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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.

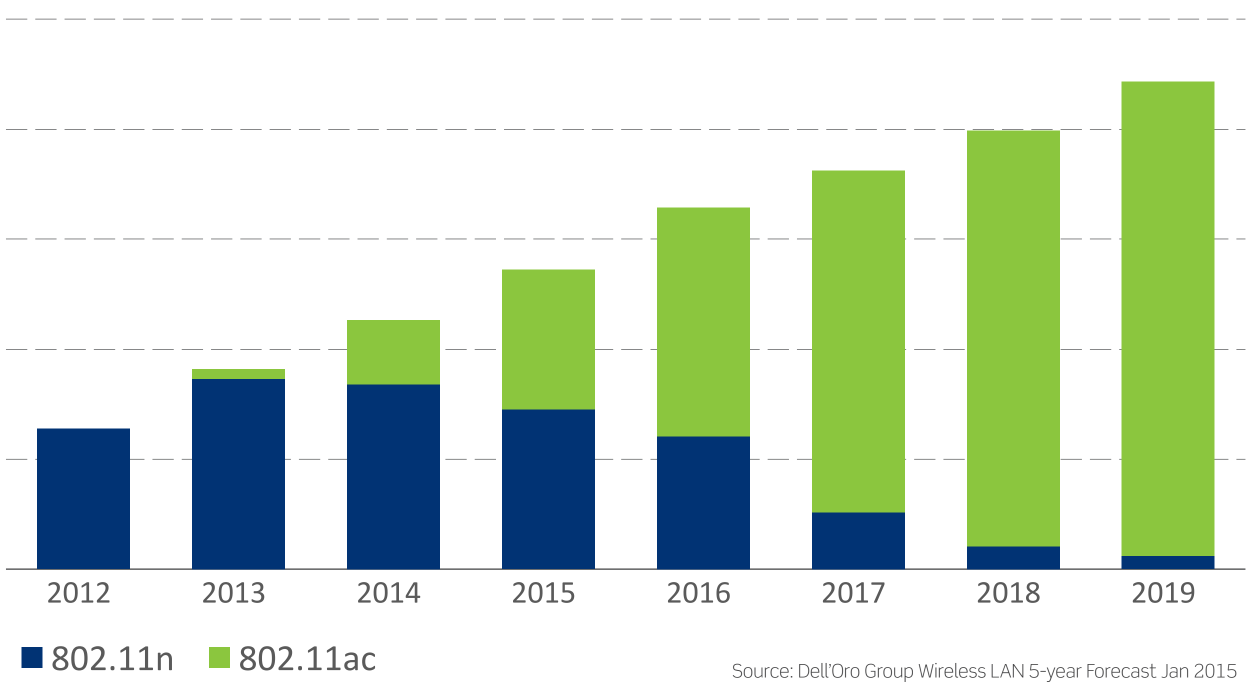
Wireless networks are now ubiquitous in the workplace, and a growing number of companies are adopting Bring Your Own Device (BYOD) policies. These policies aren't just covering smartphones: A Forrester Survey of 35,000 IT managers found an increasing number of BYOD tablets and PCs gaining acceptance. 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. By 2016, shipments of 802.11ac enterprise access points had surpassed 802.11n, and according to forecasts by the Dell'Oro Group, 802.11ac will make 802.11n and older devices obsolete by 2018.

Enterprise AP Volume Split



Source: Dell'Oro Group Wireless LAN 5-year Forecast Jan 2015

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 the 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 Gb/s per radio for Wave 1 products, and eventually up to 6.9 Gb/s 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.

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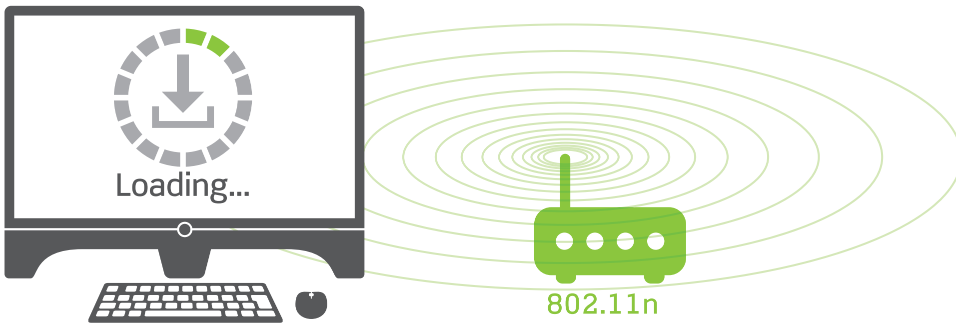


3. Better Link Reliability

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.

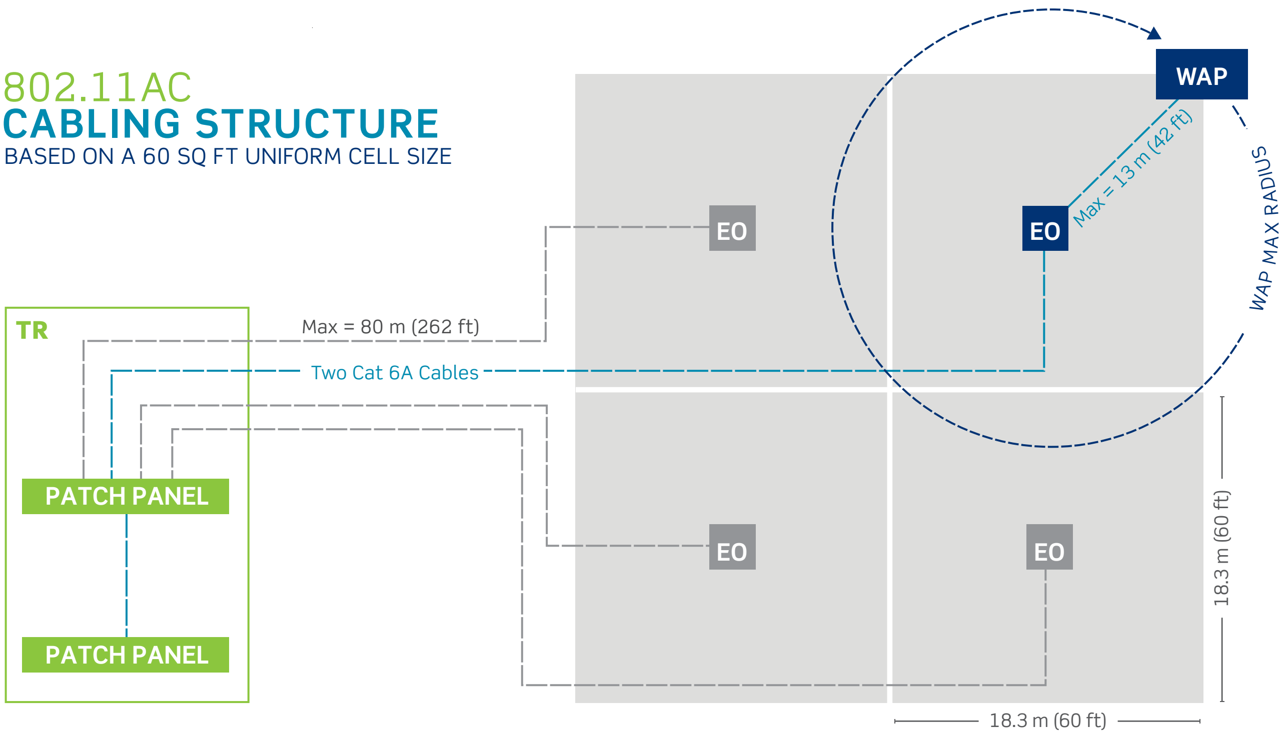
The TSB specifies installing twisted-pair Cat 6A for horizontal cabling to WAPs. These high-bandwidth solutions can prepare wireless networks for the next waves of 802.11ac devices, as data rates grow from 433kb/s to 1.3 Gb/s and eventually 6.9 Gb/s. The recommendations also address cabling to IEEE 802.11ad 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.

Both ISO/IEC and TIA provide recommendations for a wireless network architecture using a cell design. The ISO/IEC TR-24704 technical report for customer premises cabling for WAPs recommends placing a WAP in an array of tight-fitting hexagonal cells with no more than 12 meters in radius, with outlets closest to the center of the cell. The TR-27704 recommendations provide a good design for WAPs that have only a directional signal, such as 802.11n or prior devices.

TSB-162-A recommends a grid-based zone cabling architecture, 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. The TSB-162-A recommendations are mainly for 802.11ac.

802.11AC CABLING STRUCTURE

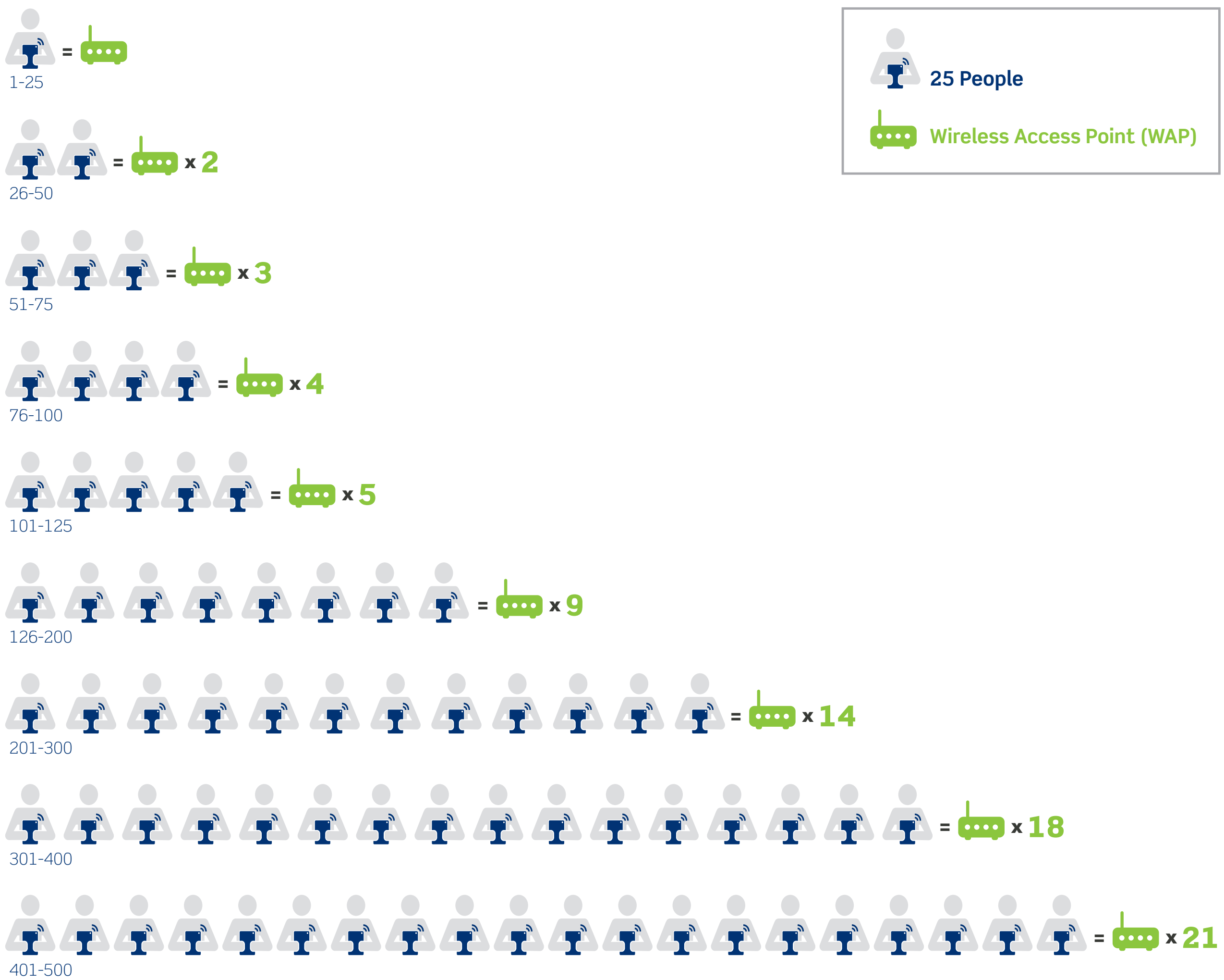
BASED ON A 60 SQ FT UNIFORM CELL SIZE



In TSB-162-A, 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 10 Gb/s and offer greater network capacity. The standard is expected to be complete by 2019. Also, both IEEE and TIA published standards for 2.5GBASE-T and 5GBASE-T in 2016. The recently released IEEE 802.3bz and TIA TSB-5021 specifications allow enterprise networks to swap out active gear and transmit 2.5 Gb/s and 5 Gb/s speeds over existing Cat 5e or Cat 6 cabling to WAPs, extending the life of their current infrastructure.

However, the biggest driving factor for 2.5 Gb/s and 5 Gb/s deployment is also its greatest challenge. The bandwidth demand for wireless is increasing at a faster rate than that of wired networks. As the demand for greater wireless performance continues to grow, even 5 Gb/s networks may struggle to keep up, as 802.11ac already allows wireless speed up to 6.9 Gb/s and 802.11ax will support 10 Gb/s and greater.

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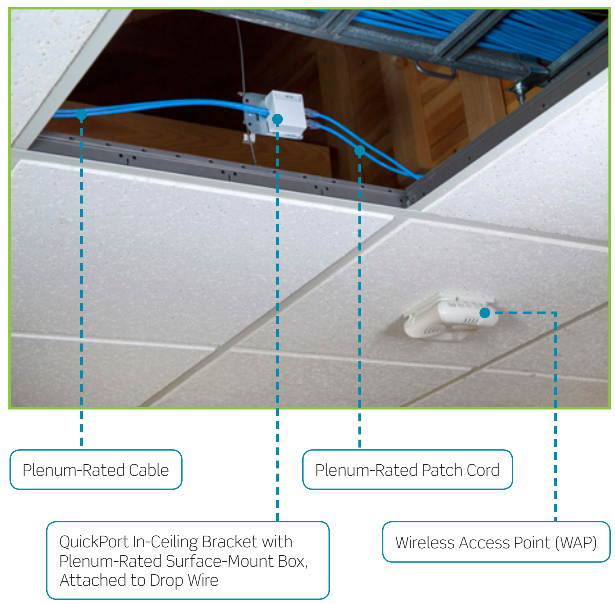
It's important to consider your anticipated needs and plan accordingly. Some facilities only need a small boost in bandwidth, but networks that intend on using 2.5GBASE-T or 5GBASE-T as a short-term solution will require multiple tech refreshes. In this instance, a 10GBASE-T upgrade with Cat 6A cabling may provide greater overall cost savings and prepare your infrastructure to handle emerging wireless demands.

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 for 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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