



ENTERPRISE WIRELESS:

FOUR STEPS

to Successful Deployment



Bicsi

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

- Understand what determines wireless speed
- Understand different properties of wireless network planning
- Plan properly for wireless deployment
- Make the right product choices



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Four Steps to Successful Wireless Deployment



STEP 1

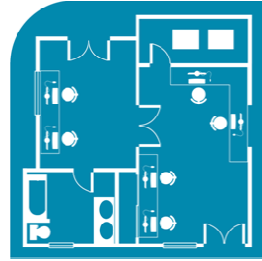
Understand Wireless Technology

— Knowledge —



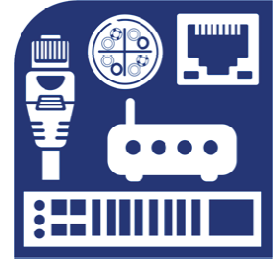
STEP 2

Understand Applications and Capacity



STEP 3

Understand Environments and Architecture



STEP 4

Make Cabling and Connectivity Choices

— Planning —

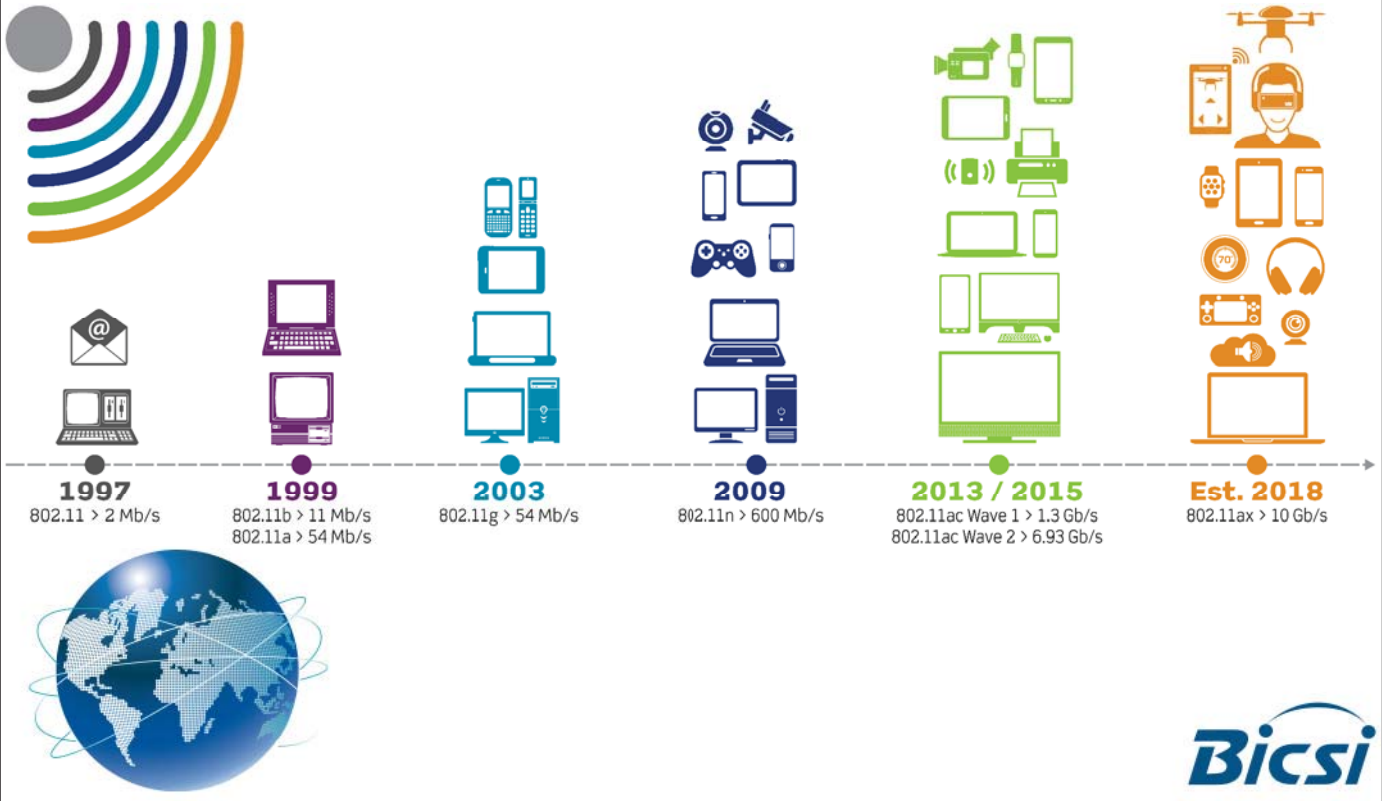


UNDERSTAND

Wireless Technology



Evolution of 802.11



Market Driver:

Bandwidth Explosion from Digital Transformation

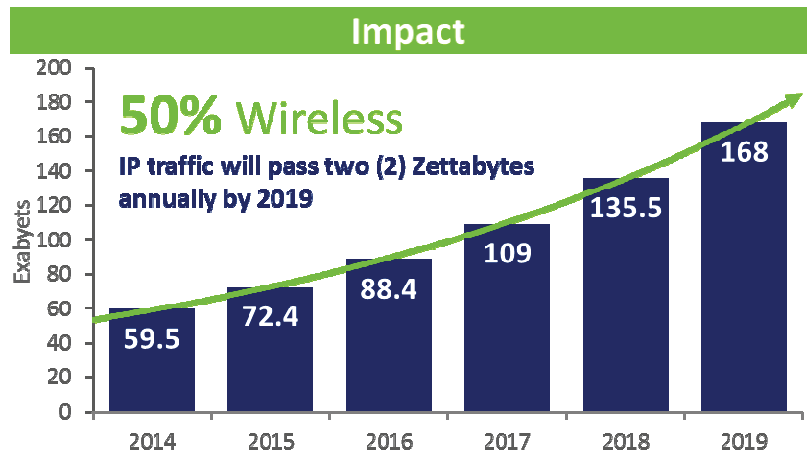
Drivers

Office Buildings
BYOD and Video Conferencing

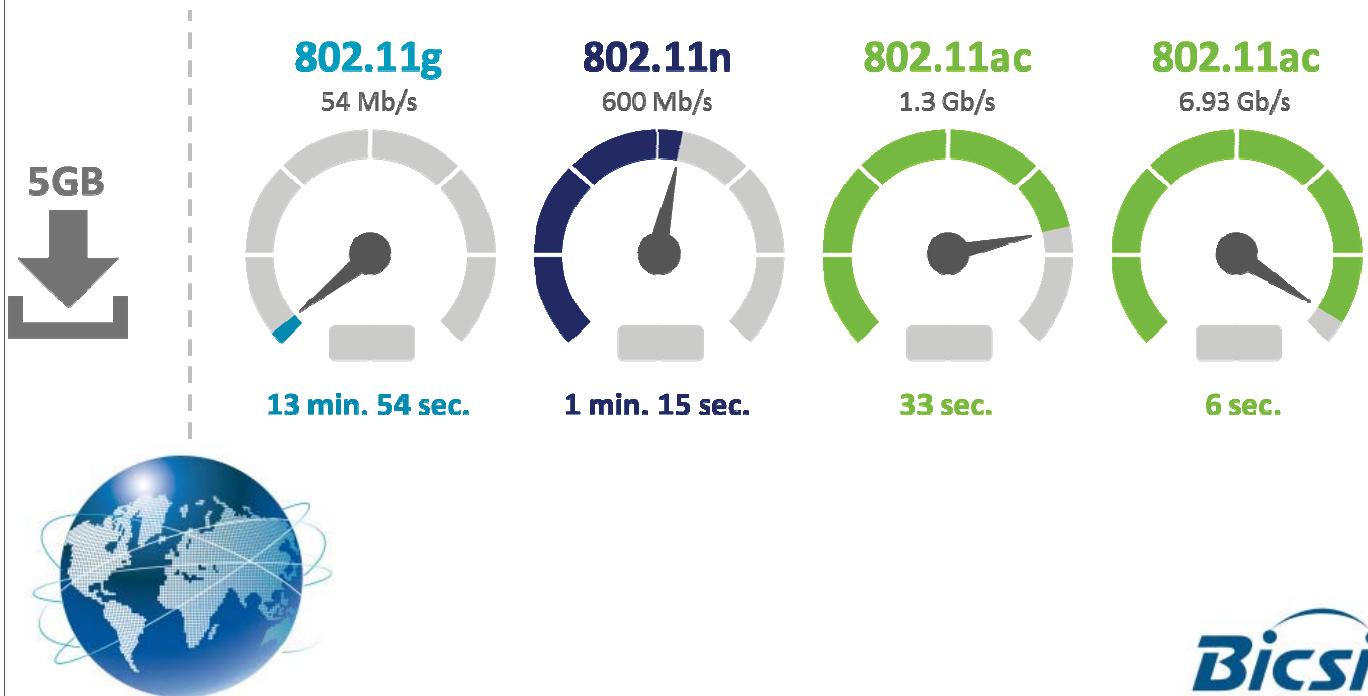
Manufacturing
Smart Machines

Education
Digital Learning and Security

Health Care
Medical Devices



Workplace Efficiency



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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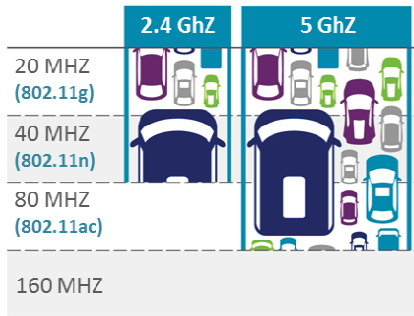
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What Determines Wireless Speed?

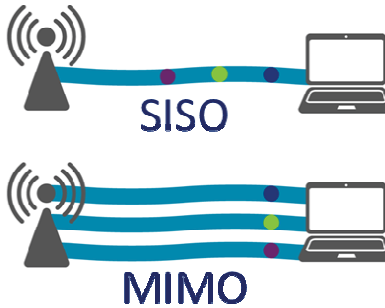
Channel Bandwidth

Capacity



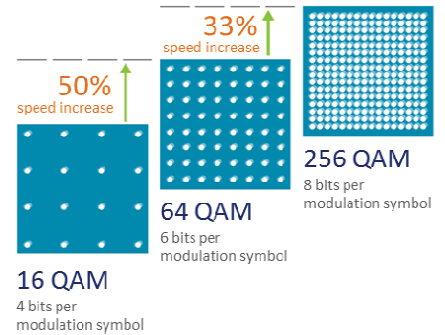
Antenna and Spatial Streams

Concentrated signal through multiple paths



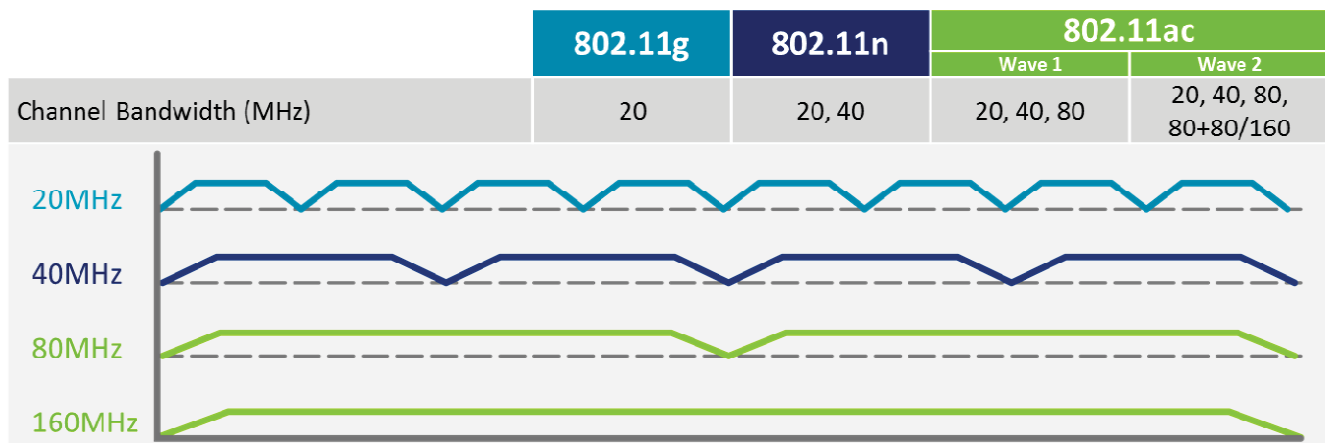
Modulation

Speed



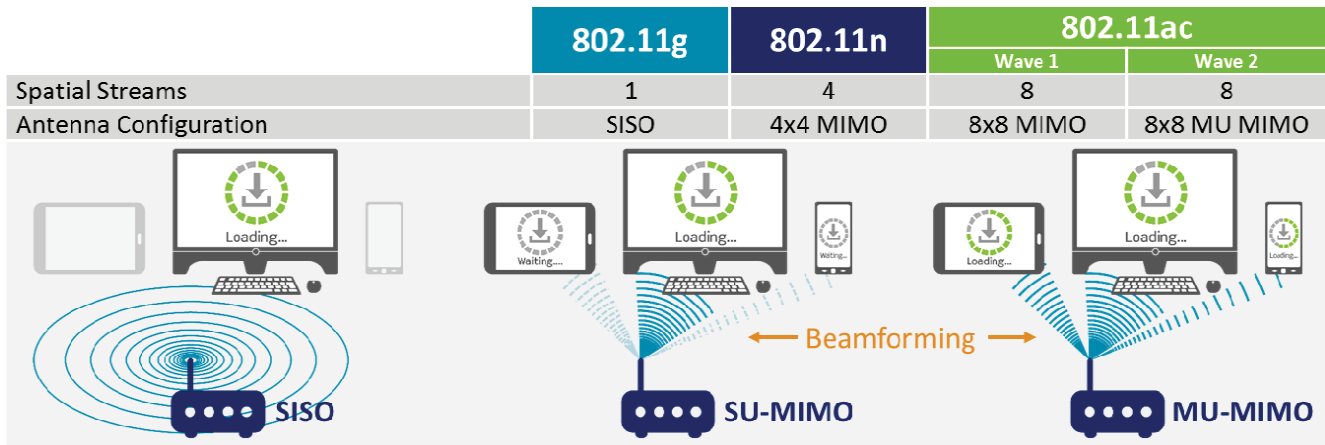
Channel Bandwidth

Wider Bandwidth – More Capacity



Antenna and Spatial Streams

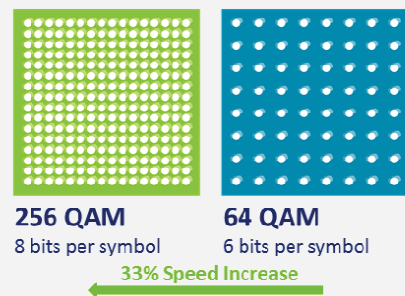
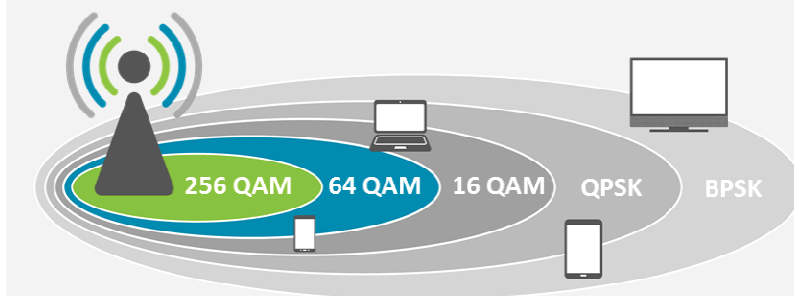
Concentrated signal through multiple paths



Modulation

Higher order modulation – Faster Speed

	802.11g	802.11n	802.11ac	
			Wave 1	Wave 2
QAM	64	64	256	256



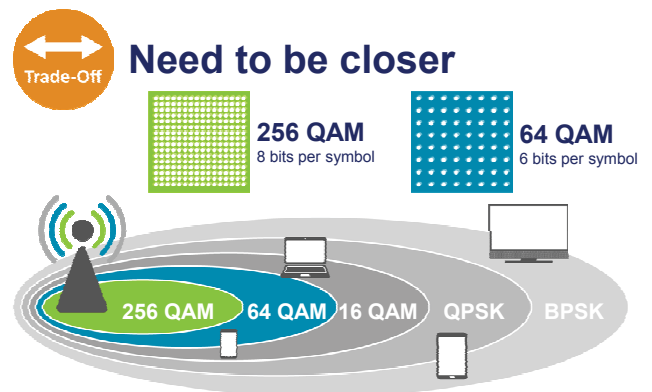
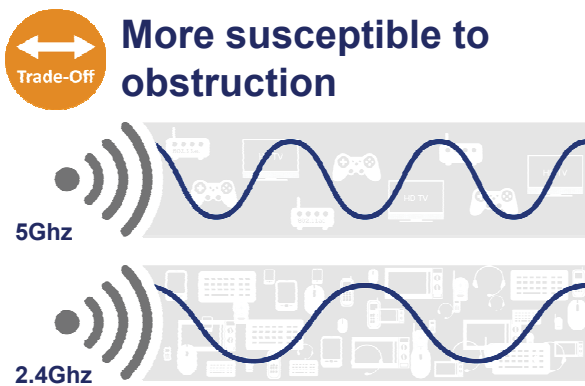
Benefits of 802.11ac

- 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**



Understanding Tradeoff

Coverage

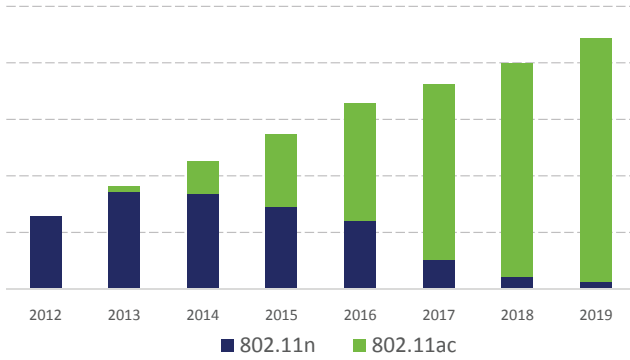


Planning is critical



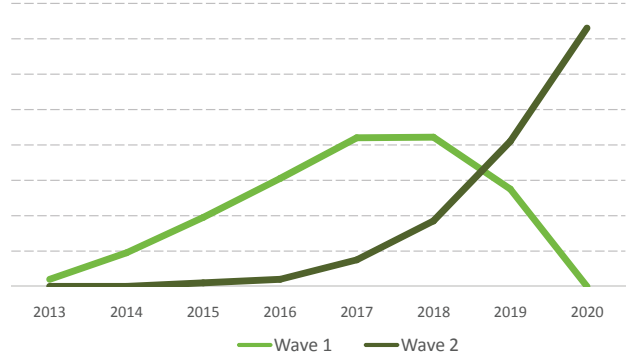
Wireless Access Point Transition

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



UNDERSTAND

Applications and Capacity



Applications and Capacity

Application Type & Number of People and Devices



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



Enterprise Building Applications



Commercial

Laptops
Computers
Video Conferencing
VoIP
Smart phones
Tablets



Education

Laptops
Computers
Tablets
Smart phones
Lecture



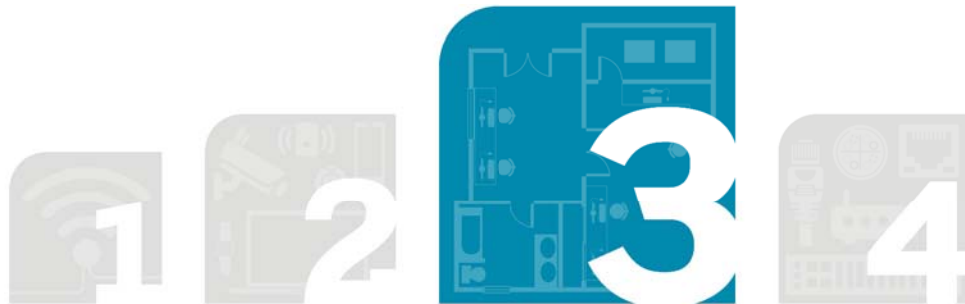
Health Care

Computers
Smart phone
Laptops
Imaging Devices
Tablets
RTLS



Manufacturing

Inventory Control
Line automation
Smart Machines



UNDERSTAND

Environments and Architecture



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



WAP Installation Consideration



Drop Ceiling



Wall



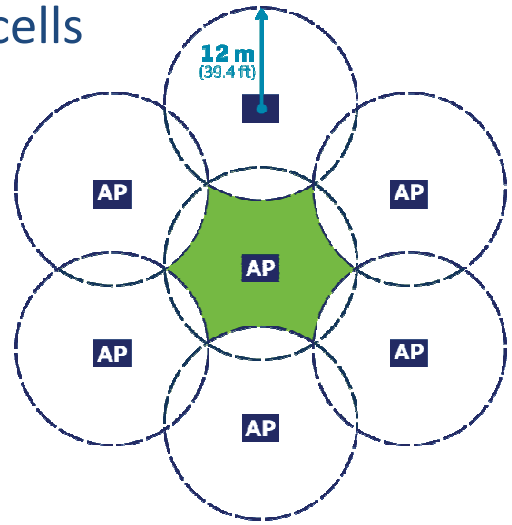
Enclosures



Design Recommendations

ISO/IEC TR-24704

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

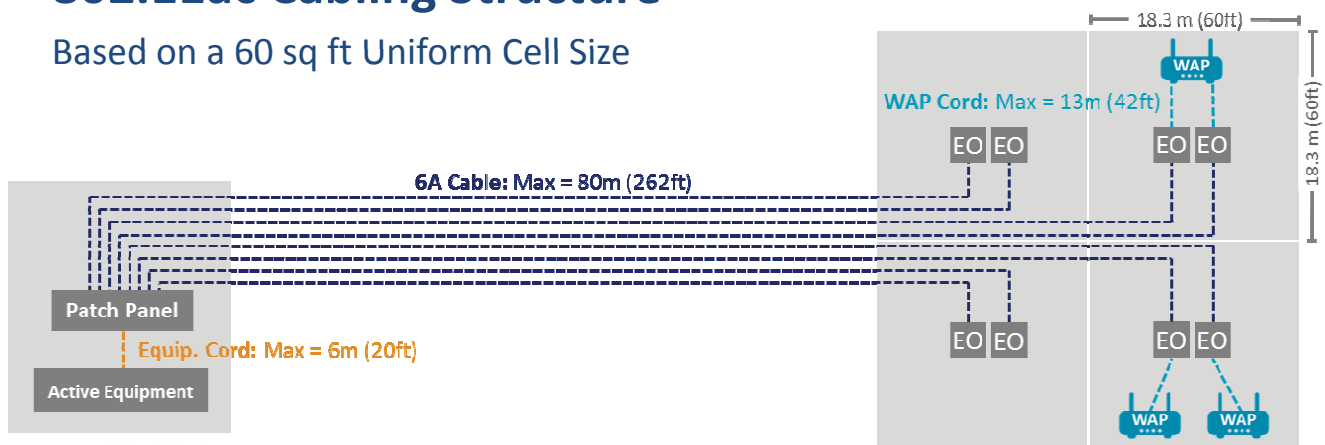


Design Recommendations

TIA TSB-162-A

802.11ac Cabling Structure

Based on a 60 sq ft Uniform Cell Size

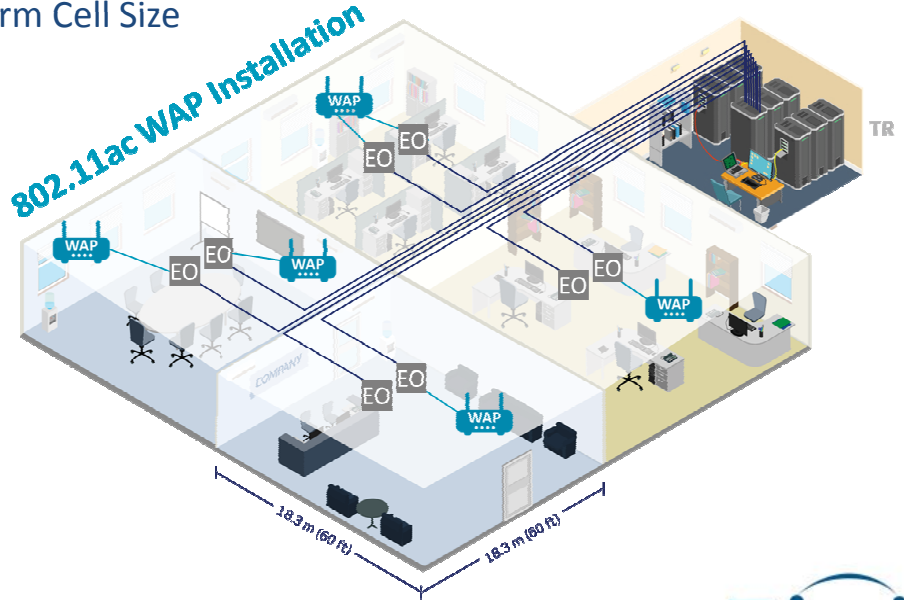


Design Example

TIA TSB-162-A

802.11ac Cabling Structure

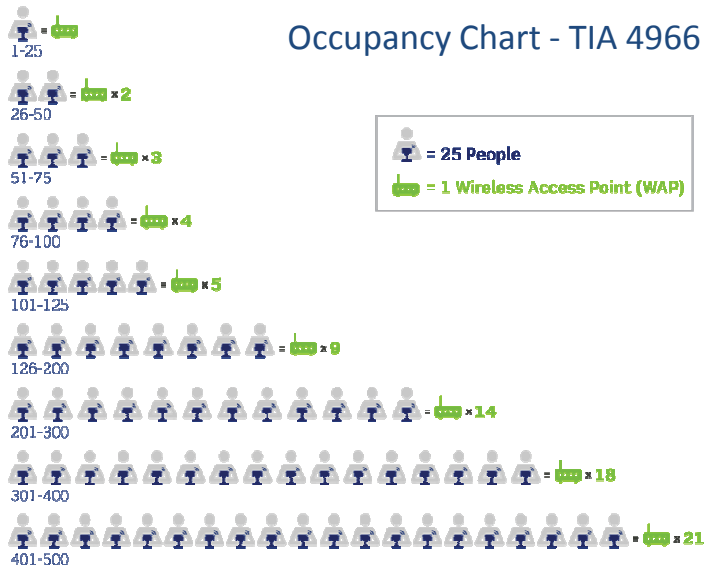
Based on a 60 sq ft Uniform Cell Size



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





MAKE

Cabling and Connectivity Choices



Wireless Speed



1997
802.11 > 2 Mb/s



1999
802.11b > 11 Mb/s
802.11a > 54 Mb/s



2003
802.11g > 54 Mb/s



2009
802.11n > 600 Mb/s



2013 / 2015
802.11ac Wave 1 > 1.3 Gb/s
802.11ac Wave 2 > 6.93 Gb/s



Est. 2018
802.11ax > 10 Gb/s



BASE-T Evolution and Migration Path

Standards Bodies



Telecommunications Industry Association



Institute of Electrical & Electronics Engineers



International Organization for Standardization

RJ45 from 1G to 25G/40G



Twisted-Pair Migration Roadmap

RJ45 Simplifies the Upgrade Path

	1G to 2.5G		2.5G to 5G	10G to 25G		10G to 40G
Category	1G	2.5G	5G	10G	25G	40G
Maximum Bandwidth	100 / 250MHz	100 / 250MHz	250 / 250MHz	500MHz	1250MHz	2000MHz
Maximum Application Data Rate	1000BASE-T	2.5GBASE-T	5GBASE-T	10GBASE-T	25GBASE-T	40GBASE-T
Maximum Reach	100m	Target: 100m	Target: 100m	100m	30m	30m
Number of Connectors in Channel	4	4	4	4	2	2
Cable Construction	Unshielded or Shielded	Unshielded or Shielded	Unshielded or Shielded	Unshielded or Shielded	Shielded	Shielded
Date Created	1999	2017	2017	2006	2017	2017



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



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
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



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**

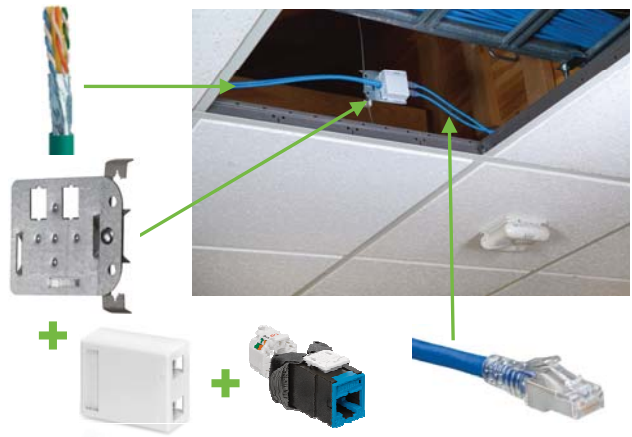


Cabling and Connectivity Choices

Quality, Reliability, and Performance

Cables + Connectors + Cords

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



Wireless Access Point and PoE

PoE and Cable Bundle

- **PoE is the most convenient method to power WAP**
 - Power consumption increasing due to advanced technology
 - Approximately 20 million PoE enabled APs will ship by 2020
- **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



Power over Ethernet

The Evolution – How We Got Here

■ 802.3af completed in 2003

- 15.4W power sent = 12.95W of delivered power (Type 1)

■ 802.3at PoE+ completed in 2009

- 30W power sent = 25.5W of delivered power (Type 2)

■ PoE-enabled port and device shipments are expected to grow to \$1B by 2021



Applications

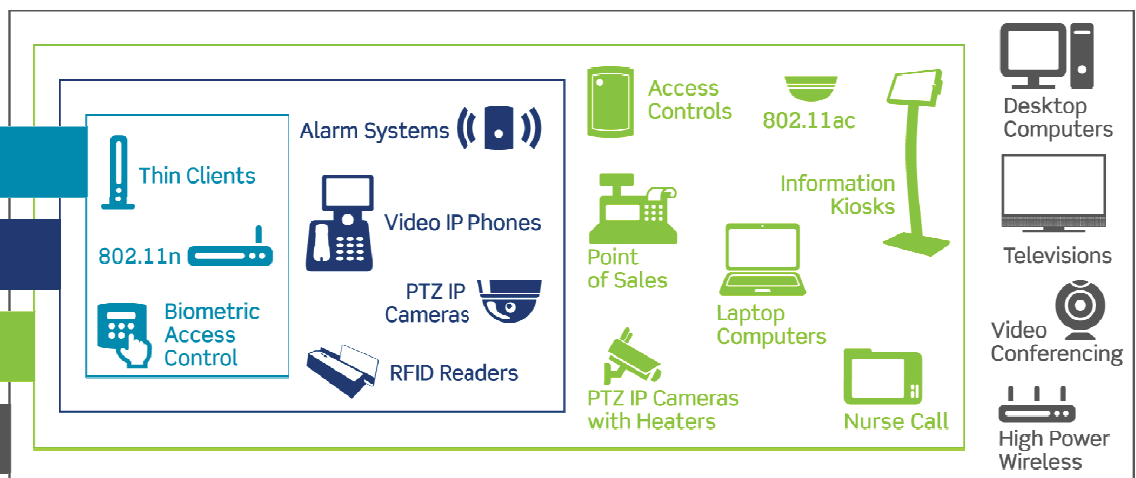
Why We Need More Power

Up to
15.4 Watts

Up to
30 Watts

Up to
60 Watts

Up to
100 Watts



Category 6A

■ Solutions that meet and exceed current standards

- 802.3at (Type 1) = 15.5 Watts
- 802.3at (Type 2) = 30 Watts
- UPOE = 60 Watts 802.3bt (Type 3)

CAT
6A

■ Capable of meeting emerging standards, up to 100 watts

- 802.3bt (Type 4) = 100 Watts

■ Component-rated end-to-end system with enhanced margins for better performance and easier installation



Bicsi

Why Category 6A?

Operational Advantages

■ Lower costs by supporting higher power per cable, avoiding additional bundles and trays

■ 23 AWG conductors generate less heat than 24 AWG

- Limits cable derating – running cooler without compromising insertion loss, enabling longer runs
- Cooler temp maintains cable integrity and lifespan
- Reduced OPEX, less facility cooling required
- Improved environmental impact



Bicsi

Four Steps to Successful Wireless Deployment



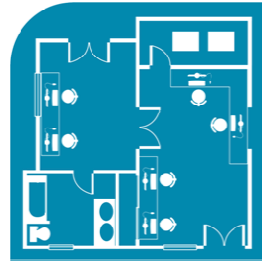
STEP 1

Understand Wireless
Technology



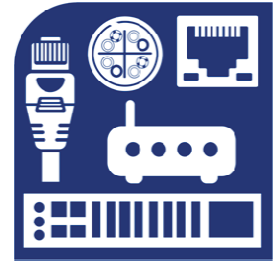
STEP 2

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.



Questions?

