



Yuna Shin
Leviton Network Solutions

ENTERPRISE WIRELESS:

FOUR STEPS

to Successful Deployment



2017 BICSI *Fall*
CONFERENCE & EXHIBITION
SEPTEMBER 24-28 | LAS VEGAS, NV

Presenter Bio

- Yuna Shin
- Senior Product Manager, Copper Leviton Network Solutions
- Bothell, WA U.S.A.
- Manages Leviton's extensive selection of Category 6A, 6, and 5e patch panels and connectors



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By the end of this webinar, you will be able to

- Understand what determines wireless speed
- Plan properly for wireless deployment
- Make the right product choices
- Understand 2.5GBASE-T and 5GBASE-T



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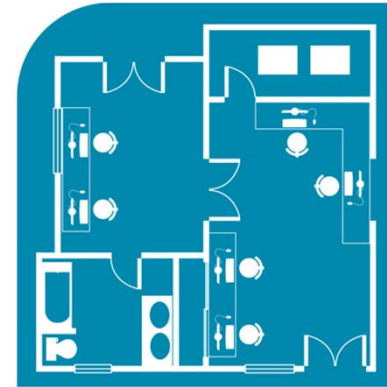
Four Steps to Successful Wireless Deployment



STEP 1

Understand Wireless
Technology

— Knowledge —

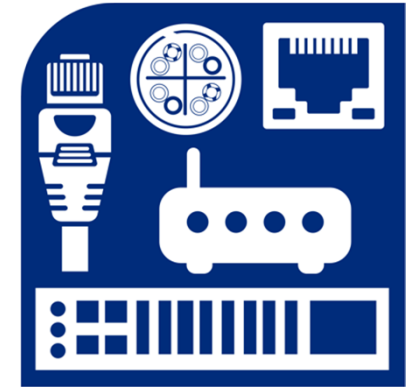


STEP 2

Understand Applications
and Capacity

STEP 3

Understand Environments
and Architecture



STEP 4

Make Cabling and
Connectivity Choices

— Planning —



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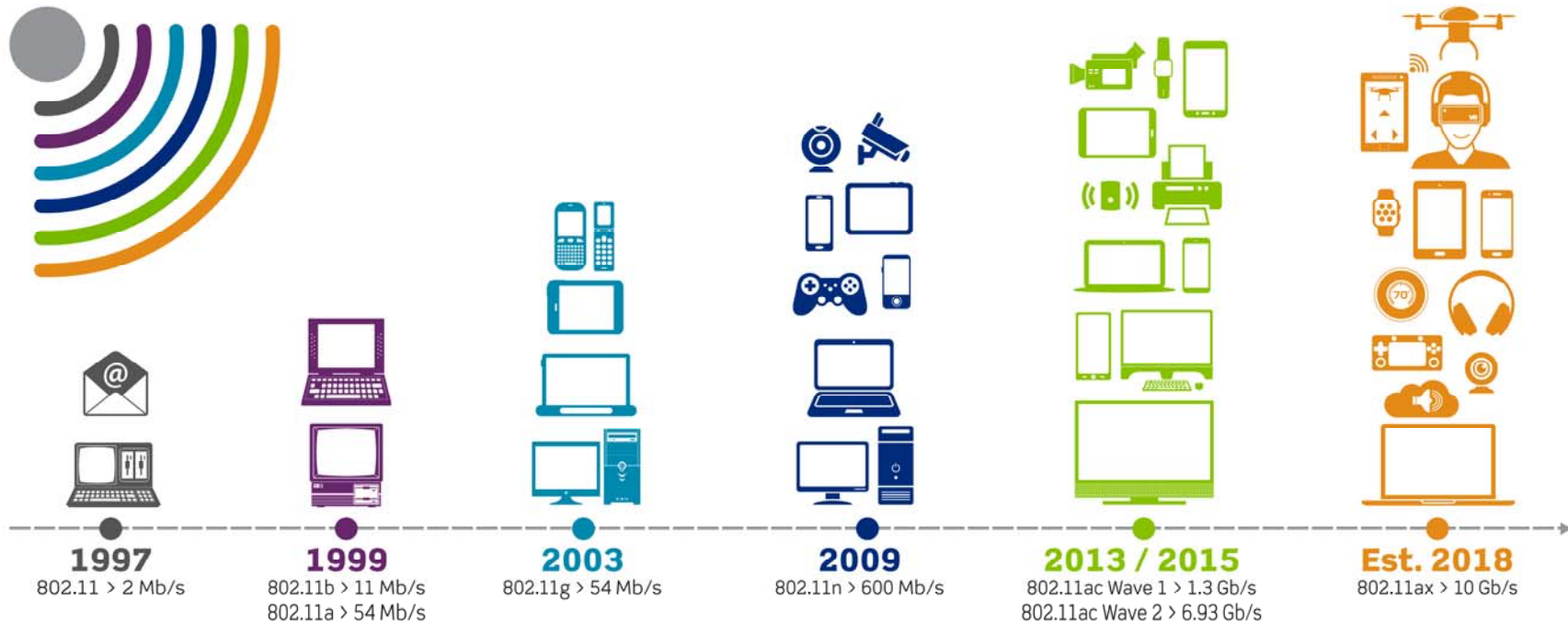
UNDERSTAND

Wireless Technology



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Evolution of 802.11



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Market Driver:

Bandwidth Explosion from Digital Transformation

Drivers



Office Buildings

BYOD and Video Conferencing



Manufacturing

Smart Machines



Education

Digital Learning and Security



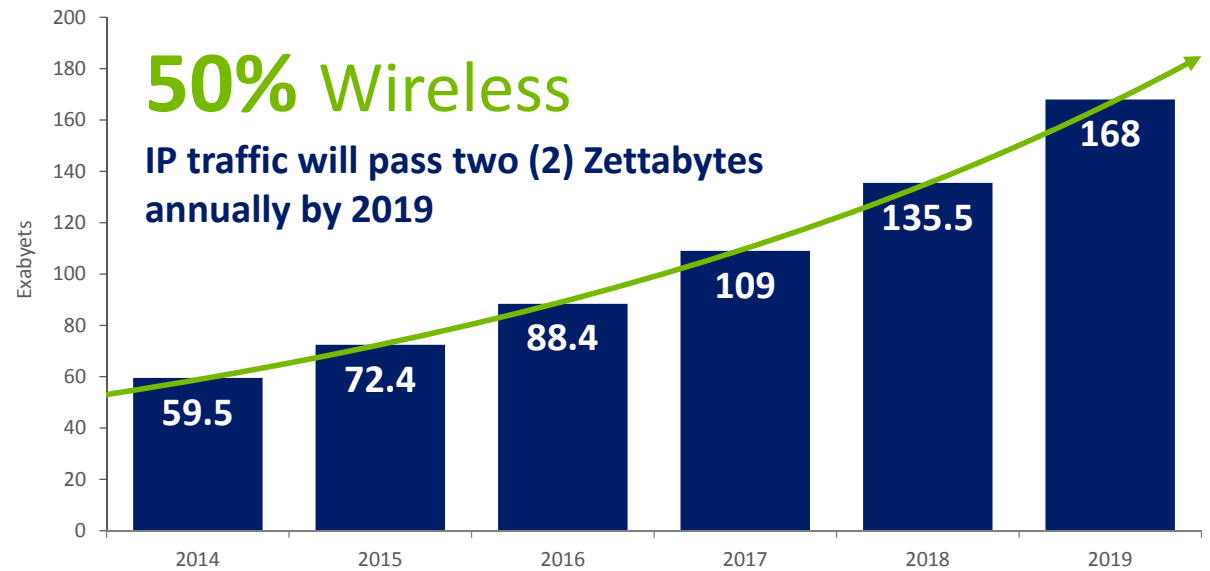
Health Care

Medical Devices

Impact

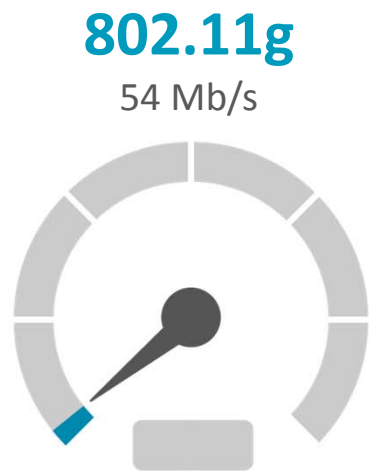
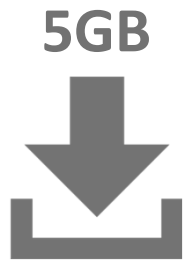
50% Wireless

IP traffic will pass two (2) Zettabytes annually by 2019

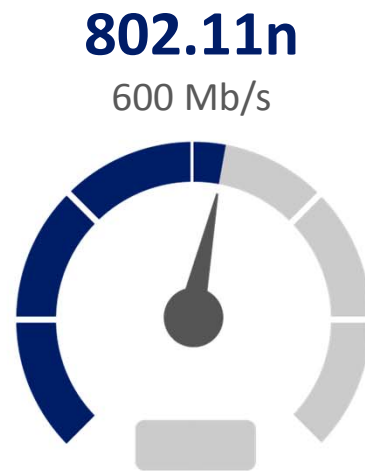


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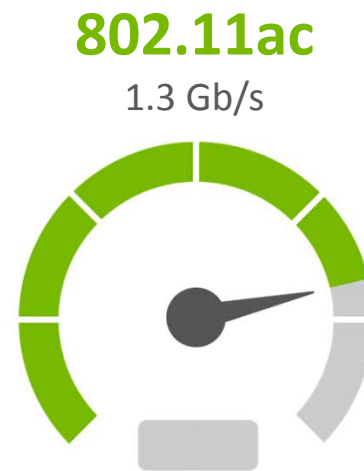
Workplace Efficiency



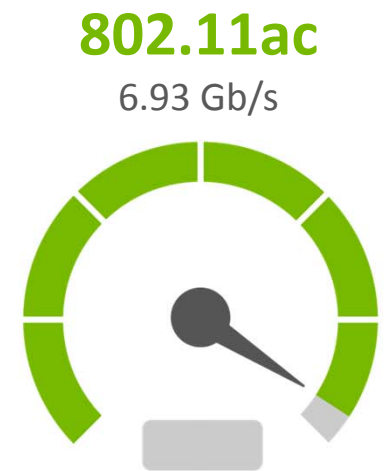
13 min. 54 sec.



1 min. 15 sec.



33 sec.



6 sec.



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Wireless Standards at a Glance

INCREASING SPEED AND POWER



	802.11a	802.11b	802.11g	802.11n	802.11ac Wave 1	802.11ac Wave 2	802.11ax In Development
Year Introduced	1999	1999	2003	2009	2013	2015	2018 (est.)
Channel Bandwidth	20MHz	20MHz	20MHz	20, 40 MHz	20,40,80 MHz	20,40,80, 80+80/160 MHz	20, 40, 80 80+80/160 MHz
Frequency Band	5 GHz	2.4 GHz	2.4 GHz	2.4 & 5 GHz	5 GHz	5 GHz	5 GHz
Spatial Streams	1	1	1	4	8	8	8
Antenna Configuration	SISO	SISO	SISO	4X4 MIMO	8X8 MIMO	8X8 MU-MIMO	8X8 MU-MIMO
Highest order Modulation	64 QAM	DQPSK	64 QAM	64 QAM	256 QAM	256 QAM	TBD
Maximum Throughput	54 Mb/s	11 Mb/s	54 Mb/s	600 Mb/s	1.3 Gb/s	6.93 Gb/s	10 Gb/s



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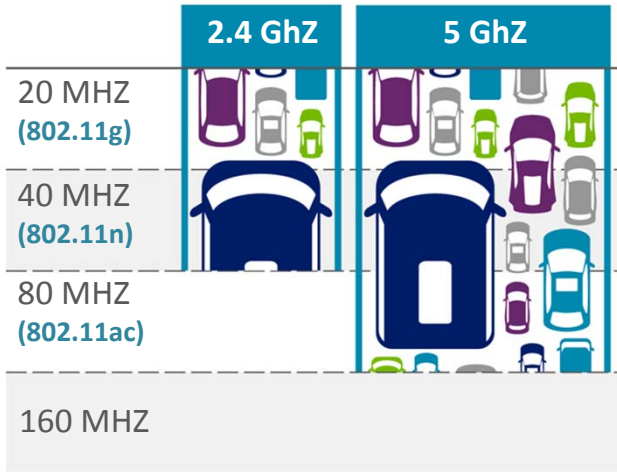


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What Determines Wireless Speed?

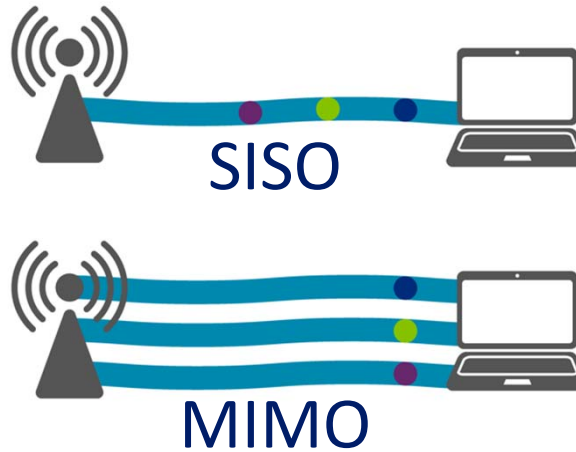
Channel Bandwidth

Capacity



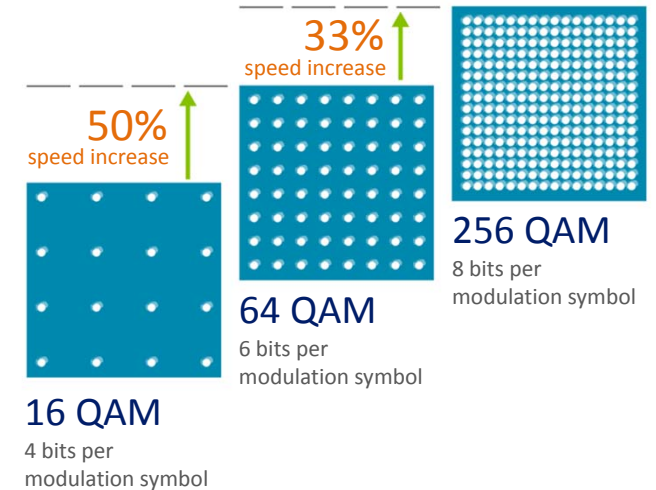
Antenna and Spatial Streams

Concentrated signal through multiple paths



Modulation

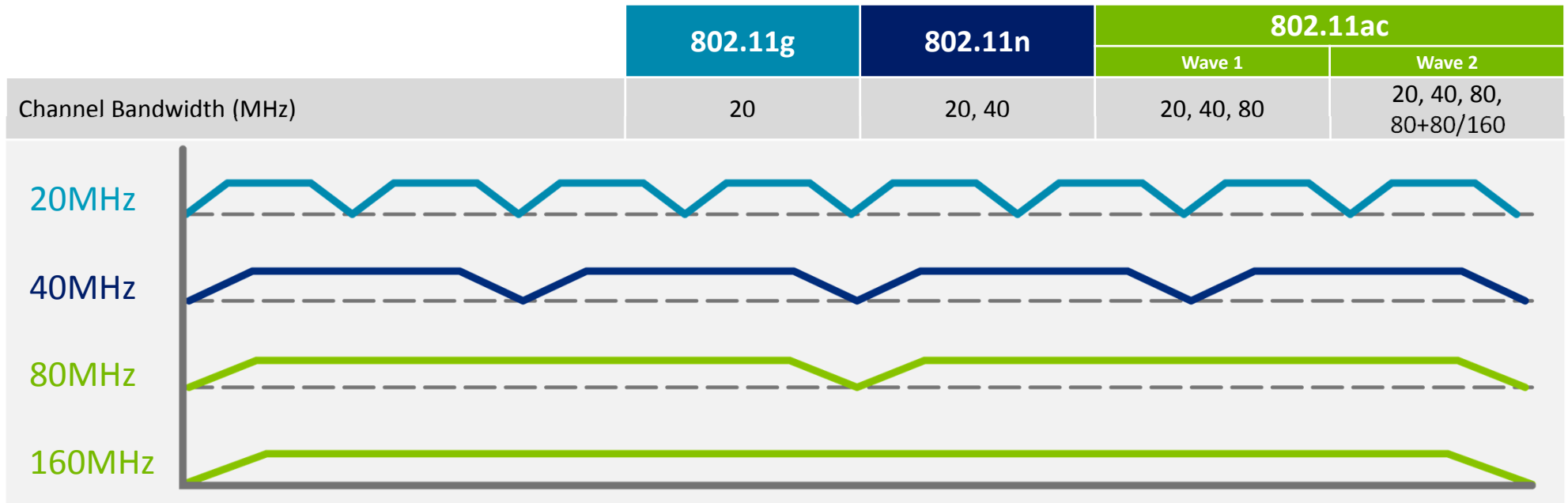
Speed



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Channel Bandwidth

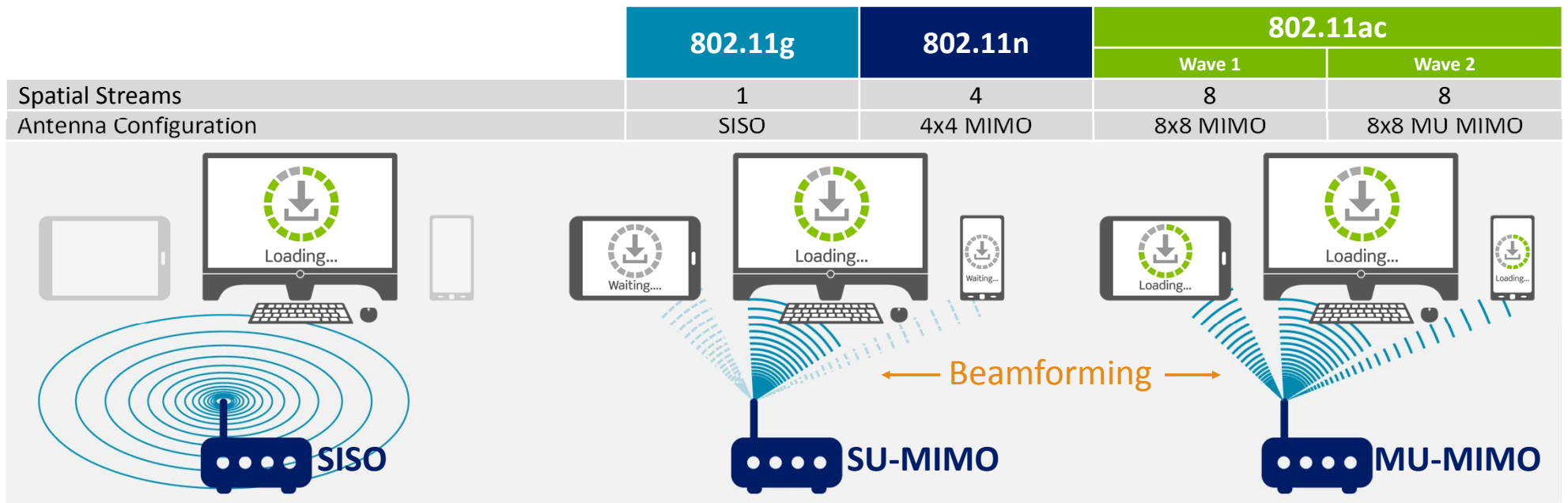
Wider Bandwidth – More Capacity



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Antenna and Spatial Streams

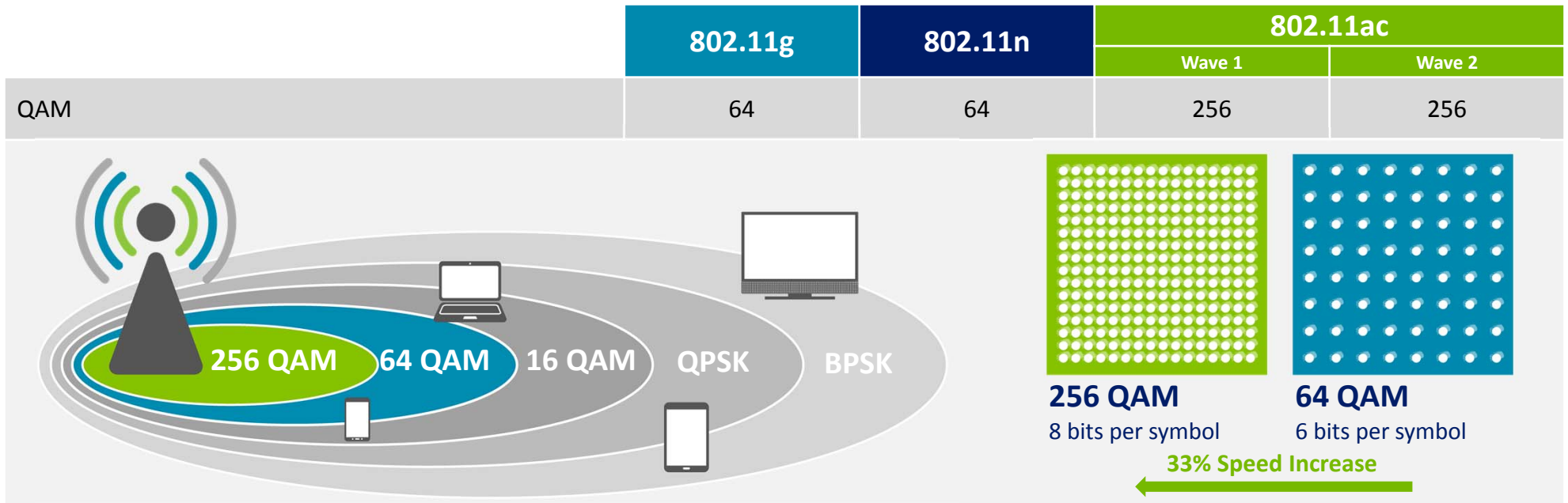
Concentrated signal through multiple paths



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Modulation

Higher order modulation – Faster Speed



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Benefits of 802.11ac

- Does 802.11ac WAP provide more capacity? **YES**
- Does 802.11ac WAP provide faster speed? **YES**
- Does 802.11ac WAP provide cleaner signal? **YES**
- Does 802.11ac WAP provide wider range? **NO**

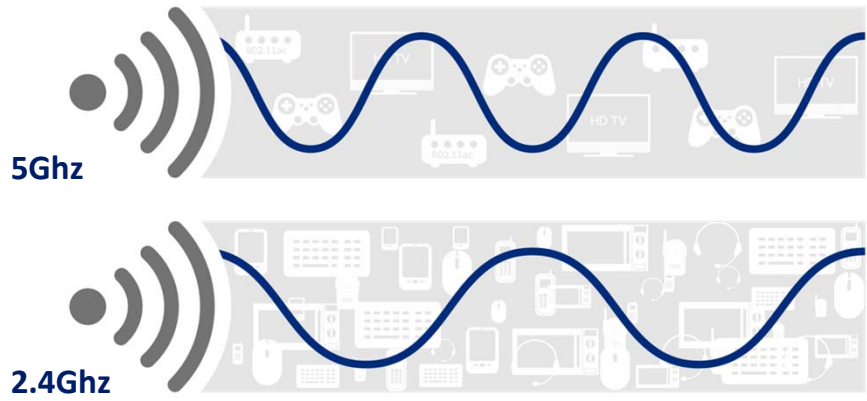


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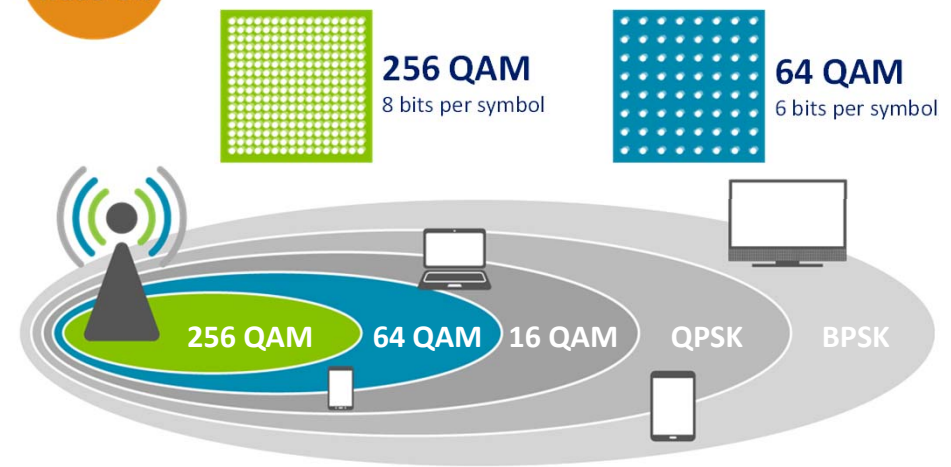
Understanding Tradeoff

Coverage

 **More susceptible to obstruction**



 **Need to be closer**



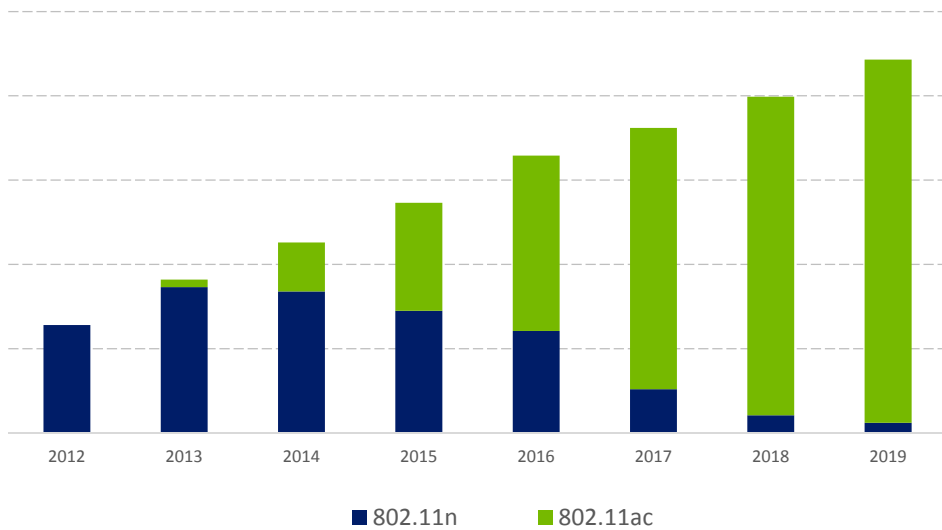
Planning is critical



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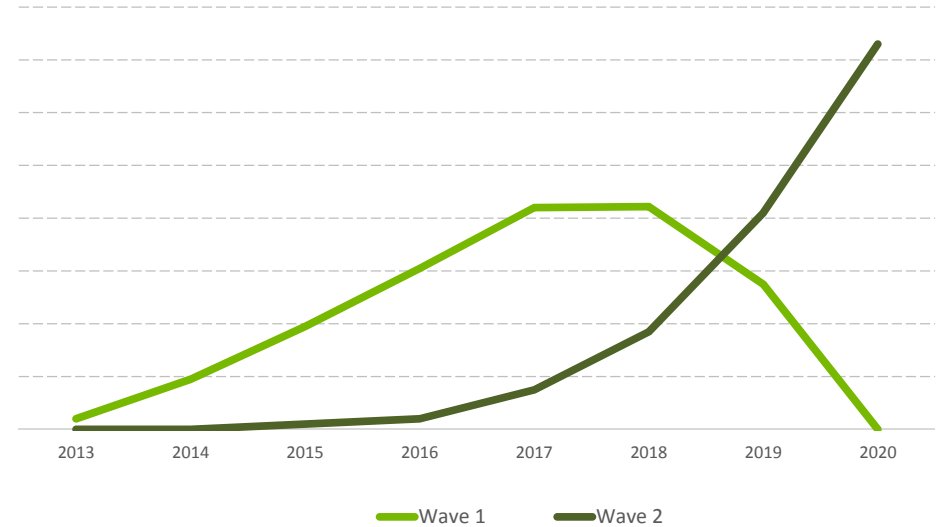
Wireless Access Point Transition

Enterprise AP Volume Split



Source: Dell'Oro Group Wireless LAN 5-year Forecast Jan 2015

Enterprise 802.11ac AP Transition



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



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UNDERSTAND

Applications and Capacity



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Applications and Capacity

Application Type & Number of People and Devices



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Enterprise Building

Capacity



Commercial

Open spaces
Offices
Conference Rooms



Education

Lecture Halls
Classrooms
Dormitories
Libraries
Open Spaces



Health Care

Waiting Rooms
Reception Areas
Doctors Offices
Surgery Rooms
Imaging Rooms



Manufacturing

Factory Floors
Warehouses
Offices



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Enterprise Building

Applications



Commercial

Laptops
Computers
Video Conferencing
VoIP
Smart phones
Tablets



Education

Laptops
Computers
Tablets
Smart phones
Lecture



Health Care

Computers
Smart phone
Laptops
Imaging Devices
Tablets
RTLS

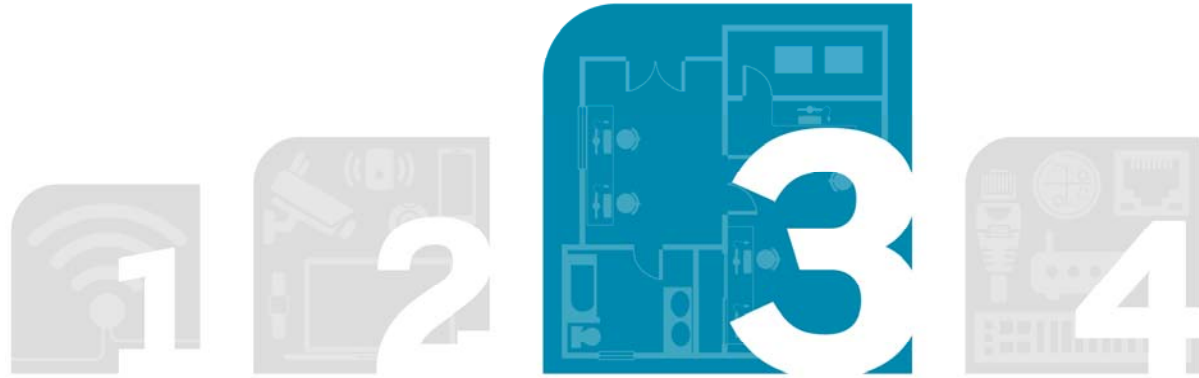


Manufacturing

Inventory Control
Line automation
Smart Machines



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UNDERSTAND

Environments and Architecture



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Environments and Architecture

■ Floor layout

- Open, closed, semi closed

■ Size

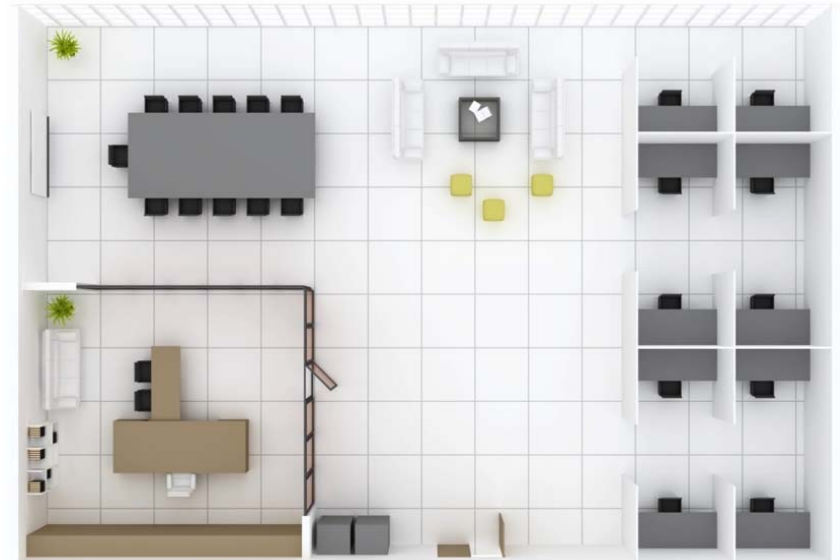
- Small, medium, large

■ Building materials

■ Building furnishing

■ 802.11ac – RF Barriers at 5GHz

- Concrete, security glass, metal partitions



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WAP Installation Consideration



Drop Ceiling



Wall



Enclosures

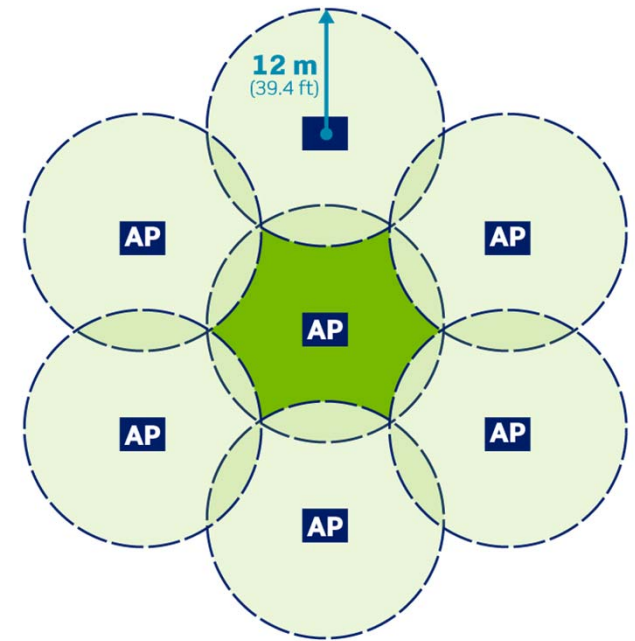


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Design Recommendations

ISO/IEC TR-24704

- Array of tight-fitting hexagonal cells
- 12-meter radius limit
- Outlet at center of the cell



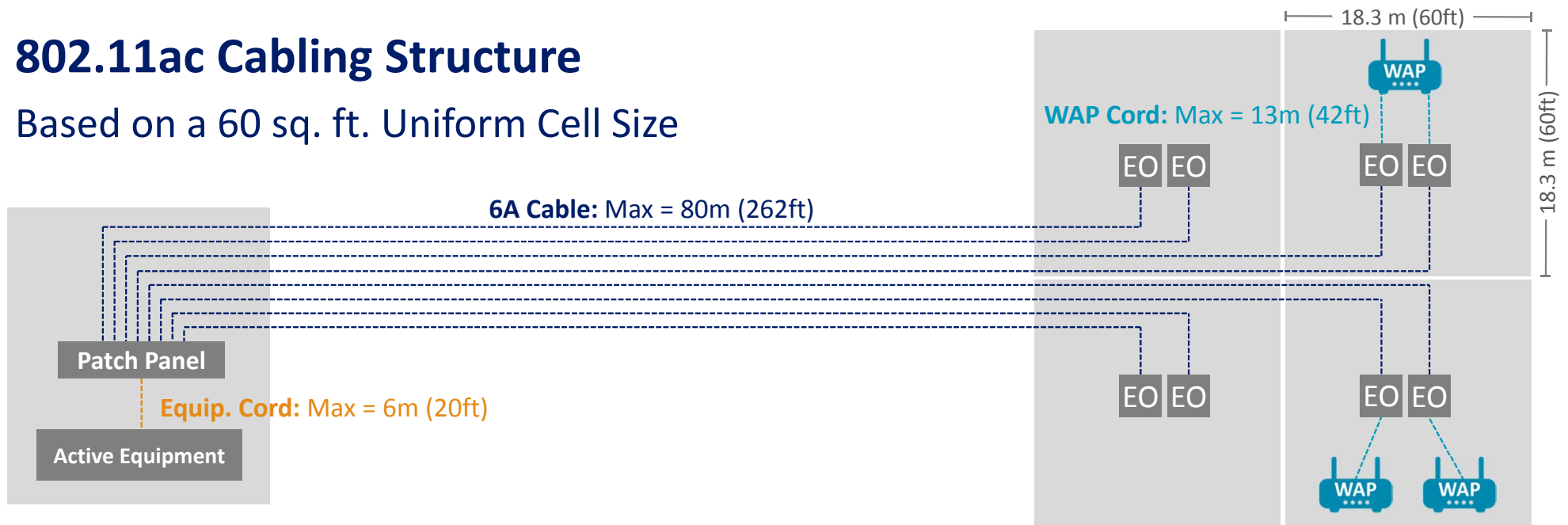
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Design Recommendations

TIA TSB-162-A

802.11ac Cabling Structure

Based on a 60 sq. ft. Uniform Cell Size



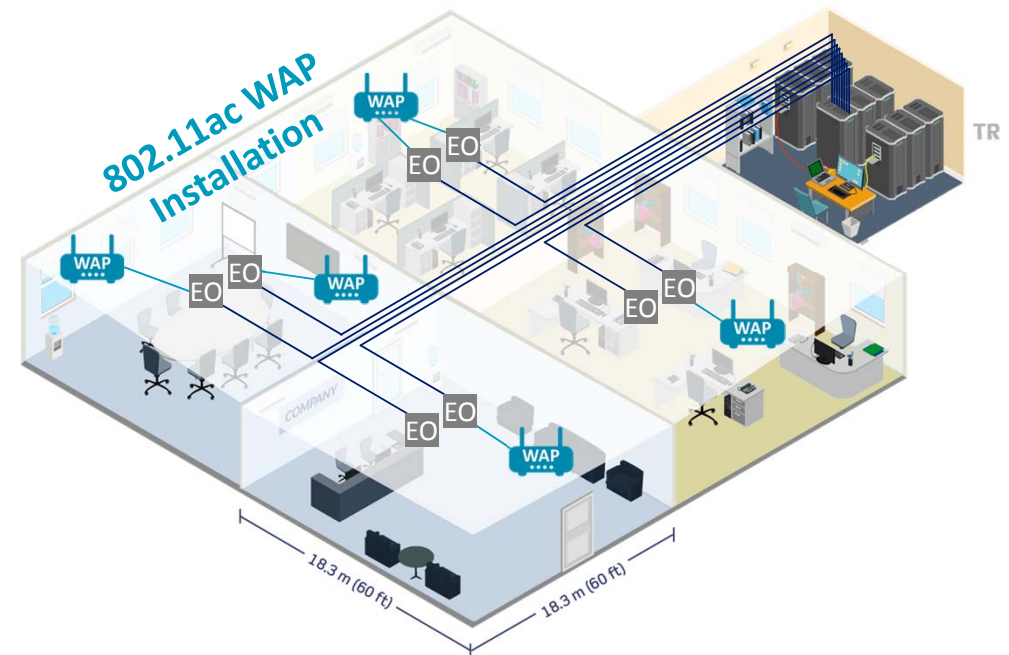
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Design Example

TIA TSB-162-A

802.11ac Cabling Structure

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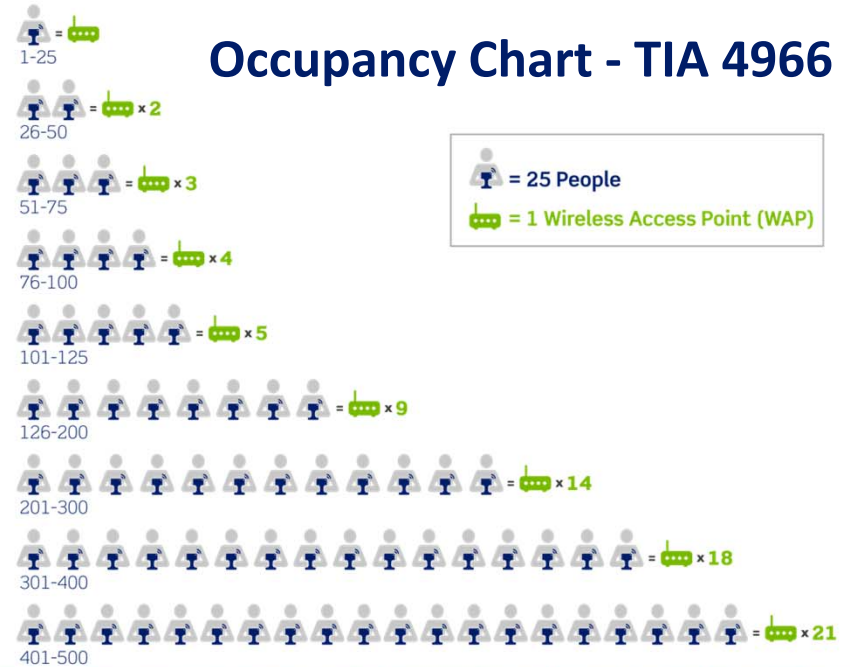


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Design Recommendations

TIA-4966

- Occupancy recommendation
- One access point per 230 square meters
- Noisy environments with high RF interference concentration
 - One access point per 150 square meter

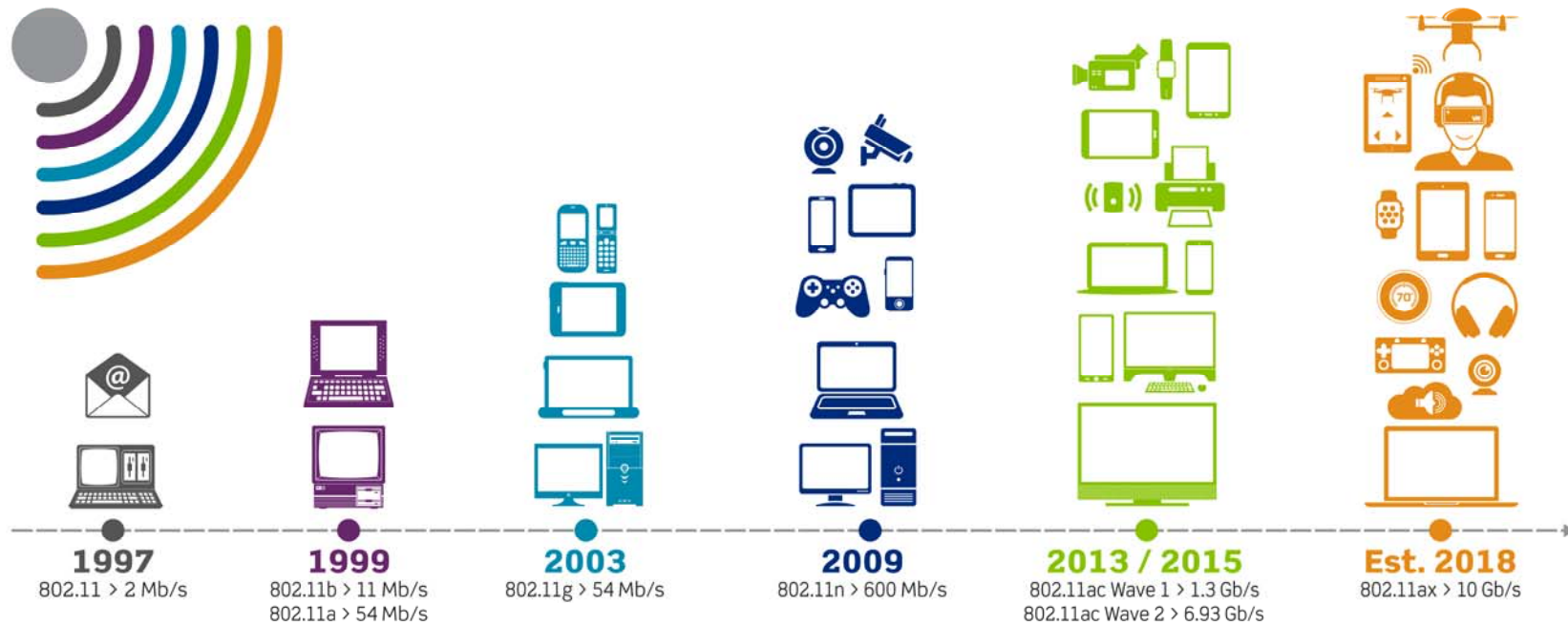


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Wireless Speed



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Category Cabling Supporting Wireless Speed

	1G	1G	10G	10G
Category	5e	6	6A	6A
Maximum Bandwidth	100 MHz	250 MHz	500 MHz	500 MHz
Maximum Data Rate	1000BASE-T	1000BASE-T	10GBASE-T	10GBASE-T
Maximum Reach	100m	100m	100m	100m
Number of Connectors in Channel	4	4	4	4
Cable Construction	Unshielded/Shielded	Unshielded/Shielded	Unshielded/Shielded	Unshielded/Shielded
Date Created	1999	1999	2006	2006

●	●	●	●
802.11g > 54 Mb/s	802.11n > 600 Mb/s	802.11ac Wave 1 > 1.3 Gb/s Wave 2 > 6.93 Gb/s	802.11ax > 10 Gb/s



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Only Cat 6A Supports 802.11ac or Higher

	1G	1G	10G	10G
Category	5e	6	6A	6A
Maximum Bandwidth	100 MHz	250 MHz	500 MHz	500 MHz
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Cabling and Connectivity

TIA TSB-162-A Recommendation

- **Two Cat 6A cables per AP**
 - Higher data rates
 - Increased power delivery
- **Four Cat 6A drops to every AP for future needs**
- **Plenum rated equipment outlets and patch cords**



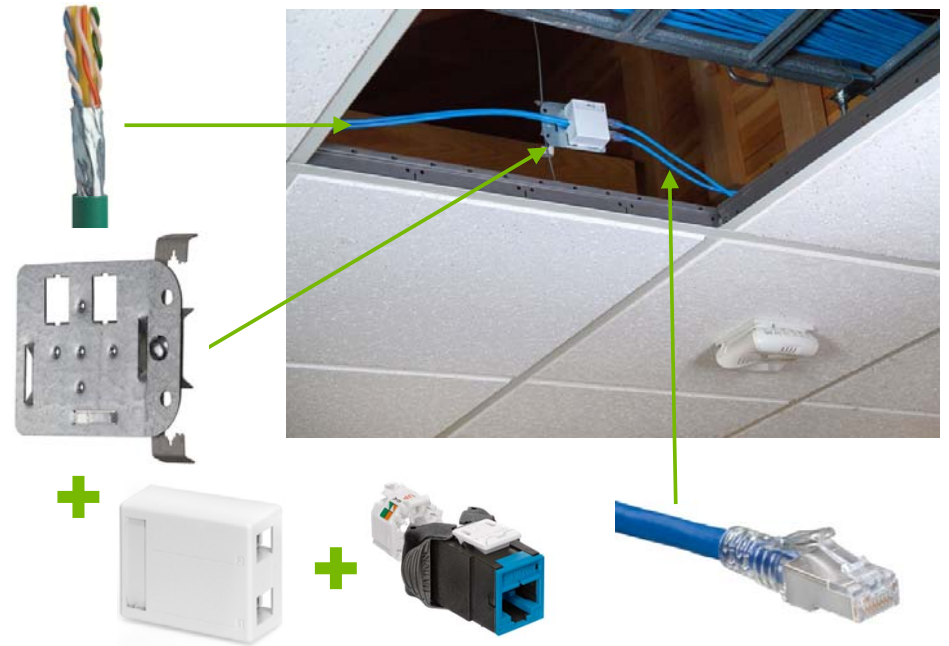
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Cabling and Connectivity Choices

Quality, Reliability, and Performance

Cables + Connectors + Cords

- Third Party Tested
- Plenum Rated
- Support PoE and PoE+
 - 802.11n: PoE (15W)
 - 802.11ac: PoE + (30W)



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2.5/5GBASE-T

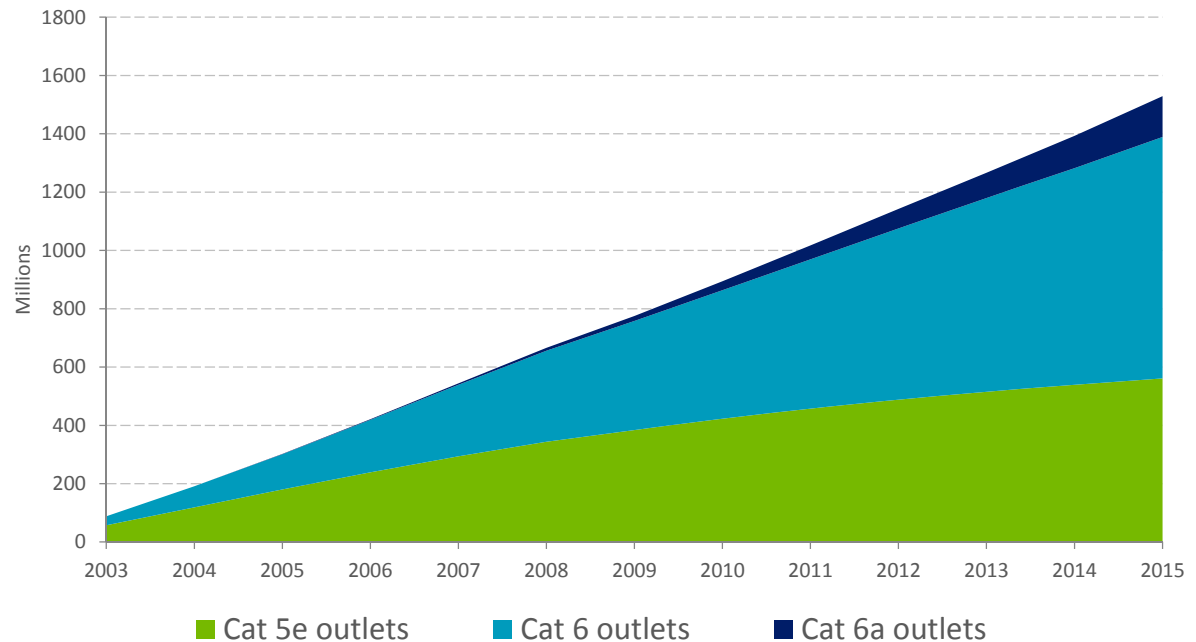
Getting more with existing Cat 5e and Cat 6 infrastructure?



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Currently Installed Cat 5e and Cat 6 Components

More than 70 Billion meters of Cat 5e and Cat 6 cabling were sold and **More than 1.3 Billion** Cat 5e and Cat 6 ports are installed last 12 years

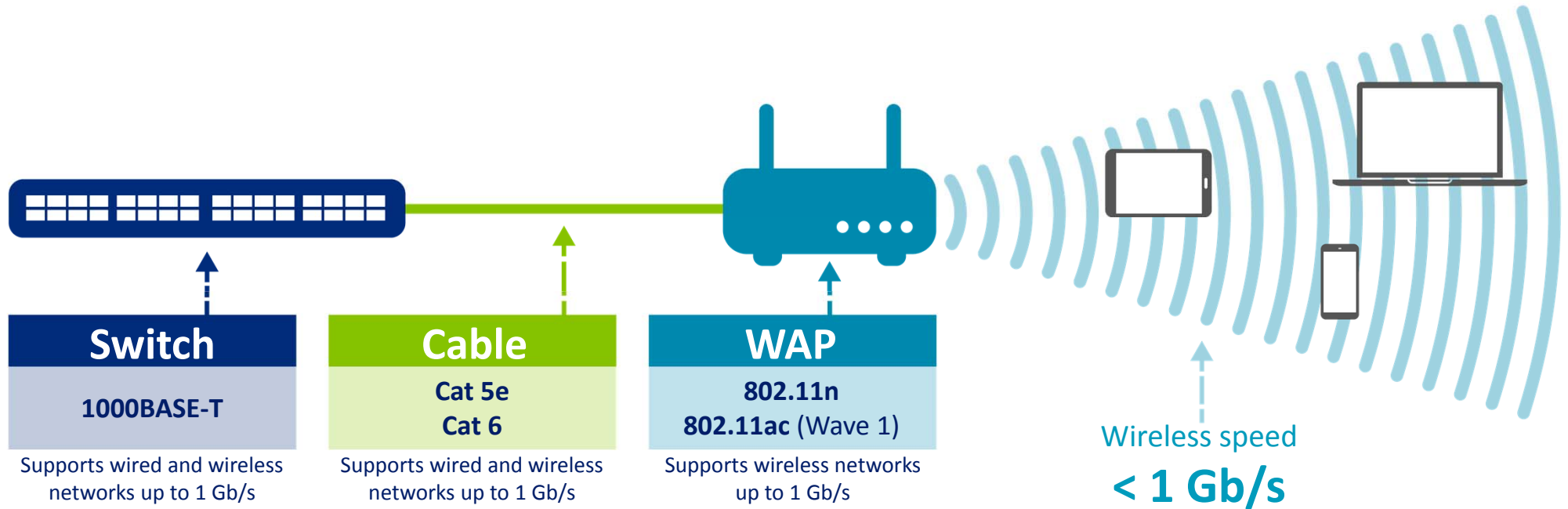


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Source: BTIA, 2015

Infrastructure for 1G Wireless Network

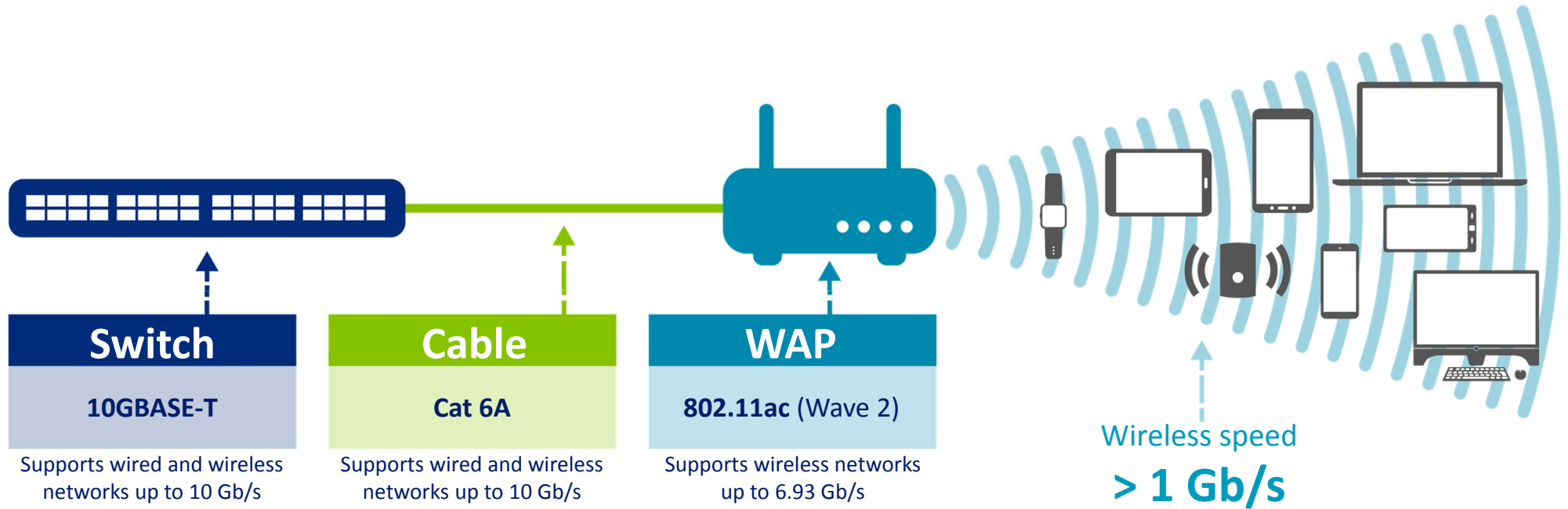
Category 5e and 6 Cabling



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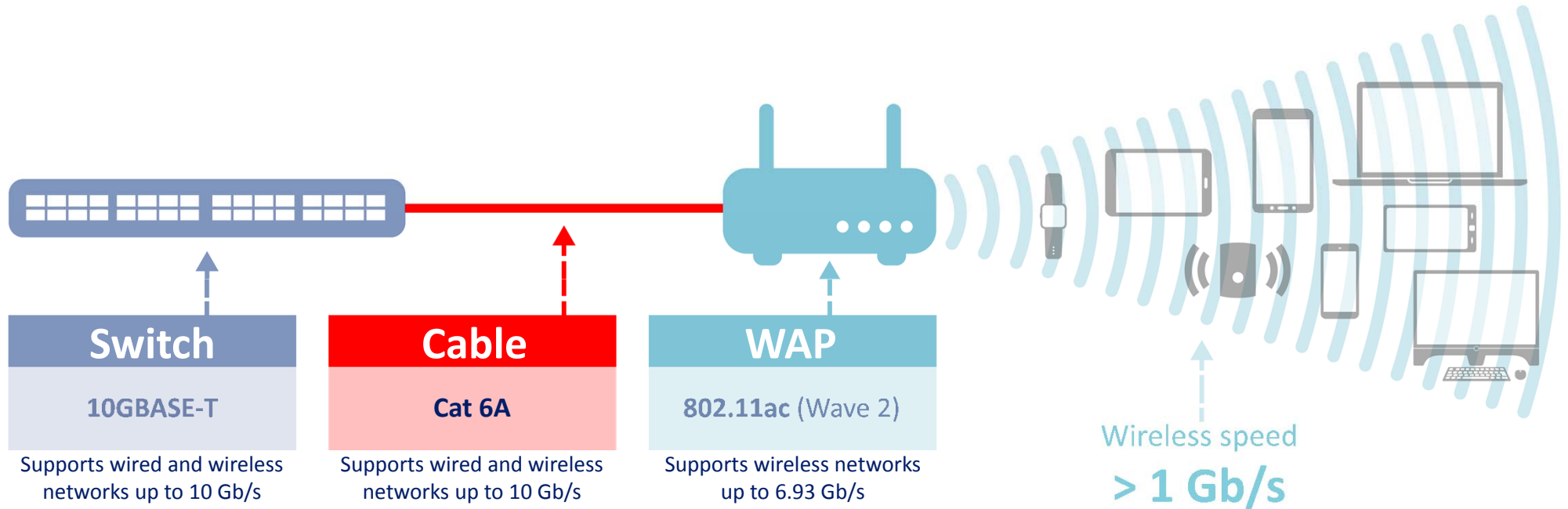
Infrastructure for 1G Wireless Network

Category 6A Cabling



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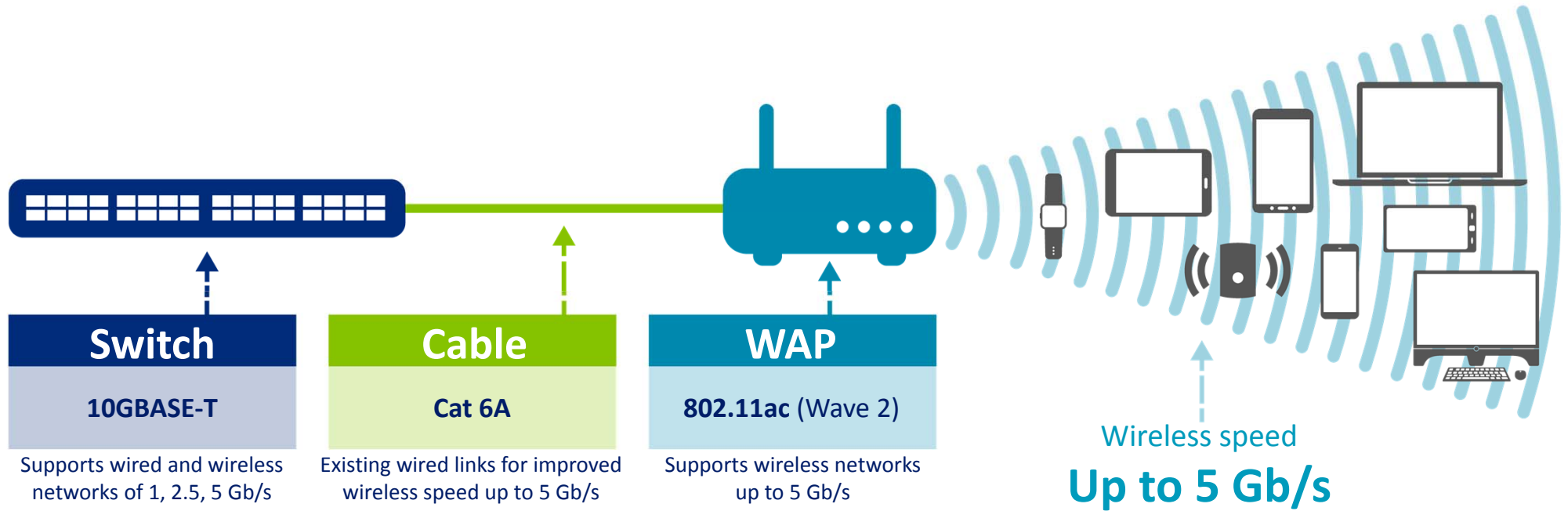
Upgrading to Cat 6A is Expensive



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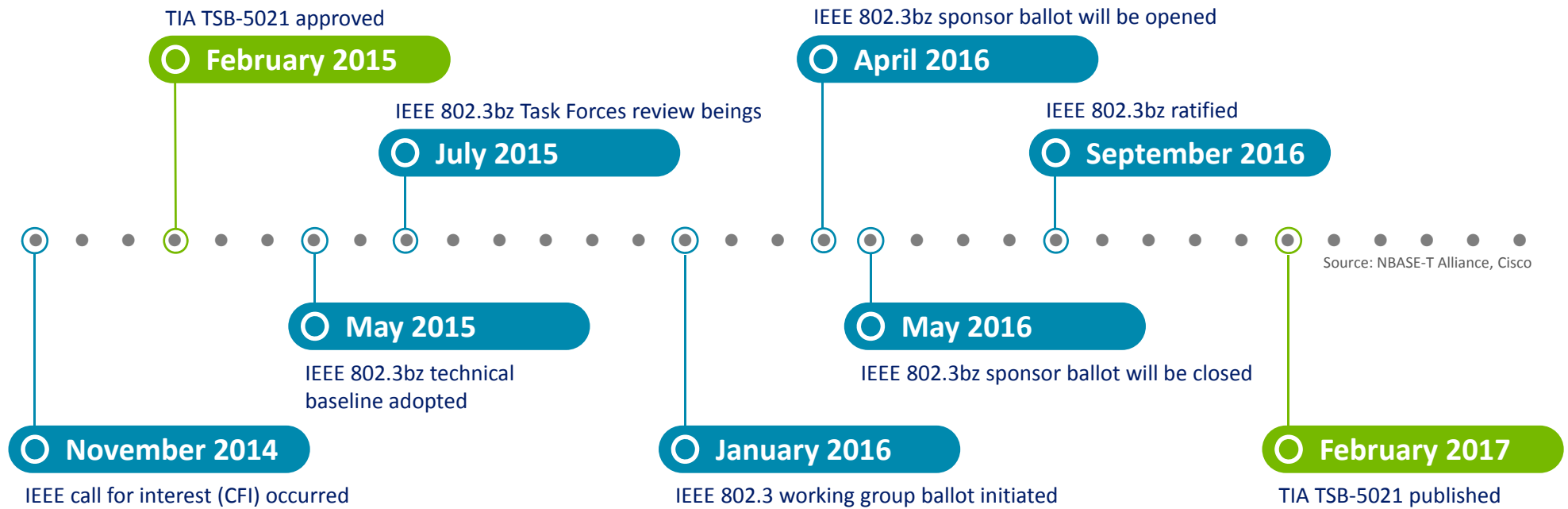
What is 2.5GBASE-T and 5GBASE-T?

Temporary Alternative to Upgrading Infrastructure



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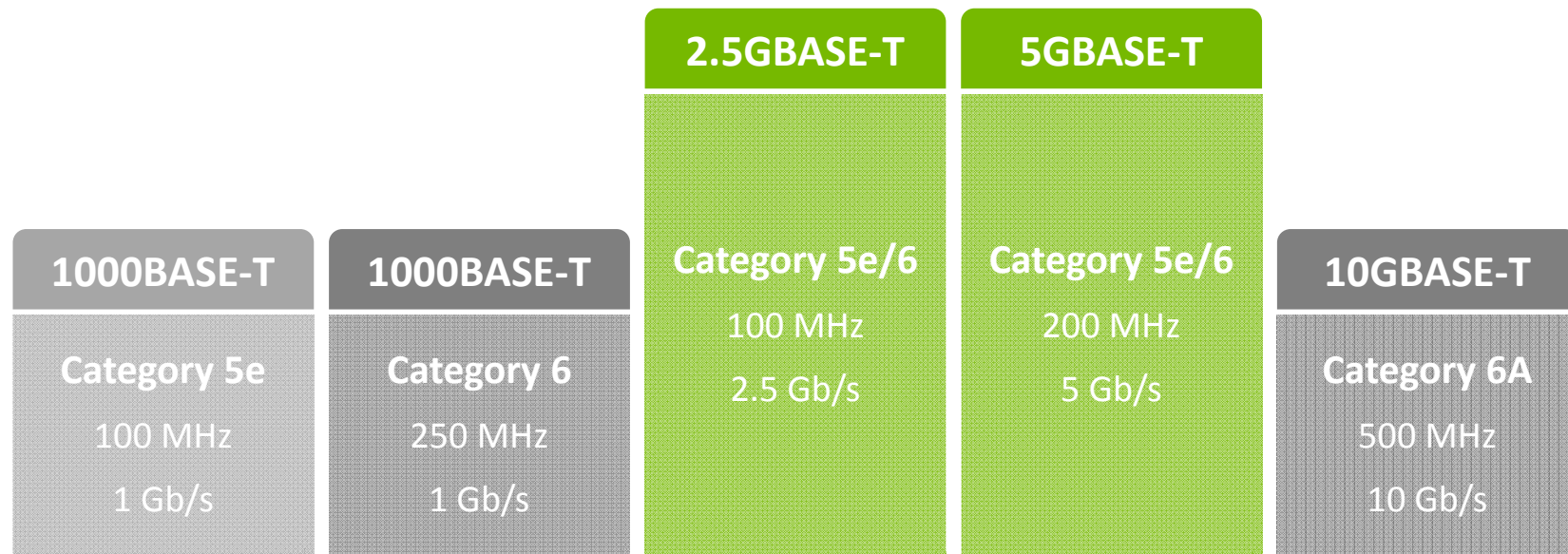
IEEE 802.3bz and TIA TSB-5021



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3 Things You Need to Know About

2.5GBASE-T and 5GBASE-T



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Remember!

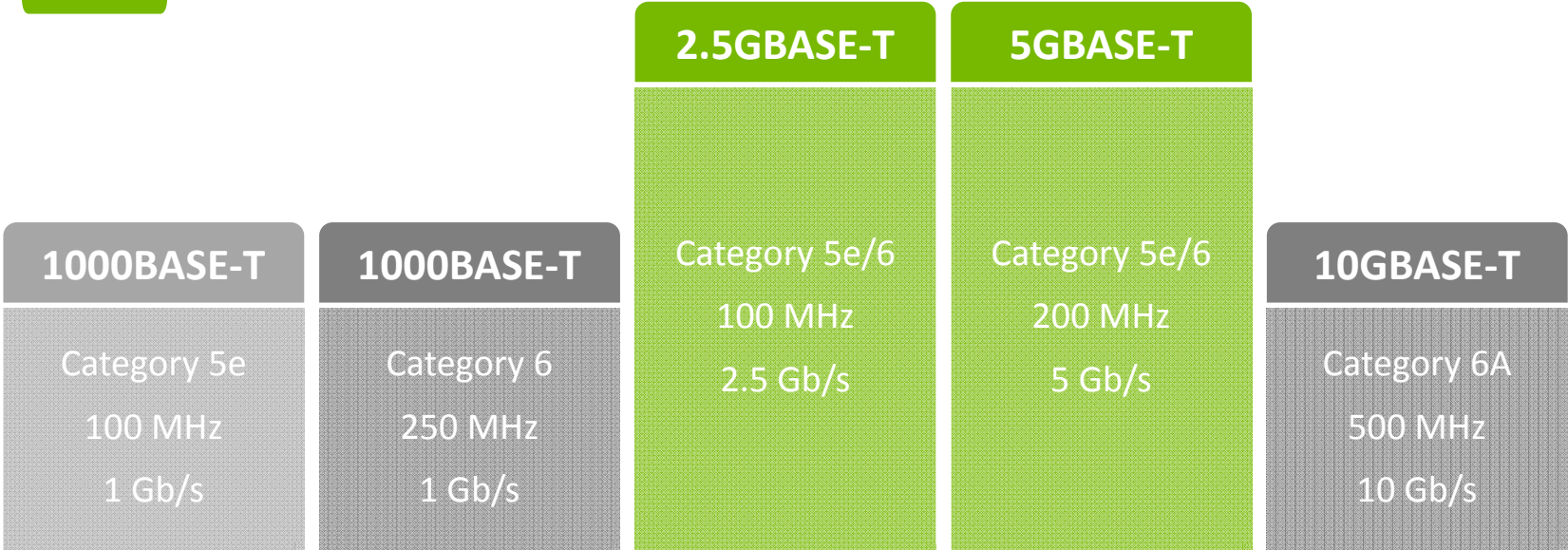
2.5GBASE-T and 5GBASE-T are only for EXISTING Cat 5e and Cat 6 cabling

1000BASE-T	1000BASE-T	2.5GBASE-T	5GBASE-T	10GBASE-T
Category 5e 100 MHz 1 Gb/s	Category 6 250 MHz 1 Gb/s	Category 5e/6 100 MHz 2.5 Gb/s	Category 5e/6 200 MHz 5 Gb/s	Category 6A 500 MHz 10 Gb/s



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1 Alien Crosstalk



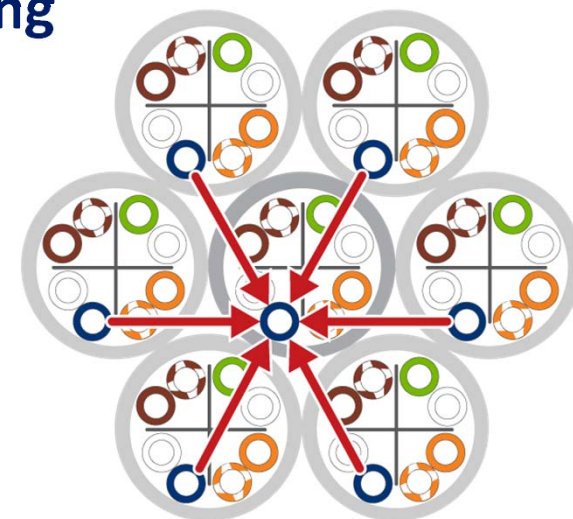
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2.5GBASE-T and 5GBASE-T

Alien Crosstalk

- Alien Crosstalk not specified for Cat 5e or 6 cabling
- Alien crosstalk limits also not specified for 2.5/5GBASE-T
 - HOWEVER, new criteria developed to assess channel's susceptibility to AXT
- ALSNR (Alien Limited Signal to Noise Ratio)

ALSNR > 28 dB



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2.5GBASE-T and 5GBASE-T

Alien Crosstalk

- ALSNR testing to be implemented in field testers
- Field testing of AXT time consuming and expensive
- Summary of risk assessment based on bundled lengths

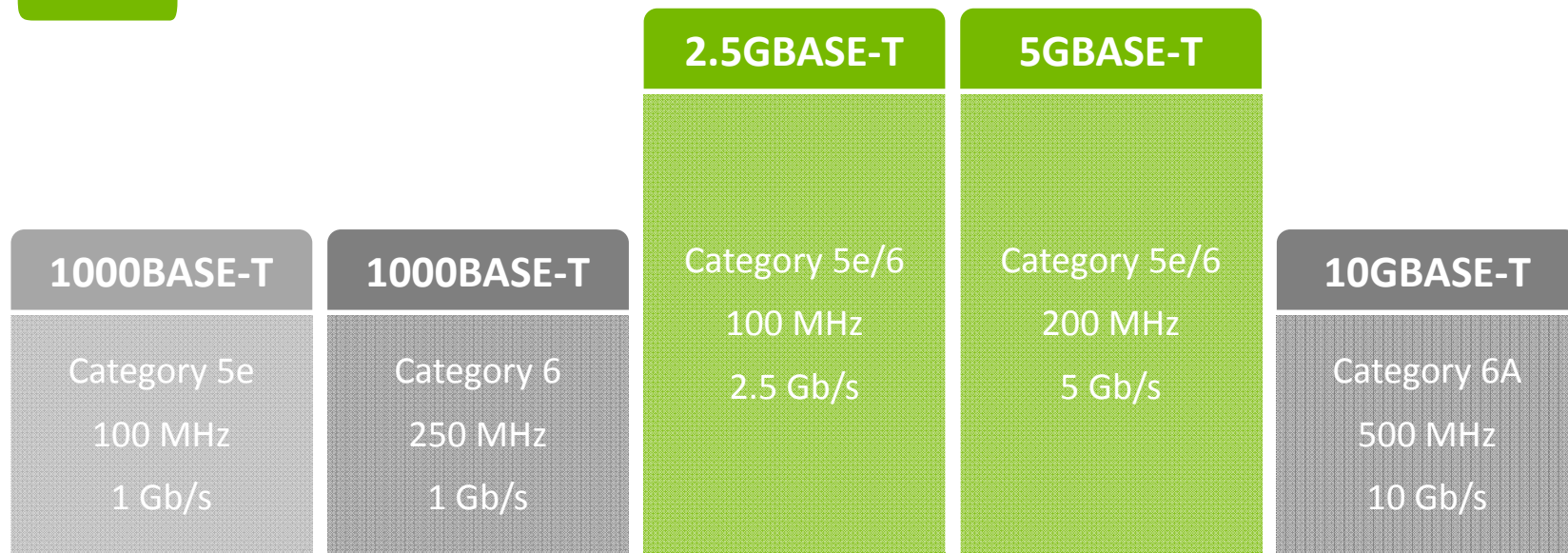
Bundle Distance (meters)	Speed	Cat 5e			Cat 6		
		Victim Length (m)			Victim Length (m)		
		1 - 20	20 - 75	75 - 100	1 - 20	20 - 75	75 - 100
0 - 20	2.5G	Negligible			Negligible		
	5G	Negligible		Low	Negligible		Low
20 - 75	2.5G	N/A	Low	Medium Low	N/A	Negligible	
	5G	N/A	Medium Low	Medium High	N/A	Low	Medium
75 - 100	2.5G	N/A	N/A	Medium	N/A	N/A	Medium Low
	5G	N/A	N/A	High	N/A	N/A	Medium High



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Source: TIA TSB-5021

2 Power over Ethernet (PoE)



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2.5GBASE-T and 5GBASE-T

PoE and Cable Bundle

■ PoE is the most convenient method to power

- Approximately 18 million PoE enabled APs shipping annually
 - 25 million by 2020
- Power consumption increasing due to advanced technology

■ 802.11ac WAP has faster speed but less coverage

- More APs required, which means more cables
- Potential issues with heat generation

■ Key considerations for network PoE capabilities

- Ambient temperature, cable jacket rating, wire gauge and cable construction



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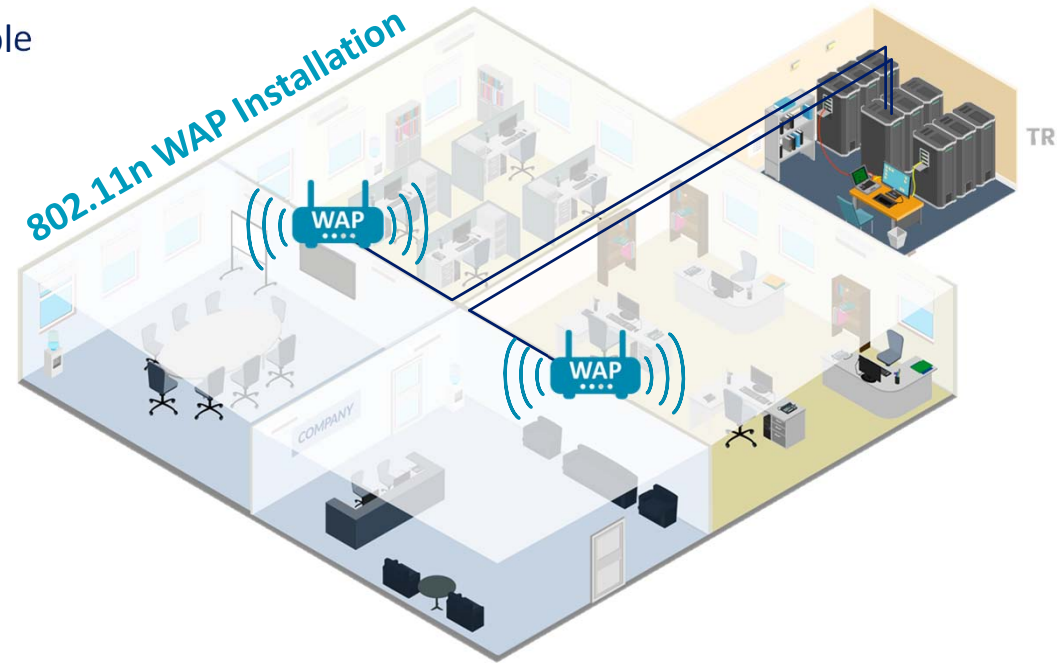
2.5GBASE-T and 5BASE-T

PoE and Cable Bundle

Signal is weak but travels further = Less WAPs = Less Cable
Older devices have less antennas = Less power



Low PoE
Small cable bundle



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2.5GBASE-T and 5GBASE-T

PoE and Cable Bundle

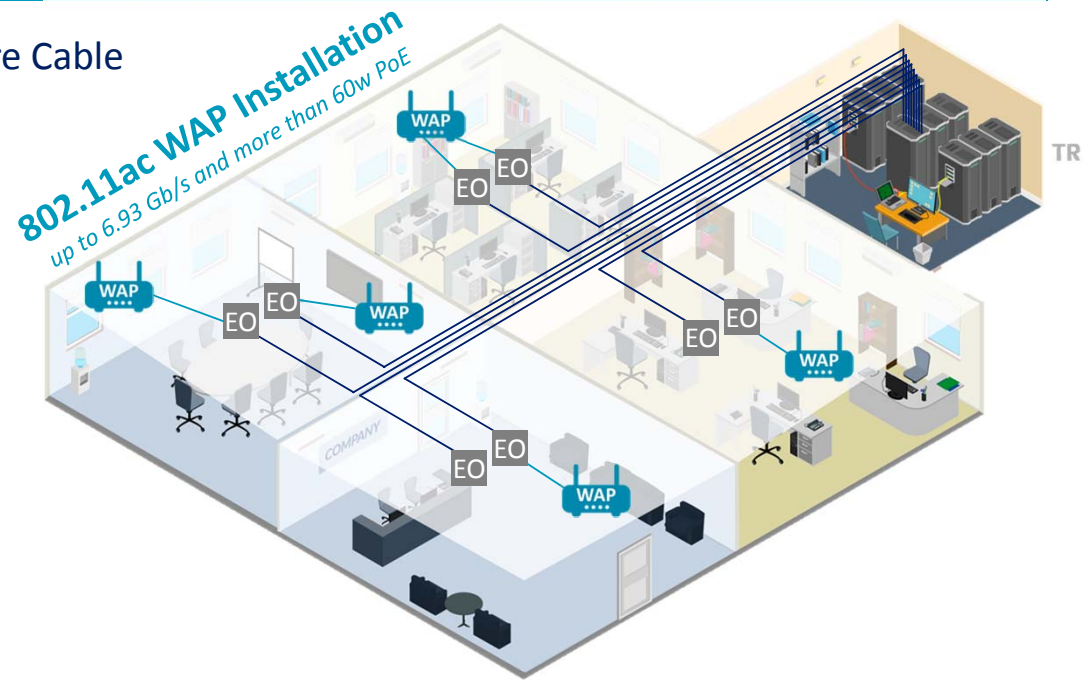
Signal is strong but travels shorter = More WAPs = More Cable
Newer devices have more antennas = More power



High PoE
Large cable bundle

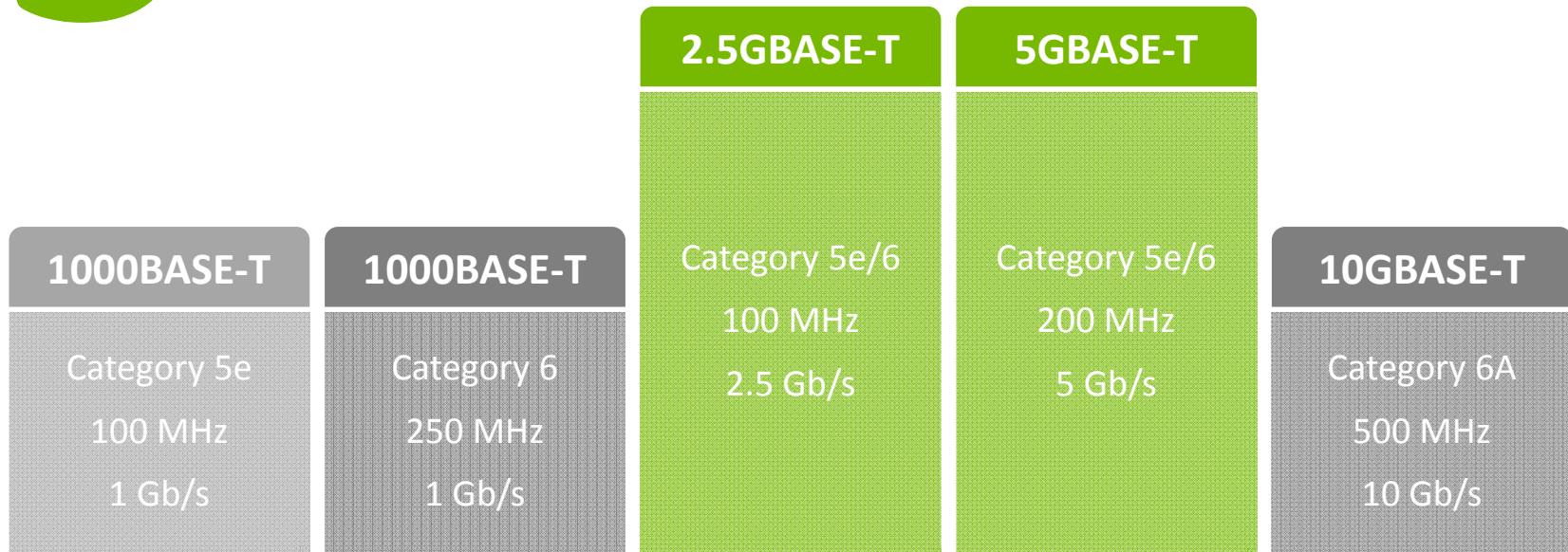


Limitations on 5e
and 6 cable bundles



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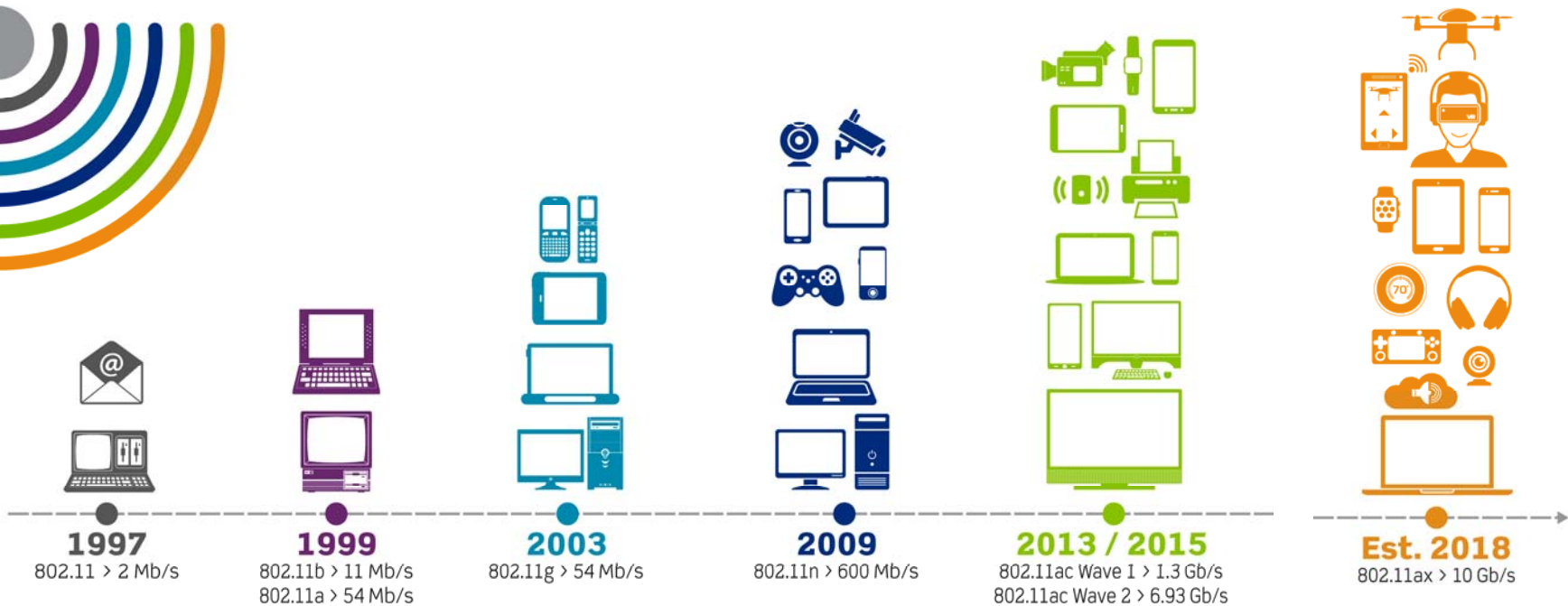
3 802.11ax → 10 Gb/s



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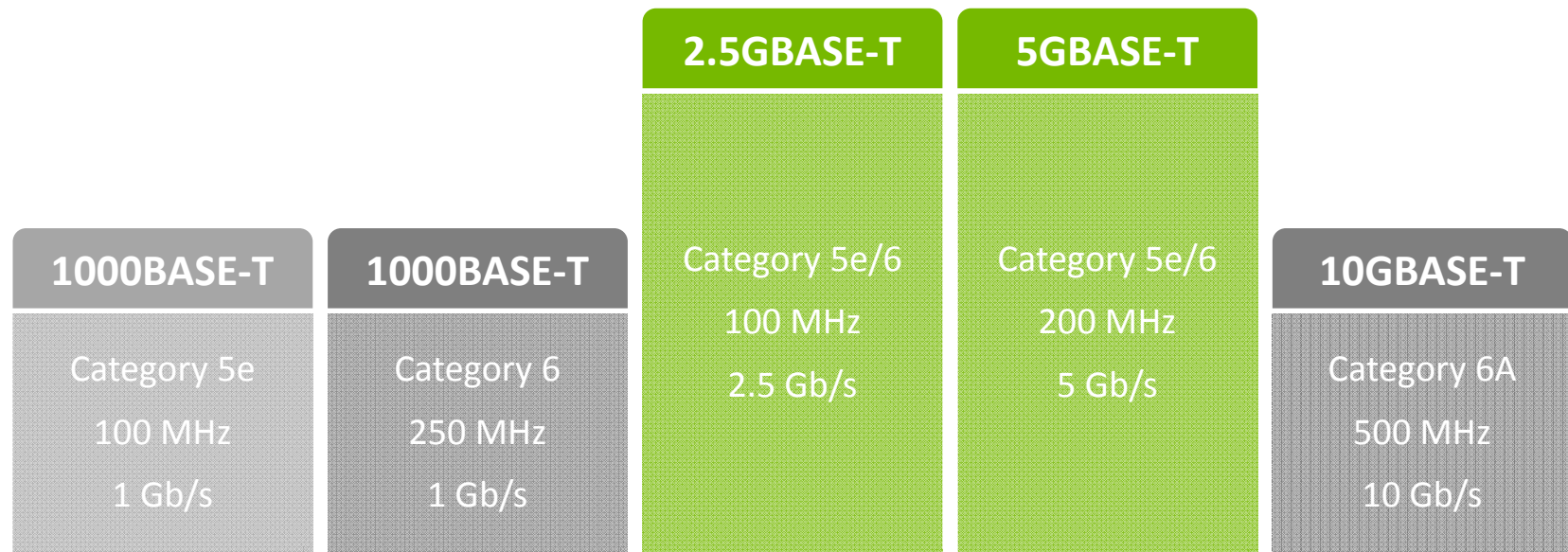
2.5GBASE-T and 5GBASE-T

Only up to 5Gb/s



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Recommendations



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Recommendations

2.5GBASE-T and 5GBASE-T Deployment

Brownfield

Understand limitations and challenges

- AXT, PoE, Cable Length and Bundle Size

Run cost and risk analysis

- Keep Cat 5e/Cat 6 or upgrade to Cat 6A

Upgrade to Cat 6A

- Cable, connectors, patch cords and panels

If existing Cat 5e/Cat 6 cabling is used, assess costs associated with mitigation strategies before implementation

- Test for ALSNR \$
- Unbundle TR patch cords \$
- Consider replacing TR patch cords with Cat 6A \$
- Consider replacing TR patch panels and connectors with Cat 6A \$
- Consider unbundling horizontal cables \$



$$\text{Material \$} + \text{Labor \$} = \text{System Longevity} = \text{Roi}$$

New Cat 6A Vs. Existing Cat 6/5e



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Recommendations

Greenfield

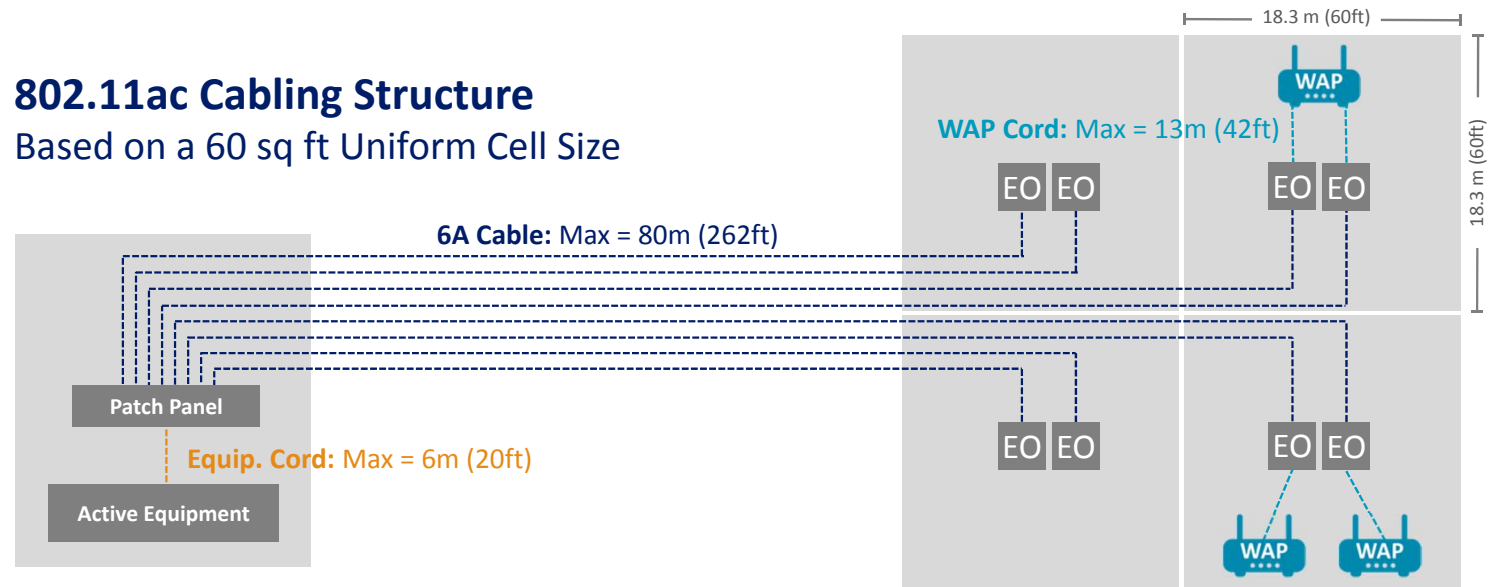
Use Cat 6A

Plan for future

- TIA TSB-162-A

802.11ac Cabling Structure

Based on a 60 sq ft Uniform Cell Size



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Four Steps to Successful Wireless Deployment

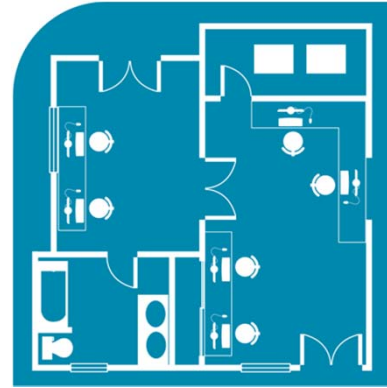


STEP 1

Understand Wireless Technology

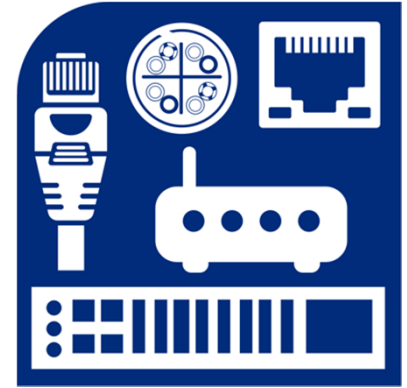
STEP 2

Understand Applications
and Capacity



STEP 3

Understand Environments
and Architecture



STEP 4

Make Cabling and
Connectivity Choices

Category 6A Offers the Best Solution

for enterprise applications seeking system longevity, faster data transfer, and support for high-bandwidth wireless networks.



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Questions?



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