NBASE-T in the Real World
Solving Your Customers' Problems Right Now

Peter Jones   Cisco Systems, Principal Engineer & NBASE-T Alliance Chairman

Daniel Shin   Cisco Systems, Technical Solutions Architect

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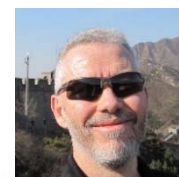# What You Will Hear Today

- I'll start with NBASE-T
  - Alliance, technology and market
- Daniel will cover NBASE-T in the wild
  - Opportunities and successes
- I'll wrap up
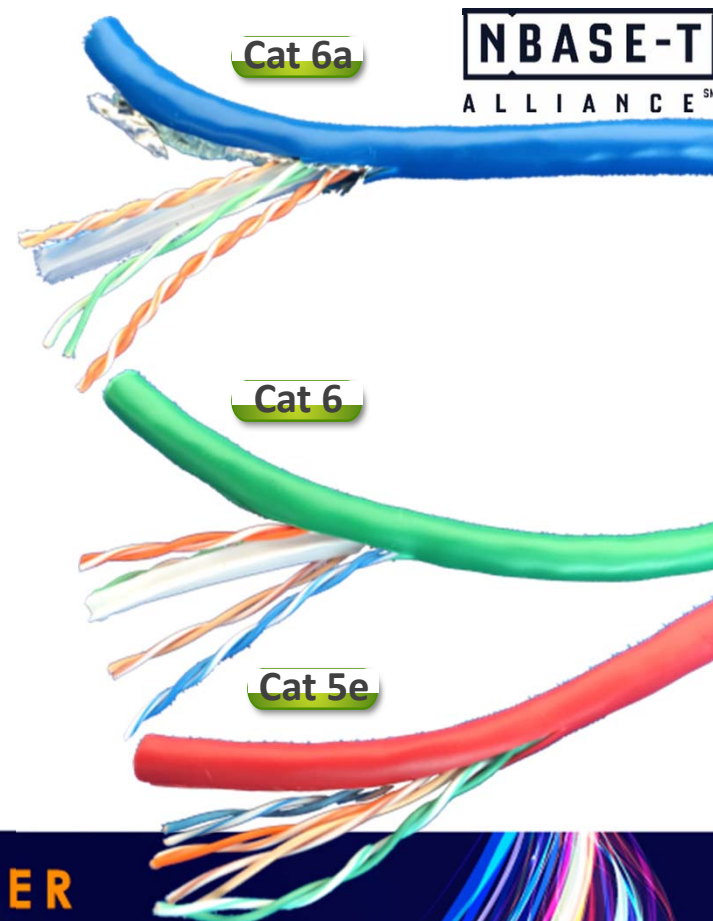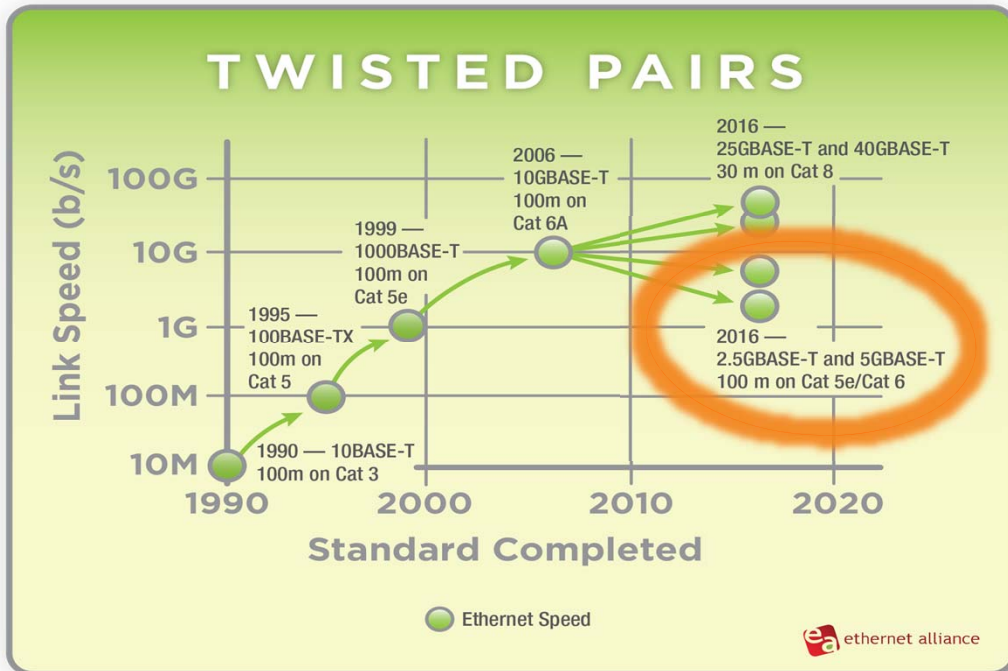 - Closing thoughts and call to action

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NBASE-T OVERVIEW

BASE-T Evolution

802.11 Driving Wired Bandwidth Needs

With 802.11ac, wireless crosses a gigabit

11n to 11ac is a rapid transition

Enterprise AP Radio Bandwidth

- Low
- Mid

10000
1000
100
10
(Mbps)

2002+   2007+   2013+   2015+

Updates pending:
New data 2018c

Enterprise AP 802.11n/11ac Transition
Source: Dell'Oro Group Jan 2017

802.11ac

2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

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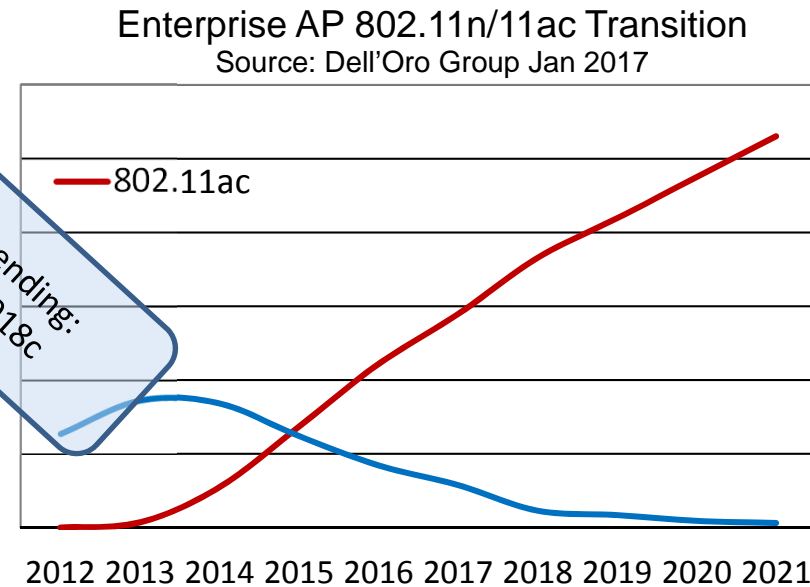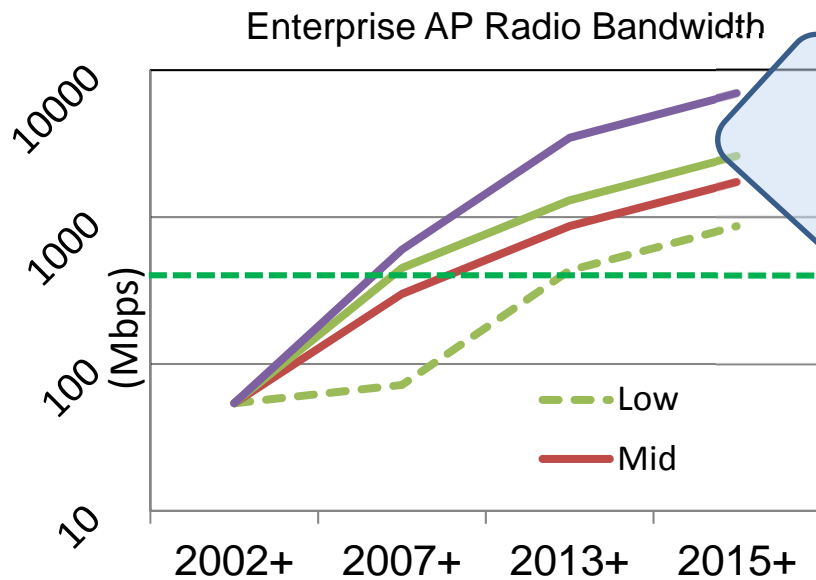
The Application Spaces of BASE-T

NBASE-T ALLIANCE℠

George Zimmerman, CME Consulting - Spaces of BASE-T
http://www.ethernetalliance.org/
wp-content/uploads/2016/04/BASE-TSpaces_EA_FINAL-041816.pdf

ENTERPRISE OFFICES   **DATA CENTRE**

Reach

100m

30m

5m

1000BASE-T

2.5/5GBASE-T

10GBASE-T

25GBASE-T

40GBASE-T

Floor or Room-based

Row-based (MoR/EoR)

Rack-based (ToR)

Data Rate
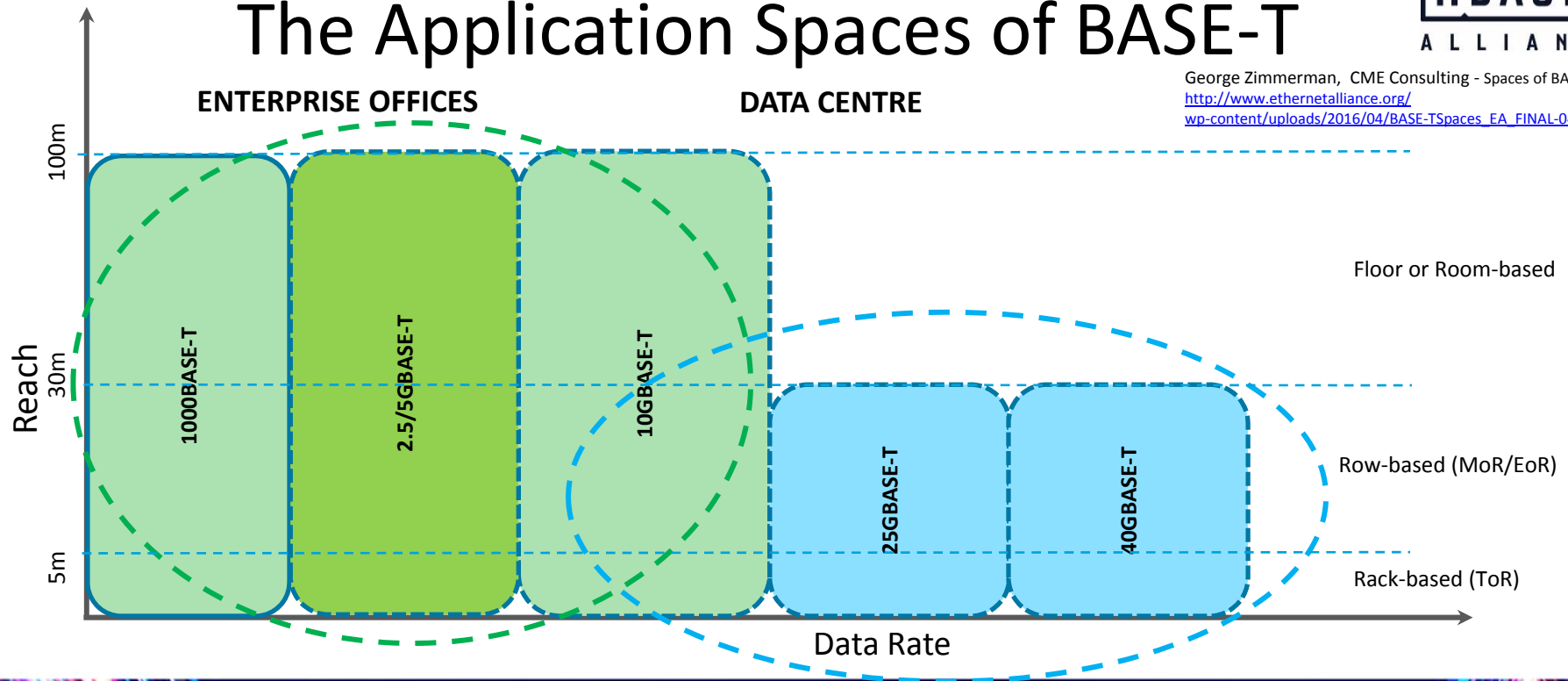
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BASE-T & Alien Crosstalk

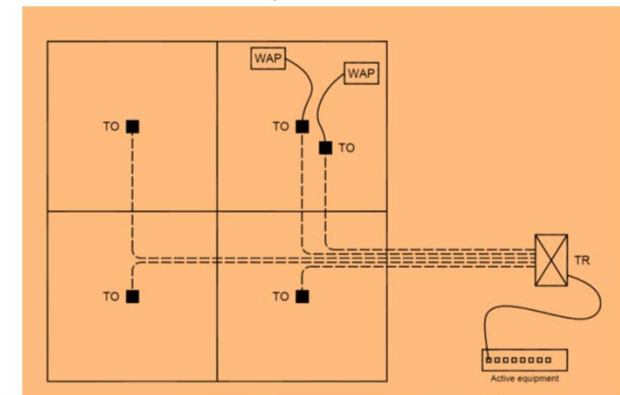- Modern BASE-T PHYs (>= 1Gb/s) are impacted by "Alien Crosstalk" from other cables
  - Cables tightly bundled over long distances and/or close to the transmitter impact performance

- With NBASE-T many links can support rates > 1Gbps
  - Links to Wireless Access Points fan out, reducing alien crosstalk

- Cat5e/Cat6 not specified for alien crosstalk
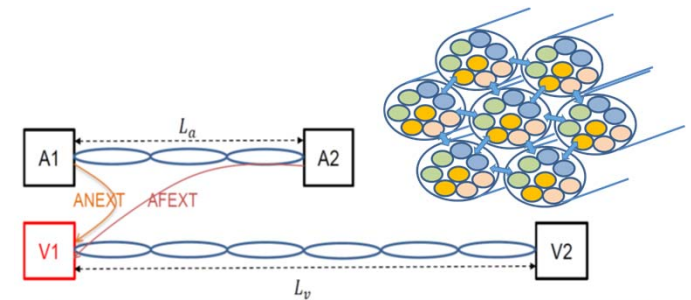
Why 2.5G and 5G BASE-T?

- Between 2003 to 2014 ~70 billion meters of Cat 5e and Cat 6 cabling were sold….
  - ~90% of installed base
  - Enormous network infrastructure investment
- Existing specifications supported 1Gb/s over this cable, but we knew faster data rates were possible
- BASE-T allows incremental upgrade

Lets increase the value of this asset!

10 meters of **BASE-T cabling** for every man, woman, and child on Earth …

Installed Cable Plant 2014	
Cat 5e Outlets	539 M
Cat 6 Outlets	743 M
Cat 6a Outlets	111 M
Cat 7 Outlets	10 M
Total	1.4 B

Cat 5e outlets Cat 6 outlets Cat 6a outlets Cat 7 outlets

Source: BSRIA December 14

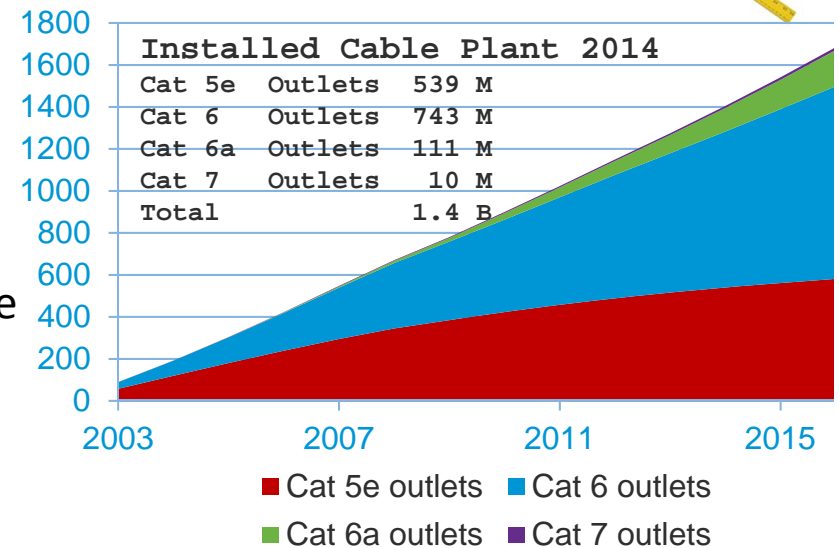**2018 BICSI WINTER CONFERENCE & EXHIBITION**
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NBASE-T Alliance - Overview

- NBASE-T Alliance (www.nbaset.org)
  - 2.5G/5GBASE-T vendor alliance, ~50 member companies
- Who is in the Alliance?
  - Components, silicon, systems, cabling, test, ….
- What is role of the Alliance?
  - Build and support the market

Alliance Strength - Full Ecosystem

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NBASE-T/802.3bz Timeline

OCTOBER 2014
NBASE-T Alliance launched

NOVEMBER 2014
NBASE-T Physical Layer Specification 1.0 available

NOVEMBER 2014
IEEE 802.3 Call for interest

JANUARY 2015
First switch products announced

MARCH 2015
802.3bz Task Force authorized

APRIL 2015
First multivendor interoperability demos for NBASE-T technology at Interop Las Vegas

MAY 2015
802.3bz Technical Baselines adopted, compatible to NBASE-T specification

JULY 2015
802.3bz Task Force Review begins

AUGUST 2015
First NBASE-T technology plugfest

NOVEMBER 2015
NBASE-T Alliance membership hits 45+ companies

JANUARY 2016
First access points and test equipment products announced

JANUARY 2016
802.3 Working Group Ballot initiated

FEBRUARY 2016
First machine vision products announced

APRIL 2016
15 companies showcase NBASE-T interoperability demos at Interop Las Vegas

APRIL 2016
802.3bz Sponsor Ballot opened

SEPTEMBER 2016
802.3bz standard approved

OCTOBER 2016
NBASE-T and Ethernet Alliance joint plugfest

DECEMBER 2016
NBASE-T Physical Layer Specification version 2.3 available

MARCH 2017
NBASE-T and Ethernet Alliance joint webinar on plugfest results

MAY 2017
10 companies showcase NBASE-T interoperability at Interop ITX Las Vegas

OCTOBER 2017
2nd NBASE-T and Ethernet Alliance plugfest

APRIL 2018
NBASE-T at Interop ITX Las Vegas

10 — 11 — 2015 — 01 — 03 — 04 — 05 — 07 — 08 — 11 — 2016 — 01 — 02 — 04 — 09 — 10 — 12 — 2017 — 03 — 05 — 10 — 2018 — 04

Updated December 2017, © NBASE-T Alliance, Inc

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NBASE-T and 802.3bz Technology
Based on 10GBASE-T

- PAM-16 with the same LDPC code for good performance
  - Good interoperability, improved robustness
  - Upper frequency of ½ (5G) and ¼ (2.5G) that of 10GBASE-T
- NBASE-T and 802.3bz are interoperable with each other
  - Joint Ethernet Alliance/NBASE-T Alliance plugfests in late 2016 & 2017
 - Auto Negotiation enables multi-mode PHY operation
- Supports PoE!

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IEEE 802.3bz or NBASE-T

- NBASE-T adds "Downshift" to 802.3bz
  - Ethernet Auto Negotiation selects the fastest common rate (regardless of cable etc.)
  - With Cat5e/6, bandwidth capacity can depend on crosstalk from other links
  - Downshift automatically selects the speed based on the channel noise
- With downshift, users always get a reliable link

IEEE 802.3bz + Automatic Downshift = NBASE-T
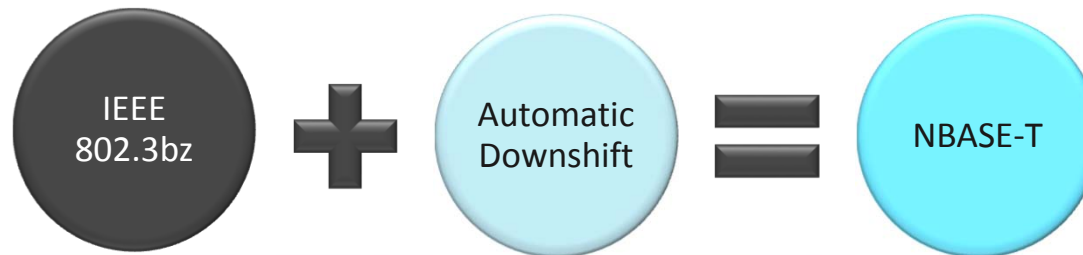
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NBASE-T vs IEEE 802.3bz

For Your Reference

NBASE-T ALLIANCE℠

Feature	NBASE-T	IEEE 802.3bz
Auto-Negotiation	Clause 28/55 for 10G - modified to use Extended page with NBASE-T OUI	Clause 28/55/126 - Infofield message during training
Fast Retrain	Specified in ENG-977716 Revision 2.0	Clause 126 – Infofield message during training for fast retrain ability advertisement
Energy Efficient Ethernet	NBASE-T PHY 2.3 - Clause 126 - Infofield message during training, as per 802.3bz. (Note NBASE-T PHY 1.x EEE using extended next page is deprecated)	Clause 126 - Infofield message during training for EEE ability advertisement
Downshift – Change speed in case of cable issues	Yes – adjust data rate in case of issue due to cable and noisy environment – see section 2.11	No – NBASE-T feature ONLY
2.5G MDI Return Loss	2.5G spec to 125MHz 5G spec to 250MHz	2.5G spec to 250MHz 5G spec to 250MHz

BASE-T AutoNeg enables 802.3bz/ NBASE-T co-existence

NBASE-T Downshift selects lower data rate if link establishment fails
(http://www.nbaset.org/technology/library/nbase-t-downshift-optimization-2-5gbs-5gbs-ethernet-data-rates-cat5ecat6-cabling/)

NBASE-T/802.3bz MDI Return Loss harmonized via 802.3 Maintenance Request

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NBASE-T Application Areas

Enterprise:
    Switch
    Wireless AP
    Desktop
    Storage
    Small Cell

Industrial:
    Switch
    Wireless AP
    Workstation
    Storage
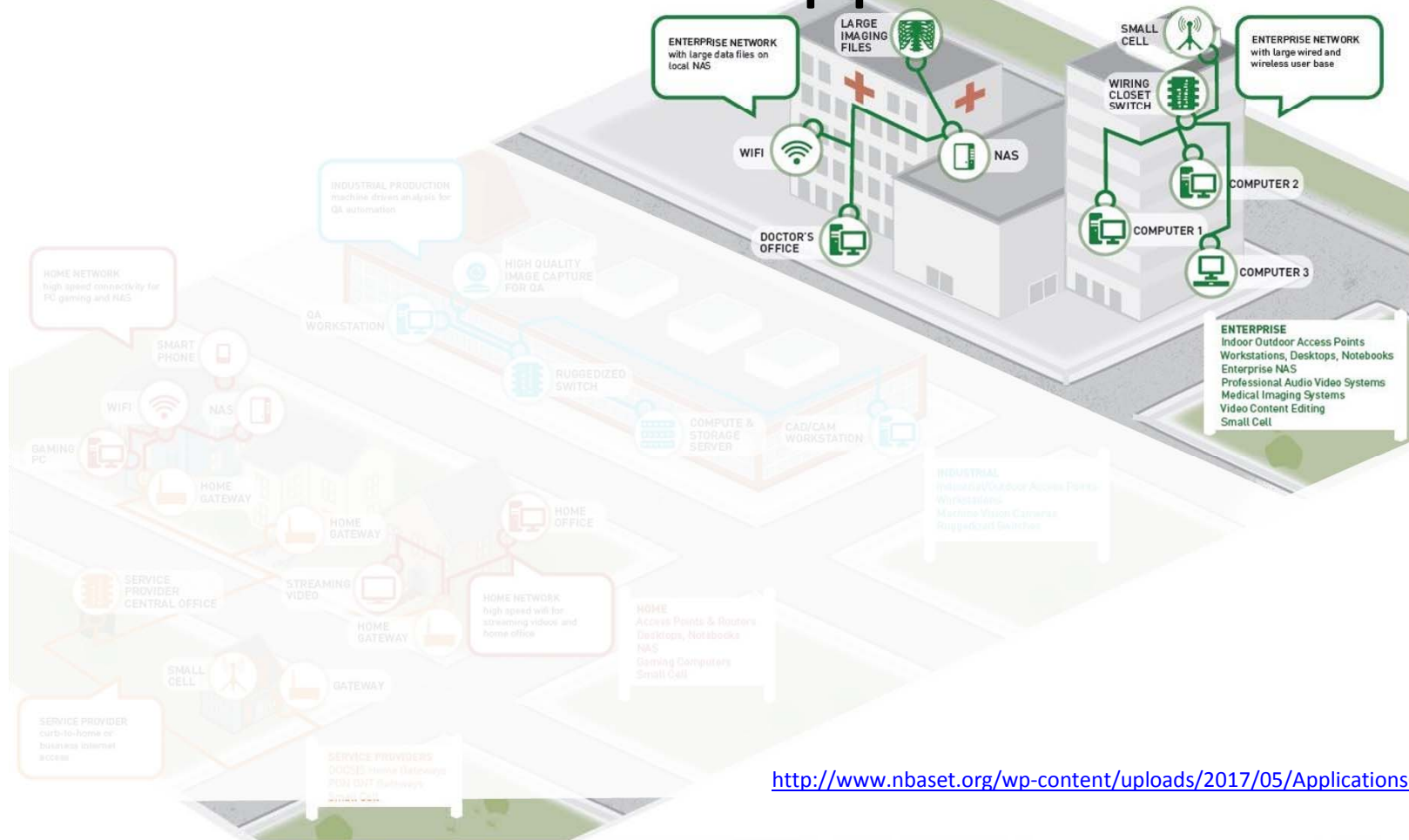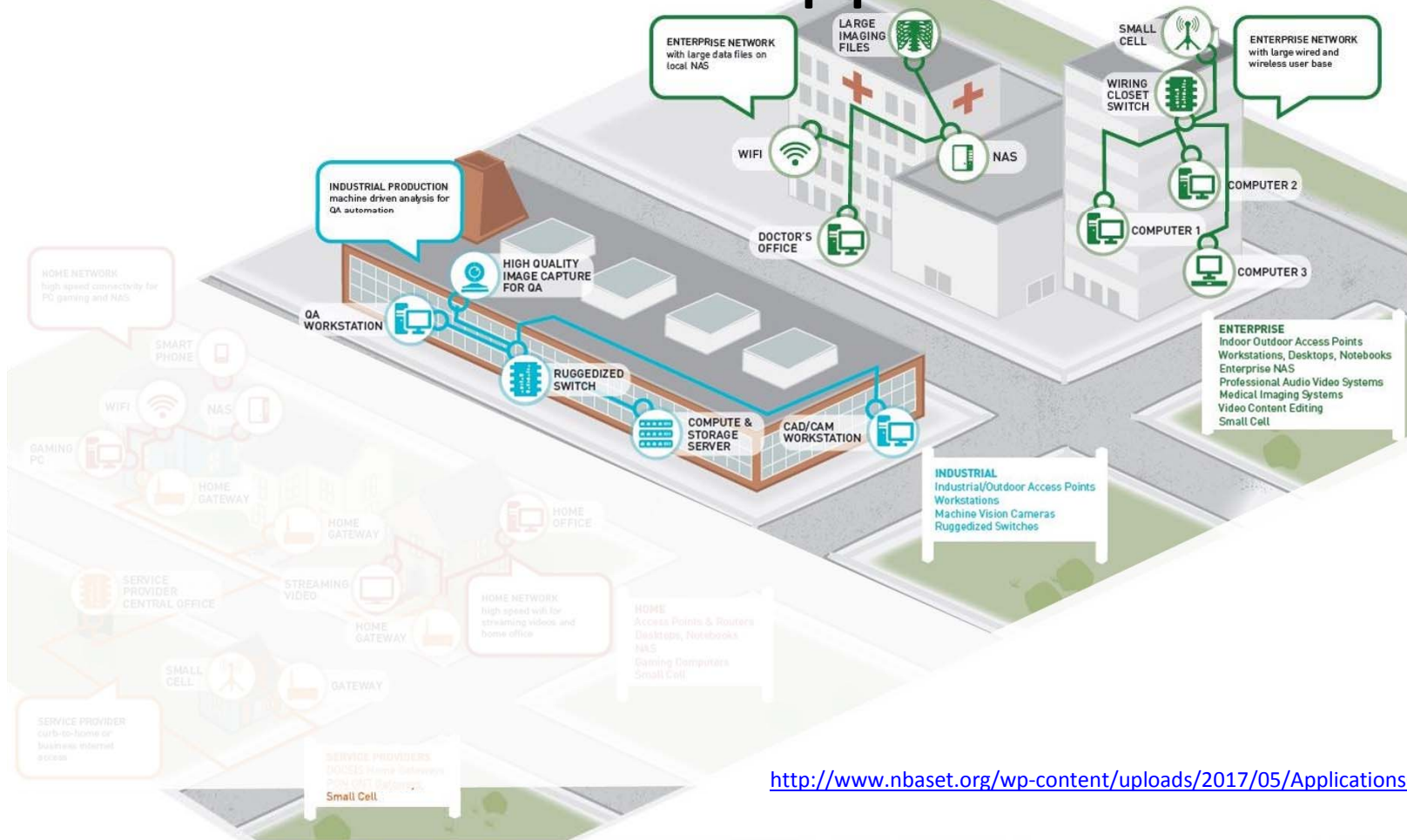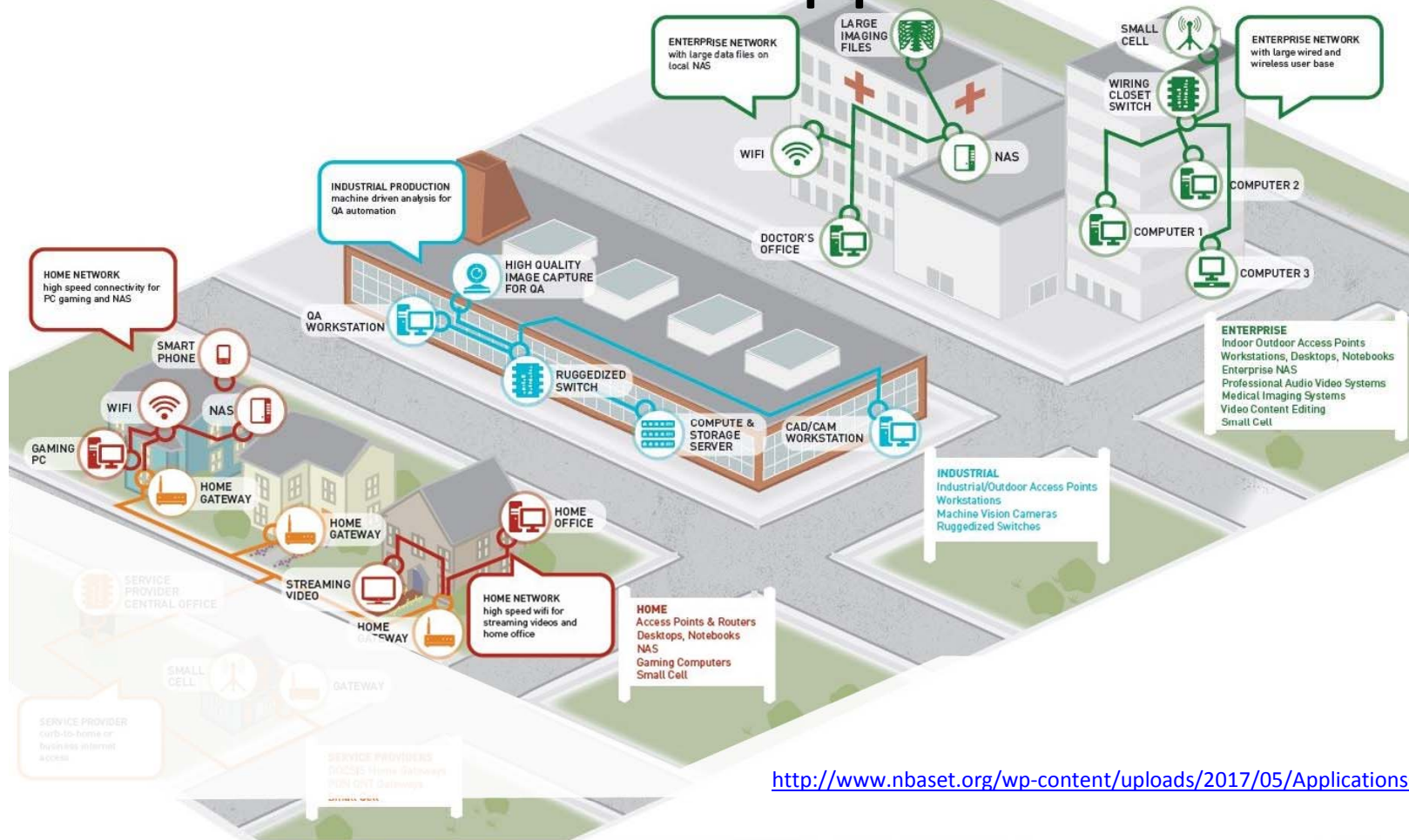   Compute
    Machine Vision

Home:
    Switch
    Wireless AP
    Storage Server
    Home Gateway
    Streaming

Service Provider:
    Small Cell
    Home Gateway

http://www.nbaset.org/wp-content/uploads/2017/05/ApplicationsGraphic_051517.pdf
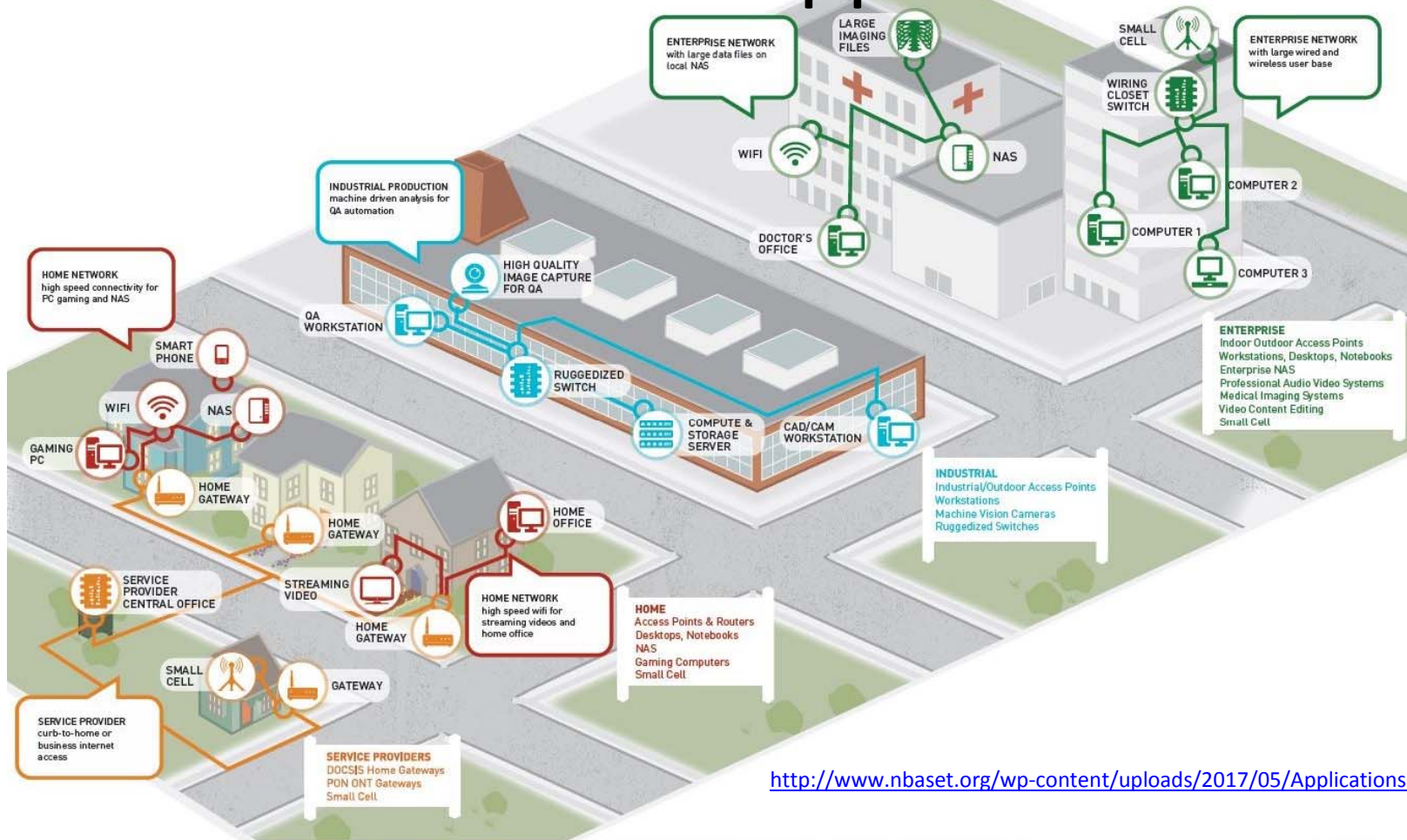
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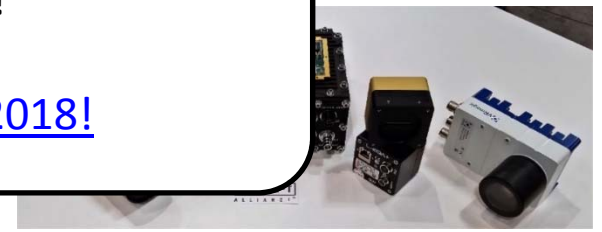- Streaming

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http://www.nbaset.org/wp-content/uploads/2017/05/ApplicationsGraphic_051517.pdf

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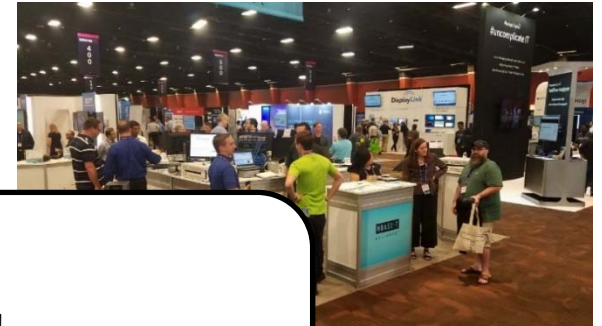- Streaming

Service Provider:
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http://www.nbaset.org/wp-content/uploads/2017/05/ApplicationsGraphic_051517.pdf

NBASE-T Alliance - InteropITX 2017 Demo
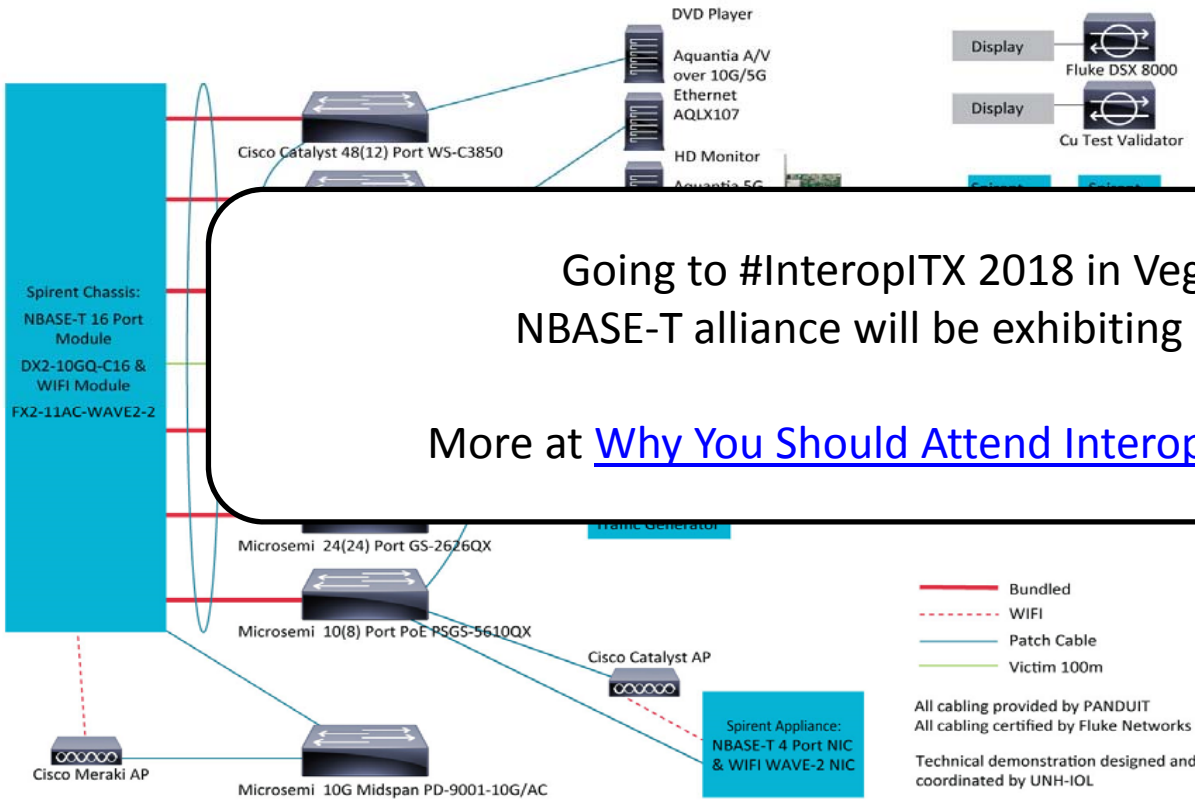
Going to #InteropITX 2018 in Vegas?
NBASE-T alliance will be exhibiting again!

More at [Why You Should Attend Interop ITX 2018!](#)

http://www.nbaset.org/showcasing-nbase-t-interoperability-2017-interop-itx/NBASE-T Alliance at Interop 2017

BRKCRS-3900

NBASE-T IN THE WILD

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So what's a TSA (Technical Solutions Architect)?

NBASE-T ALLIANCE ℠

- Background (how I got here)
  - X1
  - x2
- Work
  - Partners with sales (AM – Account Manager).
  - Listen to customer, sales and corporate, and try to find balance.
  - Win the deal after this one by
- Current work obsession - Automation and Orchestration
  - What
  - Why
  - Result – consumable value
- Outside work
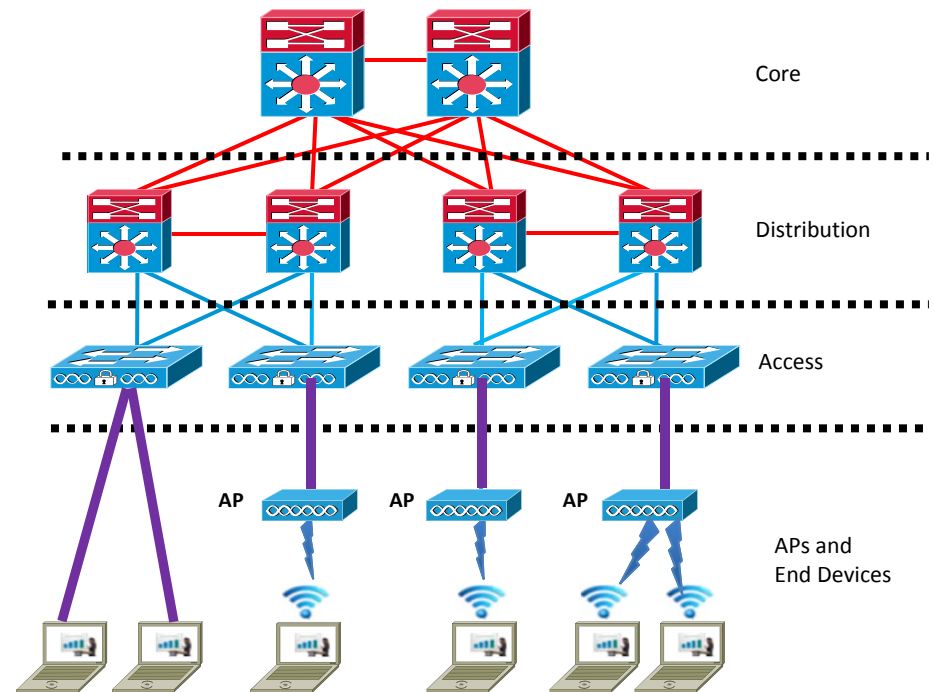 - Pictures – diving and snow boarding

Updates pending
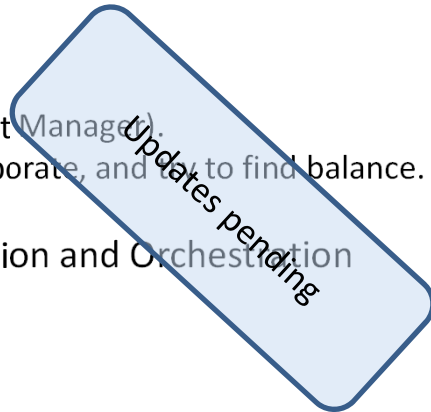
Picture 1

Picture 2

Picture 3

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Typical Enterprise Network Structure

- Three tier design
- Proven, stable, adaptable
- BASE-T **downlinks** from access switches

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Questions & Answers

NBASE-T ALLIANCE℠

Three questions:

1. Why > 1Gb/s access?
2. Pre NBASE-T roadblocks?
3. Value of NBASE-T?

Three answers:

1. Evolve to a smart network edge.
2. Installed cabling.
3. Leverage biggest asset, enable network evolution.

USE CASES

NBASE-T
ALLIANCE℠

Enterprise Wireless -
University of British Columbia

Scientific Compute -
Monash University

Cruise Ships -
Carnival

**2018 BICSI WINTER
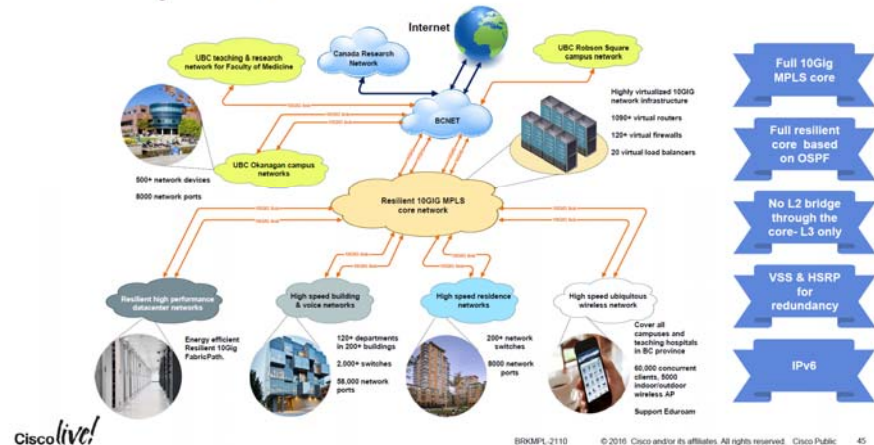CONFERENCE & EXHIBITION**
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Enterprise Wireless – UBC Network

NBASE-T ALLIANCE℠

University of British Columbia – Network Overview

"As one of the world's top research universities, the University of British Columbia has created positive change at home and abroad for more than a century. Today our two major campuses—in Vancouver and the Okanagan—attract, nurture and transform more than 60,000 students from Canada and 140+ countries around the world."

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UBC & Wireless

Updates pending

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Scientific Compute –Monash University

Australian public research university Melbourne, Aus.
Founded in 1958
73,807 Students (50,461 + 22,848)
In 2016, Monash was ranked in the world top:

      20% in teaching
      10% in international outlook
      20% in industry income
      10% in research

https://www.monash.edu/
https://en.wikipedia.org/wiki/Monash_University

Sir John Monash once said...."Adopt as your fundamental creed that you will equip yourself for life, not solely for your own benefit but for the benefit of the whole community.“

Who we are - At Monash, the desire to make a difference informs everything we do. But we go beyond good intentions. We make an impact, both locally and internationally. We are a global university with a presence on four continents. And our plans for the future are ambitious.

Our world university rankings - At Monash, we take our reputation seriously. Monash has achieved an enviable national and international reputation for research and teaching excellence in a short 50 years. Monash is ranked in the top one per cent of world universities.

Monash & NBASE-T

Updates pending

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Las Vegas Resort vs Cruise Ship

Encore Las Vegas

https://disneyworld.disney.go.com/resorts/contemporary-resort/
https://en.wikipedia.org/wiki/Encore_Las_Vegas

Opened: 2008
Rooms: 2,034
Floors: 48

Floor Space: 4.5 million sq. ft.
Height: 631 feet
Width: 93 feet

Regal Princess

https://www.princess.com/ships-and-experience/ships/gp-regal-princess/
https://en.wikipedia.org/wiki/Regal_Princess_(2014)

Inaugural Cruise: 2014
Cabins(Guests): 1,780 (3560)
Decks: 19

Tonnage: 141,000
Length: 1,083 feet
Height: 217 feet

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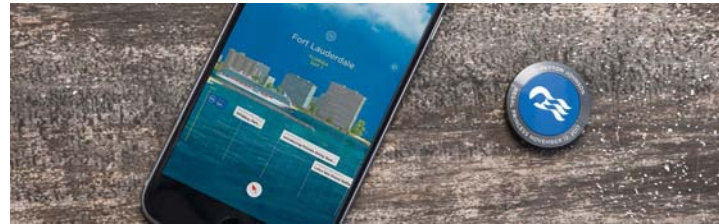## Orlando, FL | February 4-8

Networks on Cruise Ships

Updates pending

Carnival – Ocean Medallion

O·C·E·A·N — or One Cruise Experience Access Network FAQ
https://www.princess.com/ships-and-experience/ocean-medallion/

Carnival Ocean Medallion: 5 takeaways from one of 2017's premier IoT projects
http://www.zdnet.com/article/carnival-ocean-medallion-5-takeaways-from-one-of-2017s-premier-iot-projects/

- A proprietary digital portal on board each ship
- Operates through a network of sensors
- Data analytics and machine learning
- Overcoming timing and technology challenges
- Multiple communication technologies at work

2017 CES Keynote https://youtu.be/Im7xJeHrvkM
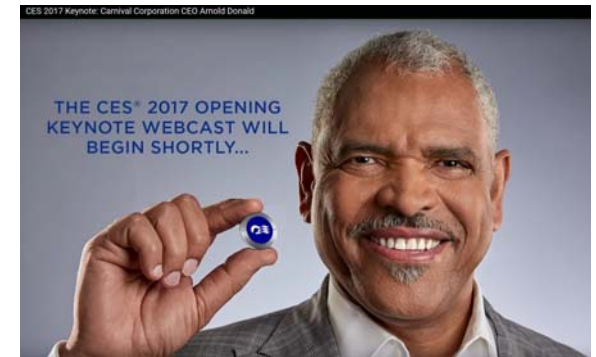
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Carnival & NBASE-T

Updates pending

NBASE-T FUTURE
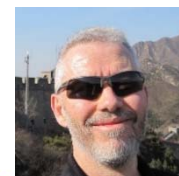
Product Sampler
more at www.nbaset.org

http://www.buffalotech.com/products/terastation-5010-series

NBASE-T
A N C E ℠

https://www.aquantia.com/products/aqtion/nics/

VisionSystems
DESIGN
2017
Innovators
Awards
GOLD

https://www.apple.com/imac-pro

https://www.e2v.com/products/imaging/
cameras/uniiqa-4k-mono-and-colour/
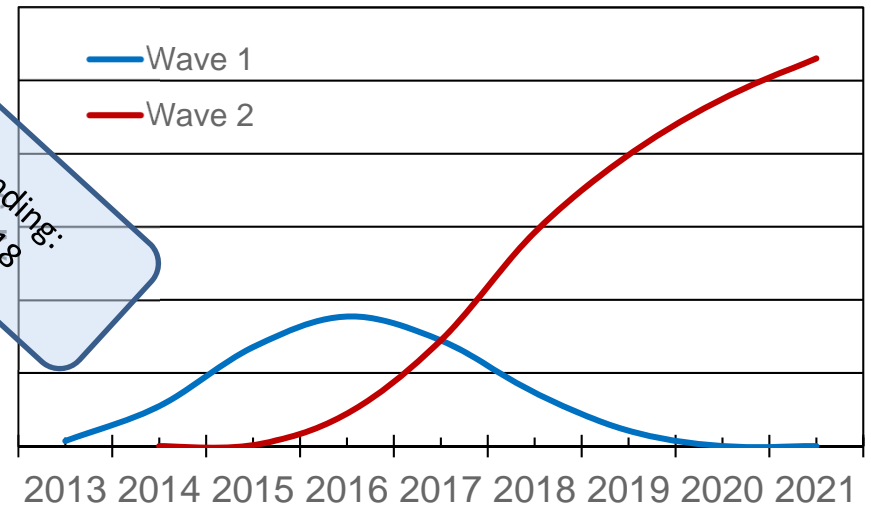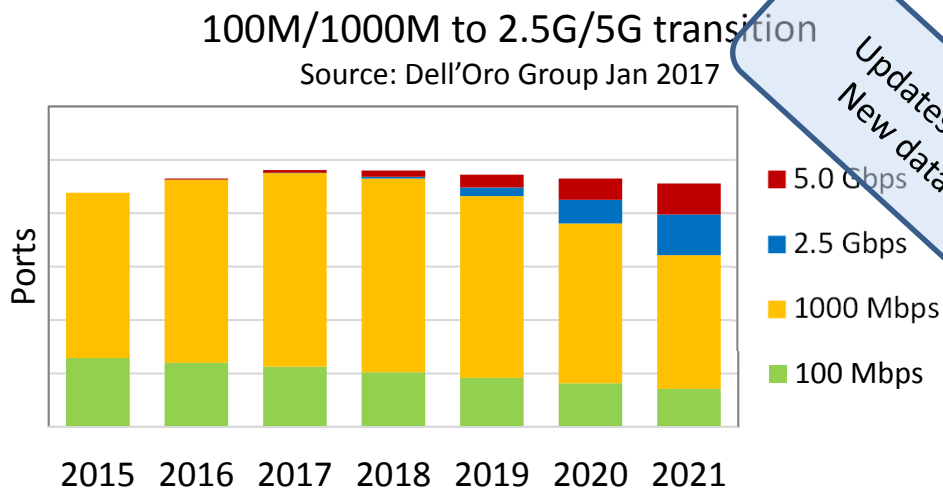
http://www.marvell.com/transceivers/alaska/

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Forecasts

There is a rapid transition from 11n to 11ac

Wave 2 started ramping in 2016, exceeds Wave 1 in 2017

100M/1000M to 2.5G/5G transition
Source: Dell'Oro Group Jan 2017

Ports

- ■ 5.0 Gbps
- ■ 2.5 Gbps
- ■ 1000 Mbps
- ■ 100 Mbps

2015 2016 2017 2018 2019 2020 2021

Updates pending:
New data 2018

Enterprise AP 802.11ac Wave Transition
Source: Dell'Oro Group Jan 2017

— Wave 1
— Wave 2

2013 2014 2015 2016 2017 2018 2019 2020 2021

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NBASE-T Wrap-up

- NBASE-T provides 2.5Gbps and 5Gbps over installed cabling
  - Interoperable with IEEE 802.3bz (2.5GBASE-T and 5GBASE-T)
  - NBASE-T Downshift adapts to cabling to achieve the best performance
- NBASE-T supports use cases (including 802.11ac Wave 2) at > 1Gbps
- Cabling standards and guidelines for NBASE-T/802.3bz on the way
- Field test procedures to maximize performance are available

How can you make use of NBASE-T?

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Thank You!

Blanks