



An Independent Assessment:
Cisco Mobility Express
WLAN Deployment Simplified



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Miercom

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1 - Executive Summary

Miercom was engaged by Cisco Systems to independently assess the Cisco Mobility Express Solution – a new, simplified enterprise-class AireOS offering that revamps Wireless LAN (WLAN) deployment and management processes. Mobility Express can handle up to 100 Access Points (APs) and 2,000 wireless clients per instance, accommodating small to medium sized businesses or distributed enterprises with one or more sites. To evaluate this solution, a representative Wi-Fi network was recreated and tested with specific use cases to demonstrate functionality.

Key Findings and Observations:

- **Integrated Controller** - Mobility Express integrates a WLAN controller on all the latest Aironet 802.11ac Wave 2 APs. With no other physical controller hardware, software or license required, making this solution ideal for small to medium sites or branch deployments.
- **Simplified Setup** - With a Mobility Express image installed on each AP, initial configuration can be done over-the-air via a web browser graphical user interface (GUI), the **Cisco Wireless** mobile application for iOS and Android or using the command line interface (CLI). The wizard-driven setup is intuitive and easy to follow. With only a dozen input values, a full out-of-box setup can be completed within 10 minutes.
- **Advanced Enterprise Features** - We found that Mobility Express, though simple to deploy and manage, can also comprehensively deliver a rich set of enterprise features, management, and assurance capabilities similar to those supported by Wi-Fi vendors like Aruba and Ruckus.
- **Enterprise Management** - Mobility Express fully integrates with Cisco Digital Network Architecture Center (DNAC) and Prime Infrastructure (PI) enterprise management systems to enable deployment, provisioning, monitoring, and troubleshooting for multi-site management in distributed enterprises.
- **Performance and Scale** – We verified Cisco’s rated claim of supporting up to 100 APs and 2,000 clients by witnessing a real, live deployment of 100 APs and approximately 900 5-GHz clients on a corporate network using Mobility Express.

Having exercised all aspects of Mobility Express, we found this solution supported single and multi-site enterprise-grade Wi-Fi for small to mid-size networks. These deployments were quickly achieved with minimal technical expertise needed to provide a fully advanced feature set, integration and management. We subsequently award the **Miercom Performance Verified** certification to Cisco’s Mobility Express Solution.



Robert Smithers

CEO

Miercom

2 - About the Product Reviewed

Cisco Mobility Express is a virtual WLAN controller hosted on Cisco's 802.11ac (11ac) Wave 2 APs. The scale limits are based on the AP hosting the controller and can scale up to 100 APs and 2,000 wireless clients in a single deployment. There are no additional controller hardware or licenses required to deploy and manage the Mobility Express network. You can also have multiple sites with Mobility Express and manage these using Cisco Prime and Cisco DNA Center.

As of this report, Mobility Express is supported on the following Cisco Aironet APs:

- Indoor - AP4800, 3800 and 2800 Series
- Indoor - AP1852, 1832, 1815I, 1815M and 1815W Series
- Outdoor - AP1560 and 1542 Series
- Cisco 1000 series Integrated Services Router with integrated AP1815i running Mobility Express
- Previous generation 11ac Wave 1 APs (e.g. Cisco Aironet 1700, 2700 and 3700 series) can join the Mobility Express controller and serve clients

Mobility Express offers a rich enterprise-class feature set, regardless of deployment size. One can deploy a single site with a few APs or deploy multiple sites, with up to 100 APs.

Key highlights of this solution are as follows:

- **Easy and Simple Setup - Over-the-air set-up** and deployment, including configuring the virtual controller, via a few simple UI-driven wizards via a mobile application, web browser or CLI. We confirmed during our review that deployment can be done within minutes by anyone with minimal technical expertise.
- **Best Practices, enabled by default** - A well thought out GUI shows a list of Cisco's Wireless Best Practices – a majority of them enabled by default, minimizing the technical knowledge needed to deploy a secure, enterprise-class Wi-Fi network.
- **Enterprise Class Features** – Even though it is a virtual WLAN controller running on an AP, Cisco Mobility Express offers all the enterprise-class controller functions for WLAN Security and RF, as well as from the management standpoint.
- **Supports Site Surveys** – Site Surveys are key to deploying a reliable and predictable RF environment. Mobility Express supports internal DHCP and enables Site Survey capability across all the supported APs.
- **Management and Assurance** – For single site management, we felt the WLAN Controller WebUI was simple and adequate for network management. For multi-site deployments, one can use PI (we tested version 3.4) or Cisco's DNAC for both automation and assurance. We felt that with DNAC Assurance, Mobility Express can be a viable solution for multi-site distributed enterprise without the need for a physical controller appliance.

3 – How We Did It

Several scenarios were used to evaluate the capabilities of Mobility Express. They were as follows:

1. Out-of-box deployment of Mobility Express
2. Addition of multiple Mobility Express APs to the deployment, including 11ac Wave 1 APs
3. Configuring and testing of WLAN capabilities, including Advanced Enterprise use cases
4. Testing advanced RF capabilities, such as Flexible Radio Assignment (FRA)
5. Monitoring capabilities of the network, APs and clients
6. Software update
7. Controller redundancy
8. Management and assurance capabilities for multi-site deployments
9. Live demonstration of Mobility Express network running at scale

For testing and evaluating items 1 through 8 above, we created two small networks in the lab.

For the last use case, an office building was set up to run Mobility Express at scale (100 APs with 1000+ clients) and enabled corporate Wi-Fi on Mobility Express for employee devices. We captured live data from this live deployment.

4 - Ease of Deployment and Use

The goal of this section was to evaluate how easy it is to deploy and use Mobility Express.

Of the three options available, and we exercised two (items 1 and 3 below) for the initial setup of the Mobility Express (on separate APs). The options were as follows:

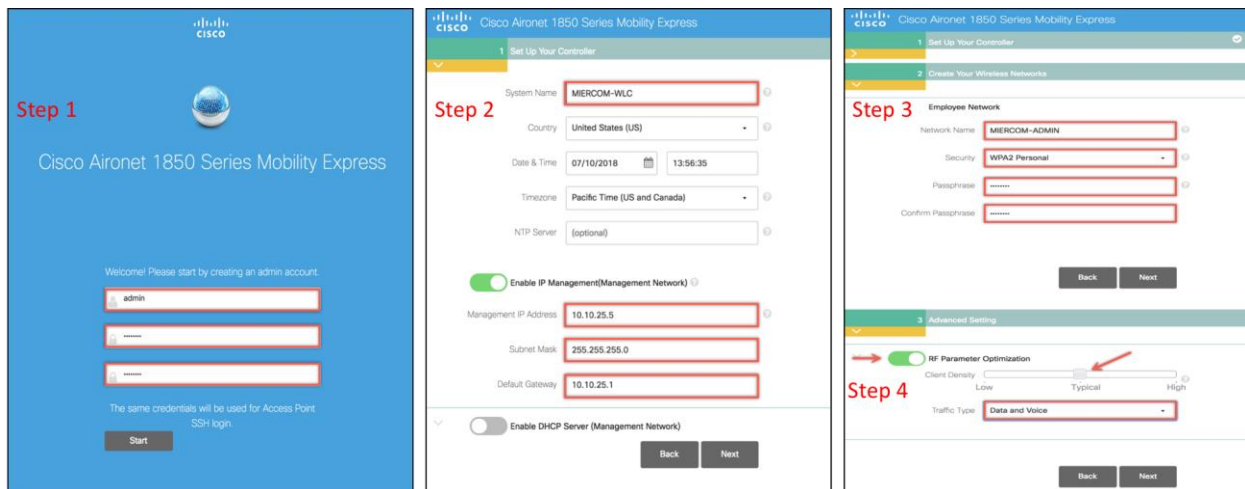
1. Cisco Mobility Express configured over-the-air via web browser
2. Cisco Mobility Express configured over-the-air via the Cisco Wireless mobile application
3. Cisco Mobility Express configured via CLI setup wizard

The choice of configuration usually depends on personal preference – whether the administrator is more comfortable with a GUI or a Cisco CLI. In our review, this setup process took less than 10 minutes.

4.1 Configuring Cisco Mobility Express via Browser GUI

Configuring Mobility Express was quite simple. We connected our MacBook to **CiscoAirProvision** SSID, opened the web browser and accessed the Setup Wizard at **mobilityexpress.cisco**. There were only three steps needed to configure and deploy the controller:

1. Configured the admin username and password for the controller
2. Configured System Name and IP address of the Controller (some fields were optional)
3. Created the Employee SSID
4. (Optional) Enabled RF Parameter Optimization



Source: Miercom

4.2 Configuring Cisco Mobility Express via CLI Setup Wizard

As a second option for setting up Mobility Express, we used the CLI Setup Wizard, accessed directly from the console. We connected to the console of the AP and powered up the AP. When the controller was ready to be configured, we saw the following:

Welcome to the Cisco Wizard Configuration Tool

Then the application begins the configuration dialog:

```
Enter Administrative User Name (24 characters max): admin
Enter Administrative Password (3 to 24 characters): *****
Re-enter Administrative Password          : *****
System Name [Cisco_f5:0a:40] (31 characters max): MIERCOM
Enter Country Code list (enter 'help' for a list of countries) [US]:
Configure a NTP server now? [YES][no]: YES
Use default NTP servers [YES][no]: YES
Enter timezone location index (enter 'help' for a list of timezones): 5
Management Interface IP Address: 10.10.25.5
Management Interface Netmask: 255.255.255.0
Management Interface Default Router: 10.10.25.1
Cleaning up Provisioning SSID
Create Management DHCP Scope? [yes][NO]: NO
Create Employee Network? [YES][no]: YES
Employee Network Name (SSID)?: MIERCOM-ADMIN
Employee Network Security? [PSK][enterprise]:
Employee PSK Passphrase (8-63 characters)?: Cisco123
Re-enter Employee PSK Passphrase: Cisco123
Enable RF Parameter Optimization? [YES][no]: Yes
Client Density [TYPICAL][Low][High]:
Traffic with Voice [NO][Yes]: Yes
Configuration correct? If yes, system will save it and reset. [yes][NO]: yes
```

After the reset, the AP came back up and started the WLAN Controller. The controller was fully functional.

5 - Feature Parity and Advanced Enterprise Features

In terms of Wi-Fi network operations, what capabilities are considered “advanced features,” and to what extent are these supported by the Cisco Mobility Express Solution?

To determine what competitive advanced features are broadly offered in the Wi-Fi market, we conducted a comparative analysis of the Cisco Mobility Express alongside the Aruba Instant and the Ruckus Unleashed.

Aruba and Ruckus are leading competitors to Cisco. We did not perform tests on those systems. Rather, we developed a list of advanced enterprise features that are generally supported by all three systems and then sought to determine whether, and to what extent, Cisco Mobility Express supported them.

We sorted the Advanced Enterprise Features set into three categories:

- **Enterprise-ready feature set**
 - Best-in-class Cisco RF innovations like FRA, Cisco CleanAir, Cisco ClientLink 4.0, Cisco HDX and Spectrum Intelligence are all supported on Mobility Express for a small site with a few clients or a site with a high-density environment
 - AAA Override on WLANs – The Authentication, Authorization and Accounting override option of a VLAN, lets the administrator configure the wireless network for RADIUS authentication and apply VLAN, Quality of Service (QoS), and Access Control Lists (ACLs) to individual clients based on attributes from returned an AAA server
 - Application Visibility and Control – The ability to identify applications being accessed by clients and to apply controls to rate limit, drop or mark traffic on those applications
 - Guest Solutions – The ability of the product to offer and support a comprehensive suite of Guest WLAN options including Lobby Ambassador, Walled garden and Central Web authentication
 - Optimizations for Apple devices – With Cisco and Apple partnership, enterprise features such as roaming, prioritization of business app and iOS client analytics
 - mDNS Gateway –Required in K-12 deployments, allows mDNS services to be learned and offered to clients across multiple wired and wireless networks
 - Controller Redundancy – Ability to elect a new AP to run the controller when the AP actively running the controller goes down
 - Cisco Umbrella integration with Mobility Express allows blocking of requests to malicious domains and IPs before a connection is ever made to stop threats earlier
- **Network Management** of single and multi-site deployments
 - Site deployment
 - Site provisioning and configuration management
 - Monitoring and reporting
 - Operation and software updates
 - Troubleshooting
- Performance and Network **Assurance**
 - Proactive network and client health monitoring
 - Fault detection
 - Root-cause analysis
 - Historical data analytics and reporting

5.1 Mobility Express – Enterprise Feature Set

With the previous Advanced Enterprise Feature set in mind, we exercised the key enterprise features that Mobility Express supports. The following summarizes our findings.

Creating a WLAN with WPA2 Enterprise

To perform this task, we first clicked on “Wireless Settings / WLANs” and created a new WLAN called MIERCOM-DOT1X-AP. Under the “WLAN Security” tab we set “Security Type” as “WPA2 Enterprise and ‘Authentication Server’ as AP.” For this option, user accounts were created on Master AP and verified for functionality. We also confirmed functionality with the External RADIUS (Identity Services Engine) and the AAA VLAN ID Override capability for RADIUS authenticated users.

Creating a Guest WLAN with CMX Engage

For Guest WLAN, we created a “MIERCOM-GUEST” WLAN configured to serve Captive Portal from CMX Engage. CMX Engage is a cloud service offered by Cisco to deliver targeted, interactive experiences through smart captive portals. We tested this by connecting a client to MIERCOM-GUEST and the guest splash page was presented. We acknowledged the “Terms and Conditions”, entered the email address and answered a few survey questions. Subsequently, the client was onboarded and redirected to <https://cmx-engage.cisco.com/>.

Creating a Guest WLAN with Internal Splash Page

We modified the Guest WLAN “MIERCOM-GUEST”, and instead of the Splash Page being served from CMX Engage”, under WLAN security, we selected “Internal Splash Page” for the Captive Portal and selected “Local User Account” with an expiration of 600 seconds (10 minutes) for the guest account.

We tested this by connecting another client to MIERCOM-GUEST and the built-in internal guest Splash Page was presented on the device. We entered the guest username and password and was granted access to the network. We then disconnected and tried gaining access to the network after 10 minutes. This was rejected as the guest account had expired.

Applying AV-Control on the Guest WLAN

We found that on Mobility Express, we could configure control capabilities to the applications which clients can access. As an example, we blocked users from watching YouTube videos via the Guest network. Selecting “Monitoring / Applications” we selected YouTube from the application list, selected the action “Drop” and applied this new rule to the MIERCOM-GUEST WLAN.

Afterwards, we confirmed guest users could no longer watch the YouTube video but could still access other applications, like Netflix, and browse different websites.

Optimization for Apple devices - Enabling Adaptive 11r, and Fastlane on WLAN, iOS Device analytics

Cisco and Apple have an active partnership, enabling the development of features on the wireless infrastructure side to optimize client roaming, application prioritization and better analytics for Apple devices. These include “Adaptive 11r” for faster roaming and “Fastlane,” which is a special QoS designation for Apple Mac iOS 10.x devices.

IEEE 802.11r is a specification for Fast Transition, or FT, that provides several methods for controlling Wi-Fi authentication while roaming. With one of these, Adaptive 11r, the Wi-Fi network doesn't advertise but will use FT if the client does. This enables Apple iOS devices to move between APs without having to re-authenticate WPA2.

Fastlane is a QoS categorization especially for Apple iOS 10.x devices, which prioritizes Audio/Video traffic for better Apple device video and voice calls.

We found that on the MIERCOM-DOT1X-AP WLAN, 802.11r was already set to Adaptive (default), and we only had to enable Fastlane. Also, we did not have to configure anything for iOS analytics.

We tested with both an iOS device and Android mobile client and verified that both devices could connect to the same MIERCOM-DOT1X-AP SSID. For Fastlane, we verified that the Android device could not benefit like the iOS device for traffic prioritization. In addition, there was detailed reporting on the controller WebUI about the Apple device; we not only observed the device model but also the OS version. The same information was not available for Android devices. We then disconnected the client and were able to verify the reason why the client disconnected. This level of client detail and analytics will enable administrators to identify and troubleshoot client issues down to actual device type, OS versions and even reasons for client connectivity issues.

RF Features and Parameters

RF configuration is automatically optimized based on the user selection during initial setup. Even though one may not need to further optimize RF, Mobility Express does expose an adequate set of RF controls which may be desired by a wireless expert. These RF controls are presented in Expert View.

In addition, advanced feature such as FRA, ClientLink, CleanAir, HDX on AP3800 and 2800 is also supported by Mobility Express. The AP1800 series also supports Spectrum Intelligence, and the above features along with CleanAir detects malicious rogues and interferers.

FRA – Flexible Radio Assignment

The Cisco 3800 and 2800 APs feature FRA – a Cisco innovation designed to provide a better mobile user experience through more efficient RF coverage. FRA automatically detects the operational frequencies of clients when there are a large number of devices connected to a WLAN network.

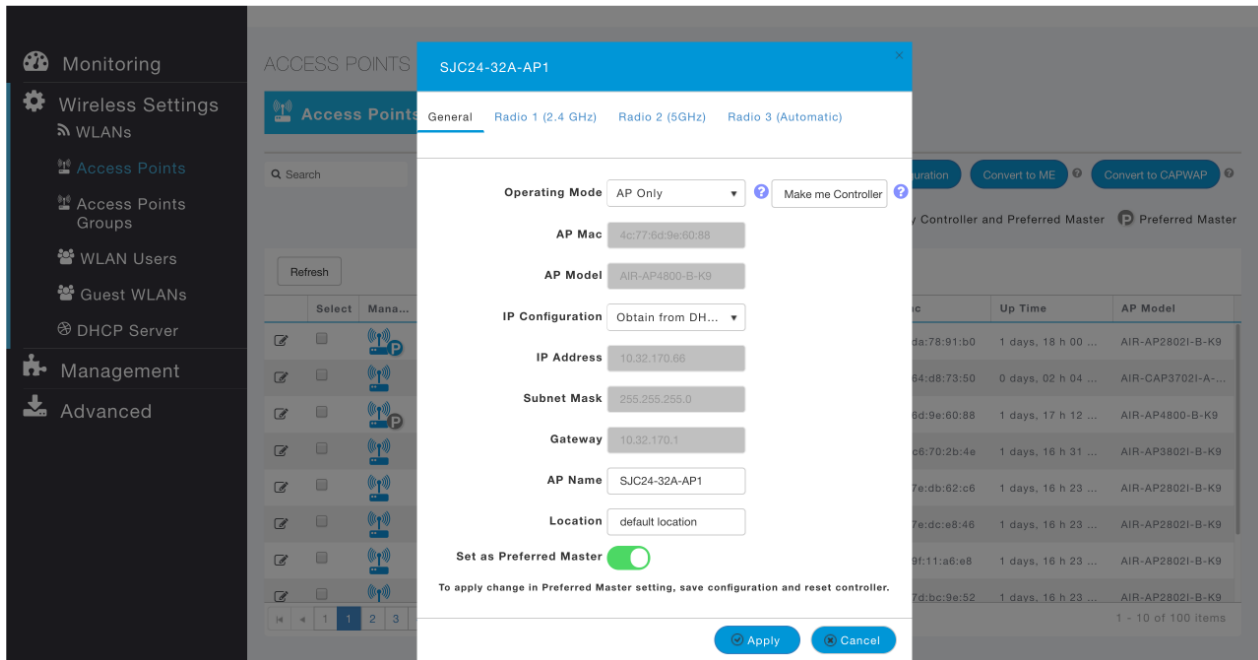
If a determination is made that more 5-GHz coverage is appropriate, FRA changes the dual radio setup in the AP from 2.4/5-GHz to 5/5-GHz to better serve high volumes of 5-GHz clients. (One or more of the other APs would still support 2.4-GHz on their radios to service clients with older Wi-Fi devices that still support only 2.4-GHz.)

What's more, the AP performs this frequency-adjustment function while still monitoring the network for security threats and RF interference that may affect performance.

We verified FRA support by configuring the Flexible Radio(XOR) on a 2800 from 2.4GHz to 5 GHz thus having two 5 GHz radios for serving clients.

Master Election – Configuring the Preferred Master

When a Master AP (running a controller) fails, a new AP is automatically elected to support the controller function based on a ruleset. If the administrator wants to override that election method and ensure that the failover happens to the administrator’s designated AP, a ‘Next Preferred Master’ can be configured. A designated Preferred Master doesn’t become the active Master until and unless the current Master fails. At that point the Preferred Master becomes the active Master.



Source: Miercom

5.2 Management

Depending on the type of deployment; single-site or multi-site, we verified Cisco's multiple management options for managing (Configuring, Operating, Monitoring and Troubleshooting) Cisco Mobility Express:

- Mobility Express controller WebUI
- Prime Infrastructure (PI)
- Digital Network Architecture Center (DNAC)

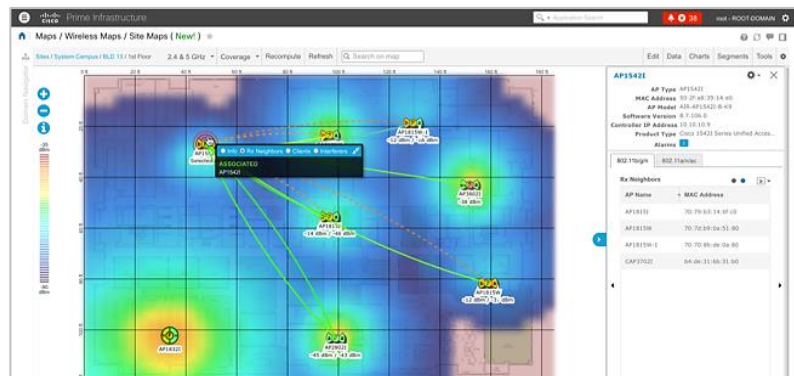
Mobility Express controller WebUI

For single-site deployments, one can manage these sites via a simplified controller WebUI interface. The controller WebUI has all the necessary controls to efficiently manage the network. For advanced functions not available in UI, one can always use CLI as well.

Prime Infrastructure (PI)

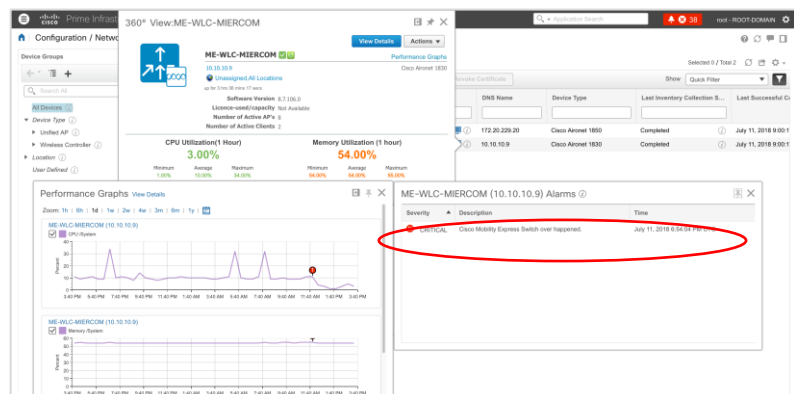
We verified that PI v3.4 can support multi-site Mobility Express deployments at scale. All the management capabilities available for an appliance-based WLC deployment are also available for Mobility Express. In addition, PI also supports flows for a new site setup and updates to the AireOS Mobility Express software at the time of site setup; thus, automating the site setup process. Moreover, PI can be used to gather historical data and reporting capabilities.

For illustration, we captured a PI site map. The site map takes as input a floor plan and the location of the Mobility Express APs on that floor. With data it collects from the APs, PI puts the information together and produces a "heat map" (shown right) which displays RF coverage across the floor along with other pertinent information.



Source: Miercom

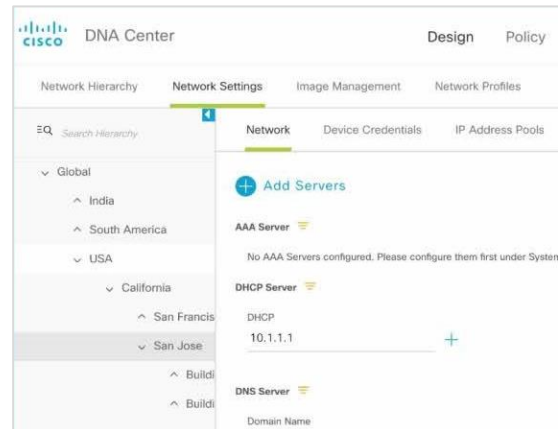
Shown in the bottom image, PI was used to drill down to a device and view a chronological timeline of any issues. Here PI reports an AP Master switch-over incident. Note the setting of a critical alarm.



Source: Miercom

5.3 DNA Center (DNAC)

DNAC is Cisco's latest management and orchestration solution and offers similar capabilities to the PI. DNAC is Cisco's long-term approach to overall network monitoring and management, along with other additional features like hierarchy-based design and provisioning capabilities (e.g. Automation, SD-Access, Assurance). DNA Assurance for Mobility Express, network administrators now have the same troubleshooting tools and capabilities available for WLC-based deployments. Network 360, Client 360, Device 360, Client Real Time Packet Capture and Analysis, Anomaly Detection and other capabilities are supported by Mobility Express.



Source: Miercom

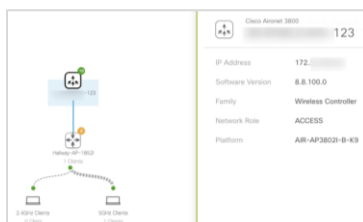
DNA Assurance automatically collects and organizes device, application and user data over a period of time. Data is correlated and analyzed to provide actionable insight that network managers can use to troubleshoot and improve performance. This helps administrators make smarter decisions before users are affected by service-impacting issues in the end-to-end wired and wireless network. All events are logged and accessible at any point in time for further analysis. Administrators can take real-time packet captures for a deeper dive while troubleshooting.

DNA Assurance addresses four main categories:

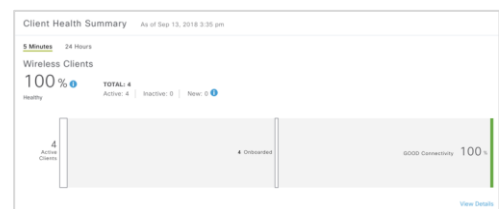
1. Health Monitoring – Is the network performing well for all users, devices and applications?
2. Fault Detection – What issues are being reported by the network and sensors?
3. Root-Cause Analysis – What is causing the issues? How severe are they? And did an applied fix resolve the issue?
4. Sensor Tests – Over 15 synthetic tests using network sensors evaluate and benchmark performance

Among the insightful DNA Center tools is the AP performance view (by selecting "Wireless Dashboard" and then "Client Performance"). APs are graphically shown by operating frequency band, traffic, interference, RSSI and available capacity.

The same screen shows client density by AP and by frequency band and many other comprehensive data points.



Source: Miercom



Source: Miercom

6 –Mobility Express in the Corporate Network

As noted in Section 3, a second Mobility Express network with 100 APs was deployed in a live network configured to broadcast two SSIDs. One was a corporate SSID, and the second was the internal 'Alpha' test SSID. This network was used by building employees for real production traffic over a week-long evaluation of management, monitoring and fault-analysis capabilities of Mobility Express. As it turned out, this network functioned for the entire period without any issues. Even so, an abundant amount of traffic details was collected for subsequent analysis.

Several views of live network using the Cisco Wireless application are shown below:



Source: Miercom

About "Miercom Performance Verified" Testing

This report was sponsored by Cisco Systems, Inc. The data was obtained completely and independently by Miercom engineers and lab-test staff as part of our Performance Verified assessment. Testing such as this is based on a methodology that is jointly co-developed with the sponsoring vendor. The test cases are designed to focus on specific claims of the sponsoring vendor, and either validate or repudiate those claims. The results are presented in a report such as this one, independently published by Miercom.

About Miercom

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Use of This Report

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