

Enabling Dense Wireless LAN Deployments with the Meru Radio Switch

Wireless LANs bring freedom to connect to the Internet, email and other network applications without being tethered. This is leading many enterprises to deploy them throughout their campus and especially in areas such as meeting rooms, conference centers, libraries, resulting in new productivity gains. People *like* wireless, and its use is increasing exponentially as more and more discover its lack of restrictions.

As wireless LAN deployments and usage has increased, coupled with the near ubiquity of embedded Wi-Fi in laptops and smart phones, many enterprises are experiencing complaints from their users of slow or even dropped connections. Many times this is due to a high density of users all accessing the wireless LAN (WLAN) simultaneously. Unfortunately, today's wireless LAN solutions are not designed to deal with high densities of users and what was formerly liberating is now frustrating.

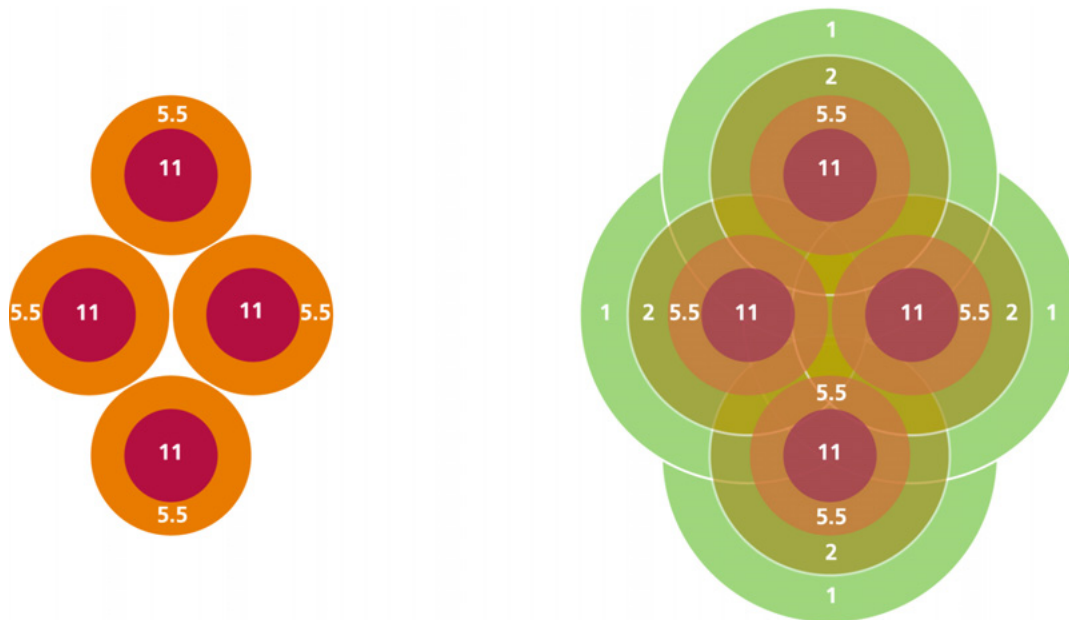
Why Traditional LANs Fail in High Density Situations

Traditional wireless LANs are analogous to an Ethernet hub. As the 802.11 protocol is a shared medium, all users contend for the same bandwidth delivered by a single Access Point (AP). As higher numbers of users access the wireless LAN, the collision avoidance protocol¹ used by 802.11 to manage contention increases each individual client's time to access the network. As the number of users increases, more and more delay occurs resulting in slower speeds for each user and even application timeout.

To solve these issues, conventional wisdom is to deploy more access points at a closer spacing. The reasoning is that if one access point provides 54 Mbps of bandwidth (802.11g or 802.11a), then additional APs will increase the capacity. This is true only to a limited extent. A number of reasons including only three non-overlapping channels² and co- and cross-channel interference as more than three APs are deployed limit the effectiveness of this approach. Reducing cell size by reducing the access point transmit power is often mentioned as a way to mitigate this, but when it comes right down to it, the solution is still inadequate for dense environments. The more APs deployed in an area, the more contention there is, resulting in even more problems with throughput and connectivity for high numbers of users.

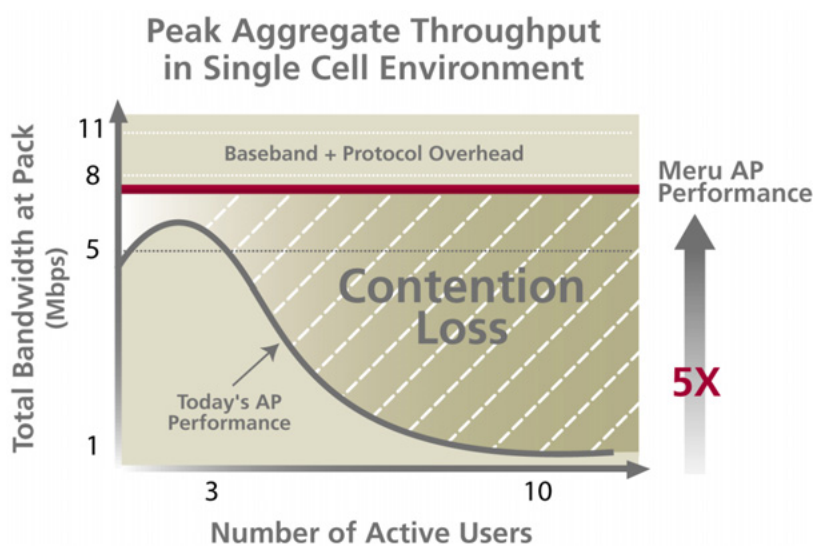
¹ Carrier Sense Multiple Access/Collision Avoidance (CSMA/CA)

² 802.11b and 802.11g



Reducing the spacing between APs and limiting transmission to higher data rates does not improve performance in a highly dense client area. The lower data rates continue to propagate, causing significant co-channel interference, degrading performance.

In fact, because of the nature of the 802.11 protocol, with only three to five simultaneous contenders, 802.11 throughput dramatically decreases because of the increased back off caused by contention among the users.



A further complication is termed ‘hidden node.’ Hidden node occurs when there are multiple clients within a single cell that are able to communicate with an access point, but cannot ‘hear’ each other. While the CSMA/CA protocol works well for those clients within range of each other, this will not always be the case. Clients may be separated suitably far from each other due to the Access Point range at low data rates, or separated by a physical obstacle. In addition, further sources of contention will come from clients outside in neighboring cells. Even when access point transmit powers are turned down to provide a denser environment, client transmit powers are not modified and thus will radiate into neighboring cells.

Voice Applications Aggravate the Problem

The challenges described above are even worse as voice clients enter the WLAN environment. Voice traffic requires low latency, low jitter, and fast handoffs. The traditional method for increasing client density - using more APs - has the exactly the opposite intended effect. More access points will increase latency, increase jitter and create more handoffs. All of these combine to make most high density WLAN deployments unusable for voice at all. The significant contention in such an environment will cause such a high packet loss that voice calls will be unintelligible.

The Meru Difference

While others have created WLAN switch architectures, they focus primarily on ease of deployment and central management of AP configuration parameters. Solving this problem is both important and necessary, but it is not enough. The key challenge is managing contention, interference and Quality of Service in a dense Wi-Fi environment with both data and voice clients. Meru has done just that with its WLAN System.

Managing Contention

With the foresight that Wi-Fi will become the primary enterprise network connection in the years to come, the Meru Wireless LAN System uses advanced techniques within the 802.11 protocol to *schedule* client access to the network. Patented Air Traffic Control technology makes channel access more deterministic to eliminate the back off problem that occurs when a high density of clients connected to a single access point contend with each other. In this way, throughput for the network stays high and consistent, regardless of the number of simultaneous clients contending for the same channel.

Managing Interference

Interference from overlapping AP channels and co-channels raises the level of noise which reduces performance of the network. Meru avoids this problem through the use of Cellular WLAN technology. Cellular WLAN technology coordinates contention across cells. Clients that require Quality of Service, such as a smart phone, are scheduled such that there is no interference when they are on the air, even from hidden nodes.

Delivering Upstream and Downstream Quality of Service

Latency sensitive applications, such as voice over Wi-Fi, require quality of service to work properly in even a lightly loaded network³. By building on the system's ability to control channel activity with its Air Traffic Control technology, Meru dynamically recognizes when a VoIP call is initiated and reserves bandwidth over the air for the call resulting in unparalleled call quality and connection reliability. While IEEE is introducing 802.11e to solve some of the quality of service issues, this standard does not address several important areas. Meru uses 802.11e and builds upon it to provide a much more robust system. 802.11e only delivers downstream Quality of Service performance. This means that client communications upstream to the Access Point are not managed and contention is likely in a dense environment. Contention is destructive, especially to voice applications as even the dropping of a single packet every 200 seconds will result in clipping and lost speech. Meru's patented call flow intelligence determines which streams are voice applications and automatically manages quality of service in both directions.

In addition, 802.11e does not provide Quality of Service on a per application basis. This means that if a laptop is simultaneously running a soft phone for a voice over Wi-Fi call as well as checking email, the device receives the high priority assigned to it, not just the voice over Wi-Fi application. This situation worsens contention. Meru's Quality of Service capability is on a per-application basis, not per-device, so each application receives the correct QoS settings.

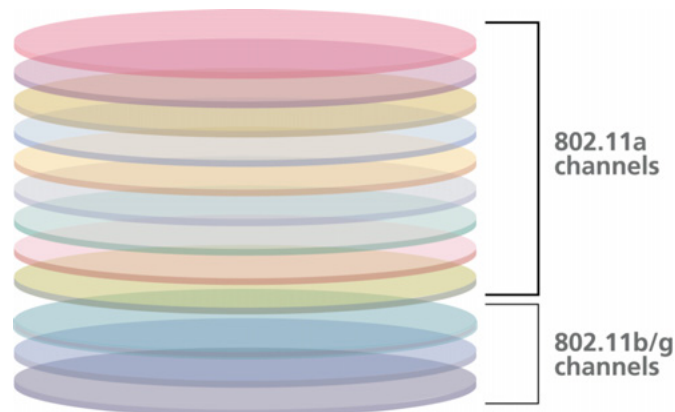
Last, 802.11e does not address the critical issue of handoff between APs or indirect sources of interference from hidden nodes or co-channel interference. Handoff can take up to several seconds, which will destroy the quality of the voice call. Contention from hidden nodes causes additional delay, which will impact voice quality. Co-channel interference - the impact of multiple access points being heard by each other - will also add noise to the environment, causing delay. Meru's Cellular WLAN Architecture creates a Virtual Cell, which eliminates handoffs and manages intercell contention. Multiple APs appear as a single AP to the voice client so no handoff or re-authentication is needed as the client roams. Client access to the medium is deterministically scheduled so that voice clients reach the network in a consistent, regular basis. These methods allow Meru to deliver a five-fold increase in density of voice calls over any other WLAN solution.

A New Approach Radically Changes the Playing Field

Now that the main challenges of contention, interference and Quality of Service have been addressed, new approaches can be made to deal with the high density WLAN environment. The Meru Radio Switch radically alters the bleak scenario described earlier when trying to use traditional WLAN architectures to solve this problem. While still using the standard 802.11 protocol and providing full interoperability to any Wi-Fi certified client, Meru is changing the game when it comes to high density WLAN deployments.

³ "Despite VoIP's low-bandwidth profile, even a small amount of data traffic on the same network can lead to seriously degraded audio quality and dropped calls, even with QoS features enabled.", Voice over Wireless LAN Clear Choice Test, Network World, 1/10/05

Meru realized that what is needed is a device much more akin to an Ethernet switch for dense environments. Much like the world of wired networking was fundamentally changed with the advent of the Ethernet switch, the new Meru Radio Switch is poised to have the same impact. With up to 12 individual 802.11 channels, the Meru Radio Switch provides the equivalent of twelve access points all in a single device. Similar to how a 12-port switch delivers dedicated bandwidth to the users on each port, the Meru Radio Switch provides high bandwidth to each group of users on each 802.11 channel.

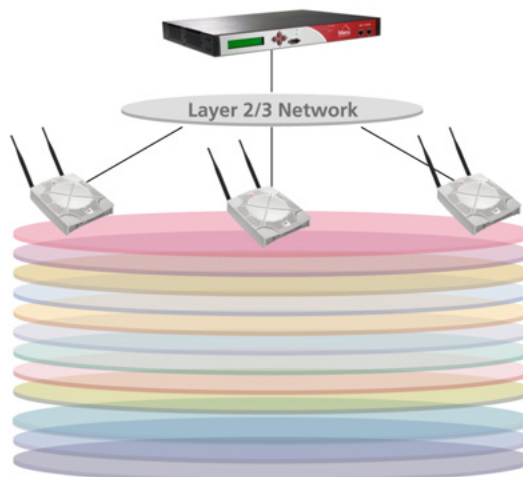


Meru Networks Radio Switch delivers 12 simultaneous overlapping AP channels much like a 12 port-10/100 switch delivers dedicated 100 Mbps of bandwidth to each port.

The key reason that Meru is able to achieve this while all other WLAN implementations will not is due to Meru's patented Air Traffic Control technology and Cellular WLAN architecture.

Using Multiple Radio Switches

For sites where multiple Radio Switches are required to provide more extensive 802.11 coverage, the Meru Controller provides a single interface for WLAN management, including security, contention management and Quality of Service. The Meru Controller works with multiple Radio Switches to form a single Virtual Cell created from multiple physical APs.

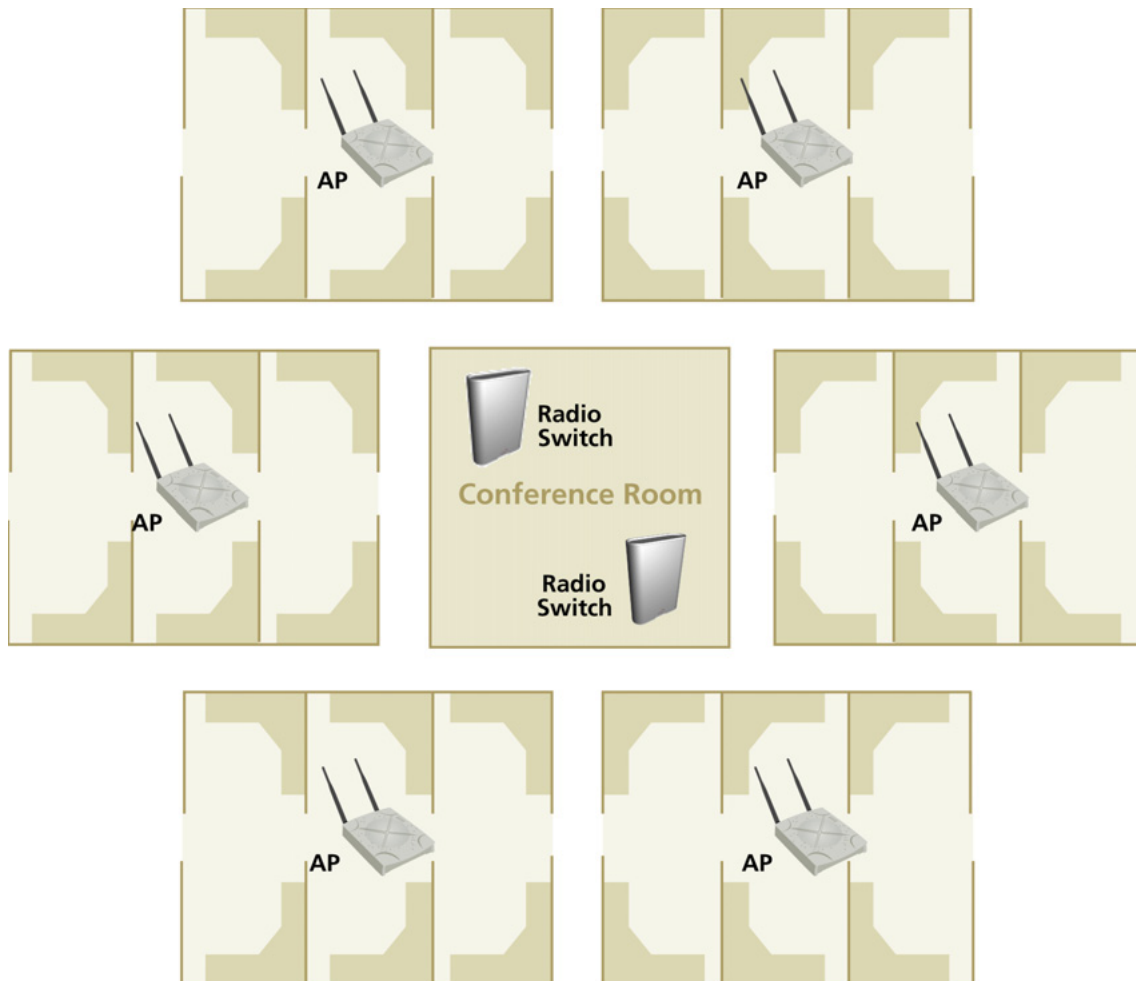


Multiple Meru Radio Switches form a Virtual Cell with up to 3 simultaneous 802.11b/g channels and 9 802.11a channels for unprecedented scalability.

Using Air Traffic Control, Meru is able to support 30 simultaneous voice over Wi-Fi calls AND a heavy data traffic load on a single access point. As the Meru Radio Switch really encompasses up to 12 APs, the scalability is enormous! This scalability is crucial, as Wi-Fi integration in cellular phones becomes commonplace and the simple act of walking into a building with a dual mode Wi-Fi/cellular phone will instantly increase the number of users on the WLAN network. Imagine now the number of users on the network in an enterprise, hotel, airport, hospital, convention center, university or any other heavily trafficked building. As multiple Meru Radio Switches are deployed, Meru's Cellular WLAN architecture enables zero handoff between cells and coordinates co-channel interference across cells, thus eliminating both direct and indirect sources of contention. For voice clients, eliminating contention and handoff time is critical to achieving toll quality voice.

Deploying the Meru Radio Switch in a Dense Wi-Fi Environment

Much like using an Ethernet switch to segment traffic and provide higher overall performance levels for each user, the Meru Radio Switch can be deployed in dense client environments with the same results. Conference centers, university libraries, and enterprise offices - all can use the Meru Radio Switch to deliver the highest WLAN performance in a mixed data and voice environment. If other areas need Wi-Fi coverage but will not have the density of clients, standard Meru APs can be deployed to provide continuous 802.11 connectivity. A single Meru Controller provides a single interface for management to both standard Meru APs and the Meru Radio Switch.



Summary

The Meru Radio Switch is akin to the Ethernet switch. It provides dedicated bandwidth to users on each AP channel, with up to 12 802.11 channels supported per device. Using patented Air Traffic Control technology and Cellular WLAN architecture, the Meru Radio Switch eliminates issues with contention, interference and Quality of Service that prevent all other solutions from delivering high performance for a voice and data WLAN network. The Meru Radio Switch delivers high throughput and reliable connections for a 12-fold increase in user density over today's WLAN solutions. It's ability to deliver high density WLAN today, and support voice over Wi-Fi with no changes to the infrastructure or clients, make it a compelling solution for any enterprise contemplating a larger scale WLAN roll out.

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