White Paper

The impact of IEEE 802.11ac on copper cabling systems.

excel without compromise.

The emergence of new wireless applications will have a major impact on the future.

Overview

This white paper will discuss the emergence of new wireless applications that will have a major impact on the future of the copper cabling systems we install in the next 5 to 10 years.

It was only a few years ago that some people questioned the future of copper cabling and believed one day it would all be wireless, the reality is, for the foreseeable future, the next generation of Wireless connectivity will actually drive an increase in the installation of high Category cabling.

802.11ac technology fundamentals

IThe current generation of 802.11ac Wave 1 products that have been certified by the Wi-Fi Alliance since mid 2013, deliver a three-fold increase in performance. This is driven by a doubling of channel bandwidth to 80MHz, the addition of a more efficient 256-QAM encoding technique and explicit transmit beam-forming to improve signal quality.

Wave 1 802.11ac supports multiple streams to the same client much as 802.11n did (MIMO). The major change in Wave 2 802.11ac will introduce multi-user MIMO where an access point (AP) transmits simultaneously to multiple clients or a single radio can transmit multiple simultaneous conversations to different clients.

The following table gives an indication of the theoretical rates available with Wave1 products.

The table on the next page shows how simple multiplication can generate all other rates, up to nearly 7 Gbps. Bear in mind that the conditions required for the highest rates – 160-MHz channels, eight spatial streams – are not likely to be implemented in any chipsets in the near future due to design complexity and power requirements.

Now is the time many organisations are looking to move ahead with 802.11ac Wave 1 products that deliver 3X the performance of the prior 802.11n generation. Some are even looking towards the 802.11ac Wave 2 products that are just starting to emerge.

802.11AC THEORETICAL LINK RATES

Channel Bandwidth	Transmit - Receive Antennas	Modulation and coding	Typical client scenario	Throughput
40MHz	1x1	256-QAM 5/6, short guard interval	Smartphone	200 Mbps
40MHz	3x3	256-QAM 5/6, short guard interval	Laptop	600 Mbps
80MHz	1x1	256-QAM 5/6, short guard interval	Smartphone, Tablet	433 Mbps
80MHz	2x2	256-QAM 5/6, short guard interval	Laptop, Tablet	867 Mbps
80MHz	3x3	256-QAM 5/6, short guard interval	Laptop	1.3 Mbps

The 802.11ac project title succinctly reads "Enhancements for Very High Throughput for operation in bands below 6 GHz." These changes enable modes of operation capable of supporting:

- A maximum multi-station (STA) throughput (measured at the MAC data service access point), of at least 1 Gbps.

If this isn't enough to convince you of the size of the potential impact, the following data might give an indication of the scale of change.

continued overleaf

DATA RATES FOR VARIOUS 802.11AC CONFIGURATIONS		
Spatial streams	Highest rates Mbps (160Mhz channel, 8x SS)	
	Long GI	Short GI
x2 for 2 SS	468.0	520.0
	939.0	1040.0
x3 for 3 SS	1404.0	1560.0
x4 for 4 SS	1872.0	2080.0
x5 for 5 SS	2808.0	3120.0
	3744.0	4160.0
x6 for 6 SS	4212.0	4680.0
x7 for 7 SS	4680.0	5200.0
	5616.0	6240.0
x8 for 8 SS	6240.0	6933.3

This has lead to one major manufacturer of Wireless technology to make the following statement:

"Preparing your wired network for 802.11ac:

- Ensure minimum 1 Gbps uplink ports for the APs
- Ensure 10 Gbps uplink from edge switches to core

- One 11ac AP can max out a 1 Gbps uplink on a switch"

Source: **ARUBA Networks**

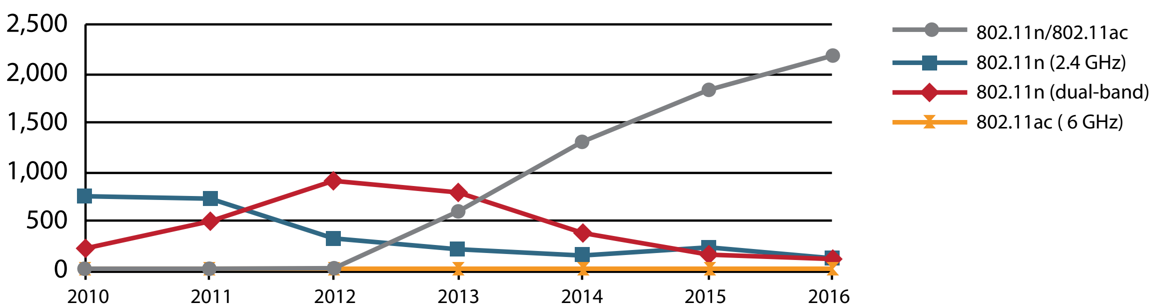
Category 6 cables to each AP location.

Whilst at this moment in time it still makes financial sense to utilise two 1Gbps switch ports, purely on the basis that the cost of these, including the cabling infrastructure, is still considerably less than trying to utilise a 10Gbps switch port. However this will probably change in the next 3-5 years according to all forecasts when we start to see commoditisation of the technology.

The other hurdle at this moment is the Ethernet ports on the APs themselves are still 1Gbps and will probably stay that way for the next few years, until Wave 2 is mature and the cost of the 10Gbps ports come down to a reasonable level.

Power options for 802.11ac in the most part, is unchanged from previous generations of wireless LAN access points. However, some vendors require the additional power provided by 802.3at (PoE+) which provides up to 25.5 watts at the end of a full-length Ethernet cable. 802.3at power is provided by many newer edge switches and can be added onto existing networks by using mid-span power injectors.

Alternatively, some products have the ability to draw power simultaneously from multiple Power over Ethernet (PoE) connections, which enable these products to add two 13-watt 802.3af sources together for higher power draw. In most cases, the cost of running a second cable to existing AP mounting locations is negligible if it is part of a new cable installation, however the level of disruption and cost could be prohibitive if this was part of a retrofit upgrade. Finally enthusiasm for bring-



Wi-Fi chipset forecast for 802.11ac chipsets (millions)

Source: ABI research

your-own-device (BYOD) programs is based on the productivity increases that flow from putting information quite literally in the hands of users. Designing a technical architecture for a BYOD program is a book topic in itself; however it is leading to a requirement to build a network that requires a significantly higher level of service due to increases in device density. 802.11ac will not only have a major impact on the corporate network it will certainly effect the cabling infrastructure that supports it.

The impact on cabling Infrastructure

The first point to highlight is the cabling standards recommend that any new cabling installation should be able to support two full hardware technology upgrades.

Therefore any cabling infrastructure needs to support a wireless LAN for much longer than the lifetime of any particular generation of access points. With the second wave of 802.11ac, the speed will rise to 1.7 Gbps in 80 MHz channels and may be as high as 3.5 Gbps, if 160 MHz channel support is introduced. With these speeds, a single gigabit link will probably be no longer sufficient.

Therefore any new cable installation required for the first-wave 802.11ac deployment, could possibly still exist using a Category 6 system, however many specifiers are now laying the foundation for the second wave and beyond by installing two

> "Now is the time many organisations are looking to move ahead with 802.11ac Wave 1 products that deliver 3X the performance of the prior 802.11n generation. Some are even looking towards the 802.11ac Wave 2 products that are just starting to emerge".

continued overleaf

Conclusions

Access points based on 802.11ac Wave 2 will add more users and more bandwidth to the wireless network. Like all legacy Wi-Fi standards, 802.11ac Wave 1 allows access points to send multiple streams to only one client at a time, which means fewer flows on the network. Wave 2 will support multiuser, multiple-input, multiple-output (multi-user MIMO), which allows access points to send multiple streams to multiple clients at the same time. This technology will allow businesses to support significantly more end users and applications. Employee productivity may get a boost - but Wave 2 won't enable these changes without the supporting infrastructure being capable of supporting it.

As far as the cabling infrastructures are concerned the days of running just one Category 6 cable to an AP location is over, many organisations are now planning at least 2 x Category 6 cables to support both the Data requirements as well as the PoE, some are even planning further ahead by installing Category 6_A at high level and Category 6 to the desktop.

One other impact that we haven't covered in this paper is the knock on effect of having to use additional switch ports to support Wave 2 of 802.11ac. It doesn't matter whether it is a College or a Corporate user, if they are going to upgrade 400 APs throughout the campus or HQ building, that is an additional 9 x 48 port Switches and 32 patch panels, using a traditional cross-connect. This will subsequently involve an additional 2 cabinets at least. Does the building physically have the space and power feed to accommodate the upgrade?

So whilst on the surface this development appears to hold a welcome enhancement in performance for the future, it doesn't come without its challenges and some major considerations if it is to go without a hitch, as it isn't just a case of replacing an existing AP with a new one . Therefore the questions that need to be asked as part of the process should include but not be limited to:

- Have enough cables been run to each AP location?
- Is the existing containment capable of holding additional new cables?
- Is there sufficient switch capacity to support the upgrade?
- Are those switches capable of supporting 802.3at (PoE+)?
- Is there space for additional switching within existing cabinets?
- Is there space for additional patching fields?
- Is there sufficient space for additional cabinets?

This White Paper has been produced by Paul Cave, Technical Manager, on behalf of Excel.

European Headquarters
Excel House
Junction Six Industrial Park
Electric Avenue
Birmingham B6 7JJ
England

T: +44 (0) 121 326 7557
E: sales@excel-networking.com

Middle East & Africa Headquarters
Office 11A
Gold Tower
Jumeirah Lake Towers
Dubai
United Arab Emirates

T: +971 4 421 4352
E: salesme@excel-networking.com

www.excel-networking.com

excel
without compromise.