

# Advanced RF Troubleshooting

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March 2013

# Agenda

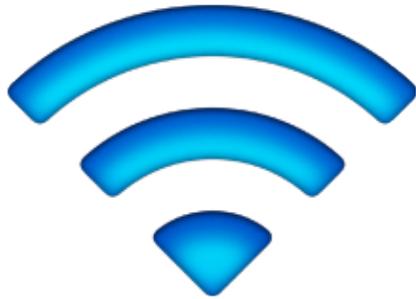


- **RF basics**
- **Tools of the trade**
- **Spectrum Analysis**
- **WiFi heatmap and site survey**
- **Client NIC**
- **Performance testing**
- **Packet captures**
- **advanced CLI examples**
- **Aruba Tools**

# Back to Basics

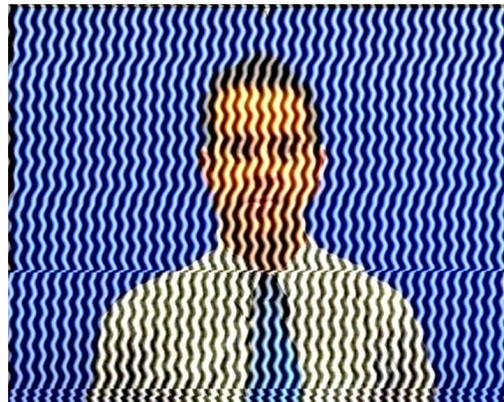


# Essential Elements of Healthy RF



Signal Strength

Low Interference



Client NIC



Good Noise Floor

Channel Utilization



# What Affects Signal Strength?



- **AP Characteristics**

- Number and type of Radios (a/b/g/n)
- Max Tx Power
- Receive Sensitivity
- Number of Spatial Streams
- Antenna – Internal/External
- Antenna Pattern
- Number of clients supported

**APs are not created equal**  
**Choose the right AP for the occasion**

# What Affects Signal Strength?



## AP Radiated Power (EIRP)

= Radio Transmit Power (dBm)

+ Transmit Antenna Gain (dBi)

Antenna is **PASSIVE** – Does Not **ADD** energy  
Higher Gain just means energy more focused  
**Not always** a good thing

- AP Regulatory Domain
- Country Code
- Radio Band (2.4GHz/5GHz)
- Channel (different channel has different allowed Max EIRP)

# What Affects Signal Strength?



- **Attenuation (Path Loss)**
  - Distance from AP/Line-of-sight
  - Building materials (walls, windows, partitions)
  - Furniture
  - People

## **Client Received Power (dBm)**

= Radiated Power/EIRP (dBm)

- Path Loss (dB)

+ Receiver Antenna Gain (dBi)

# Attenuation of Common Building Material



	2.4GHz	5.0GHz
Fabric, blinds, ceiling tiles	~1dB	~1.5dB
Interior drywall	3-4 dB	3-5 dB
Cubicle wall	2-5 dB	4-9 dB
Wood door (Hollow – Solid)	3-4 dB	6-7 dB
Brick/Concrete wall	6-18 dB	10-30 dB
Glass/Window (not tinted)	2-3 dB	6-8 dB
Double-pane coated glass	13 dB	20 dB
Steel/Fire exit door	13-19 dB	25-32 dB

- **Noise**

- **Random** ‘background’ that has got mixed up with your signal. Fairly Static.

- **Interference**

- **Additional** signals are added to the one you want. Can be intermittent or persistent.

802.11 Source	Non 802.11 Source
<ul style="list-style-type: none"><li>• Your APs (over-designed)</li><li>• Somebody else’s APs (neighbor)</li><li>• Municipal Wi-Fi Network</li><li>• iPhone Personal Hotspots</li><li>• Neighboring clients</li><li>• APs</li><li>• Faulty Clients</li></ul>	<ul style="list-style-type: none"><li>• Blue-tooth (headset, keyboards, mouse, speaker)</li><li>• Microwave Oven</li><li>• Cordless phones, mouse</li><li>• Very strong out-of-band source(GSM tower/DAS)</li><li>• Baby monitor</li><li>• WiMax (2.5GHz)</li><li>• ZigBee (802.15.4)</li><li>• Video or security cameras</li><li>• Faulty anything</li></ul>

# Signal to Noise Ratio (SNR)



**SNR is not actually a ratio**

**SNR = Signal (Received Power) – Noise floor**

**Assume:**

**Signal received is -65 dB; Noise floor is -85 dB**

$$\text{SNR} = -65 - (-85) = 20$$

**A minimum of 25-30 is essential to decode high 11n data rate**

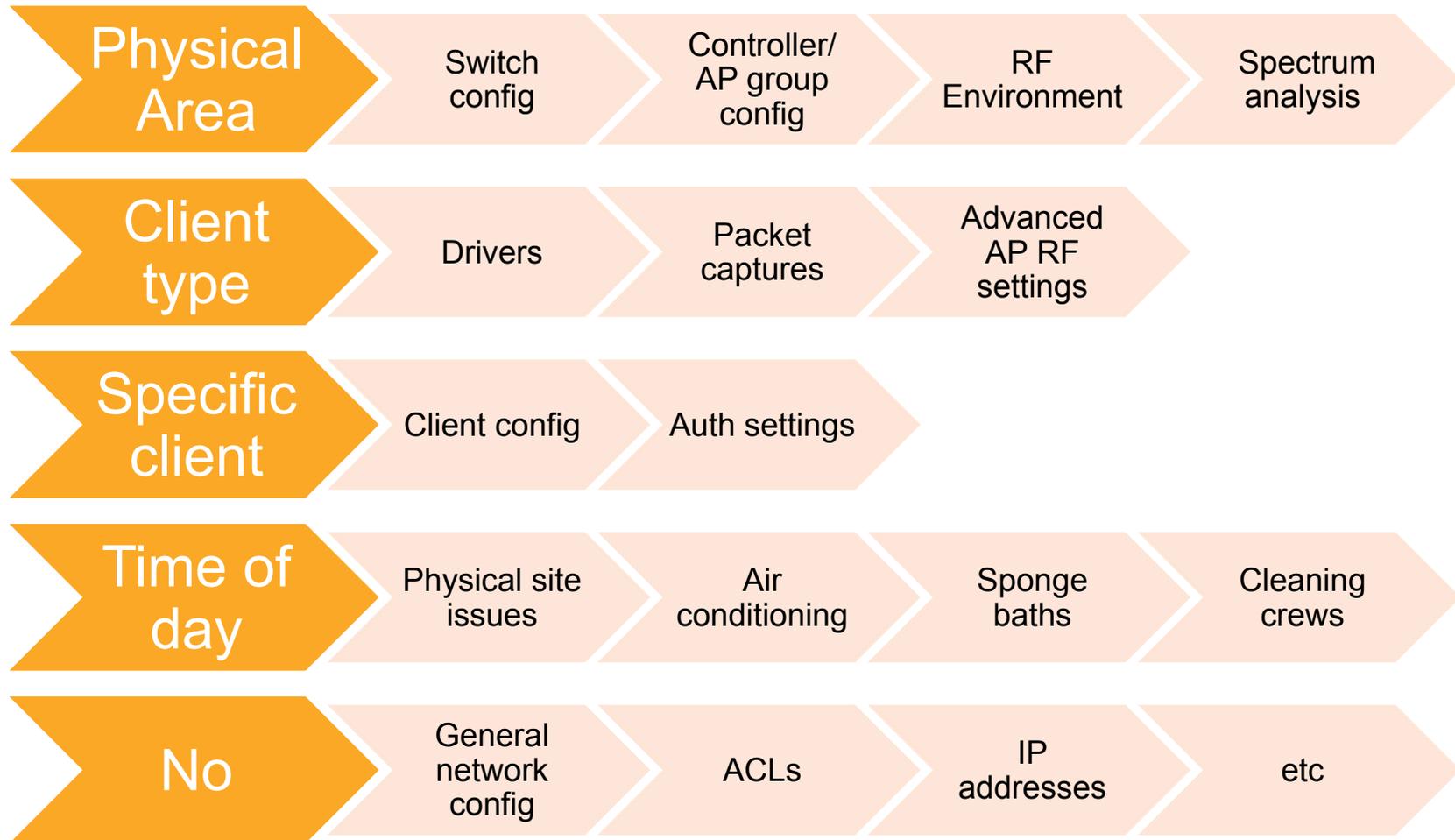
**802.11n data rates are dependent not only on SNR, but on error rates and the ability to support multiple spatial streams in the environment**

**A rough guideline is that a minimum SNR of 30 dB is necessary to demodulate higher 802.11n data rates and 35 dB required for higher 11ac rates**

# Questions to Ask



# Is the problem localized?



# Tools of the Trade



# ACE's first 7 questions



- **"show ap active" – Check power settings**
- **"show ap association client-mac xx:xx:xx" - SNR, retry rate, and noise floor in the client's area.**
- **"show ap arm history ap-name xxxx" - how many channel/power changes have been made over the last 24 hours. Any I or E flags?**
- **"show log all | include bootstrap" – APs rebooting?.**
- **"show user-table" – View mix of clients in the network. Any flags? WMM, 802.11K, band-steerable?**
- **"show user-table | include iPhone" – Large number? Turn off max-tx-fails.**
- **"tar crash" – Investigate any crashes**

- **Network Management/Monitoring Platform**
- **Spectrum Analysis**
- **Site-Survey**
- **Understanding Client NIC**
- **Performance Testing**
- **Packet Capture**
- **Command Line Interface (CLI)**
- **Aruba TAC**

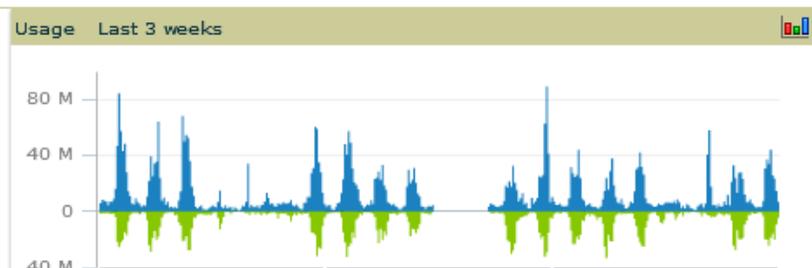
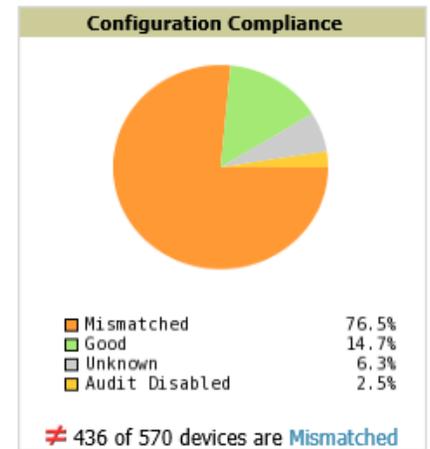
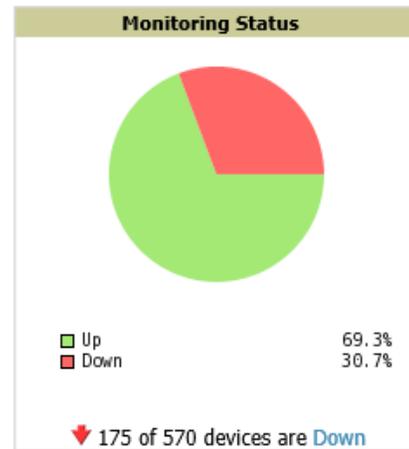
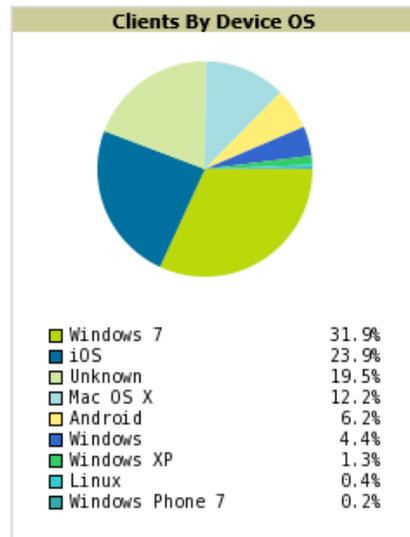
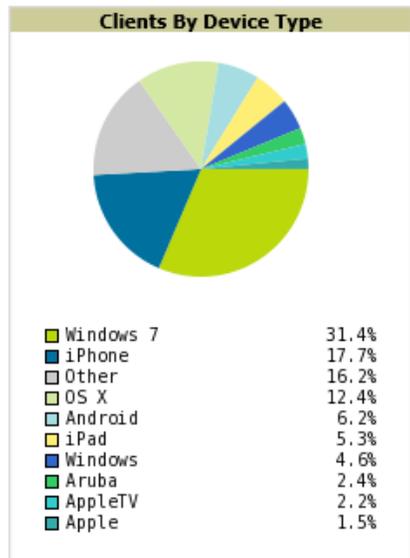
# AirWave Overview (Show user-table | include iPhone)



- Home
- Groups
- APs/Devices
- Clients
- Reports
- System
- Device Setup
- AMP Setup
- RAPIDS
- VisualRF

- Overview
- RF Performance
- Search
- Documentation
- License
- User Info

Welcome to AMP™ 7.6.3  
demo.airwave.com - Aruba Networks



# AP List (Show ap active)



Home Groups **APs/Devices** Clients Reports System Device Setup AMP Setup RAPIDS VisualRF

List New Up Down Mismatched Ignored

Modify Devices

1-55 of 55 APs/Devices Page 1 of 1 Reset filters Choose columns Export CSV

Device	1st Radio	1st Radio Ch.	1st Radio TX Power	2nd Radio	2nd Radio TX Power
dlogan-ap65	802.11bg	11	22 dBm	802.11a	149
1344-2-72c (1344-1-al1.arubanetworks.com)	802.11bgn	11	12 dBm	802.11an	165
1344-2-140C	802.11bgn	6	12 dBm	802.11an	36
1344-2-130C	802.11bgn	1	12 dBm	802.11an	165
1344-1-AL21 (1344-1-al21.arubanetworks.com)	802.11bgn	1	12 dBm	802.11an	149
1344-1-AL33 (1344-1-al33.arubanetworks.com)	802.11bgn	1	12 dBm	802.11an	36
1344-1-AL3 (1344-1-al3.arubanetworks.com)	802.11bgn	-	-	802.11an	-
1344-2-205C	802.11bgn	6	12 dBm	802.11an	165
1344-2-184C	802.11bgn	11	12 dBm	802.11an	165
1344-1-AL10 (1344-1-al10.arubanetworks.com)	802.11bgn	11	12 dBm	802.11an	157

- TX Power settings
- Channels
- AP types
- Up/Down status
- Firmware

# AirWave RF Performance Dashboard



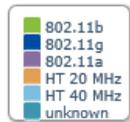
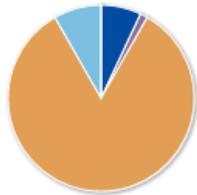
New Devices: 11    Wired: 38    Wireless: 361    Down: 166    Rogue: 300    Clients: 413    Alerts: 79

205c

[Home](#)   [Groups](#)   [APs/Devices](#)   [Clients](#)   [Reports](#)   [System](#)   [Device Setup](#)   [AMP Setup](#)   [RAPIDS](#)   [VisualRF](#)  
[Overview](#)   **RF Performance**   [Search](#)   [Documentation](#)   [License](#)   [User Info](#)

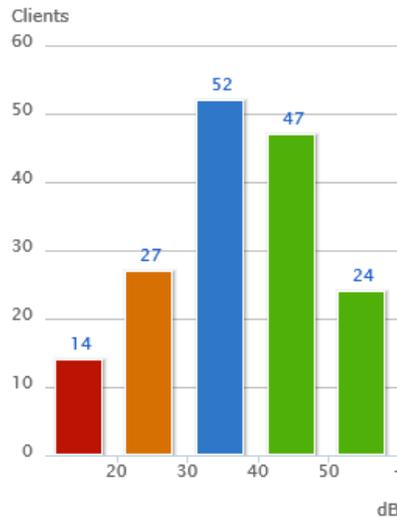
Clients | Folder ▾ Top

Summary



Clients ▾	2.4 GHz	5 GHz
802.11a	-	5
802.11b	0	-
802.11g	27	-
HT 20 MHz	133	190
HT 40 MHz	0	32
Total	160	227

SNR

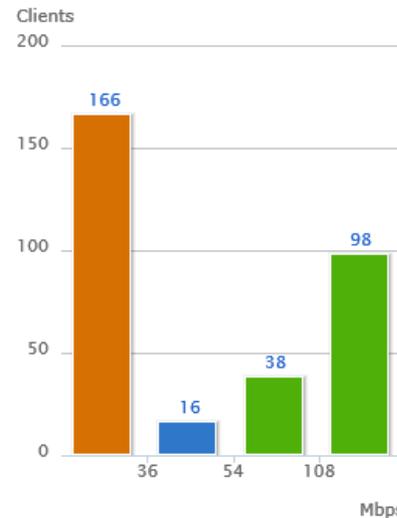


Lowest SNR Clients

Client ▾	SNR (dB)
64:20:0C:69:BE:79	15
70:56:81:EC:F8:6B	15
ARUBANETWORKS\ccourtney	12
marayanan	6
shirinaz@arubanetworks.com	13

More

Speed

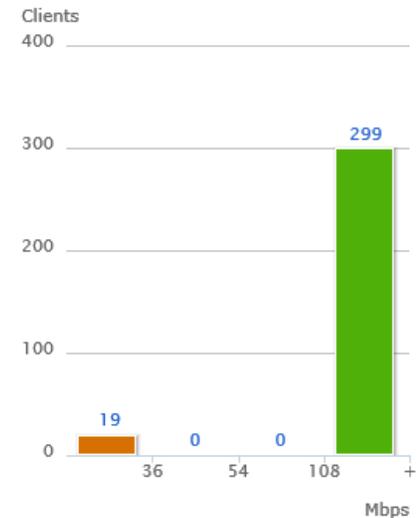


Lowest Speed Clients

Client ▾	Speed (Mbps)
20:16:D8:33:E2:5A	0
ARUBANETWORKS\kmeredith	0
ARUBANETWORKS\sdamodaran	0
kenc	0
mmudaliar@arubanetworks.com	0

More

Goodput



Lowest Goodput Clients

Client ▾	Goodput (Mbps)
78:CA:39:DE:3A:EE	0
ARUBANETWORKS\apingale	0
svitamanti@arubanetworks.com	0
vnambiar	0
wdai	0

More



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# AP Monitoring (Show User Table)



Home Groups **APs/Devices** Clients Reports System Device Setup AMP Setup RAPIDS VisualRF

List Monitor Manage Audit Compliance New Up Down Mismatched Ignored

### Device Info

Status: Up (OK)

Configuration: **Mismatched** (The settings on the device do not match the desired configuration policy.)

Controller:	ethersphere-lms3	Aruba AP Group:	Corp1344-AM	Upstream Device:	1344-1-AP-alpha-sw1	Upstream Port:	gigabitethernet0/0/15
Type:	Aruba AP 135	Remote Device:	No	Last Contacted:	2/28/2012 9:43 AM	Uptime:	2 days 8 hrs 12 mins
LAN MAC Address:	D8:C7:C8:C0:C7:BC	Serial:	AX0025566	Usage:	19.06 Kbps		
IP Address:	10.6.66.71	Clients:	5				

Notes:

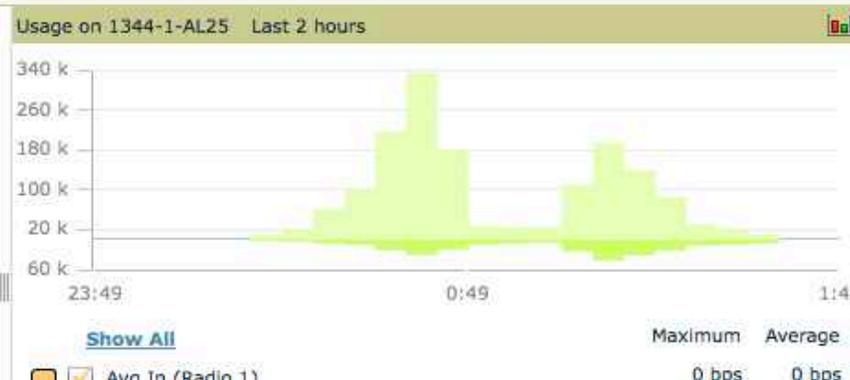
### Radios

Index	Name	MAC Address	Clients	Usage (Kbps)	Channel	Tx Power	Antenna Type	Role	Active SSIDs
1	802.11bgn	D8:C7:C8:8C:7B:C0	0	0.00	1	0 dBm	Internal	AirMonitor and Access	-
2	802.11an	D8:C7:C8:8C:7B:D0	4	19.06	149	12 dBm	Internal	Access	ARUBA-VISITOR, et...

### Wired Interfaces

Name	MAC Address	Clients	Admin Status	Operational Status	Type	Duplex	Aruba Port Mode	Input Capacity	Output Capacity
Enet0	D8:C7:C8:C0:C7:BC	0	Up	Up	gigabitEthernet	Full	N/A	1000 Mbps	1000 Mbps
Enet1	D8:C7:C8:C0:C7:BD	0	Up	Down	gigabitEthernet	Half	Active Standby	10 Mbps	10 Mbps

### View Device Events



# Radio Details



📶 New Devices: 11
📶 Wired: 38
📶 Wireless: 361
📶 Down: 166
📶 Rogue: 300
📶 Clients: 417
📶 Alerts: 79

205c

- Home
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- Reports
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- Device Setup
- AMP Setup
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## AP Monitoring | Radio Statistics

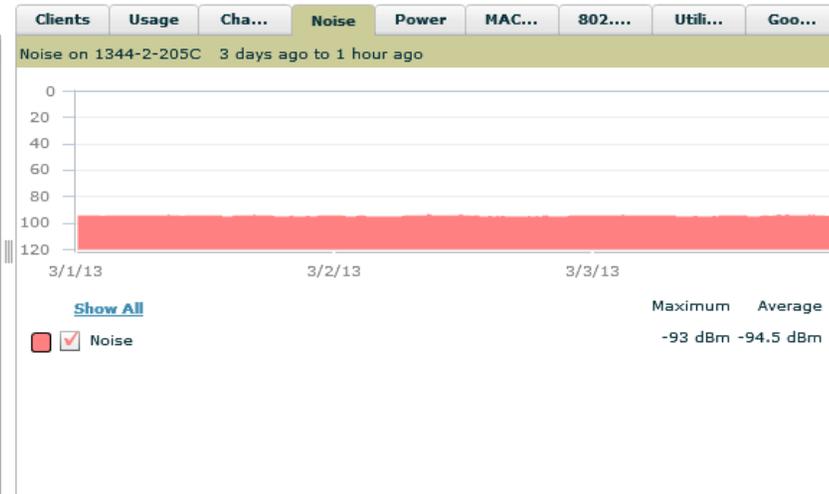
Monitoring **802.11bgn** radio for AP **1344-2-205C**

Run a command... ▼

Issues Summary	
Issue:	Description
Interfering Devices Detected:	Cordless Base Freq Hopper, Video Device Fixed Freq

### 802.11 Radio Counters Summary (frames/sec)

	Current	Last Hour	Last Day	Last Week
Unacked	0	1	59	32
Retries	0	0	4	3
Failures	0	1	5	4
Dup Frames	0	0	0	0
FCS Errors	7	14	58	172



1 year ago 
📅
now
🔄



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# Radio Details Continued (Show AP ARM history)



## ARM Events

1-5 of 13 ARM Events Page 1 of 3 > | [Reset filters](#) [Choose columns](#) [Export CSV](#)

Time	Trap Type	Previous Tx Power	Current Tx Power	Previous Channel	Current Channel	Previous Secondary Channel	Current Secondary Channel	Change Reason
3/4/2013 7:31 PM	Channel Change	-	-	1	6	None	None	Noise Threshold
3/4/2013 7:26 PM	Channel Change	-	-	6	1	None	None	Interference
3/4/2013 12:32 PM	Channel Change	-	-	1	6	None	None	Interference
3/4/2013 9:53 AM	Channel Change	-	-	6	1	None	None	Interference
3/4/2013 7:15 AM	Channel Change	-	-	11	6	None	None	Interference

1-5 of 13 ARM Events Page 1 of 3 > | [Reset filters](#)

## Detected Interfering Devices

1-5 of 5 Interfering Devices Page 1 of 1 [Choose columns](#) [Export CSV](#)

Device Type	Last Seen	Start Channel	End Channel	Signal	Duty Cycle (%)
Video Device Fixed Freq	3/4/2013 7:33 PM	1	4	-46	99
Cordless Base Freq Hopper	3/4/2013 7:33 PM	1	14	-75	5
XBox Freq Hopper	3/4/2013 6:29 PM	1	14	-82	5
Microwave	3/4/2013 3:19 PM	4	9	-61	50
Bluetooth	3/4/2013 12:53 PM	1	14	-69	5

1-5 of 5 Interfering Devices Page 1 of 1

## Active BSSIDs

BSSID	SSID	Controller Web UI
D8:C7:C8:88:D0:C0	ethersphere-wpa2	<a href="#">Dashboard &gt; Access Point</a>
D8:C7:C8:88:D0:C2	ARUBA-VISITOR	<a href="#">Dashboard &gt; Access Point</a>

# Client Diagnostics



New Devices: 35
Up: 560
Wired: 34
Down: 194
Wired: 5
Rogue: 1
Clients: 210
Alerts: 23

Log out peter

205c

[Home](#)
[Groups](#)
[APs/Devices](#)
[Clients](#)
[Reports](#)
[System](#)
[Device Setup](#)
[AMP Setup](#)
[RAPIDS](#)
[VisualRF](#)

[Connected](#)
[All](#)
[Rogue Clients](#)
[Guest Users](#)
[Client Detail](#)
[Diagnostics](#)
[VPN Sessions](#)
[VPN Users](#)
[Tags](#)

**Client**  
 ARUBANETWORKS\jturner  
  
good

**Network**  
 ethersphere-wpa2  
  
good  
 1 possible issue

**AP**  
 1344-2-92C  
  
good

**Controller**  
 ethersphere-lms3  
  
good

---

**Radio Info**

AP: 1344-2-92C  
 AP Type: Aruba AP 135  
 Last Contacted: 2/27/12 10:09 PM  
 Radio: 802.11an  
 Band: 5 GHz  
 Channel: 165  
 TX Power: 16 dBm  
 Antenna:  
 MAC Address: D8:C7:C8:83:A3:70  
 Notes:  
 Floor Plan: [Sunnyvale -> 1344 Crossman -> HQ\\_Floor2](#)

**Performance**

Clients: 1  
 Noise: -93 dBm  
 Total Usage: 1.59 Kbps  
 Usage To Clients: 616 bps  
 Usage From Clients: 976 bps  
 Uptime: 100%

**Trends**

**Clients**

**Channel Utilization**

**Usage**

**Noise (dBm)**

**Quality**

Overall rating good

Possible Issues (Network)

Indicator	Value	Ideal
<a href="#">Too Many Down Neighbor APs</a>	21	0

Additional Indicators (Network)

Indicator	Value	Ideal
<a href="#">Channel Utilization</a>	5.51%	≤ 60%
<a href="#">Noise floor</a>	-93 dBm	≤ -90 dBm
<a href="#">Avg. SNR</a>	40.02 dB	≥ 35 dB
<a href="#">Avg Frame errors/sec</a>	7 frames/s	≤ 250 frames/s

# ArubaOS Dashboard - Performance



All Radios 5 GHz 2.4 GHz

## Clients

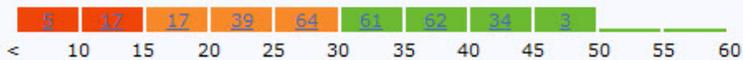
Total: [396](#)

Client PHY

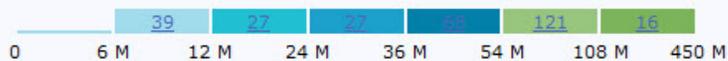
a [10](#) a HT [386](#) a HT 40MHz 0  
 g 0 g HT 0 g HT 40MHz 0  
 b 0

# SNR

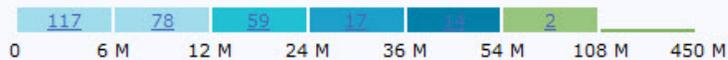
SNR (dB)



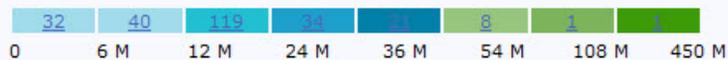
Speed (bps)



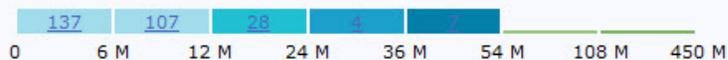
Goodput (bps)



To Client (bps)

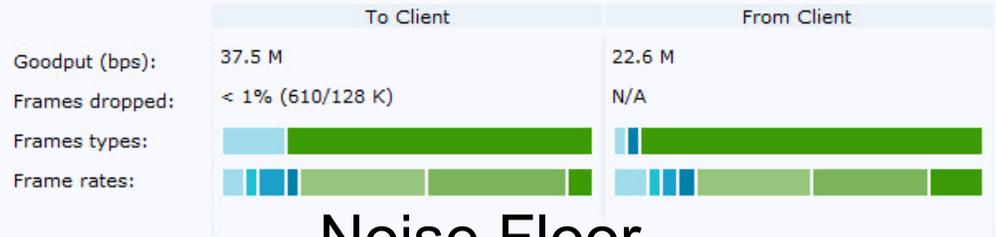


From Client (bps)



## APs

Overall Goodput (bps): [32.2 M](#)



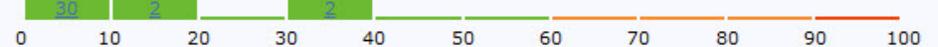
# Noise Floor

Noise Floor (dBm)

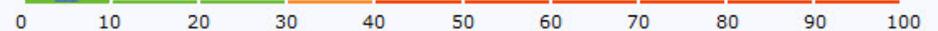


# Channel Utilization

Channel Busy (%)



Interference (%)



# Interference

# AOS RF Dashboard – Security



MOBILITY CONTROLLER | [Monitoring > Security Summary](#)

Dashboard | Monitoring | Configuration | Diagnostics | Maintenance | Plan

Last updated: 08:05:23 pm | ? | [Logout admin](#)

- Performance
- Usage
- > **Security**
- Potential Issues
- WLANs
- Access Points
- Clients

Discovered APs & Clients			
		Active APs	Associated Clients
<span style="color: red;">■</span>	Rogue	0	0
<span style="color: orange;">■</span>	Suspected Rogue	<a href="#">9</a>	<a href="#">4</a>
<span style="color: gray;">■</span>	Interfering	<a href="#">35</a>	<a href="#">67</a>
<span style="color: blue;">■</span>	Neighbor	0	0
<span style="color: green;">■</span>	Valid	<a href="#">192</a>	<a href="#">57</a>
<span style="color: black;">■</span>	Manually Contained	0	0
<b>Total</b>		<a href="#">236</a>	<a href="#">128</a>

		Last 4 hrs	Last 24 hrs	All
Containment	Infrastructure	0	0	0
	Client	0	0	0
	<b>Total</b>	0	0	0
Detection	Low	0	0	0
	Med	<a href="#">28</a>	<a href="#">72</a>	<a href="#">669</a>
	High	<a href="#">34</a>	<a href="#">64</a>	<a href="#">334</a>
	<b>Total</b>	<a href="#">62</a>	<a href="#">136</a>	<a href="#">1,003</a>

**Discovered Access Points: Active = Yes, AP Classification = Rogue**

[Locate](#) | [Contain Manually](#) | [Reclassify](#) | [Delete](#) | [Export](#)

BSSID	Band	PHY Type	SSID	Channel	Clients	AP Classification	Encryption	Marked to
- No matches found -								



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# AOS RF Dashboard – Potential Issues



MOBILITY CONTROLLER | [Monitoring > Potential Issues](#)

[Dashboard](#) | [Monitoring](#) | [Configuration](#) | [Diagnostics](#) | [Maintenance](#) | [Plan](#)

Last updated: 08:05:56 pm

- Performance
- Usage
- Security
- > **Potential Issues**
- WLANS
- Access Points
- Clients

## Potential Issues

Clients with potential issues: [11 out of 21](#)

Radios with potential issues: [25 out of 198](#)

	2.4 GHz	5 GHz
Low SNR	0	<a href="#">1</a>
Low speed	0	<a href="#">1</a>
Low goodput	<a href="#">5</a>	<a href="#">6</a>

	2.4 GHz	5 GHz
High noise floor	0	0
Busy channel	0	0
High interference	<a href="#">12</a>	0
Low goodput	<a href="#">8</a>	<a href="#">6</a>
High client association	0	0



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# AOS RF Dashboard – WLAN



MOBILITY CONTROLLER | Monitoring > WLANs

Dashboard | Monitoring | Configuration | Diagnostics | Maintenance | Plan

Last updated: 08:08:15 pm | ? | [Logout admin](#)

Performance

Usage

Security

Potential Issues

> WLANs

Access Points

Clients

WLANs (3) Show: Default Columns

WLAN	Clients	APs	Radios	Usage (bps)	Frames	Bytes	Frames Retried (to client)	Frames Dropped (to client)	Goodput (bps)
AMX	0	13	13	0	0	0	0%	0%	--
GLC	14	99	157	277.1 K	8.6 K	2.1 M	17% (625/3.6 K)	< 1% (18/3.6 K)	16.7 M
SANDS HOTSPOTS	7	14	22	78.4 K	896	588.2 K	67% (285/425)	5% (23/448)	3.2 M

All WLANs (22)

Clients

Usage

AP Name	Band	Clients	Usage (bps)
MIC05-AP20	2.4 GHz	0	--
MIC05-AP20	5 GHz	0	0
MIC04-AP26	2.4 GHz	0	0
MIC04-AP26	5 GHz	0	0
MIC05-AP21	2.4 GHz	0	0
MIC05-AP21	5 GHz	0	0
MIC04-AP28	2.4 GHz	0	--
MIC04-AP28	5 GHz	0	0
MIC04-AP01	2.4 GHz	0	--

Client	Device Type	Client PHY
10.0.0.187	Win 7	a HT
10.0.0.64	Win 7	a HT
10.0.1.30	--	a HT
10.0.1.21	iPhone	g HT
10.0.0.84	iPhone	g HT
30:38:55:4e:4c:3b	--	g
10.165.163.44	iPad	a HT
44:d8:84:66:af:24	--	g HT

# AOS RF Dashboard – Access Points



MOBILITY CONTROLLER | [Monitoring > Radios](#)

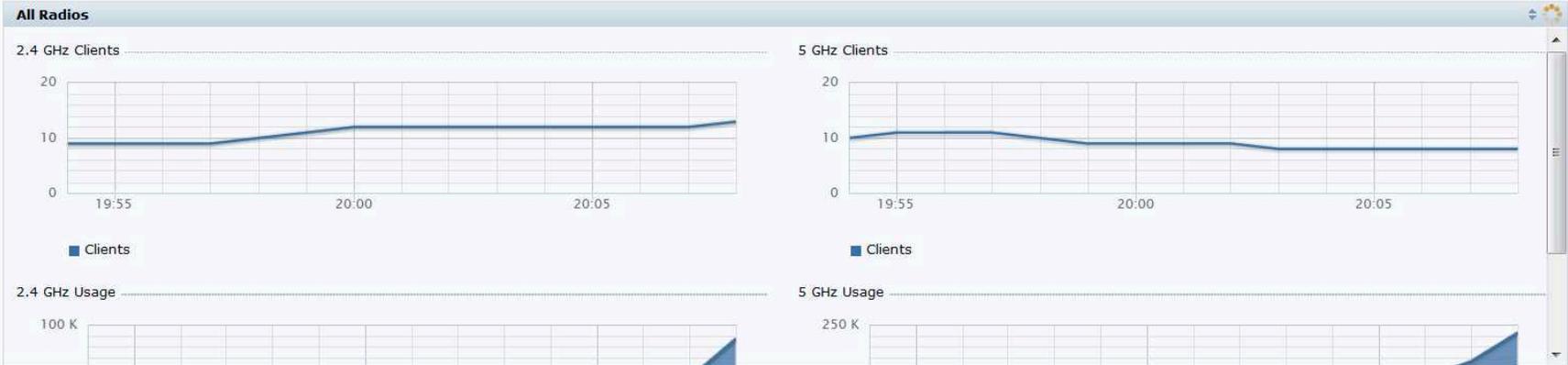
Dashboard | Monitoring | Configuration | Diagnostics | Maintenance | Plan

Last updated: 08:08:55 pm | ? | [Logout admin](#)

- Performance
- Usage
- Security
- Potential Issues
- WLANs
- > **Access Points**
- Clients

**Radios (157 of 198):** Radio Mode = Access Prev 100 Next 100 APs Radios All Radios 5 GHz 2.4 GHz Show: Default Columns

AP Name	Band	Radio Mode	Clients	Channel	Noise Floor (dBm)	EIRP (dBm)	Channel Utilization	Frames	Bytes	Frames (to client)	Frames Retried (to client)	Frames Dropped (to client)	Frames (from Frame Rates (to client)
<a href="#">MIC04-AP01</a>	5 GHz	Access	0	165	-96	20	<div style="width: 0%;"></div>	0	0	0	0%	0%	0 --
<a href="#">MIC04-AP02</a>	2.4 GHz	Access	2	1	-96	15	<div style="width: 0%;"></div>	63	4.8 K	59	0%	0%	4 <div style="width: 100%;"></div>
<a href="#">MIC04-AP02</a>	5 GHz	Access	1	153	-94	20	<div style="width: 0%;"></div>	452	71.4 K	223	5% (11/223)	0%	229 <div style="width: 100%;"></div>
<a href="#">MIC04-AP03</a>	2.4 GHz	Access	0	6	-94	15	<div style="width: 0%;"></div>	0	0	0	0%	0%	0 --
<a href="#">MIC04-AP03</a>	5 GHz	Access	0	48	-92	20	<div style="width: 0%;"></div>	0	0	0	0%	0%	0 --
<a href="#">MIC04-AP04</a>	2.4 GHz	Access	0	11	-93	15	<div style="width: 0%;"></div>	0	0	0	0%	0%	0 --
<a href="#">MIC04-AP04</a>	5 GHz	Access	0	44	-94	20	<div style="width: 0%;"></div>	0	0	0	0%	0%	0 --
<a href="#">MIC04-AP05</a>	2.4 GHz	Access	0	11	-95	15	<div style="width: 0%;"></div>	0	0	0	0%	0%	0 --
<a href="#">MIC04-AP05</a>	5 GHz	Access	0	52	-95	20	<div style="width: 0%;"></div>	0	0	0	0%	0%	0 --
<a href="#">MIC04-AP06</a>	2.4 GHz	Access	0	1	-96	15	<div style="width: 0%;"></div>	0	0	0	0%	0%	0 --



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# AOS RF Dashboard – Clients



MOBILITY CONTROLLER | [Monitoring > Clients](#)

Dashboard | Monitoring | Configuration | Diagnostics | Maintenance | Plan

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Performance

Usage

Security

Potential Issues

WLANs

Access Points

> Clients

**Clients (21)** Show: Default Columns

Client	Client PHY	Device Type	Role	SNR (dB)	Speed (bps)	Goodput (bps)	Usage (bps)	Frames	Bytes	Frames Retried (to client)	Frames Dropped (to client)	WLAN
<a href="#">10.0.0.187</a>	a HT	Win 7	authenticated	41	98 M	10.2 M	6.4 K	400	48.0 K	24% (38/158)	0%	GLC
<a href="#">10.0.0.64</a>	a HT	Win 7	authenticated	39	68 M	17.9 M	37.8 K	1.1 K	283.3 K	24% (106/439)	0%	GLC
<a href="#">10.0.1.30</a>	a HT	--	authenticated	37	134 M	20.4 M	26.0 K	857	194.8 K	13% (51/381)	0%	GLC
<a href="#">10.0.1.21</a>	g HT	iPhone	authenticated	42	65 M	3.8 M	34	6	256	0%	0%	GLC
<a href="#">30:38:55:4e:4c:3b</a>	g	--	--	--	--	--	--	--	--	0%	0%	SANDS_HOTSPOT:
<a href="#">10.165.163.44</a>	a HT	iPad	MBS_GUEST	--	--	--	0	0	0	0%	0%	SANDS_HOTSPOT:
<a href="#">44:d8:84:66:af:24</a>	g HT	--	--	--	--	--	0	0	0	0%	0%	SANDS_HOTSPOT:
<a href="#">48:60:bc:bf:58:76</a>	g HT	--	--	42	--	--	0	0	0	0%	0%	GLC
<a href="#">58:94:6b:a9:02:50</a>	a HT	--	--	34	129 M	14.3 M	20.6 K	778	154.6 K	37% (119/325)	< 1% (2/327)	GLC
<a href="#">78:a3:e4:a9:f5:1e</a>	a HT	--	--	25	65 M	--	0	0	0	0%	0%	GLC



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# Spectrum Analysis



- **Aruba AP in Spectrum Mode**
- **Aruba AP in Hybrid Spectrum Mode**
  - AP-9x/10x/13x
  - Software configurable
- **Dedicated Spectrum Analysers**
  - Fluke Networks – AirMagnet Spectrum XT
  - Metageek – Wi-Spy
  - Others
- **Airwave VisualRF**

# Wireless Tools – Spectrum Analysis



MOBILITY CONTROLLER | Aruba3200 > Spectrum Analysis

Spectrum Dashboards

Spectrum Monitors

Session Log

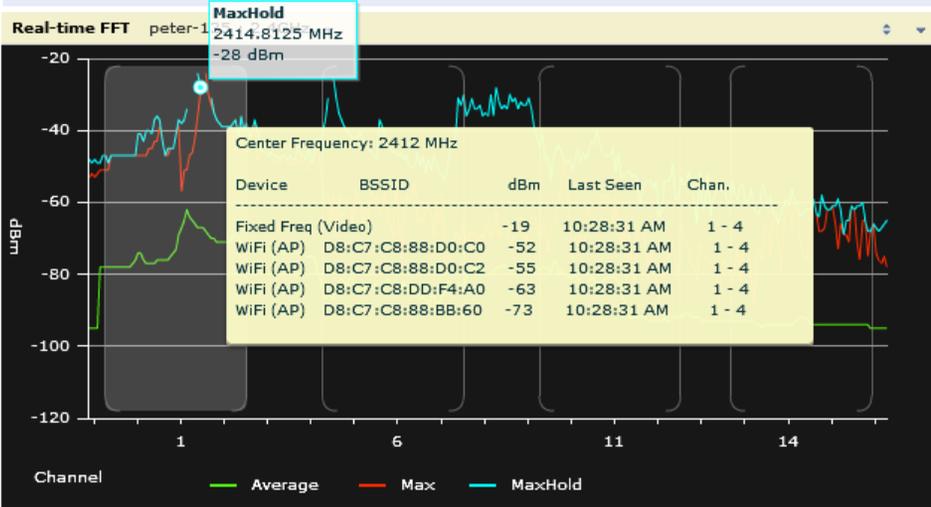
[Log out admin](#)

View 1 View 2 View 3 Playback View

Record

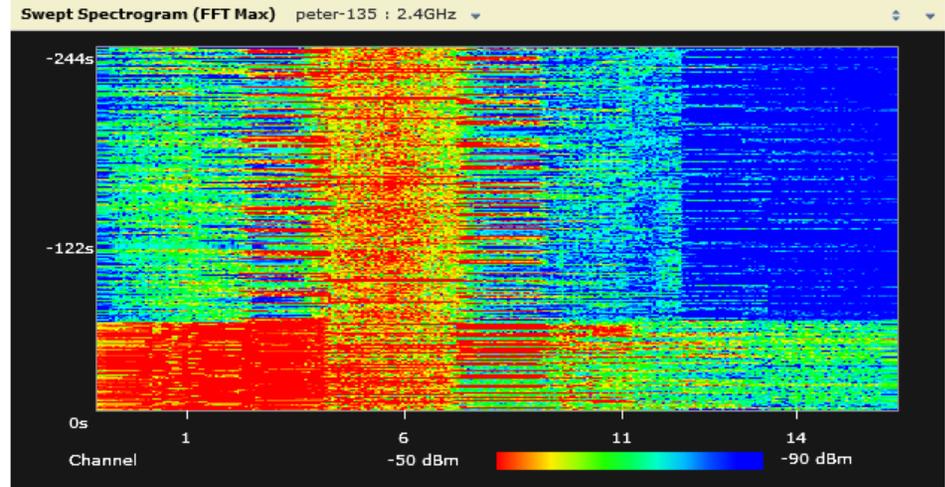
Save Spectrum Views

?



**Active Devices Table (139)** peter-135 : 2.4GHz

Device Type	BSSID	SSID	Signal (dBm)	Duty Cycle	Discovered	Activ Durat
WiFi (AP)	00:24:6C:81:A6:B0	peter-plm-3200	-37	1%	3-5 11:21:41 AM	5m 2
WiFi (AP)	D8:C7:C8:88:D0:C2	ARUBA-VISITOR	-55	0%	3-5 11:21:41 AM	5m 2
WiFi (AP)	D8:C7:C8:87:EE:00	appletest	-42	0%	3-5 11:21:41 AM	5m 2
WiFi (AP)	D8:C7:C8:87:EE:01	test-wep	-44	1%	3-5 11:21:41 AM	5m 2
WiFi (AP)	00:1A:1E:50:17:D0	aruba-ap	-56	0%	3-5 11:21:41 AM	5m 2
WiFi (AP)	6C:F3:7F:B7:29:A3	employee200-7	-61	1%	3-5 11:21:41 AM	5m 2
WiFi (AP)	6C:F3:7F:A6:0E:82	instant	-64	1%	3-5 11:21:42 AM	5m 2
WiFi (AP)	D8:C7:C8:AC:3D:81	CPPM-test	-65	1%	3-5 11:21:42 AM	5m 2
WiFi (AP)	6C:F3:7F:A6:0C:C2	instant	-64	0%	3-5 11:21:42 AM	5m 2
WiFi (AP)	D8:C7:C8:8C:71:62	ARUBA-VISITOR	-61	0%	3-5 11:21:42 AM	5m 2
WiFi (AP)	00:18:4D:DB:E4:50	Net-AP	-59	0%	3-5 11:21:42 AM	5m 2
WiFi (AP)	D8:C7:C8:5B:7C:23	Q_Amigo_IAP	-65	0%	3-5 11:21:43 AM	5m 2



# Wireless Tools – Spectrum Analysis



MOBILITY CONTROLLER | Aruba3200 > Spectrum Analysis

Spectrum Dashboards

Spectrum Monitors

Session Log

[Log out admin](#)

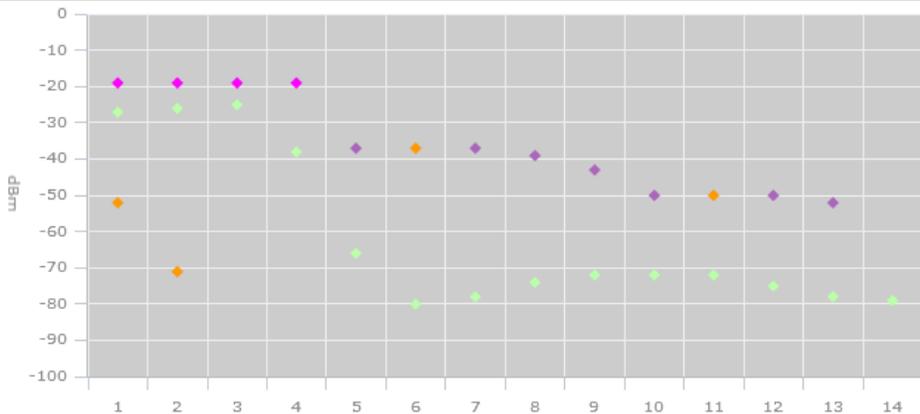
View 1 View 2 View 3 Playback View

Record

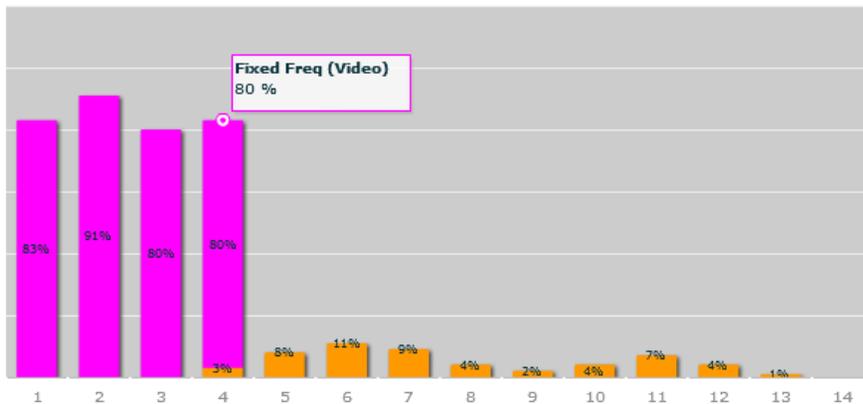
Save Spectrum Views



Interference Power peter-135 : 2.4GHz

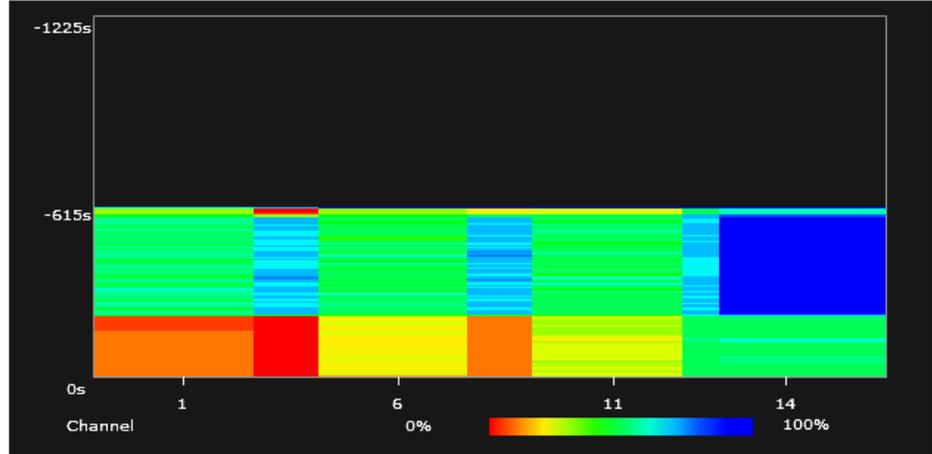


Device Duty Cycle peter-135 : 2.4GHz

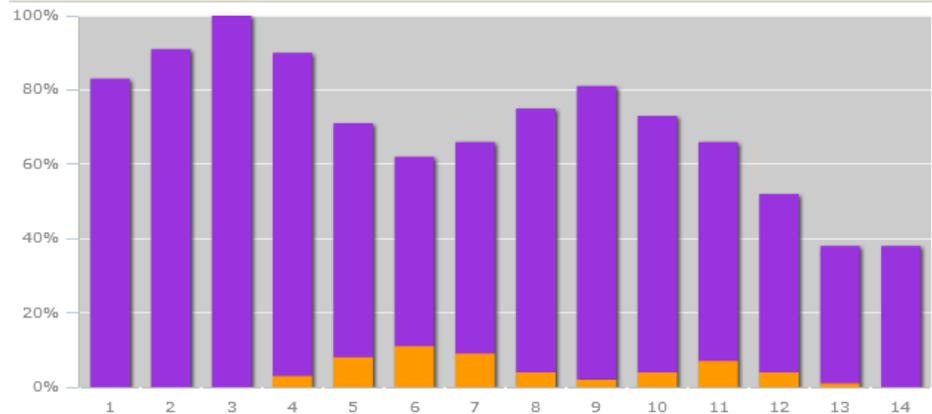


WiFi (AP) Fixed Freq (Others) Fixed Freq (Video) Freq Hopper (Cordless Base)

Quality Spectrogram (Channel Availability) peter-135 : 2.4GHz

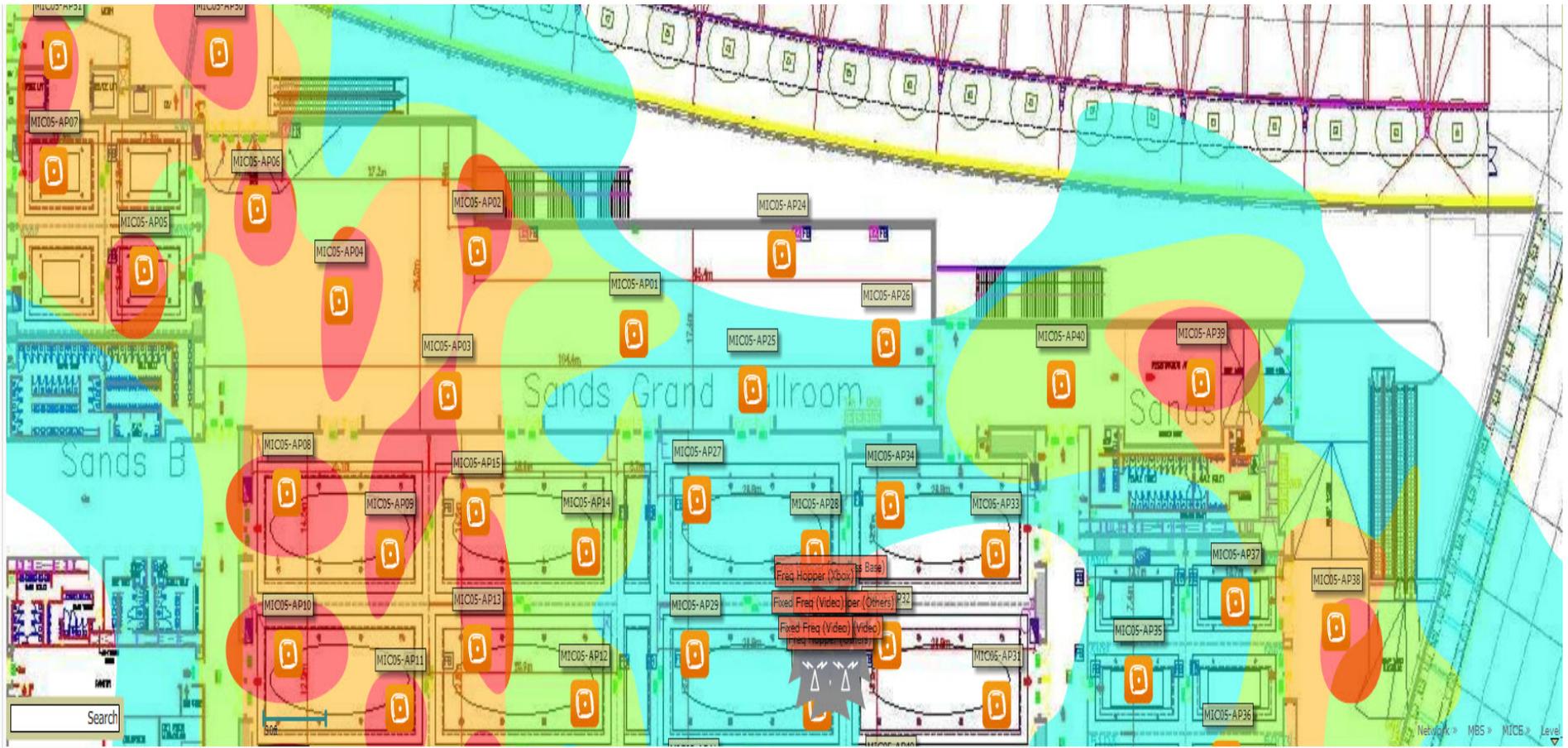


Channel Metrics peter-135 : 2.4GHz

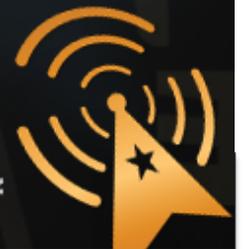


WiFi Utilization Non-WiFi + WiFi ACI Utilization

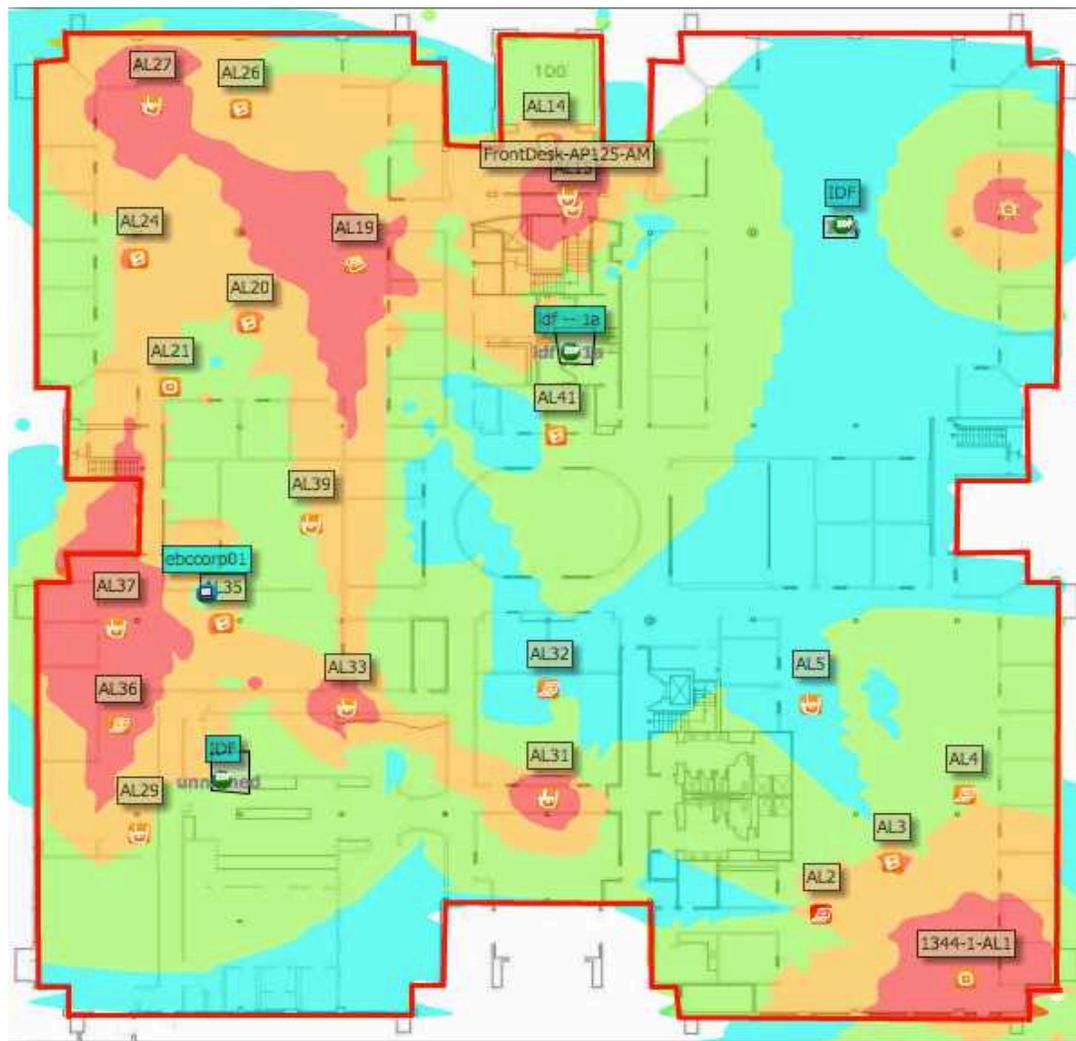
# Wireless Tools – Visual RF



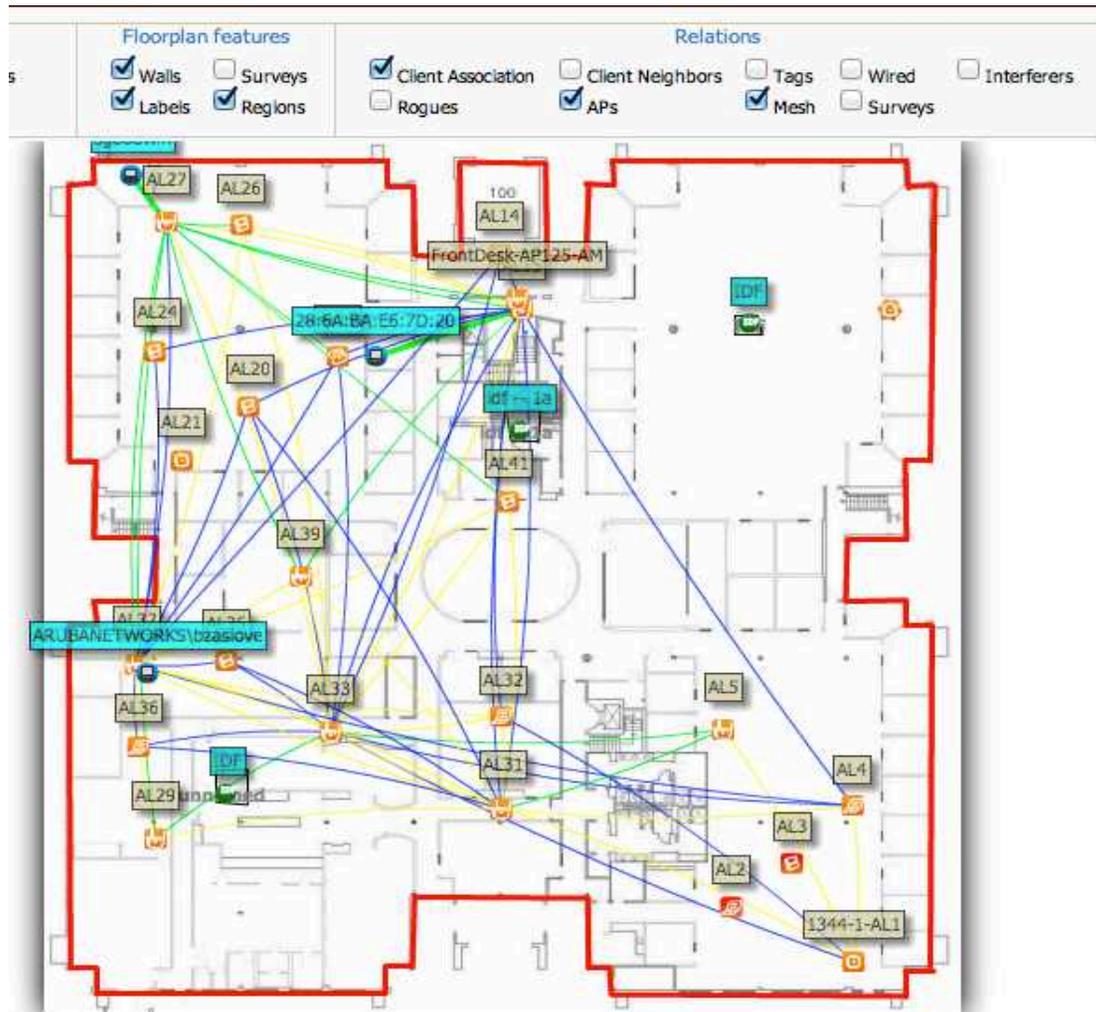
# Wi-Fi Heatmap & Site-Survey



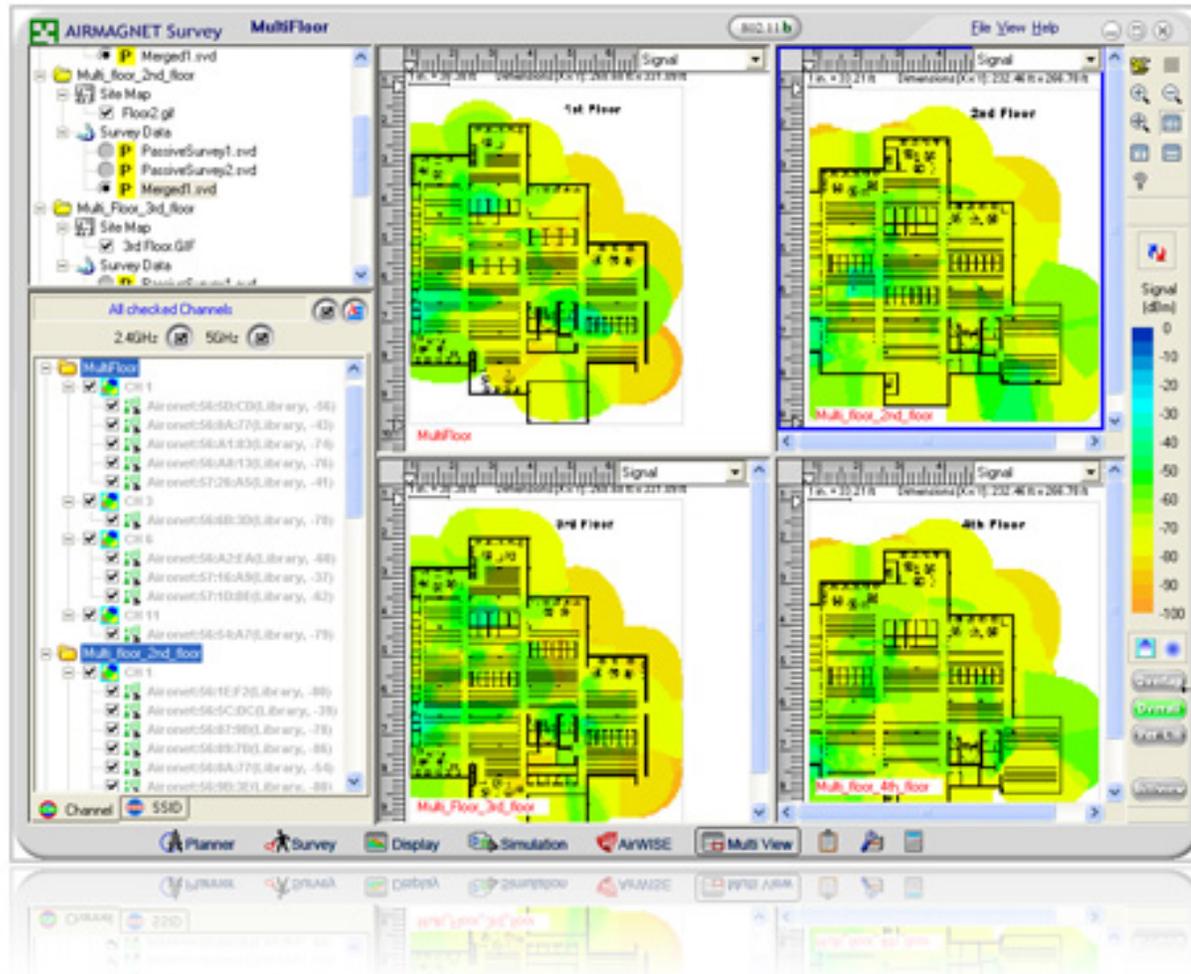
# Heatmap (AirWave VisualRF)



# AirWave (Client Association)



# Site-Survey (AirMagnet Survey Pro)



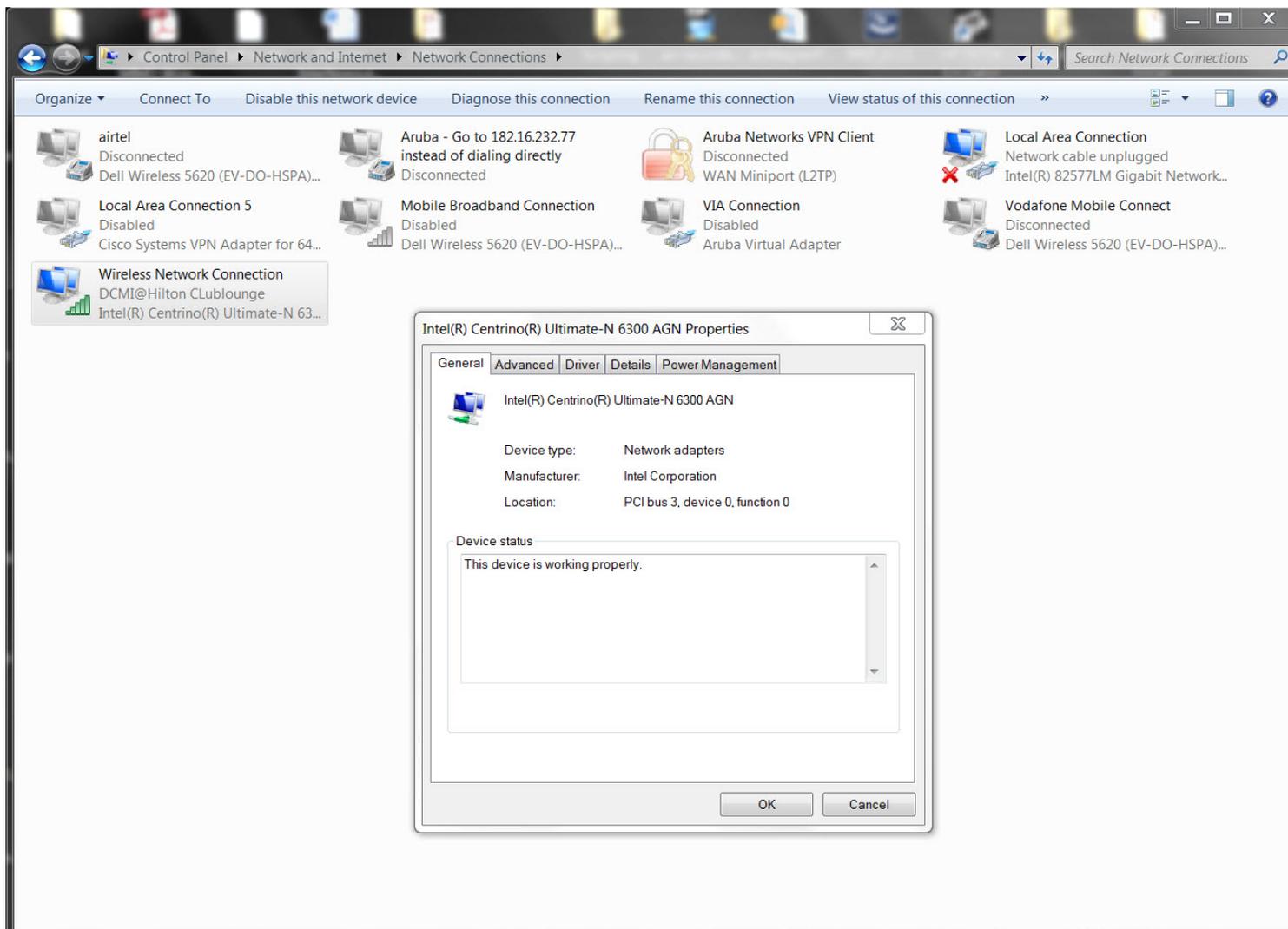
Takes two to Tango

Understanding the client NIC

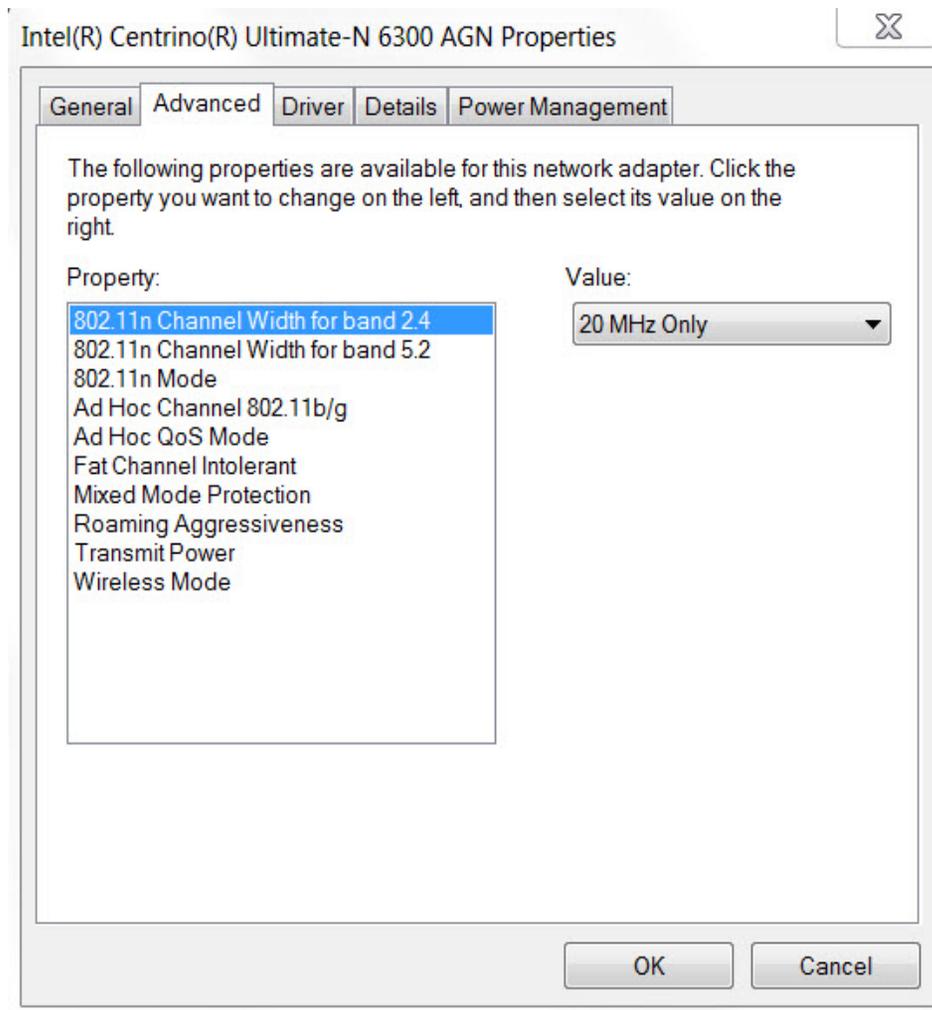


- **Client devices have different characteristics and capabilities**
  - Is it 802.11a, 802.11g, b/g/n, a/b/g/n?
  - If the client supports 11n, is it 1, 2 or 3 spatial streams?
  - Is the wireless NIC using the latest driver?
  - Smartphones often use lower transmit power to save battery
  - SNR works in **both directions**—the client needs sufficient SNR to demodulate 802.11 data rates—noise close to the client can hurt performance
  - Sometimes, the client can hear the AP, but the AP cannot hear the client

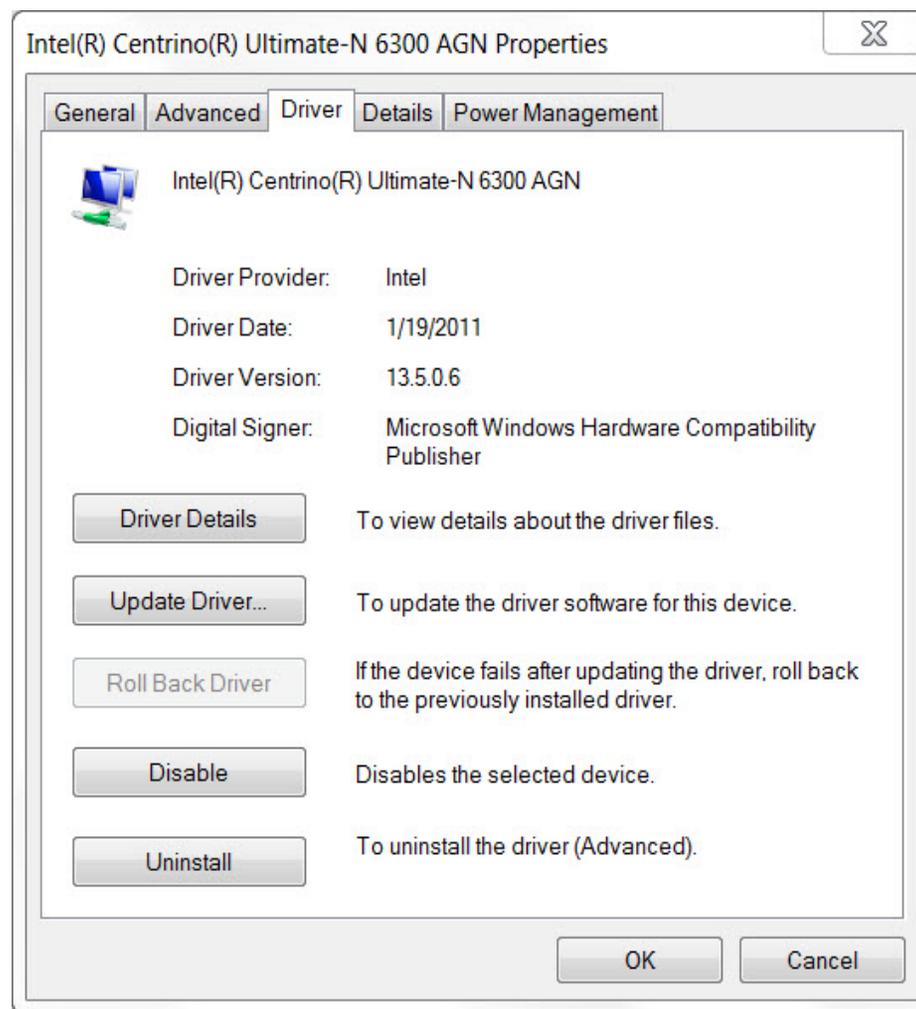
# Wireless NIC Details



# Wireless NIC Details Cont.



# Wireless NIC Details Cont.



# Wireless NIC Connectivity (Windows 7)



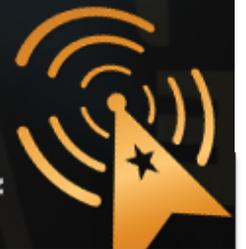
```
C:\Users\ckrispin>netsh wlan show interface
```

```
There is 1 interface on the system:
```

```
Name                : Wireless Network Connection
Description         : Intel(R) Centrino(R) Ultimate-N 6300 AGN
GUID               : f079b84f-1fdf-47a9-8baa-6e8ab9b10b8c
Physical address   : 00:24:d7:7c:44:28
State              : connected
SSID               : DCMI@Hilton CLublounge
BSSID              : 00:04:e2:ff:d8:78
Network type       : Infrastructure
Radio type         : 802.11g
Authentication     : Open
Cipher             : None
Connection mode    : Auto Connect
Channel            : 11
Receive rate (Mbps) : 54
Transmit rate (Mbps) : 54
Signal             : 99%
Profile            : DCMI@Hilton CLublounge

Hosted network status : Not available
```

# Performance Testing



# Performance Testing



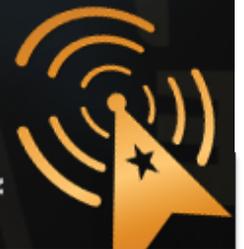
When testing, it is best to do **wired** to **wireless** client testing.

This allows testing the performance of the wireless LAN, and not depending on Internet access and limited bandwidth.

Pure performance can be measured.

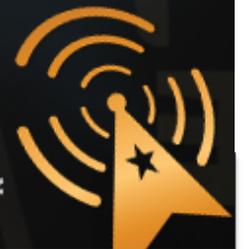
- **iperf/jperf**
- **ixChariot**
- **Veriwave – WaveDeploy**
  
- **iperf (Traffic flow is from client to server)**
  - Server (receiver)
    - `iperf -s -w 512k -i 1`
  - Client (sender)
    - `iperf -c <Server IP> -w 512k -i 1 -t 60 -P 4`

# Packet Capture



- **Local Packet Capture**
  - Tools running on laptop (Omnipeek/Wireshark)
  - You have to be where the problem is
- **Remote Packet Capture**
  - Use Aruba AP as remote agent
  - Anywhere with network access to AP
- **Session and port Mirroring**

# Advanced RF Troubleshooting with CLI



# Running Controller CMD from AWMS



## Device Info

Status: Up (OK)  
Configuration: **Mismatched** (The settings on the device do not match the desired configuration policy.)  
Controller: **ethersphere-lms3** Aruba AP Group: **corp1344** Upstream Device: **1344-1-AP-alpha-sw1** Upstream Port: **gigabitethernet0/0/35**  
Type: **Aruba AP 135** Remote Device: **No** Last Contacted: **2/23/2012 2:22 AM** Uptime: **4 days 16 hrs 9 mins**  
LAN MAC Address: **D8:C7:C8:C0:B4:C6** Serial: **AX0023139**  
IP Address: **10.6.66.32** Clients: **2** Usage: **-**  
Quick Links:

## Radios

Index	Name	MAC Address	Clients	Usage (Kbps)	Channel	Tx Power	Antenna Type	Role	Active SSIDs
1	802.11bgn	D8:C7:C8:8B:4C:60	0	0.00	1	20 dBm	Internal	Access	ARUBA-VISITOR, et...
2	802.11an	D8:C7:C8:8B:4C:70	2	0.00	149	20.5 dBm	Internal	Access	ARUBA-VISITOR, et...

## Wired Interfaces

Name	MAC Address	Clients	Admin Status	Operational Status	Type	Duplex	Aruba Port Mode	Input Capacity	Output Capacity
Enet0	D8:C7:C8:C0:B4:C6	0	Up	Up	gigabitEthernet	Full	N/A	1000 Mbps	1000 Mbps
Enet1	D8:C7:C8:C0:B4:C7	0	Up	Down	gigabitEthernet	Half	Active Standby	10 Mbps	10 Mbps

# Useful AOS CLI (run from AirWave)



Monitoring **AL21 (1344-1-al21.arubanetworks.com)** in group **Ethersphere-lms3** in folder **Top > Sunnyvale HQ** Poll Control

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

### Device Info

Status: Up (OK)  
Configuration: **Mismatched** (The settings on the device do not match the desired configuration policy.)

Controller:	<a href="#">ethersphere-lms3</a>	Aruba AP Group:	corp1344	Upstream Device:	<a href="#">1344-1-A</a>
Type:	Aruba AP 135	Remote Device:	No	Last Contacted:	2/23/201
LAN MAC Address:	D8:C7:C8:C0:B4:C6	Serial:	AX0023139		
IP Address:	10.6.66.32	Clients:	2	Usage:	-

Quick Links:

Notes:

### Radios

Index ▲	Name	MAC Address	Clients
1	<a href="#">802.11bgn</a>	D8:C7:C8:8B:4C:60	0
2	<a href="#">802.11an</a>	D8:C7:C8:8B:4C:70	2

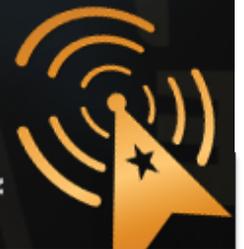
### Wired Interfaces

Name ▲	MAC Address	Clients	Admin Sta
Enet0	D8:C7:C8:C0:B4:C6	0	Up
Eport1	D8:C7:C8:C0:B4:C7	0	Up

✓ Run a command...

- show ap association ap-name "1344-1-AL21"
- show ap debug counters ap-name "1344-1-AL21"
- show ap debug client-table ap-name "1344-1-AL21"
- show datapath session ap-name "1344-1-AL21" table
- show datapath session ap-name "1344-1-AL21" counters
- show ap debug bandwidth-management ap-name "1344-1-AL21"
- show ap tech-support ap-name "1344-1-AL21"
- show ap arm bandwidth-management ap-name "1344-1-AL21"
- show ap arm state ap-name "1344-1-AL21"
- show ap arm scan-times ap-name "1344-1-AL21"
- show ap arm rf-summary ap-name "1344-1-AL21"

# Advanced CLI Examples



# Verify All Known APs are UP



- show ap active

```
(Aruba-Demo-Master3200) #  
(Aruba-Demo-Master3200) #show ap active
```

## Active AP Table

Name	Group	IP Address	11g Clients	11g Ch/EIRP/MaxEIRP	11a Clients	11a Ch/EIRP/MaxEIRP	AP Type	Flags	Uptime	Outer IP
AP-28	demo	172.30.0.242	0	AP:HT:6/9/20.5	2	AP:HT:44+/20/21	125	E	29m:7s	N/A
AP-B6	demo	172.30.0.244	1	AP:HT:1/9/20.5	0	AP:HT:36+/18/21	125abg	E	23m:11s	N/A
AP-2A	demo	172.30.0.246	0	AP:HT:1/9/20.5	1	AP:HT:157+/21/21	125	E	30m:34s	N/A
Ap105A-MPP-00:24:6c:c0:01:00	AP-Group1	172.30.0.247	8	AP:HT:6/6/20.5	4	MPP:149+/6/20.5	105	M	1h:42m:4s	N/A
AP65C-MPT-00:1a:1e:c7:68:e0	AP-Group1	172.30.0.249	1	AP:11/22/22	0	MP:149/15/23	65	EM	1h:40m:15s	N/A
AP65A-MPT-00:1a:1e:c7:67:c8	AP-Group1	172.30.0.251	12	AP:6/9/22	2	MP:149/15/23	65	EM	1h:43m:42s	N/A
AP65B-MPT-00:1a:1e:c7:67:d6	AP-Group1	172.30.0.253	16	AP:1/9/22	9	MP:149/15/23	65	EM	1h:43m:42s	N/A

Flags: R = Remote AP; P = PPPOE; E = Wired AP enabled; A = Enet1 in active/standby mode;  
L = Client Balancing Enabled; D = Disconn. Extra Calls On; B = Battery Boost On;  
X = Maintenance Mode; d = Drop Mcast/Bcast On; N = 802.11b protection disabled;  
a = Reduce ARP packets in the air; S = RFprotect Sensor; d = Disconnected Sensor  
M = Mesh; U = USB modem; K = 802.11K Enabled;

Channel followed by "\*" indicates channel selected due to unsupported configured channel.

Num APs:7

```
(Aruba-Demo-Master3200) #
```

# Verify All Known SSIDs are Broadcasting



- **show ap bss-table ap-name <ap name>**

```
(ArubaThailand) #show ap bss-table
```

```
Aruba AP BSS Table
```

bss	ess	s/p	ip	phy	type	ch/EIRP/max-EIRP	cur-cl	ap name	in-t(s)	tot-t	mtu	acl-state
00:1a:1e:80:02:f0	Bangkok_Corp	1/1	192.168.101.253	a-HT	ap	153-/19/36	2	Bangkok_ICH_AP1	0	2h:41m:15s	1578	-
00:1a:1e:80:02:f1	Bangkok_Voice	1/1	192.168.101.253	a-HT	ap	153-/19/36	0	Bangkok_ICH_AP1	0	2h:41m:15s	1578	-
00:1a:1e:80:02:e0	Bangkok_Corp	1/1	192.168.101.253	g-HT	ap	1/19/33	0	Bangkok_ICH_AP1	0	2h:41m:15s	1578	-
00:1a:1e:80:02:e1	Bangkok_Voice	1/1	192.168.101.253	g-HT	ap	1/19/33	0	Bangkok_ICH_AP1	0	2h:41m:15s	1578	-
00:1a:1e:c0:00:2f	N/A	1/1	192.168.101.253	e	N/A	N/A	N/A	Bangkok_ICH_AP1	0	2h:41m:15s	1578	N/A

Channel followed by "\*" indicates channel selected due to unsupported configured channel.

```
Num APs:5
```

```
Num Associations:2
```

```
(ArubaThailand) #
```

# Check Device's 802.11 status



```
(Aruba-Demo-Master3200) #show ap association client-mac 00:21:6a:51:71:ea
```

```
Flags: W: UMM client, A: Active, K: 802.11K client, B: Band Steerable
```

```
PHY Details: HT: High throughput; 20: 20MHz; 40: 40MHz  
<n>ss: <n> spatial streams
```

## Association Table

Name	bssid	mac	auth	assoc	aid	l-int	ssid	vlan-id	tunnel-id	phy	assoc. time	num assoc	Flags
AP-B6	00:1a:1e:89:4b:70	00:21:6a:51:71:ea	y	y	2	10	demo	1	0x1090	a-HT-40sgi-2ss	18m:48s	1	W&B

## 00:21:6a:51:71:ea-00:1a:1e:89:4b:70 Stats

Parameter	Value
Channel	36
Channel Frame Retry Rate(%)	0
Channel Frame Low Speed Rate(%)	0
Channel Frame Non Unicast Rate(%)	0
Channel Frame Fragmentation Rate(%)	0
Channel Frame Error Rate(%)	0
Channel Bandwidth Rate(Kbps)	1
Channel Noise	96
Client Frame Retry Rate(%)	0
Client Frame Low Speed Rate(%)	0
Client Frame Non Unicast Rate(%)	0
Client Frame Fragmentation Rate(%)	0
Client Frame Receive Error Rate(%)	0
Client Bandwidth Rate(Kbps)	1
Client Tx Packets	12030
Client Rx Packets	3884
Client Tx Bytes	996873
Client Rx Bytes	4318530
Client SNR	56
Client Tx Rate	18 mbps
Client Rx Rate	6 mbps

```
(Aruba-Demo-Master3200) #
```

# View Device's 802.11 Performance



- **show ap debug client-table ap-name <ap name>**

```
(ArubaThailand) #show ap debug client-table ap-name Bangkok_ICH_API
```

```
Client Table
```

MAC	ESSID	BSSID	Assoc_State	HT_State	AID	PS_State	UAPSD	Tx_Pkts	Rx_Pkts	PS_Pkts	Tx_Retries	Tx_Rate	Rx_Rate	
Last_ACK_SNR	Last_Rx_SNR	TX_Chains	Tx_Timestamp	Rx_Timestamp										
00:1e:c2:b4:86:90 -128	Bangkok_Corp 11	3[0x7]	00:1a:1e:80:02:f0 Sun Aug 17 08:13:27 2008	Associated Sun Aug 17 08:13:33 2008	WM	0x1	Power-save 2008	(0,0,0,0)	6415	19684	4	1422	13	13
00:18:de:66:09:5c 54	Bangkok_Corp 54	2[0x3]	00:1a:1e:80:02:f0 Sun Aug 17 08:12:05 2008	Associated Sun Aug 17 08:13:33 2008	None	0x3	Power-save 2008	(0,0,0,0)	59	5103	0	0	54	6
00:16:ea:5f:c6:d4 61	Bangkok_CorpLegacy 57	2[0x3]	00:1a:1e:80:02:f2 Sun Aug 17 08:12:33 2008	Associated Sun Aug 17 08:13:33 2008	None	0x1	Awake 2008	(0,0,0,0)	52	1600	0	0	54	12
00:1e:4c:c9:db:72 65	Bangkok_Corp 66	2[0x5]	00:1a:1e:80:02:e0 Sun Aug 17 08:13:33 2008	Associated Sun Aug 17 08:13:33 2008	M	0x1	Awake 2008	(0,0,0,0)	1292	3011	0	0	130	130
00:11:24:92:64:70 52	Bangkok_CorpLegacy 53	2[0x5]	00:1a:1e:80:02:e2 Sun Aug 17 08:12:27 2008	Associated Sun Aug 17 08:12:27 2008	None	0x1	Awake 2008	(0,0,0,0)	256991	82863	0	390	54	36

```
UAPSD:(VO,VI,BK,BE)
```

```
HT Flags: A - LDPC Coding; w - 40Mhz; S - Short GI; M - Max A-MSDU  
D - Delayed BA; G - Greenfield; R - Dynamic SM PS  
Q - Static SM PS; N - A-MPDU disabled
```

```
(ArubaThailand) #
```

# Check 802.11 and non-802.11 Interference



```
(ArubaThailand) #show ap arm rf-summary ap-name Bangkok_ICH_AP1
```

## Channel Summary

channel	retry	low-speed	non-unicast	frag	bwidth	phy-err	mac-err	noise	cov-idx	intf_idx
161	0	0	0	0	0	0	4	106	8/0	9/106//0/0
1	57	53	3	0	7	0	7	91	10/0	853/126//0/0
48	0	0	0	0	0	0	0	0	0/0	173/123//0/0
165	0	0	0	0	0	0	0	0	0/0	198/11//0/0
5	0	0	0	0	0	0	0	0	0/0	40/849//0/0
6	0	0	0	0	0	0	0	0	0/0	537/496//0/0
7	0	0	0	0	0	0	0	0	0/0	62/929//0/0
11	0	0	0	0	0	0	0	0	0/0	736/341//0/0
149	0	0	0	0	0	0	0	0	0/0	118/70//0/0
36	0	0	0	0	0	0	0	0	0/0	286/20//0/0
153	0	0	0	0	0	0	0	0	0/0	189/83//0/0
40	0	0	0	0	0	0	0	0	0/0	57/144//0/0
157	0	0	0	0	0	0	0	0	0/0	121/63//0/0
44	0	0	0	0	0	0	0	0	0/0	343/80//0/0

## HT Channel Summary

### Summary by Channel Group

1-5	1868
7-11	2068
149-153	460
36-40	507
157-161	299
44-48	719

```
Interface Name           :wifi0
Current ARM Assignment   :161-/21
Target Coverage Index    :10
Covered channels a/g     :0/0
Free channels a/g       :9/0
ARM Edge State           :disable
Last check channel/pwr   :21s/3m:16s
Last change channel/pwr  :1h:5m:52s/54m:57s
Next Check channel/pwr   :3m:49s/3m:3s
```

```
Interface Name           :wifil
Current ARM Assignment   :1/30
Target Coverage Index    :10
Covered channels a/g     :0/0
Free channels a/g       :0/3
ARM Edge State           :disable
Last check channel/pwr   :2m:21s/1m:1s
Last change channel/pwr  :2m:21s/15m:14s
Next Check channel/pwr   :1m:43s/4m:15s
```

```
(ArubaThailand) #
```

- **General AP/Client**

- show ap active [ap-name] <AP name>
- show ap bss-table [ap-name] <AP name>
- show ap association [ap-name] <AP name>
- show ap association client-mac <client MAC>
- show ap debug client-table ap-name <AP name>
- show ap debug client-table ap-name <AP name> | include <client MAC>
- show ap debug client-stats <client MAC> advanced
- show ap remote debug mgmt-frames ap-name <AP name>

- **ARM**

- show ap monitor ap-list ap-name <AP name>
- show ap arm rf-summary ap-name <AP name>
- show ap arm history ap-name <AP name>
- show ap arm scan-times ap-name <AP name>
- show ap arm state ap-name <AP name>

- **RF**

- show ap debug radio-stats ap-name <AP name> radio [0 or 1] advanced

- **User**

- show user [IP address or client MAC]
- show user-table verbose
- show auth-tracebuf [client MAC or count]
- show datapath session table <user IP address>

- **System**

- show ap debug system-status ap-name <AP name>
- show ap tech-support ap-name <AP name>
- show ap spectrum tech-support ap-name <AP name>
- show tech-support
- tar logs tech-support

## 6.2 troubleshooting updates



- **Show AP debug counters**
- **Show ap radio-summary**
- **Show ap debug system-status**
- **PCAP enhancements**



# Aruba Tools



# AirRecorder



- Routinely Gather CLI output
- Java based, can run in Windows or Mac OS X
- Available from the support site in the tools section

ARUBA networks

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Change Password Logout

Search

HOME DOWNLOAD SOFTWARE **TOOLS & RESOURCES** DOCUMENTATION KNOWLEDGE BASE MIGRATION TOOL Lifetime Warranty Software

ARUBA SUPPORT CENTER

TOOLS & RESOURCES

Navigator

- ACE Air Recorder
- Aruba Demo Kit (ADK)
- Aruba Wi-Fi Config
- ArubaOS 2.5 to 3.1 Migration
- Beta
- Cricket
- Hardware
- HPOpenViv NNM Support
- PEAP-GTC Plug-in
- RADIUS Dictionary Files
- RFPlayback
- RFprotect

Tools & Resources

Root Collection

ACE Air Recorder

Folder Up Mail Documents

Description	Remarks	Last Modified	Size
ACE Air Recorder v 1.1	This is a java based script tool that will loo	5/17/2012	1.2 MB

Airheads Accepted Solutions

Latest Accepted Solutions

Is it possible to limit online game traffic???

Does anyone have suggestions to limit traffic being used to play online games?

We have students who suck up all the bandwidth and I'm hoping to choke that off

<...[More]

Author: edflecko  
Posted: 03-04-2013

Encrypted password in

- **\$ java -jar AirRecorder-1.1-release.jar -u admin -p admin -e enable 192.168.1.1**

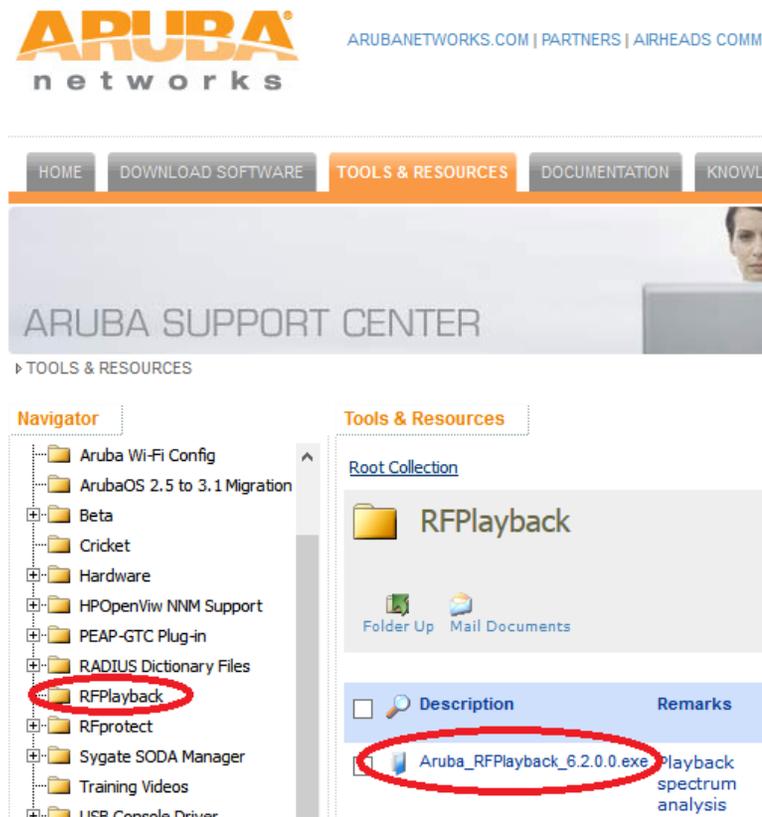
300,show ap arm bandwidth-management ap-name %  
{ap:name}

3600,show ap arm neighbors ap-name %{ap:name}

300,show ap arm rf-summary ap-name %{ap:name}

3600,show ap arm scan-times ap-name %{ap:name}

- **View Spectrum recordings without connecting to the controller**
- **Installs Adobe Air as part of the installation**
- **Available from the Tools section of the support site**



The screenshot shows the Aruba Networks Support Center website. The top navigation bar includes links for HOME, DOWNLOAD SOFTWARE, TOOLS & RESOURCES (highlighted), DOCUMENTATION, and KNOWLEDGE. Below the navigation bar, the page title is "ARUBA SUPPORT CENTER" and the sub-section is "TOOLS & RESOURCES".

The "Navigator" sidebar on the left lists various folders, with "RFPlayback" circled in red. The "Tools & Resources" main content area shows a "Root Collection" containing a folder named "RFPlayback". Below this, there is a table with columns for "Description" and "Remarks". The entry "Aruba\_RFPlayback\_6.2.0.0.exe" is circled in red, with a red arrow pointing to it from the "RFPlayback" folder.

Description	Remarks
Aruba_RFPlayback_6.2.0.0.exe	Playback spectrum analysis



**AIRHEADS**  
LAS VEGAS 2012

Questions?

▶ [community.arubanetworks.com](http://community.arubanetworks.com)

▶ [#airheadsconf](https://twitter.com/airheadsconf)



# AIRHEADS

## LAS VEGAS 2012

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