Cisco Aironet Series Migrating to 802.11ac

Revised: January 30, 2017,

Abstract

As more and more any Cisco customers are converting to all-wireless workspaces; there is an expectation that the users of the WLAN network expect the same performance and reliability of a wired network.

The goal of this paper is to provide an overview of the differences between 802.11n and the newer 802.11ac Wave1 and Wave2 standards and what you might find helpful when migrating to 802.11ac.

It is important to understand that 802.11ac increases the scale and capacity of the network by significantly increasing the overall performance of each individual access point increasing the reliability while significantly improving on-air time utilization.

A typical use case one where Cisco Access Points were recently deployed in a true all-wireless fashion was the Republican and Democratic conventions as well as the debates where connectivity was indeed considered to be mission critical. In this deployment 802.11ac permitted a single access point to allow 100-200 clients each receiving over 50 Mbps. For more on this see the following URL: http://blogs.cisco.com/wireless/cisco-devices-take-center-stage-at-presidential-debates

Now let's take a look at the enhancements 802.11ac brings over the older 802.11n standard as it relates to Cisco Access Points and how the Cisco Access Points bring features beyond the IEEE standards as well.

Cisco Access Points and 802.11n

802.11n was the first significant breakthrough in Wi-Fi technology with regard to performance and enabled the following features:

- Datarates up to 450 Mbps compared to 54 Mbps .11a/g rates
- Ability to use wider channels (40 MHz) for faster communication
- Introduced more complex modulation 64 QAM (more data per packet)
- Concept of multiple spatial streams (additional transmitters)

In addition to those features, Cisco also introduced unique enhancements beyond the 802.11n specification providing real value and performance over the competition and those include:

- Cisco Clean Air Technology—creating a self-healing, self-optimizing wireless network
- Cisco VideoStream—Enhancement to efficiently deliver multicast video
- Cisco ClientLink—Unique beamforming technology permitting access points to fill in coverage holes, providing improved coverage for 802.11a/g as well as 802.11n clients.

The same reasons that drove migration to 802.11n is now driving the migration to 802.11ac.

Smartphones and personal devices have become far more powerful in the last few years as the chipsets within these devices now support much faster speeds then 802.11n.

Tablets and more importantly smartphones (now increasing in size) to become "mini-tablet like" devices are using much more data than ever before. These devices now have 802.11ac chipsets driving a hyper growth in mobile data usage as more people are streaming voice and video along with an increase in the use of multiple devices.

Take-away—Multiple and faster devices drive the need for enterprise networks to move to 802.11ac

Looking at the Standards (Cisco Access Points and 802.11ac)

Let's take a look at some of the features of 802.11ac and features within Cisco Access Points that go beyond the standards.

Figure 1: Breakdown of the differences between the standards

	802.11n IEEE Specification	802.11ac Wave 1 Today	802.11ac Wave2 WFA Certification Process Continues
Band	2.4 GHz & 5 GHz	5 GHz	**5 GHz**
MIMO	Single User (SU)	Single User (SU)	**Multi User (MU)**
PHY Rate	600 Mbps	1.3 Gbps	**2.34 Gbps - 3.47 Gbps**
Channel Width	20 or 40 MHz	20, 40, 80 MHz	20, 40, 80, **80-80, 160** MHz
Modulation	64 QAM	256 QAM	256 QAM
Spatial Streams	4	3	3-**4**
MAC Throughout*	390 Mbps	845 Mbps	1.52 Gbps- 2.26 Gbps

* Assuming a 65% MAC efficiency with highest MCS

As you can see above 802.11ac achieves its speed increase by pushing on three different dimensions:

- Increased channel bonding, as 802.11n was limited to 40 MHz, now using 802.11ac, the ability to use wider channels up to 80 & 160 MHz are now possible (for speed increases of 117 or 333 percent, respectively) for even faster communication.
- Complex denser modulation, now using 256 quadrature amplitude modulation (QAM), up from 64QAM in 802.11n (for a 33 percent speed burst at shorter, yet still usable, ranges).
- Introduction of Multi-User MIMO (ability to send data to more than 1 client at a time).

Note With the introduction of Multi-User MIMO (Wave-2) Clients can now take advantage of concurrent downstream communications - Meaning more efficient use of the spectrum as different data can be sent at the same time to different clients (this allows clients to get on and off the network much faster creating a more efficient use of the spectrum.

In addition to those features, as we did back in the 802.11n days, Cisco has introduced unique enhancements beyond the 802.11ac specification providing real value beyond those found in the competition including:

- **Cisco mGiG port** (for Ethernet speeds that exceed 1 Gbps)*

- **Flexible Radio—**use of Dual 5 GHz operation (creating Macro/Micro cells) for optimizing client throughput and increasing overall throughput performance per AP*
- **Modular expansion port—**w/SDK for 3rd party development*
- **Hyperlocation technology** (specialized location finding technology) for AP-3700
- **Cisco Clean Air Technology—**Enhanced for 802.11ac creating a self-healing, self-optimizing wireless network
- **Cisco ClientLink—**Unique beamforming technology permitting access points to fill in coverage holes, providing improved coverage for 802.11a/g as well as 802.11n clients. While transmit beamforming is not available within 802.11ac Wave-2, Cisco ClientLink continues to enhance the performance of legacy .11n and Wave-1 clients that are not able to take advantage of beamforming technology.

So to recap higher available speeds using 802.11ac create spectrum efficiencies benefiting all clients creating significant improvement for latency-sensitive video and voice traffic.

Note *Many of these features are specific to 2800 and/or 3800 Series Access Points

Figure 2: 802.11ac Indoor Access Point Portfolio

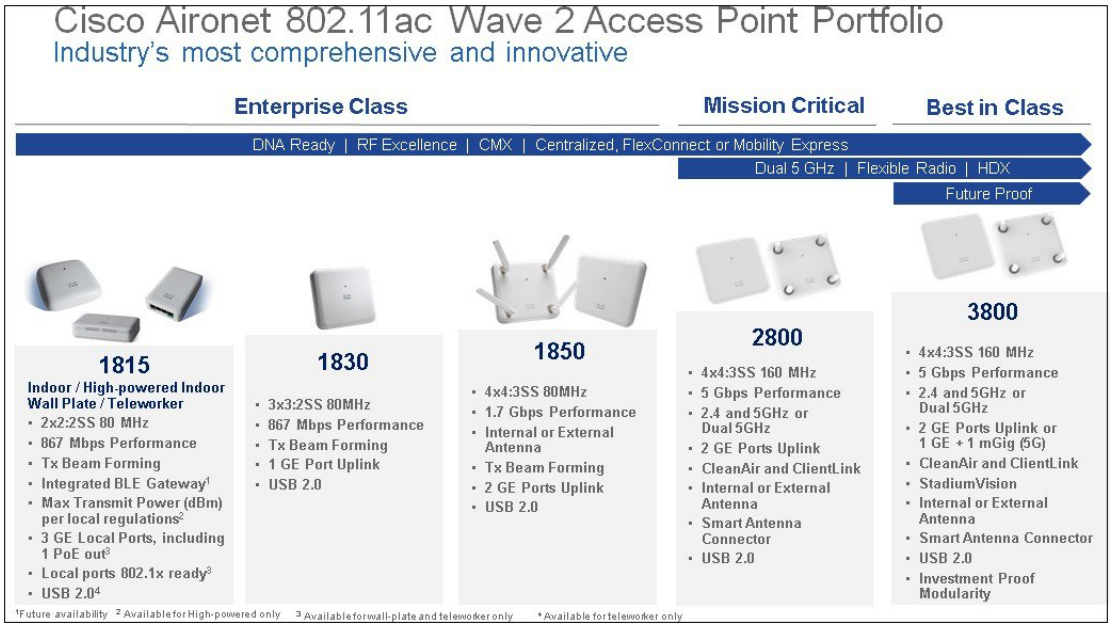
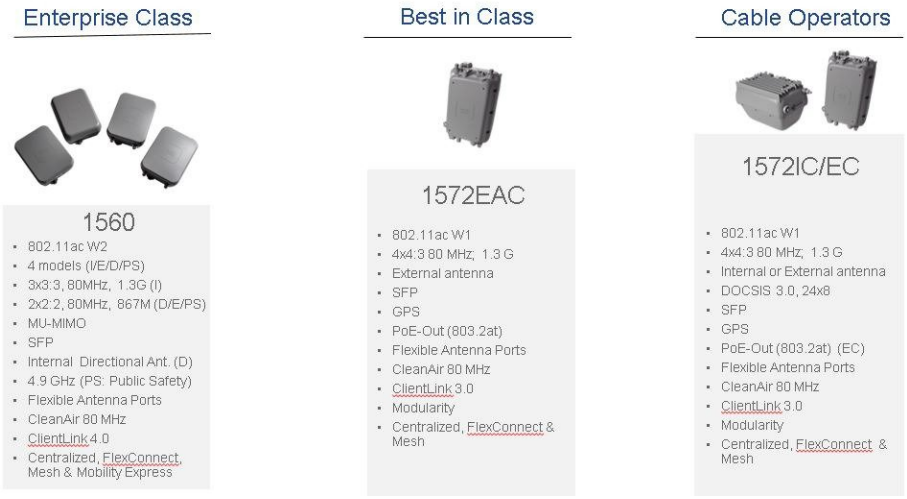


Figure 3: 802.11ac Outdoor Access Point Portfolio



Understanding an 802.11ac network

Access Point coverage (RF cell size)

802.11ac is about increasing the client's throughput (connected data rate) without significantly changing the Access Point's footprint (client coverage cell size).

When using 11ac enhancements such as, additional spatial streams (multiple transceivers), more complex modulation (256 QAM) and the ability to transmit data to more than one client at a time (MU-MIMO) the real benefit (and the engineering goal of an 11ac network) is to allow more information to be sent in a much shorter "on-air" time clearing the airwaves as quickly as possible.

Improving the airwaves (spectrum efficiency), benefits all clients (including legacy clients) resulting in a faster connected experience as the spectrum efficiency reduces airwave contention and retries.

Note It is not about changing the basic RF coverage area, it's about capacity and performance and so (before upgrading) it is important to understand how your current WLAN infrastructure functions.

If clients have good connectivity and there are no drops or dead spots then it is very likely you can replace the existing Access Points with new .11ac ones without having to perform a site survey or change much of the physical environment.

However; if you currently have areas that lack coverage you should look to address those issues first *before* migrating to .11ac as migration is not likely to fix existing coverage holes or dead spots.

Tip When upgrading Access Points, try to avoid mixing different makes/models of APs, perhaps upgrade one area or floor of your building at a time rather than a "salt and pepper" approach.

802.11ac is about performance and that requires more powerful AP hardware.

As you can see in (figure 2) many Access Points can exceed Gigabit Ethernet perhaps challenging your existing Ethernet cabling and power requirements. Newer Access Points depending on model contain:

- More powerful processors to handle radio / packet processing traffic
- Additional GbE ports and/or Multigigabit Ethernet (mGig)
- More memory (RAM) dedicated to Ethernet/Radio processors)
- Additional radios for BLE and Flexible Radio <dual 5 GHz Micro/Macro cell

What does your network look like today? Do you have the infrastructure in place? Can your infrastructure support more powerful Access Points? Let's consider the following:

Choosing the right Access Point

Before we discuss the AP, it is good to review Power over Ethernet (PoE) standards and pre-standards.

IEEE 802.3af allows for up to (15.4) Watts of power.

PoE+ Early pre-standard to .3at (something more than 15.4W) 20-30W

IEEE 802.3at allows for up to (30) Watts of power

uPoE Early pre-standard to .3bt (something more than 30W)

IEEE 802.3bt <in progress> as of this date (addresses Multigigabit and up to 60W)

PoE powering methods, Ethernet performance and WLAN controller scalability help determine the best Access Point for your environment.

Below is a general rule of thumb when looking at the Access Points in figure 2.

- **1815/1830 Series—**Designed for smaller deployments

  Example are insurance office, small cafe or other venue where the desire is to upgrade to .11ac performance but the intent is to not exceed the throughput of a single GbE connection and/or the powering method PoE is an older 802.3af system limited to 15.4W with perhaps no immediate plans to upgrade soon. Some products in these series have unique capabilities such as small compact design for wall mounting and teleworker use.

- **1850 Series—**Designed for small/medium deployments

  When the venue is a bit larger and/or perhaps the plan is to upgrade the PoE system at a later time. The Cisco 1850 series is a good fit as it is a bit more powerful yet still functions in slightly reduced power consumption modes using 802.3af (15.4W) with performance similar to the 1815/1830.

  When additional PoE power is available using 802.3at, the Access Point has significant performance enhancements for capability up to 1.7 Gbps as the extra power allows for enhanced features such as additional spatial streams and additional GbE port increasing performance capability up to 1.7 Gbps.

- **2800 Series—**Designed for any small/medium/large deployments - requiring very fast throughput.

  This Access point is very powerful and requires a powering system that exceeds 15.4W so it is not compatible with the legacy 802.3af PoE.

  This access Point supports dual 5 GHz operation. This is a significant advantage for venues that already have plenty of 2.4 GHz coverage and there is a desire to double the .11ac performance by enabling dual 5 GHz operation from a single AP. Throughput speeds can easily exceeding GbE and therefore supports dual GbE port. This Access Point requires the use of 802.3at or better PoE.

- **3800 Series—**Designed for *ANY* deployment (very best in class)

  Designed for High Density and other mission critical applications, like the 2800 series product it has dual 5 GHz radio capability, but in addition to that it also is designed to compatible with new 802.3bt standard once it is completed by the IEEE. Powering requirements are a minimum of 30W (803.3at) but will also take advantage of uPoE and 802.3bt (Multigigabit) Ethernet for speeds that exceed GbE. For more on Multigigabit see https://www.cisco.com/c/dam/en/us/products/collateral/switches/catalyst-4500-series-switches/at-a-glance-c45-733656.pdf

Tip Multigigabit increases network bandwidth and speed without running multiple cables allowing significant performance enhancements over existing cabling infrastructure.

The 3800 Series also has support for modularity.

As Cisco and perhaps others develop option modules for the 3800, the additional installed hardware could easily cause the power draw to exceed the 802.3at (30W) and therefore we have designed the 3800 to take advantage of the new uPoE and IEEE 802.3bt methods of PoE that permit up to 60W over an existing single Ethernet cable.

Rugged Access Points suited for outdoor deployments

- **AP1540 Series—**Designed for smaller deployments where size and cost are critical factors

Example - small outdoor cafe or other venue where the desire is to upgrade to .11ac performance but the intent is to not exceed the throughput of a single GbE connection and/or the powering method PoE is an older 802.3af system limited to 15.4W with perhaps no immediate plans to upgrade soon.

- **AP1560 Series—**Designed for any small/medium/large deployments requiring very fast throughput.
  This Access point is very powerful and requires a powering system of 802.3at or above and supports fiber backhaul.
- **AP1570 Series—**Designed for *ANY* deployment (very best in class)

  Designed for High Density and other mission critical applications, support PoE-out for powering wired devices such as video surveillance cameras, etc.

  Can be powered directly by AC, DC, or over UPoE and supports fiber backhaul and GPS location.

General thoughts and guidelines

- The cabling infrastructure (current or planned upgrade) along with the actual data requirements for your location determines which Access Point is the best choice.
- Consider upgrading cabling infrastructure to support 802.3at (minimum) going forward.
- If you have existing Cisco Access Points you can replace them with new .11ac Wave 2 Access Points and you do not have to perform another site survey (cell coverage is the same)
- Greenfield or new deployments, Site Surveys can be done using Cisco Mobility Express http://www.cisco.com/c/en/us/solutions/collateral/enterprise-networks/mobility-express/q-and-a-c67-734485.html
- If you have plenty of 2.4 GHz coverage consider using the 2800/3800 series with Flexible Radio Assignment https://www.cisco.com/c/dam/en/us/solutions/collateral/enterprise-networks/802-11ac-solution/at-a-glance-c45-737165.pdf
- The best location for an Access Point is as close to the users as possible, avoid mounting “in the floor” or “above the ceiling” or far away from users unless you have the expertise (and time) to properly test and qualify such an installation.
- Bluetooth and “phones that tether” are commonplace and cause more issues on 2.4 GHz than on 5 GHz (try to limit 2.4 GHz to guest access or less critical use) consider using the DUAL 5 GHz features of the 2800/3800 for best performance.
- CleanAir and RRM matter—The 2800/3800 series features Cisco’s CleanAir spectrum analysis chipset (best for areas such as medical, hospital or mission critical deployments)
- Only 802.11ac Wave-2 clients support standards beamforming - It is important to note the 2800/3800 Series has Cisco ClientLink for older Legacy Client (.11a/g/acWave1) beamforming performance .
- For installations and additional information see the AP-3800 deployment guide at http://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-3/b_cisco_aironet_series_2800_3800_access_point_deployment_guide/b_cisco_aironet_series_2800_3800_access_point_deployment_guide_chapter_01.html
- Indoor Access Points have antenna gains limited to 6 dBi – If you have requirements for higher gain antennas for example high ceilings or outdoor venues like sporting areas consider the Cisco 3800P Series products http://www.cisco.com/c/en/us/products/wireless/aironet-3800-series-access-points/index.html

Americas Headquarters
Cisco Systems, Inc.
San Jose, CA 95134-1706
USA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV
Amsterdam, The Netherlands