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Network Solutions

White Paper

Evolution of Wireless

Understanding 802.11ac and why it means more cabling in enterprise networks

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Enterprise networks using IEEE 802.11ac technology are better prepared for more wireless devices, more access points, and faster speeds in the workplace, but users won't see the true benefits of the new standard without the right cabling infrastructure in place to support it.

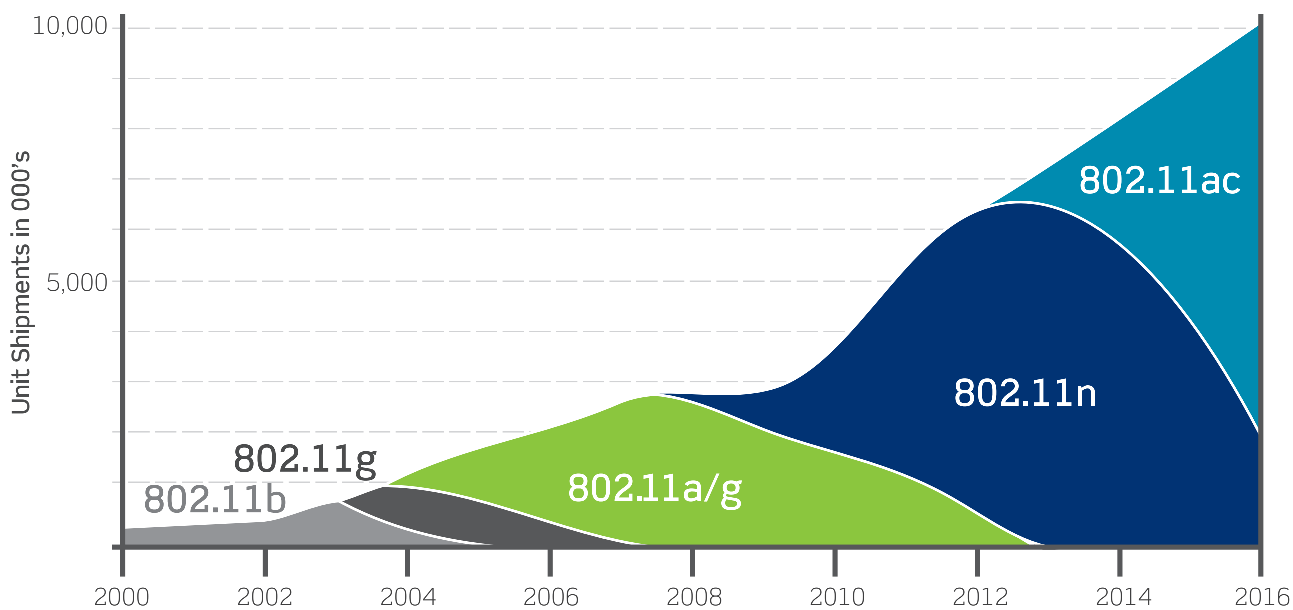
Wireless networks are now ubiquitous in the workplace, and a growing number of companies are adopting Bring Your Own Device (BYOD) policies. These policies aren't just covering smartphones: A Forrester Survey of 35,000 IT managers found an increasing number of BYOD tablets and PCs gaining acceptance. The vast majority of these devices will rely on wireless networks.

More devices in the workplace can quickly tax a wireless network. But with the help of recent standards from IEEE and TIA, along with important backbone upgrades to a high-performance Category 6A cabling infrastructure, wireless access points will be able to handle more traffic and deliver data faster now and in the future.

Enter 802.11ac

802.11ac defines the next generation of Wi-Fi, and succeeds 802.11n. While 802.11ac was approved in late 2013, 802.11ac-enabled smartphones, routers, and laptops have been on the market since 2012. Many people are already using phones and laptops capable of connecting at the higher speed and frequencies 802.11ac offers. In the enterprise segment, 802.11ac already made up more than 30 percent of dependent access point shipments in 2014, and shipments of 802.11ac access points overall will surpass 802.11n this year, according to the International Data Corporation (IDC). This is a significantly faster adoption rate than the move from 802.11a/b/g to 802.11n.

Enterprise Access Points Unit Shipments



Source: Dell'Oro Group

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802.11ac Offers Several Major Improvements Over the Previous 802.11n Standard:

1. Speed and Capacity

802.11ac promises a significant performance improvement from previous generations by implementing three major technology advancements: antennas and spatial streams, channel bandwidths, and modulation technique.

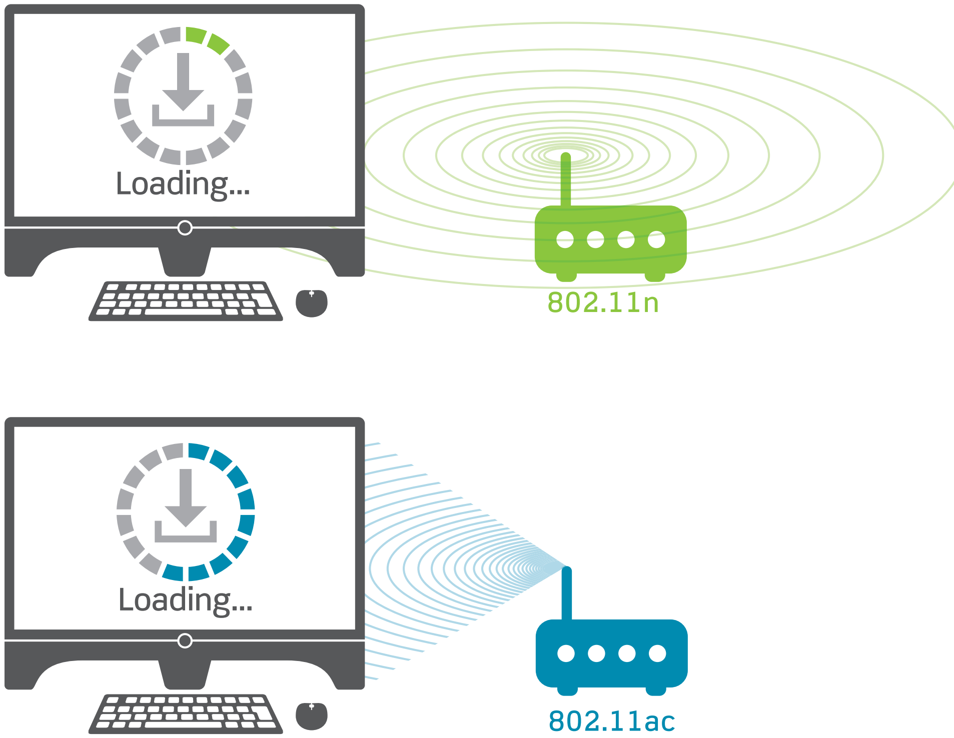
Early 802.11 networks used a single antenna and one data stream. 802.11n made improvements by supporting up to four antennas and four spatial streams for parallel data transfers within the same channel, using technology called multiple-input multiple-output (MIMO). 802.11ac goes a step further by allowing up to eight antennas and eight spatial streams for increased efficiency and higher data throughput.

In addition to supporting more antennas and spatial streams, 802.11ac uses wider channels, which provide more capacity and increased data rates. 802.11ac moved away from the congested 2.4 GHz frequency band and operates only on 5 GHz band. This frequency offers five times the capacity of 2.4 GHz with a much cleaner signal and less interference. The use of 5 GHz band also allows more channels and wider channel widths. 802.11ac adds 80 MHz and optional 160 MHz channels, while still supporting mandatory 20 MHz and 40 MHz channels. The combination of wider channel width with additional spatial streams translates into data rates of up to 1.3 Gbps per radio for Wave 1 products, and eventually up to 6.9 Gbps with Wave 2 products.

One of the most notable improvements with 802.11ac is modulation. With improved modulation and coding techniques, 802.11ac supports a higher order modulation of 256 quadrature amplitude modulation (QAM). This scheme allows transmission of 8 bits per sub-carrier — versus 6 bits per sub-carrier at 64 QAM with 802.11n — resulting in 33 percent faster data rates.

2. Multiple Users

In addition to improved speed and capacity, 802.11ac expands on the MIMO technology of 802.11n by offering Multi-User MIMO (MU-MIMO). This technology allows the access point to transmit data to multiple users at the same time, at full channel data rate, as opposed to sending signals to one device at a time. With 802.11n, data transmits to a single client at a time, delaying data transmission to other clients. With MU-MIMO, an access point can transmit independent data streams to multiple clients simultaneously. For example, one spatial stream can transmit to client A (smartphone) while another stream can transit to client B (tablet) at the same time without slowdown. In order for MU-MIMO to work, both the AP and the client device must support MU-MIMO technology.



2. Better Link Reliability
As a result of using multiple antennas with MIMO technology, 802.11ac can take advantage of beamforming, a technique that transmits a concentrated signal directly to devices instead of broadcasting the signal out to a wide area. Beamforming not only improves bandwidth utilization, it can increase the range of the wireless network. While beamforming technology was an option with the 802.11n standard, beamforming interoperability between Wi-Fi routers and adapters was not clearly defined in the standard, and was under utilized as a result. In contrast, the 802.11ac standard clearly details how to implement beamforming, and does so in such a way that if any Wi-Fi adapters don't support beamforming, they will still communicate with the Wi-Fi router.

Key Recommendations for Cabling Infrastructure

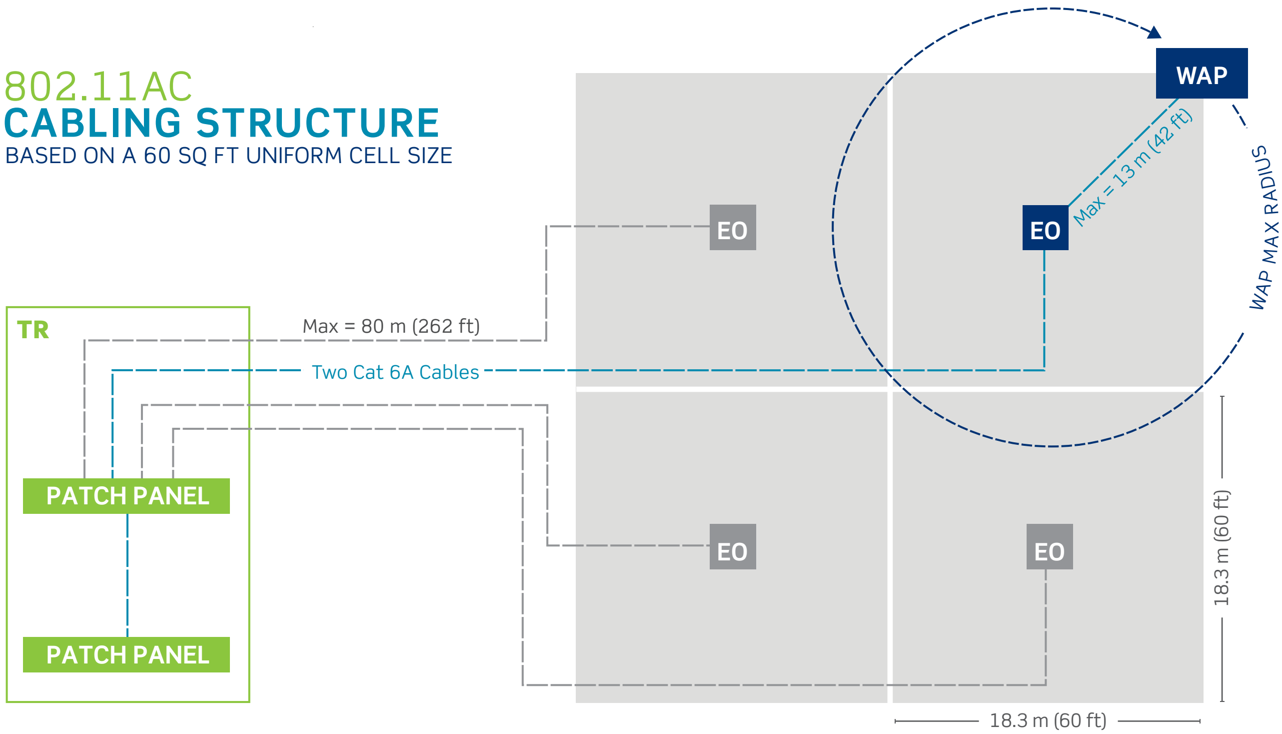
Enterprise wireless access points (WAPs) and backbone cabling infrastructure will need to be upgraded to see the real benefits of 802.11ac, and standards have been revised to support access point upgrades. In late 2013, TIA published TSB-162-A, Telecommunications Cabling Guidelines for Wireless Access Points, which provides recommendations for mounting and routing cable between LAN equipment and WAPs.

The TSB specifies installing twisted-pair Cat 6A for horizontal cabling to WAPs. These high-bandwidth solutions can prepare wireless networks for the next waves of 802.11ac devices, as data rates grow from 433kb/s to 1.3 Gbps and eventually 6.9 Gbps. The recommendations also address cabling to IEEE 802.11ad wireless technology. 802.11ad, ratified in June 2013, is designed to provide much higher data rates, but within a much shorter range. The standard targets high-bandwidth needs under 10 meters, in areas without obstructions such as furniture and walls. It operates in the 60-GHz band where there is little congestion, and serves a much narrower purpose, as it is largely used for connections between specific devices.

By using a Cat 6A RJ-45 interface and twisted-pair structured cabling system, users get the added benefit of backwards compatibility and connection from the horizontal cabling all the way to the backbone and active gear. TSB-162-A also recommends using grid-based zone cabling architectures, with each cell in the grid no greater than 60 feet (18.3 meters) wide. Many designs will likely use smaller grid cells — and in turn require additional WAPs — to improve data rates and allow for greater occupancy rates in each cell.

802.11AC CABLING STRUCTURE

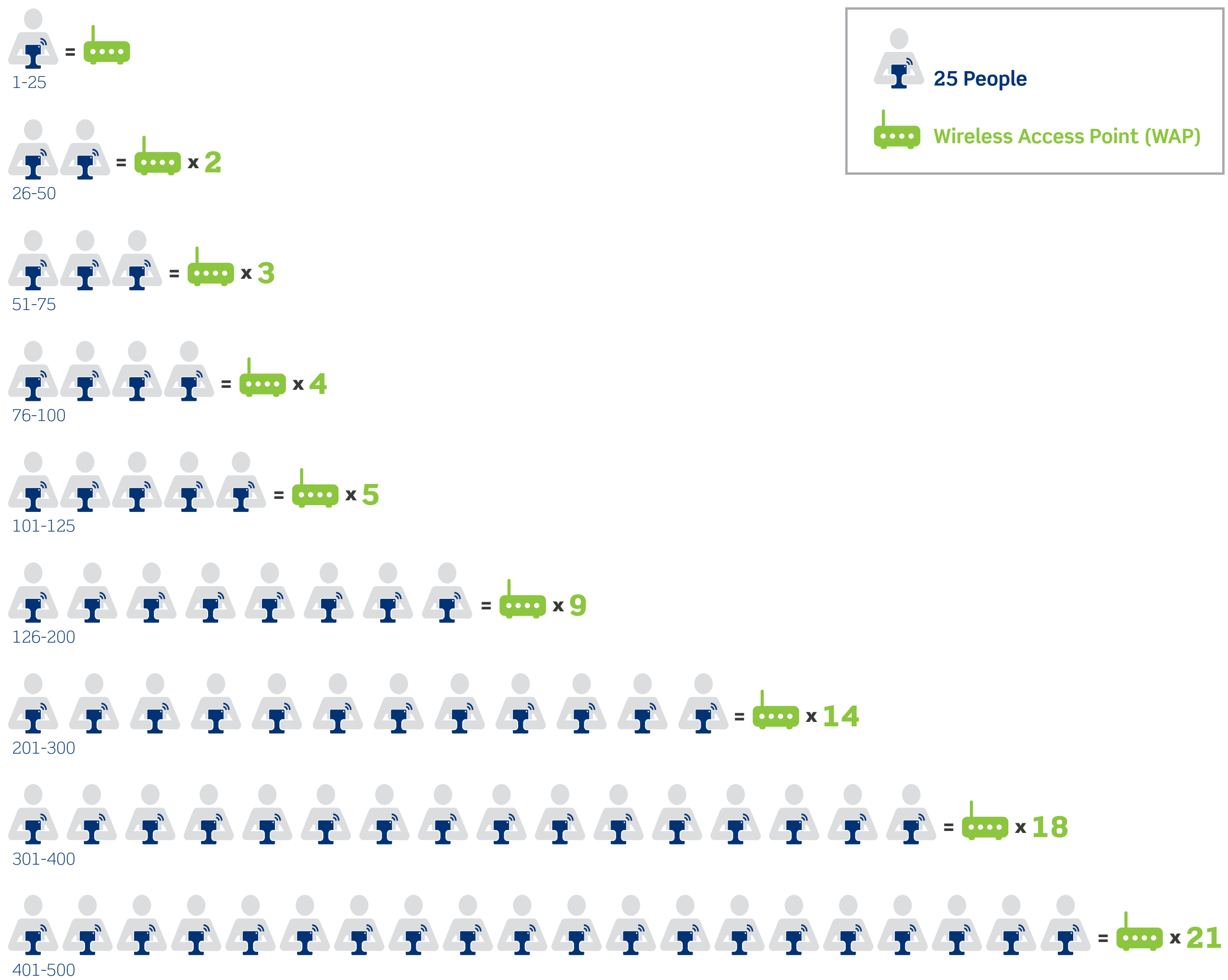
BASED ON A 60 SQ FT UNIFORM CELL SIZE



At least two Cat 6A cable runs are recommended for each cell in the grid architecture. As 802.11ac WAPs allow for Power over Ethernet (PoE), it is recommended to run two Cat 6A cables to each WAP for backup power capabilities in case one power source isn't working. Two cable runs will also prepare the infrastructure for future expansion and data requirements. Leviton suggests installing shielded cabling for these PoE applications, as it reduces heat buildup in cable bundles that may contribute to performance issues.

While TIA-162-A provides recommendations on square footage per WAP based on the grid cell architecture, it does not address the density of WAPs per wireless users. However, the 2013 TIA-4966 Telecommunications Infrastructure for Educational Buildings and Spaces standard does make recommendations based on occupancy. This standard is a good point of reference, as large classrooms and school auditoriums must typically handle a high number of wireless users. The TIA 4966 standard recommends the number of WAP installations be based on occupancy rates for large open indoor areas, with one access point for every 25 occupants (see chart on page 6). If the area of a facility is divided into separate enclosed spaces, then TIA-4966 recommends the density of WAPs be based on square footage.

Occupancy Chart — TIA-4966



What's Next

In March 2014, IEEE approved a task force to create 802.11ax, a follow-up to 802.11ac, which will support speeds of 14 Gbps and offer greater network capacity. The standard is expected to be complete by mid 2018, but, as with 802.11ac, devices that support the draft standard will arrive much sooner, likely as soon as 2016.

IEEE is in the early stages of developing a new standard for 2.5GBASE-T and 5GBASE-T over Category 5e and 6 cabling, through the 802.3bz Task Force. While this new standard could extend use of installed Category 5e and 6 cabling out to WAPs, there will likely be length limitations with this cabling. In addition, alien crosstalk can become a concern with these installations when frequencies increase to 200 MHz for 2.5GBASE-T over Category 5e and 300 MHz for 5GBASE-T over Category 6. Finally, new requirements for field testing still need to be developed in order to validate these installations.

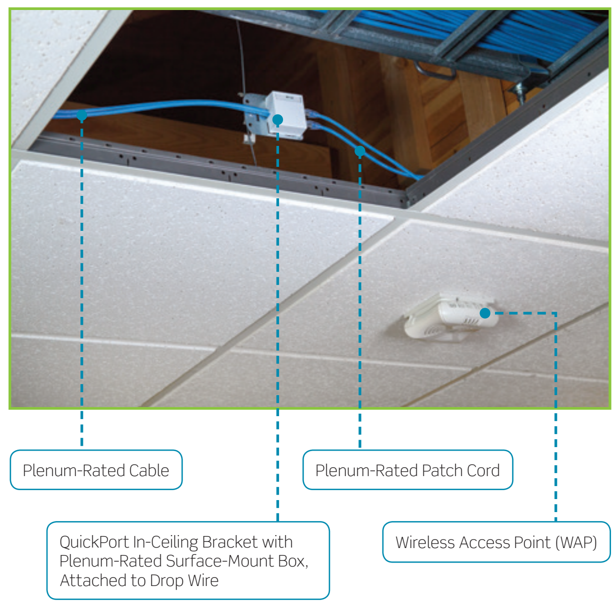
The TIA is also evaluating installed Category 5e and 6 cabling for supporting 2.5GBASE-T and 5GBASE-T through TSB-5021, and the draft currently recommends that Category 6A cabling be used for all new installations. Category 6A will support greater lengths, and provide greater alien crosstalk suppression at higher frequencies. Businesses that upgrade their backbone cabling infrastructure today with Cat 6A cabling based on TSB-162-A recommendations will not only prepare their workplaces for 802.11ac, but will be ready for 802.11ax-enabled devices and 2.5G or 5G applications in the near future.

Other Cabling and Connectivity Considerations

High-quality connectivity is essential for attaining the performance, reliability, longevity, and flexibility needed to support wireless network operations. Leviton is dedicated to delivering the highest performing cabling systems to support infrastructure in small-to-large business enterprises, with connectivity that has been third-party tested and verified to exceed standards performance.

Many wireless access points are installed in drop ceilings, which means the cabling system may require a plenum rating to meet requirements for flammability and smoke density in air-handling spaces. Leviton offers a complete plenum-rated in-ceiling system which includes patch cords, cable, Atlas-X1™ connectors, QuickPort® surface-mount boxes, and mounting brackets.

Power over Ethernet (PoE) to the WAP is another factor to consider. Currently, 802.11ac requires 30 watts of PoE. But with more spatial streams and antennas expected in next generation WAPs, you will likely need a cabling infrastructure that can deliver more power in the future. Leviton Atlas-X1 connectivity has been tested to deliver 100-watt PoE, allowing or driving power and data to a wider range of remote devices.



Learn more about the Atlas-X1 system at Leviton.com/Atlas-X1.

Learn about Leviton's In-Ceiling system at Leviton.com/Plenum.

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