

Introduction - Ethernet Bandwidth Assessment, Part II

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IEEE 802.3 NEW ETHERNET APPLICATIONS AD HOC

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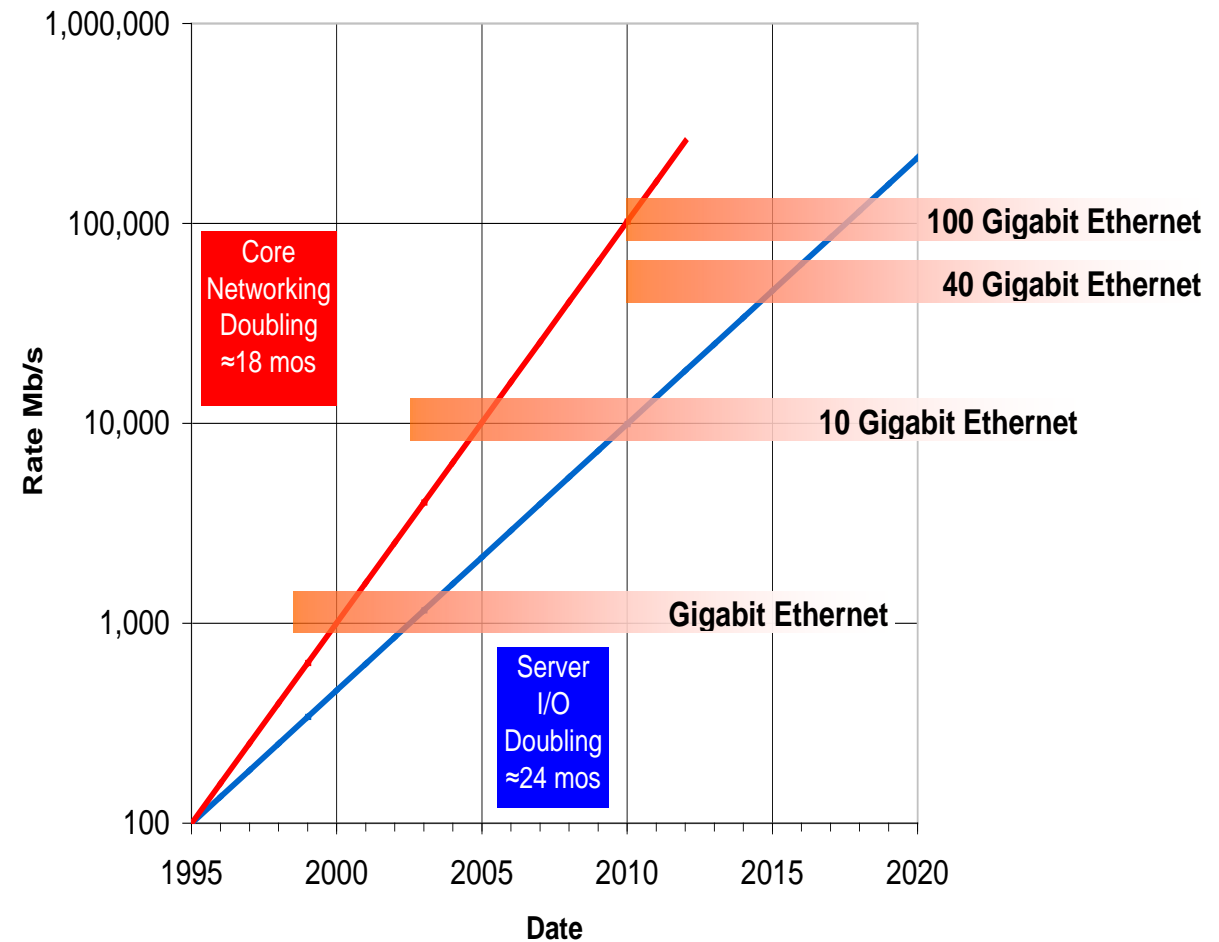
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Introduction

- Understanding bandwidth trends useful for consensus building for initiating new Ethernet standards efforts.
 - “Classic” examples include -
 - IEEE 802.3 HSSG 2007
 - IEEE 802.3 400GbE Study Group
 - IEEE 802.3 2.5G / 5G BASE-T Study Group
 - Emerging Applications examples
 - IEEE 802.3 Beyond 10km Optical PHYs Study Group
 - Automotive Networking (Card to Cloud)
 - WDM Ethernet
- Information gathered can impact other non “Next Rate” projects
- Discuss / discover new emerging applications
- Can foster meaningful technical discussions
- Such efforts take time to gather data, and the opinion of authors – better to do before the next Ethernet rate project starts..



Background

IEEE 802.3 Ethernet Bandwidth Assessment (2012)

- “The focus of this IC activity will be to perform an appraisal of future “Ethernet Wireline Bandwidth Needs” of applications within the Ethernet eco-system.” – IEEE 802.3 BWA Background
- Webpage - http://www.ieee802.org/3/ad_hoc/bwa/index.html
- Feb 2011 to July 2012
- Final Report - http://www.ieee802.org/3/ad_hoc/bwa/BWA_Report.pdf
- Tutorial - http://www.ieee802.org/802_tutorials/2012-07/BWATutorial_D1_12_0716.pdf

BWA #1 Assessment Limitations

Assessment Duration: 18 months maximum

- Limited study time
- Prevent data from becoming dated
- Information provided snapshot at time of submission

Past trends may not be an accurate predictor of the future

- Emerging applications
- Technology
- Standardization Efforts
- Will Ethernet cost per gigabit continue to decrease?

Underlying assumptions

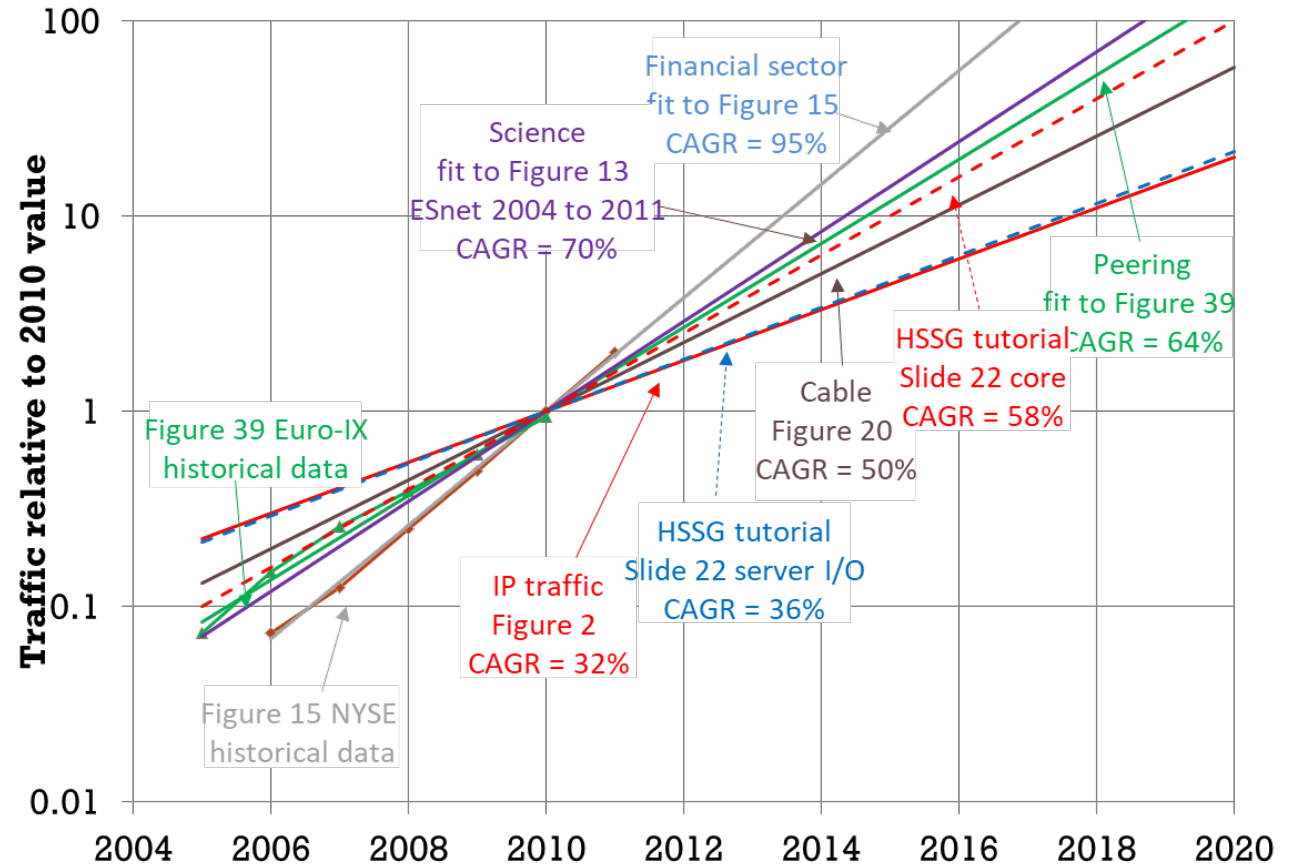
- Market adoption
- Continuation of applications that require increasing bandwidth

IEEE 802.3 BWA Findings

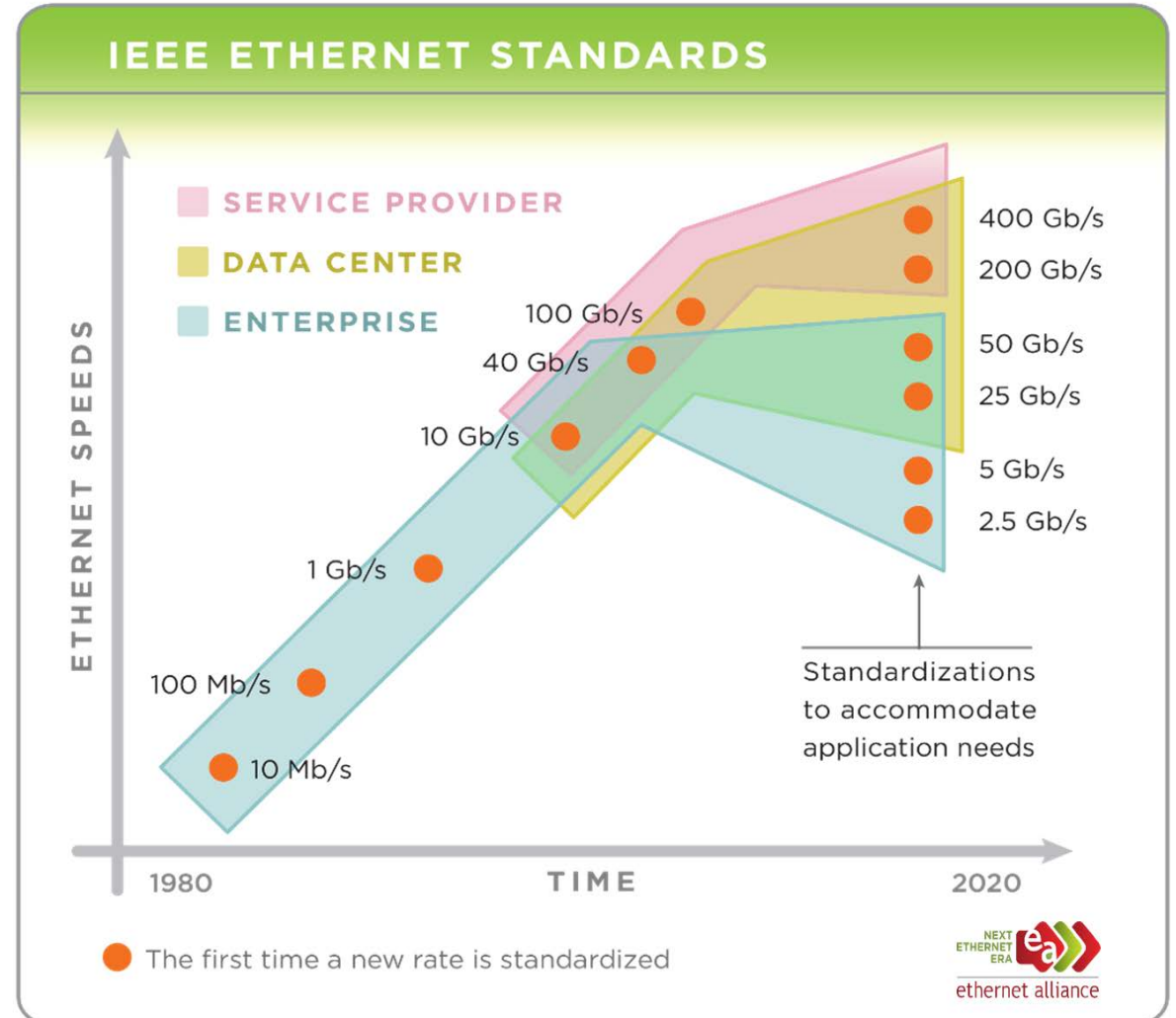
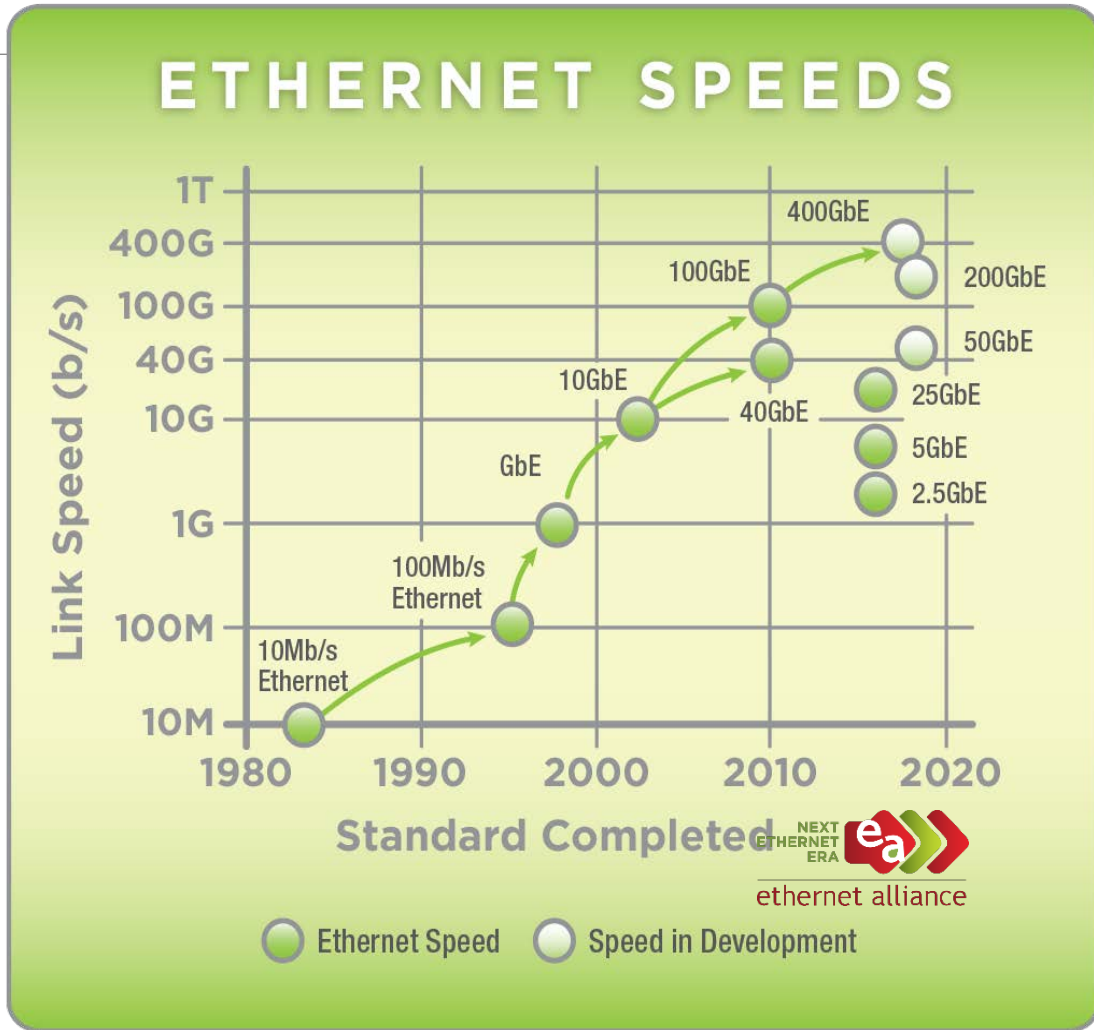
The exponential rise in traffic is predicted to continue

$$\text{Increased \# of users} + \text{Increased access rates and methods} + \text{Increased services} = \text{Bandwidth explosion everywhere}$$

Servicing demand with existing rates or new ones > 100 Gb/s will depend on the cost effectiveness of the solution



Remember the Great Rate Debate?

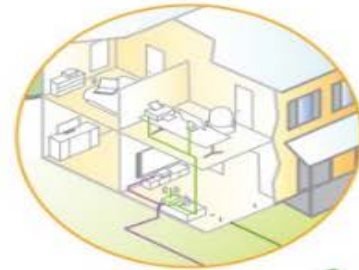
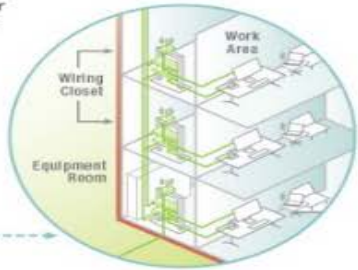
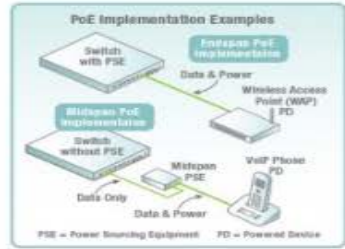


ENTERPRISE AND CAMPUS

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 2					4-Pair PoE In Standardization			
	PoE - Type 1					5	6	7	8
Class	0	1	2	3	4				
PSE Power (W)	15.4	4	7	15.4	30	45	60	75	90
PD Power (W)	13	3.84	6.40	13	25.5	40	51	62	71

4 - Pair PoE - Type 3
4 - Pair PoE - Type 4



— Ethernet
— Telecom Network
— Cable Network
— CD Network

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.

Automotive Ethernet
Ethernet is being deployed in automobiles and will become the default 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.

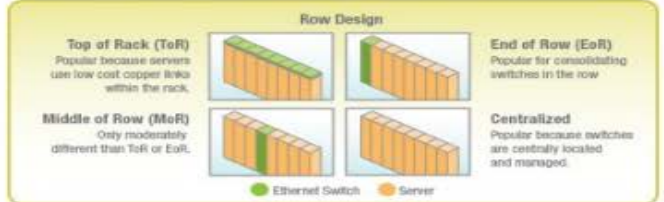
Power Over Data Lines (PoDL)
PoDL delivers data and power to cameras, lights, entertainment systems, controls and other devices throughout the car.

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

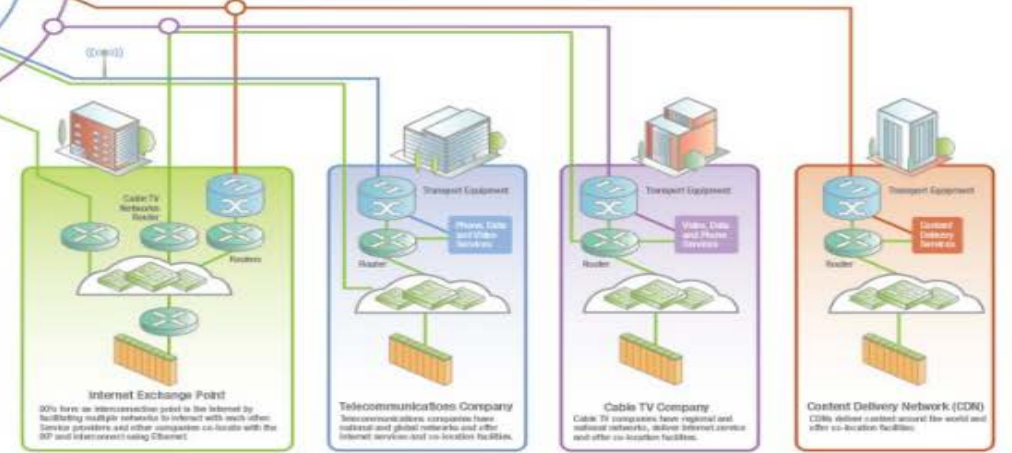


BACKBONE TO OTHER CITIES

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.

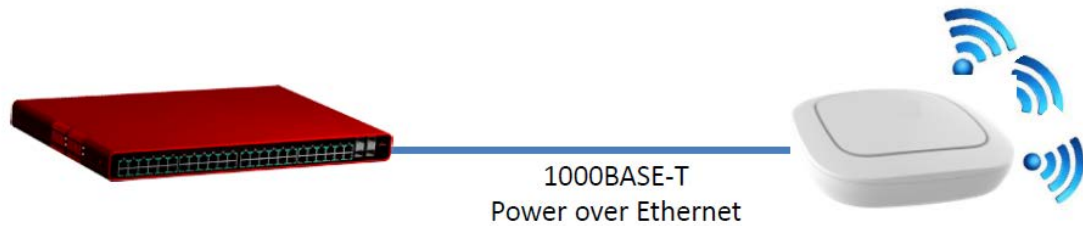
Service Providers deploy MANs and WANs to connect businesses and consumers. Some carriers deploy hyperscale data centers as well.

HYPERSCALE DATA CENTER

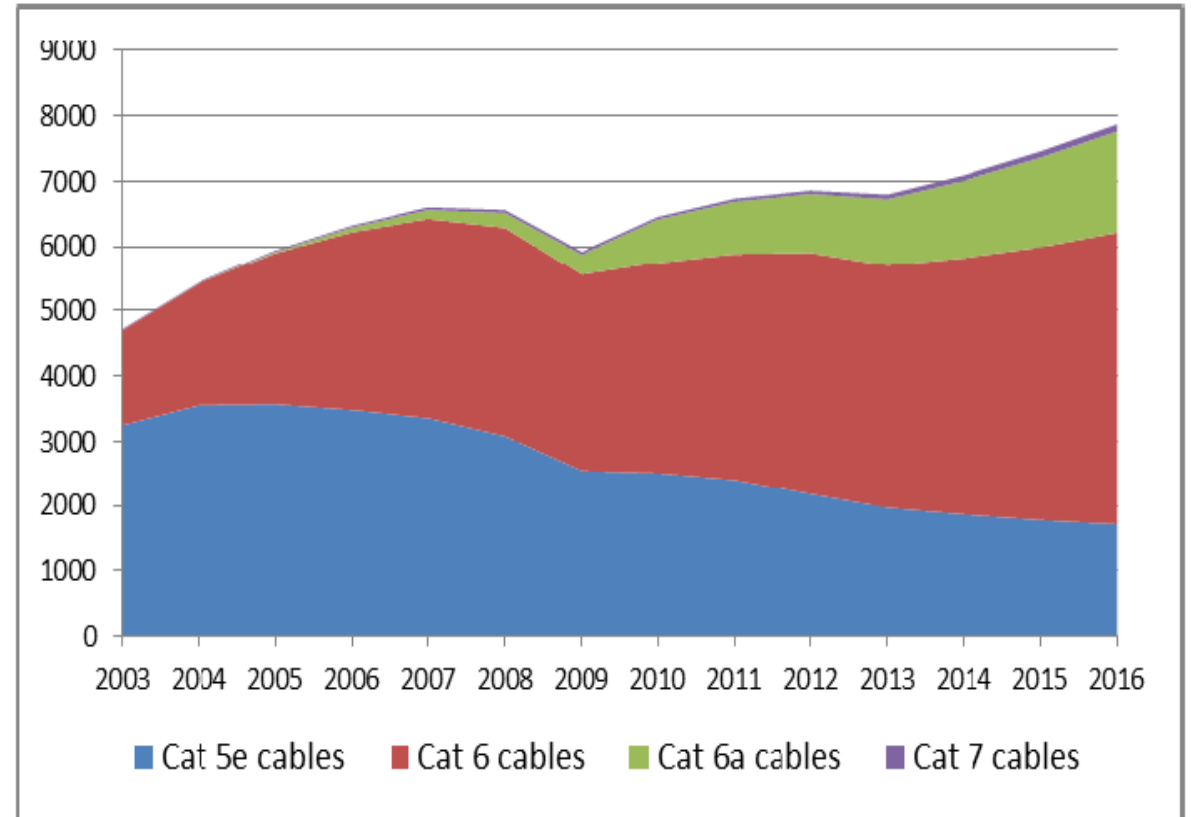
SERVICE PROVIDERS



2.5G / 5G BASE-T & Influence of infrastructure

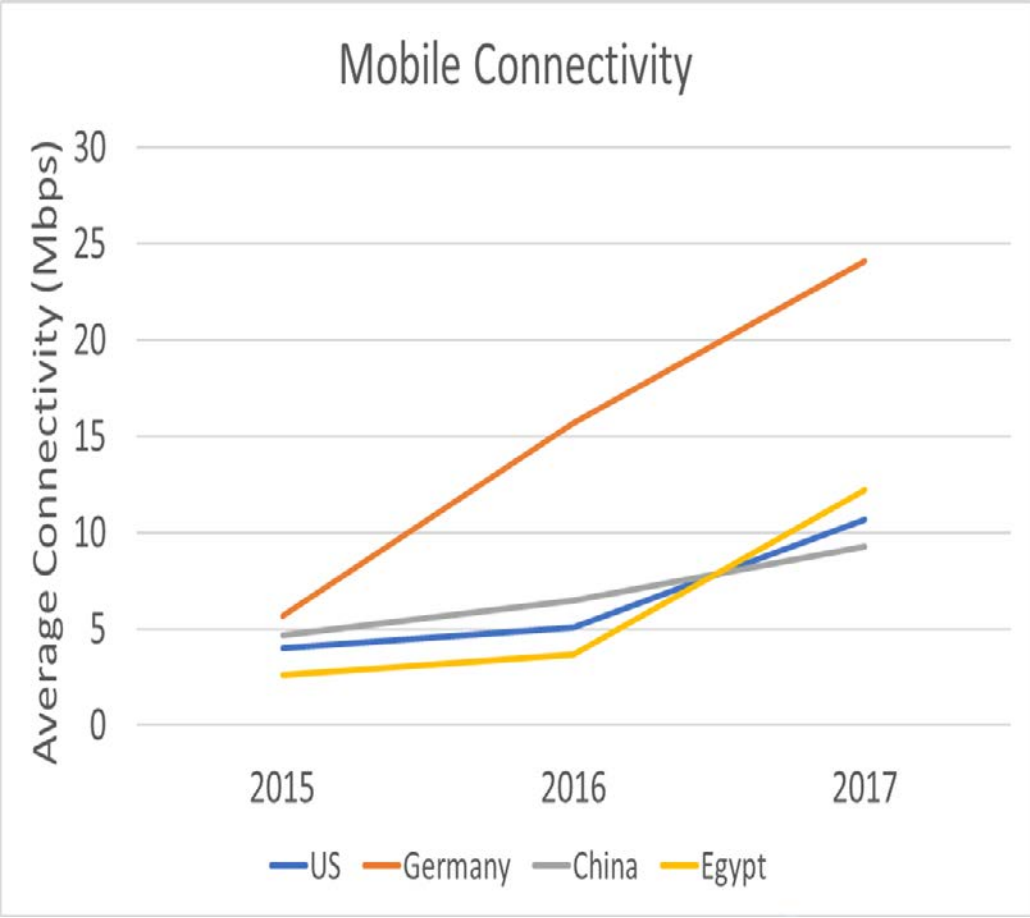
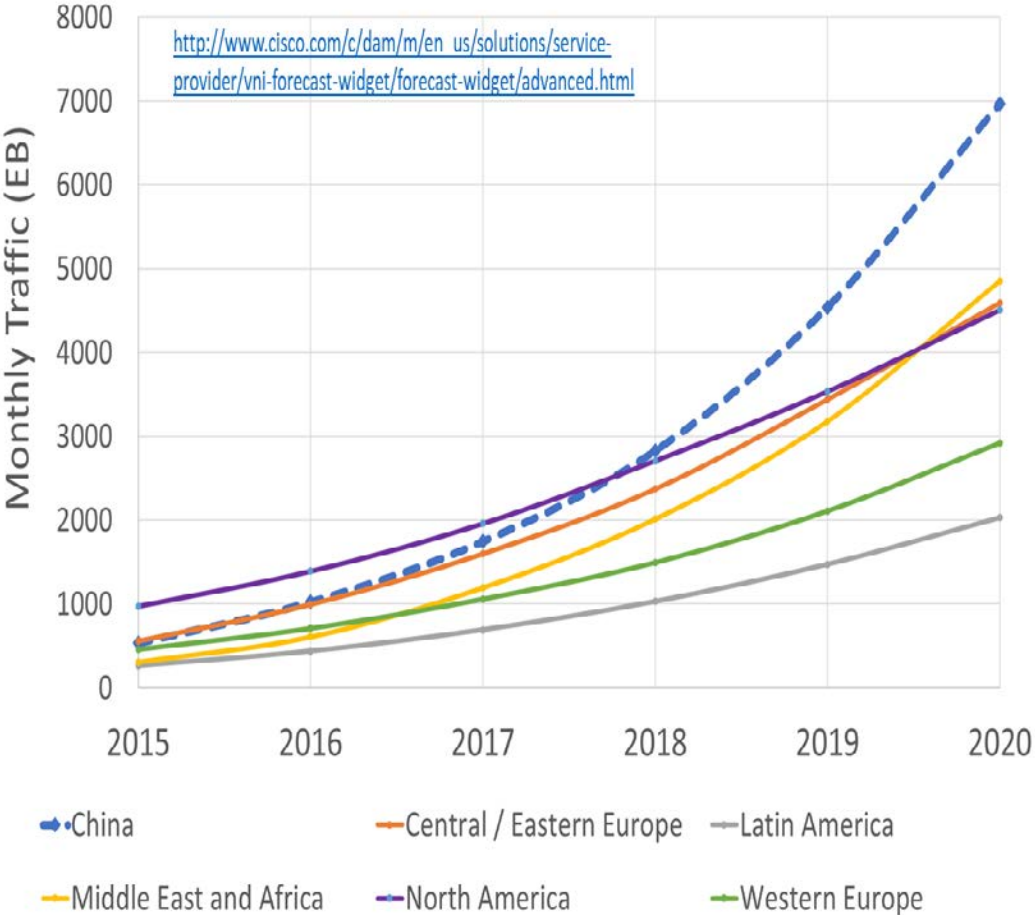


Bandwidth solution for installed based of CAT 5e and CAT 6 helped justify development of 2.5G / 5G BASE-T



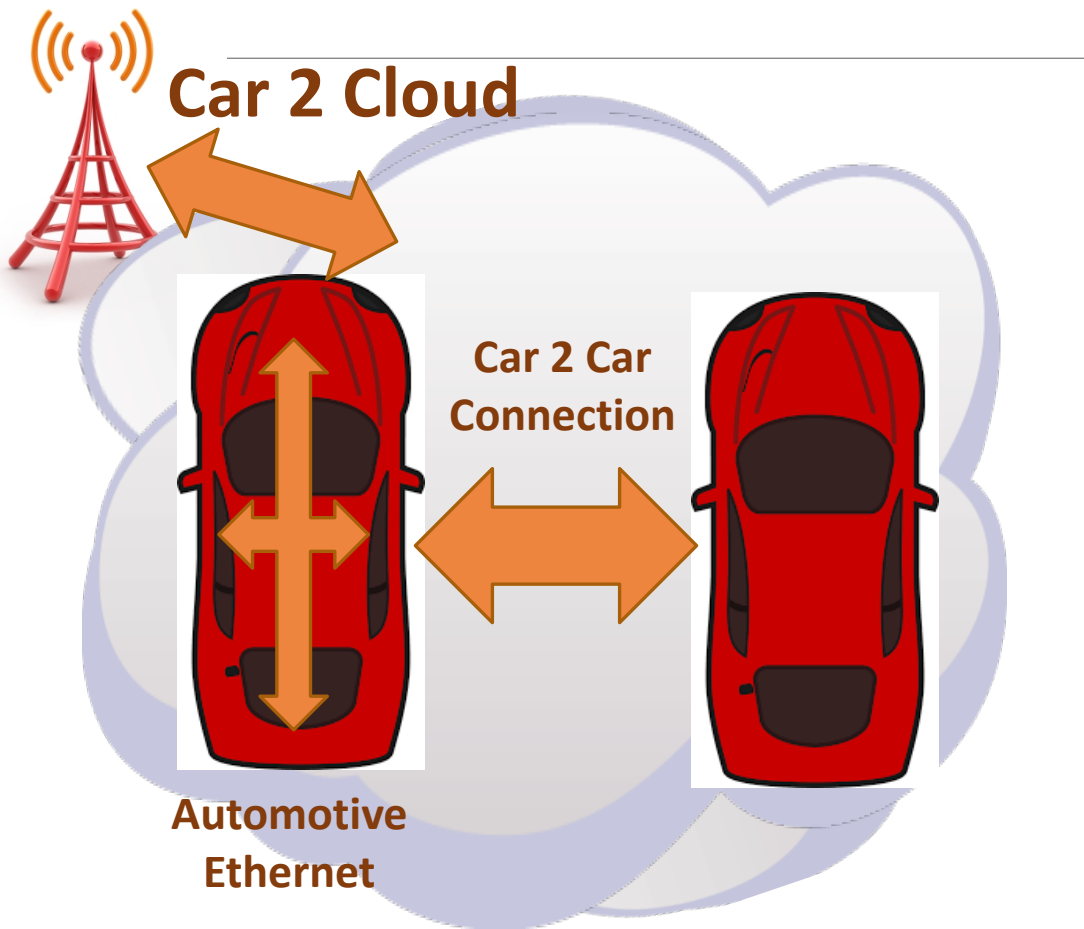
Source: http://www.ieee802.org/3/NGEBASET/public/jan15/jones_ngeabt_04c_0115.pdf

Mobile Networks



Mobile Networks Bandwidth Trends (5/17)

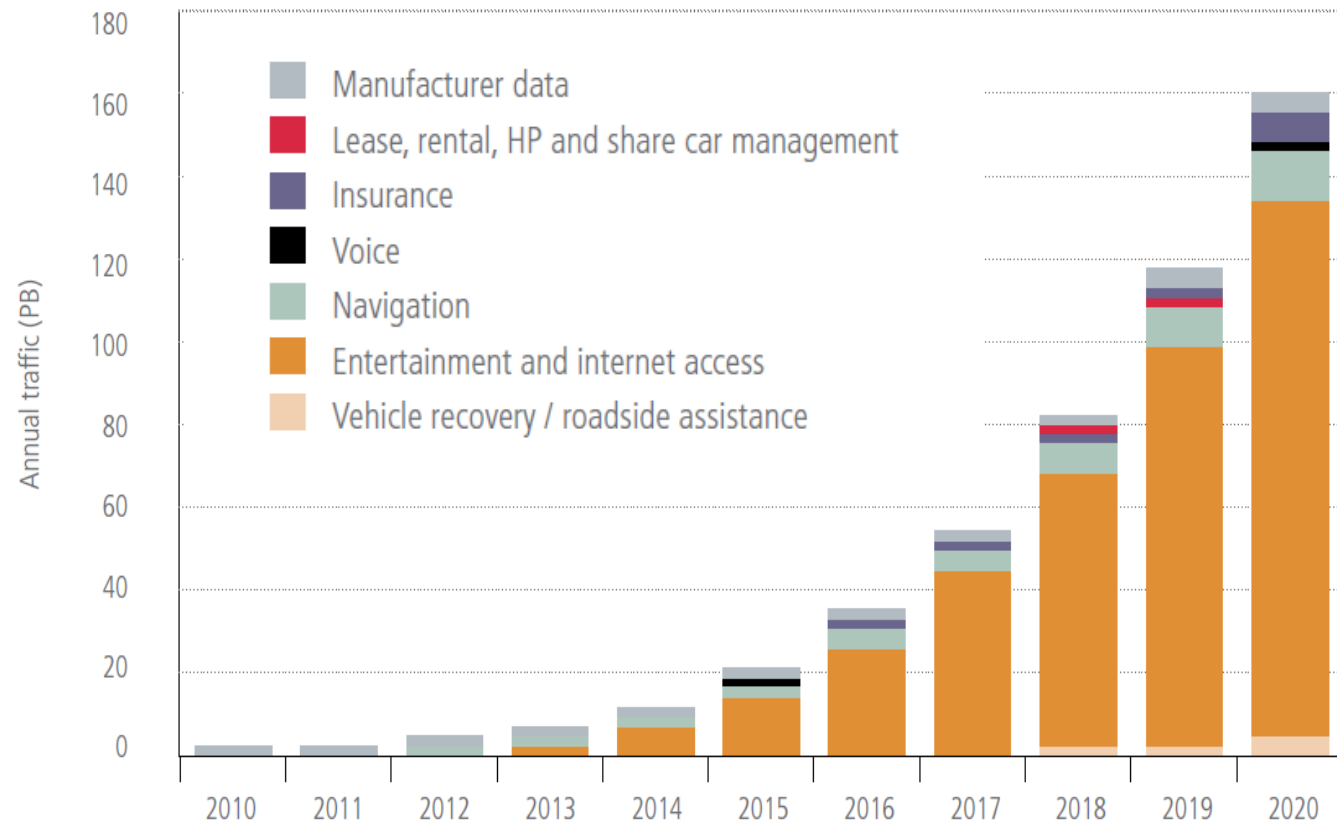
Connected Cars –BW on Mobile Networks?



2019- 117 Million Vehicles to be produced *

* CFI Multi-Gig Automotive Ethernet PHY,

http://www.ieee802.org/3/cfi/1116_1/CFI_01_1116.pdf.

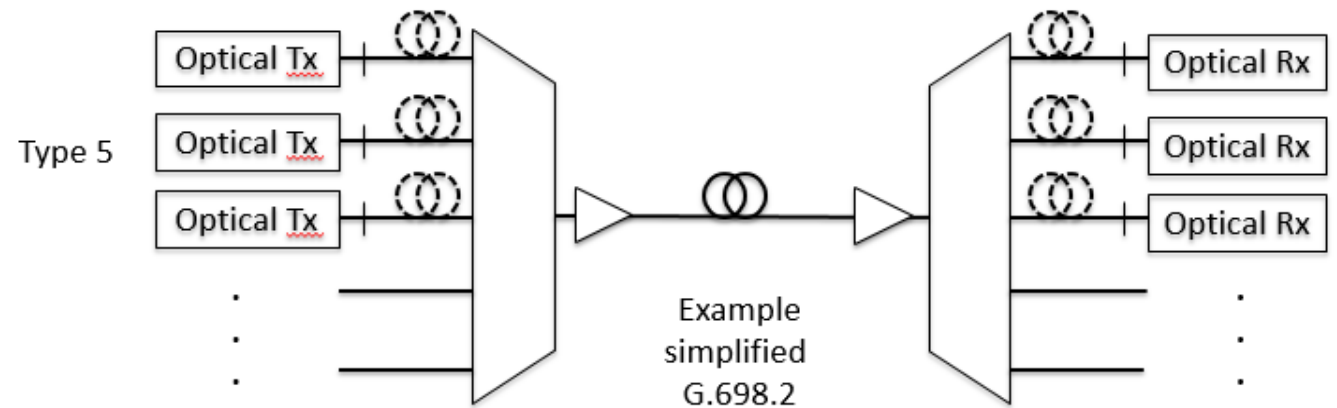


2011 Forecast for Global Wireless Traffic Generated by Embedded Mobility by Application

Source - GSMA, Connecting Cars: The Technology Roadmap, February 2013, https://www.gsma.com/iot/wp-content/uploads/2013/02/GSMA_mAutomotive_TechnologyRoadmap_v2.pdf

WDM Ethernet

- 3 efforts currently underway addressing / considering / discussing WDM technology
 - Beyond 10km Optical PHYs Study Group
 - Super PON Study Group
 - NEA – Potential Applications for WDM
- What applications may use this technology and what are the bandwidth trends
 - MSO
 - DCI
 - Metro?
 - Other?



What does this mean for Ethernet?

Background summary

- Different applications have different bandwidth needs
- Continuing growth of bandwidth growth, but growing diversity between application spaces
- There may be new application spaces
- There may be an overlay of application spaces
- Other factors impacting bandwidth growth
 - Deployed infrastructure
 - Mobile traffic / access rates
 - Emerging space / applications

Ethernet Bandwidth Assessment, Part II

Ethernet Bandwidth Assessment #2

- How good was BWA #1 forecast?
- Key Items to explore
 - Bandwidth Demand
 - Application Spaces
 - Market Timing
- Forecast out to \approx 2025
- Identify application spaces

Types of Data

- Target Application – Ethernet
 - Data Centers (including DCI)
 - Internet Exchanges
 - Carriers
 - Financial Community
 - R & D
 - Content Providers
 - Mobile Networks
 - Access Networks
 - Enterprise Networks
 - Automotive Backhaul
 - Compute / Server
 - Other
- Users
- Access Rates (Mobile / Wi-Fi / Other)
- Applications
- Other

Moving forward

- Focus is on the problem, i.e. bandwidth related, not on the solution
- Duration – 12 months data gathering + 6 months analysis / report creation
- Reach out to organizations with potential data
 - ITU-T Study Group 15
 - CableLabs
 - Euro-IX
 - General Call for Information
- Leverage NEA Ad hoc Face-to-face meetings and teleconferences.