

Enterprise



**Operating Wireless LANs for
High Reliability and Performance:
Six Best Practices That You Can
Implement Today**

June 2010

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1 Executive Summary

802.11n technologies have reached maturity. They are reliable, high-performing, dependable, secure, and often very affordable. These characteristics are making it possible to offer the benefits of enterprise mobility to everyone, everywhere. Organizations are deploying 802.11n infrastructures to expand existing wireless LANs (WLANs) to more locations, replace older, less reliable technologies, and rightsize their wired networks.

The technology has arrived. End-user demand is high. So, what challenges are holding the all-wireless enterprise back? *With today's technologies, infrastructure is no longer the critical factor in driving the reliability and performance of the wireless network.* In fact, the most challenging issues for the current generation of WLANs revolve around the unique characteristics of users: their mobility, unpredictable usage patterns, and diverse range of client devices.

Because of these unique characteristics, wireless users break away from the traditional, port-based models of network management. Operating a wireless network for high reliability and performance requires a new operating model — a model that looks at the network as a business enabler, not as a set of technology components. It means developing a disciplined approach to service quality, not just evaluating success based on infrastructure uptime. While the right operating model for your network must take into account your individual business needs and user dynamics, Aruba Networks has identified six best practices that are common across the best-run networks in our customer base of more than 10,000 organizations. This white paper describes each of these best practices:

1. Know your users
2. Adopt planning processes that accommodate change
3. Focus on minimizing problem-resolution time
4. Set up early warnings so that you know in advance when and where to add capacity
5. Minimize manual efforts in rogue access point (AP) detection and mitigation
6. Deploy a network operations management solution that can grow with your network

In order to put these best practices into operation, you must be able to capture timely data about your network. Throughout the white paper, we will talk about how Aruba solutions enable you to capture this data and to manage work more efficiently across your entire team — today. The centerpiece of the solution is Aruba's AirWave 7™, the only integrated, multi-vendor operations management solution that manages wireless networks, wired infrastructure, and client devices in a single, user-centric interface. AirWave 7 brings a number of advantages to your organization, including:

- **A better user experience** for the whole IT organization, from the service desk, to the network operations center (NOC), to network engineering.
- **User-centric management** with a single, accurate picture of everything that affects service quality for your end-users — from wired infrastructure, to the RF environment, to individual mobile devices.
- **Intelligence for better decision-making**, aided by data that spans days, months, and seasons.
- **The flexibility you need to get the most from tight budgets**, with support for infrastructure from multiple vendors, crossing multiple generations.

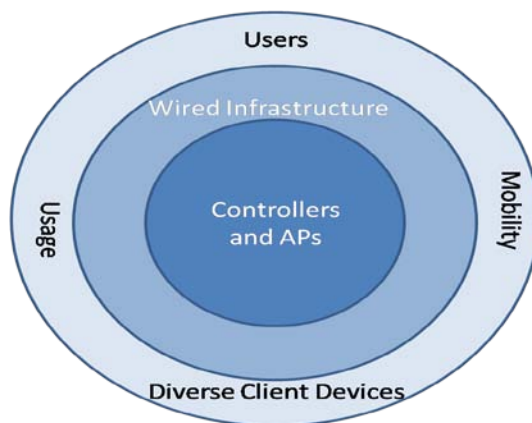
2 The Emergence of 802.11n Shifts the Barriers to the All-Wireless Enterprise

With the maturing of 802.11n technologies, WLANs have reached a new stage of evolution — where their reliability, performance, dependability, security, and affordability have made it a reality to offer the benefits of enterprise mobility to everyone, everywhere. Organizations are deploying 802.11n infrastructures to expand existing WLANs to more locations, replace older, less reliable technologies, and rightsize their wired networks.

End-users across both private and public sector enterprises are ready and waiting for this new generation of networking. If you are one of the organizations that deployed a wireless network out of convenience only to see adoption grow much more quickly than expected, your experience probably confirms the extent of this pent-up demand. In addition, consider the following facts:

- ABI Research reports that approximately 580 million Wi-Fi devices shipped in 2009¹
- Gartner estimates that 44% of all PCs sold to enterprises in 2008 were mobile PCs²
- According to IDC, worldwide shipments of converged mobile devices (commonly referred to as smartphones) will reach 226.8 million units in 2010, up 30.7% from the 173.5 million units shipped in 2009³

So, with the right technologies available and ample demand from end-users, what challenges are holding the all-wireless enterprise back? *With today's technologies, infrastructure is no longer the critical factor in driving the reliability and performance of the wireless network.* In fact, the most challenging issues for the current generation of WLANs revolve around the unique characteristics of users: their mobility, unpredictable usage patterns, and diverse range of client devices.



3 A New Operating Model for the Changing Network Architecture

Because of these unique characteristics, wireless users break away from the traditional, port-based models of network management. Operating a wireless network for high reliability and performance requires a new operating model — a model that looks at the network as a business enabler, not as a set of technology components. It means developing a disciplined approach to service quality, not just evaluating success based on infrastructure uptime. While the right operating model for your network must take into account your individual business needs and user dynamics, Aruba Networks has identified six best practices that are common across the best-run networks in our customer base of more than 10,000 organizations:

1. Know your users
2. Adopt planning processes that accommodate change

¹ http://www.wi-fi.org/news_articles.php?f=media_news&news_id=969

² Gartner, "Market Share Snapshot: Worldwide Enterprise Notebook Market, 2008," March 2009

³ IDC, "Worldwide Converged Mobile Device 2010-2014 Forecast and Analysis," March 2010

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3. Focus on minimizing problem-resolution time
 4. Set up early warnings so that you know in advance when and where to add capacity
 5. Minimize manual efforts in rogue AP detection and mitigation
 6. Deploy a network operations management solution that can grow with your network

All of these best practices require you to be able to capture critical data so that you can take timely, proactive actions. In the next sections, we will talk about how Aruba solutions enable you to capture this data and to manage work more efficiently across your entire team — today. The centerpiece of the solution is Aruba's AirWave 7™, the only integrated, multi-vendor operations management solution that manages wireless networks, wired infrastructure, and client devices in a single, user-centric interface.

A Real-World Example of the New Network Operating Model

From just a few APs in 2001, Intel's WLAN has grown to support about 80,000 mobile employees at 150 sites worldwide. Intel IT has implemented a distributed wireless infrastructure that uses multiple designs and suppliers. To support this infrastructure, we developed a new philosophy focused on managing the WLAN as a service, not as a collection of disparate components. Our WLAN management system is the first wholly centralized managed service within our organization.⁴

3.1 Best Practice #1: Know Your Users

User behavior has a dramatic effect on network reliability and performance. Gartner summarizes this best practice as follows: "If network architects have a solid understanding of what their users do for a living at the end of the network connection, they will be in a much better position to design a network architecture with a set of services to improve the productivity or decision-making capabilities of those users."⁵ For example, coverage alone might be critical for a warehouse management application, while coverage and low latency are more important for wireless voice over IP (VoIP). User behavior can have other indirect effects on network performance. In several cases, K-12 schools that use AirWave 7 have reported that they see a spike in frame check sequence (FCS) error rates every day at 11:30 a.m., when their kitchen staffs start running microwave ovens to cook lunch.

If you have an existing wireless network in place, AirWave 7 can give you a comprehensive picture of what is actually happening with your users on your network. You can use this data to plan more effectively and to troubleshoot more efficiently. AirWave 7 tracks users in real-time and captures over one year of historical data. It makes information immediately accessible to IT through dashboards, alerts, and standard or customizable reports.

⁴ IT@Intel White Paper, "Managing a Global Wireless LAN," April 2010

⁵ Mark Fabbi and Eric Paulak, "Five Dimensions of Network Design to Improve Performance and Save Money," Gartner, March 2009

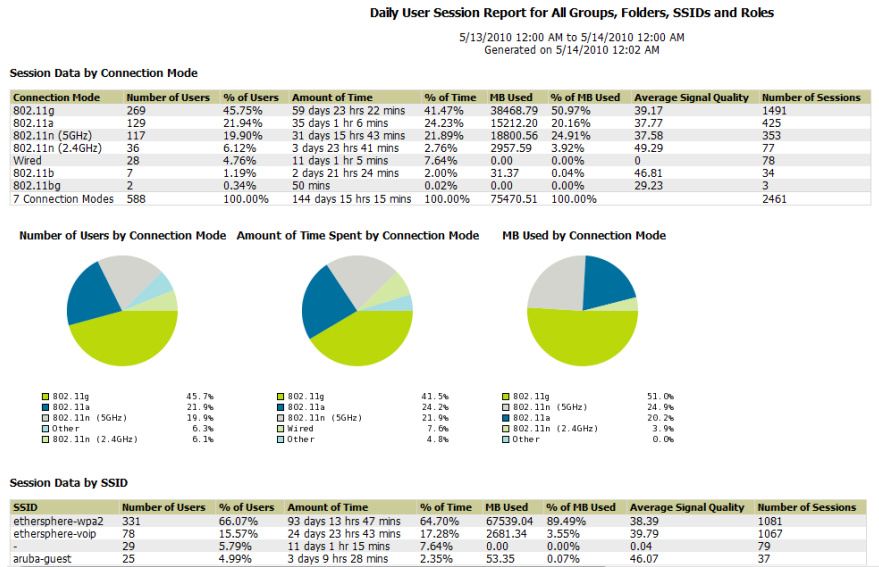
The **User Session Report** is particularly useful for gaining insights on how users are using the network. It displays information such as the number of users, average session duration, and average session traffic. You can break this information down by connection mode (802.11a/b/g/n). The report can analyze your entire network, or it can focus in on a specific portion of the network or even a single AP.

Potential actions you can take with AirWave 7 data: If you see a lot of legacy 802.11b connections, you may need to upgrade clients or consider changing supported 802.11 data rates in order to increase network performance.

AirWave Mobile Device Manager™ also delivers valuable insights about your users. For example, it can provide a detailed inventory of what clients are connecting to the network, including manufacturers, model numbers, capabilities, and locations. You will know what devices are actually in use, not just what you have purchased or on what you are paying support.

Potential action: A detailed client inventory allows you to optimize your applications to the most common models and interfaces being used.

Figure 1. The AirWave 7 User Session Report.



3.2 Best Practice #2: Adopt Planning Processes that Accommodate Change

User mobility means that the requirements for any given physical area can change at any time. In this type of environment, the planning processes that worked well for wired networks will miss the mark. Not only does AirWave 7 provide the data you need to plan effectively, but also it makes planning more efficient so that it doesn't slow down your operations. Finally, Aruba's Adaptive Radio Management (ARM) technology uses automatic infrastructure-based controls to take the guesswork out of RF management and maximize the performance and reliability once your APs are deployed.

“Wireless is always a moving target.”

Gary Putman, Enterprise Network Manager
Cabela's, the world's largest direct marketer of hunting, fishing, camping and related outdoor merchandise

Several standard AirWave 7 reports and views deliver critical planning data.

The **Network Usage Report** provides you with a snapshot of your users and the bandwidth that is being used on all or part of the network. It gives you an at-a-glance view indicating how network use is growing.

Potential action: Plan your future network expansion or rightsizing with a clear picture of user adoption trends.

Figure 2. The Network Usage Report.

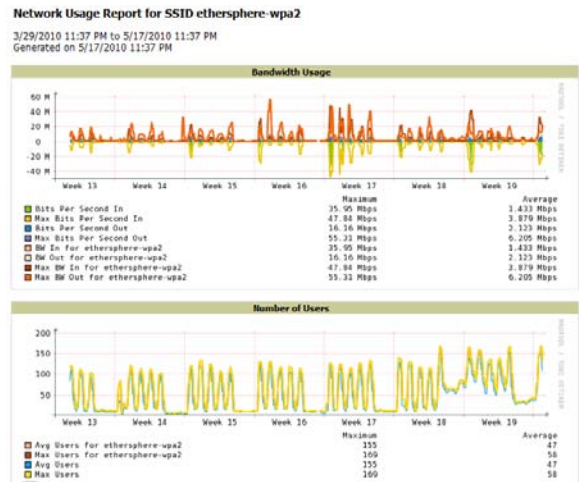


Figure 3. Configuring the Capacity Planning Report.

Report Definition

Title: January planning report
 Type: Capacity Planning

Report Restrictions

Group: -- All Groups --
 Folder: -- All Folders --
 Device Search Filter: This report will be run against Devices that match this search.
 SSID: -- All SSIDs --
 Include detail: Yes No
 Filter By: Combined Bandwidth (n +)
 Use Average/Maximum Bandwidth: Average
 Capacity Threshold (0-100 %): 70
 Min Time Above Threshold (0-100 %): 10
 Max Time Above Threshold (0-100 %): 100

The **Capacity Planning Report** provides a deeper look at device bandwidth capacity and throughput for portions of your network or for specific SSIDs. You can configure it to identify devices that are operating above a specific threshold.

Potential action: Allocate your budget to the locations where added capacity will drive the biggest improvement in user experience.

Channel Utilization metrics available on the AP monitoring page help you identify APs and areas that are exceeding capacity, as well as the reasons for high capacity. An intuitive set of graphs breaks down the percentage of time that radios transmit data, receive data, listen, and experience interference. Using AirWave 7's **device summary report**, you can identify the APs with the highest channel utilization and then drill down on each individual AP for further detail.

Figure 4. Channel utilization metrics in AirWave 7.



Potential action: Target upgrades from 802.11b/g equipment to 802.11n for areas where channel utilization is the highest.

Did You Know?

- 802.11n has 22 channels, while 802.11b/g has only four.
- 802.11n has as much as four times the coverage as 802.11b/g.
- The maximum theoretical data rate for 802.11n is 300 Mbps.
- The real-world application data rate for 802.11n is 180 Mbps while 802.11g is 20 Mbps and Fast Ethernet is just over 96 Mbps.

Finally, the **Port Usage Report** provides insight into the level of port utilization across the enterprise. This data is particularly valuable for network rightsizing initiatives.

Once you have your usage data together and have made decisions about where to invest, AirWave VisualRF™ provides automated capabilities that significantly improve the speed and accuracy of the planning process. Using floor plans you import manually or using bulk upload tools, VisualRF optimizes AP placement by analyzing your floor plan and determining the number and exact location of APs based on the following variables: coverage criteria, building characteristics, manufacturer, and model. The product includes a catalog of all of the RF characteristics for any device supported in AirWave 7 so that your design takes into account the unique characteristics of your chosen infrastructure. You can also determine the required wired upstream infrastructure and automatically generate a bill of materials. As a result, VisualRF helps you to optimize your network performance before any infrastructure is put in place. Furthermore, those organizations that deploy Aruba APs benefit from the ongoing optimization provided by ARM.

Figure 5. Data from the AirWave 7 Port Usage Report shows that the majority of switches are underutilized.

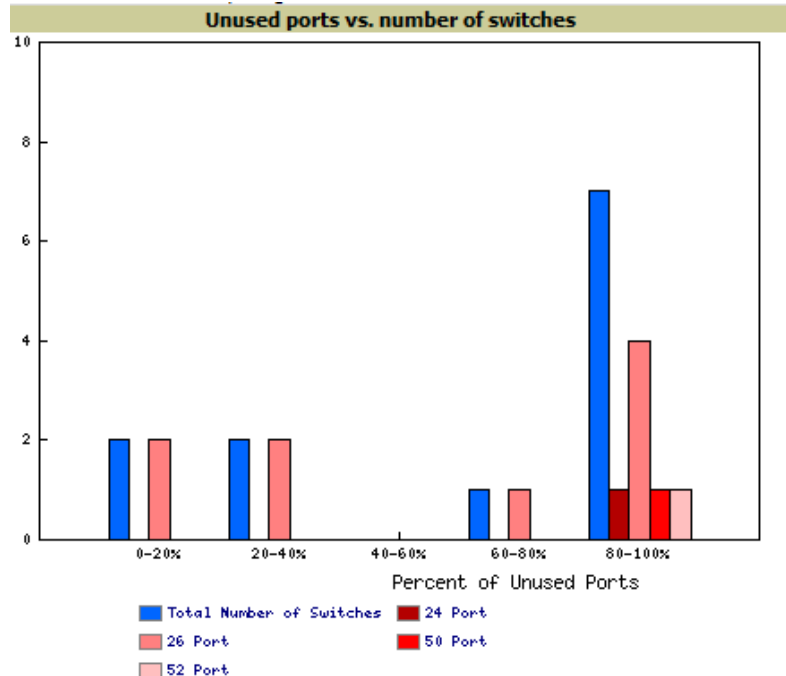
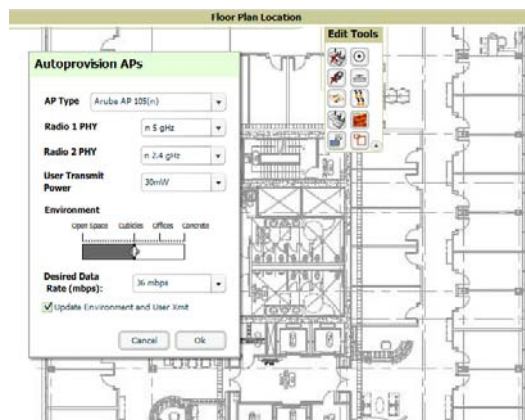


Figure 6. AirWave VisualRF suggests the placement of new APs.



3.3 Best Practice #3: Focus on Minimizing Problem-Resolution Time

Although network engineers often concentrate on building networks to maximize mean time before failure (MTBF), the real metric that matters is mean time to problem resolution (MTTR). When you add users, wired infrastructure, and the RF spectrum into the equation, no network will ever be failure-free. The bottom line is: How quickly can you repair it, regardless of where the fault lies?

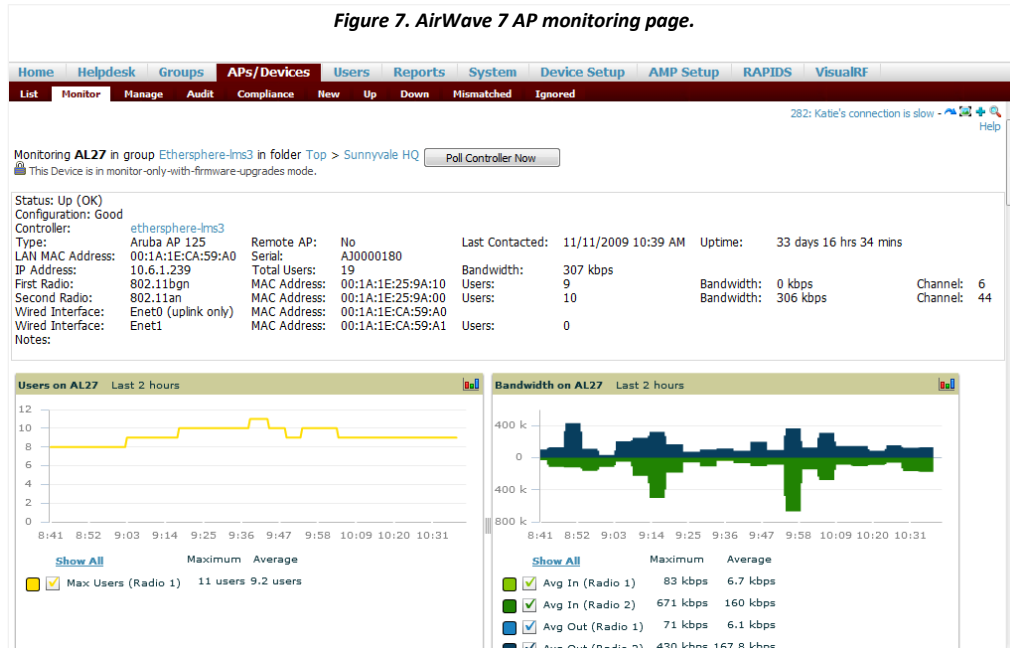
AirWave 7 gives you a complete picture of what infrastructure devices you have, whether they are configured properly, how they are operating now, and how they have operated in the past. Its visual dashboards let you distinguish immediately between what's normal for your network and what's not. You can then drill down into detailed information in just a few clicks. AirWave 7 includes monitoring views for individual users, APs, controllers, and switches, with upstream relationships mapped to enable root cause analysis.

“With the AirWave Wireless Management Suite, I can be ‘onsite’ in a few clicks of the mouse, and can usually resolve the problem without dispatching a technician. Instead of spending hours investigating the source of the problems, I can figure out what’s wrong in minutes.”

James Lersch, Network Services Engineer for Giant Eagle

For example, the AP monitoring page shown below provides a set of summary charts, data, and diagnostics that let network engineers and even service desk personnel identify potential problems and take action quickly. In addition, AirWave 7 has configurable alerts that notify you immediately about important conditions, including: down APs or radios, misconfigured devices, new devices discovered (including potential rogues), excessive AP usage, excessive numbers of connected clients, excessive bandwidth usage by individual clients, and IDS events. All of these alerts can be sent directly to your existing network management system to accelerate problem resolution.

Figure 7. AirWave 7 AP monitoring page.



Potential action: In the situation depicted to the right, the root cause of the problem appears to be a down switch. A staff member on the service desk can easily understand to which resource the problem should be escalated.

Monitoring 3600 AP124 in group amontesting in folder Top > aruba3600-Local-aps

This Device is in monitor-only-with-firmware-upgrades mode. Poll Controller Now

Status: Down (AP is No Longer Associated with Controller — Upstream Device switch55 is Down)

Configuration: Verifying

Controller:	Aruba3600-Local	Upstream Device:	switch55	Upstream Port:	-
Type:	Aruba AP 124	Remote Device:	No	Last Contacted:	1/22/2010 8:21 AM
LAN MAC Address:	00:1A:1E:C0:00:EC	Serial:	AD0000618	Location:	Dev Lab
IP Address:	10.51.5.19	Total Users:	-	Bandwidth:	-
First Radio:	802.11bgn (Statistics)	MAC Address:	00:1A:1E:80:0E:C0	Users:	-
		Transmit Power:	20.5 dBm	Antenna Type:	External
Second Radio:	802.11an (Statistics)	MAC Address:	00:1A:1E:80:0E:D0	Users:	-
		Transmit Power:	16 dBm	Antenna Type:	External
Wired Interface:	Enet0 (uplink only)	MAC Address:	00:1A:1E:C0:00:EC	Users:	0
Wired Interface:	Enet1	MAC Address:	00:1A:1E:C0:00:ED		

Notes:

Diagnostics for 00:17:3F:20:99:6B

Possible Issues		
Issue	Ideal	Actual
Low signal quality:	>= 20	-
Excessive roaming in last two hours:	<= 10 roams	0
High user bandwidth:	<= 50% of radio capacity	72
Unauthenticated user:	Authenticated	Authenticated
High user load on AP/radio:	<= 15	6
High AP/radio bandwidth:	<= 75% of radio capacity	3 kbps (0.01%)
802.11b users associated to 802.11bg radio:	None	0
802.11bg or 802.11a users associated to 802.11n radio:	None	-
High FCS error rate:	<= 100	51

Potential action: A user diagnostic chart such as the one to the left might indicate that a user is consuming excessive

bandwidth. If that user is not reporting bandwidth-intensive activities, you might want to investigate whether his or her client device has a virus.

Potential action: This same table might indicate that the user has been roaming to different APs over the last two hours. If the user has not been moving around, you might determine that a client problem is causing “sticky roaming.”

AirWave 7 also looks at issues outside of the network infrastructure. For example, it tracks RADIUS authentication failures because user connectivity problems are frequently caused by down RADIUS servers or incorrect passwords.

Did You Know?

Many AirWave customers estimate that less than ten percent of wireless trouble tickets are escalated to WLAN engineering, a much lower rate than before they implemented the solution.

3.4 Best Practice #4: Set Up Early Warnings So That You Know In Advance When and Where to Add Capacity

Wireless adoption can spike up quickly in many organizations, especially with the popularity of new devices such as iPhones and iPads. That’s one of the reasons that AirWave 7 includes a number of alerts that let staff know immediately when certain thresholds are met. These triggers include excessive AP usage (bandwidth in/out), number of connected clients exceeding a threshold you set, high channel utilization, and excessive bandwidth usage by individual clients. You establish the trigger points for and criticality of each alert yourself, so that you only get notified about meaningful events.

Figure 8. Setting up an alert in AirWave 7.

Option	Condition	Value
User Count	>=	10

Potential action: A network engineer at a retailer receives several alerts about high user counts on Jan. 25. His organization conducts annual inventory during this period in preparation for its Jan. 31 fiscal year-end; scanner gun usage is always extremely high. He knows that inventory is the primary cause of the high user counts but that some new VoIP phones are also in operation. After looking at the last six months' data, he knows that he'll need to increase capacity significantly before the holiday season.

3.5 Best Practice #5: Minimize Manual Efforts in Rogue AP Detection and Mitigation

As WLANs evolve from best-effort to mission-critical infrastructure, organizations are finding that the operational aspects of network security take on much greater importance. Despite strict policies banning the installation of unauthorized rogue APs, few enterprises have the tools or resources to adequately enforce these guidelines and to follow up and resolve threats on a consistent basis. Given that many WLAN deployments now have hundreds of APs and that neighboring businesses may generate an overwhelming number of unidentified devices, operating a network for high reliability and performance also means being able to investigate and mitigate these potential threats quickly and efficiently. AirWave RAPIDS™ automatically detects and locates unauthorized APs through a patented combination of wireless and wired network scans. It then correlates all of this data and uses a set of customizable rules to highlight those devices that are truly a threat to the organization, greatly reducing false-positives and allowing you to work much more efficiently.

AirWave RAPIDS can:

- Correlate information from wired and wireless scans, including SSID, RF channel, security method, radio MAC address or BSSID, network type, LAN MAC address, IP address, and operating system.
- Compare wired and wireless scans to eliminate duplicates and refine threat assessment.
- Classify potential threats based on rules you customize to define what a rogue device is. These rules reduce false-positives because they take into account your business and physical environment. As a result, your security team can focus on the most significant threats first.
- Set an alert priority based on the discovered device's classification.
- Depict the device's actual location on a floor plan.
- Perform manual or automated rogue AP containment with Aruba and Cisco controllers.



AirWave RAPIDS works in conjunction with the Aruba Wireless Intrusion Protection (WIP) module to offer customers comprehensive wireless security threat protection. Customers can deploy this solution with "hybrid" APs serving as both APs and sensors or as an overlay architecture where Aruba APs act as dedicated sensors called air monitors (AMs). RAPIDS uses data from both the dedicated sensors and deployed APs to provide the most complete view of

your wireless environment. The solution improves network security, manages compliance requirements, and reduces the cost of manual security efforts.

Rogue Detection and Mitigation at Texas A&M University

Texas A&M University, founded in 1876 as Texas' first public institution of higher learning, has 1,900 APs providing more than 5.8 million square feet of wireless coverage. More than 16,000 users log into the WLAN each day. AirWave RAPIDS has helped Texas A&M's field service team to increase productivity in tracking potential unauthorized APs. "With such a large campus, the list of potential unauthorized APs is in the hundreds," according to Justin Hao, network engineer. "The filtering capabilities in RAPIDS trim that list to an actionable size so that we can focus on the real threats."

3.6 Best Practice #6: Deploy a Network Operations Management Solution That Can Grow With Your Network

The larger your network grows, the more you need real-time information and centralized management. You are more likely to have multiple generations of architectures and even multiple infrastructure vendors. In the Aruba customer base, organizations generally upgrade approximately 20% of their infrastructure per year. That means that as much as 80% of the infrastructure is from one or more prior generations. Your operations management solution must be able to shield support staff from this complexity and drive consistent processes across everything that you have in place today.

In addition, large organizations will probably want to delegate responsibilities to staff members spread across their operations. AirWave 7 lets you provide data access to people across the IT organization — network engineers, network operations center staff, service desk personnel, or even IT executives — without sacrificing security or control. Each staff member is assigned a role that specifies whether he or she has read-only, read-write, or audit privileges. In addition, you can restrict administrative privileges to a set of devices in addition to role. Team members may not view monitoring or configuration information for portions of the network for which they do not possess the appropriate permissions. This allows for efficient delegation to teams that may be geographically located or centrally located with responsibility for specific types of facilities (for example, retail stores versus distribution centers).

For very large networks that encompass tens of thousands of wireless APs, controllers, supporting infrastructure, and wired ports, AirWave 7 can be deployed on multiple, distributed servers. The AirWave Master Console then aggregates data from these different servers and presents a single, real-time view of critical information across the network.

4 Summary: Use AirWave 7 to Optimize WLAN Reliability and Performance

The six best practices described in this white paper address the critical challenges facing wireless network engineers and operations staff today: users' mobility, unpredictable usage patterns, and diverse range of client devices. As organizations take advantage of the reliability, performance, dependability, security, and affordability of 802.11n technologies to expand, upgrade, and rightsize their networks, they must conquer the user challenges if they are to achieve the levels of performance that they need and that users expect.

AirWave 7 is the key to putting the six best practices into effect today. Regardless of whether your network consists of equipment from a single vendor or multiple generations of products from multiple vendors, AirWave 7 gives you a

single operational view with data that guides you to concrete actions that improve reliability and performance. AirWave 7 brings a number of advantages to your organization, including:

- **A better user experience:** Unlike element management systems, AirWave 7 has been designed from the ground up as an operations solution for the whole IT organization, from the service desk, to the NOC, to network engineering. Each team member has role-based access to relevant information such as the dashboards and reports shown throughout this white paper.
- **User-centric management:** AirWave 7 gives you a single, accurate picture of everything that affects service quality for your users — from wired infrastructure, to the RF environment, to individual mobile devices. It also integrates easily with existing IT service management tools for faster problem resolution.
- **Intelligence for better decision-making:** With the wealth of information available in AirWave 7 and data that spans days, months, and seasons, you always have what you need to spot trends, plan capacity, and craft the right strategies for your organization.
- **The flexibility you need to get the most from tight budgets:** AirWave 7 lets you optimize the performance of the network you have today in addition to helping you plan for your network of the future.

AirWave 7 is available through a variety of delivery models to meet your specific needs, whether you have 50 APs from a single vendor or 50,000 Wi-Fi, mesh, and wired devices from a variety of different providers. Whether deploying on-premise, using an AirWave appliance, or in the cloud, many customers have been able to go live within weeks of their purchases. AirWave 7 sits at the foundation of the next-generation operating model for wireless networks and will take you one big step towards the 802.11n promise of wireless networking for everyone, everywhere.

About Aruba Networks

Aruba is the global leader in distributed enterprise networks. Its award-winning portfolio of campus, branch/teleworker, and mobile solutions simplify operations and secure access to all corporate applications and services - regardless of the user's device, location, or network. This dramatically improves productivity and lowers capital and operational costs.

Listed on the NASDAQ and Russell 2000® Index, Aruba is based in Sunnyvale, California, and has operations throughout the Americas, Europe, Middle East, and Asia Pacific regions. To learn more, visit Aruba at <http://www.arubanetworks.com>. For real-time news updates follow Aruba on [Twitter](#), [Facebook](#), or the [Green Island News Blog](#).



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