

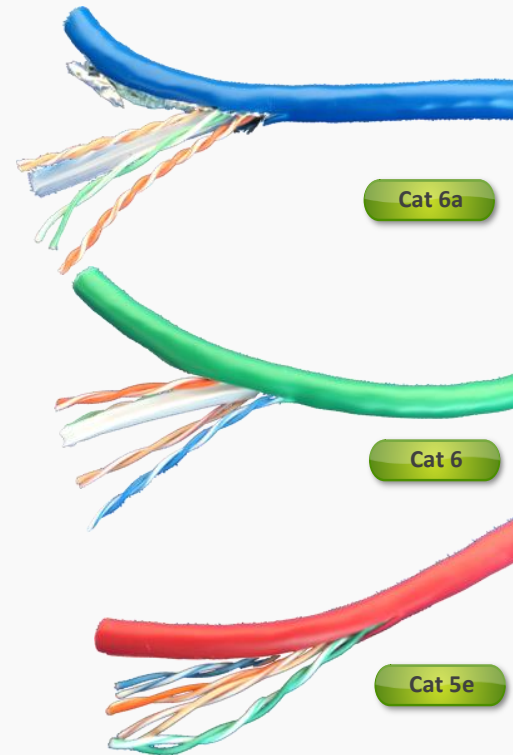
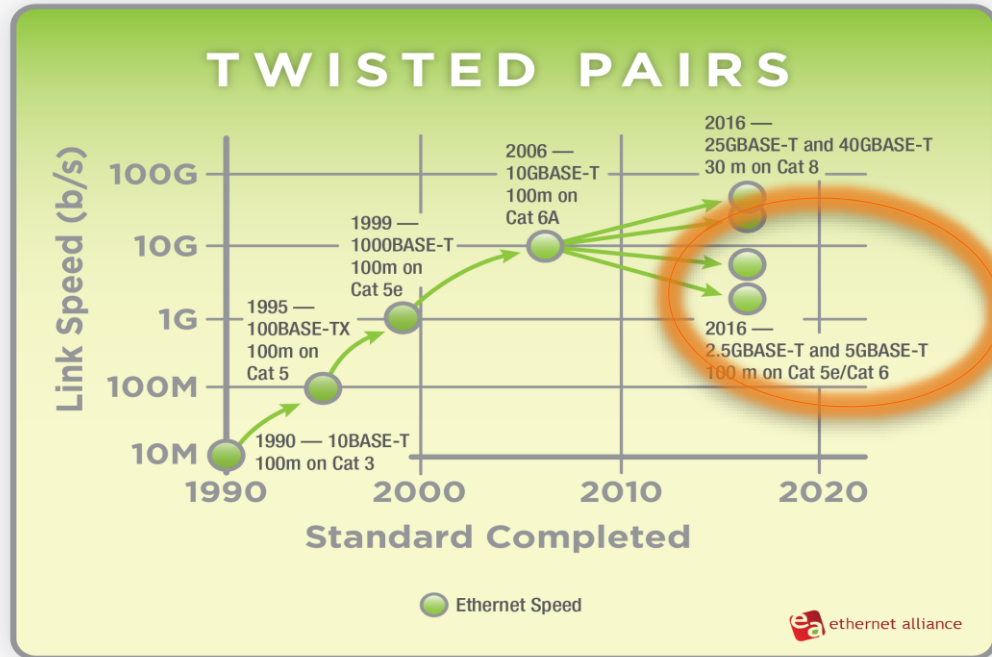
# Vive La Ethernet Evolution! Effortlessly Speed Your Network 5x with NBASE-T



George Zimmerman

Board of Directors, NBASE-T Alliance

# When there's a fork in the road...



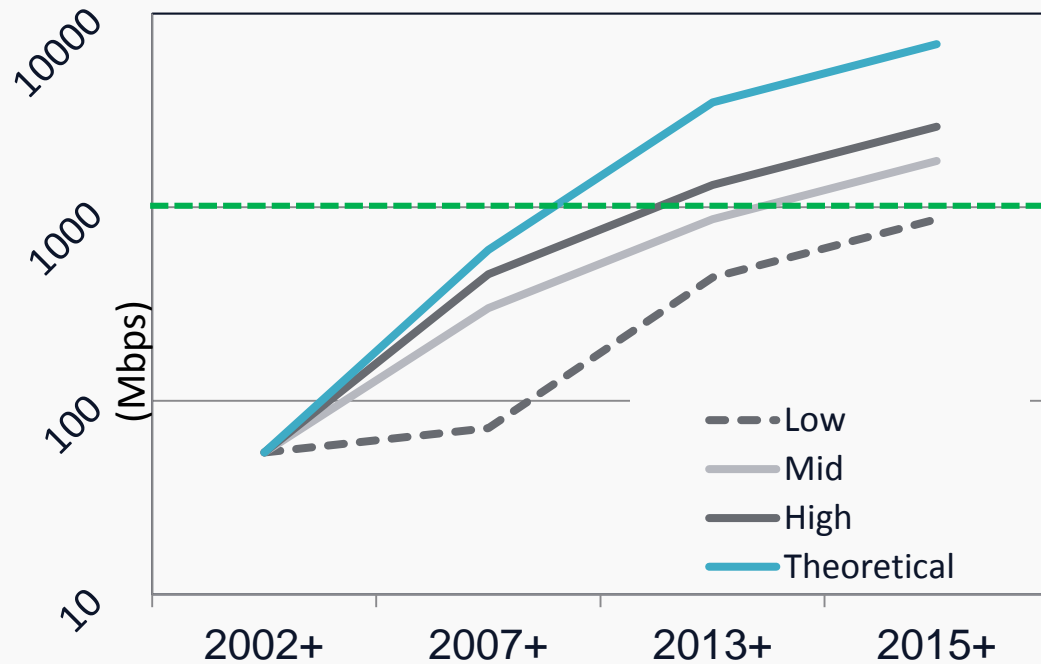
Take it!

# 802.11ac transitions



**With 802.11ac, wireless crosses a gigabit**

Enterprise AP Radio Bandwidth



802.11 in time:

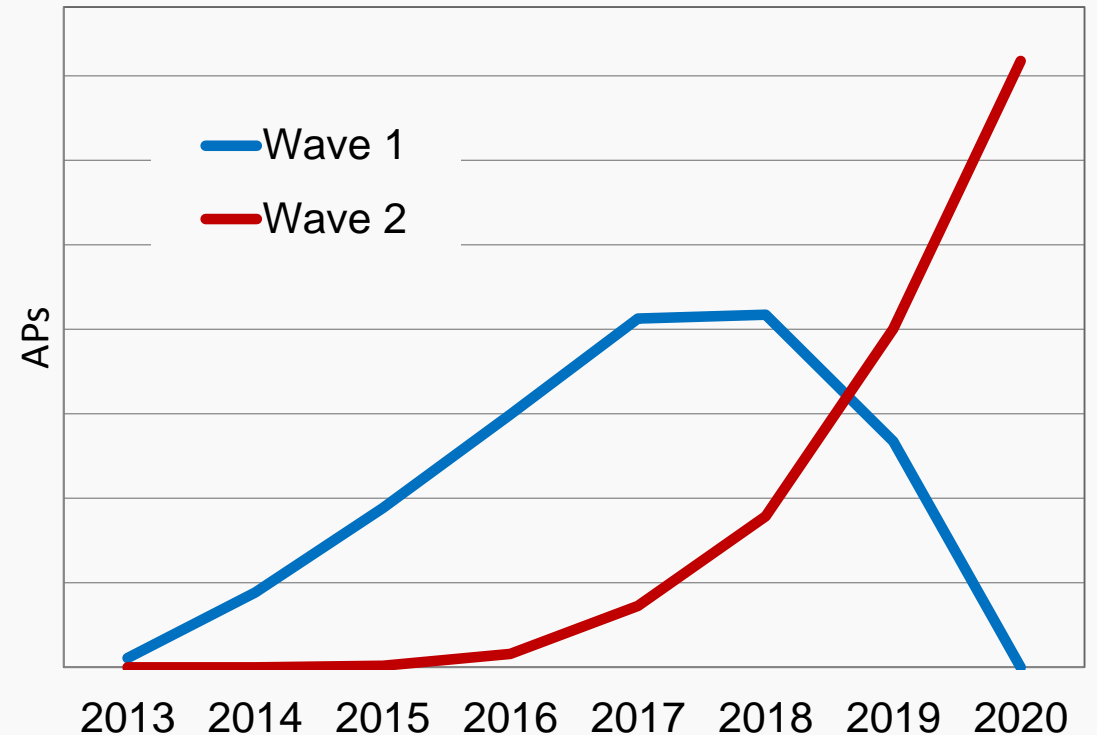
- 2002-2006: 802.11g/a
- 2007-2011: 802.11n
- 2013-2015: 802.11ac W1
- 2015-2017: 802.11ac W2

**11n to 11ac is a rapid transition**

**802.11ac Wave 2 starts ramping in 2016**

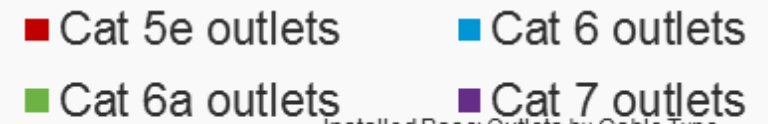
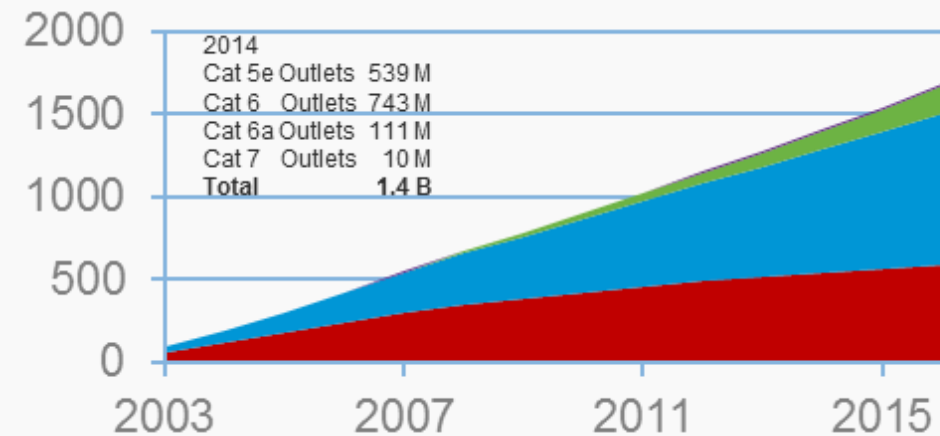
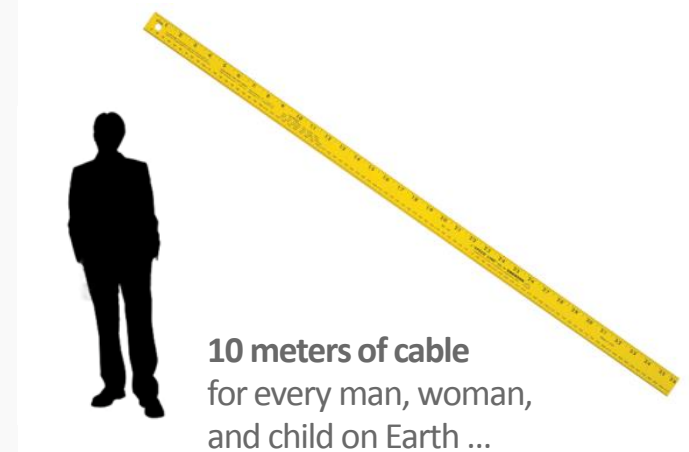
Enterprise 802.11ac AP Transition

Source: Dell'Oro Group Wireless LAN 5-year Forecast Jan 2016



# Why 2.5G and 5GBASE-T?

- Between 2003 to 2014 ~70 billion meters of Cat 5e and Cat 6 cabling were sold....
  - In 2014, 1.3 Billion outlets, ~90% of installed base
  - Enormous network infrastructure investment
- Existing specifications support 1Gb/s over this cable, but faster data rates are possible
- BASE-T allows incremental upgrade
  - **Lets get more value from this investment!**
  - **What can we enable?**



Installed Base: Outlets by Cable Type  
Source:  
BSRIA December 14

# 802.3 Ethernet and 802.11 WLAN: Deployments Today



## Access Switch

Mostly 1000BASE-T ports  
PoE PSE (15/30w, 4PPoE)

1000BASE-T  
Power over Ethernet

## 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 PD (Powered Device)  
Footprint sensitive (e.g. power, heat, etc.)  
11acWave 2 drives backhaul traffic > 1 Gb/s.  
*No easy way to get above 1Gb/s.*

- The needs of 802.11ac Wave 2 access points demanded development of NBASE-T/802.3bz
  - Must support: >1Gbps rates, installed cabling and PoE

# Gigabit Bottleneck



WiFi > 1G



Cat 5e Cables

Limited to 1G!



- Existing gigabit infrastructure is insufficient to handle
  - 802.11ac deployment
  - Workstations and PCs that handle large data transfers
- Gigabit Ethernet has been around since 1999 and is the bottleneck
- Market needs technology to support >1G over existing cables



# NBASE-T Alliance<sup>SM</sup> - Overview

- NBASE-T Alliance ([www.nbaset.org/](http://www.nbaset.org/))
  - Vendor alliance for 2.5G/5G BASE-T with 45+ participant companies.
- Who is in the Alliance?
  - Components, silicon, systems, cabling, test, etc.
- Alliance role?
  - Enable widespread deployment, evolve specifications, facilitate interoperability.

## Alliance Strength - Full Ecosystem

### Promoters



### Contributors



### Adopters

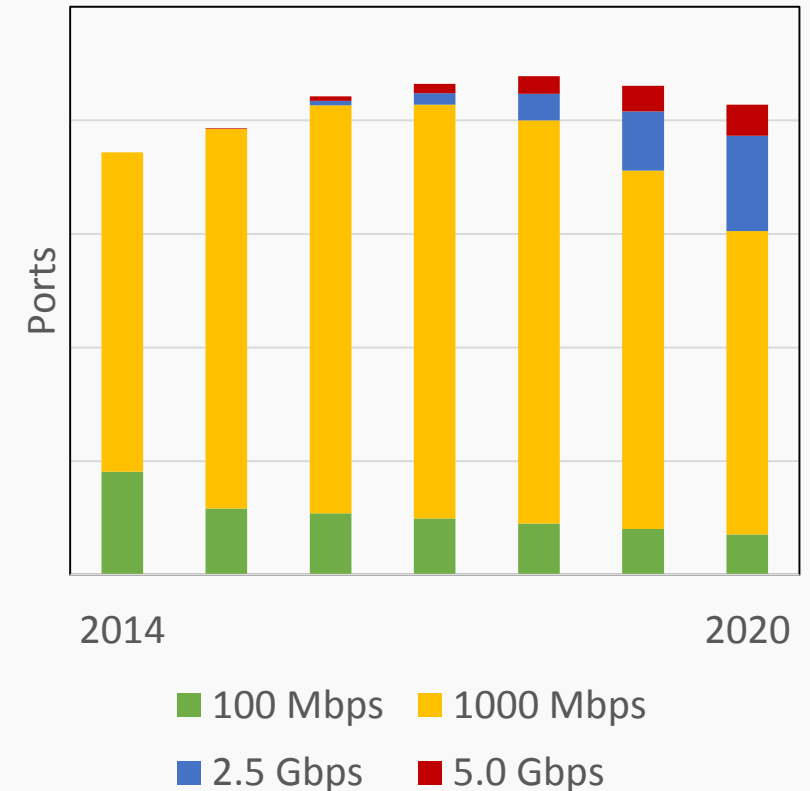


# Where are we now?

- NBASE-T provides 2.5Gbps and 5Gbps over installed cabling
  - NBASE-T downshift matches speed to channel
- 802.11ac Wave 2 APs shipping with > 1Gbps wired backhaul
- IEEE 802.3bz™ received final approval September 2016
- Joint EA & NBASE-T Plugfest October 16
- Cabling standards in final stages to support rollouts
  
- Rapid transition from 100/100M to 2.5G/5G BASE-T
  - Combined forecast says 25% of ports will be 2.5G/5G BASE-T
  - Over 3 Million Ports in 2017\*!



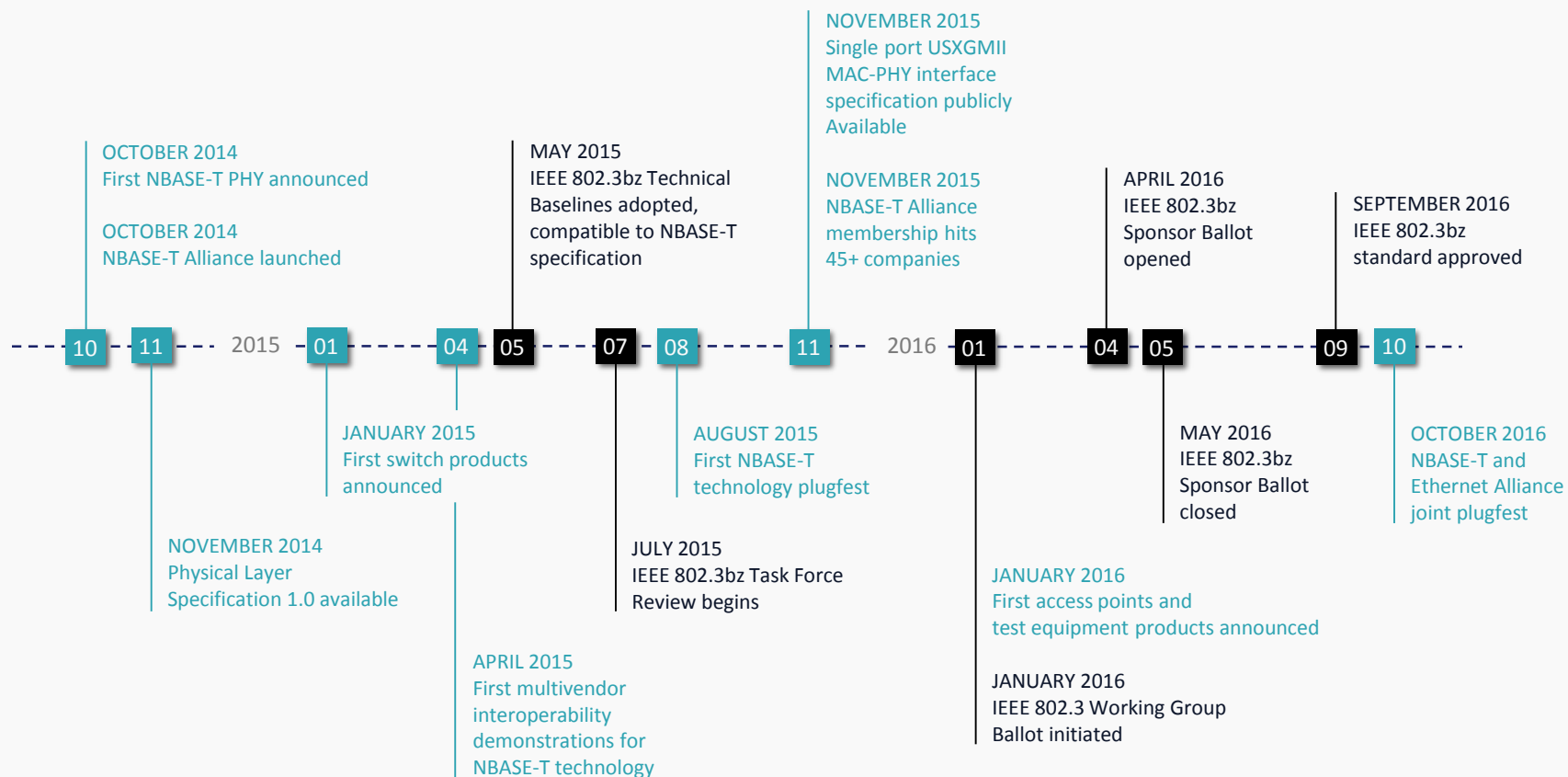
100M/1000M to 2.5G/5G transition  
Source: Dell'Oro Group Ethernet Switch 5-year Forecast Jan 2016



\* Dell Oro – Sept 2016



# Timeline of Success



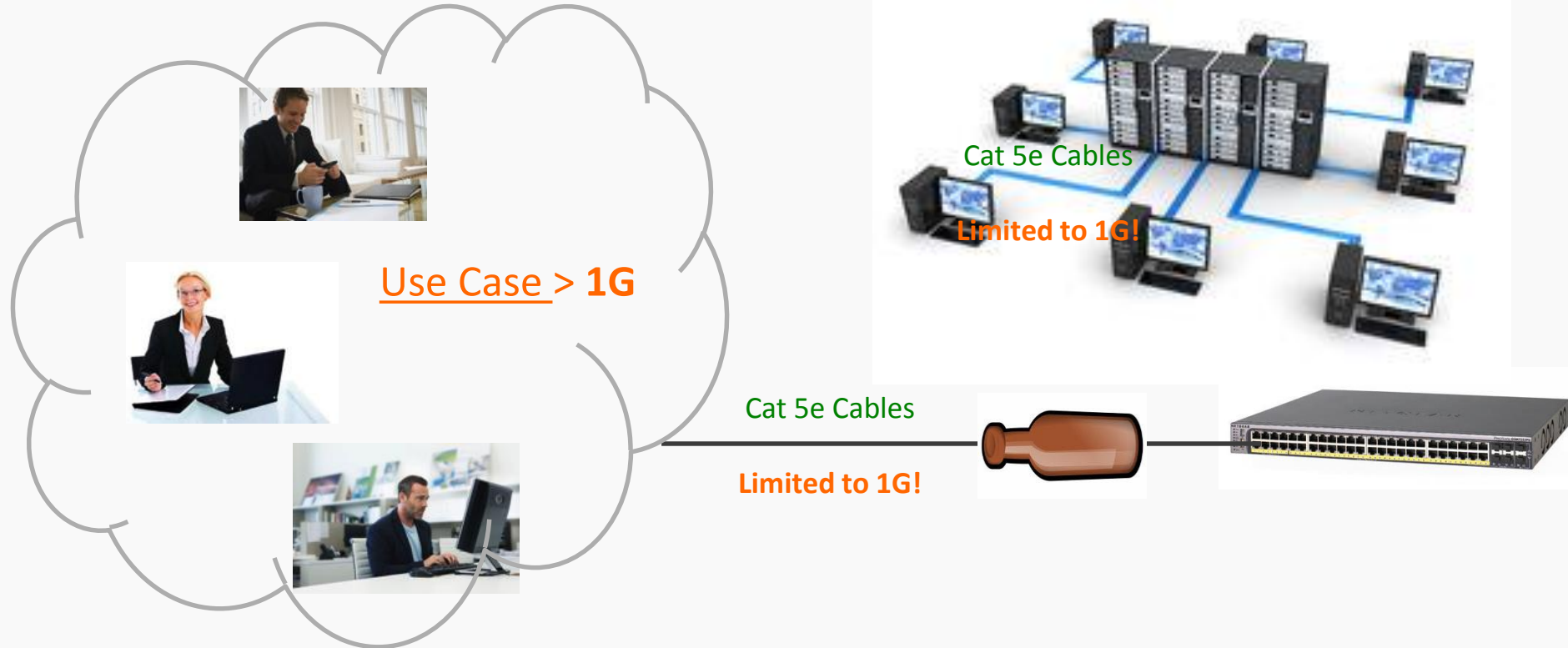


# IEEE 802.3bz or NBASE-T?

- Users expect an easy transition, so what's different?
- Minor differences in AutoNeg/link setup
- NBASE-T adds “downshift” to 802.3bz
  - Normal Auto Negotiation selects the fastest rate both PHYs support, irrespective of the cabling, noise or environment
  - But, in 2.5G/5GBASE-T, the speed you get varies with the cabling configuration and other links crosstalking
  - So... “downshift” automatically shifts the rate based on the channel noise
    - Similar to Wi-Fi rate adaptation
- Users always get a reliable link at the best speed for the cabling!

***The Answer is: Yes!***

# Gigabit Bottleneck



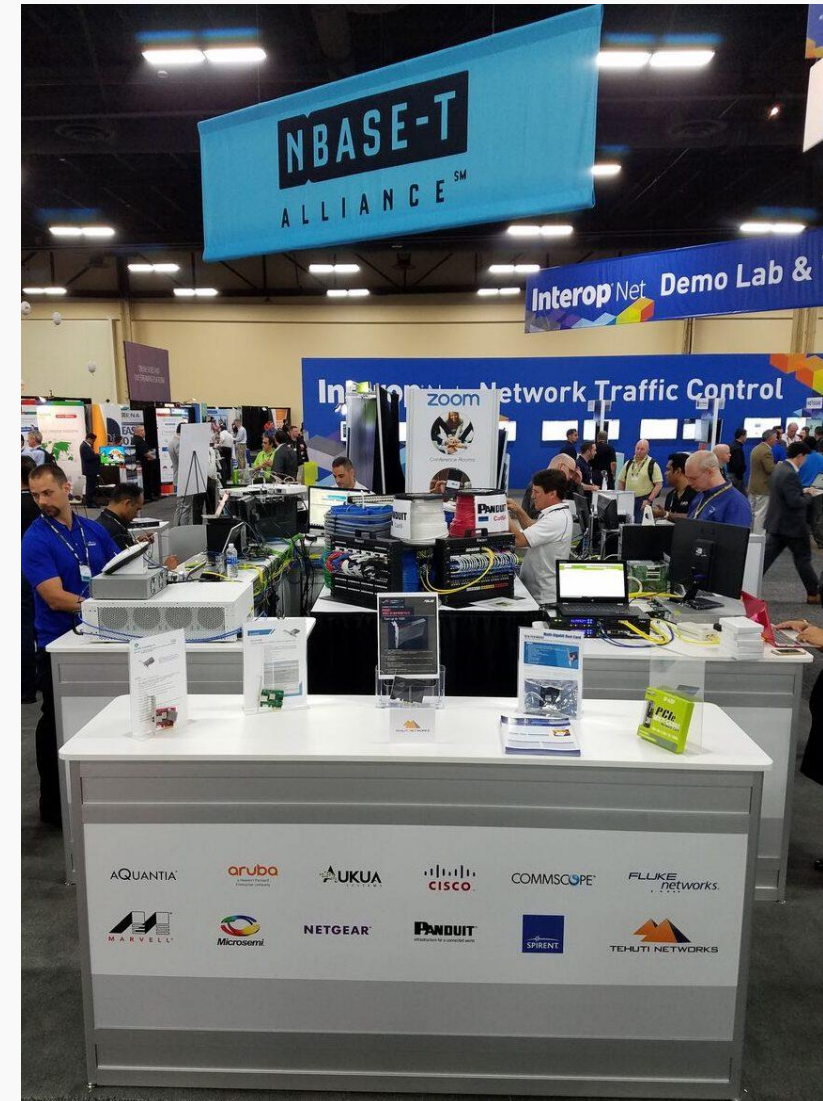
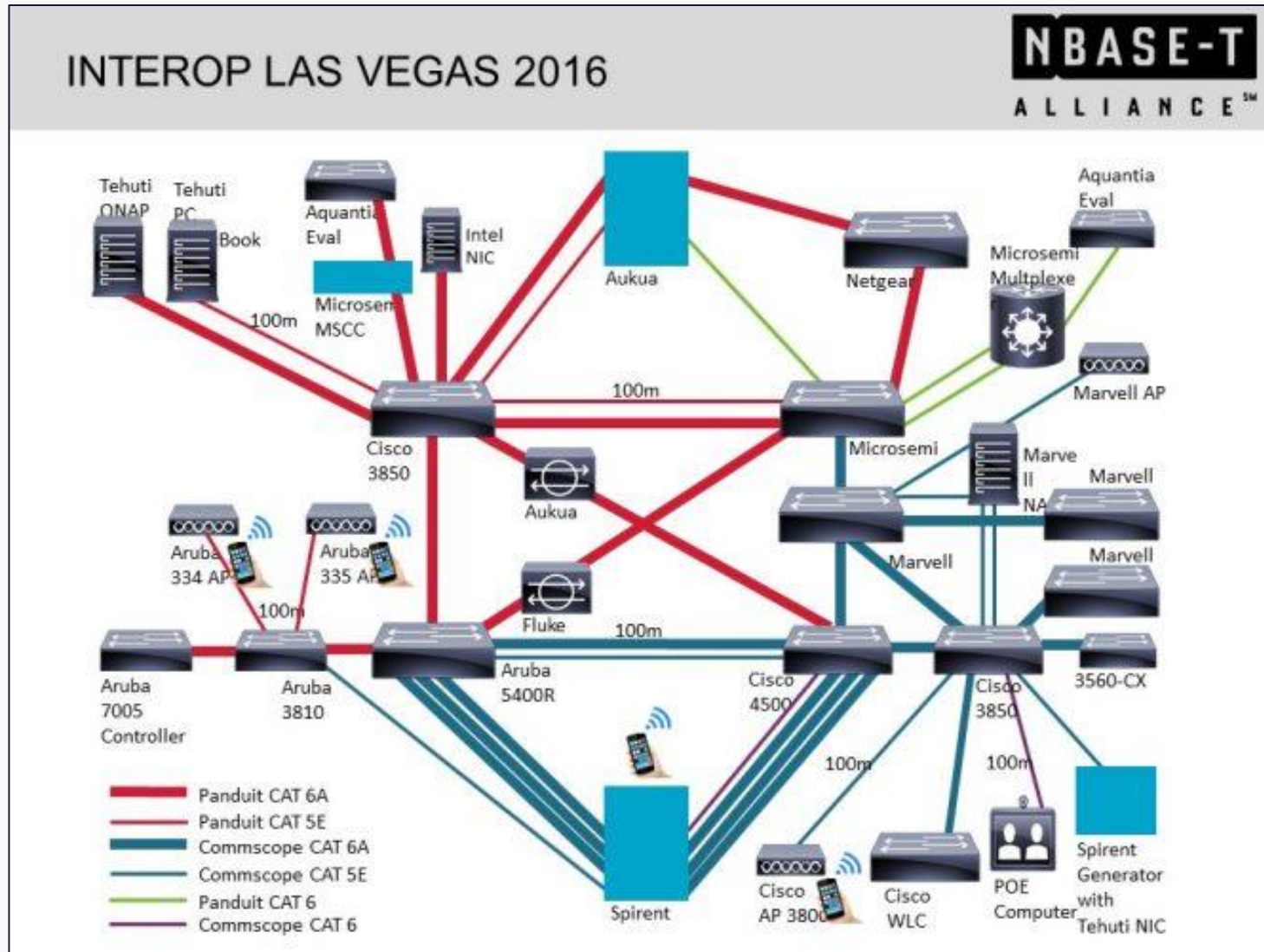
- Gigabit Ethernet has been around since 1999 and is the bottleneck
- Market needs technology to support >1G over existing cables

***THE PROBLEM ISN'T WIRELESS LAN BACKHAUL, IT'S NETWORKING – AND IT GENERALIZES***

# NBASE-T/Ethernet Evolves to Fill Niches



# NBASE-T Alliance at Interop 2016 Las Vegas



# Ethernet finds its uses... Campus

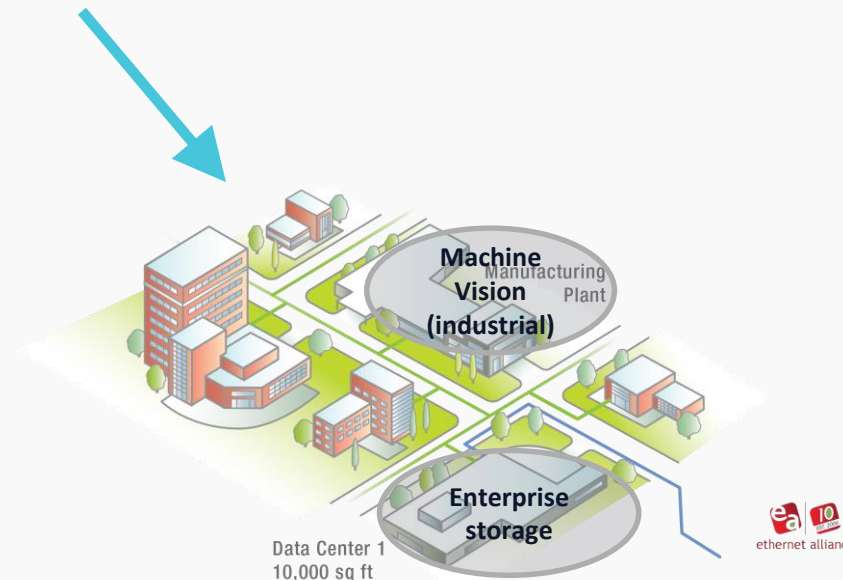
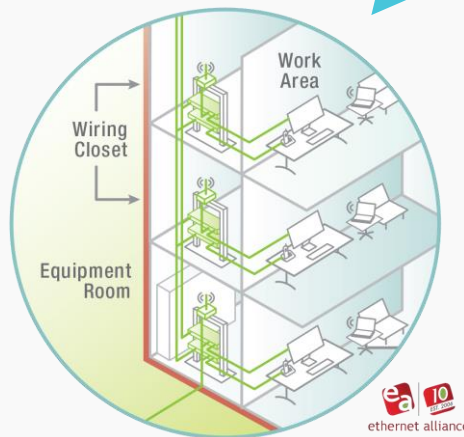
## ENTERPRISE

Indoor/Outdoor Access Points  
Workstations, Desktops,  
Notebooks  
Enterprise NAS  
Professional Audio Video Systems  
Medical Imaging Systems  
Video Content Editing

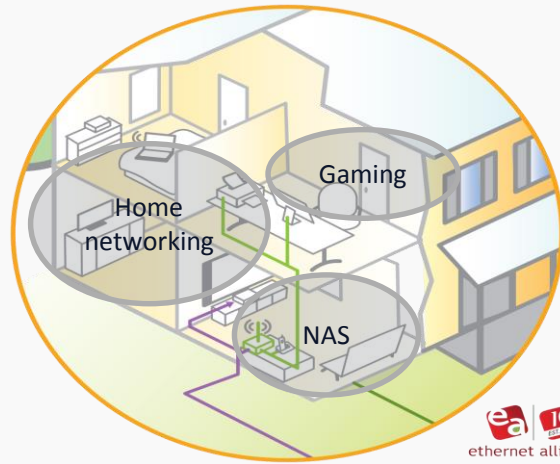


## INDUSTRIAL

Industrial/Outdoor Access Points  
Workstations  
Machine Vision Cameras  
Compact Switches



# Residential



## HOME

- Access Points & Routers
- Desktops, Notebooks
- NAS
- Gaming Computers
- Small Cells

Multigig Automotive?

### 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.

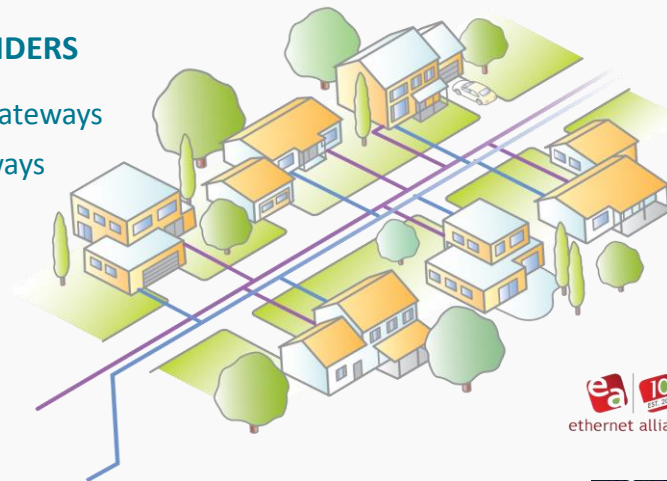
### Wireless Connectivity

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



## SERVICE PROVIDERS

- DOCSIS Home Gateways
- PON ONT Gateways
- Small Cells



# Filling out the Roadmap

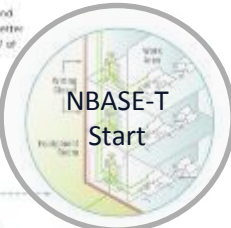


## ETHERNET ECOSYSTEM

### 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 5e or better cabling recommended. 4-Pair PoE is being standardized to deliver over 70W of power over a 4 twisted pairs instead of the two pairs in PoE and PoE+.

PoE Type and Class	Class 0				Class 1				Class 2				Class 3			
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PoE Power [W]	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4
PoE Power [W]	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4



### 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.



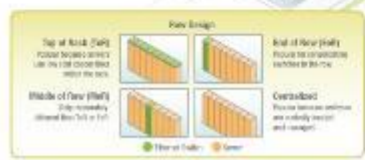
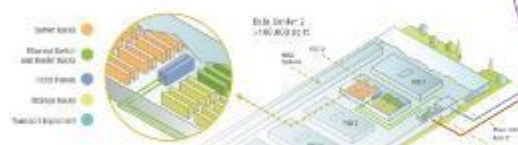
**Wireless Ethernet**  
 100Mbps or higher. Deployed to extend Ethernet to devices that are not in the same room as the switch. Based on all requirements for throughput rates, Ethernet can be deployed to four times the power over a single pair of wires to distances of 10 meters at 100Mbps and 150m.

**Power over Ethernet (PoE)**  
 PoE delivers data and power to cameras, lights, wireless routers, switches and other devices throughout the LAN.

**Wireless Security**  
 Connected cameras are required to deliver increased security to wireless networks that would be more vulnerable to attacks over Wi-Fi.

BACKBONE TO OTHER CITIES

BACKBONE TO OTHER CITIES

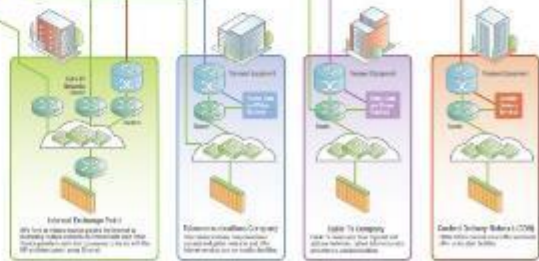


Hyperscale data centers drive amazing Ethernet volumes when hundreds of thousands of servers are connected on one site.

### HYPERSCALE DATA CENTER

### MANs

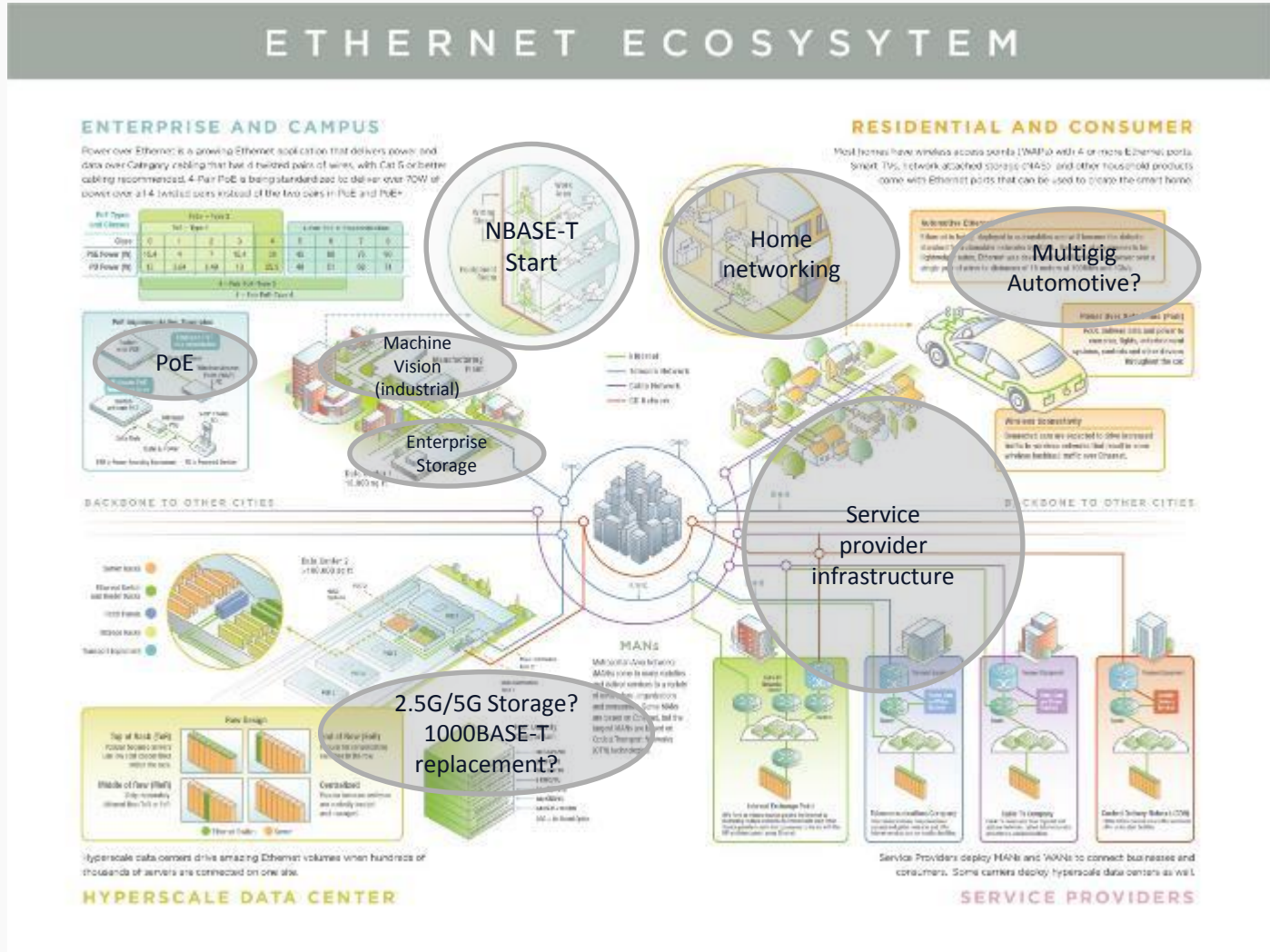
MANs (Metropolitan Area Networks) connect to many satellites and other systems in a number of industries, transportation and consumer. Some MANs are based on Ethernet, and the largest MANs are based on Cloud Managed Network (CMN) technologies.



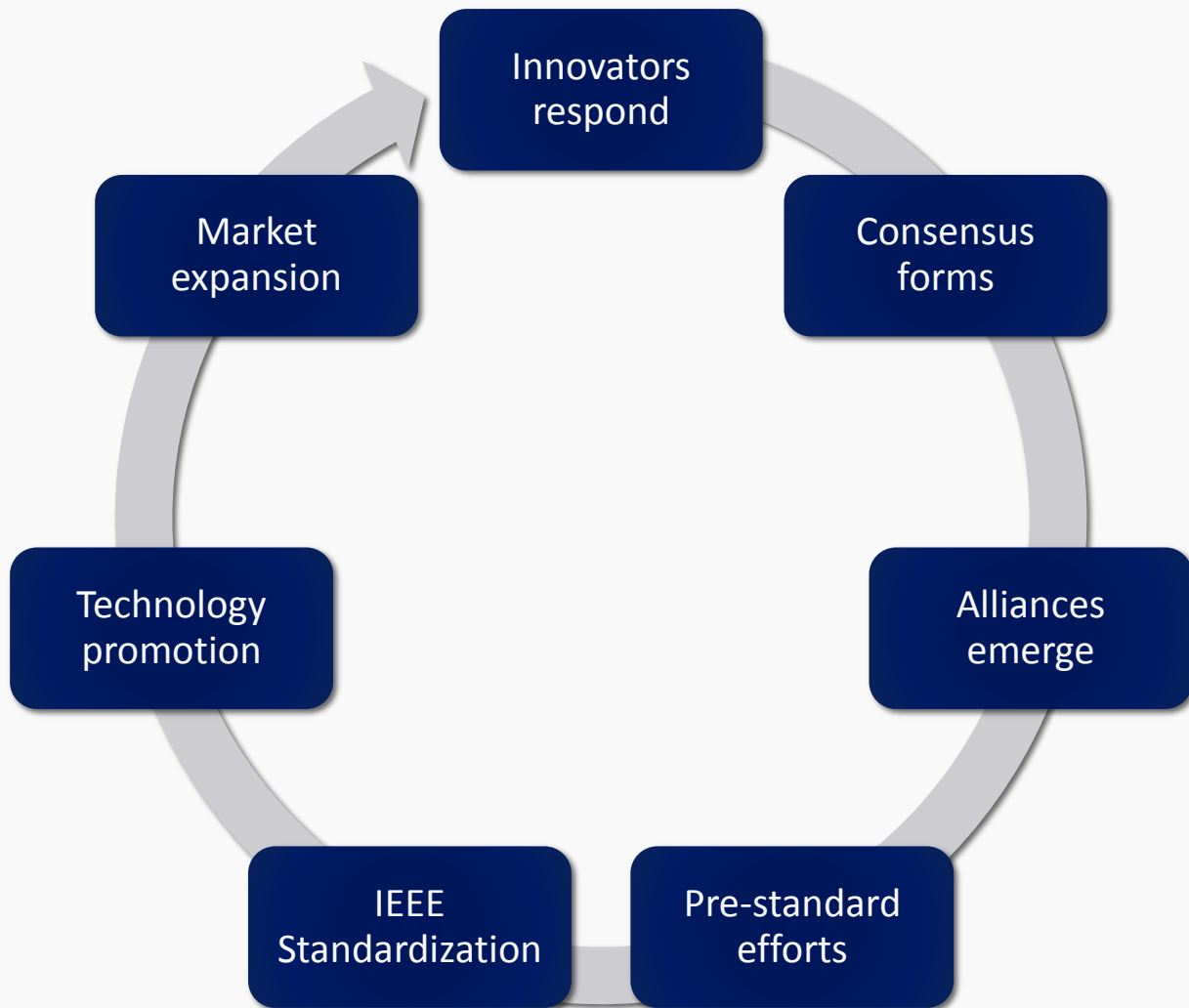
Service Providers deploy MANs and WANs to connect businesses and consumers. Some carriers deploy hyperscale data centers as well.

### SERVICE PROVIDERS

# Filling out the Roadmap



# Cooperatively driving the virtuous cycle...





# THANK YOU

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September 28, 2016

