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A SURVEY AND PERFORMANCE ANALYSIS OF IEEE 802.11ac WIFI NETWORKING

Sunit Nitin Kelkar

A.S.M's Institute of Management & Computer Studies
Plot C-4, Wagle Industrial Estate, Near Mulund Check Naka, Opp. to Aplab, Thane (W) – 400604 India.

Abstract: **The Wi-Fi has many features for internet access; the most important benefit is that they provide freedom from the web of wires. Wireless fidelity was first launched in the year 1999.IEEE 802.11 is the Wi-Fi code largely accepted all over the world. Wi-Fi has changed the way people use Internet today. According to the ongoing IEEE 802.11ac amendment, the wireless network is about to embrace the gigabit-per-second raw data rate. There are many Wi-Fi technologies which are used with the help of router. The latest router is AC router, it is also known as 802.11AC router with many benefits including speed, bandwidth etc. Two best evolving standards are IEEE 802.11ac in wireless-local-area-network (WLAN) products and 3GPP LTE-Advanced in cellular communications. IEEE 802.11ac promises data rates of up to 1.73Gbps between an access point and a wireless client. The IEEE802.11ac is an emerging WLAN standard which operates at 5GHz band. Ac router offers the ultimate performance and excellent bandwidth with antennas compare of N router (802.11N router).It is also upgrade of the previous technology network. In this research paper we will grasp the basics of 802.11ac and the features involved such as :Extended channel binding, Downlink Multi-user MIMO, Beam-forming, High-Definition video streaming data at high speeds, Syncing and Backing Up, Modulation types. Through numerical analysis and simulations, we compare the MAC of 802.11n and 802.11ac,the result is,802.11ac with a configuration of 80MHz and single(two) spatial streams outperforms 802.11n with a configuration of 40MHz and two spatial streams and its maximum throughput.**

Keywords: **Extended channel binding, Multi-user MIMO, Beam-forming, Definition video streaming data at high speeds, Syncing and Backing Up.**

I. INTRODUCTION

Late in 2008, a new task group (TG) was formed within the IEEE 802 Standards Committee with the goal of creating a new amendment to the 802.11-2007 standard. The new amendment, known as 802.11ac, includes mechanisms to improve the data throughput of the existing Wireless Local Area Networks (WLAN), enabling wireless networks to offer wired network

performance.Existing 802.11 technologies operate in the 2.4 GHz band (802.11b, 802.11g), the 5 GHz band (802.11a), or both (802.11n). 802.11ac operates strictly in the 5GHz band, but supports backwards compatibility with other 802.11 tech nologies operating in the same band (most notably 802.11n). To achieve its goals, 802.11ac relies on a number of improve ments in both the MAC and Physical Layer the Physical Layer improvements include: Increased band width per channel. Increased number of spatial streams.

Higher-order modulation -- 256 Quadrature Amplitude Modulation (QAM).

Multi-User Multiple Input Multiple Output (MU-MIMO).There will be dramatic improvements in wireless reliability, range, and coverage. The places now having dead-spots will have a better reception and as the data is transferred at high transfer rates the battery consumption is also reduced hence leading to a longer battery life.Digital-content consumption is on a rise day after day, with video content (streaming) expected to reach approximately 90percent of global consumer traffic. At the same time, internet traffic is shifting rapidly from wired to wireless networks. Due to this there is tremendous pressure on the earlier IEEE models and it leads to poor performance but 5th generation WIFI overcomes all these issues of increasing dependability on wireless networks and the number of increasing users.

II. INTRODUCTION OF 802.11 AC FEATURES

- 80MH Extended channel binding with bandwidth.
- Eight spatial streams.
- Multiuser-MIMO (MU-MIMO) - each with one or more antennas, transmits or receive data stream concurrently.
- Multiple access streams not speared by frequency.
- 256 QMM, rate 3/4 , and 5/6 added s optional.
- Beam forming with standard sounds for capability between vendors. MAC Modifications.
- 800ns regular guard interval.
- Single spatial streams.

III. NETWORK ARCHITECTURE FOR 802.11 AC

Throughout the evolution of wireless LAN technology, there have been a number of approaches to adding the wireless LAN access layer onto an existing wired backbone network. Most approaches share two fundamental attributes, and they remain unchanged by 802.11ac. Fundamentally, 802.11 provides MAC-layer (or, after the OSI nomenclature, “layer 2”) mobility. As an 802.11 station moves throughout the coverage area of the network, from the perspective of the routing and switching infrastructure it remains in a fixed spot. All commercially available products that support large-scale networks have extended the fundamental MAC-layer mobility to encompass the entire network, sometimes even going so far as to make a single subnet available in many different locations with VPN technology. Additionally, ever since the 2006 introduction of WPA2, the 802.1X security framework (sometimes also called “WPA2-Enterprise” after the Wi-Fi Alliance certification program) has provided strong authentication and transparent encryption to client devices. The 802.1X framework offers network administrators the capability of designing network authentication around user-specific policies, often assigning a bundle of access rights (variously called a “profile” or a “role”) to users upon connection to the network.Many network administrators are familiar with the concept of protocol layering and the Open Systems Interconnection (OSI) model. Network protocols are often classified by where they fit in the OSI model. Less well known, but just as important, is the separation of network technologies into *planes*, as shown in the depth dimension Each plane has its own protocol layers, of course, but each plane also has a specialized purpose. Common planes include the following:

A. *Data plane:*

Protocols in the data plane move bits from one location to another and are concerned with moving frames from input interfaces to output interfaces. In an IP network, the main data plane protocols are TCP and IP, with applications such as HTTP riding on top of the network and transport layers.

B. Management plane:

The management plane provides protocols that allow network administrators to configure and monitor network elements. In an IP network, SNMP is a protocol in the management plane. A vendor’s configuration application would also reside in the management plane; wireless LANs may use CAPWAP as a transport protocol in the management plane. Without exception, large-scale IP networks use centralized management and thus have a centralized management plane. The management plane of the network is responsible for planning and implementation, policy definition, and ongoing monitoring.

C. Control plane:

The control plane helps make the network operate smoothly by changing the behavior of the data plane. An IP network uses routing protocols for control, while switched networks use the spanning tree protocol. The control plane of a wireless LAN is responsible for ensuring mobility between access points, coordinating radio channel selection, and authenticating users, among other tasks. The control plane is also responsible for enforcing policy.

Wireless networks can be classified based on the location of the control plane, and much of the development across the history of wireless LANs has been about refinements to the control plane. Early wireless LANs were built out of completely independent APs. The management plane was practically nonexistent (consisting of the APs' serial ports and, in a highly engineered network, perhaps a terminal server), and the control plane was not unified. Networks based on autonomous APs did not automatically select channels and did not always support smooth handoff between APs without proprietary protocol extensions at both ends of the link.

The development of wireless LAN controllers a decade ago led to a redesign in the way that networks were built, with the control and management planes being centralized in this new piece of the network. In a typical controller-based deployment, the access points have limited functionality without a connection to the controller. Authenticating and authorizing users is handled by the controller, as are algorithms that provide RF management functions such as channel selection. Centralized management and control made much larger networks possible, and essentially, nearly every large-scale network built prior to the emergence of 802.11n was built using a controller-based architecture. In addition to the control and management planes, early controller-based network architectures centralized the data plane as well. All data from APs was forwarded through the controller; this is often referred to as a *network overlay* because the wireless network was separate from the existing core network and existed as a layer on top of the existing core. In effect, the controller took on the role of a distribution switch for users attached to APs and provided mobility by serving as an anchor for the logical point of attachment. Early applications of wireless LANs were driven by application-specific traffic, not general-purpose user access, which made the overlay model acceptable to network administrators.

With the emergence of higher-speed wireless network technologies, there was a shift in how wireless LANs were used: rather than simply being small one-off deployments to automate processes, they became general-purpose access methods. Add-on PC cards were replaced by 802.11 interfaces integrated into the motherboard. With the standardization of 802.11n and 802.11ac traffic volumes have increased dramatically, due to both the higher speeds and the increase in the number of wireless devices attached to a typical network. As network load increased, centralized forwarding through controllers became a traffic bottleneck. Many vendors responded to the bottleneck by moving the forwarding decision out of the controller and back to the AP at the edge of the network, an approach often referred to as *distributed forwarding* because the data plane function has moved from the controller out to the AP, and, in fact, back to a parallel location with wired traffic. Although this architecture looks superficially similar to autonomous APs, it is typically paired with centralized management. Increased processing power also made varying control plane implementations possible, enabling distributed AP architectures to handle typical control functions by working among themselves.

IV. CATCHING THE 802.11AC TECHNOLOGY WAVE

Early in the development of wireless LAN technology, a new PHY was brought to market all at once. With 802.11n, however, the standards started to become much more complex, and different levels of capability came to the market in distinct "waves" or "phases." Once the basic technical details are worked out, it can often be much easier to write a standard than to build a product. For example, the work required to add four-spatial-stream support into the 802.11n standard was relatively minimal after the basic ground rules were complete, but as of the 2013 publication date of this book, four-stream 802.11n devices have yet to be brought to market because of the engineering challenges involved in building the powerful DSP required to perform the spatial mapping while staying within the 15-watt 802.3af power limit.

802.11n came to the market in waves due to the overall complexity of the standard. 802.11ac will follow this well-worn path, with a rough estimate of the contents of the first two waves in Table 5-1. The first generation of 802.11ac delivers another jump in channel bandwidth, along with a new modulation. Taken together, these two features are enough to nearly double the speed of a typical three-stream client device. The second wave of 802.11ac will add even wider channels, four-stream support, and beamforming. Although there is a temptation to focus on the headline rates only, beamforming has the potential to deliver significant gains in network capacity by improving the data rates at which most clients transmit. Not all transmissions occur at the fastest rate, so the beamforming boost can be substantial if it increases the data rates used by clients.

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Table 5-1. 802.11ac technology waves

	Wave 1	Wave 2
Standard basis	802.11ac, draft 2.0	802.11ac, final version
Timeframe	Mid-2013	2014
Channel width	20, 40, and 80 MHz	Potential to add 160 MHz channels
Modulation support	Up to 256-QAM	Same as wave 1
Lowest 11ac speed	173 Mbps (20 MHz, 2-stream, 256-QAM)	Same as wave 1
Typical 11ac speed	867 Mbps (80 MHz, 3-stream, 256-QAM)	1.7 Gbps (160 MHz, 3-stream, 256-QAM)
Maximum 11ac speed	1.3 Gbps (80 MHz, 3-stream, 256-QAM)	3.5 Gbps (160 MHz, 4-stream, 256-QAM)
Beamforming	Yes (depending on underlying chipset)	Yes, possibly MU-MIMO

V. FIRST WAVE 802.11 AC VERSUS SECOND WAVE 802.11 AC

A key decision in planning for 802.11ac is when to jump in and deploy widely. Unlike previous physical layers in 802.11, the first wave of 802.11ac does not offer a clear-cut compelling advantage for every user. First-wave 802.11ac products are now available, and derive their additional speed from two main protocol features. Getting the most out of the first wave of 802.11ac will require an environment that can use one or both of these features:

A. 256-QAM:

The two top data rates in 802.11ac add 33% to the speed over 802.11n, but they require significantly higher signal-to-noise ratios. As a practical matter, such high SNRs require clean radio spectrum and short AP-to-client distances.

B. 80 MHz channels:

Clean spectrum is required to allocate contiguous 80 MHz blocks, and even with Dynamic Frequency Selection (DFS) support, there will only be five available 80 MHz channels. Five channels is enough to plan a network, but it will not be as easy as it was with the multitude of channels that were available in 802.11n.

VI. EFFECT OF 802.11 AC ON CLIENT CAPABILITIES

Table 5-3 shows the evolution of client capabilities as they move from 802.11n to the first wave of 802.11ac technology. Naturally, there will be departures from the table, but the general rule is that high-end laptops will use the fastest connectivity available while small battery-powered devices will use power-efficient single-stream interfaces. Low-end laptops fall somewhere in between and will typically settle for a less expensive wireless interface that has middle-of-the road capabilities. High-end tablets may also opt for two-stream interfaces.

Table: 5-3. Effect of 802.11ac on client capabilities

Type of device	Radio type (in 2013 & earlier)	Channel width (2013 & earlier)	Data rate (2013 & earlier)	Radio type (2014)	Channel width (2014)	Data rate (2014)
Dual-band smartphone	802.11n, 1-stream	20 MHz	72 Mbps	802.11ac, 1-stream	20/40/80 MHz	Up to 433 Mbps
VoIP handset	802.11a/b/g or1-stream802.11n	20 MHz	54 Mbps	802.11a/b/g or1-stream802.11n/ac	20 MHz	Up to 87 Mbps
Tablet	802.11n, 1-stream	20/40 MHz	72 or 150 Mbps	802.11ac, 1-stream	20/40/80 MHz	Up to 433 Mbps
Netbook/low-end laptop	802.11n, 2-stream	40 MHz	Up to 300 Mbps	802.11ac, 2-stream	80 MHz	867 Mbps
High-end laptop	802.11n, 3-stream	40 MHz	Up to 450 Mbps	802.11ac, 3-stream	80 MHz	1.3 Gbps

VII. EQUIPMENT SELECTION

With an estimate of the number of APs and their tentative initial locations, it is time to start picking out an actual implementation, rather than working with generic APs. At a high level, APs connect the free-flowing wireless world with the high-performance, fixed-in-place wired world. After reviewing your network requirements and determining what constraints drive the logical architecture, it's time to pick out your access point hardware. Access points all perform the same basic function in that they shuttle frames between radio networks and Ethernet LANs, but there can be tremendous differences in cost and functionality. Comparing access points on the basis of price alone may prevent you from discovering a critical feature that improves your ability to manage and run the network. If you're building a network of more than just a handful of access points, you probably want to look beyond the hardware available at electronics stores and at highly functional APs. Here are some things you may want to consider:

A. Wi-Fi Alliance interoperability certification:

In June 2013, the Wi-Fi Alliance launched an interoperability program for 802.11ac. Ensuring that your product vendor has successfully passed interoperability testing is not an absolute guarantee of interoperability, but it is a strong statement that the manufacturer believes in interoperability and has taken steps to ensure compatibility with a wide variety of client devices. To check on the certification status of a product, visit the Wi-Fi Alliance website and click on the "Wi-Fi CERTIFIED Products" button on the left hand side of the page.

B. High performance:

Performance is not just a matter of the rate at which products push data. Many products are capable of pushing "air rate" data speeds, but only corporate-grade APs have "air rate" performance while providing a sophisticated feature set under heavy load. As with many other areas of networking technology, vendors of corporate-grade hardware invest much more heavily in software tuning because their products are used in deployments where more than just the number of bits per second matters. This investment pays dividends in providing high data rates at longer ranges from the AP with higher numbers of active client devices.

C. Hardware quality and robustness:

Corporate-grade devices are designed to be used for many years before replacement, and therefore are often designed with future expandability in mind. Components are selected with a view toward quality and long life, instead of basing decisions primarily on cost. Sophisticated antennas or other radio frontend components may be used to improve the quality of the network, either in terms of throughput or coverage. Radios will be enabled on all available channels, even though the cost of regulatory compliance before using DFS channels can be substantial, and software supports automatic configuration of radio channel selection. Some deployment areas may require specialized hardware designs due to either very high or very low operating temperatures.

Software functionality, upgradability, and quality:

Generally speaking, more expensive devices have significantly more functionality, with advanced features in several areas. Vendors regularly plan for the release of such features, and it is common for new features to be provided midway through a product's life cycle. Understanding the future functionality that might be delivered and whether your deployment would benefit from planned features allows you to consider new features appropriately in the decision process. Additionally, extensive QA testing is used to ensure that corporate-grade devices can be run for months at a time under heavy loads.

D. Antenna options:

Internal antennas allow an AP to be self-contained and to blend smoothly into the aesthetic environment. External antennas typically have higher gain, which improves range. In a deployment based on area of coverage instead of density, or a deployment in a challenging radio environment, selecting the right external antenna can make the difference between a poor-quality network and a successful one. External antennas are also frequently used for outdoor deployments. Picking the right external antenna is still something of an art, and the antenna must be matched to the performance characteristics of the AP. A high-gain antenna will dramatically increase the transmit range of an AP, but if the AP has low receive sensitivity, the high-gain antenna will cause more problems than it solves.[45] Product manufacturers are responsible for obtaining regulatory authorization for each type of external antenna used, so a larger selection of external antennas indicates more extensive regulatory testing.

E. Power options:

Consumer-grade devices are typically powered with a "wall wart" transformer and must be installed close to existing electrical outlets, while corporate-grade devices can draw power from the device at the other end of the Ethernet cable. Power over Ethernet enables placement of devices in out-of-the way locations, and can be used to provide power even on very high ceilings.

F. Security:

Security is not just about providing solid encryption, though that is the obvious starting point. Corporate-grade products offer flexible authentication through RADIUS and directory interfaces, per-user VLAN mapping, traffic filtering and queuing, and built-in captive web portals for web-based authentication. Fast roaming support extends the basic encryption to support mobile applications.

G. Quality of service:

At the most basic level, quality of service support involves compliance with the Wi-Fi Multimedia (WMM) certification requirements, which divides traffic on the air into four classes of differing priority. More complex queuing systems can be used to improve service quality for voice devices, or to ensure that airtime is balanced fairly between network users.

H. Manageability:

If you are reading this book, you need centralized management. Evaluate management tools for a wireless network in the same way you evaluate management tools for a wired network. Ensure that the management software provides something beyond simple configuration management and can report on the overall state of the network.

VIII. DRAWBACKS (TRADE-OFFS)

I don't think you'll find 802.11ac clients as standard equipment for computers. So, you need to buy one, connect it to the computer via Ethernet, configure the client, and finally pair the client with the router/access point.

Unless your application requires streaming large amounts of data, you probably will not experience a noticeable improvement in performance.

The 80 MHz-wide channel is more susceptible to RF interference or congestion from other Wi-Fi channels by virtue of its larger width.

The 80 MHz channel eats up four of the available channels in the 5.0 GHz band. Some routers implement DCS (dynamic channel selection) whereby they will jump to a better channel in the presence of RF interference. But if you are using 80 MHz channels your choices for better channels are few or non-existent.

IX. SOLUTION

- The higher the frequency (5.0 GHz versus 2.4 GHz), the greater the bandwidth which allows more data carrying capacity.
- Attenuation is the reduction of signal strength during transmission.
- RF signals are attenuated exponentially over distance.
- Attenuation is directly proportional to the frequency.
- My concern rides on 802.11ac needing to use the 5.0 GHz frequency range in order to get the monster data throughput being advertised. That means -- per the physics above -- users will have to live with a significantly smaller coverage area, something those more familiar with 2.4 GHz devices will not expect.

X. CONCLUSION

The objective of this paper is to investigate some of the issues arising in the design of 802.11ac Routers. In particular, we consider the fairness behavior between competing flows in networks between the 802.11ac and 802.11n. We analyze various problems such as lower throughput, higher delay, and large congestion at the network.

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