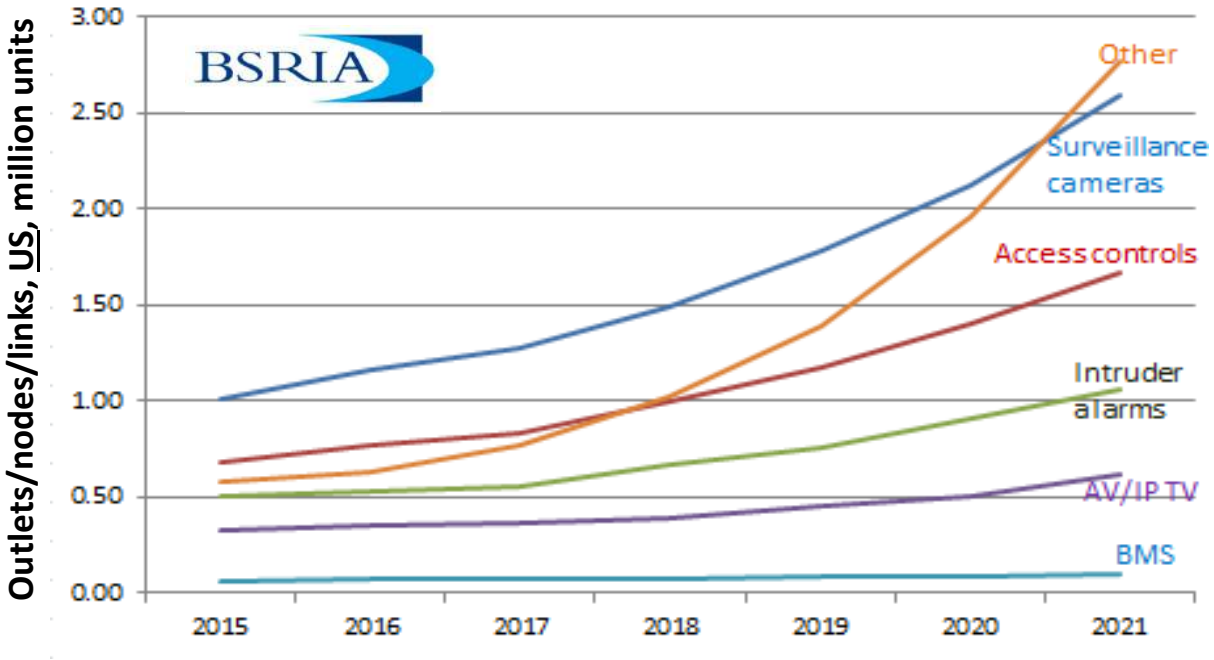


Network links/nodes sales and growth, USA



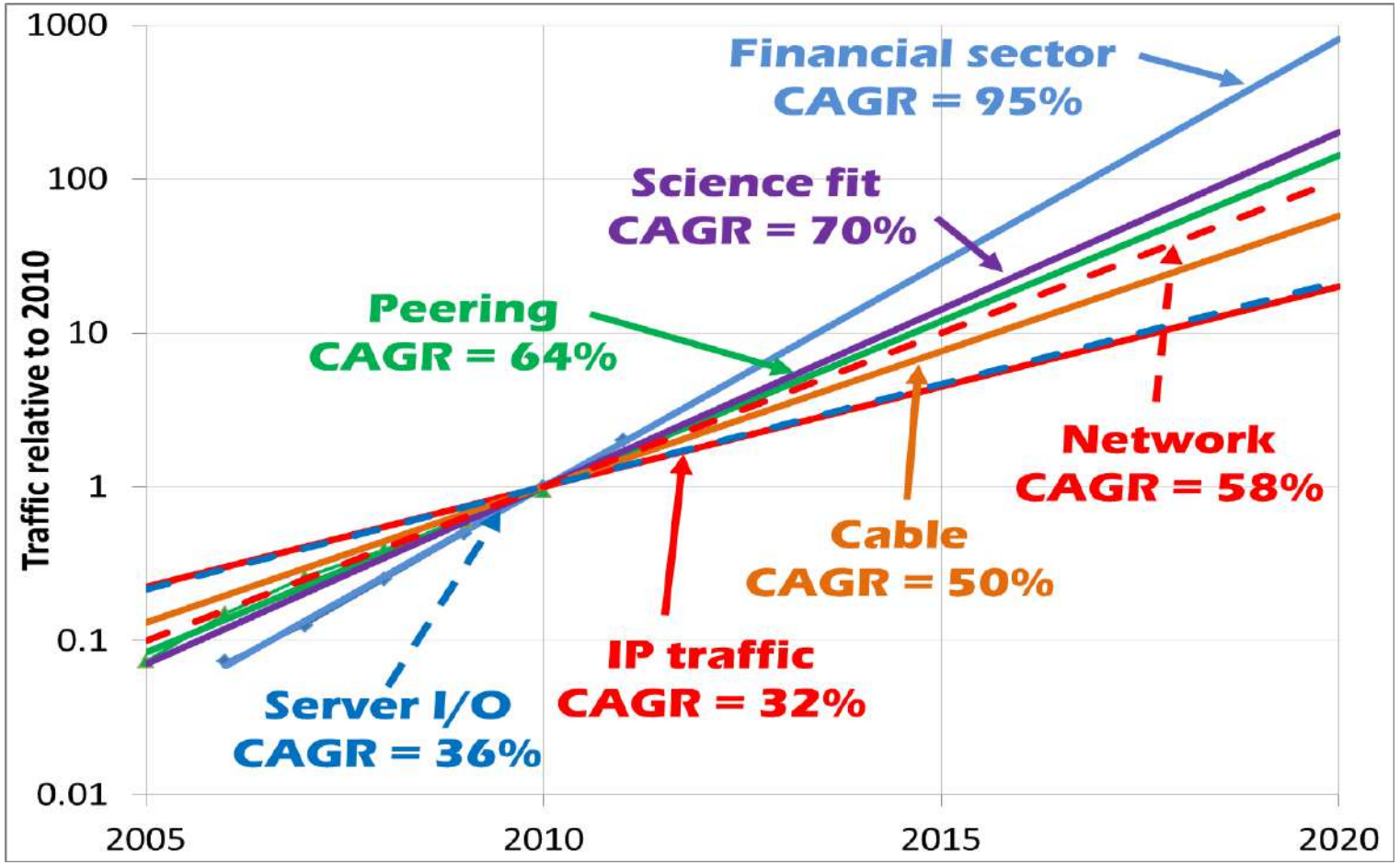
Source: BSRIA survey and modelling May 2017

"IoT" Breakout



Other: Lighting, digital signage, point of sales/card readers, white boards, smoke detection, room booking

This Chart Helped Launch 400GbE



- Diverse applications!
- Diverse bandwidth growth rates!

- New Ethernet Bandwidth Assessment underway!

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

http://www.ieee802.org/3/ad_hoc/bwa2/index.html

If you have any questions or comments, please email admin@ethernetalliance.org

Ethernet Alliance: visit www.ethernetalliance.org

Join the Ethernet Alliance LinkedIn group

Follow @EthernetAllianc on Twitter

Visit the Ethernet Alliance on Facebook