

# Fundamentals of 802.11ac

## Frequently Asked Questions

### Standards, Clients, Compatibility and Regulations

**Q: Are there still different FCC-mandated output wattage restrictions in the US among the different 5 GHz channels for indoor use?**

**A:** Yes, there are still different FCC-mandated output levels. The FCC will still follow Part 15.247 to regulate radio transmit output. There is an amendment in FCC to further expand current channel 165, disclosed in FCC alternative guidance 644545-D2.

**Q: If we have dual-radio a/g/b/n APs, and then clients come out with ac, will our APs be somewhat downwardly compatible?**

**A:** The interoperability between an 802.11ac client and an 802.11n AP is supported, but only as an 802.11n connection. The client will be the conforming entity and operate as an 802.11n client.

**Q: Will the currently shipping laptops be able to work with the newer 802.11ac? Is 802.11ac backward compatible with 802.11n?**

**A:** Yes, commercially available laptops that provide support for 802.11n capability will interoperate with 802.11ac enabled networks. This is because the standard requires 802.11ac access points to be backward compatible with 802.11n.

**Q: Are you limited to 802.11n in mixed 802.11n/802.11ac networks?**

**A:** In the same way that 802.11n clients and legacy 802.11a/b/g clients can coexist on the same network and not impact each other, 802.11ac clients can coexist with 802.11n clients. The larger the number of legacy devices present, the more airtime will be utilized by clients that only support lower data rates.

Airtime Fairness® helps mitigate the impact to some extent, but there are only so many channel access slots available to a client. This is another area where Meru's® unique architecture serves to provide more tools to network administrators, enabling them to manage their spectrum as well as their infrastructure.

Meru's single-channel and multi-channel architectures allow users to create channel layers, either to simply add capacity or to segregate devices or applications. In this case, legacy devices can be put in one chunk of the spectrum, while new 802.11ac clients receive their own portion of the spectrum to help ensure maximum efficiency and performance.

**Q: Is it true that there will still be a need for single antenna (single stream) support, as more mobile tablets like Amazon's Kindle Fire HD incorporate multiple antennas?**

**A:** Silicon vendors appear to be focusing on single-stream combo chips that support 802.11ac and Bluetooth. It is anticipated that for the next few years, smartphone devices will continue to be single stream (1x1:1).

## RF Coverage, Beamforming and Network Designs

**Q:** Since 802.11ac operates at 5 GHz, the network design will require a much higher density of APs to penetrate walls and floors. Can you comment on density, since we see a lot of consultants using a spacing of 40' to 50' on center?

**A:** The effective nominal range of a 5 GHz AP, supporting 802.11ac clients, will be no different than that of any 5 GHz AP servicing legacy 802.11a or 802.11n clients.

It is expected that 802.11a/b/g/n clients will represent the majority of devices found in WLANs well into late 2014 or early 2015. Consequently, WLAN designs will have to take into account these devices, and the design recommendations for now are to continue to use the same AP placement strategies as represents current best practices for supporting 5GHz clients and the corresponding applications (voice, video, data, or RTLS).

Variances in the coverage pattern resulting from beam forming are temporal and do not have a persistent effect on coverage. Therefore, "cell size" should be determined based on the understood propagation characteristics of 5 GHz rather than trying to take into account the impact of beamforming in any particular deployment. This will help to ensure consistent coverage and performance across all device types.

**Q:** How will beamforming work in a mixed (legacy) environment? Will it be degraded? Will it be degrading to other legacy devices?

**A:** Explicit beamforming benefits 802.11ac capable clients by providing better data rates at the same range. Features such as implicit beamforming and Maximal Ratio Combining (MRC) are intended to improve the connection quality and throughput of legacy clients. Airtime Fairness helps to ensure that there is a minimal impact on both legacy and 802.11ac clients, due the presence of either.

**Q:** Will the gain increase with beamforming and 802.11ac?

**A:** Gain is a concept for radio frequency technology. In general, an RF transmitter will oscillate low current energy first, and then pass over to the antenna. Then, the antenna radiates the energy from the current as electromagnetic waves. Gain value will be determined in the hardware design rather than in interrelationship with 802.11ac technologies.

However, at the given gain, a network with an 802.11ac access point will effectively steer electromagnetic energy towards the user (as beamforming) instead of emitting such energy in all directions. Thus, it is expected to provide the user with better performance.

**Q:** Is the antenna array directional?

**A:** There is not a requirement for directional antennas to support beamforming, because this is performed at a much lower level by driving the signals to the multiple MIMO antennas. A directional antenna can be configured (for an external AP) to meet specific deployment needs, such as for mesh.

**Q:** Is beamforming going to require line-of-sight between AP and client?

**A:** No. Through an explicit feedback mechanism called sounding, the station and access point understand the condition of the RF environment between them, and use this information to modulate the signal when beamforming. It is expected that clients with varying degrees of attenuation between themselves and the access point will benefit from beamforming to improve the client receive data rates.

**Q: Are the 802.11ac client devices going to be able to use their own beamforming to transmit back to the AP?**

**A:** Beamforming is available when the transmitter has more antennas than there are spatial streams to be sent to the receiver, and both support explicit notification. Beamforming is not supported at the client level. The protocol that is used by the AP to optimize beamforming does not make sense in a client context. The AP is not moving and when RSSI drops below a defined threshold, the client's appropriate action would be to roam to another AP.

Beamforming can enhance the receive signal strength of the client by focusing more energy on that specific device. Depending upon the configuration, device capabilities, and provisioning, there may still be cases where the client can "hear" the AP, but can't transmit to the AP. In such cases, the client will be roamed to another access point in the Virtual Cell.

**Q: 802.11ac can talk to four users at a time. How many clients can talk to the AP at once?**

**A:** The MU-MIMO function is a downstream capability. Upstream traffic (from a client) will proceed in half-duplex mode where normal collision detection mechanisms are used.

**Q: Can you review the optimal SNR that will be needed for 802.11ac?**

**A:** The SNR implications are found on slide #30 of the webinar deck. There is a direct correlation between SNR and data rate, and the SNR is directly impacted by the use of beamforming, MRC, and other technologies incorporated in the 802.11ac standard. You can download the slide deck from the corporate website.

**Q: Will 802.11ac create bottlenecks for controller-based technologies?**

**A:** The concept of controller-based technologies should not be confused with a centralized data plane. All WLAN architectures, even the so-called controller-less ones still need to provide a centralized management plane for configuring, managing and monitoring the WLAN services and infrastructures.

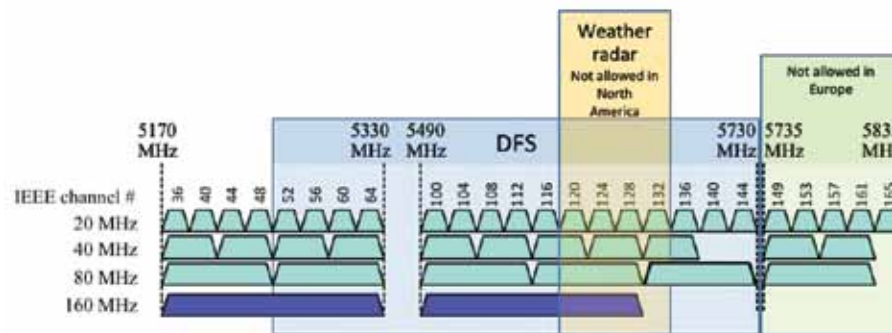
The control plane and data plane benefit from being able to be configured in the way that best meets the needs of the customer and the deployment scenario. For example, a K-12 customer may want the simplicity of centralized data and control planes in their elementary schools, while an enterprise customer with a large number of small sites may benefit from distributed data and control planes.

Meru offers WLAN controllers that support multiple 10 Gbps interfaces and high availability, but Meru's unique architecture also supports a completely distributed data plane, which provides you with options to use the right tool for the job.

Finally, it should be noted that the aggregate bandwidth of WLAN traffic will continue to trend up and to the right, but it still lags behind the data rates by orders of magnitude. This same concern was raised when the 802.11n standard was close to ratification, but the fears over orders of magnitude increases in aggregate bandwidth for the cores of networks, where WLAN controllers live, never materialized. Meru's architecture is designed to allow you to deploy today with the switches, power injectors, and infrastructure that you have today, and migrate to larger controllers, or a distributed data plane, when the need dictates. Does your WLAN vendor offer this same flexibility?

**Q: What advantage is there to an 80+80 MHz-wide channel over a straight 160 MHz-wide channel?**

**A:** With 802.11ac, the encoding was enhanced from 64 to 256 to give a 4x higher density for transmission. Wider channels add to the higher data rate by providing more capacity within a channel. However, the availability of contiguous portions of the spectrum to create 160 Mhz-wide channels is limited, particularly due to current regulations and current restrictions on spectrum use:



It was initially believed that by splitting a 160 MHz wide channel into two 80 MHz wide channels would enable more flexibility and better use of the spectrum. However, support for 80+80 MHz channels will not be in 1st generation 802.11ac chips, and there is some question as to how viable the discontinuous 80+80 solution is for 2nd generation chips as well.

**Q: Are there additional security considerations to think about with 802.11ac?**

**A:** 802.11ac is an RF standard affecting the physical and MAC layers. The security concerns remain the same as those found with 802.11n networks for perimeter security, authentication, encryption and message integrity, and access control. These challenges have been addressed in the standards with 802.11i (WPA2) and in implementations of firewalls.

The dramatically higher throughput of 802.11ac, coupled with industry trends towards a more distributed data plane, mean VLANs will be used more intensively for Layer-2 traffic segregation, and you may have larger, spanning VLANs in your deployment as you distribute wireless VLANs throughout areas of a campus and still try to minimize the number of Layer-3 roaming domains.

**Q: How will three-channel microcell designs utilize the 160 MHz ac on only 2 channels?**

**A:** Having fewer than three open channels will make it almost impossible to design and deploy a VHT wireless network that covers larger areas without a "single-channel architecture" design. At best, islands of VHT can be deployed. Worst-case scenarios will leave one 160 MHz channel that may be impacted by false positives in the DFS-required portions of the spectrum.

**Q: Will the coverage of 802.11ac be similar to 802.11n in 5 GHz?**

**A:** It is anticipated that the nominal coverage of 802.11ac will be exactly the same as observed with 802.11n. The propagation characteristics of RF in the 5GHz range remain constant. The effects of beamforming will be most advantageous in the normal operating range, which may result in better data rates at the same distances, but preliminary testing shows improvements in range to be marginal. Variances in the coverage pattern resulting from beam forming are temporal and do not have a persistent effect on coverage.

## Power

**Q: Will a customer with actual PoE switches need to change them to support 802.11ac? Will PoE+ be sufficient for powering 802.11ac radios?**

**A:** As mentioned in our webinar, power draw for 802.11ac is as good as, or slightly better than, 802.11n radios. This is due,

at least in part, to the use of 40nm technology in the radios. Existing PoE power is expected to work with new 802.11ac access points.

## Vertical and Business Drivers

**Q: Who is driving the demand for greater throughput? In my environment (university), what I see is more demand for increased coverage and distance rather than data rate. Our users are happy with what they're getting now. (They want access to the Internet and that's a limited pipe in any case.) However, they would welcome being able to get a good signal further from the access point, or maybe better RF penetration and fewer dead zones. I didn't hear anything about those features with 802.11ac.**

**A:** The major impetus for the 802.11ac task group was to create a new RF design that would provide a 1+ Gbps data rate for HD video applications. In fact, the first 802.11ac solutions in the market will be HD TVs and other video gear. One major benefit to be gained from 802.11ac will be an increase in capacity (more clients per AP). This will help to address network access for cases such as lecture hall, where you may find 200 to 300 users with tablets. You are correct in observing that, for many cases, the data rates provided by a standard 802.11n access point are more than sufficient for the user base. For these customers, deployment of an 802.11ac solution will be delayed until there is a real need.

**Q: Why move from 802.11g to 802.11n, if 802.11g is sufficient? ["if it ain't broke, don't fix it principle"]?**

**A:** Good question. We would not recommend moving to new technologies simply to make a sale -the solution needs to be a real solution to the buyer. "If it ain't broke, don't fix it."

**Q: How would 802.11ac, with its beamforming, be used in an educational environment with 40+ clients in one small area?**

**A:** This is a very good question. The value of beamforming works for clients within a certain dB range of the AP. However, when there are a large number of highly mobile clients associated to an AP, the effectiveness of beamforming is diminished. In this use case, the client devices are likely to be single-stream tablets or smartphones that we anticipate will benefit greatly from MU-MIMO when it becomes available in 2nd generation chips and from the increased data rates provided with 802.11ac.

**Q: In the healthcare vertical, many establishments spoke about the effects of Wi-Fi on health. Now with 802.11ac, do you think they will be even more concerned? Do you know if the government health departments have already analyzed health effects?**

**A:** SAR (Specific Absorption Rate) testing is a standard procedure for 802.11 class devices. To date, there have been no serious health concerns raised regarding exposure to 2.4 GHz or 5 GHz radiation. Each country dictates the level of certification required for RF-based devices, and though the debate will likely continue in some circles, we do not expect an elevation in the dialogue.

## Meru 802.11ac Solutions

**Q: What kind of solution does Meru provide for early 802.11ac adopters?**

**A:** Meru's 802.11ac solution will include all the mandatory features specified in the draft 802.11ac standard. We will provide details on our capability when we get closer to product launch in mid-2013.

**Q: Should our prospect customers postpone their investments in 802.11n and wait for 802.11ac infrastructure? Or will manufacturers be offering any “upgrade” to 802.11ac on existing/upcoming equipment?**

**A:** According to most industry analysts, this is a great time to be investing in 802.11n technology, for several reasons. First, we are currently on the fourth generation of 802.11n products, which offer great quality and near-gigabit capacity at a very attractive price point. Second, most of the mobile devices shipping today only operate in the 2.4 GHz band. 802.11ac, which only operates in the 5 GHz band, will not be able to relieve capacity constraint for today’s mobile devices. Change to 5 GHz and 802.11ac mobile devices will be gradual, and it will be several years before there will be meaningful device penetration to take advantage of the higher 802.11ac capacity. By that time, second-generation 802.11ac products will be available to take advantage of optional features such as 160 MHz channel widths and multi-user MIMO to deliver significantly higher capacity. Meru, with its unique channel layering architecture, can deliver twice the capacity of competing 802.11n solutions in the 2.4 GHz band, and thus can be a good choice for enterprises struggling to cope with the BYOD phenomenon today.

**Q: What is the upgrade path for current customers who have 802.11n access points and controllers? A new controller? New access points? Both?**

**A:** 802.11ac is inherently a new radio technology. Meru customers will be able to leverage their old controllers that are not at end-of-life and replace their access points with 802.11ac access points where desired.



For more information visit [www.merunetworks.com](http://www.merunetworks.com) or email your questions to: [info@merunetworks.com](mailto:info@merunetworks.com)

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