IEEE 802.11ac: The promise of increased performance

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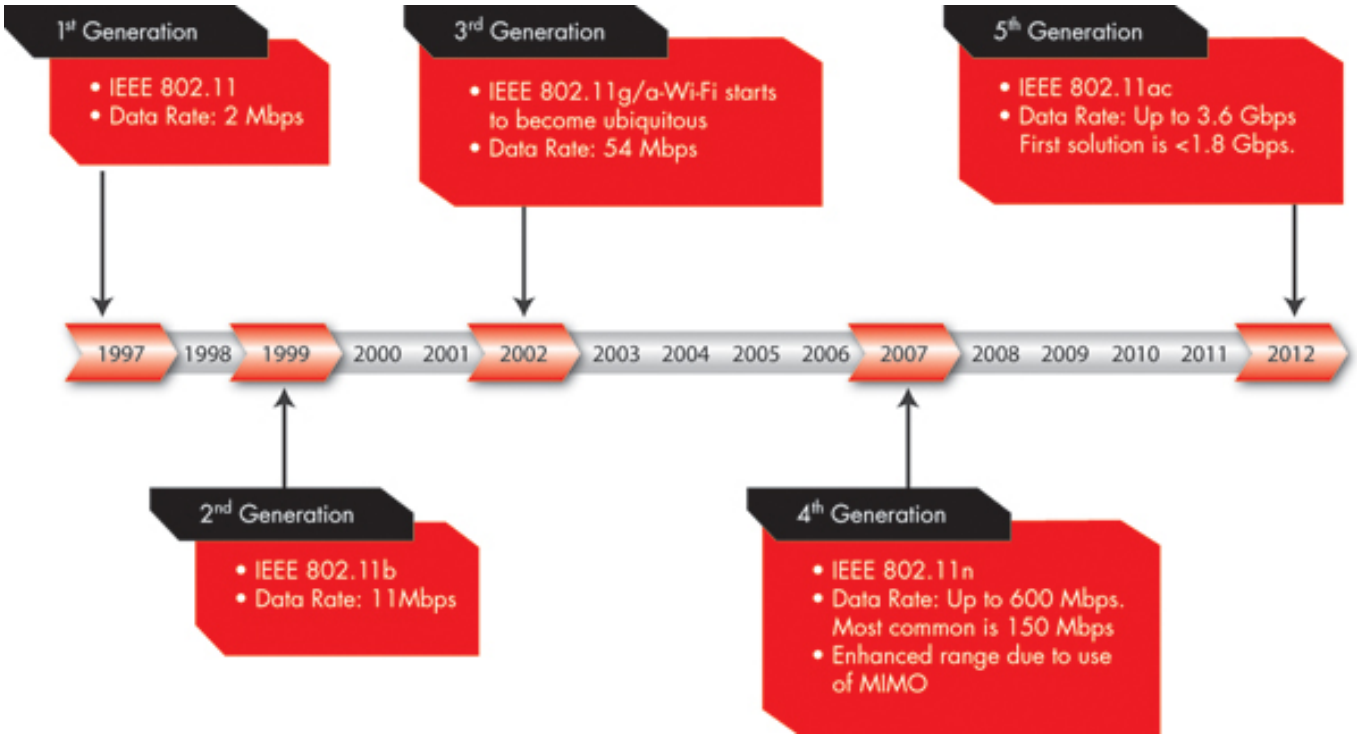
Digital content consumption is on a steep rise – witness the mass adoption of multiple connected devices such as smartphones, tablets and laptops. This surge and the increased reliance on wireless networks –not to mention the growth of video content, which is expected to reach more than 86 percent of global consumer traffic by 2016 according to the Cisco Visual Networking Index: Forecast and Methodology, 2011-2016— is putting stress on existing 802.11a/b/g/n wireless networks.

Enter IEEE 802.11ac, the next generation of the 802.11 standard. The new standard promises to deliver higher bandwidth while retaining better quality of experience (QoE) for consumers. This solves existing problems with end users experiencing poor performance, choppy videos and slower load times. The introduction of this protocol means we will finally be able to break the wireless Ethernet gigabit barrier and it is expected to be quickly incorporated into all markets: residential, enterprise, carrier and large venue.

A brief history of the 802.11 protocol

Until now, all 802.11 revisions have focused on increasing transport speeds. This leads to higher traffic delivery rates and ultimately to faster response times as experienced by the end user. The introduction of 802.11n brought advances of MIMO (multiple-in, multiple-out)to deliver traffic over multiple spatial streams, and packet aggregation. MIMO delivered marked improvements in physical transport rates, enabling more bits per second to be transmitted than ever before over Wi-Fi. Packet aggregation delivered equally impressive improvements in transport experience, allowing devices to send more data once they had gained access to the wireless media. The new 802.11ac has not only preserved these aggregation techniques, but it has also advanced the physical transport rates yet again, and introduced the concept of parallel transport into Wi-Fi through a technique known as Multi-User MIMO(MU-MIMO), where multiple client devices are receiving packets concurrently.



Now, directed traffic can be delivered to multiple client device sat the same time – a first for Wi-Fi's history. This ability has a significant impact on delivery of content to any location with multiple users, especially where content is revenue-generating or critical. This will be especially important for large venues, hotspots, enterprises, and even home video delivery, all of which stand to experience improved per-user experience.

Fortunately, adoption of 802.11 continually experiences healthy growth, despite that there have been four major revisions to the base protocol and numerous additions since inception. This is because the designers of 802.11 sided with end users by making the protocol backward compatible. This way, consumers aren't forced to immediately upgrade their network each time a new solution is released. However, any engineer will tell you that the fastest, most reliable way to deliver a new technology is to eliminate any requirement to interoperate with previous technologies. This creates several technical challenges for 802.11 developers.

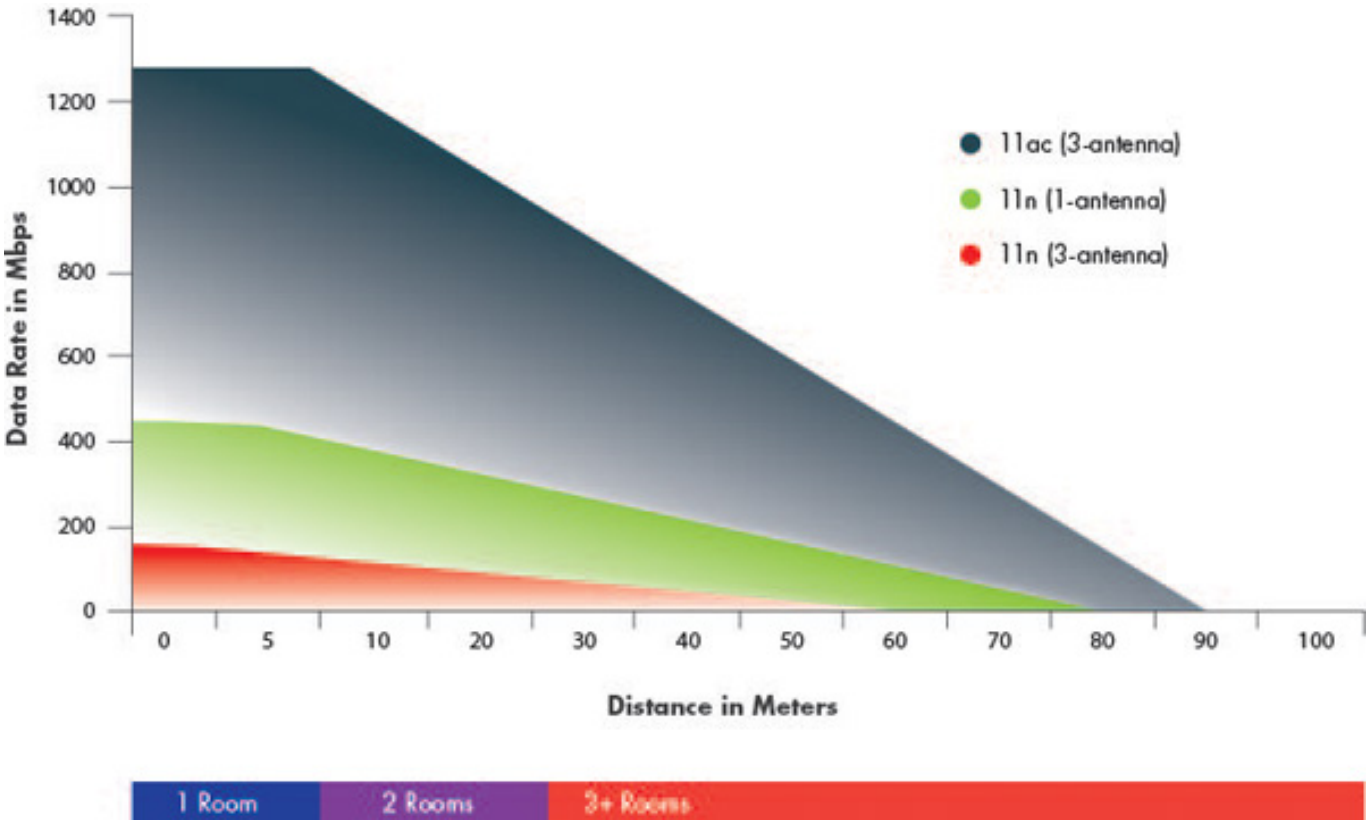
A developer's challenge

Not only does IEEE 802.11ac need to work with ten years' worth of previous releases, it also uses advanced technologies that are substantially more complex and demanding than its predecessors. This requires a rethinking of how the technology is developed and tested to include a much more holistic view through the product development lifecycle. One of the most difficult challenges is that it can be extremely difficult to identify the root cause of development problems. For example, when an application performs poorly, it is often times hard to determine if it is due to an environmental, client, or network issue. The various devices in an 802.11 network are highly correlated so an issue in one area quickly ripples through to many other areas. Developers have lacked an effective means to assess the total picture from the RF to the application layer.

Ensuring testing equipment matches 802.11ac's capabilities

802.11ac brings the promise of turning Wi-Fi into a trusted and capable communication protocol and will require equipment and rigor to match. Traditionally, the RF section is verified using one set of equipment, and then the upper layer functions are tested using a second set of tools. But the overall technical complexity and the introduction of new technologies demand coordination and control between the different layers of the protocol stack. Without this coordination, it would be difficult to utilize these functions and to quickly pinpoint performance issues.

The new generation of testing should be able to decode every frame in real-time and determine each frame's RF characteristics, as well as their frame-level performance, and generate every frame without limitation in real-time to adequately test receiver performance. Previous approaches use a digitized data record approach for both generation and analysis, creating or capturing what are known as I/Q files, and equipment typically adapted from the general-purpose RF domain. This result in equipment being capable of a single spatial stream and able to generate or capture a small fraction of the frames required to perform testing. To meet the need, the approach needs to be able to generate and analyze all frames in real-time to the limit of the specification, tightly integrate RF and MAC functionality in 802.11ac, and include integral, real-time channel emulation.



Benefits for all markets

802.11ac is positioned to overcome the digital content challenge on wireless networks in residential, enterprise, carrier and large venue markets. Residential video streaming, data syncing between mobile devices, and data backup will be some of the first applications for 802.11ac's faster speeds. Consumers and enterprises will be able to stream digital media between devices faster, and simultaneously connect more wireless devices. Carriers will deploy the new technology to offload traffic from congested 3G and 4G-LTE cellular networks, and in dense operator hotspots 802.11ac will supply better performance to more users.

But chip and hardware developers must navigate some significant technical challenges to fully experience the performance and density promise of 802.11ac, as detailed in this article. Providing backward compatibility and delivering high performance, while at the same time gracefully migrating from existing deployed solutions will be some of their toughest challenges. Developers must maintain high performance to multiple clients under the channel conditions that will exist in real deployments. At a time when IT managers report that network users are now averaging more than one Wi-Fi connected device per person, solutions to handle the rapid growth of devices are at a premium. With video consumption rapidly increasing, developers need to ensure that key application traffic can be delivered with quality, while simultaneously providing the high reliability and feature robustness to enable enterprise and carrier-grade 802.11 adoption. If you have any questions or would like to talk more about the testing process and solutions available, please feel free to contact me at jzeto@ixiacom.com [1].

http://www.ecnmag.com/articles/2012/09/ieee-80211ac-promise-increased-performance

Links:
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