



Preparing Your Network for Wave 2 of 802.11ac

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By 2019

1.2X

Growth in Avg. Wi-Fi
Device Connection Speed
(10.1Mbps. Per Device)

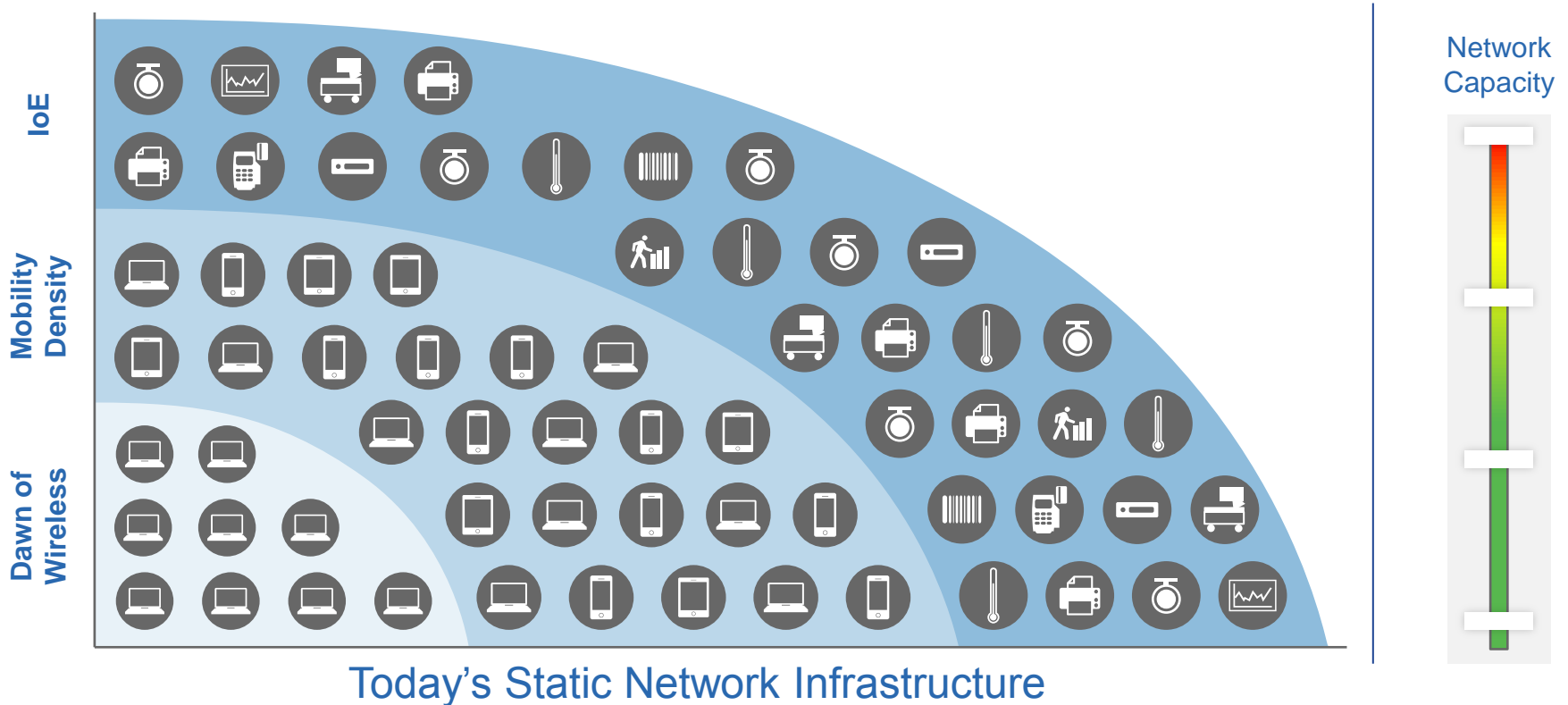
28.2%

Device Connections will be
Machine to Machine Traffic

53%

Fixed IP Traffic will be Wi-Fi
Exceeding Wired by 21%

Do You Know Which Devices Really Impact the Network?



Introducing 802.11ac Wave 2



More Bandwidth – More Applications

Support growing number of
mobile applications

Increased Scale and Coverage

Extend Wi-Fi Everywhere

Improved Client Density Support

For wireless end-user and
IoT devices

802.11ac Industry Drivers & Use Cases

A Transformation Across Verticals

Education



- Widespread adoption of BYOD Social Networking
- Collaborative Classrooms HD Video
- Live streaming to 802.11ac and 802.11n devices

Enterprise



- Next Generation Workplace Transformation
- Increasing demands of Collaborative Workspace
- VDI & Personalized devices in Workplace

Healthcare



- CT, MRI, Cardiac Imaging, and 4D modeling demands higher bandwidth
- Large file movement of images over wireless
- Patient and Guest wireless Services

Stadium



- 802.11ac and CMX deliver next-gen fan experience such as CMX maps
- Enhanced scaling for inherently High density environments
- New revenue opportunities - sponsorship, merchandising

Service Provider



- Enhanced service offerings with the latest technology
- SP-Wi-Fi off-load – balancing users between Wi-Fi and 3G/4G/LTE
- Rich user experience to Apps such as Netflix or Hulu Plus

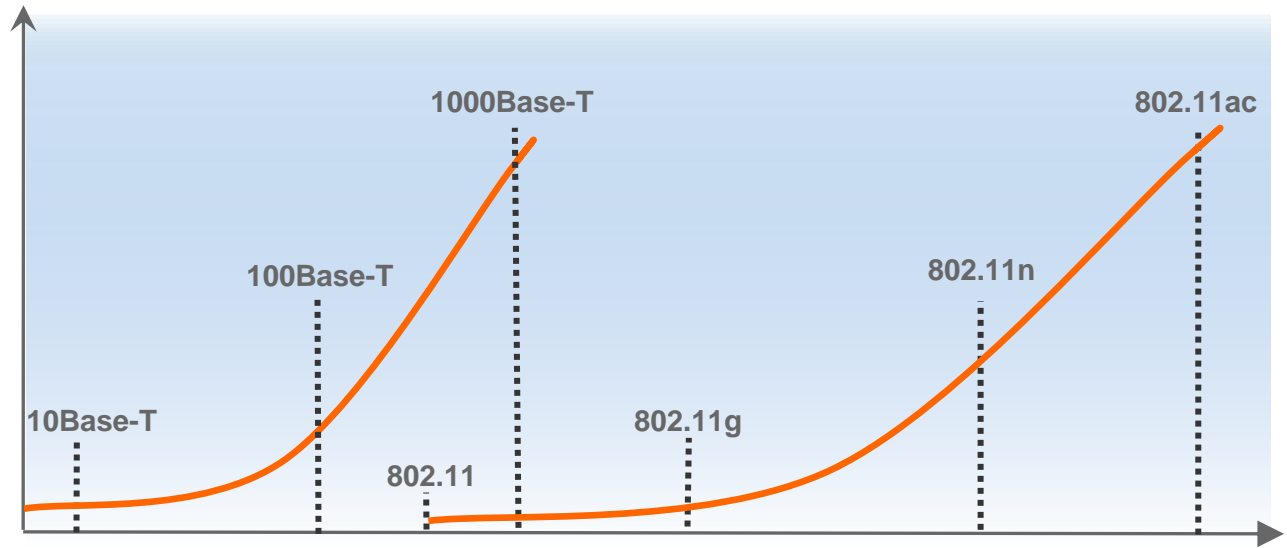


802.11ac Wave 2 Overview

Access Networking Trends The Age of Gigabit Wi-Fi...

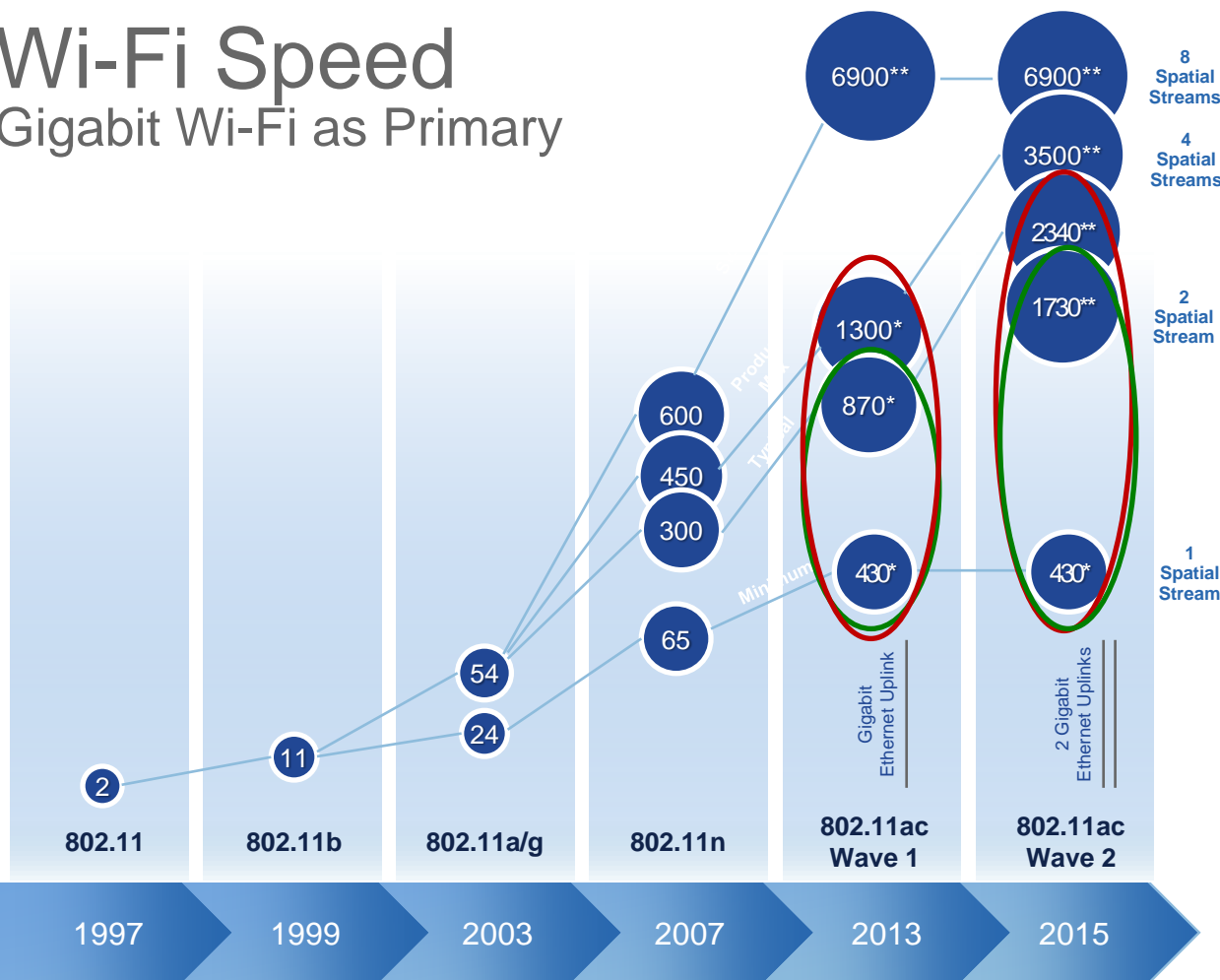
IEEE 802.11ac

- Supports Bandwidth Intensive Apps
- Supports More Devices Than 802.11n
- Improves battery efficiency 2X for Smartphones, Tablets, and Laptops



Wi-Fi Speed

Gigabit Wi-Fi as Primary

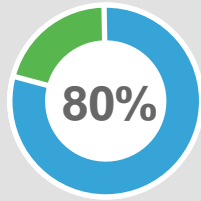


4SS	Desktops
3SS	Desktops / Laptops
2SS	Laptops / Tablets
1SS	Tablets / Smartphones

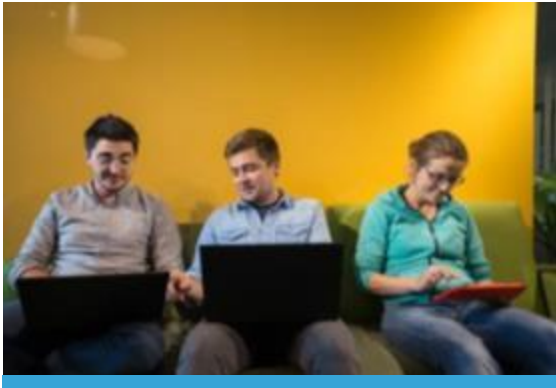
● = Connect Rates (Mbps)
SS = Spatial Streams

*Assuming 80 MHz channel is available and suitable
**Assuming 160 MHz channel is available and suitable

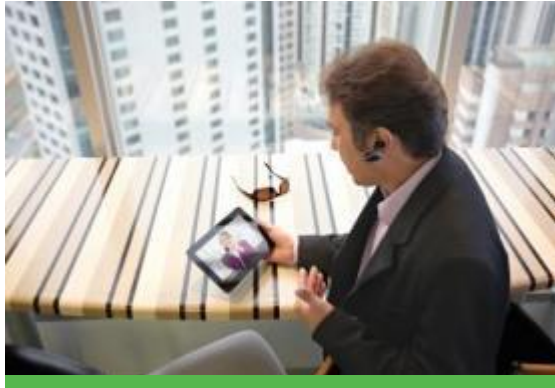
How 802.11ac Wave 2 Works



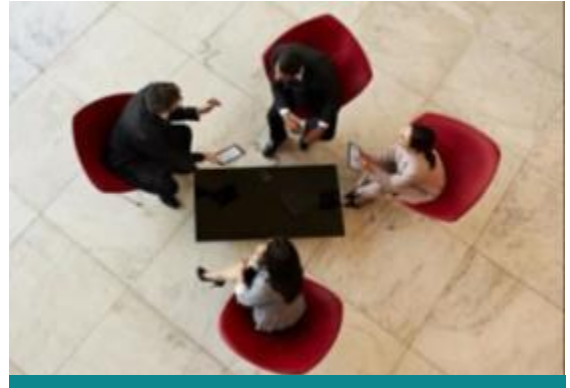
speed boost compared to Wave 1, thanks to:



Multi-User MIMO
(MU-MIMO)



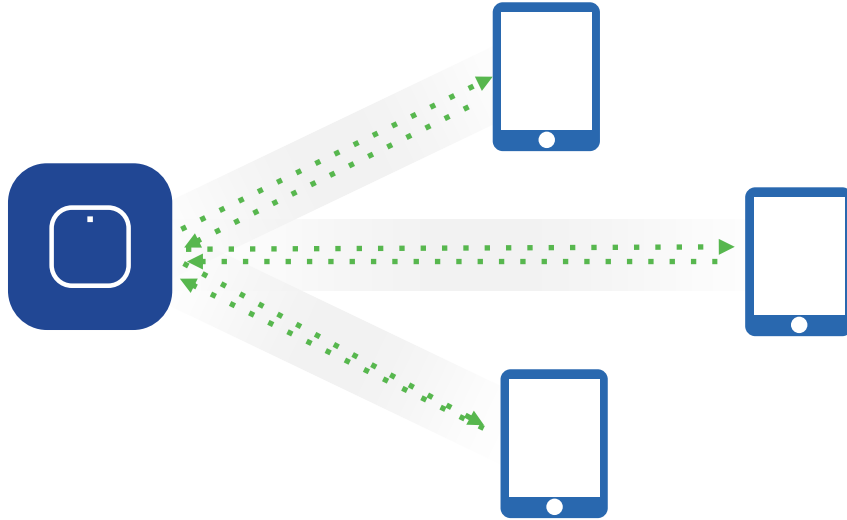
Wider RF Channels



Four Spatial Streams

How 802.11ac Wave 2 Works

Multi-User MIMO (MU-MIMO)



Clients get on and off the network quicker, allowing more clients to be served.



How 802.11ac Wave 2 Works

BW (MHz)	# Spatial Streams	MCS (QAMr5/6)	PHY Rate (Mbps)	MAC Throughput (Mbps)*
80	3	256	1300	845
80	4	256	1733	1126
160	1	64	650	422
160	1	256	780	507
160	1	256	866	563
160	2	64	1300	845
160	2	256	1560	1014
160	2	256	1732	1126
160	3	64	1950	1268
160	3	256	2340	1521
160	3	256	2600	1690

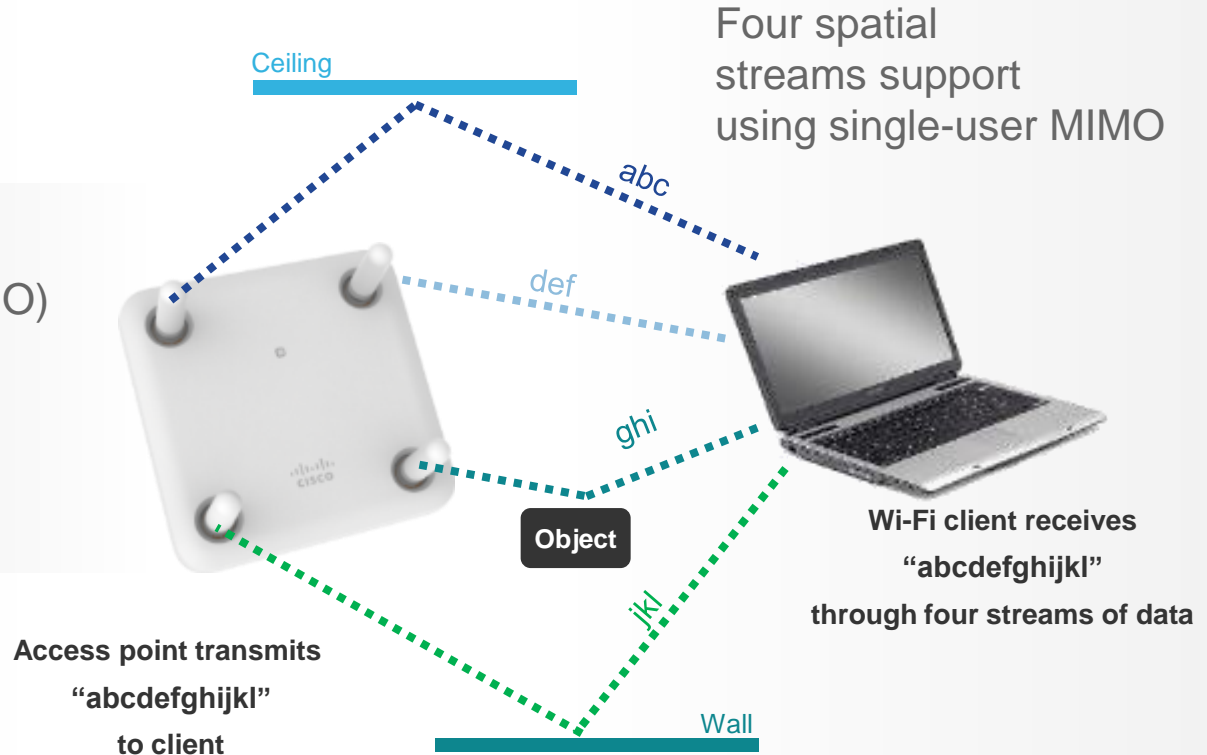
Potential throughput at 160-MHz channel widths:
Data rates introduced with 802.11ac Wave 2

- Multi-user MIMO (MU-MIMO)
- Wider RF channels

* Based on 65% MAC utilization

How 802.11ac Wave 2 Works

- Multi-user MIMO (MU-MIMO)
- Wider RF channels
- **Four spatial streams**



What's New: Cisco Aironet 1850 Series AP

802.11ac Wave 2 Access Point



BETTER COVERAGE AND PERFORMANCE*

2X Data Rate Increase | 4x4 4SS SU-MIMO



IMPROVED CLIENT PERFORMANCE*

4X4 3SS MU-MIMO | Transmit Beam Forming



FASTER OFFLOAD TO WIRED NETWORK

2 GbE Ports | Load-balancing



QUICKLY EXPAND FUNCTIONALITY

USB 2.0 Port

Gigabit Wi-Fi has Fully Arrived

*Then Previous 802.11ac Wave 1 Aironet 1700 Access Point

Next-Generation Wave 2 802.11ac Access Point



Cisco Aironet® 1850

- Next-generation 4x4 MIMO:4 spatial streams (SS) **Wave 2** 802.11ac access points
- Dual radio, 802.11ac Wave 2, 80 MHz
- 5 GHz: 4x4 supporting
 - 3 SS MU-MIMO
 - 4 SS SU-MIMO
 - 1.7 Gbps Max 5-GHz PHY
 - 2.0 Gbps Max Aggregate PHY
- 2 times Gigabit Ethernet and USB 2.0
- Internal and external antenna models



Gigabit Wi-Fi has fully arrived

Cisco Aironet Indoor Access Points

Industry's Best 802.11ac Series Access Points

Enterprise Class 1700



- 802.11ac W1
- 870 Mbps PHY
- 3x3:2SS
- CleanAir Express
- Tx Beam Forming
- 2 GbE Ports

New

Enterprise Class 1850



- 802.11ac W2
- 2.0 Gbps PHY
- 4x4:4SS
- Spectrum Analysis*
- Tx Beam Forming
- 2 GbE Ports, USB 2.0

Mission Critical 2700



- 802.11ac W1,
- 1.3 Gbps PHY
- 3x4:3SS
- HDX: High Density Experience
- CleanAir 80 MHz
- ClientLink 3.0
- 2 GbE Ports

Best in Class

3700



- 802.11ac W1, 1.3 Gbps PHY
- 4x4:3SS
- HDX: High Density Experience
- CleanAir 80 MHz
- ClientLink 3.0
- StadiumVision
- Modularity: Security, 3G Small Cell or Wave 2 802.11ac

Enterprise

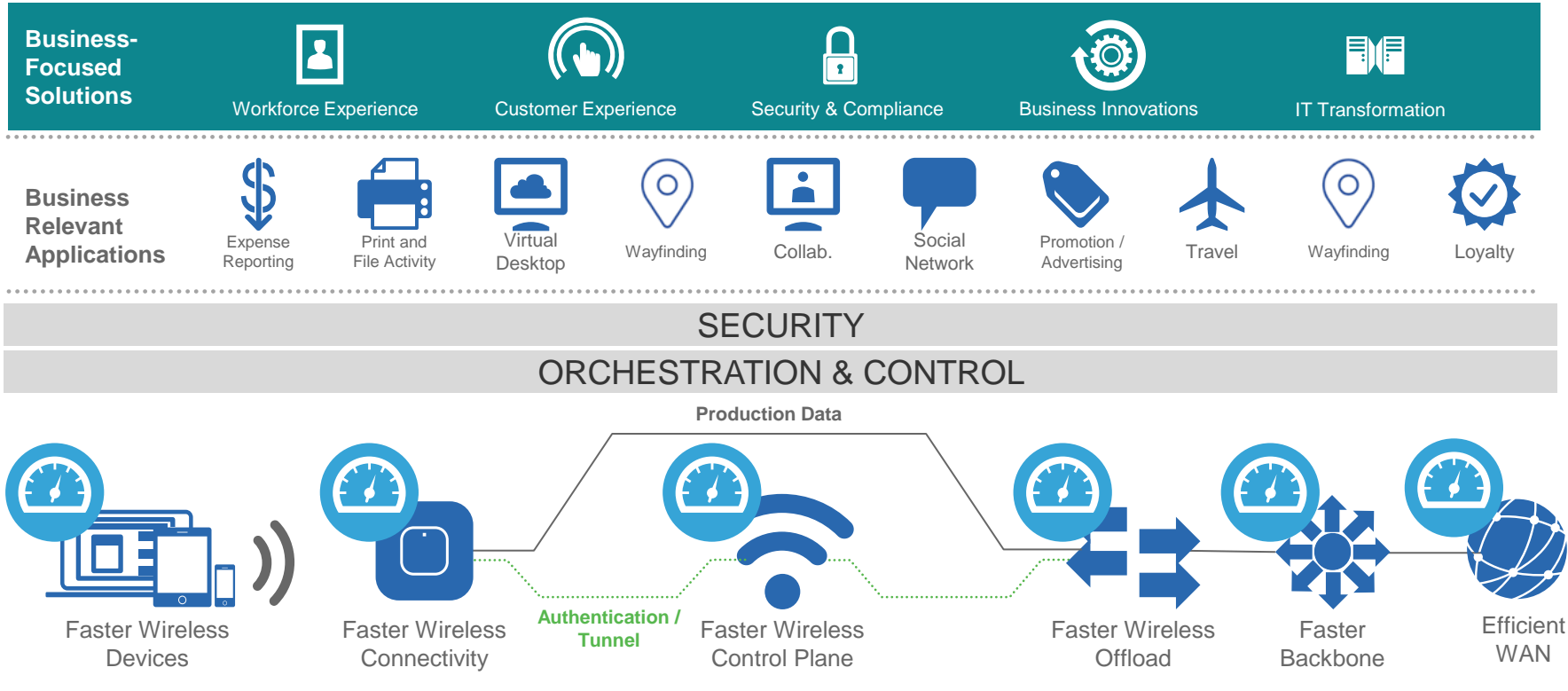
Mission Critical

Best In Class



Looking Beyond Wireless

For Large Deployments



FASTER MOBILITY: NOT JUST A Wi-Fi PROBLEM

What's New: Controllers

Preparing for the Impact of 802.11ac Wave 2

33%

Performance Increase*

5520 Wireless Controller



- 10-1500 access Points
- 20,000 Clients
- 20Gbps.

75%

Performance Increase*

8540 Wireless Controller



- 100-6000 access Points
- 64,000 Clients
- 40Gbps.

HIGH-SCALABILITY



Support for Next-Gen Mobile and IoT Devices

INTEGRATED SERVICES



AVC | Bonjour | Guest & BYOD | TrustSec | ISE

RETURN ON INVESTMENT



License Portability | Faster Deployment

HIGH-AVAILABILITY



Sub-Second Stateful Switchover | Fast Restart

Faster Mobility Needs Faster Switching

FASTER ACCESS

4500E, 3850 & 3560-CX
Multigigabit Switches



- 4500 multigigabit line card module
- Stackable 3850 multigigabit switches
- Compact multigigabit switch

FASTER AGGREGATION

3850 10G SFP+



- Up to 48 ports of 10G in 1RU
- Stackwise 480G support*
- New 8x10G and 2x40G Uplinks

FASTER BACKBONE

6840-X, 6800 & 6500-E



- 6800 & 6500: New 10G Line Cards with up to 32 10G Ports per slot
- 6840-X: Up to 40 10G Ports
- 40G Support

What's New: Cisco Catalyst Multigigabit Switches

Prepare Your Network Access Layer 802.11ac Wave 2



New

4500E

- Best In Class Modular Access
- New 48 Ports Line Card Module
- 12 Ports of Multigigabit per slot
- Up to 96 Multigigabit ports per system
- UPOE, EEE, MacSec Support



New

3850

- Industry leading Fixed Access
- 24 & 48 Port Stackable Switches
- 24 & 12 Multigigabit Ports
- New 8x10G & 2x40G Uplinks
- UPOE, EEE, MacSec support



New

3560CX

- NG Workspace switch
- Multigigabit in smallest form factor
- 2 Multigigabit Ports with POE/POE+
- 2 SFP+ Ports
- Easy Management with Instant Access

Next Generation Mobility and IoT Ready!!

What's New: Cisco Catalyst 3850 10G

Preparing Your Aggregation Layer for 802.11ac Wave 2

New



NEXT GEN MOBILITY READY

New high bandwidth, high density models with higher capacity Uplink Modules



UNIFIED ACCESS

Programmable UADP architecture for IT simplicity
Uncompromised security with Trustsec and ISE



HIGH-AVAILABILITY

Stateful Switch-Over* | StackPower* | Power Resiliency | 1+1 Redundant Power Supply



INVESTMENT PROTECTION

Stackable up to 480Gbps*

* Supported on 12 & 24 port models

Faster Aggregation with High Density 10G/40G ports

What's New: Cisco Catalyst 6840-X

Preparing Your Backbone Layer for 802.11ac Wave 2

New



NEXT GEN MOBILITY READY

High density 10G/40G in small form factor
C6800 DNA with over 3000 features

HIGH-AVAILABILITY

Robust availability with VSS, 1+1 power
redundancy

IT SIMPLICITY & SECURITY

Instant Access for easy management,
Network As A Sensor

NETWORK SEGMENTATION

Advanced Services with MPLS, VPLS,
TrustSec, A-VPLS , LISP and EVN

Faster Backbone with Small Form Factor switches

What's New: Cisco Catalyst 6800 10G Modules

Preparing Your Backbone Layer for 802.11ac Wave 2

New



FULL FEATURED MODULAR BACKBONE

Catalyst 6k DNA with over 3,000 Features



SCALE & PERFORMANCE

Up to 160G/slot, 2M Netflow,
Up to 1M IPv4 entries, Deep buffers



IT SIMPLICITY & SECURITY

Instant Access for easy management,
Network As A Sensor



NETWORK SEGMENTATION

Advanced Services with MPLS, VPLS,
TrustSec, A-VPLS, LISP and EVN

Faster Modular Backbone with High Density 10G line cards

Preparing Your Network for Wave 2 of 802.11ac

Summary



Growth in Wi-Fi Traffic,
Apps and Wi-Fi Devices
including IoT Devices



802.11ac Wave 2 Provides
better Performance,
Coverage and Improved
Client Density Support



Look Beyond Wireless:
Faster Mobility needs
Faster Switching

Key Takeaways for 802.11ac Wave 2

Twitter:

- [@Cisco_Mobility](#)

Facebook:

- facebook.com/CiscoWireless

Wireless and Switching Collateral

- cisco.com/go/wireless
- cisco.com/go/80211ac
- cisco.com/go/multigigabit
- cisco.com/go/switches

Wireless and Switching Blogs

- blogs.cisco.com/wireless/
- blogs.cisco.com/enterprise/





CISCO

TOMORROW starts here.