ETHERNET 104: INTRODUCTION TO 2.5G/5G BASE-T ETHERNET

Peter Jones, Cisco
John D'Ambrosia, Dell
Dave Chalupsky, Intel

May 21, 2015

ethernet alliance

Disclaimers

- Opinions expressed during this presentation are the views of the presenters, and should not be considered the views or positions of the Ethernet Alliance.

- Per IEEE-SA Standards Board Bylaws, Dec 2013
  - "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."

THE ETHERNET ALLIANCE

A global community of end users, system vendors, component suppliers and academia

- **Our Mission**
  - To promote industry awareness, acceptance and advancement of technology and products based on, or dependent upon, both existing and emerging IEEE 802 Ethernet standards and their management.
  - To accelerate industry adoption and remove barriers to market entry by providing a cohesive, market responsive, industry voice.
  - Provide resources to establish and demonstrate multi-vendor interoperability.
- **Activities**
  - Promote marketing and education awareness
  - Interoperability testing and demonstration
  - Industry consensus building
  - Technology and standards incubation

Ethernet Alliance Strategy

Expand Ethernet Ecosystem

- Facilitate interop testing
- Expand the market
- Go global

Support Ethernet Development

- Support consensus building
- Host Technology Exploration Forums (TEFs)
- Team with other organizations

Promote Ethernet

Marketing Education

University of Ethernet Webinar Series

Ethernet 101:
Introduction to Ethernet

Physical Layer

- Ethernet 102: The Physical Layer Of Ethernet
- Ethernet 103: Introduction to 25 Gb/s Ethernet
- Ethernet 104: Introduction to 2.5G/5G BASE-T Ethernet
- Ethernet 202: 10GBASE-T Revamped
- Ethernet 203: 40G & 100G Ethernet
- Ethernet 301: 40/100GbE Fiber Cabling and Migration Practices

Protocols

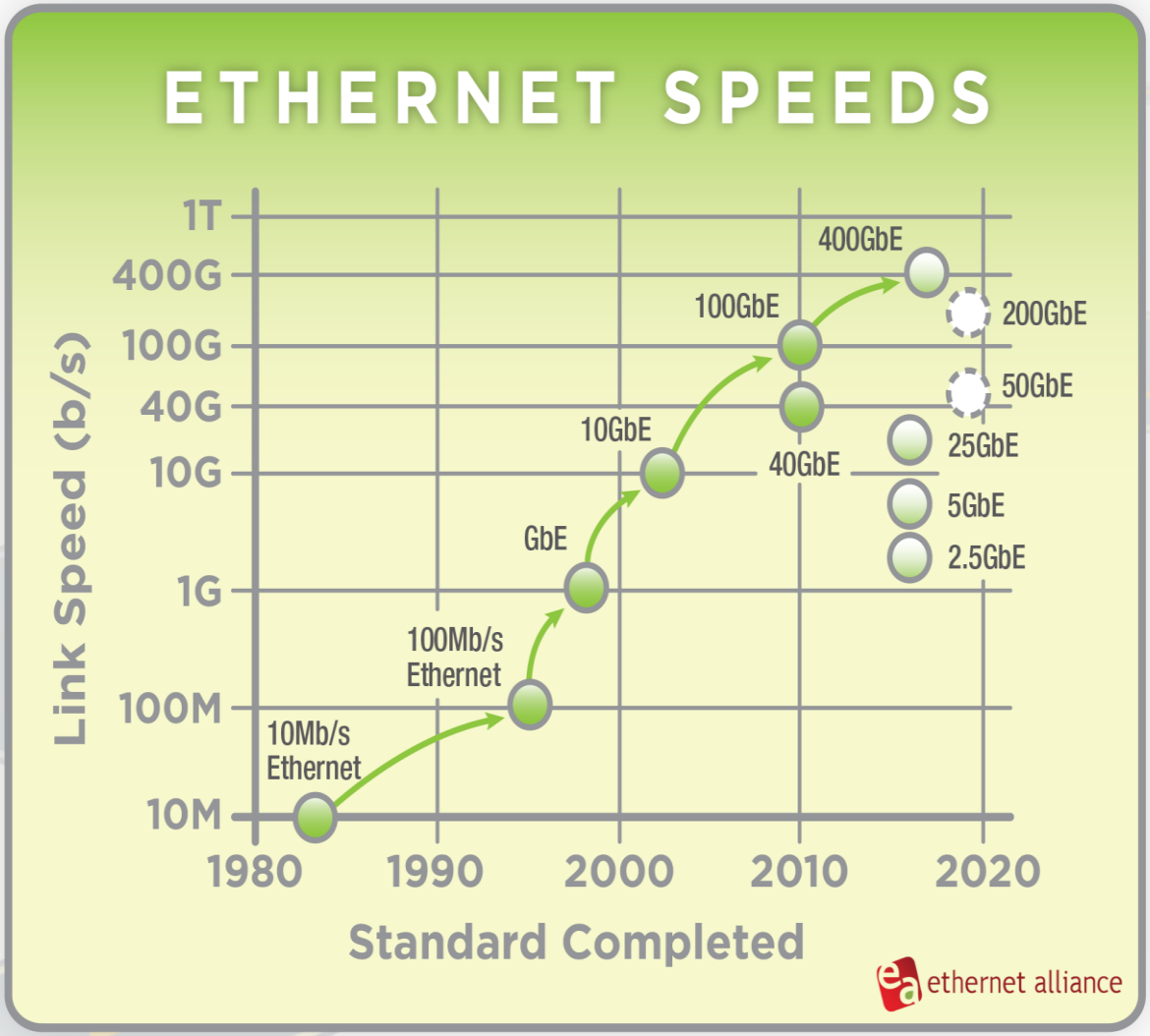
- Ethernet 211: Data Center Convergence
- Ethernet 311: Multi-tenancy

Ethernet Topics

- Ethernet 151: Ethernet Alliance Plugfests

All Webinars archived at: http://www.ethernetalliance.org/library/university-of-ethernet-webinar-series/

2015 Ethernet Rate Roadmap



Today's Speakers

John D'Ambrosia
Chief Ethernet Evangelist
CTO Office, Networking
Dell

Peter Jones
Principal Engineer
Cisco Systems

Dave Chalupsky
Network Hardware Architect, Intel
Chair, IEEE P802.3bz 2.5G/5GBASE-T Task Force (i.e. NGEA BASE-T)

Agenda

- Introduction
- Market Drivers
- Technology Overview
- Standards Activities
- In Closing
- Q&A

The following Ethernet Alliance member companies wish to express support for the IEEE 802.3 Ethernet Working Group to develop a single standard to support multi-vendor interoperability for 2.5G/5G BASE-T Ethernet.

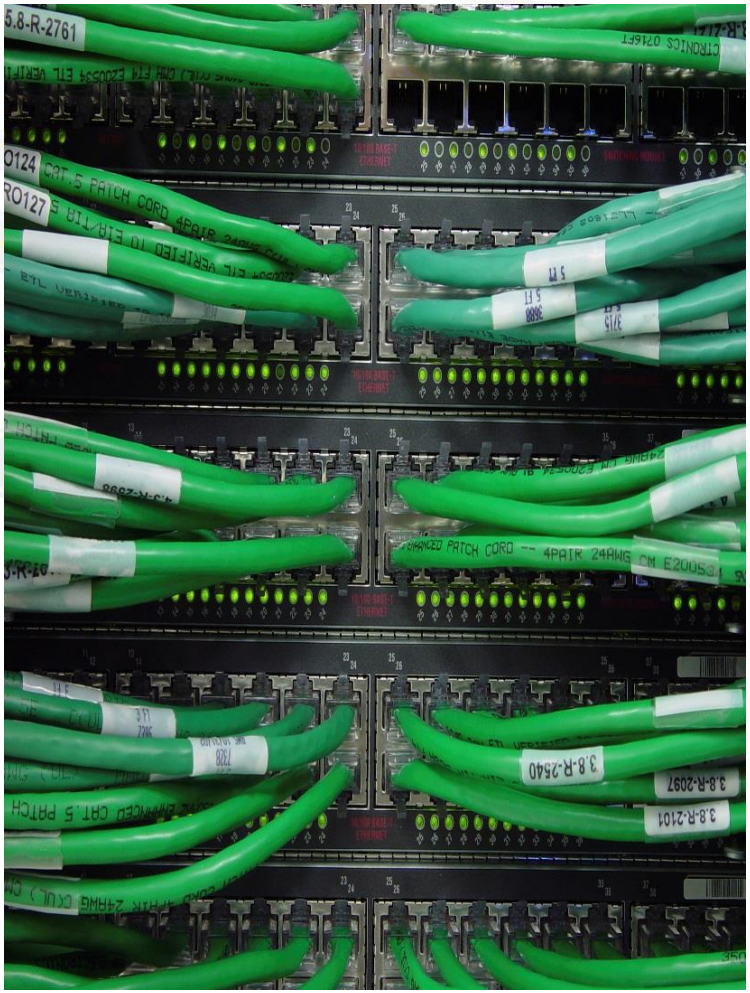
High Speed Design


INTRODUCTION

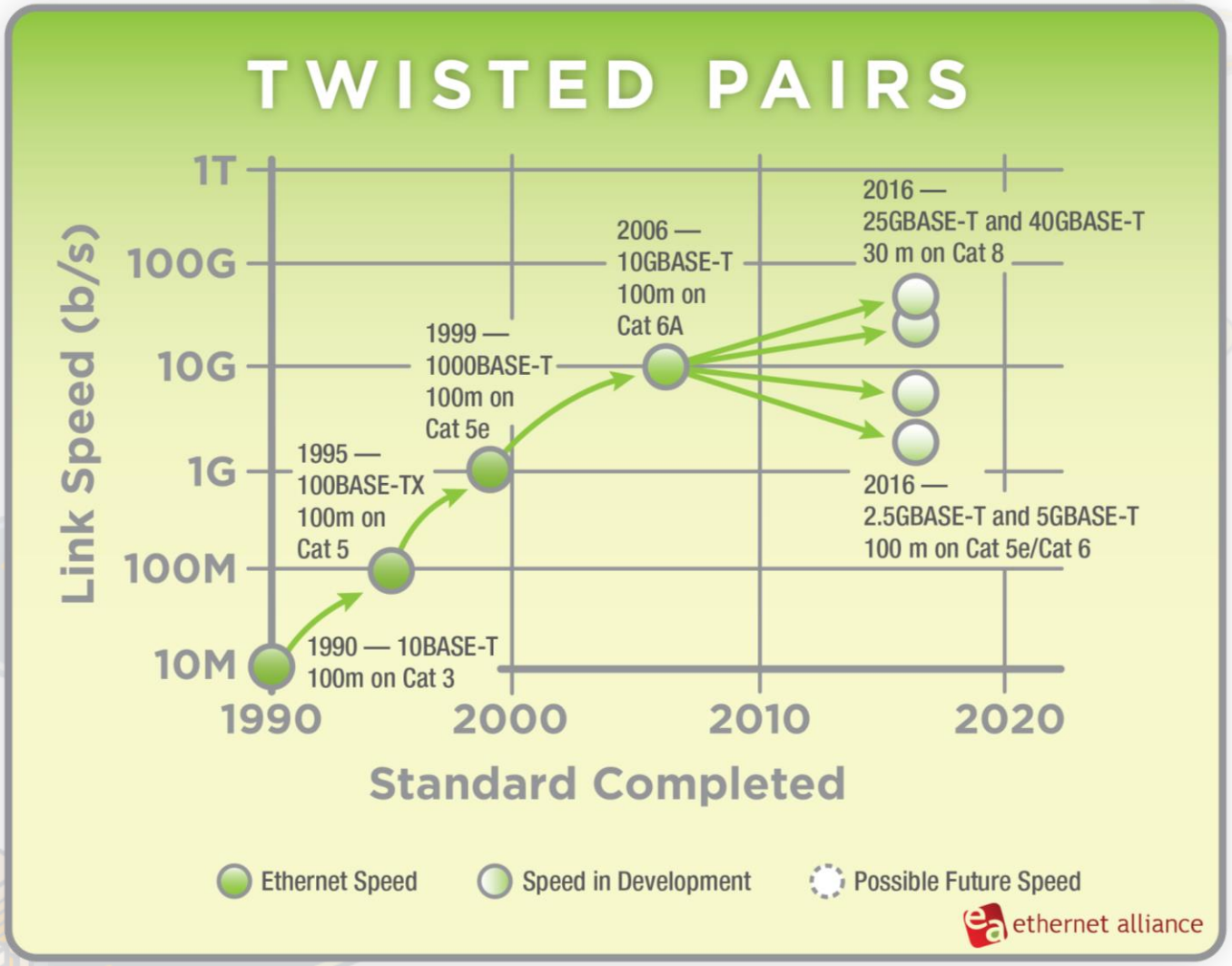
DAVE CHALUPSKY, INTEL

BASE-T Deployment

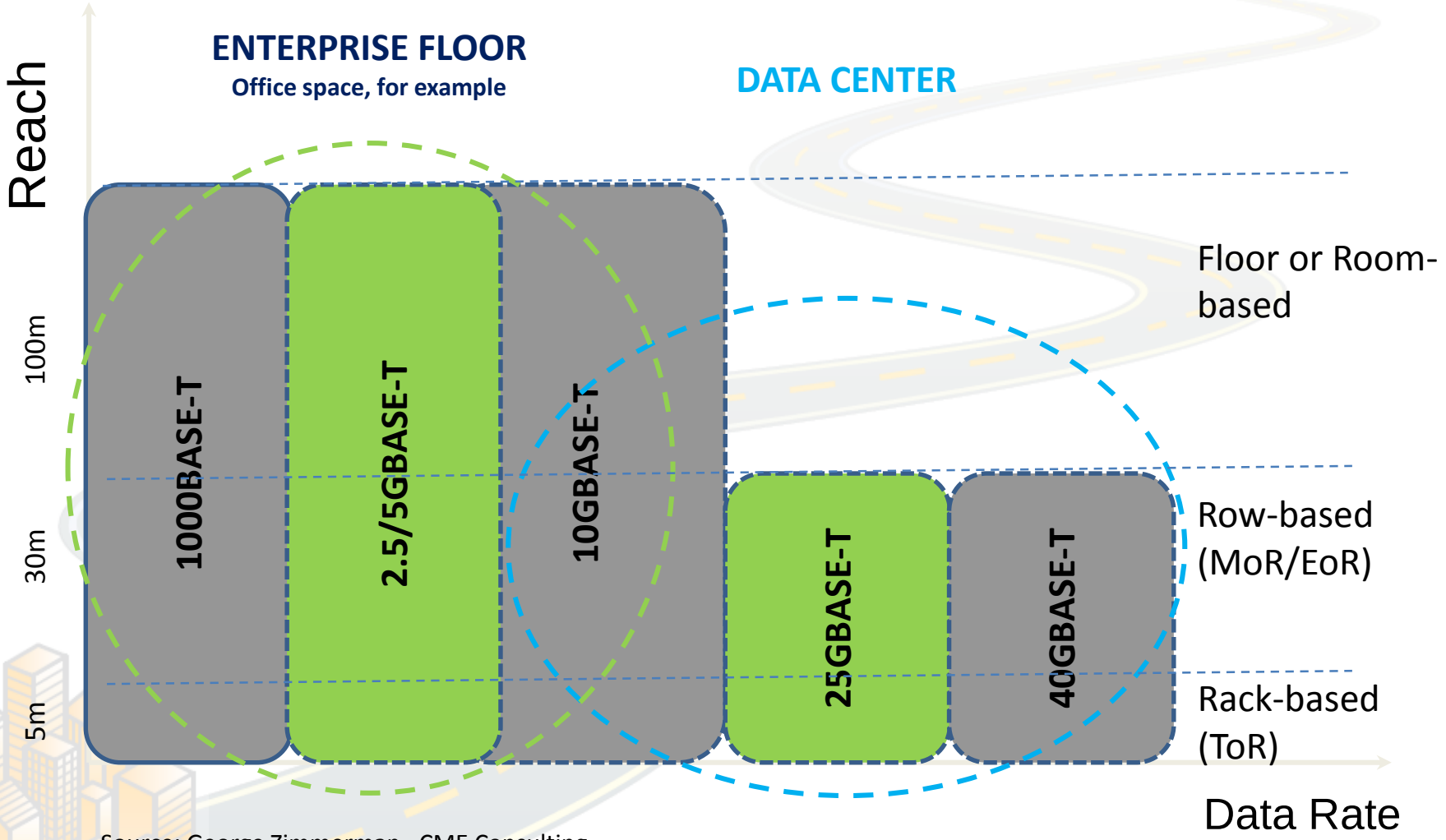
- **Major Applications of BASE-T Endpoints**
  - Desktop computers, servers,
  - IP Phones, Wireless Access Points
  - Consumer electronics
- **>4 Billion 100BASE-T & 1000BASE-T switch ports shipped in last 20 years.**
  - Similar # for end points
  - BASE-T port total is approaching 1B/year
- **BASE-T success attributes**
  - Ease Of use and backward compatibility
  - Structured cabling
  - Incremental speed upgrades
  - Multi-vendor interoperability
  - Supports Power Over Ethernet
    - Single-cable delivery of power and data to end devices
  - Optimal cost / performance



The 2015 BASE-T Roadmap



The Application Spaces of BASE-T



Source: George Zimmerman, CME Consulting

Why 2.5G / 5G BASE-T?

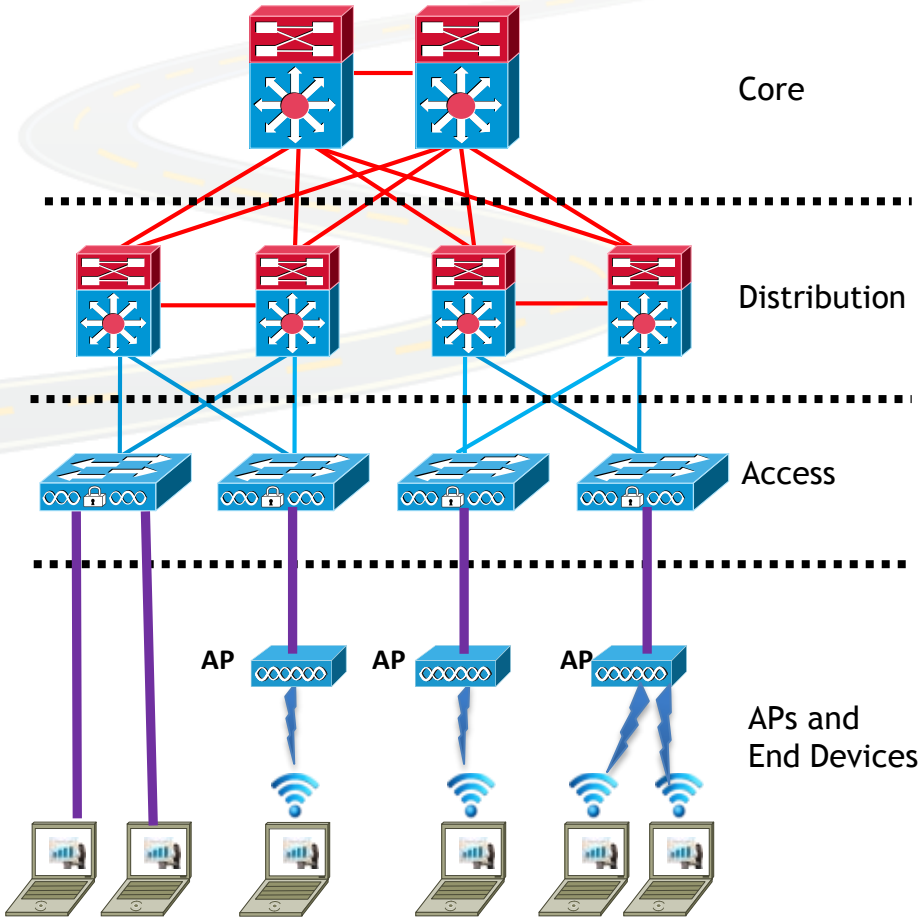
- From 2003 to 2014 *~70 billion meters* of Cat 5e and Cat 6 cabling have been sold….
  - ~90% of installed base
- Existing specifications support 1Gb/s over this cable, but faster data rates are possible.
- Customers demanding more value from this infrastructure.

MARKET DRIVERS

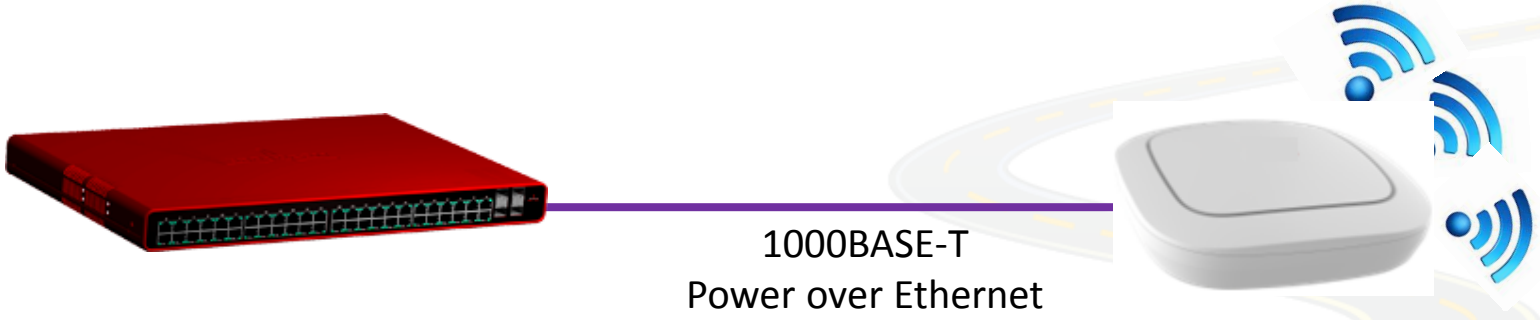
PETER JONES, CISCO

Enterprise Network Structure Today

- Typically built using this three tier design
- It's proven stable and durable
- Copper BASE-T links between Access switches and APs



802.3 Ethernet and 802.11 Wireless LAN



Access Switch

Mostly 1000BASE-T

PoE PSE (15W, 30W, *802.3bt/4PPoE)*

Cabling

Cat 5e/6/6A up to 100M

New installs using Cat 6A for 10+yr life

Access Point

Connects 802.11 to 802.3

PoE powered

Footprint sensitive (e.g. power, heat, etc.)

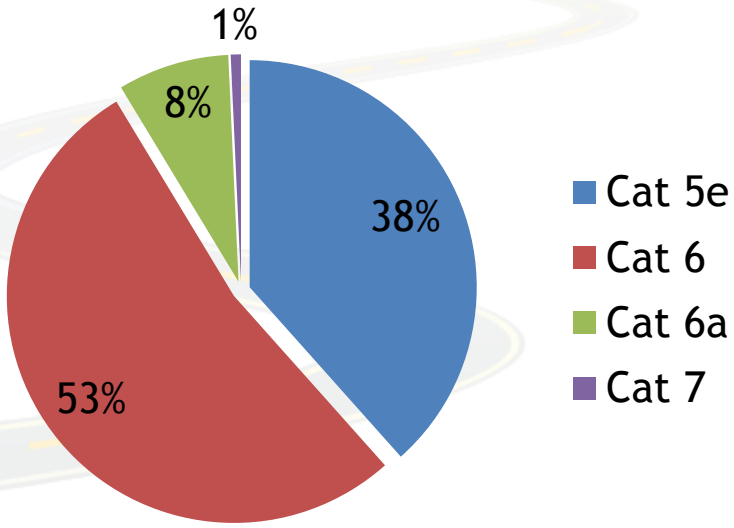
802.11ac Wave 2 drives wired traffic > 1 Gb/s.

LinkAgg (Nx1000BASE-T) or 10GBASE-T only options today

Enterprise Access Links Today

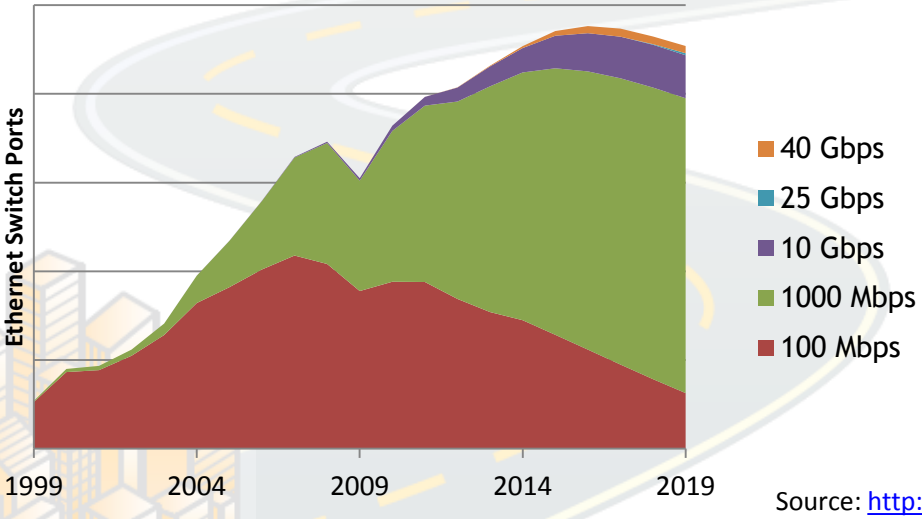
World wide BASE-T cabling is dominated by Cat 5e & Cat 6.

Based on cable sales data, average drop lengths and replacement rates
Source: BSRIA December 14



Ethernet Switch Ports by Speed

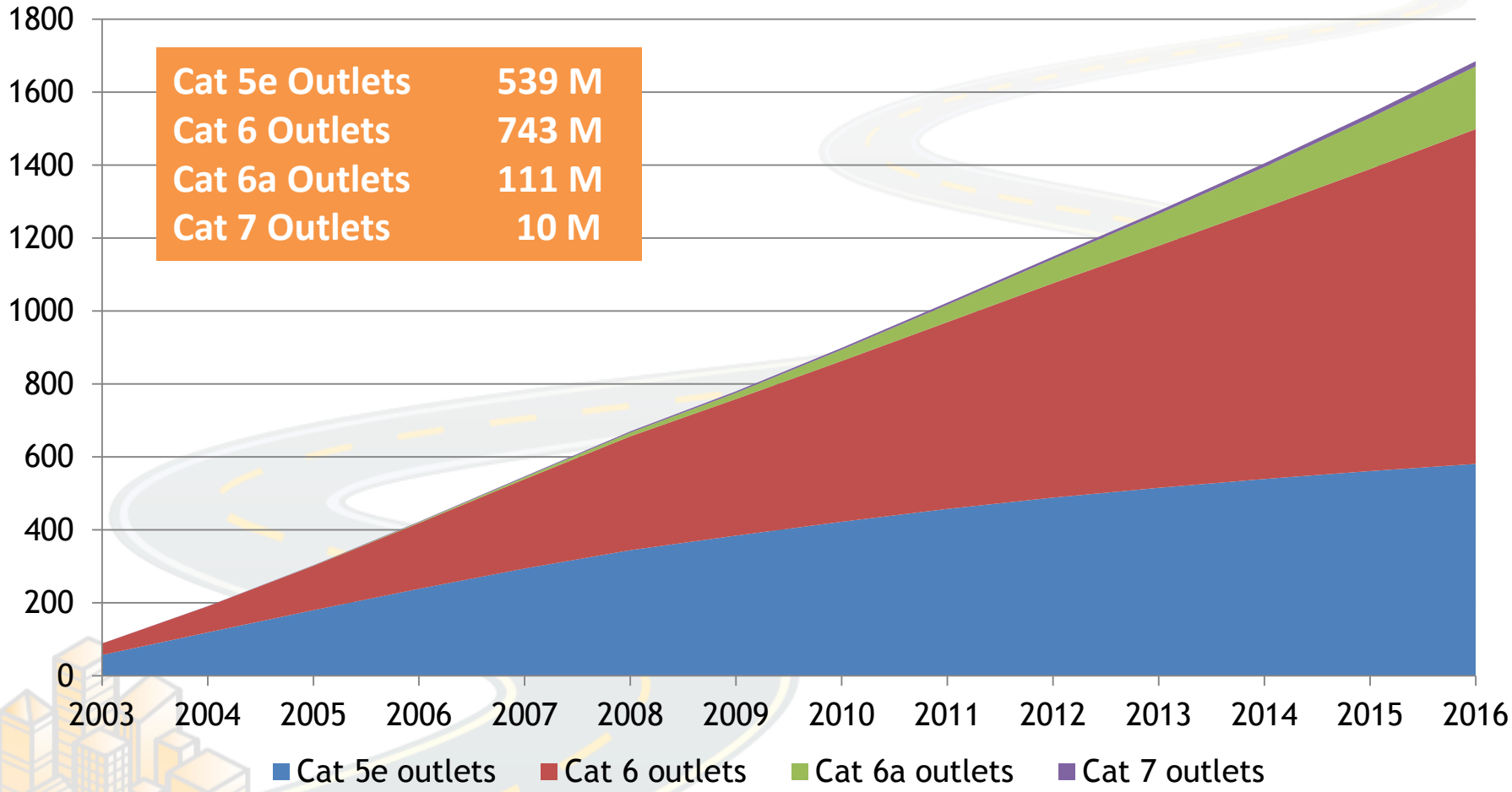
Dell'Oro Group Ethernet Switch 5-year Forecast Jan 2015



Enterprise Access port types are dominated by 1000BASE-T

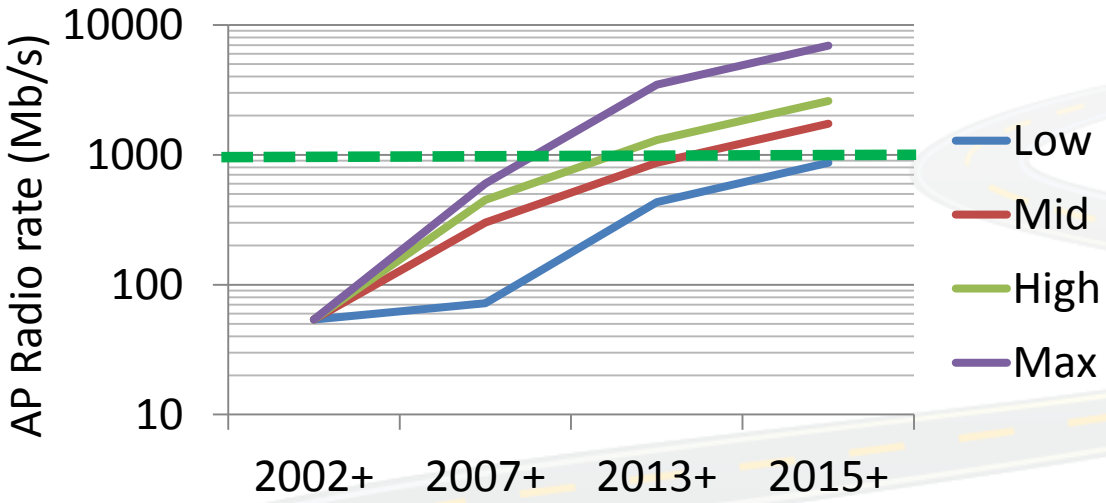
Source: http://www.ieee802.org/3/NGEBASET/public/jan15/jones_ngeabt_04c_0115.pdf

Installed Base Over Time



Source: BSRIA December 14

Enterprise AP Radio Bandwidth



Period	802.11 Standard	Max (Mb/s)
1997-1998	11	2
1999-2001	11b	11
2002-2006	11a/g	54
2007-2011	11n	600
2013-2015	11ac Wave1	3470
2015-2017	11ac Wave2	6930

Graph data: Cisco 802.11ac White Paper (link)

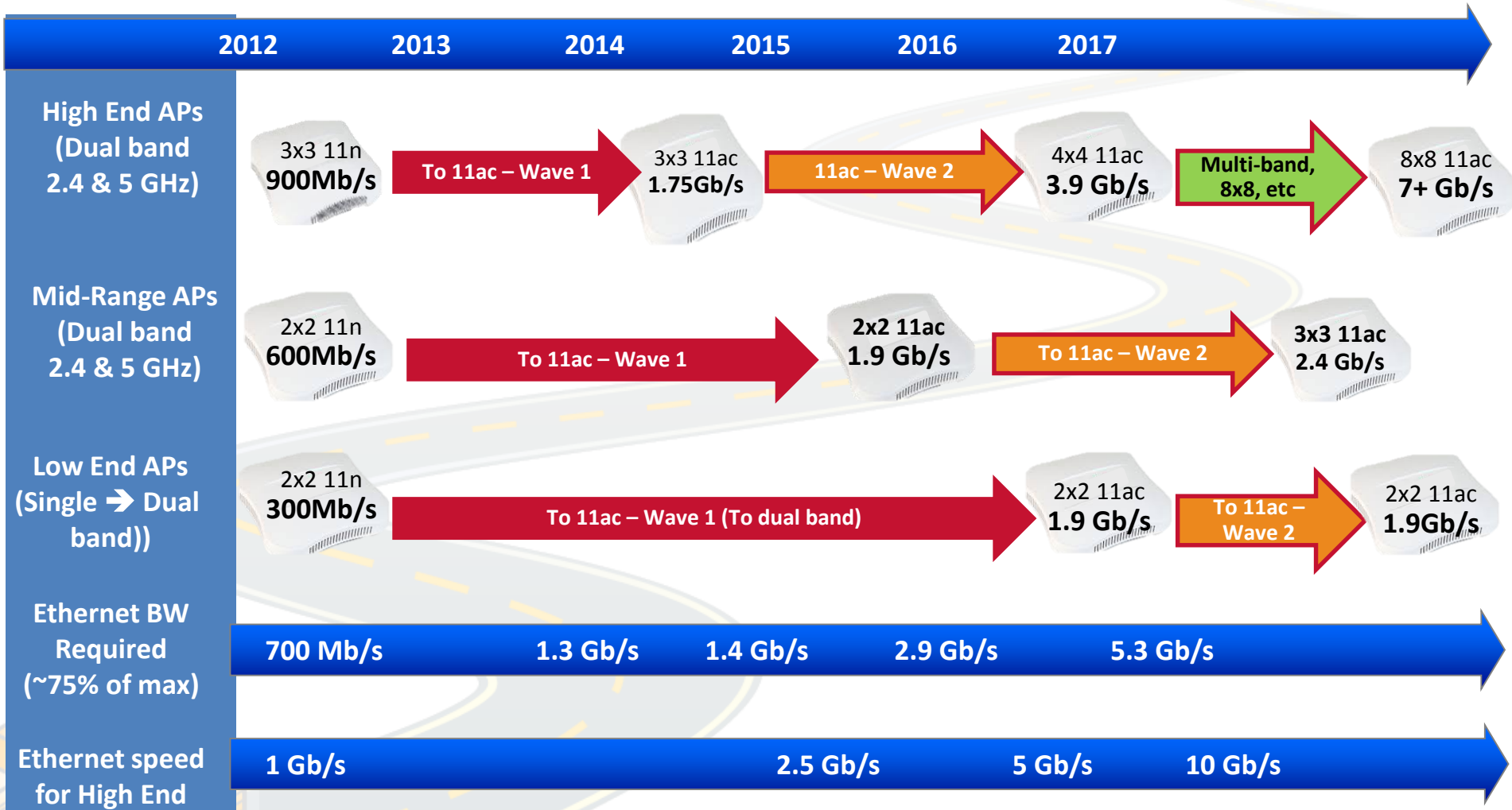
802.11 is clearly outgrowing 1000BASE-T

APs upgraded faster than switches, switches faster than cabling

802.11ax (High Efficiency WLAN) is coming, targets 4x throughput per station.

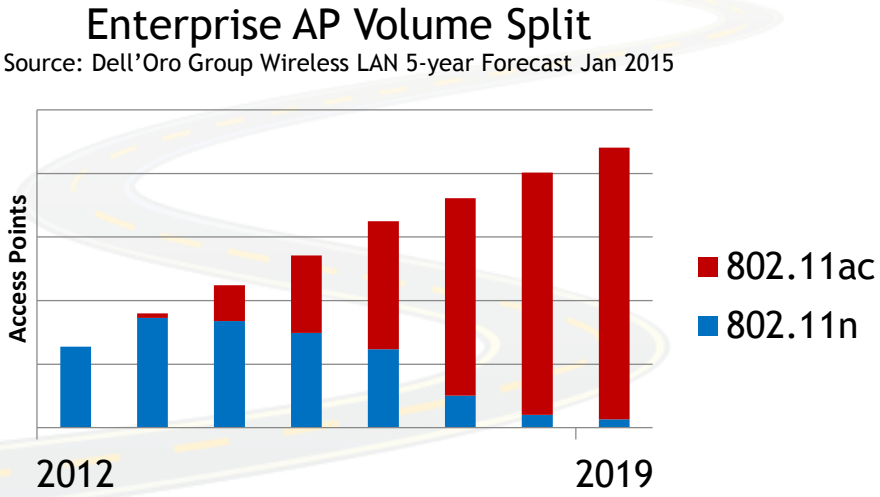
AP to switch bandwidth should be ~75% of radio bandwidth (to avoid Ethernet link as system bottleneck)

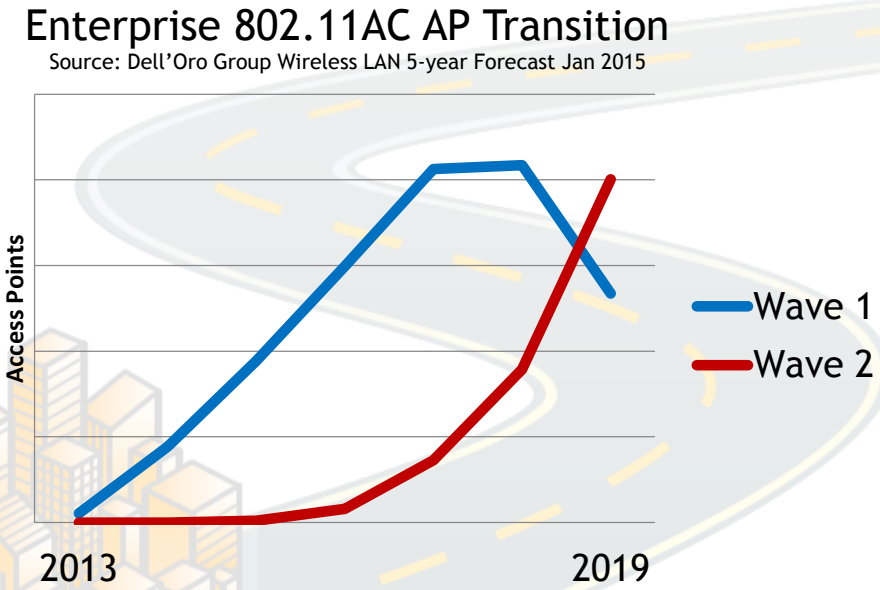
802.11 Enterprise AP Segments and Trends



What's happening with 802.11?

Rapid transition from 11n to 11ac





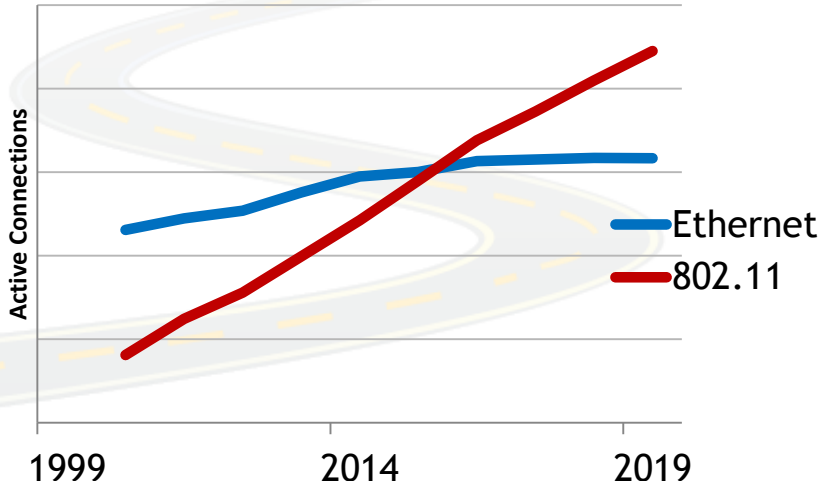
Wave 2 starts ramping in 2016

What does this mean for Ethernet?

In 2015 more users connecting via WiFi than Ethernet

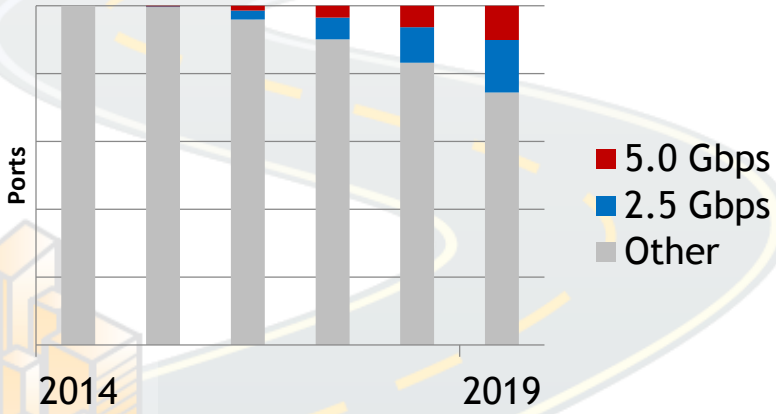
Enterprise Edge: Ethernet and 802.11 connections

Source: Dell'Oro Group Enterprise Edge 5-year Forecast Jan 2015



Enterprise Edge: 2.5G/5G Ethernet transition

Source: Dell'Oro Group Enterprise Edge 5-year Forecast Jan 2015

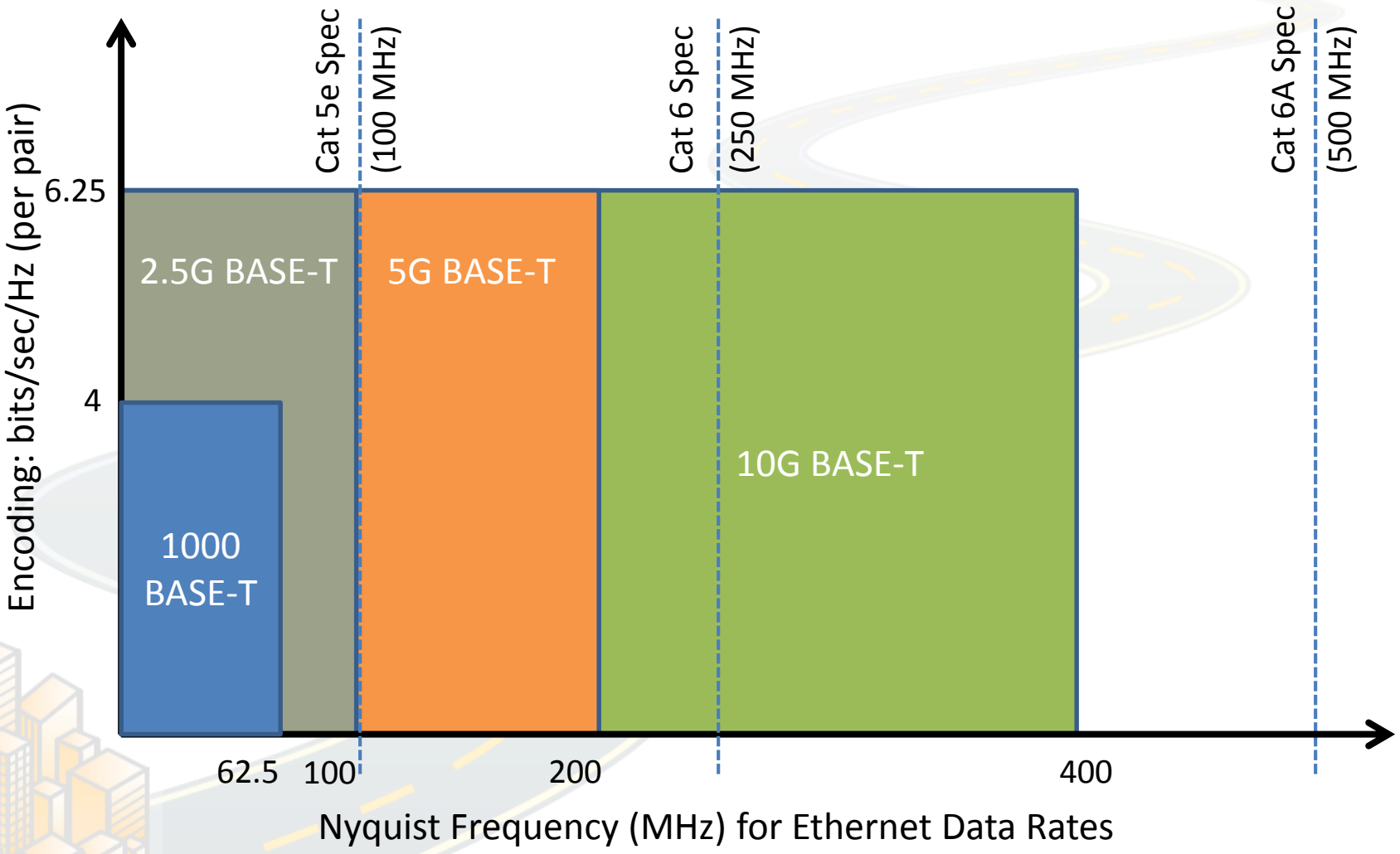


2.5G/5G BASE-T Ethernet is expected to be rapidly adopted

TECHNOLOGY OVERVIEW

DAVE CHALUPSKY, INTEL

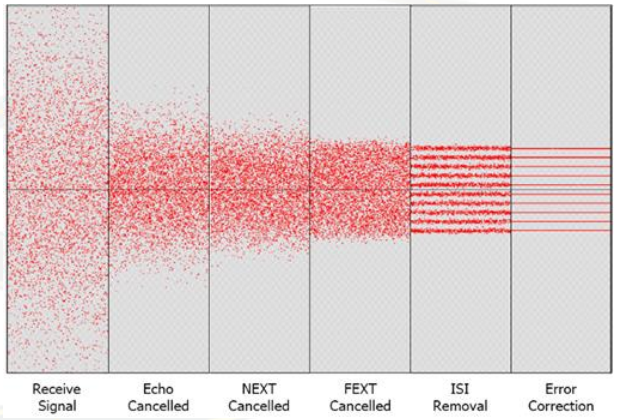
Between 1G and 10G, There's Lots of Room for BASE-T PHYs



Leveraging 10GBASE-T Investment

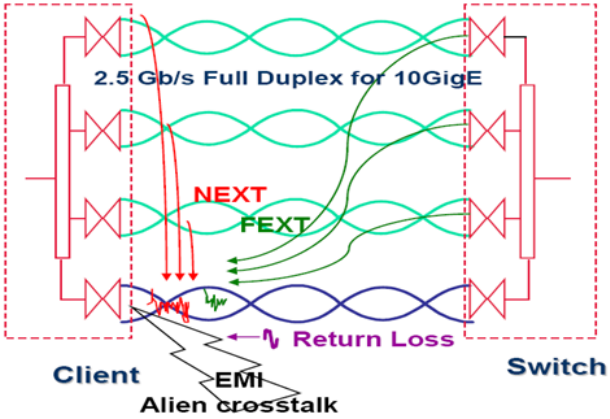
1000BASE-T and 10GBASE-T already share many common attributes

- RJ45 connector
- 4-pair Category cabling
- Full duplex communication
  - Transmit & receive on same wires simultaneously
- Support for PoE, EEE, Autonegotiation…



10GBASE-T technologies could be used to squeeze more usable bandwidth out of installed cabling

Advanced coding and signal processing allow 2.5Gb/s and 5Gb/s operation of Cat5e cabling developed for 1Gb/s



STANDARDS ACTIVITIES

DAVE CHALUPSKY, INTEL

IEEE P802.3bz 2.5G/5GBASE-T Task Force

- November'14: IEEE 802.3 Call For Interest led to formation of Next Generation Enterprise Access BASE-T PHY a study group
- March'15: P802.3bz 2.5G/5GBASE-T Task Force formed
  - URL: http://www.ieee802.org/3/bz/index.html
- Approved objectives includes specifying 2.5 Gb/s and 5 Gb/s operation over Category 5e and 6 cabling.
  - Hot Topics: deployed cabling topologies and bundling; noise in the target environment, etc.

IN CLOSING

JOHN D'AMBROSIA, DELL

In Closing

BASE-T is the foundational technology for Ethernet Enterprise Access.

Speeds higher than 1000BASE-T are required to support future 802.11 wireless deployments

Market diversity has introduced the need for new speeds between Gigabit and 10 Gigabit.

This may be a “once in a decade” transition of the basic network access speed.

Q&A

PETER JONES, CISCO
JOHN D'AMBROSIA, DELL
DAVE CHALUPSKY, INTEL

ethernet alliance

Thank You!

- If you have any questions or comments, please email admin@ethernetalliance.org
- Ethernet Alliance 2015 Roadmap - http://www.ethernetalliance.org/roadmap/
- Ethernet Alliance: visit www.ethernetalliance.org;
  - Follow @EthernetAllianc on Twitter
  - Join the Ethernet Alliance LinkedIn group
  - Visit the Ethernet Alliance Facebook page