IEEE 802.3
Call For Interest on
Next Generation Enterprise BASE-T Access

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CFI Objectives

- To gauge the interest in starting a study group to **investigate a "**Next Generation Enterprise BASE-T Access**" project.**

- This Meeting will **NOT**:
  - Fully explore the problem
  - Choose any one solution
  - Debate strengths and weaknesses of solutions
  - Create a PAR or CSD (including 5C)
  - Create a standard or specification

- Anyone in the room may speak / vote
- **RESPECT**… **give** it, **get** it.

Agenda

❑ **Overview**	Yong Kim	Broadcom
❑ **Presentations**		
▪ **Market Drivers**	Peter Jones	Cisco
▪ **Technical Feasibility**	George Zimmerman	CME Consulting
▪ **Why Now?**	David Chalupsky	Intel
❑ **Q&A**		
+ **Expert Panel**	Amrik Bains	Cisco
	Ron Cates	Marvell
	Jacky Chang	HP Networking
	Kamal Dalmia	Aquantia
	Tom Souvignier	Broadcom
❑ **Straw Polls**		

Overview: Next Generation Enterprise BASE-T Access

- Provide cost optimized connections in Enterprise Ethernet Access networks at rates between 1 Gb/s and 10 Gb/s using structured UTP wiring.
- Provide new MAC rate(s) and PHY(s) that:
  - Leverage 10GBASE-T PHY technology.
  - Optimize data rates on installed structured wiring. i.e. 100 meters over Cat 5e (or better).
- Provide a speed upgrade for Enterprise Access using the installed base of structured cabling.
  - 1000BASE-T has been massively successful.
  - End devices are increasing in number and capacity faster than cabling is being upgraded.
  - Many client devices (e.g. laptops, smartphones, tablets, etc.) have been shifting to 802.11 for network access.
  - The needs of 802.11ac Wave 2 Access Points (APs, next slide) are a key driver.

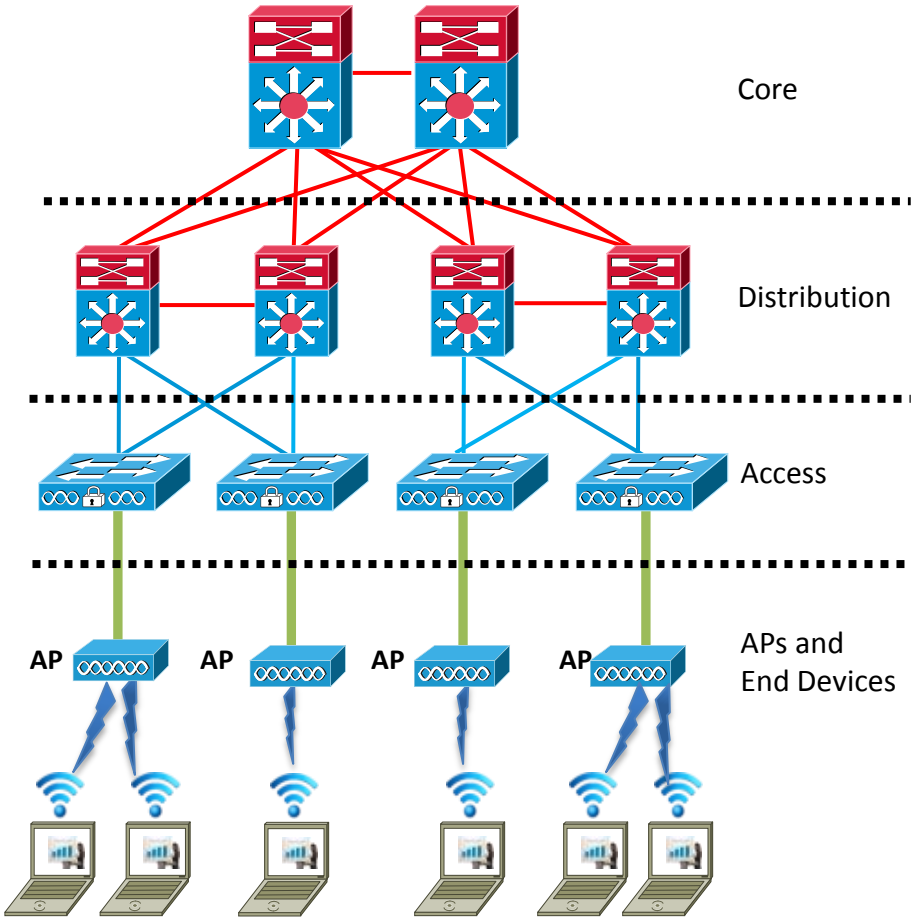
Overview: Next Generation Enterprise BASE-T Access (cont.)

- Support needs of 802.11ac (aka Gigabit Wi-Fi) APs
  - IEEE 802.11ac-2013 was approved December 13. Many products shipped pre-standard. Wi-Fi Alliance launched the "Wi-Fi CERTIFIED ac" program in June 13.
  - The first round of devices (aka "Wave 1") with 80MHz channels/single-user MIMO (SU-MIMO) is deploying today in enterprise markets.
  - The 2nd round (aka "Wave 2") is in the pipe. It adds features like four spatial streams, 160 MHz channels and multi-user MIMO (MU-MIMO)
  - The Ethernet bandwidth needs of 802.11ac Wave 2 APs approach 2Gb/s within 12 months, and 4Gb/s in 24-36 months
  - **The rule of thumb is that the AP Ethernet speed should be at least 75% of maximum radio speed to avoid the Ethernet link being the system bottleneck.**

MARKET DRIVERS

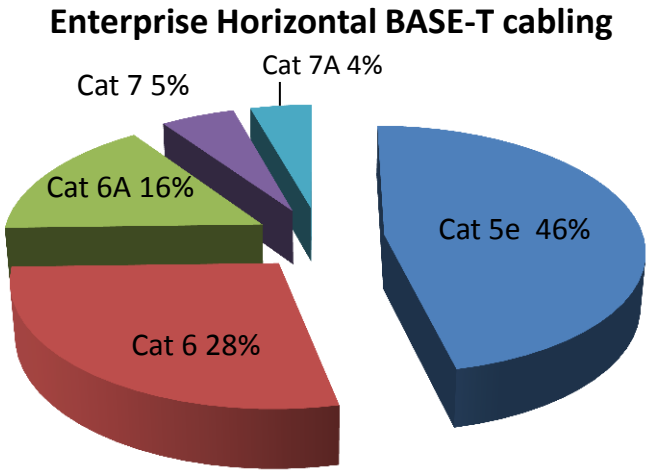
Enterprise Network Structure today

- Enterprise campus networks are typically built using a three tier design shown at the right
- This design (very different to DC spine/leaf) has proven stable and durable over a number of technology evolutions.
- The **links** between the Enterprise Access switches and the APs are the key focus of this presentation

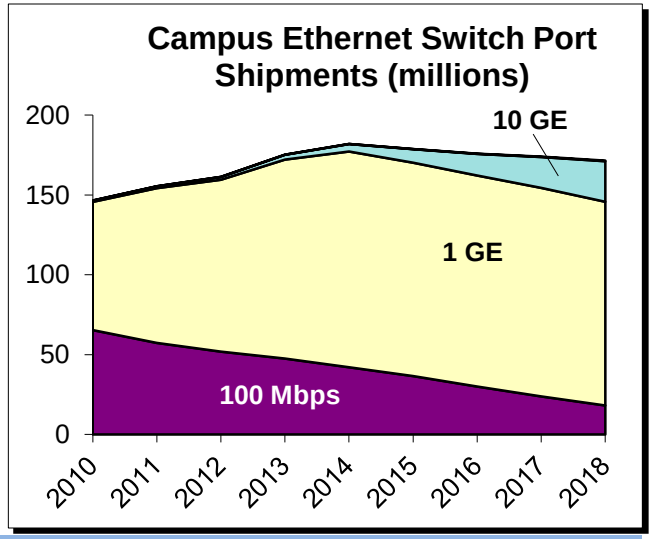


Enterprise Access links today

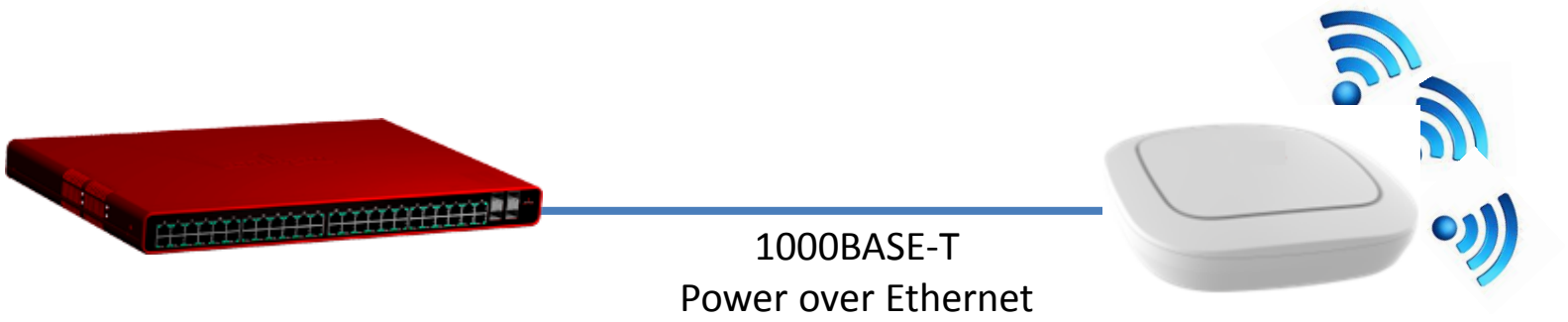
- Enterprise access links (aka horizontal links) are dominated by 1000BASE-T over Cat 5e/Cat 6
  - Source: Cable Install&Maint Feb14
  - Survey participants were asked to identify all major cable types in their Horizontal Links
  - The chart shows the proportions of cable types for BASE-T links
- Enterprise Access port types are dominated by 1000BASE-T
  - Source Dell'Oro July 14



Source: Cabling Installation & Maintenance Magazine, Cabling Market Outlook Consumption Trends and Analysis Enterprise and Data Center Organizations, February 2014



802.3 Ethernet and 802.11 Wireless LAN



Ethernet Access Switch

- Dominated by 1000BASE-T ports
- Power over Ethernet Power Sourcing Equipment (PoE PSE) supporting 15W, 30W, *4PPoE*

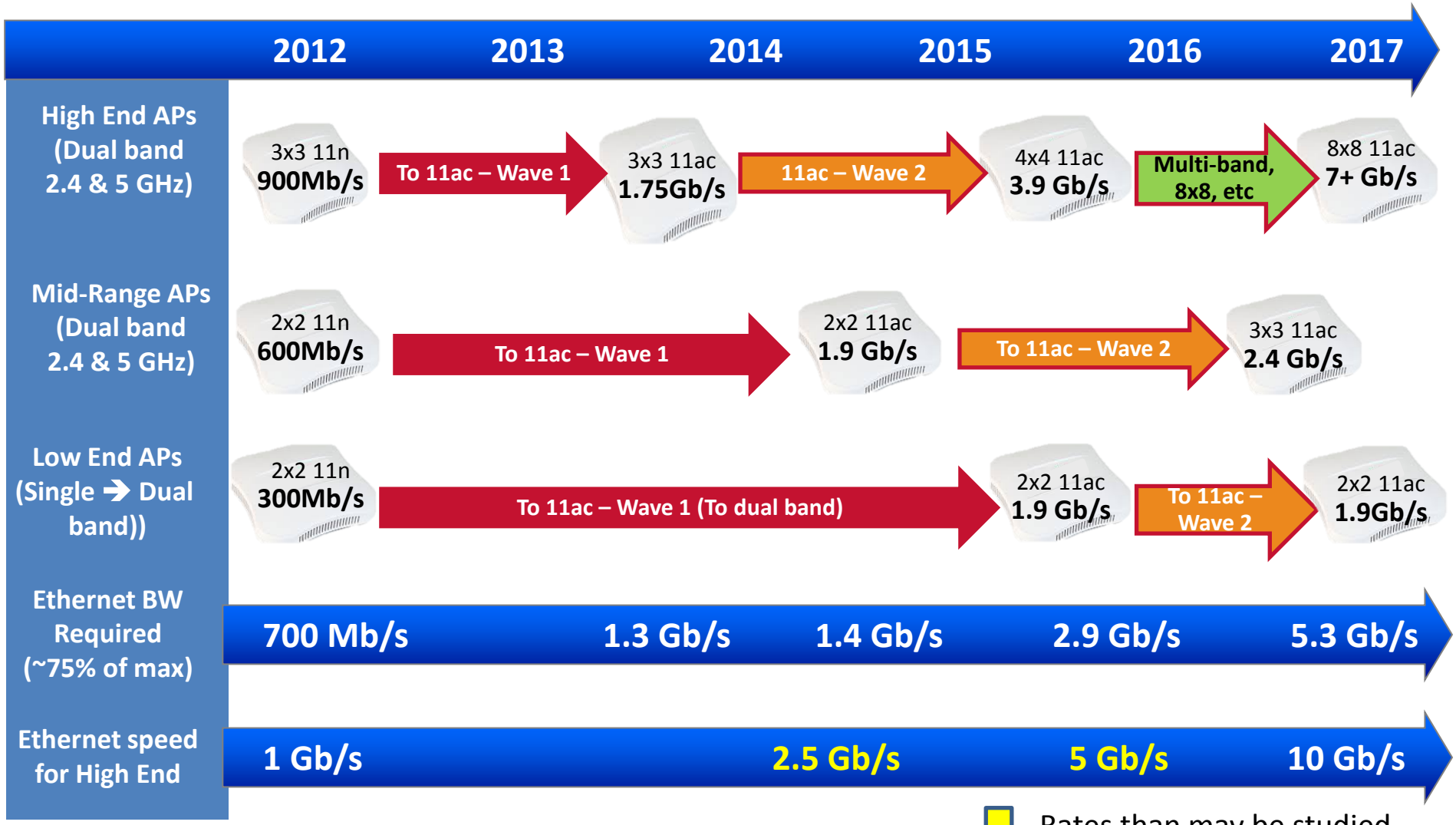
Cabling

- 100m Cat 5e/6/6A installed base.
- New installs moving to Cat 6A for 10+yr life.

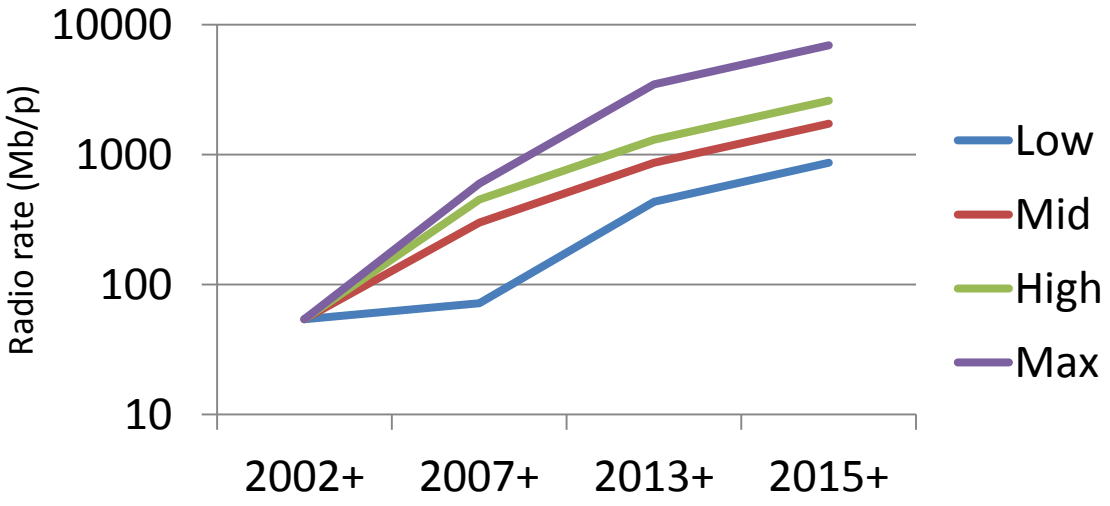
Wireless Access Point

- Mainly connects 802.11 to 802.3
- Normally PoE powered
- Footprint sensitive (e.g. power, cost, heat, etc.)
- Increasing 802.11 radio capability (11ac Wave 1 to Wave 2) drives Ethernet backhaul traffic beyond 1 Gb/s.
- Link Aggregation (Nx1000BASE-T) or 10GBASE-T only options today

802.11ac Enterprise AP Segments and Trends



Enterprise AP Radio Bandwidth

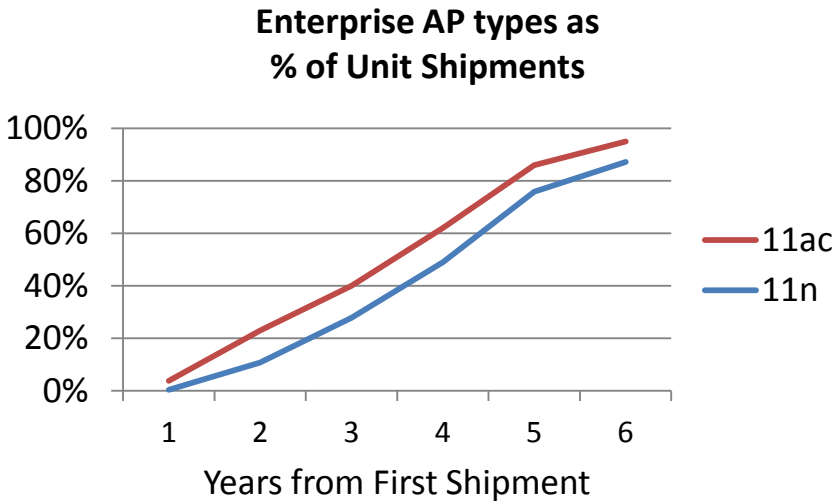


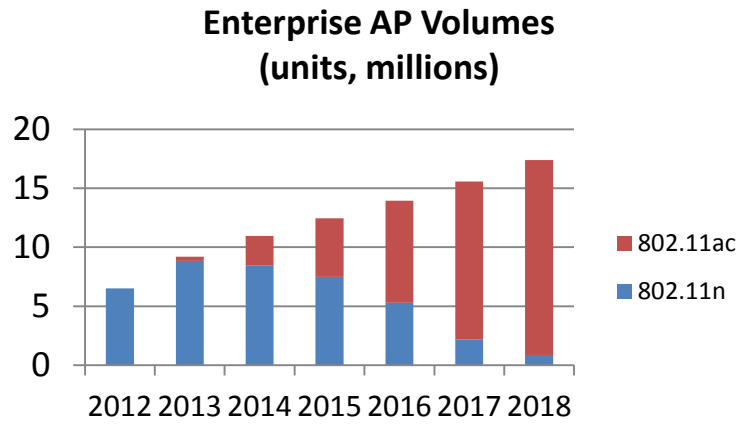
Period	Standard	Max (Mb/s)
1997-1998	802.11	2
1999-2001	802.11b	11
2002-2006	802.11a/g	54
2007-2011	802.11n	600
2013-2015	802.11ac	3470
2015-2017	802.11ac W2	6930

- 802.11 is clearly outgrowing 1000BASE-T as an Enterprise access media.
- APs upgrade cycle is faster than switches or cabling (in the order of 3Y/7Y/15Y)
- 802.11ax High Efficiency WLAN (HEW) became a TG May14, target date 1H/2019.
  - Its PAR states "enable at least one mode of operation capable of supporting at least four times improvement in the average throughput per station."
- **The rule of thumb is that the AP Ethernet bandwidth should be at least 75% of radio bandwidth to avoid the Ethernet link being the system bottleneck.**

Enterprise 802.11 Market Forecast

- Enterprise 802.11ac AP adoption rate is growing faster than 802.11n did
  - 21% in 5th quarter of shipments
- 802.11ac Wave 2 APs will offer significant performance improvements for campus deployments
- BYOD devices (e.g., the latest smart phone, the newest tablet) are driving technology adoption in the enterprise
  - Within 5 years >95% of shipping 802.11 devices will support 802.11ac.
  - Lots of devices drives multi-user MIMO adoption





Source: Dell'Oro June 2014

Other Broad Market Uses

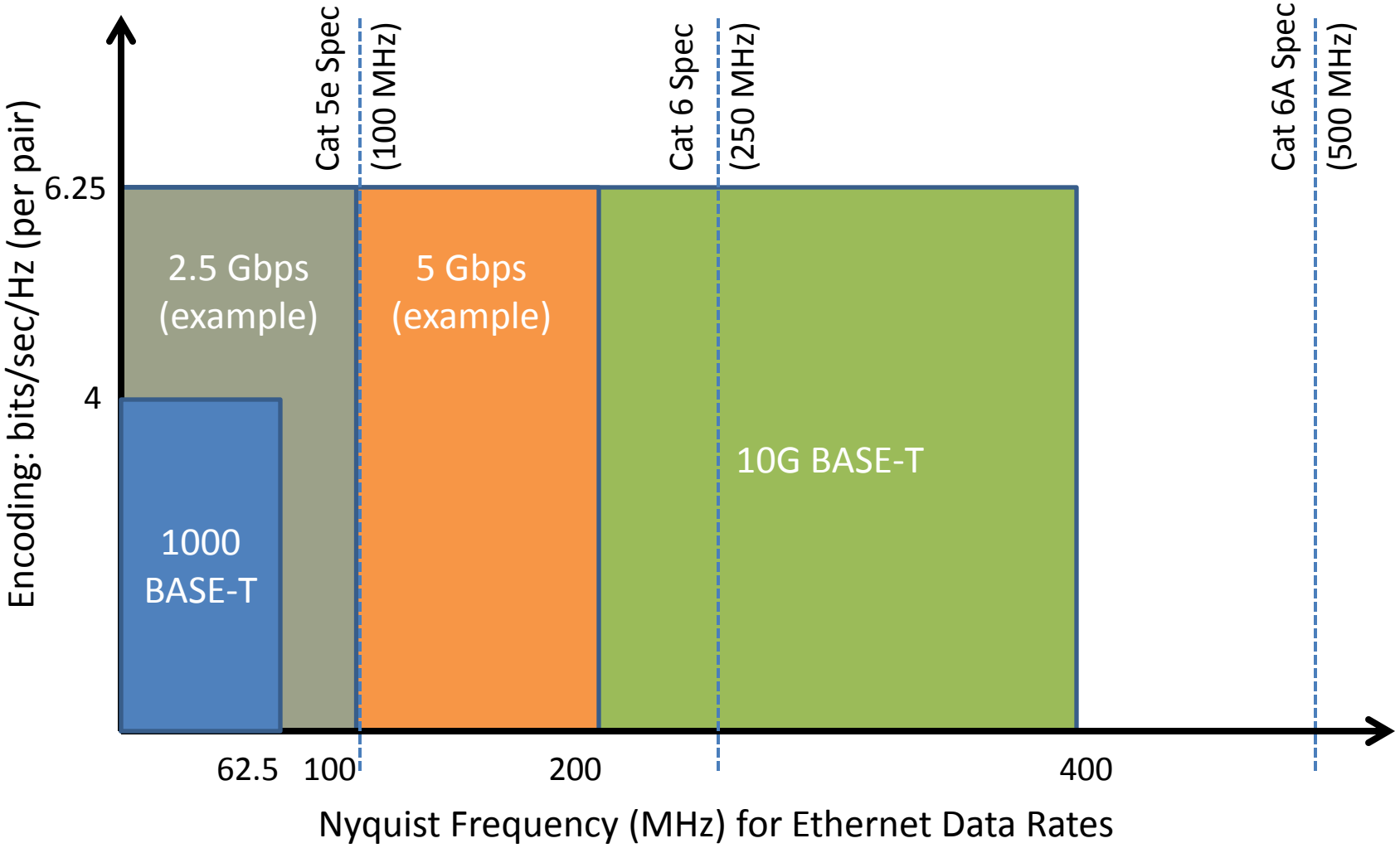
- A speed upgrade for 1000BASE-T using existing installed structured wiring.
  - Because 100BASE-TX to 1000BASE-T used existing cabling, it had a low barrier to adoption.
  - We can do the same for the current 1000BASE-T user base.
- Speed upgrades are often made when an existing link becomes congested.
  - Enable applications to more than 1Gb/s bandwidth without cable rip/replace.
- When do increased Ethernet link speeds get mass adoption?
  - When marginal cost of deployment is small compared to the increase in bandwidth.

TECHNICAL FEASIBILITY

Wealth of Prior Experience

- Industry already has experience in this space with MACs & PHYs at intermediate rates between 1G and 10G
- The MAC is feasible in existing technology, and designs can leverage a Gigabit Ethernet MAC and run it faster, or run a 10G Ethernet MAC slower.
- The PCS is feasible in existing technology, a sensible PCS choice is:
  - Re-use the 10GbE PCS, 64B/66B, but run slower.
- 10GBASE-T proves much of the PHY functionality:
  - Significant base of knowledge of channel and component characteristics
  - Can run on some Cat 5e at reduced distances.
  - Supports Cat 6 at 55m (and some to 100m), and Cat 6A to 100m
  - Supporting data rates between 1G and 10G are enabled with symbol rate trade offs allowing longer reaches on Cat 5e/Cat 6
- Energy efficient Ethernet approaches are well known for 1G and 10G

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



2.5G/5G Technology for installed base well understood

- IEEE 802.3: considered as part of 10GBASE-T SG
  - http://www.ieee802.org/3/10GBT/public/jul03/yousefi_1_0703.pdf
  - http://www.ieee802.org/3/10GBT/public/jul03/powell_2_0703.pdf
  - Targeted to address the next speed-step to the desktop
  - No disagreements on technical feasibility
- FibreChannel: FCBASE-T 1G, 2G, 4G
  - See, e.g., ftp://ftp.t11.org/t11/member/fc/baset/05-653v0.pdf
- Conclusions:
  - **Technical feasibility has already been well accepted**

WHY NOW?

Why Now?

- The application is imminent!
  - Enterprise Access Points transitioning to 802.11ac ~2 Gb/s speed in the next 12 months, and near ~4Gb/s speed for high end Wave 2 APs.
  - Cost and power sensitive for nearer-term deployment
- Industry has recognized the need & possible solutions
  - Switching & PHY silicon under development
  - The market needs an interoperable, open standard to avoid fragmentation and poor user experience.
  - Launch of Consortiums targeting this market highlights the need.
- The Ethernet Ecosystem has been very successful
  - Open and common specifications
  - Ensured Interoperability
  - Security of development investment

Possible topics for Study Group

- 802.11 data rate requirements for Ethernet backhaul
- Rates & reaches on cable categories served
- BER/Reliability requirements
- Compatibility Considerations
  - Line power with PoE
  - Clause 28 Auto-Negotiation
  - Coexistence with BASE-T from 100Mb to 10Gb
  - Energy Efficiency and EEE

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67+ individuals
26+ companies

Q&A

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	David Chalupsky	Intel
Expert Panel	Amrik Bains	Cisco
	Ron Cates	Marvell
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STRAW POLLS

Call-for-Interest Consensus

- Should a study group be formed for “Next Generation Enterprise BASE-T Access”?

- Yes 41+36+20= 97
- No 0+0+1 = 1,
- Abstain 11+7+5 =23,

- Room Count 27+55+49 =131

Participation

- I would participate in a “Next Generation Enterprise BASE-T Access” study group in IEEE 802.3

  Tally: 6+14+21 = 41

- My company would support participation in a “Next Generation Enterprise BASE-T Access” study group

  Tally: 8+4+12 =24

Future Work

- Ask 802.3 at Thursday's closing meeting to form a "Next Generation Enterprise BASE-T Access" study group

- If approved:
  - 802 EC informed on Friday of formation of the study group.
  - First study group meeting would be during January 2015 IEEE 802.3 interim meeting.

THANK YOU!