Lab Testing Summary Report

March 2012

Report SR120306

Product Category:

Wireless Access Points

Vendor Tested:

CISCO

Products Tested:

Cisco AP 3600i
Cisco AP 3600e
Aruba AP-134
Aruba AP-135

Miercom PERFORMANCE VERIFIED

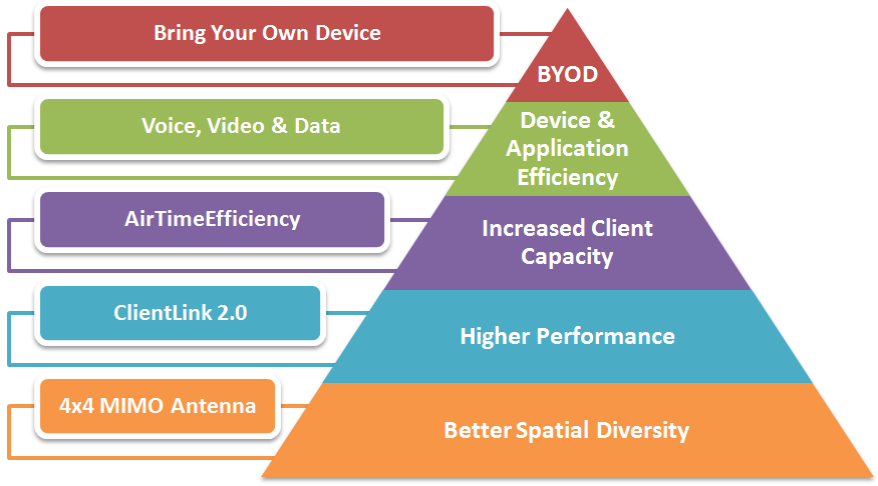
Key findings and conclusions:

- **Battery usage for wireless only devices such as tablets show 38% improvement with Cisco AP 3600i/e**
- **Cisco AP 3600i/e supports 3x as many clients as Aruba AP-134 and AP-135 with mixed traffic**
- **True implementation of Bring Your Own Device (BYOD) with high air time efficiency**
- **4x4 MIMO allows for beam forming with any client, exhibiting average gains of 67%**
- **AP 3600i/e maintains high throughput at great distances, containing varying interference**

Cisco engaged Miercom to perform an independent validation of their ClientLink 2.0 architecture featured in the AP 3600e and AP 3600i access points, with a focus on capacity and capability as it applies to Bring Your Own Device (BYOD) for an enterprise deployment. For comparison purposes, we also looked at solutions from Aruba, specifically the Aruba AP-134 and AP-135. Competitive products by Cisco and Aruba will be referred to as AP 3600X and AP-13X, respectively.

As enterprise environments evolve, customers, clients and employees are bringing their own personal devices with them everywhere, and using them as they would an IT-sanctioned device. Prior to the BYOD phenomenon, only devices given by an IT department would be allowed access to the network. As consumer products rapidly evolve and advance, consumers find it to be more efficient to use their own devices. Simply getting IT approval is not enough. While that may suffice for basic functionality, a much higher capacity and capable system is required for a true BYOD enterprise environment.

Figure 1: Cisco AP 3600X Access Point
Components that Build towards BYOD Functionality



Source: Miercom, March 2012

This pyramid shows the foundation and support required to support a BYOD enterprise environment.

To assess these concerns, Miercom evaluated metrics of varying kinds of traffic and scenarios for wireless use cases. For all tests we used the 802.11n 5GHz frequency, with a non-overlapping 40MHz wide channel, and one AP enabled at a time. In each of these cases, the Cisco AP 3600X clearly demonstrated its superior capability, functionality, and overall efficiency. *Figure 1* on *page 1* shows the infrastructure design used to create the BYOD environment. Built on top of the 4x4 MIMO system, ClientLink 2.0 integrates real beam forming for any client, allowing for the Wi-Fi "sweet spot" to follow you anywhere. Additionally, AirTime Efficiency showed advanced intelligent algorithms to make the highest usage of total 802.11n 5GHz capacity. By combining packets and minimizing air-transmission time, this allows more devices, more throughput, and higher capacity for a BYOD environment.

Connectivity

Utilizing the 4x4 MIMO antenna structure, Cisco is capable of having three spatial streams, which is typically found on newer laptops with the fourth antenna reserved for beam forming. By adjusting the phase and amplitude, the fourth antenna can find the client and create a sweet spot of signal strength anywhere the client moves.

To test this, Miercom moved the client test device to various locations with increasing distance and measured throughput. Since signal strength is developed by a local algorithm and could be erroneous, it was ignored and throughput was instead used as the primary metric. *Figure 2* is the throughput versus distance chart, showing the advantage of ClientLink 2.0. Cisco AP 3600X had a an average gain of 67%.

In *Figure 2*, large drop off points are seen where the spatial streams were forced to disconnect due to weak signal. This happened in roughly the same distance for both vendors APs. At 25 feet, we saw the client drop from three to two streams. At 50 feet, the client on an Aruba infrastructure dropped from two to one stream, while Cisco maintained two stream operation. This is the largest factor in affecting throughput, but because of ClientLink 2.0 and the high efficiency radio frequency (RF) utilization, Cisco AP 3600X maintained continuously higher throughput.

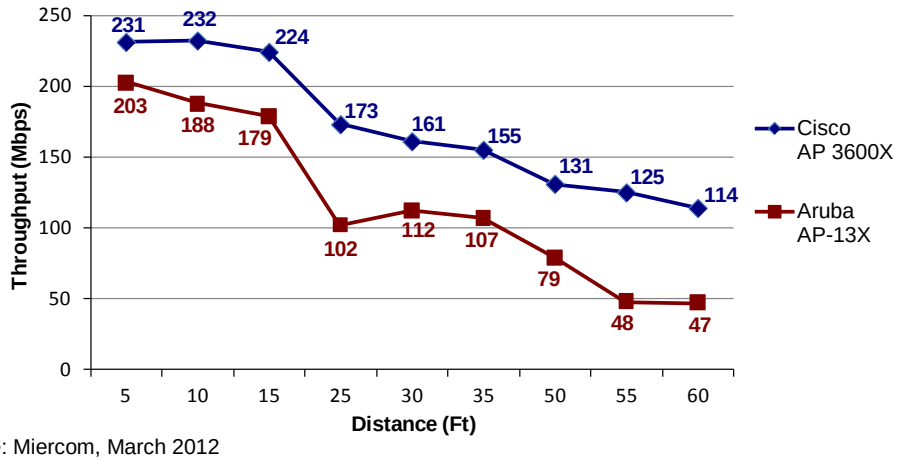
In addition to testing with a three spatial stream client, which is included in most new laptops, Miercom conducted the same testing with a Motorola XOOM tablet as seen in *Figure 3* on *page 3*. Using Ixia IxChariot software, we performed throughput testing directly on the tablet for accurate results. All other variables and applications on the tablet were held constant to ensure fair and accurate results. The 30-foot data point was recorded using an alternate placement (the tablet was turned 90 degrees) for both AP tests, and both APs experienced an improvement in connectivity.

AirTime Efficiency

Efficiency of the RF spectrum at hand is a key component to adding new, unplanned devices to a

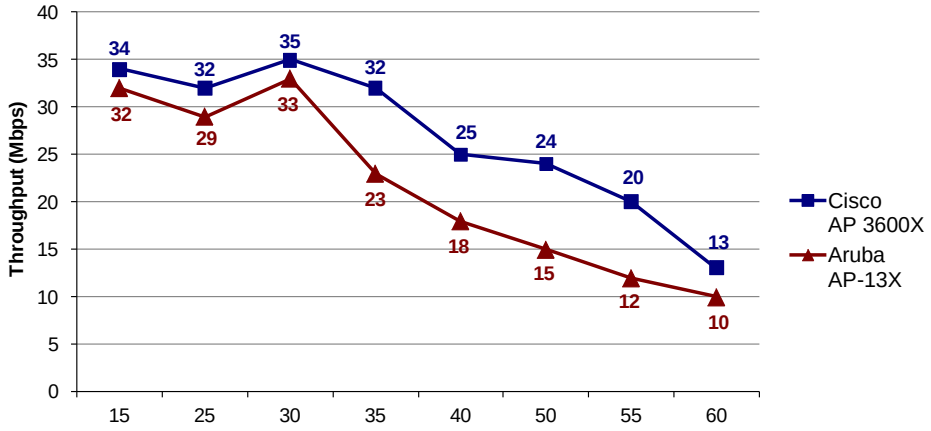
Cisco AP 3600X maintained higher and more continuous throughput. Signal degradation and spatial stream dropping occur as distance increases, as the client gets further away. The average overall gain was 67% for Cisco.

Figure 2: Cisco AP 3600X
TCP Downstream Throughput – Three Spatial Stream Client



Source: Miercom, March 2012

Figure 3: Cisco AP 3600X
TCP Downstream Throughput – Single Spatial Stream Client

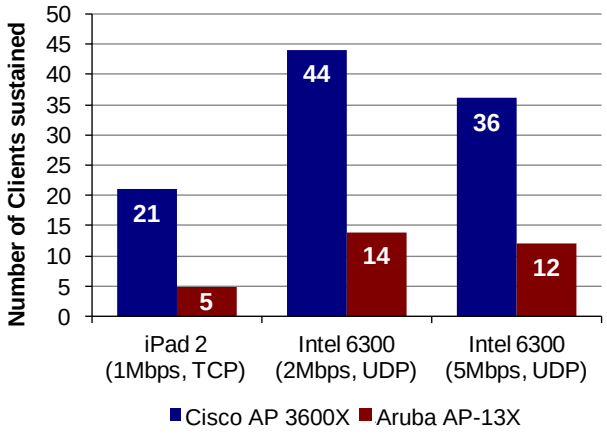


Source: Miercom, March 2012

Aruba AP-13X throughput decreases linearly with distance, whereas Cisco AP 3600X shows higher continuous throughput as well as boosts to traffic, due to ClientLink 2.0 and 4x4 MIMO antenna array. The overall average gain is 33% for Cisco.

network infrastructure. APs are very restricted in the number of devices they can handle because all devices must communicate over a single frequency. Because of this constraint, AirTime Efficiency is of paramount importance, and is the mitigating factor in how many devices an AP can support and how well supported each device is. Our testing consisted of several types of devices, and several kinds of downstream data testing. We used isolated traffic scenarios, as well as mixed traffic scenarios and gathered the results to give a larger picture for what any flexible enterprise deployment might be able to handle.

Figure 4: Simultaneous Video Streaming with Apple TV Mirroring



Source: Miercom, March 2012

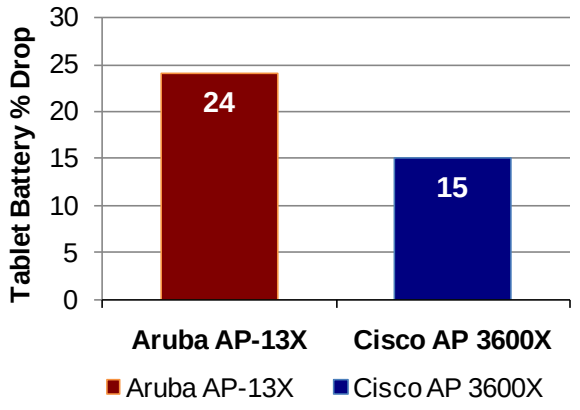
Aruba AP-134 and AP-135 could only sustain five iPad2s. Cisco AP 3600X was able to sustain 21 iPad2s. For the singular 2Mbps streams, the Cisco AP sustained 44 clients, and 36 clients for the 5Mbps streams.

Our first use case is for a collegiate environment, where a lecture is being streamed from an iPad2 to an Apple TV, while students are simultaneously trying to connect their iPad2s to the same AP for network access. In *Figure 4*, Cisco AP 3600X sustained more than four times as many clients as the Aruba AP-134 and AP-135.

When the number of iPad2 clients was increased to six while associated to the Aruba AP-13X, one of the devices used between 5-60 seconds to initialize and prepare the buffer; when a seventh device was added, the Apple TV was disconnected. While 21 iPads were connected to the Cisco AP 3600X, the Apple TV was still able to mirror the display in real-time. All of the test streams to iPads were 1Mbps video downstream supplied by a server that was wired to the network. In streaming, tests for higher capacity wireless cards capable of three spatial streams were also run. These were tested with 2Mbps and 5Mbps UDP streams, individually. This scenario emulates any environment, as laptops on Wi-Fi are now commonplace. Cisco showed an advantage in both streaming comparisons at 44 and 36 devices on 2Mbps and 5Mbps streams, respectively, compared to Aruba's 14 and 12.

Stream clarity was judged independently, where a score of 4.5 or higher out of 5 is considered a good quality feed. Comprised of several factors, a score below 4 has very visible artifacting, skipping, or out-of-sync errors; below 3 is significant streaming issues, and below 2 is unwatchable. A score of 1 indicates the stream is a total failure and no information could be transmitted. All of the streams tested were held at above 4.9, and if the score

Figure 5: Battery Power used for 11GB Download on a Motorola Xoom



Source: Miercom, March 2012

By using 37.5% less battery than Aruba AP-13X, Cisco AP 3600X provides increased productivity and general usage. The difference between the AP 3600X and AP-13X is 2.16 Watt-Hours, which equates to 54 minutes of browsing, more than 7 hours of music playback, or more than 30 hours of standby.

dipped below for an independent test, the number of clients was then reduced, and the assessment re-run.

We combined 1Mbps, 2Mbps, and 5Mbps streams on different devices equipped with Intel 6300, 5300, and 4965 wireless cards as well as iPad2s and MacBook Pros. We varied the quantities of all devices until we found the maximum number of mixed devices with which we could sustain a score of 4.9 or higher, and maintaining no disconnections or drops. The results of this testing and a further breakdown of the additional cases tested with their associated scores are shown in *Figure 6*.

Battery Savings

By running a more efficient AP, any device would reduce its time and stress downloading a file. We analyzed the traffic for information, but the primary metrics were time spent during the FTP download and the amount of battery required to perform the task. We used a tablet from a distance of 40 feet to download an 11GB file over FTP. The download was started with the tablet at 75% battery life remaining for both tests, and all other variables were held constant. In order to ensure the tablet would not go into a sleep cycle, the tablet screen was kept on for the duration of the test, and brightness was set to 70%.

The file transfer took 70 minutes on the Aruba AP-13X, and 56 minutes on the Cisco AP 3600X. Additionally, the battery drop can be seen in *Figure 5*. This directly translates to approximately 52 minutes of browsing activity on an iPad2, in terms of power consumption, which means by using one AP over another, you would either save, or lose, 52 minutes of general usage per charge.

Bottom Line

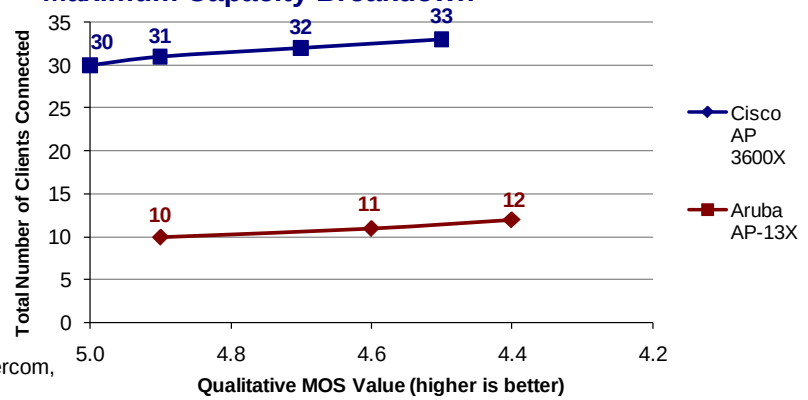
Cisco AP 3600X showed superior values on all metrics tested, and showed itself to be the superior AP. Thanks to ClientLink 2.0 and the 4x4 MIMO antenna structure, beam forming allowed for significant increases in signal vs. distance, which in turn allows for significant increases in throughput.

Showing an overall average gain of 245% for 1, 2, and 5 Mbps streams, and an overall gain of 210% for mixed streams, AP 3600X exhibited high efficiency of air time utilization, which is attributed to its new AirTime Efficiency system.

Overall, we were impressed with the AP 3600X and its ability to not only compensate for but truly enable a BYOD work environment.

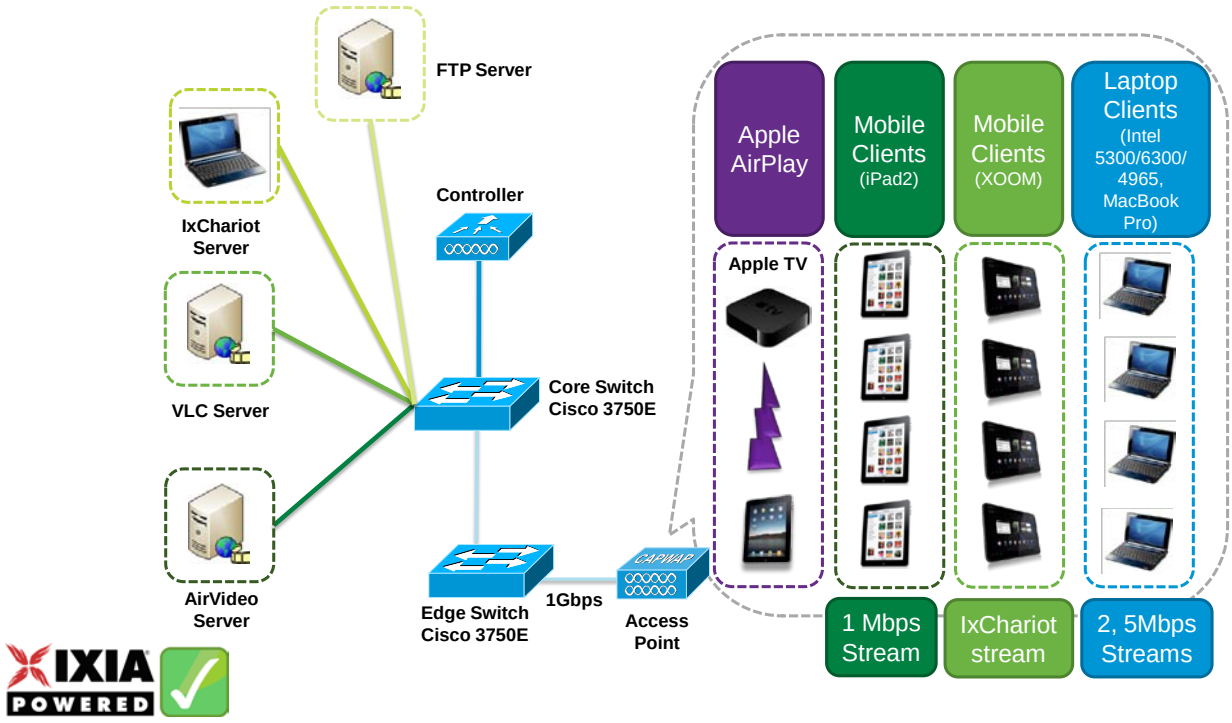
In a one-way partial factorial experimental design, Cisco AP 3600X was found to be the stronger AP of the two, holding an aggregate of thirty-one clients comprised of 5Mbps, 2Mbps, 1Mbps streams, compared to Aruba AP-13X holding ten clients with an assessment score of 4.9 or higher. Clients were adjusted up and down to ensure this was the best case scenario for both APs.

Figure 6: Multi-Client Multi-Video Stream Maximum Capacity Breakdown



Source: Miercom, March 2012

Test Bed Diagram



Source: Miercom, March 2012

How We Did It

The network architecture provided no interference for wireless transmissions while each individual AP was active. Aruba AP-134/135 was running firmware 6.1.3.0, and was controlled by an Aruba 6000 controller. Cisco AP 3600i/e was running firmware 7.2.103.0 and was controlled by a Cisco 5508 controller. All iPad2s and Motorola XOOMs were running the latest firmware available (iOS 5.0.1 for iPad2 and 4.0.3 ICS for XOOM).

An Ixia IxChariot server (version 7.10) running on a wired laptop sending traffic to a Motorola XOOM was used to perform wireless single spatial stream 802.11n throughput tests. A controlled environment with specified distance and controller real-world-simulated interference was designed for throughput and signal vs. distance testing.

For iPad2 client testing, all devices were placed in line of sight of the Device Under Test so interference would not play a factor. All frequencies under test were heavily monitored to ensure interference would not affect the results.

Multi-client and multi-stream testing was performed with all clients facing the AP directly, such that the configuration of the wireless antenna(s) of the devices would not affect the testing.

Each vendor controller holds the same configurations to guarantee fair testing. The testing environment is unchanged during each vendor's testing.

Miercom recognizes IxChariot by Ixia (www.ixiacom.com) as a leading test tool for simulating real-world applications for predicting device and system performance under practical load conditions. Consisting of the IxChariot Console, Performance Endpoints and IxProfile, the IxChariot product family provides network performance assessment and device testing by testing hundreds of protocols across several kinds of network endpoints. IxChariot is used to accurately assess the performance characteristics of any application running on wired and wireless networks.

The tests in this report are intended to be reproducible for customers who wish to recreate them with the appropriate test and measurement equipment. Miercom recommends customers conduct their own needs analysis and testing specifically for the expected environment for the product deployment before making a product selection. Current or prospective customers interested in repeating these results may contact reviews@miercom.com to receive assistance from Miercom professional services to conduct these tests.

Miercom Performance Verified

Based on lab testing of the Cisco AP 3600i/e Access Point with ClientLink 2.0 feature, Miercom verifies that their performance capabilities offer superior throughput and extended coverage for 802.11a/n clients.

Hands on testing confirmed that Cisco's ClientLink 2.0 feature can greatly enhance the end user experience in today's mixed wireless environments. Customers can be assured that the 4x4 MIMO antenna structure further strengthens wireless environments by allowing true beam forming for clients anywhere in its range.

The Cisco AP 3600i/e Access Point with ClientLink 2.0 earned the Miercom Performance Verified Certification.

Cisco AP3600i/e Access Point

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Miercom's private test services include competitive product analyses, as well as individual product evaluations. Miercom features comprehensive certification and test programs including: Certified Interoperable, Certified Reliable, Certified Secure and Certified Green. Products may also be evaluated under the NetWORKS As Advertised program, the industry's most thorough and trusted assessment for product usability and performance.