AIRHEADS
LAS VEGAS 2012

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Presented by
Ken Peredia
Aruba Networks
March 2012

RF TROUBLESHOOTING

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Back to Basics

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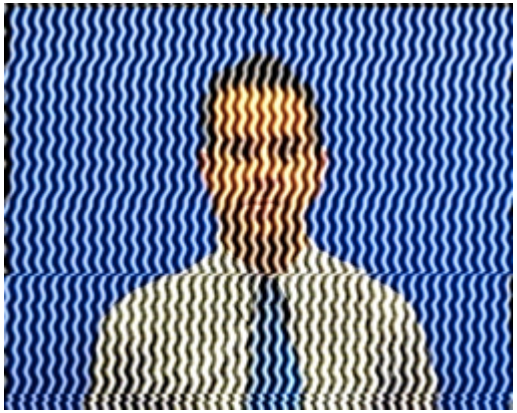
Essential Elements of Healthy RF

Signal Strength

Client NIC

Good Noise Floor

Low Interference



Channel Utilization

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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

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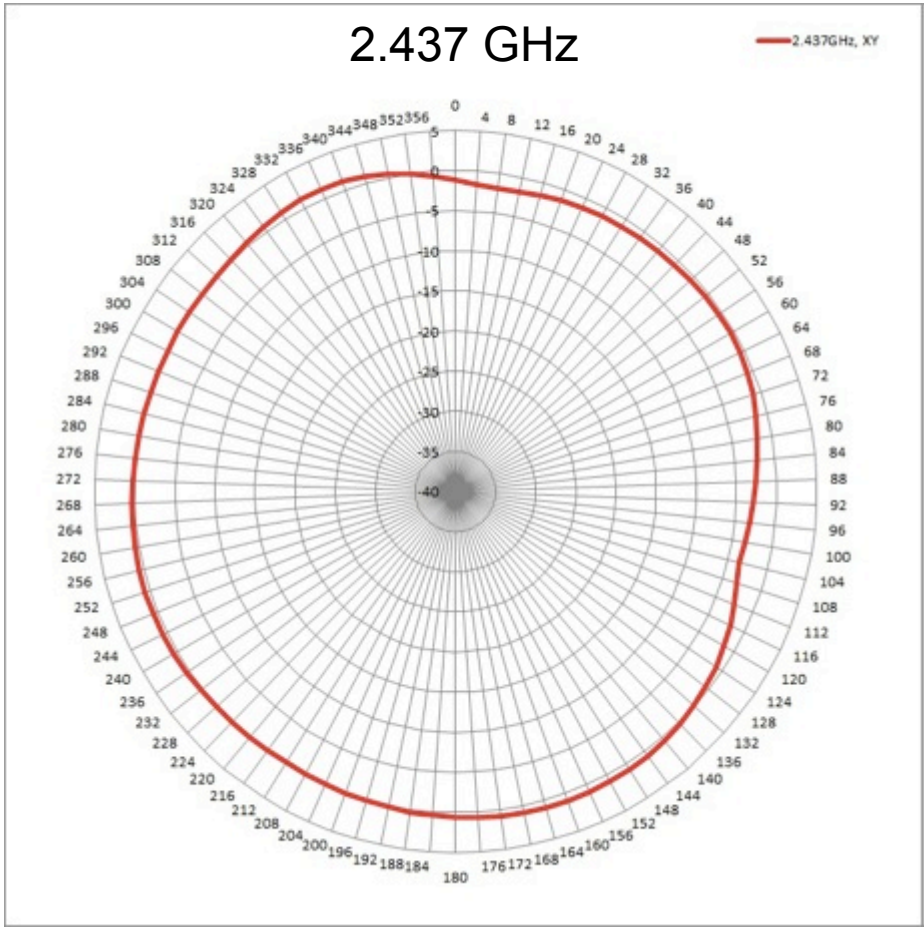
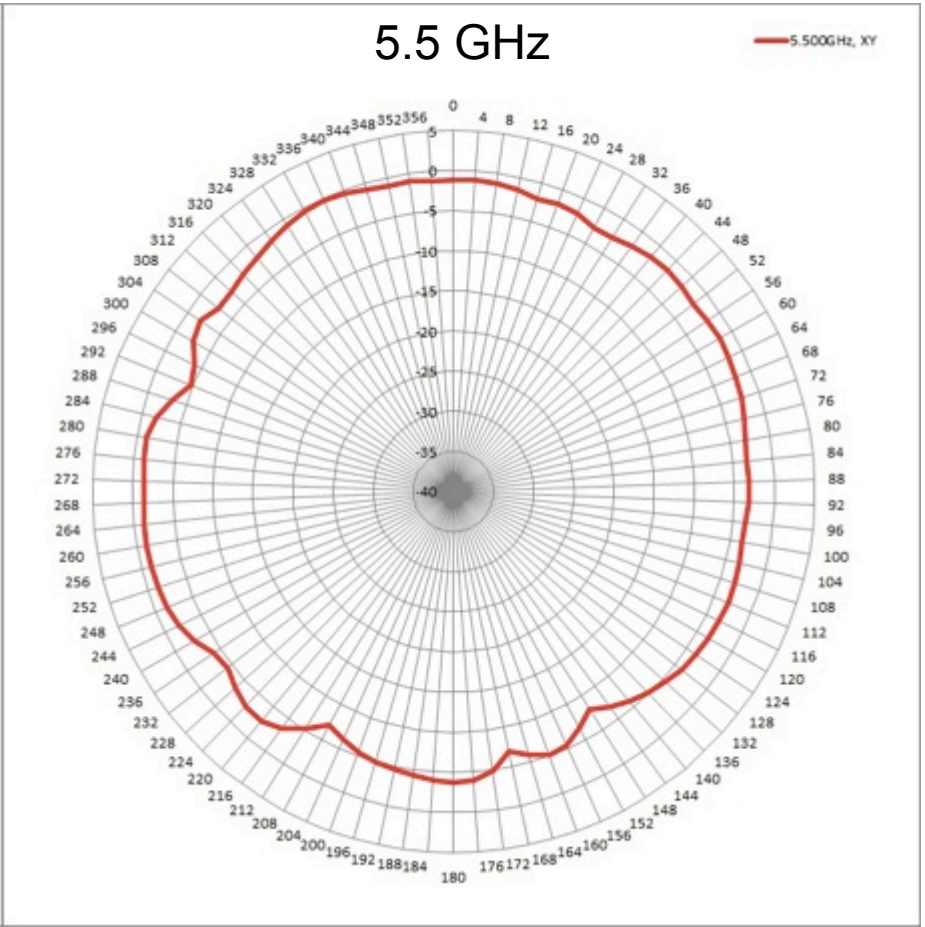
AP-93 Antenna Pattern, H-plane

2.437 GHz



5.5 GHz



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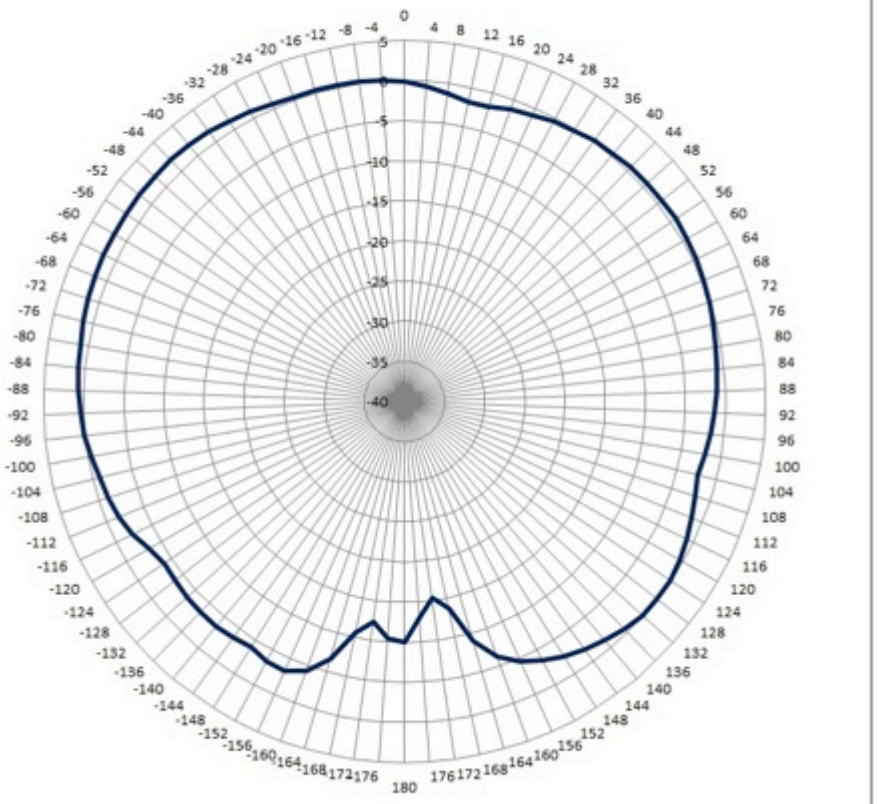
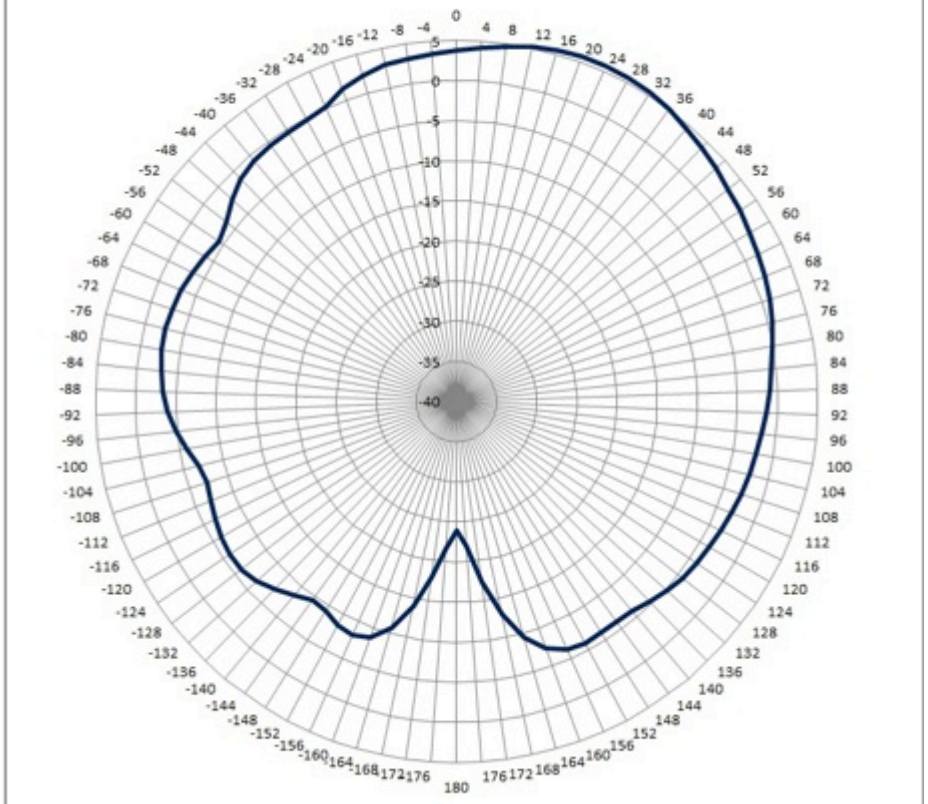
AP-93 Antenna Pattern, E-plane

2.437 GHz



5.5 GHz



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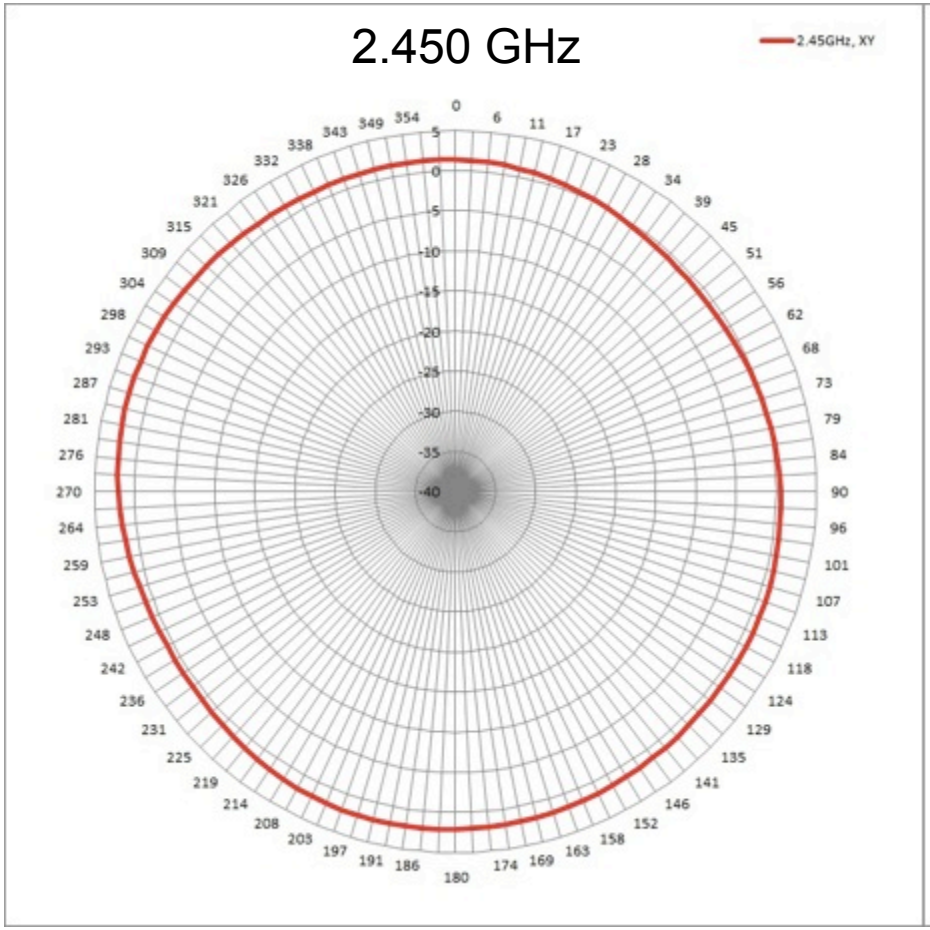
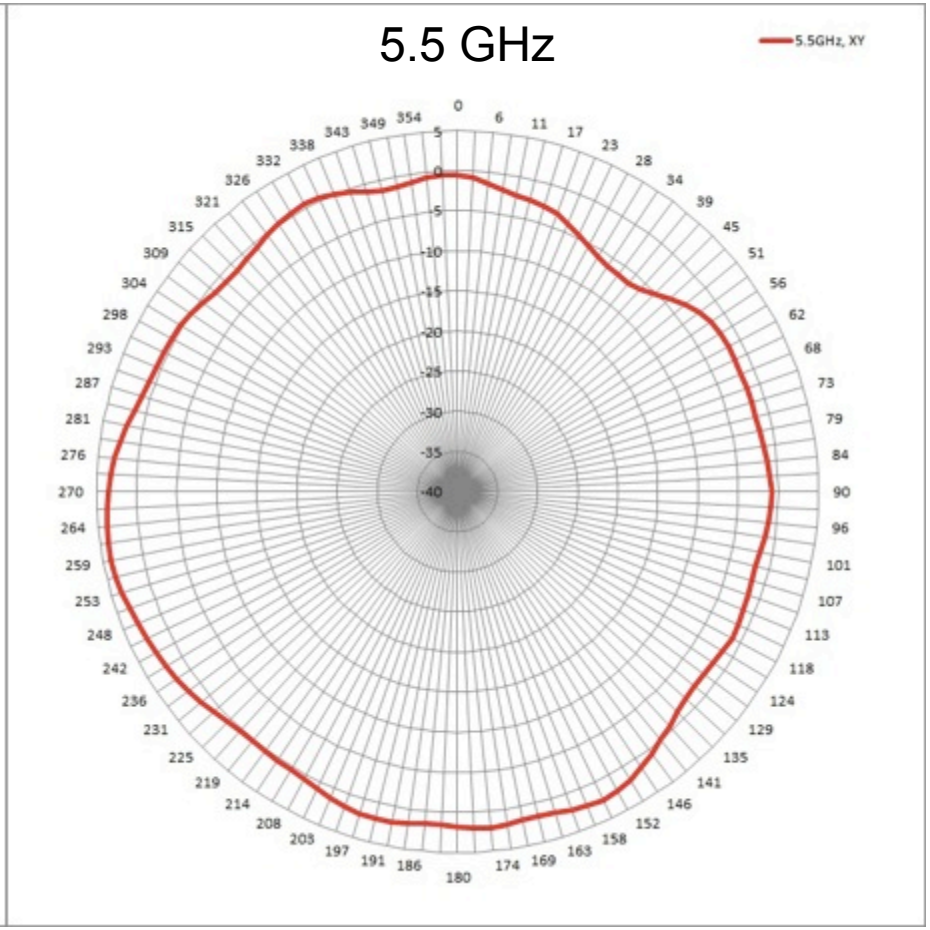
AP-105 Antenna Pattern, H-plane

2.450 GHz



5.5 GHz



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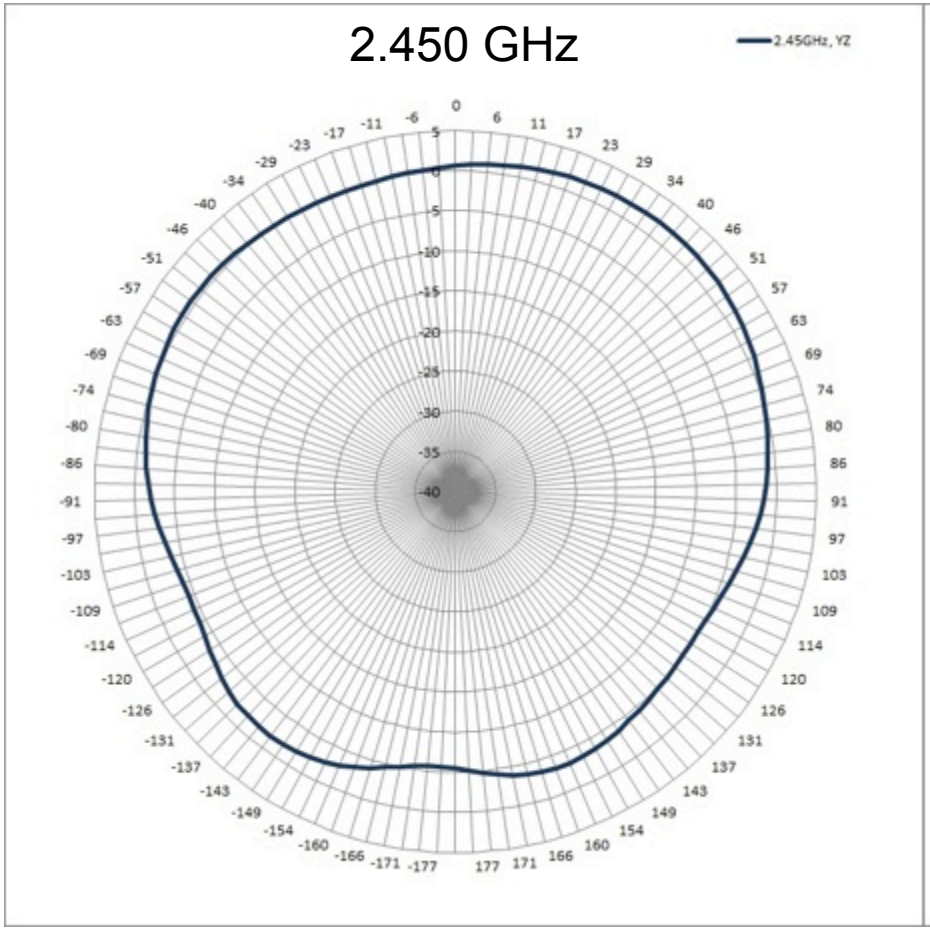
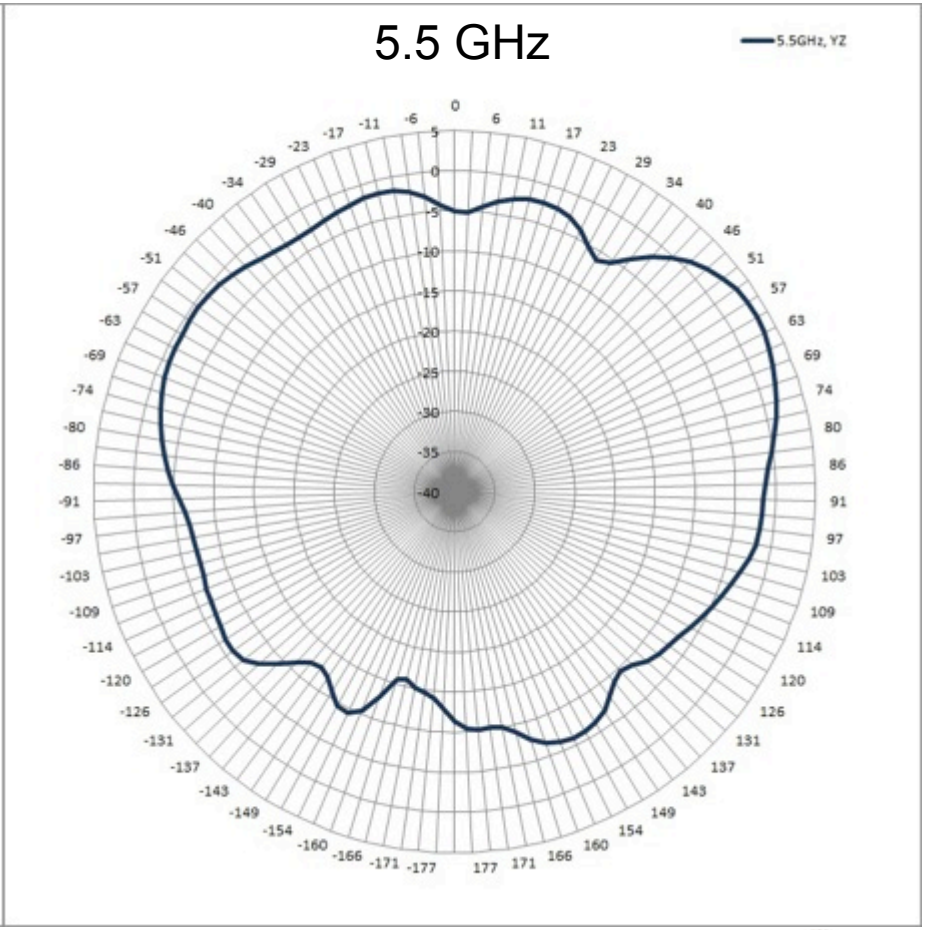
AP-105 Antenna Pattern, E-plane

2.450 GHz



5.5 GHz



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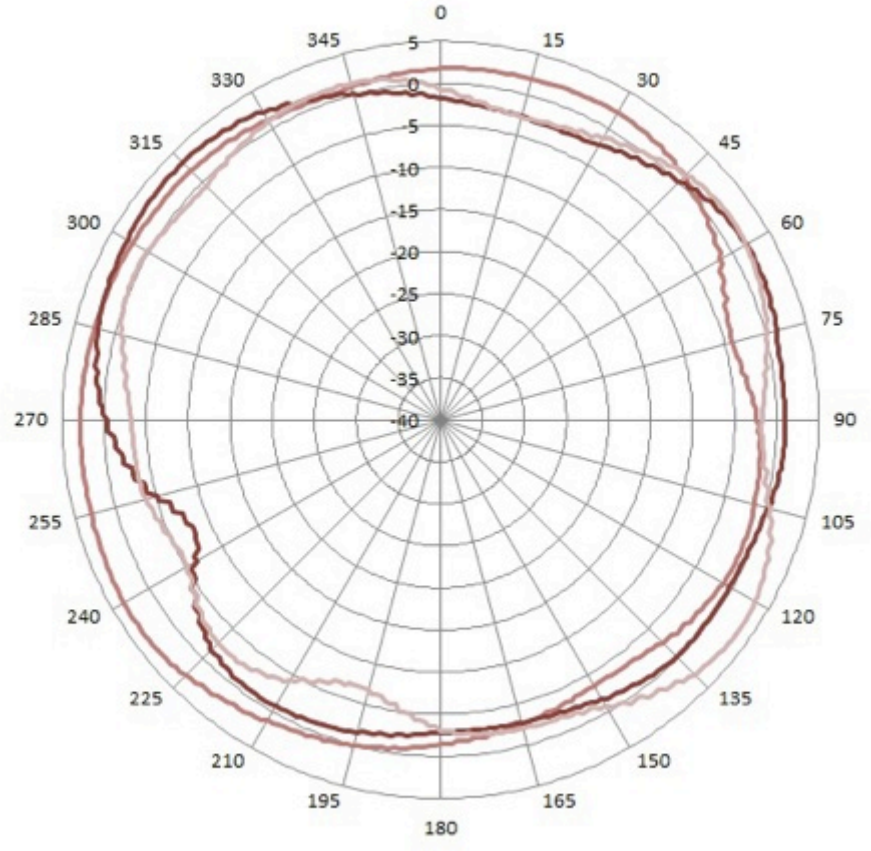
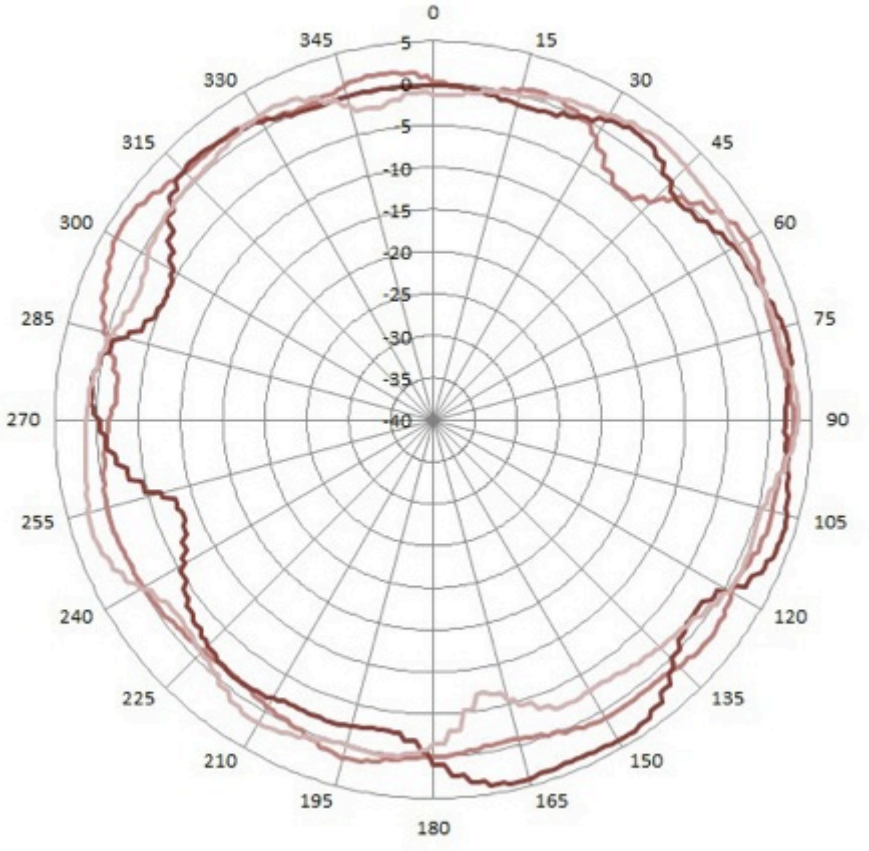
AP-135 Antenna Pattern, H-plane

2.450 GHz



5.5 GHz



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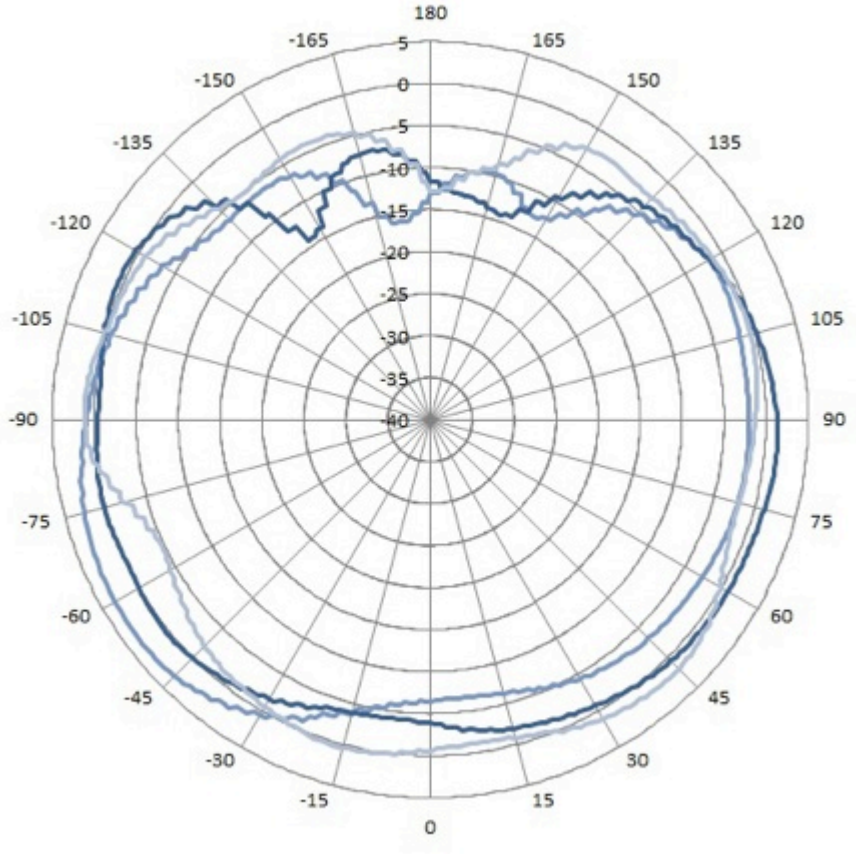
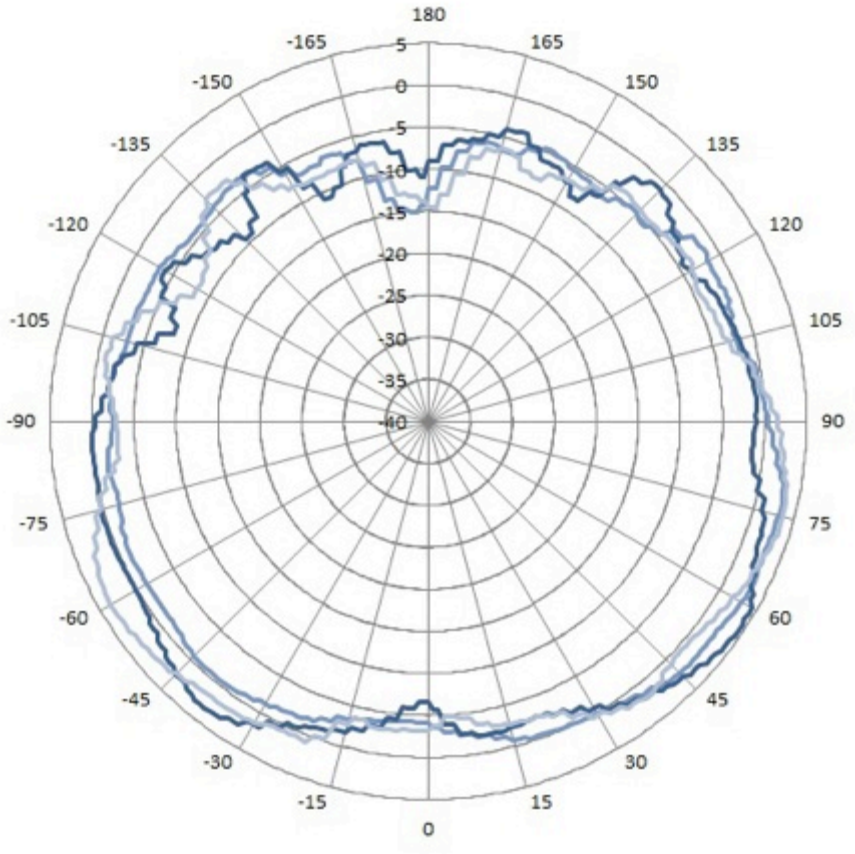
AP-135 Antenna Pattern, E-plane

2.450 GHz



5.5 GHz



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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)

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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)

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Attenuation of Common Building Material

Material	2.4GHz	5.0GHz
Brick 3.5"	6 dB	10 dB
Bullet-Proof Glass 1"	10 dB	20 dB
Concrete Wall 18"	18 dB	30 dB
Concrete Wall 8"	10 dB	13 dB
Cubical Wall (Fabric) 2.25"	1 dB	2 dB
Exterior Double Pane Coated Glass 1"	13 dB	20 dB
Fabric, blinds, ceiling tiles	~1 dB	~1.5 dB
Glass/Window (not tinted)	2-3 dB	6-8 dB
Hollow Wood Door 1.75	4 dB	7 dB
Interior drywall	3-4 dB	3-5 dB

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Attenuation of Common Building Material

Material	2.4GHz	5.0GHz
Interior Office Door w/Window 1.75"/0.5"	4 dB	6 dB
Interior Office Window 1"	3 dB	6 dB
Interior Solid Wall 5"	14 dB	16 dB
Marble 2"	6 dB	10 dB
Safety Glass-Wire 0.25"	3 dB	2 dB
Safety Glass-Wire 1.0"	13 dB	18 dB
Solid Wood Door 1.75"	6 dB	10 dB
Steel Fire/Exit Door 1.75"	13 dB	25 dB
Steel Fire/Exit Door 2.5"	19 dB	32 dB
Steel Rollup Door 1.5"	11 dB	19 dB

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Noise, Interference, and SNR

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Noise & Interference

…. Signals are corrupted so they don't make sense to the receiver …

- **Noise**
  - **Random** 'background' that has got mixed up with your signal. Usually doesn't vary too much over time.
- **Interference**
  - **Additional** signals are added to the one you want. Can be intermittent or persistent.

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Source of Interference

802.11 Source	Non 802.11 Source
• Your own APs (over-designed) • Somebody else's APs (neighbor) • Municipal Wi-Fi Network • iPhone Personal Hotspots • Clients connected to other's APs • Faulty Clients	• Blue-tooth (headset, keyboards, mouse, modem) • Microwave Oven • Cordless phones, mouse • Very strong out-of-band source (GSM tower) • Baby monitor • WiMax (2.5GHz) • ZigBee (802.15.4) • Video or security cameras • Faulty anything

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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 -90 dB

SNR = -65 – (-90) = 25

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

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Why SNR is Important

SNR determines the ability of wireless devices to demodulate data rates

AP-104 AND AP-105 RF PERFORMANCE TABLE							
	Subcarrier Modulation	Max tX Power per Active tX chain	rX sensitivity (dbm)	SNR (NF 100)	Max tX Power per Active tX chain	rX sensitivity (dbm)	SNR (NF 100)
		2.4 GHz			5 GHz		
802.11b							
1 Mbps	BPSK	20	-96	4			
2 Mbps	QPSK	20	-96	4			
5.5 Mbps	CCK	20	-94	6			
11 Mbps	CCK	20	-93	7			
802.11a/g							
6 Mbps	BPSK	20	-96	4	20	-96	4
9 Mbps	BPSK	20	-96	4	20	-96	4
12 Mbps	QPSK	20	-96	4	20	-96	4
18 Mbps	QPSK	20	-95	5	20	-95	5
24 Mbps	16-QAM	20	-92	8	20	-91	9
36 Mbps	16-QAM	19	-89	11	19	-88	12
48 Mbps	64-QAM	18	-85	15	18	-84	16
54 Mbps	64-QAM	17	-83	17	17	-83	17

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Why SNR is Important

AP-104 AND AP-105 RF PERFORMANCE TABLE							
	Subcarrier Modulation	Max tX Power per Active tX chain	rX sensitivity (dbm)	SNR (NF 100)	Max tX Power per Active tX chain	rX sensitivity (dbm)	SNR (NF 100)
		2.4 GHz			5 GHz		
802.11n HT20							
MCS0	BPSK	20	-96	4	20	-96	4
MCS1	QPSK	20	-95	5	20	-94	6
MCS2	QPSK	20	-93	7	20	-92	8
MCS3	16-QAM	20	-90	10	20	-89	11
MCS4	16-QAM	19	-87	13	19	-86	14
MCS5	64-QAM	18	-82	18	18	-82	18
MCS6	64-QAM	17	-81	19	17	-80	20
MCS7	64-QAM	15	-80	20	15	-79	21
MCS8	BPSK	20	-95	5	20	-95	5
MCS9	QPSK	20	-93	7	20	-92	8
MCS10	QPSK	20	-91	9	20	-90	10
MCS11	16-QAM	20	-87	13	20	-87	13
MCS12	16-QAM	19	-84	16	19	-84	16
MCS13	64-QAM	18	-81	19	18	-80	20
MCS14	64-QAM	17	-80	20	17	-78	22
MCS15	64-QAM	15	-77	23	15	-77	23

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Why SNR is Important

AP-104 AND AP-105 RF PERFORMANCE TABLE							
	Subcarrier Modulation	Max tX Power per Active tX chain	rX sensitivity (dbm)	SNR (NF 100)	Max tX Power per Active tX chain	rX sensitivity (dbm)	SNR (NF 100)
		2.4 GHz			5 GHz		
802.11n HT40							
MCS0	BPSK	20	-93	7	20	-92	8
MCS1	QPSK	20	-93	7	20	-92	8
MCS2	QPSK	20	-90	10	20	-89	11
MCS3	16-QAM	20	-86	14	20	-86	14
MCS4	16-QAM	19	-83	17	19	-83	17
MCS5	64-QAM	18	-79	21	18	-80	20
MCS6	64-QAM	17	-77	23	17	-77	23
MCS7	64-QAM	15	-76	24	15	-76	24
MCS8	BPSK	20	-92	8	20	-92	8
MCS9	QPSK	20	-89	11	20	-90	10
MCS10	QPSK	20	-87	13	20	-87	13
MCS11	16-QAM	20	-84	16	20	-84	16
MCS12	16-QAM	19	-82	18	19	-81	19
MCS13	64-QAM	18	-76	24	18	-77	23
MCS14	64-QAM	17	-76	11	17	-75	25
MCS15	64-QAM	15	-73	27	15	-73	27

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SNR and 11n

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 25 dB is necessary to demodulate higher 802.11n data rates

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Tools of the Trade

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WLAN Engineer Toolkit

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

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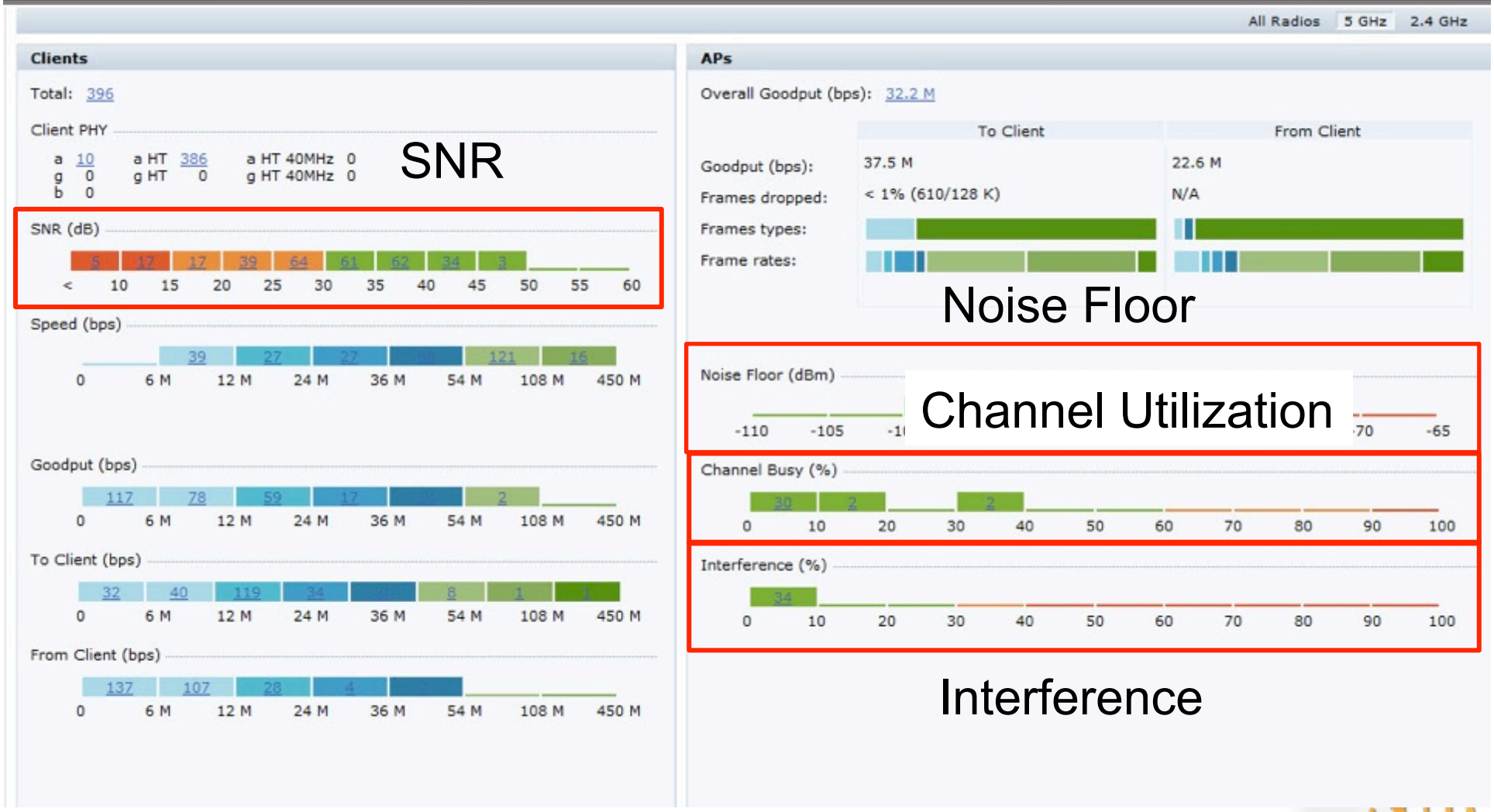
ArubaOS Dashboard - Performance



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AOS RF Dashboard – Usage

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AOS RF Dashboard – Security

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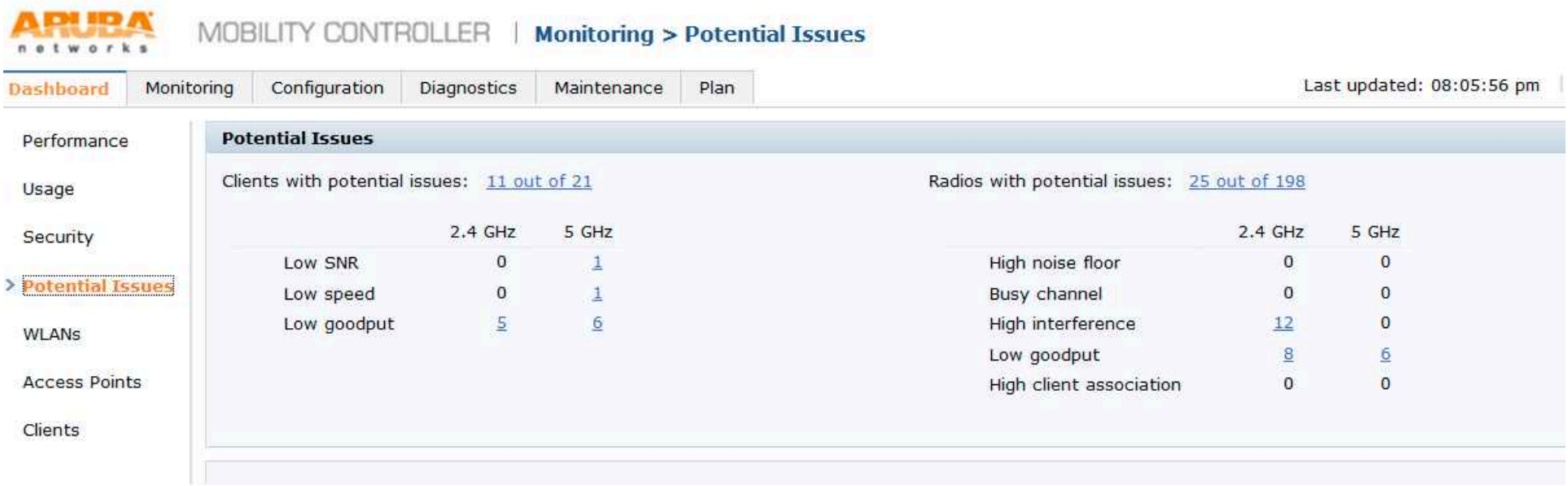
AOS RF Dashboard – Potential Issues



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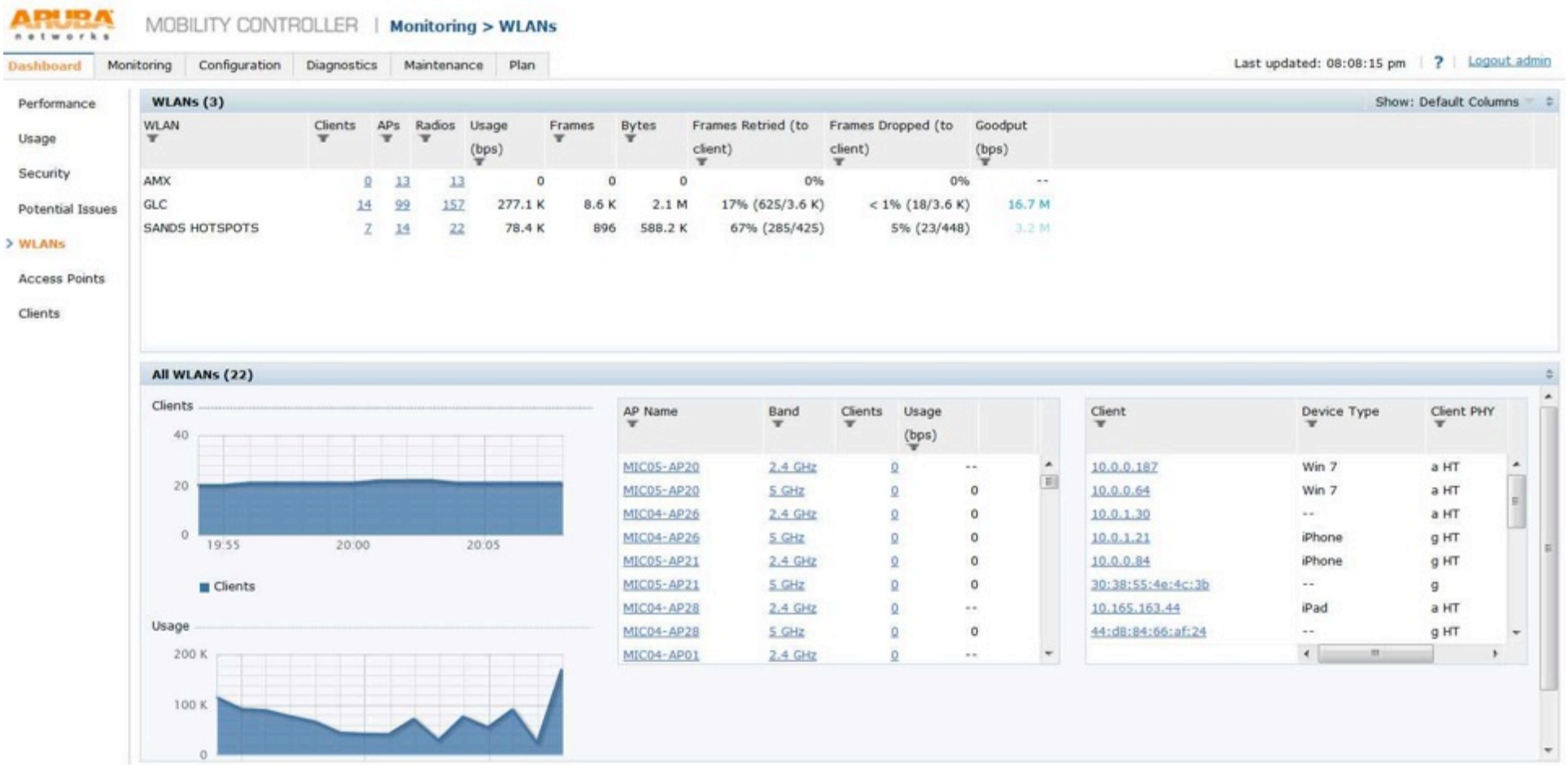
AOS RF Dashboard – WLAN



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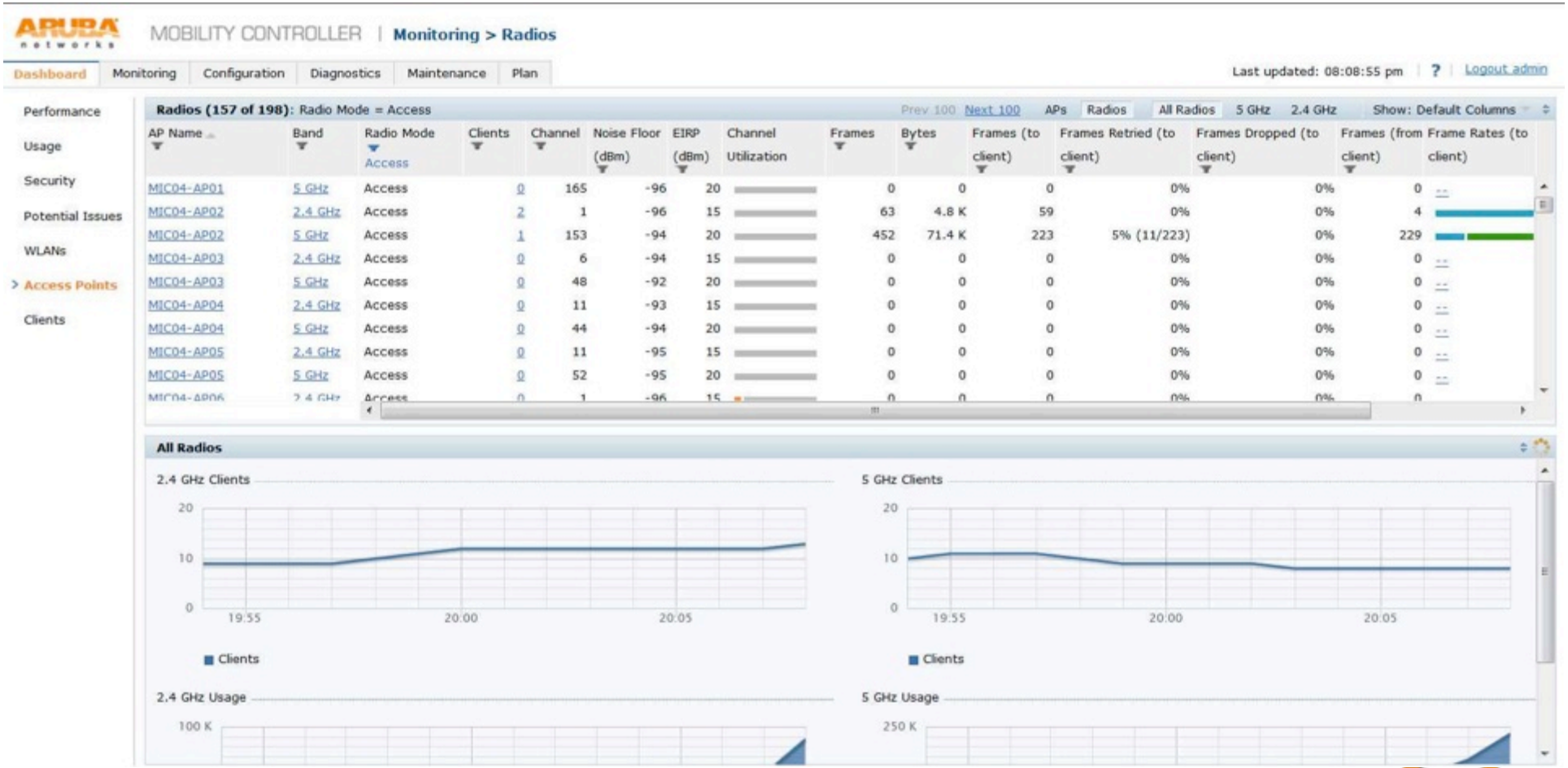
AOS RF Dashboard – Access Points



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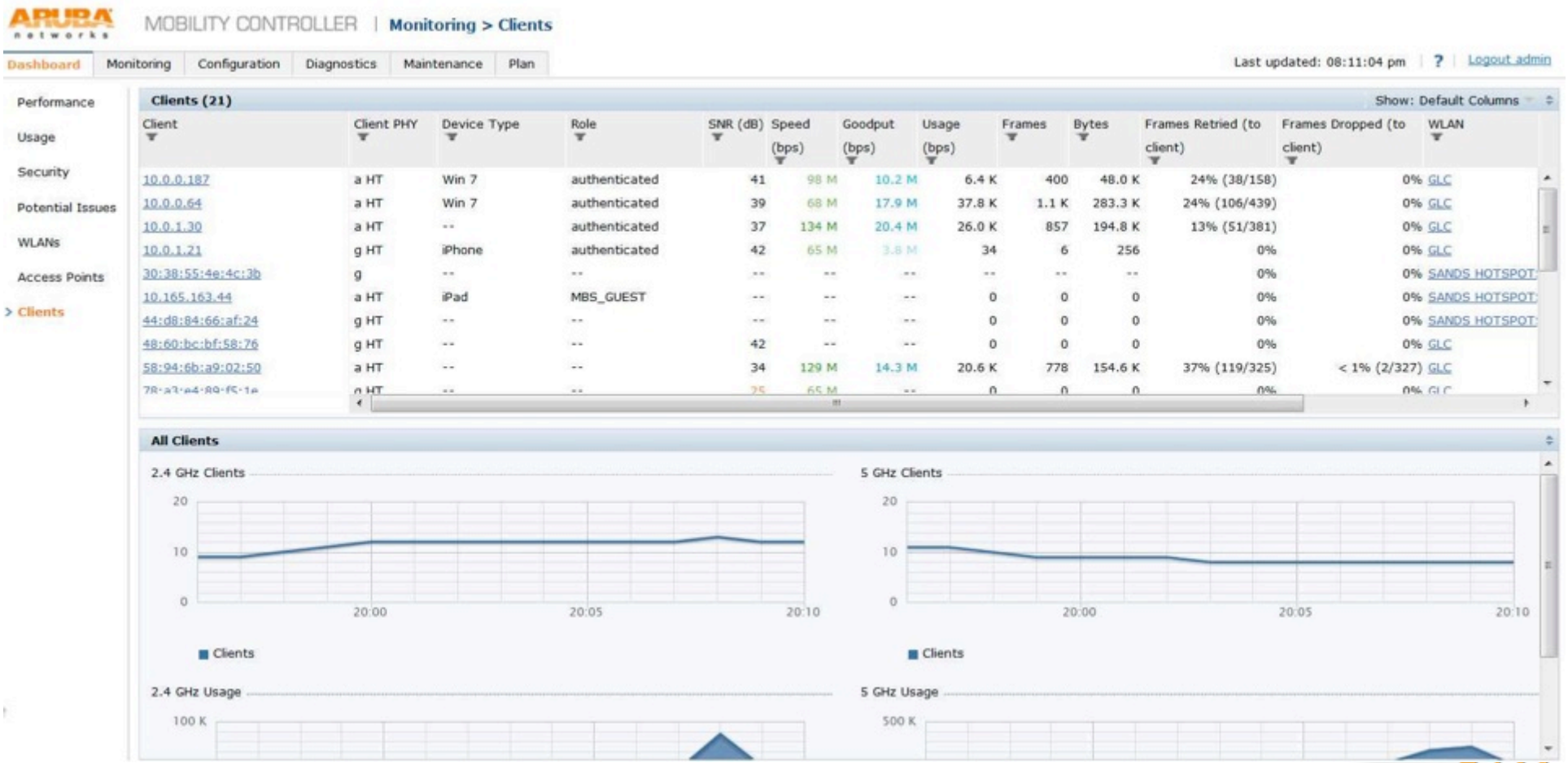
AOS RF Dashboard – Clients



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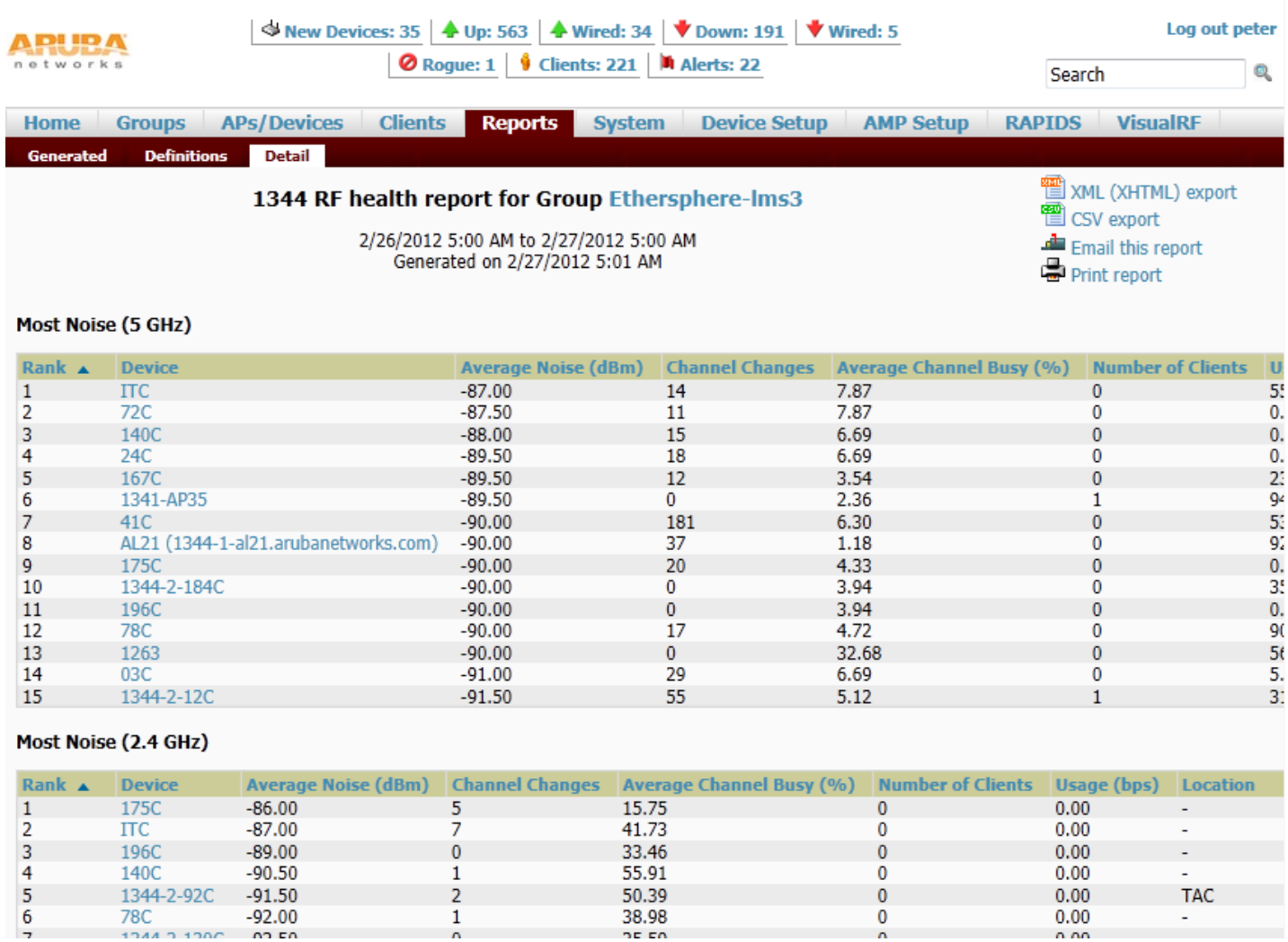
RF Health report



New Devices: 35 | Up: 563 | Wired: 34 | Down: 191 | Wired: 5
Rogue: 1 | Clients: 221 | Alerts: 22
Log out peter
Search

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

Generated | Definitions | Detail

1344 RF health report for Group Ethersphere-lms3

2/26/2012 5:00 AM to 2/27/2012 5:00 AM
Generated on 2/27/2012 5:01 AM

XML (XHTML) export
CSV export
Email this report
Print report

Most Noise (5 GHz)

Rank ▲	Device	Average Noise (dBm)	Channel Changes	Average Channel Busy (%)	Number of Clients	U
1	ITC	-87.00	14	7.87	0	5
2	72C	-87.50	11	7.87	0	0.
3	140C	-88.00	15	6.69	0	0.
4	24C	-89.50	18	6.69	0	0.
5	167C	-89.50	12	3.54	0	2
6	1341-AP35	-89.50	0	2.36	1	9
7	41C	-90.00	181	6.30	0	5
8	AL21 (1344-1-al21.arubanetworks.com)	-90.00	37	1.18	0	9
9	175C	-90.00	20	4.33	0	0.
10	1344-2-184C	-90.00	0	3.94	0	3
11	196C	-90.00	0	3.94	0	0.
12	78C	-90.00	17	4.72	0	9
13	1263	-90.00	0	32.68	0	5
14	03C	-91.00	29	6.69	0	5.
15	1344-2-12C	-91.50	55	5.12	1	3

Most Noise (2.4 GHz)

Rank ▲	Device	Average Noise (dBm)	Channel Changes	Average Channel Busy (%)	Number of Clients	Usage (bps)	Location
1	175C	-86.00	5	15.75	0	0.00	-
2	ITC	-87.00	7	41.73	0	0.00	-
3	196C	-89.00	0	33.46	0	0.00	-
4	140C	-90.50	1	55.91	0	0.00	-
5	1344-2-92C	-91.50	2	50.39	0	0.00	TAC
6	78C	-92.00	1	38.98	0	0.00	-

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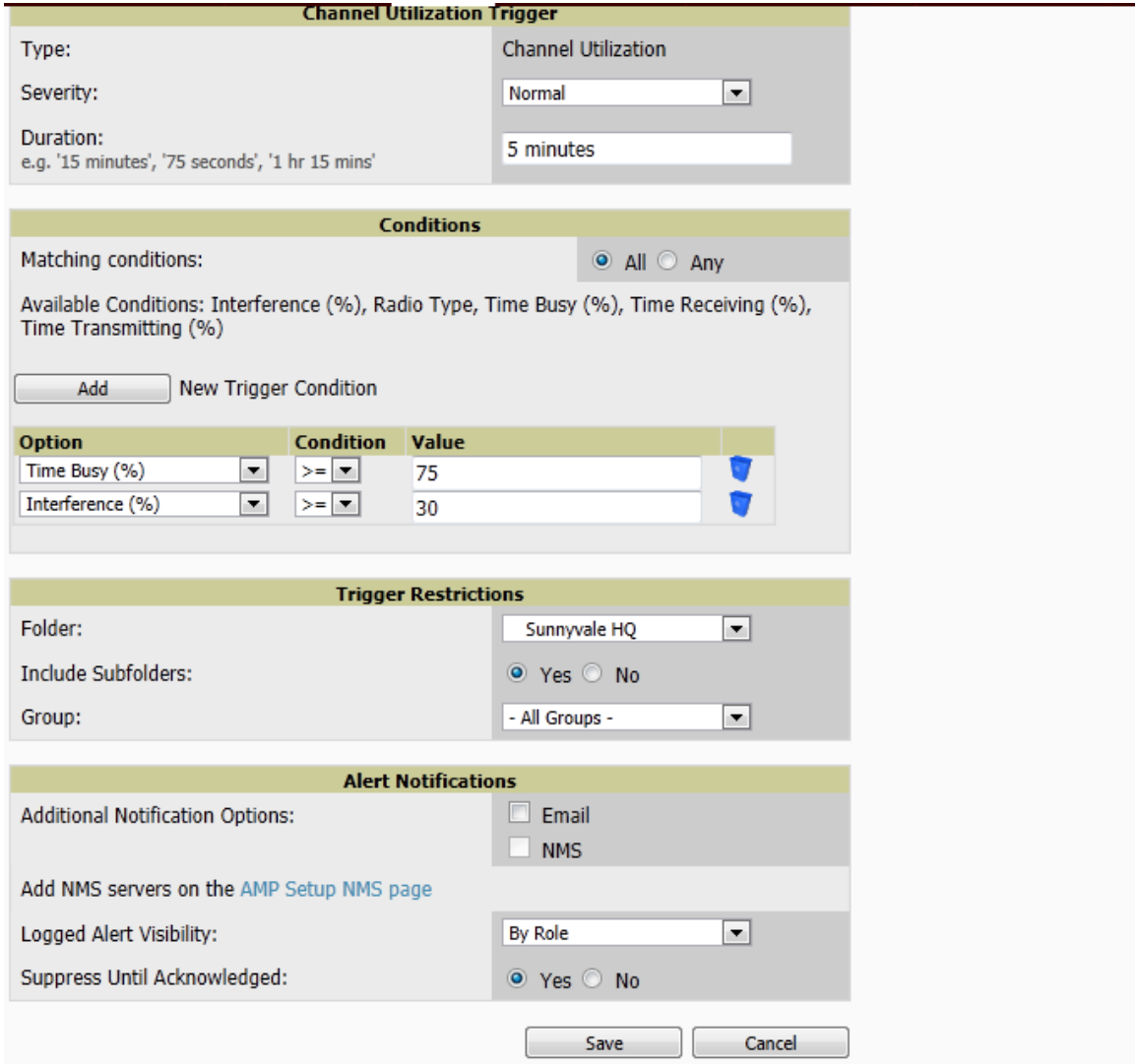
Channel utilization trigger



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AirWave – AP Monitoring

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				
IP Address:	10.6.66.71	Clients:	5	Usage:	19.06 Kbps		

Quick Links: Open controller web UI... | Run a command...

Notes:

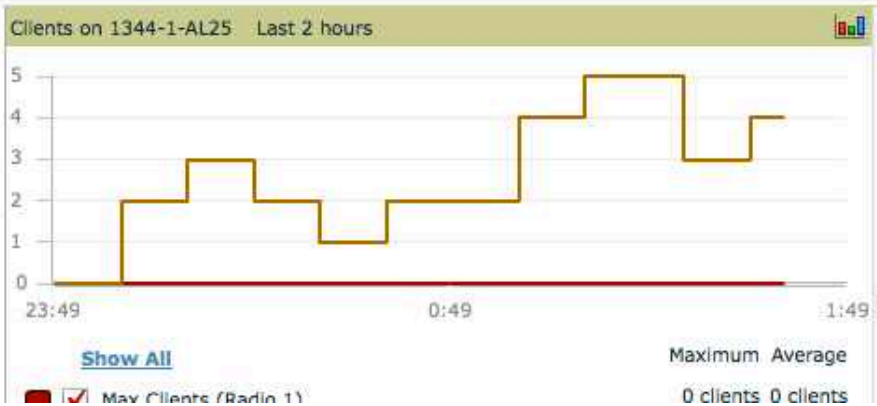
Radios

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



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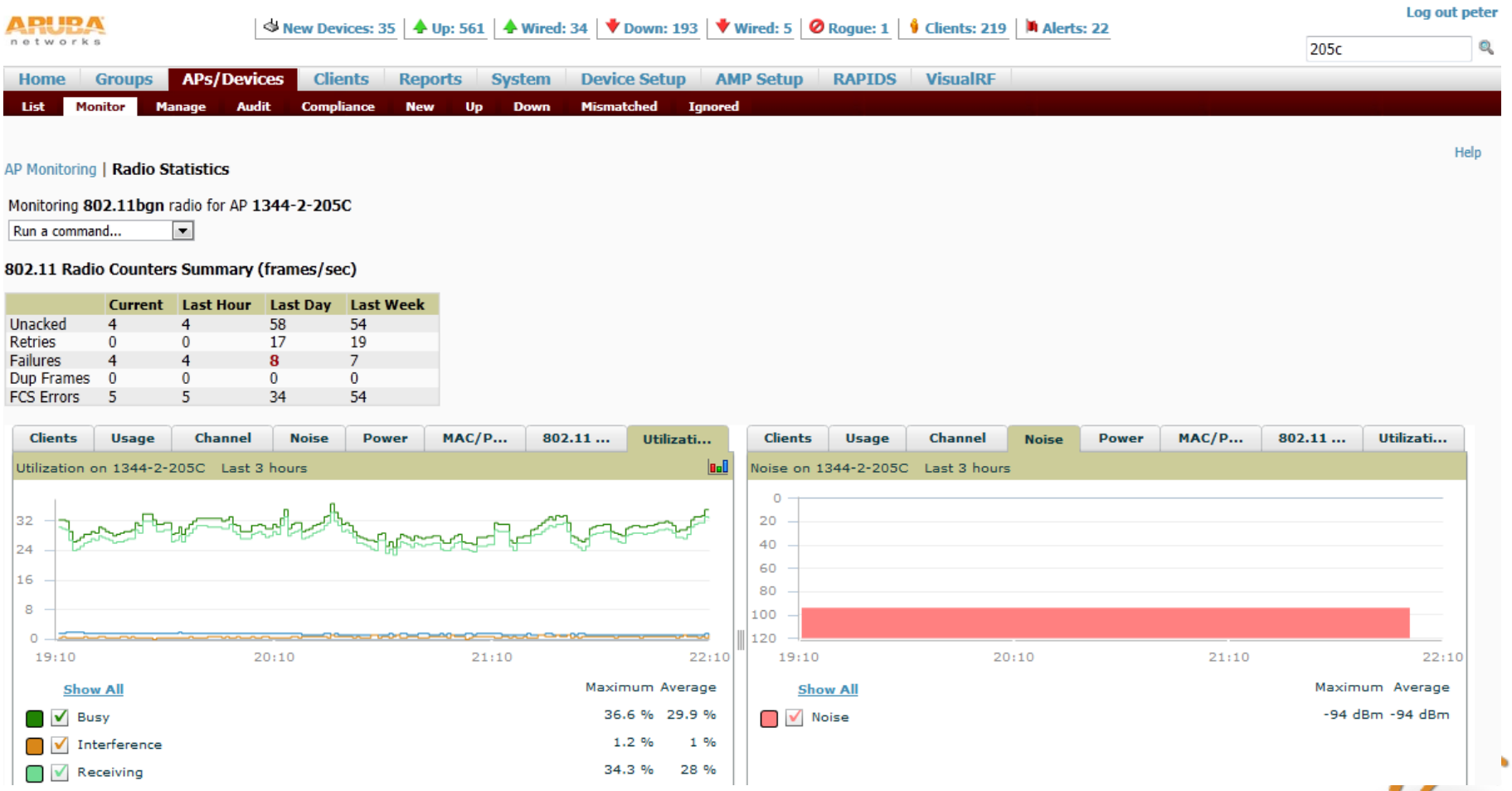
Radio Details



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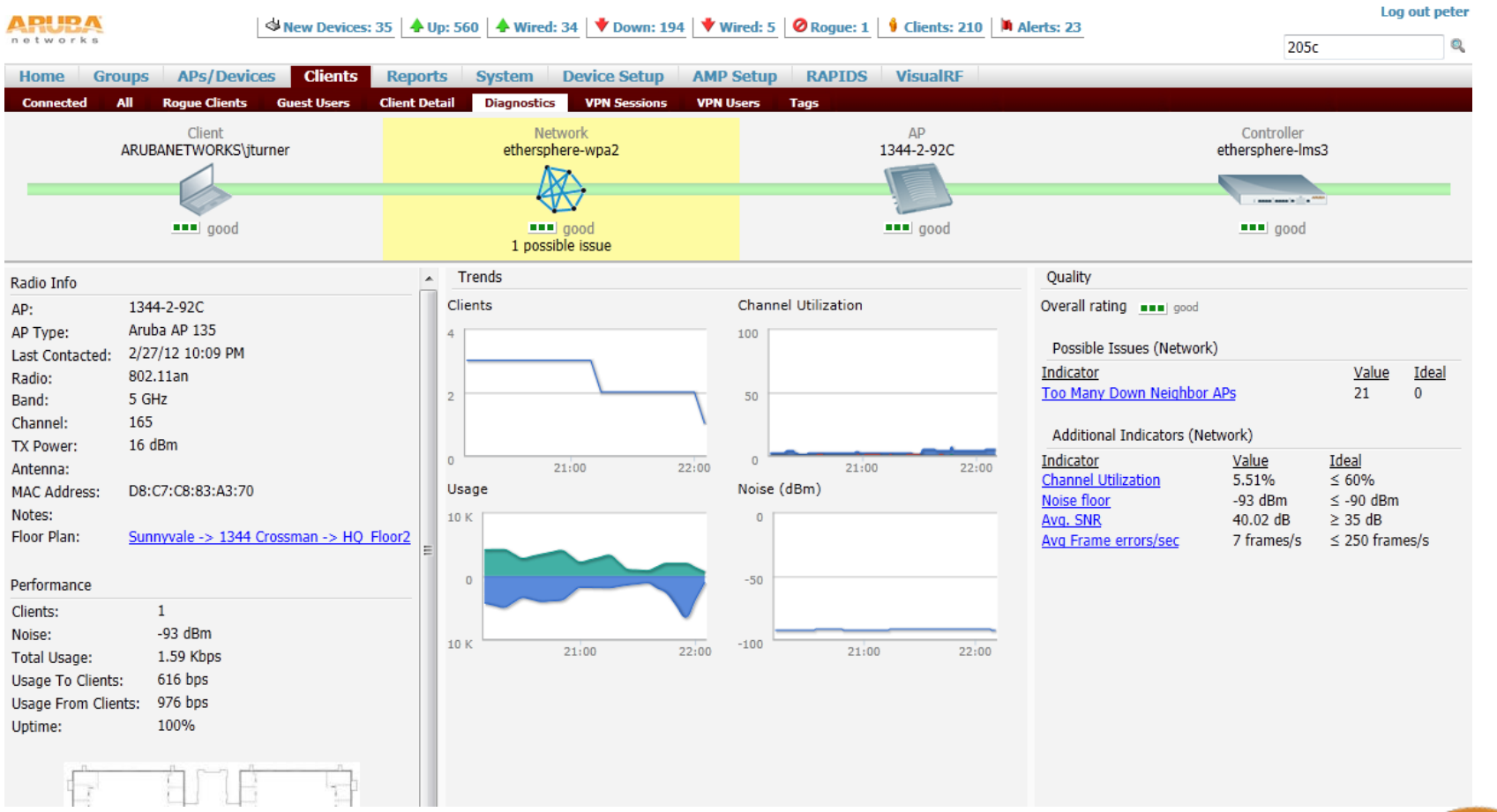
Client Diagnostics



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Spectrum Analysis

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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**

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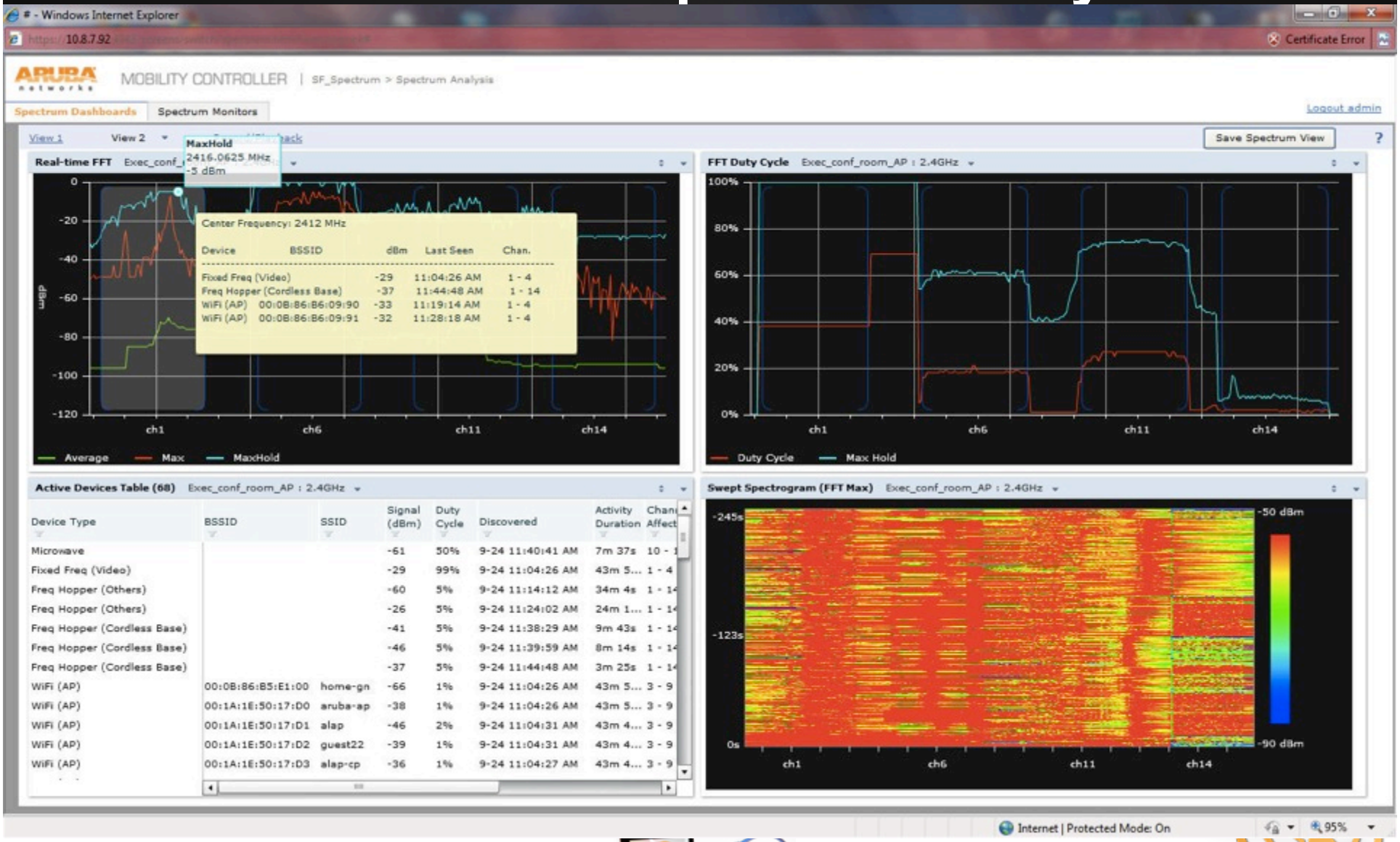
Wireless Tools – Spectrum Analysis



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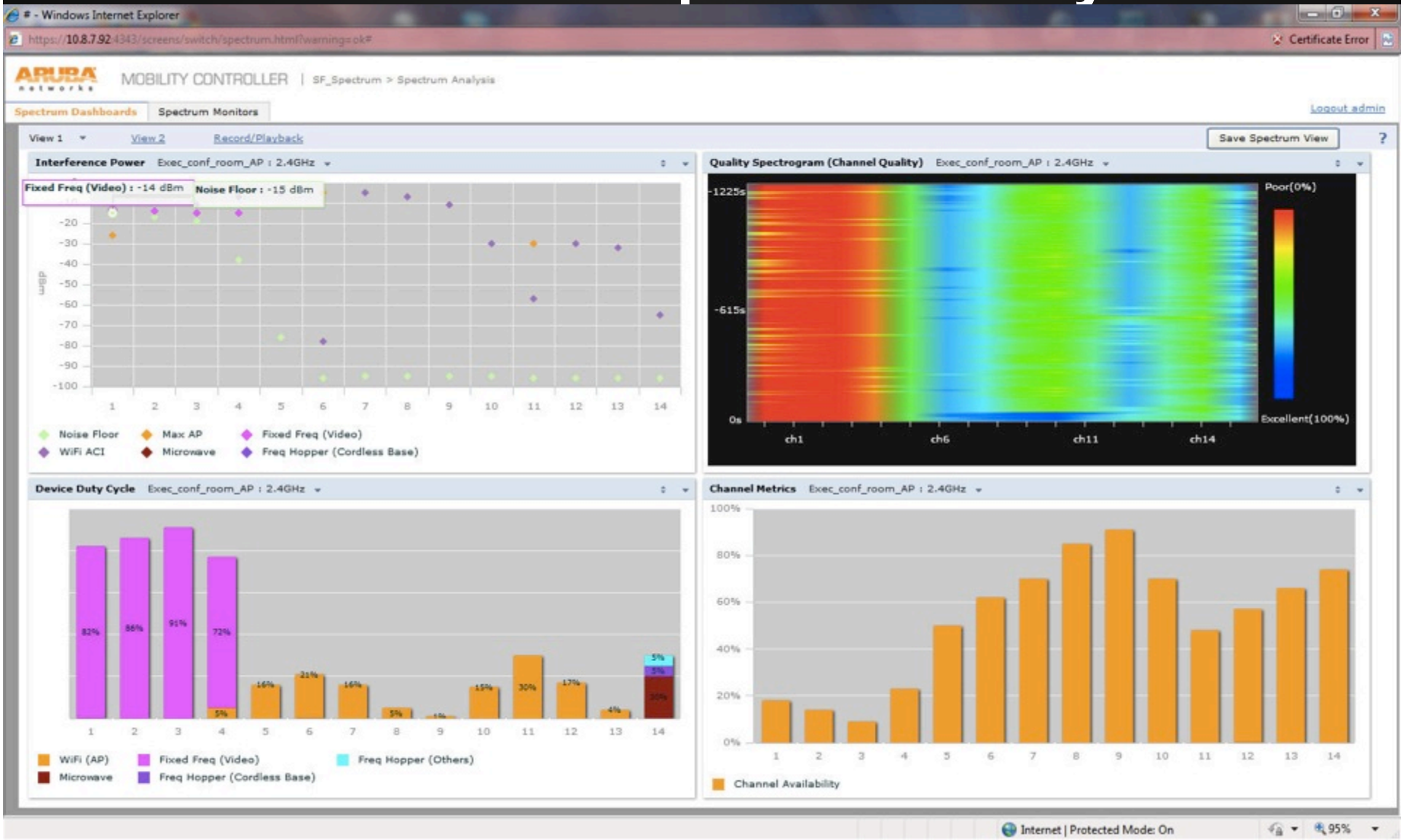
Wireless Tools – Spectrum Analysis



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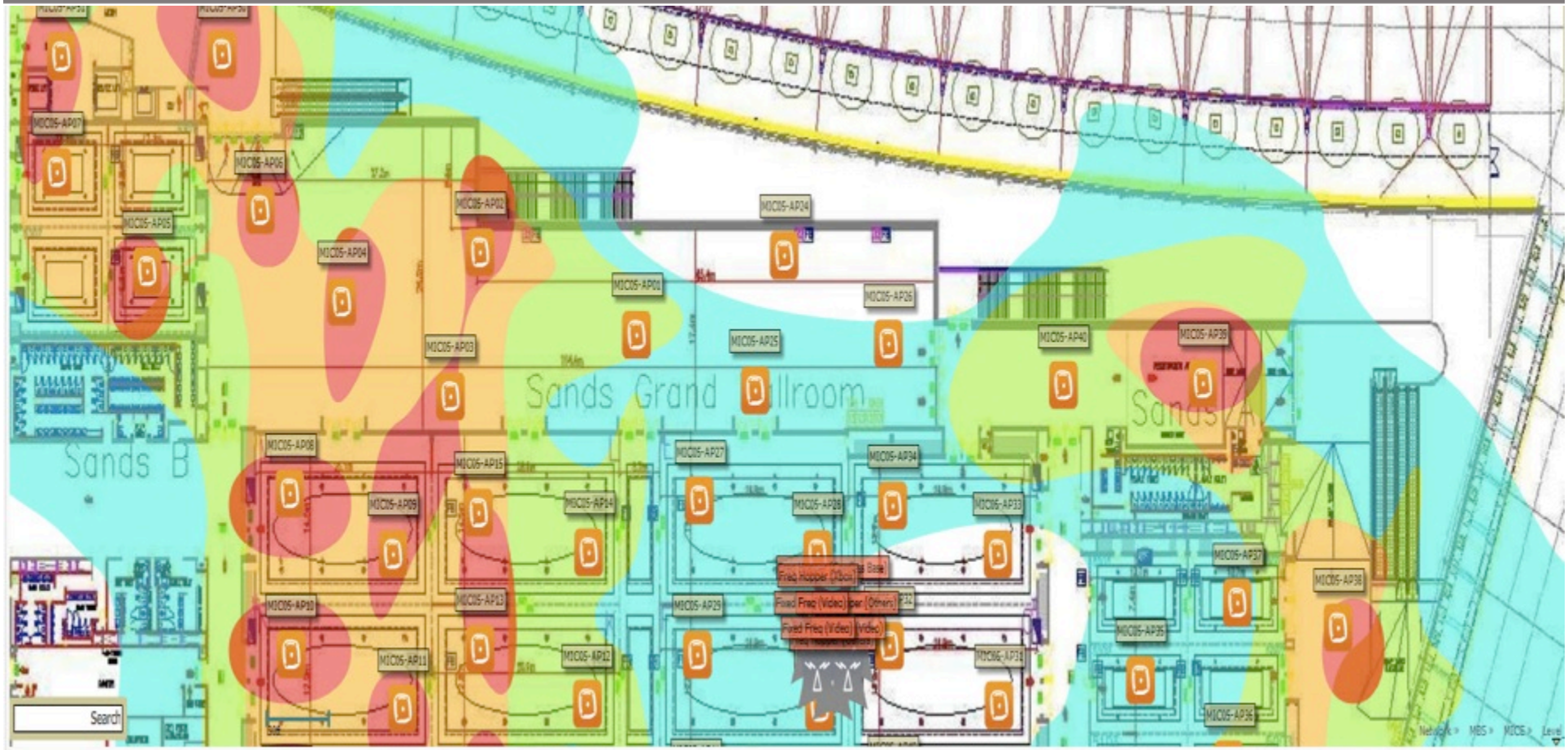
Wireless Tools – Visual RF



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Wi-Fi Heatmap & Site-Survey

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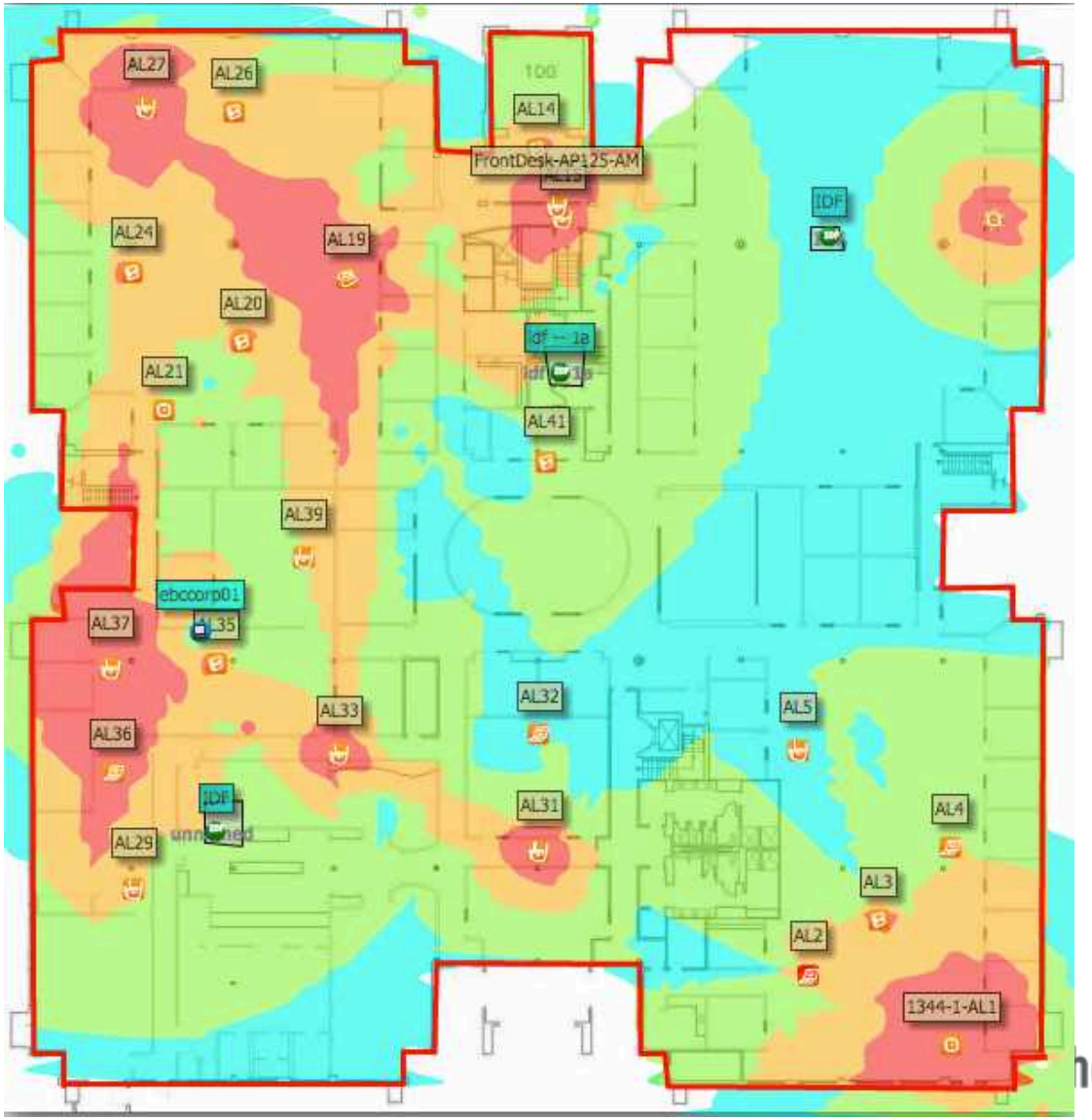
Heatmap (AirWave VisualRF)



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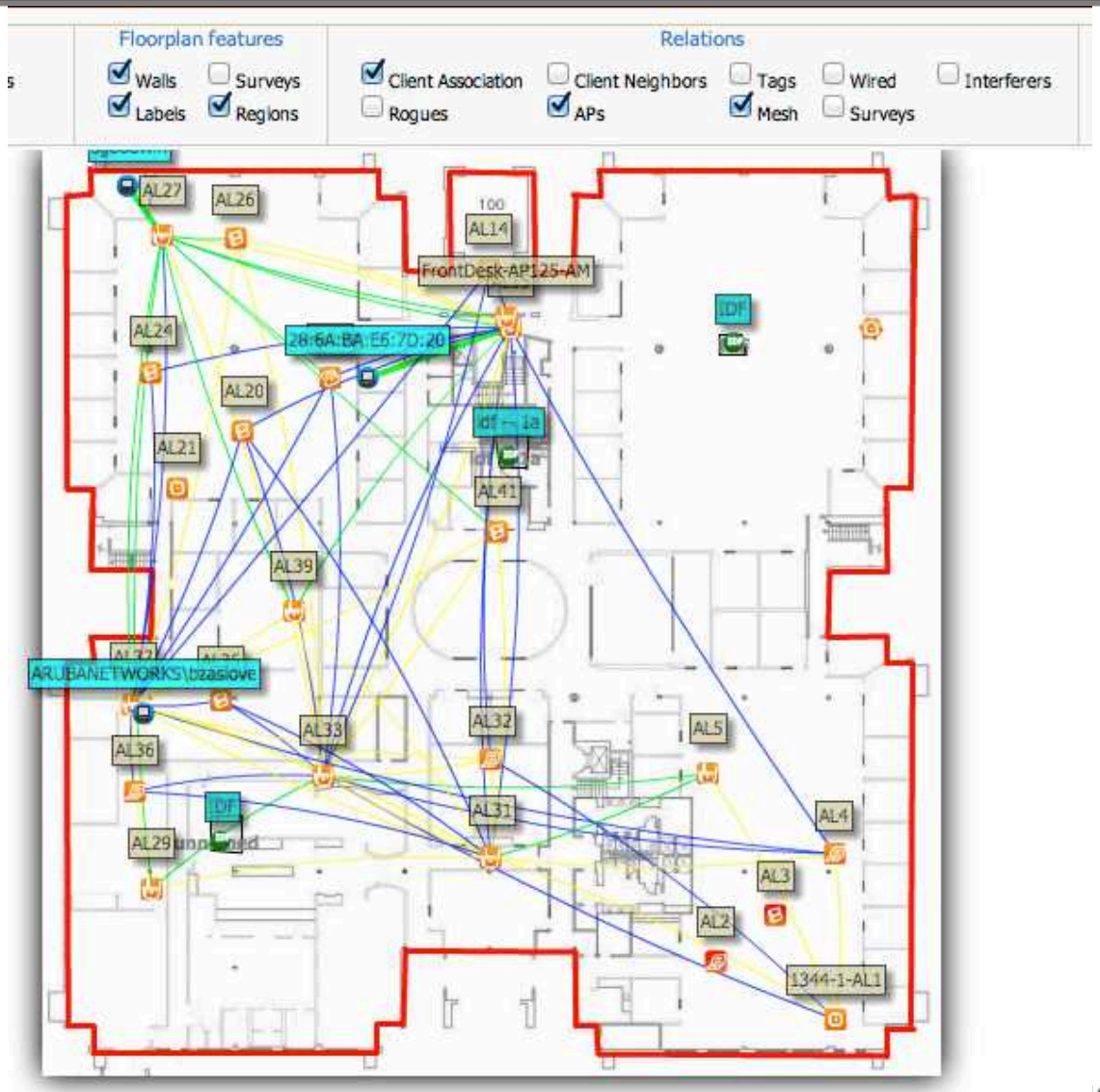
Airwave (Client Association)



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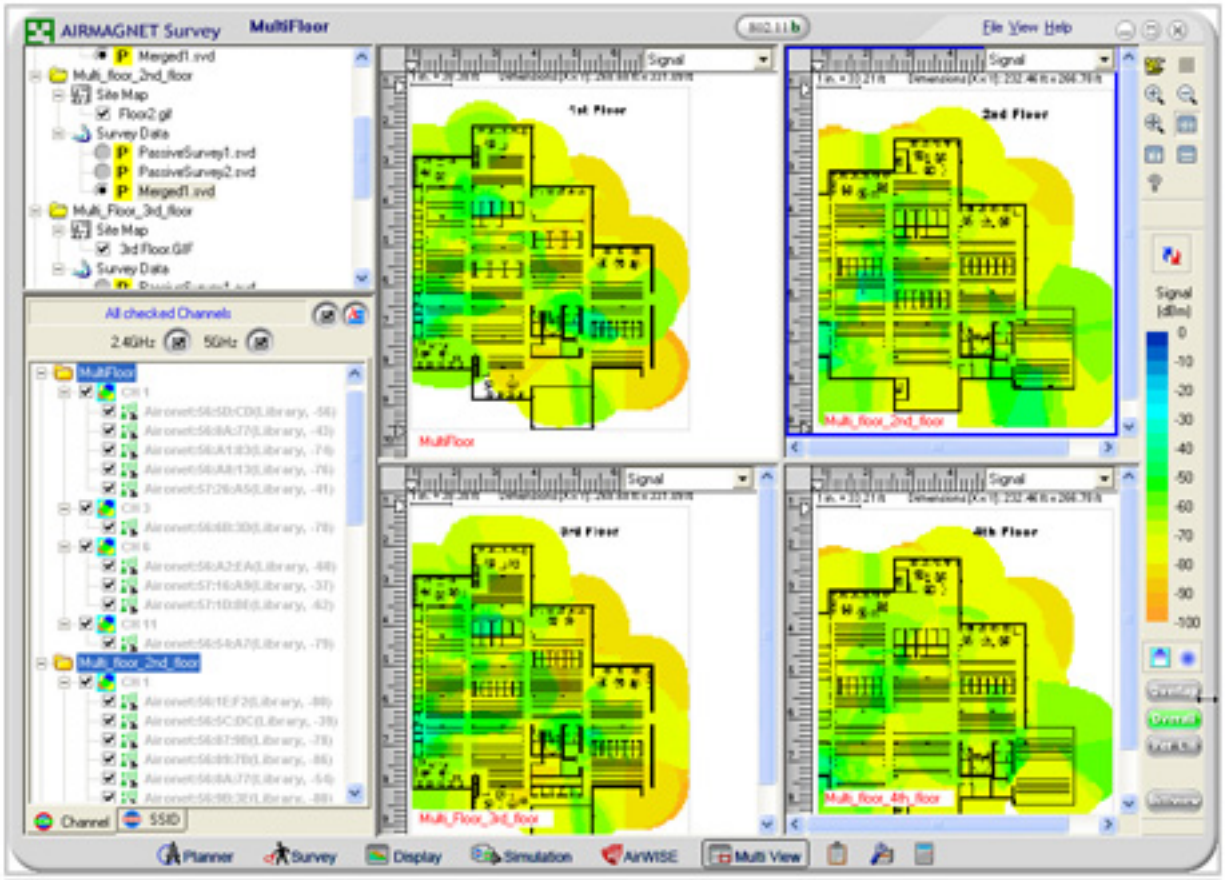
Site-Survey (AirMagnet Survey Pro)



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Takes two to Tango

Understanding the client NIC

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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 one spatial stream, 2 spatial streams, 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

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Win7 OS

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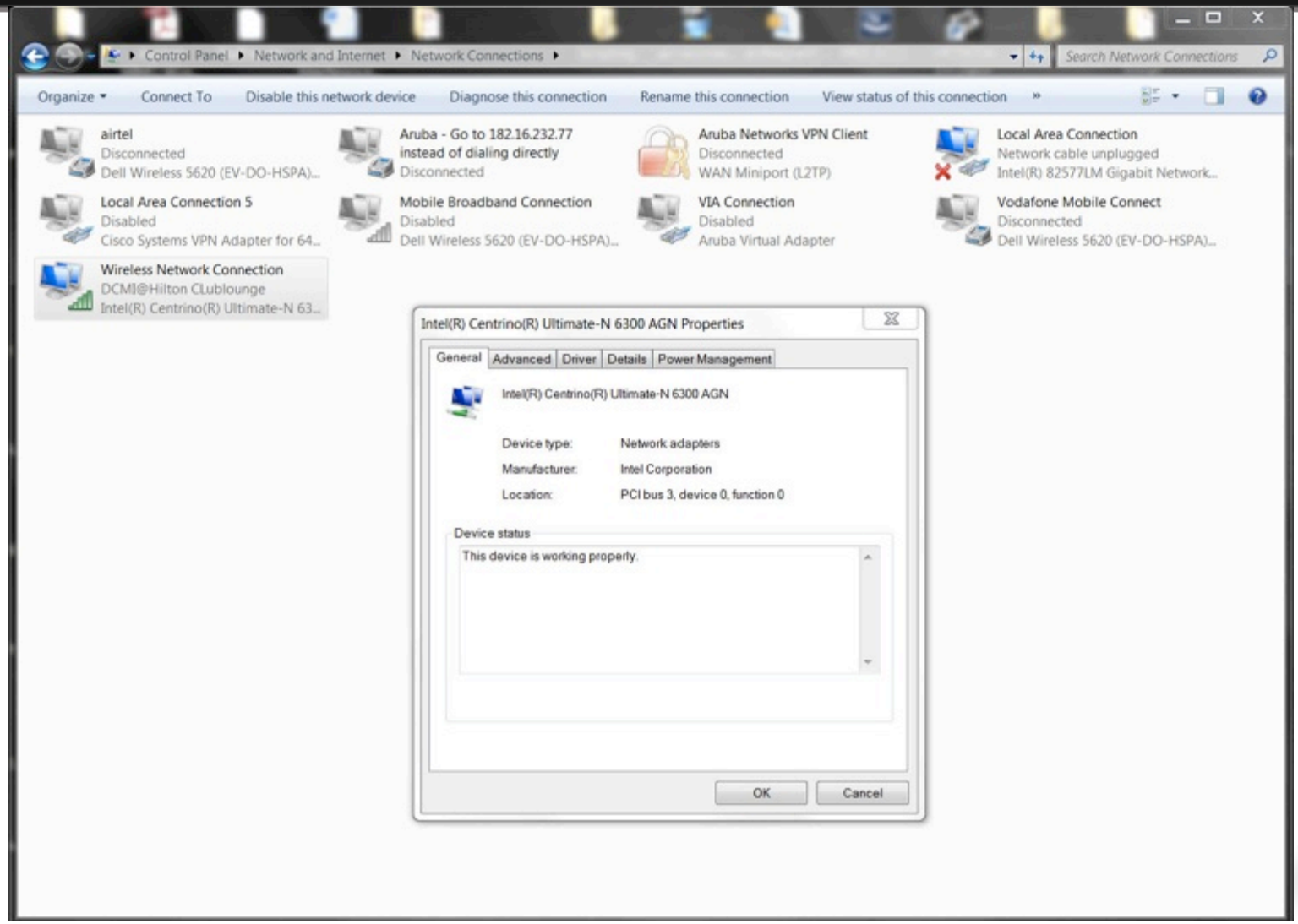
Wireless NIC Details



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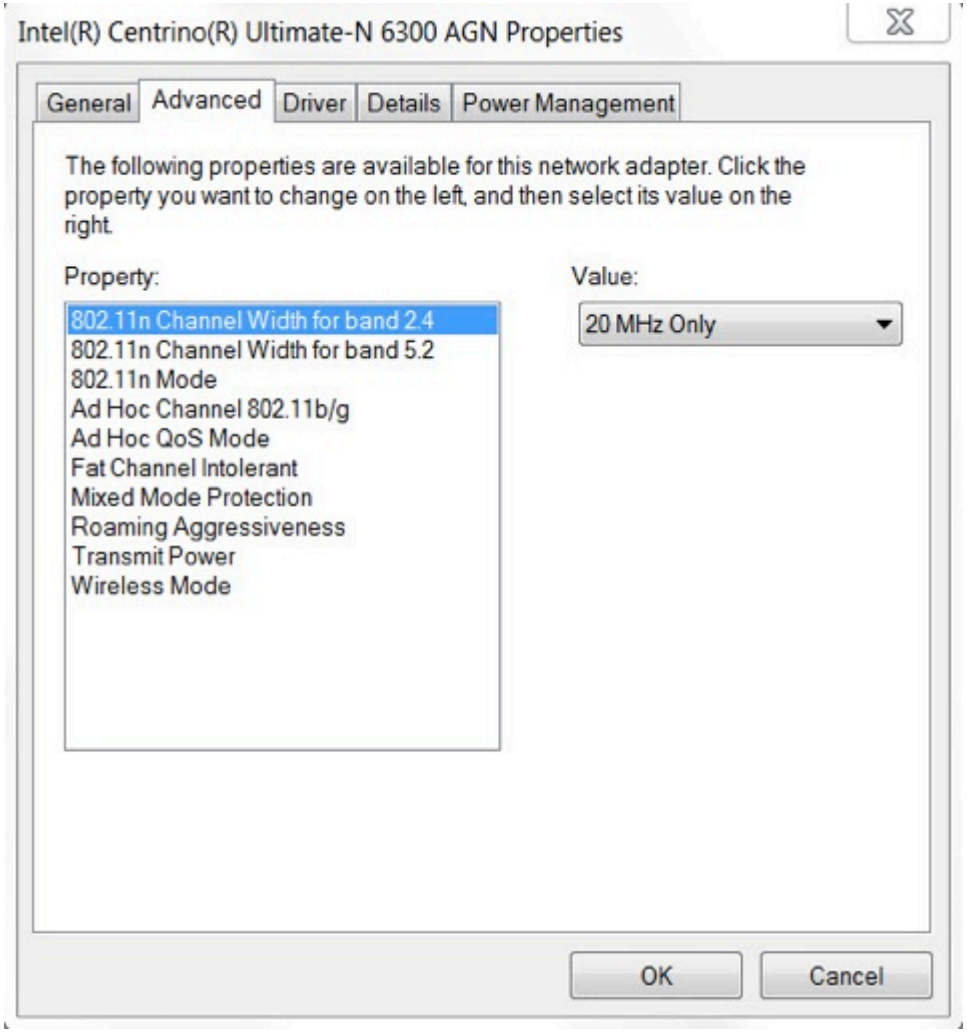
Wireless NIC Details Cont.



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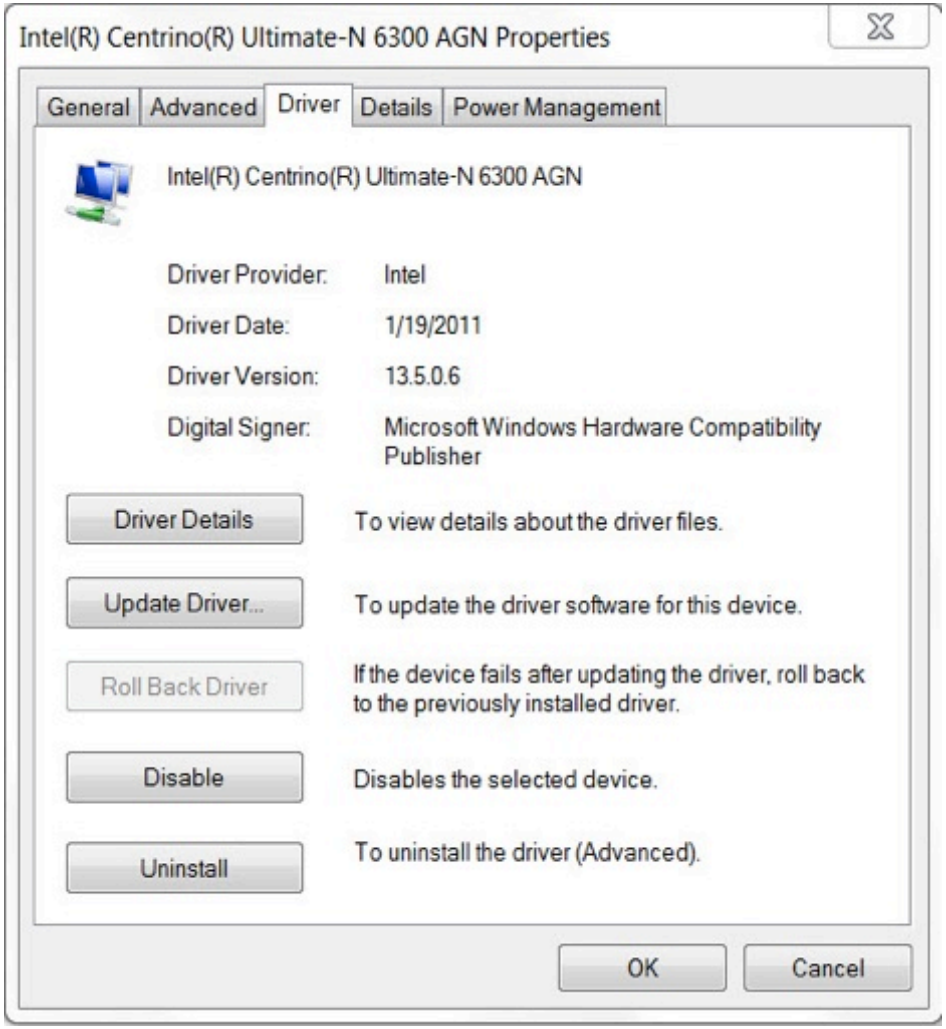
Wireless NIC Details Cont.



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Wireless NIC Details Cont.

```
C:\Users\kperedia.ARUBANETWORKS>netsh wlan show driver

Interface name: Wireless Network Connection

    Driver                     : Intel(R) Centrino(R) Ultimate-N 6300 AGN
    Vendor                     : Intel Corporation
    Provider                   : Intel
    Date                       : 10/27/2011
    Version                    : 14.3.0.6
    INF file                   : C:\Windows\INF\oem63.inf
    Files                      : 4 total
                                 C:\Windows\system32\DRIVERS\NETwNs64.sys
                                 C:\Windows\system32\NETwNc64.dll
                                 C:\Windows\system32\NETwNr64.dll
                                 C:\Windows\system32\drivers\vwifibus.sys
    Type                       : Native Wi-Fi Driver
    Radio types supported      : 802.11a 802.11b 802.11g
    FIPS 140-2 mode supported  : Yes
    Hosted network supported   : Yes
    Authentication and cipher supported in infrastructure mode:
                                 Open            None
                                 Open            WEP-40bit
                                 Open            WEP-104bit
                                 Open            WEP
                                 Shared          WEP-40bit
                                 Shared          WEP-104bit
                                 Shared          WEP
                                 WPA-Enterprise  TKIP
                                 WPA-Enterprise  CCMP
                                 WPA-Personal    TKIP
                                 WPA-Personal    CCMP
                                 WPA2-Enterprise TKIP
                                 WPA2-Enterprise CCMP
                                 WPA2-Personal   TKIP
                                 WPA2-Personal   CCMP
                                 Open            Vendor defined
    Authentication and cipher supported in ad-hoc mode:
                                 Open            None
                                 Open            WEP-40bit
                                 Open            WEP-104bit
                                 Open            WEP
                                 Shared          WEP-40bit
                                 Shared          WEP-104bit
                                 Shared          WEP
                                 WPA2-Personal   CCMP
```

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Wireless NIC Connectivity (Windows 7)

```
C:\Users\kperedia.ARUBANETWORKS>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                   : 988c7779-aeb4-41d1-af4f-c9af8d2d92b9
    Physical address       : 24:77:03:3b:aa:d0
    State                  : connected
    SSID                   : Roppongi Des
    BSSID                  : 00:07:ab:77:a7:9f
    Network type           : Infrastructure
    Radio type             : 802.11g
    Authentication         : WPA2-Personal
    Cipher                 : CCMP
    Connection mode        : Profile
    Channel                : 4
    Receive rate (Mbps)    : 72
    Transmit rate (Mbps)   : 72
    Signal                 : 99%
    Profile                : Roppongi Des

    Hosted network status  : Not available
```

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MacOS

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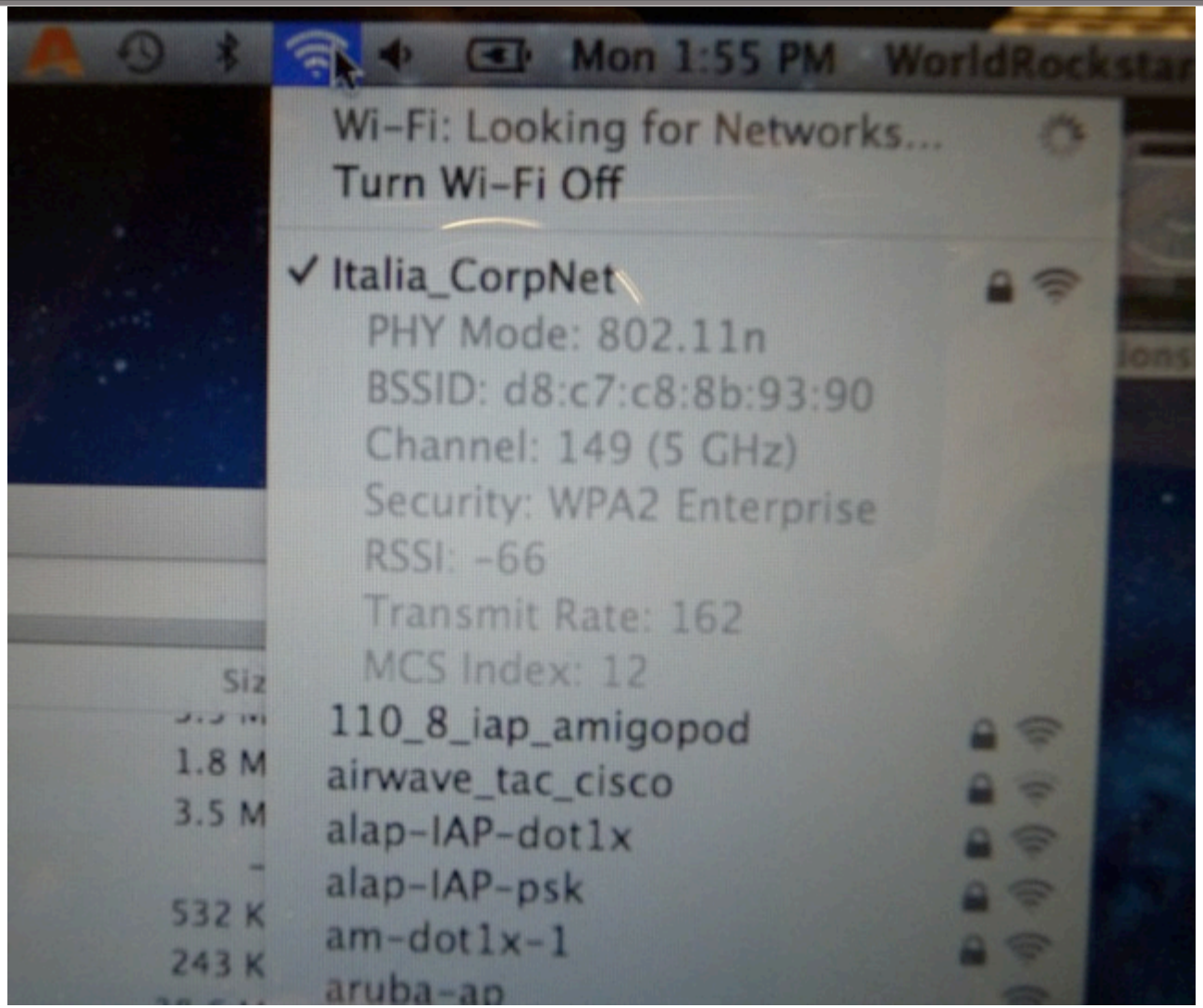
Wireless NIC Connectivity (MacOS)



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Wireless NIC Connectivity (MacOS)

- **$ sudo ln -sf /System/Library/PrivateFrameworks/Apple80211.framework/Versions/A/Resources/airport /usr/sbin/airport**
  - $ airport -I
  - agrCtlRSSI: -57
  - agrExtRSSI: 0
  - agrCtlNoise: -89
  - agrExtNoise: 0
  - state: running
  - op mode: station
  - lastTxRate: 243
  - maxRate: 300
  - lastAssocStatus: 0
  - 802.11 auth: open
  - link auth: wpa2
  - BSSID: d8:c7:c8:80:1d:f0
  - SSID: Italia_CorpNet
  - MCS: 14
  - channel: 44,1

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Wireless Diagnostics (MacOS)

- **Turn on logging**
  - sudo /usr/libexec/airportd debug +alluserland +alldriver +allvendor
  - When issue happens send the kernel.log file (that is located in /var/log directory) to TAC plus system profiler
- **Export System Profiler**

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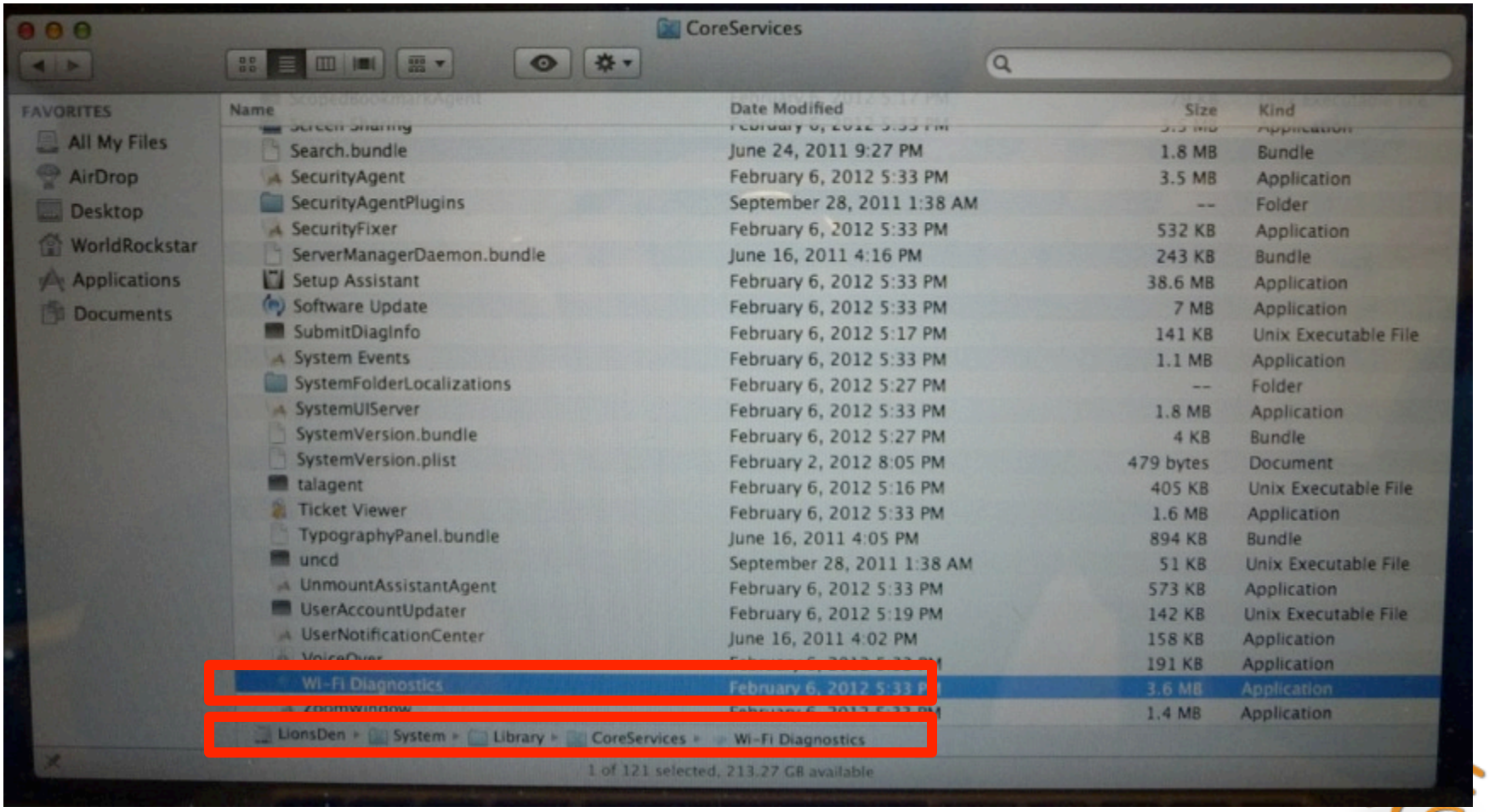
Wireless Diagnostics (MacOS Lion)



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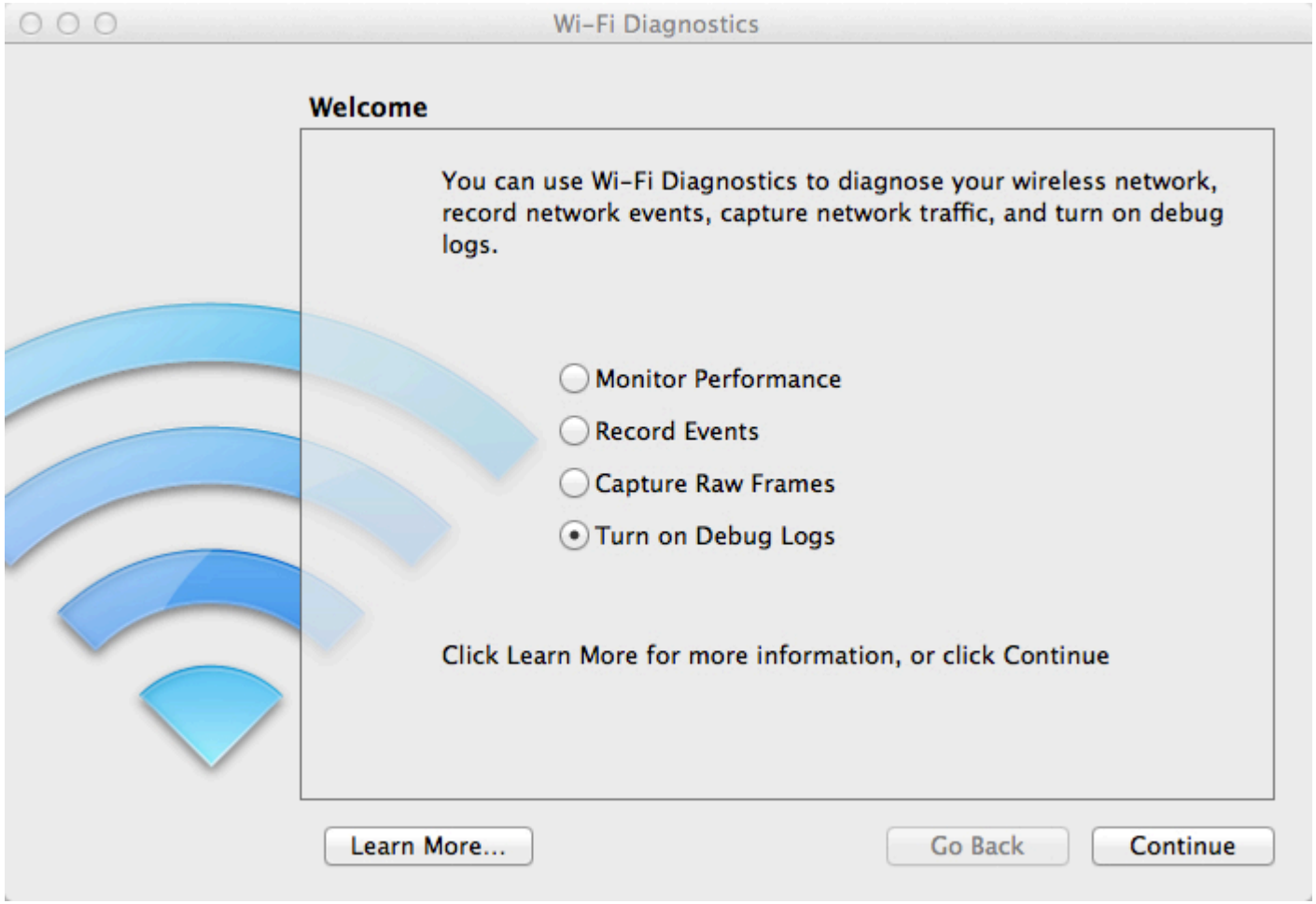
Wireless Diagnostics (MacOS Lion)



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iOS

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iOS Diagnostics (IPCU)

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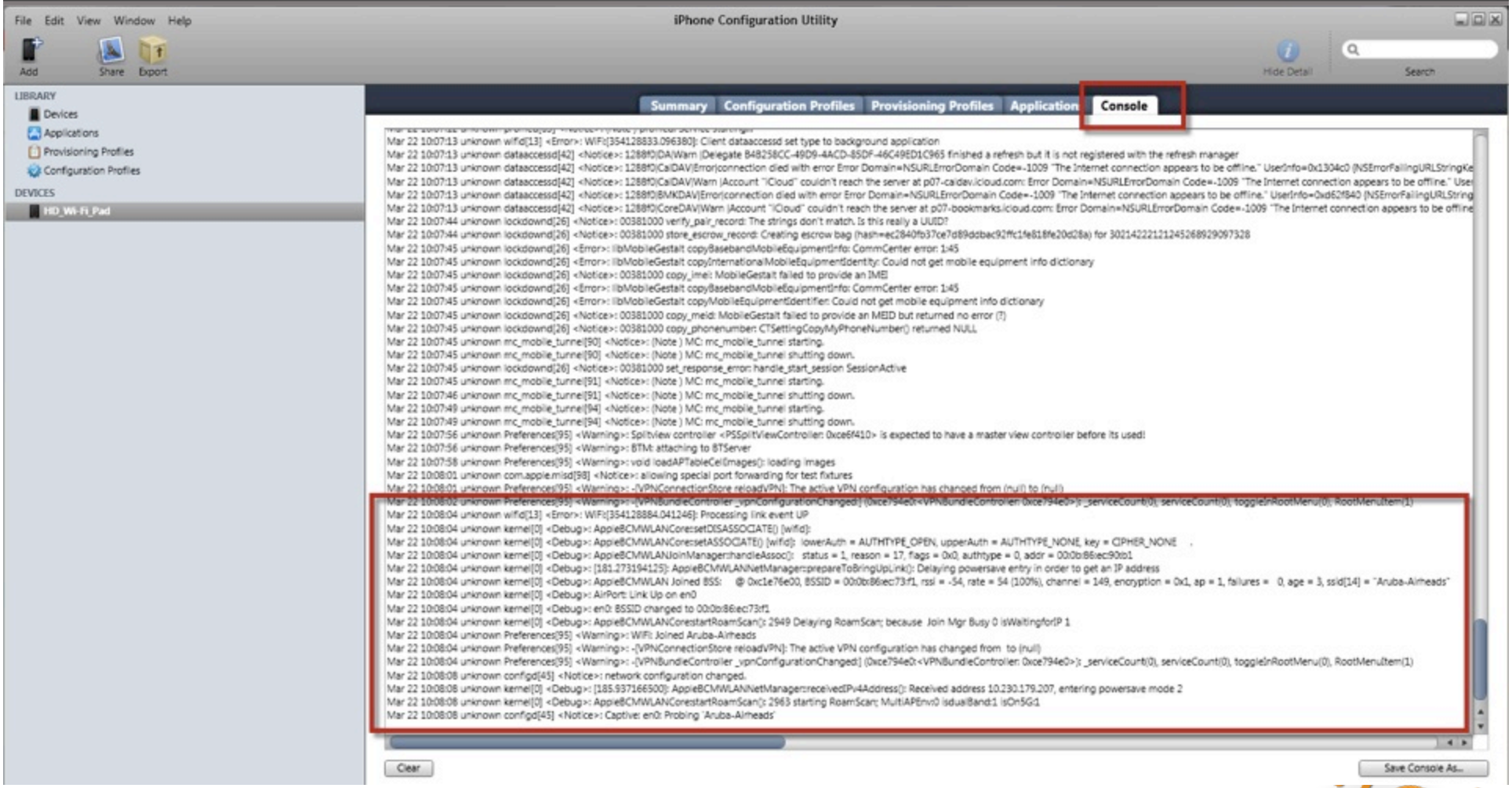
iOS Diagnostics (IPCU)



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Android

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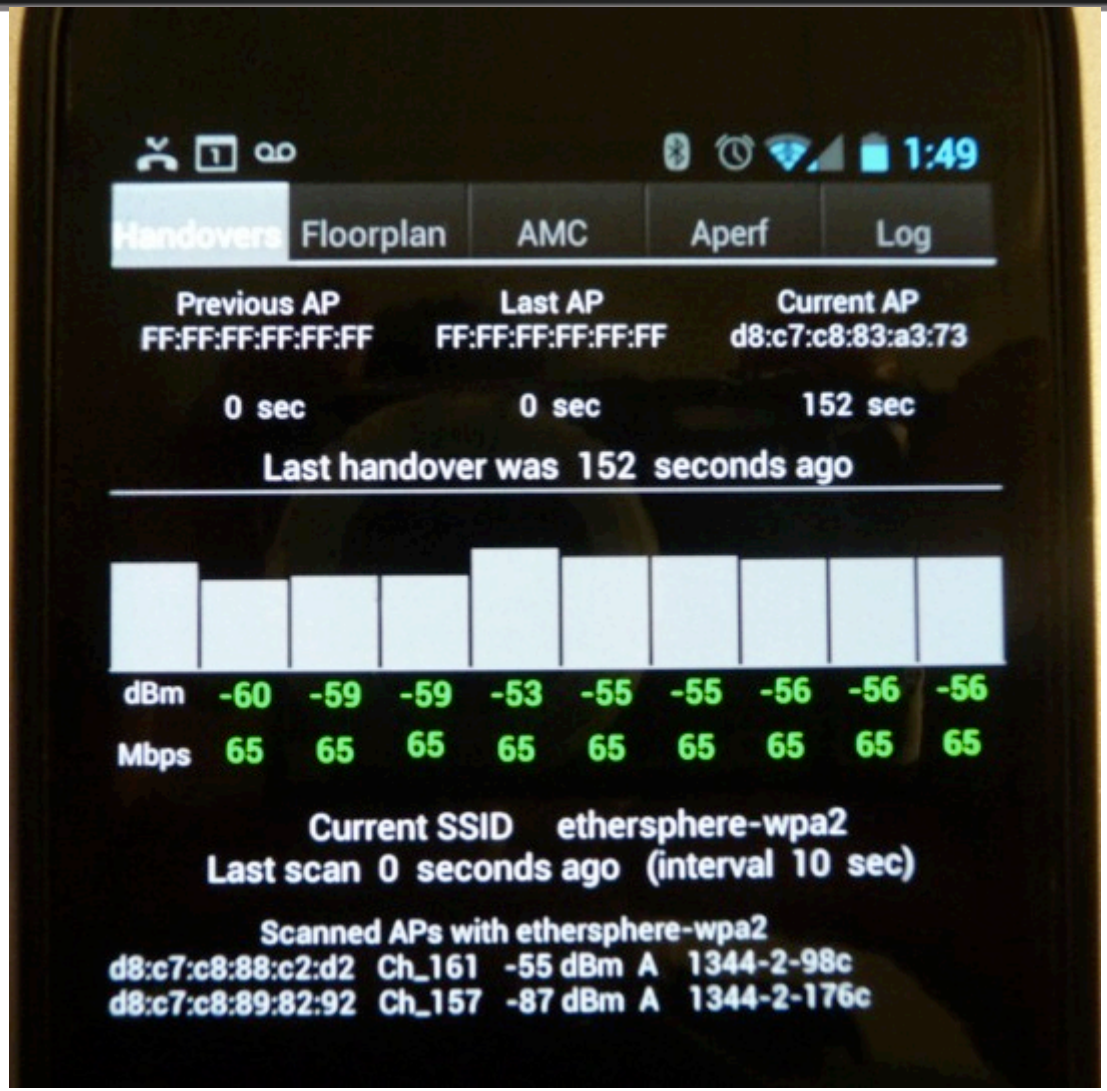
Android Diagnostics (Aruba Utility)



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Performance Testing

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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.

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Performance Testing

- **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

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Performance Testing

- **Our Aruba QA team quickly ran chariot tcp performance test against an iPad1, iPad2 and iPad3 on our AP-135 inside a RF chamber.**
  - The following are the results of that test. All ipads were running iOS 5.1 version. Please note they currently only support 20MHz 1ss and no sgi so maximum PHY data rate is 65 Mbps. Please note upstream is lower than expected on our system with this specific test.

TYPE	Downstream	Upstream	Comments
IPAD1	27+	10+	No upstream aggregation. Most robust downstream rate is 52. 65 is not robust; Chipset 4329
IPAD2	37+	14+	No upstream aggregation. Most robust downstream rate is 58.5. 65 is not robust. Chipset 4329
IPAD3	46+	46+	65mbps is robust in upstream and downstream. upstream aggregation is enabled. Chipset 4330

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Packet Capture

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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**

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Advanced RF Troubleshooting with CLI

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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: Open controller web UI... | Run a command...

Notes:

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

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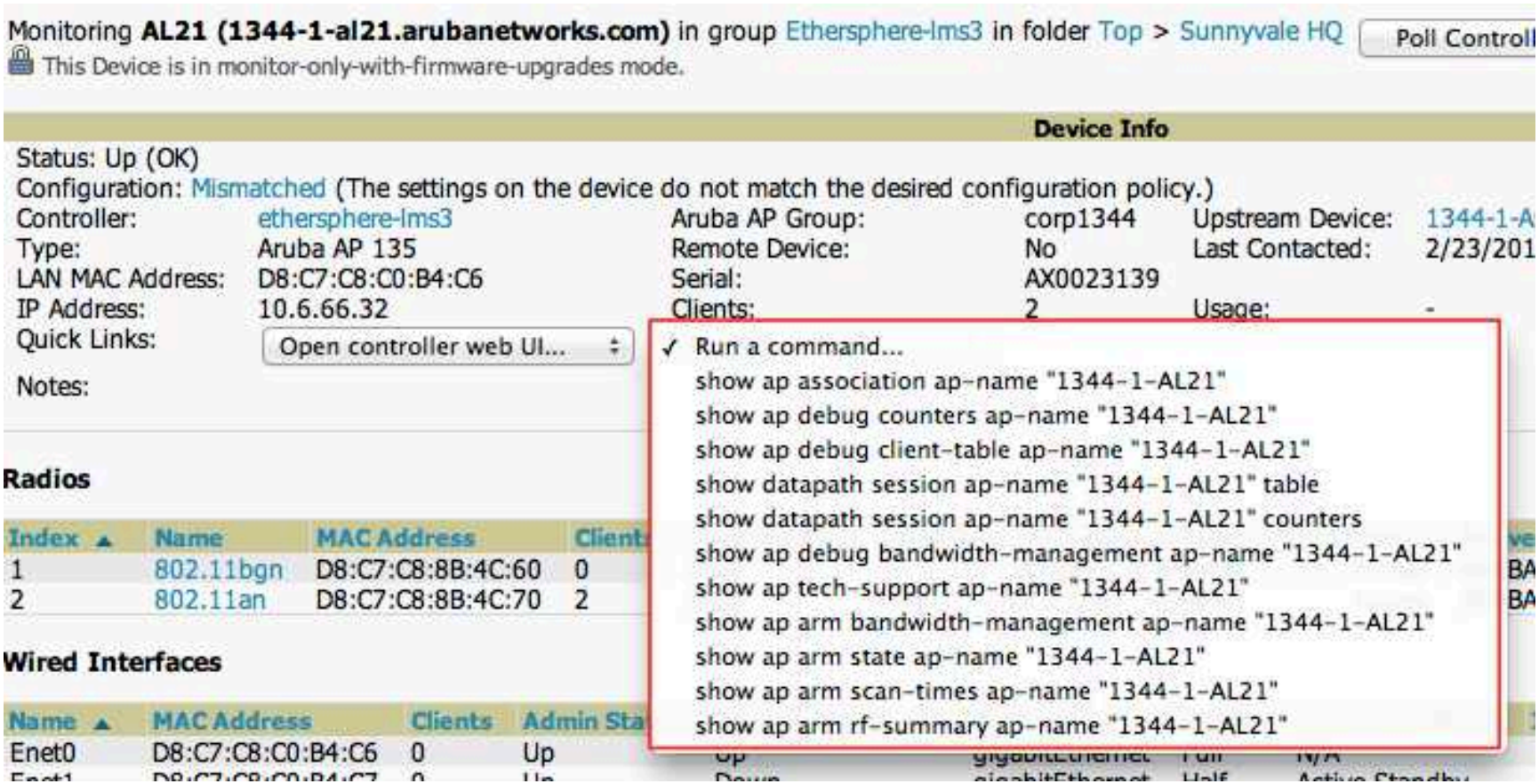
Useful AOS CLI (run from AirWave)



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Advanced CLI Examples

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#airheadsconf

Verify All Known APs are UP

```
(Aruba3600_Milano) #
(Aruba3600_Milano) #
(Aruba3600_Milano) #
(Aruba3600_Milano) #
(Aruba3600_Milano) #
(Aruba3600_Milano) #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
----     -----             ----------  -----------  -------------------  -----------  -------------------  -------  -----  ------        --------
AP135-5  Castello_APs      10.8.7.59   0            AP:HT:1/9/20         0            AP:HT:153-/18/20.5   135      A      27m:12s       N/A
AP135-2  Castello_APs      10.8.7.106  0            AP:HT:11/9/20        0            AP:HT:157+/18/20.5   135      A      27m:8s        N/A
AP135-3  Castello_APs      10.8.7.67   0            AP:HT:11/9/20        0            AP:HT:153-/20.5/20.5 135      A      27m:7s        N/A
AP135-4  Castello_APs      10.8.7.115  0            AP:HT:11/15/20       0            AP:HT:44+/16/16      135      A      26m:48s       N/A
AP135-1  Spectrum_Monitors 10.8.7.70   0            Spectrum             0            Spectrum             135      A      1d:6h:31m:3s  N/A
AP135-6  Castello_APs      10.8.7.73   0            AP:HT:1/15/20        0            AP:HT:149+/20.5/20.5 135      A      27m:11s       N/A

Flags: a = Reduce ARP packets in the air;  A = Enet1 in active/standby mode;
       B = Battery Boost On; C = Cellular; D = Disconn. Extra Calls On;
       d = Drop Mcast/Bcast On; E = Wired AP enabled; K = 802.11K Enabled; n = Don't convert IPv6 Mcast RA to Ucast
       L = Client Balancing Enabled; M = Mesh; N = 802.11b protection disabled;
       P = PPPOE; R = Remote AP; X = Maintenance Mode;
       1 = 802.1x authenticated AP; F = AP failed 802.1x authentication;2 = Using IKE version 2;

Channel followed by "*" indicates channel selected due to unsupported configured channel.
"Spectrum" followed by "^" indicates Local Spectrum Override in effect.

Num APs:6

(Aruba3600 Milano) #
```

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#airheadsconf

Verify All Known SSIDs are Broadcasting

```
(Aruba3600_Milano) #show ap bss-table

fm (forward mode): T-Tunnel, S-Split, D-Decrypt Tunnel, B-Bridge (s-standard, p-persistent, b-backup, a-always)

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	acl	fm
d8:c7:c8:88:d1:e0	Italia_CorpNet	1/3	10.8.7.115	g-HT	ap	11/15/20	0	AP135-4	0	31m:43s	1500	-	52	T
d8:c7:c8:88:d1:e1	Italia_CorpGuest	1/3	10.8.7.115	g-HT	ap	11/15/20	0	AP135-4	0	8s	1500	-	56	T
d8:c7:c8:80:1d:f0		1/3	10.8.7.70	a-HT	Spectrum	?/?/?	0	AP135-1	0	1d:6h:36m:35s	1500	-	1	Bs
d8:c7:c8:87:ee:10	Italia_CorpNet	1/3	10.8.7.73	a-HT	ap	149+/20.5/20.5	0	AP135-6	0	32m:17s	1500	-	52	T
d8:c7:c8:80:1d:e0		1/3	10.8.7.70	g-HT	Spectrum	?/?/?	0	AP135-1	0	1d:6h:36m:35s	1500	-	1	Bs
d8:c7:c8:87:d8:b0	Italia_CorpNet	1/3	10.8.7.59	a-HT	ap	153-/18/20.5	0	AP135-5	0	32m:17s	1500	-	52	T
d8:c7:c8:87:ef:10	Italia_CorpNet	1/3	10.8.7.67	a-HT	ap	153-/20.5/20.5	0	AP135-3	0	32m:14s	1500	-	52	T
d8:c7:c8:8b:93:90	Italia_CorpNet	1/3	10.8.7.106	a-HT	ap	40-/16/16	0	AP135-2	0	31m:48s	1500	-	52	T
d8:c7:c8:87:ee:00	Italia_CorpNet	1/3	10.8.7.73	g-HT	ap	1/15/20	0	AP135-6	0	32m:17s	1500	-	52	T
d8:c7:c8:87:ee:01	Italia_CorpGuest	1/3	10.8.7.73	g-HT	ap	1/15/20	0	AP135-6	0	8s	1500	-	56	T
d8:c7:c8:88:d1:f0	Italia_CorpNet	1/3	10.8.7.115	a-HT	ap	40-/16/16	0	AP135-4	0	31m:43s	1500	-	52	T
d8:c7:c8:87:d8:a0	Italia_CorpNet	1/3	10.8.7.59	g-HT	ap	1/12/20	0	AP135-5	0	32m:17s	1500	-	52	T
d8:c7:c8:87:d8:a1	Italia_CorpGuest	1/3	10.8.7.59	g-HT	ap	1/12/20	0	AP135-5	0	8s	1500	-	56	T
d8:c7:c8:87:ef:00	Italia_CorpNet	1/3	10.8.7.67	g-HT	ap	11/9/20	0	AP135-3	0	32m:14s	1500	-	52	T
d8:c7:c8:87:ef:01	Italia_CorpGuest	1/3	10.8.7.67	g-HT	ap	11/9/20	0	AP135-3	0	8s	1500	-	56	T
d8:c7:c8:8b:93:80	Italia_CorpNet	1/3	10.8.7.106	g-HT	ap	11/9/20	0	AP135-2	0	31m:48s	1500	-	52	T
d8:c7:c8:8b:93:81	Italia_CorpGuest	1/3	10.8.7.106	g-HT	ap	11/9/20	0	AP135-2	0	7s	1500	-	56	T

```
Channel followed by "*" indicates channel selected due to unsupported configured channel.
"Spectrum" followed by "^" indicates Local Spectrum Override in effect.

Num APs:17
Num Associations:0

(Aruba3600 Milano) #
```

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#airheadsconf

Check Device's 802.11 status

```
(ethersphere-lms3) #show ap association client-mac 00:26:bb:1c:0c:db

Flags: W: WMM 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  essid              vlan-id  tunnel-id  phy             assoc. time  num assoc  Flags
----       -----             ---               ----  -----  ---  -----  -----              -------  ---------  ---             -----------  ---------  -----
1341-AP09  d8:c7:c8:89:72:92  00:26:bb:1c:0c:db  y     y      15   10     ethersphere-wpa2   651      0x1195     a-HT-20sgi-2ss  11h:34m:0s   1          WAB

00:26:bb:1c:0c:db-d8:c7:c8:89:72:92 Stats
----------------------------------------
Parameter                          Value

Channel                            161
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(%)        11
Channel Bandwidth Rate(kbps)       0
Channel Noise                      92
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)        0
Client Tx Packets                  285366
Client Rx Packets                  165644
Client Tx Bytes                    23194081
Client Rx Bytes                    232608911
Client SNR                         18

(ethersphere-lms3) #
```

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View Device's 802.11 Performance

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

```
(ethersphere-lms3) #show ap debug client-table ap-name 1341-AP09

Client Table
------------
MAC               ESSID              BSSID             HT_State  PS_State    Tx_Pkts  Rx_Pkts  PS_Qlen  Tx_Retries  Tx_Rate  Rx_Rate  Last_ACK_SNR  Last_Rx_SNR
---               -----              -----             --------  --------    -------  -------  -------  ----------  -------  -------  ------------  -----------
00:26:bb:1c:0c:db  ethersphere-wpa2   d8:c7:c8:89:72:92  WSsM      Power-save  165593   323235   0        3330        130      117      35            25
e0:f8:47:0e:6b:64  ethersphere-wpa2   d8:c7:c8:89:72:92  AWSsMbB   Awake       4        163017   0        0           130      216      36            36
ec:55:f9:c7:2a:9b  ethersphere-cpass  d8:c7:c8:89:72:83  WSsM      Power-save  6        145      0        3           43       1        41            38

UAPSD:(VO,VI,BK,BE,Max SP,Q Len)
HT Flags: A - LDPC Coding; W - 40Mhz; S - Short GI HT40; s - Short GI HT20
          D - Delayed BA; G - Greenfield; R - Dynamic SM PS
          Q - Static SM PS; N - A-MPDU disabled; B - TX STBC
          b - RX STBC; M - Max A-MSDU; I - HT40 Intolerant

(ethersphere-lms3) #
```

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View Device's 802.11 Performance

```
(ethersphere-lms3) #show ap ht-rates bssid d8:c7:c8:89:72:92

AP "1341-AP09" Radio 0 BSSID d8:c7:c8:89:72:92 High-throughput Rates (Mbps)
------------------------------------------------------------------------------
MCS  Streams  20 MHz  20 MHz SGI  [40 MHz]  [40 MHz SGI]
---  -------  ------  ----------  --------  ------------
  0   1         6.5     7.2      [ 13.5]   [ 15.0]
  1   1        13.0    14.4      [ 27.0]   [ 30.0]
  2   1        19.5    21.7      [ 40.5]   [ 45.0]
  3   1        26.0    28.9      [ 54.0]   [ 60.0]
  4   1        39.0    43.3      [ 81.0]   [ 90.0]
  5   1        52.0    57.8      [108.0]   [120.0]
  6   1        58.5    65.0      [121.5]   [135.0]
  7   1        65.0    72.2      [135.0]   [150.0]
  8   2        13.0    14.4      [ 27.0]   [ 30.0]
  9   2        26.0    28.9      [ 54.0]   [ 60.0]
 10   2        39.0    43.3      [ 81.0]   [ 90.0]
 11   2        52.0    57.8      [108.0]   [120.0]
 12   2        78.0    86.7      [162.0]   [180.0]
 13   2       104.0   115.6      [216.0]   [240.0]
 14   2       117.0   130.0      [243.0]   [270.0]
 15   2       130.0   144.4      [270.0]   [300.0]
 16   3        19.5    21.7      [ 40.5]   [ 45.0]
 17   3        39.0    43.3      [ 81.0]   [ 90.0]
 18   3        58.5    65.0      [121.5]   [135.0]
 19   3        78.0    86.7      [162.0]   [180.0]
 20   3       117.0   130.0      [243.0]   [270.0]
 21   3       156.0   173.3      [324.0]   [360.0]
 22   3       175.5   195.0      [364.5]   [405.0]
 23   3       195.0   216.7      [405.0]   [450.0]

Range for 20 MHz:   6.5 - 216.7 Mbps

Items enclosed in [ ] are disabled.

(ethersphere-lms3) #
```

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Check 802.11 and non-802.11 Interference

```
(ethersphere-lms3) #show ap arm rf-summary ap-name 1341-AP09

Channel Summary
---------------
channel  retry  phy-err  mac-err  noise  cov-idx  intf_idx
-------  -----  -------  -------  -----  -------  --------
161      0      0        16       93     16/0     65/78//0/1
1        16     0        0        94     53/1     422/0//18/0
48       0      0        0        92     0/0      0/9//0/0
165      0      0        0        99     21/0     129/20//0/0
5        0      0        0        90     0/0      0/142//0/5
7        0      0        0        91     0/0      0/23//0/1
11       0      0        0        89     8/0      66/0//3/0
149      0      0        0        87     9/0      165/29//1/0
36       0      0        0        92     8/0      42/0//0/0
153      0      0        0        89     11/0     86/90//0/1
40       0      0        0        91     0/0      0/14//0/0
157      0      0        0        90     17/0     104/51//2/0
44       0      0        0        92     0/0      0/0//0/0
HT Channel Summary
------------------
channel_pair  Pairwise_intf_index
------------  -------------------
1-5           587
7-11          93
149-153       372
36-40         56
157-161       301
44-48         9

Interface Name            :wifi0
Current ARM Assignment    :161/15
Covered channels a/g      :5/0
Free channels a/g         :0/0
ARM Edge State            :enable
Last check channel/pwr    :7h:5m:1s/27s
Last change channel/pwr   :7h:5m:1s/7h:5m:1s
Next Check channel/pwr    :0s/6m:53s

Interface Name            :wifi1
Current ARM Assignment    :1/9
Covered channels a/g      :0/1
Free channels a/g         :0/0
```

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Advanced RF Troubleshooting

- **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 client-mac <client MAC>
  - show ap remote debug mgmt-frames ap-name <AP name>

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Advanced RF Troubleshooting Cont.

- **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

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Advanced RF Troubleshooting Cont.

- **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

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What To Do Before You Call TAC?
(to help resolve problems faster)

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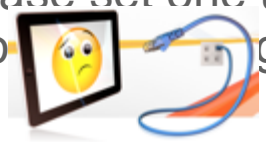
What to do before you call TAC?

- **Provide the Aruba WLAN Controller logs and output of show tech-support**
  - CLI Example:
    - tar logs tech-support
    - copy flash: logs.tar tftp:<tftp server IP address> <file name>
- **If this information is not available, then at a minimum, please provide:**
  - ArubaOS Version (including build number)
  - Controller Model
  - Client Type
  - Radio band and Channel width
  - ESSID Opmode
- **Provide the Syslog Server file of the Aruba WLAN Controller at the time of the problem.**
  - If no Syslog Server is available to capture log output from the Aruba WLAN Controller then please set one up as soon as possible since it is a highly suggested tro g and monitoring best practice.



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What to do before you call TAC? (cont'd)

- **State if this is a new or existing installation.**
  - This will help the support team to take different troubleshooting approaches depending on whether the customer has:
    - An outage in the network that worked in the past
    - A network configuration that has never worked
    - A brand new install
- **State if anything has recently changed in the network (external to Aruba) or if anything has recently changed in the Aruba WLAN Controller or AP configuration.**
- **If there was a configuration change then please list the exact configuration steps and commands used.**
- **State the date and time (if possible) when the problem first occurred**
- **Is the problem reproducible?**
  - **If the problem is reprodu please list the exact steps taken to recreate the pro**

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What to do before you call TAC? (cont'd)

- **Provide the wireless device's make, model number, and its OS version including any service packs or patches,**
- **Provide the Wireless LAN Card's make, model number, driver date, driver version, and configuration on the wireless device.**
- **Highly Useful Information:**
  - **(Information below should be provided as an addition to the previous slides that contain critical Information needed)**
  - **Provide a detailed network topology (including all the devices in the network between the user and the Aruba WLAN Controller with IP addresses and Interface numbers if possible)**
    - **The diagram can be in format of Visio, PowerPoint, JPEG, TIF, etc. or it can even be hand written and then faxed to support "1-408-227-4550"**
  - **Provide any wired or wireless sniffer traces taken during the time of the problem.**

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What to do before you call TAC? (cont'd)

- **Get the following log output during the problem IF Syslog server output can't be provided**
  - show log errorlog all
  - show log network all | include '<wireless device's mac address>'
  - show log security all | include '<wireless device's mac address>'
  - show log system all
  - show log user-debug all | include '<wireless device's mac address>'
  - show log user all | include '<wireless device's mac address>'
  - show log wireless all

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What to do before you call TAC? (cont'd)

- **Provide customer site access information to the Aruba WLAN Controller if possible.**
  - This is another highly suggested troubleshooting best practice that should be implemented.
  - The customer site access should only be enabled when a problem occurs (or if Aruba support is monitoring the device).
  - The most common access given by customers is through Adobe Acrobat Connect or WebEx.
  - Otherwise customers will provide a VPN (PPTP, L2TP, SSL) connection that limits the support person to only have IP access to the Aruba WLAN Controller, AP, and AWMS.
  - Analog dialup or SSH access to the Aruba Controller are other access methods that the support person can use to reach the Aruba WLAN Controller too.

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Coming Up:

Break

Deploying BYOD

Designing Outdoor Mesh Networks

community.arubanetworks.com

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Backup Slides

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Remote Packet Capture with Aruba AP

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Remote Packet Capture with Aruba AP

- Using any Aruba AP (AP or AM, CAP or RAP) to perform remote packet capture
- Wireshark 1.6 (or above) running on any computer
- **IP connectivity** between AP/AM and capturing computer

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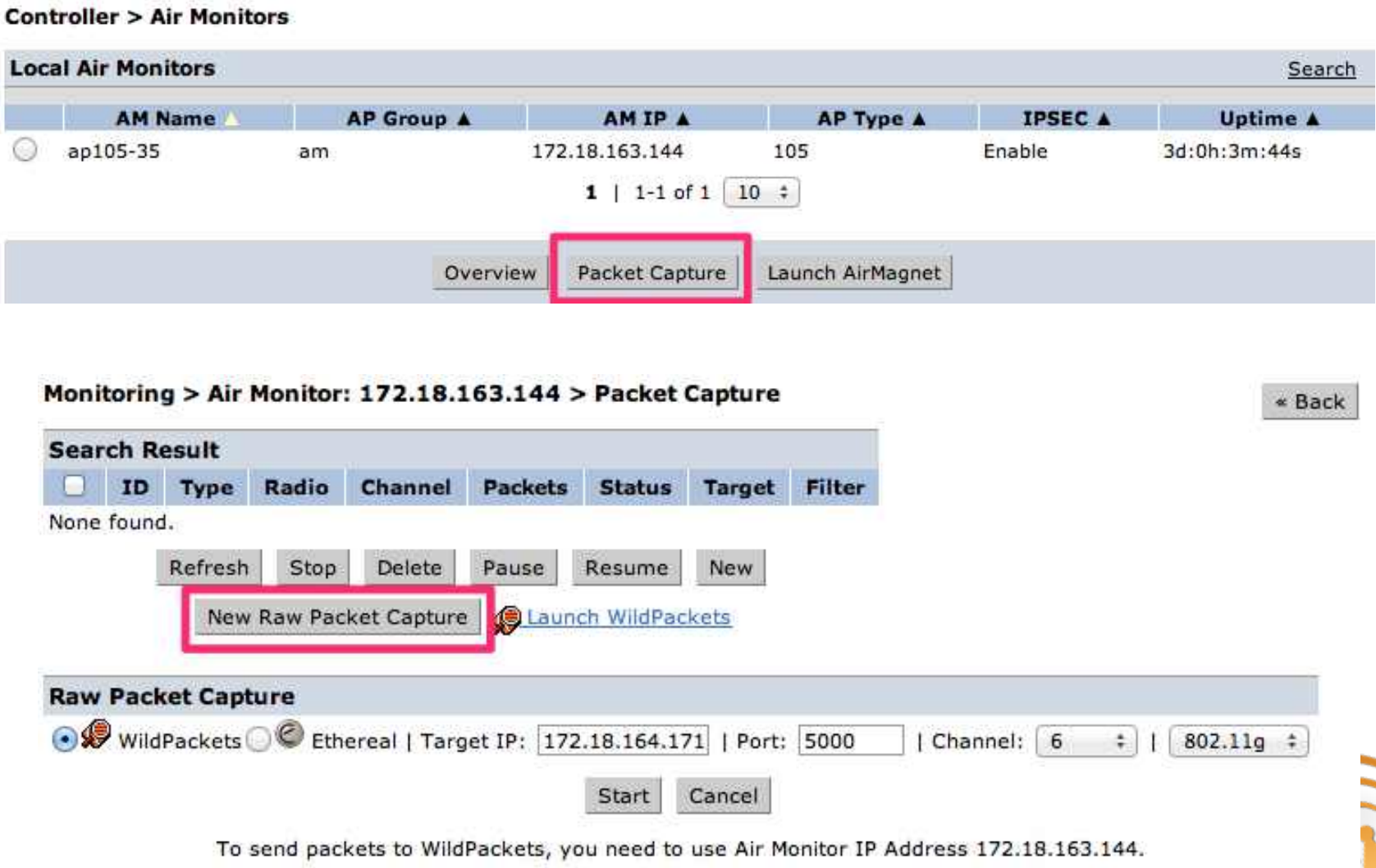
Setting Up Remote Packet Capture



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Setting Up Remote Packet Capture

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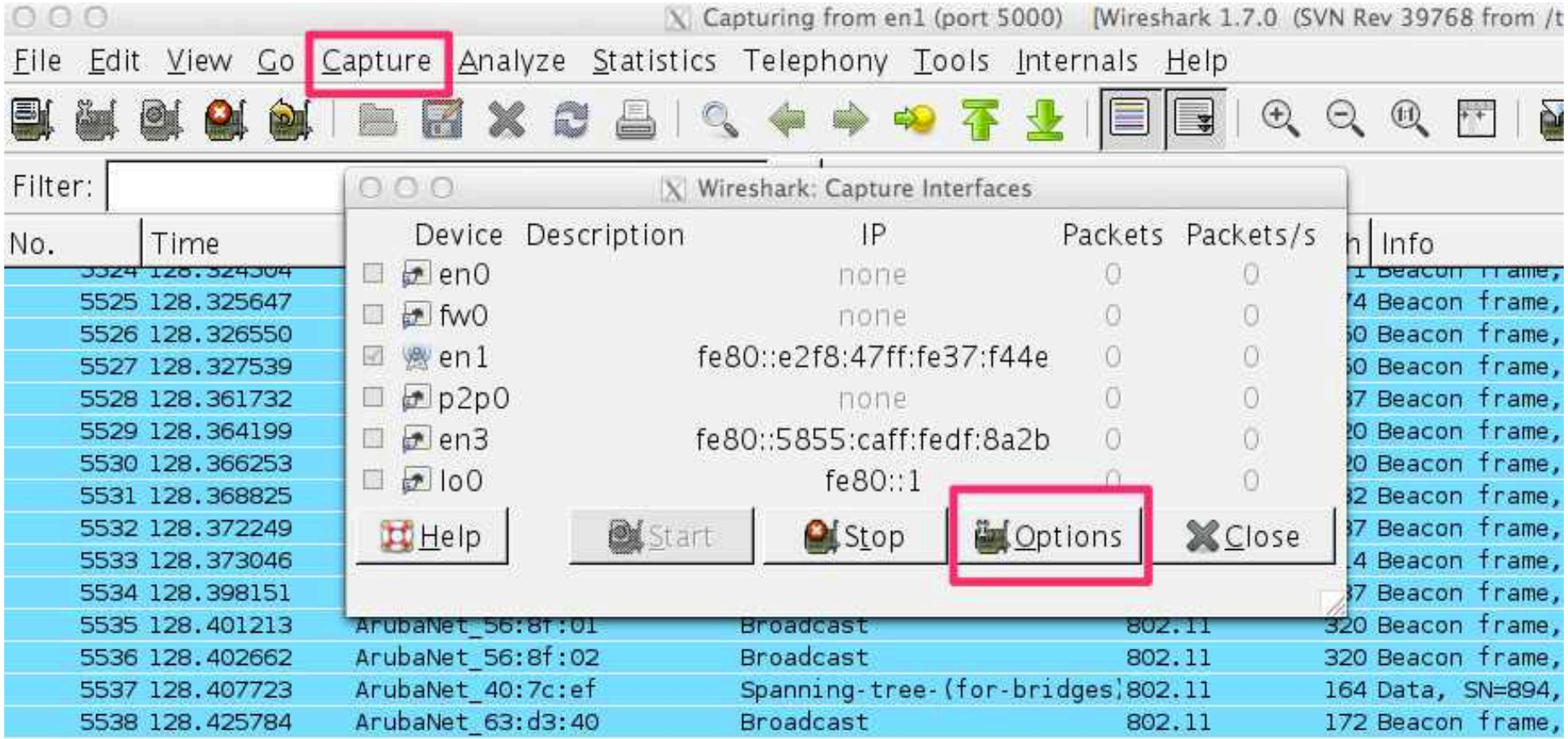
Set-up computer as receiver



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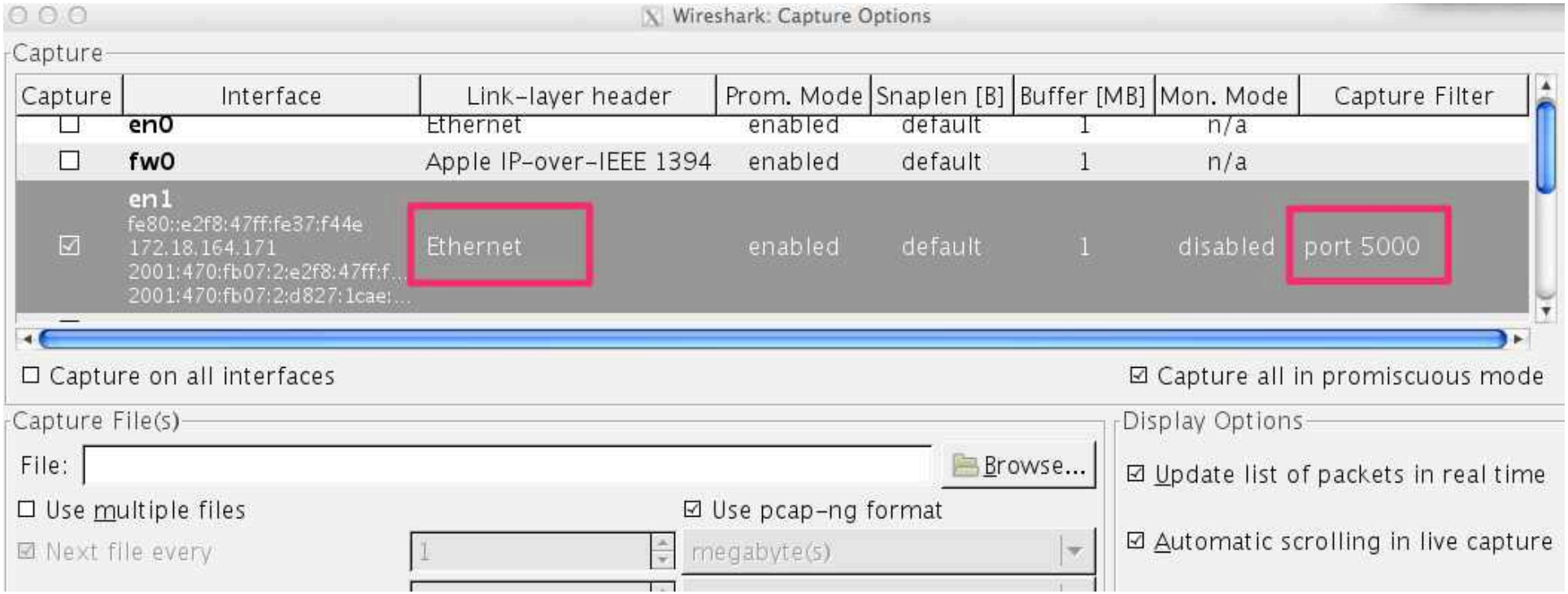
Set-up computer as receiver



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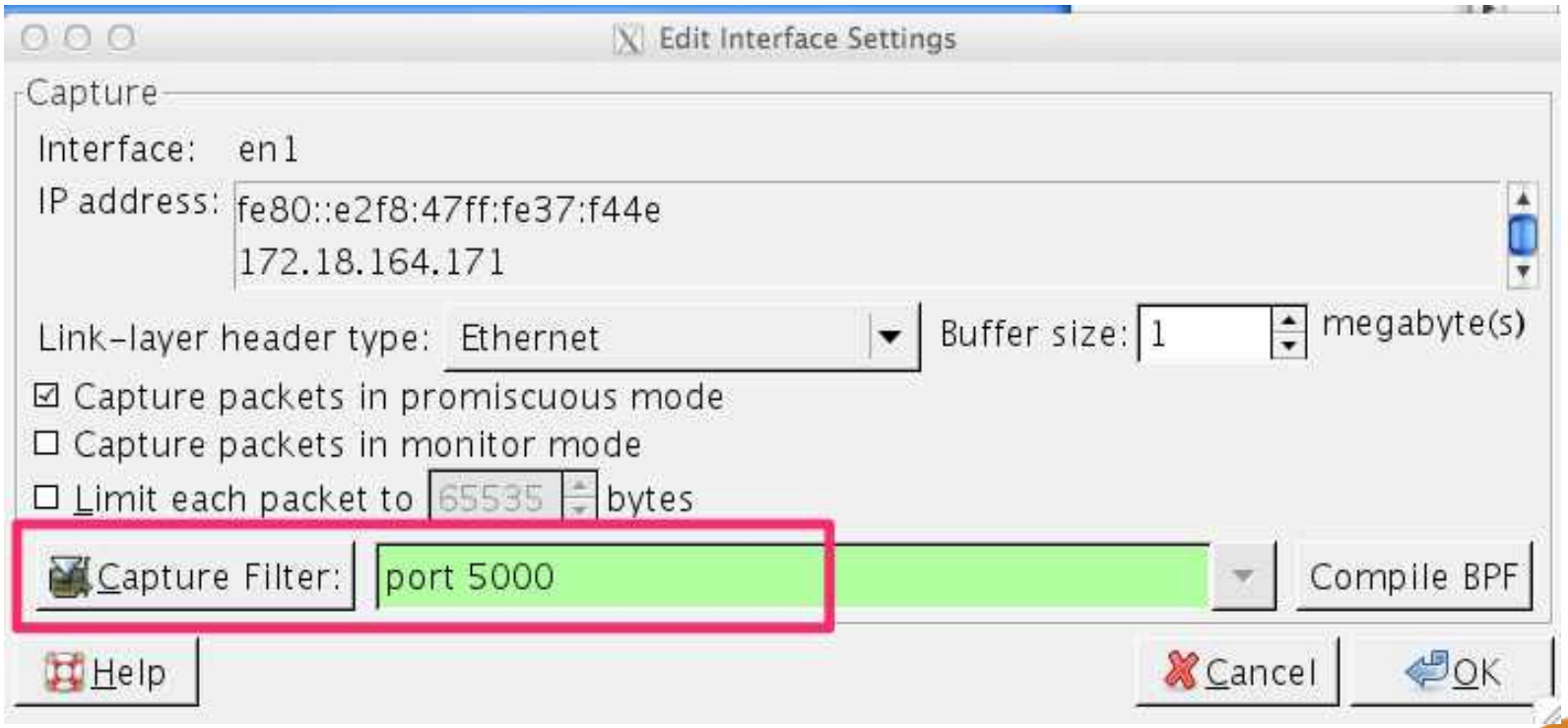
Set-up computer as receiver

- **Filter on traffic on port 5000**



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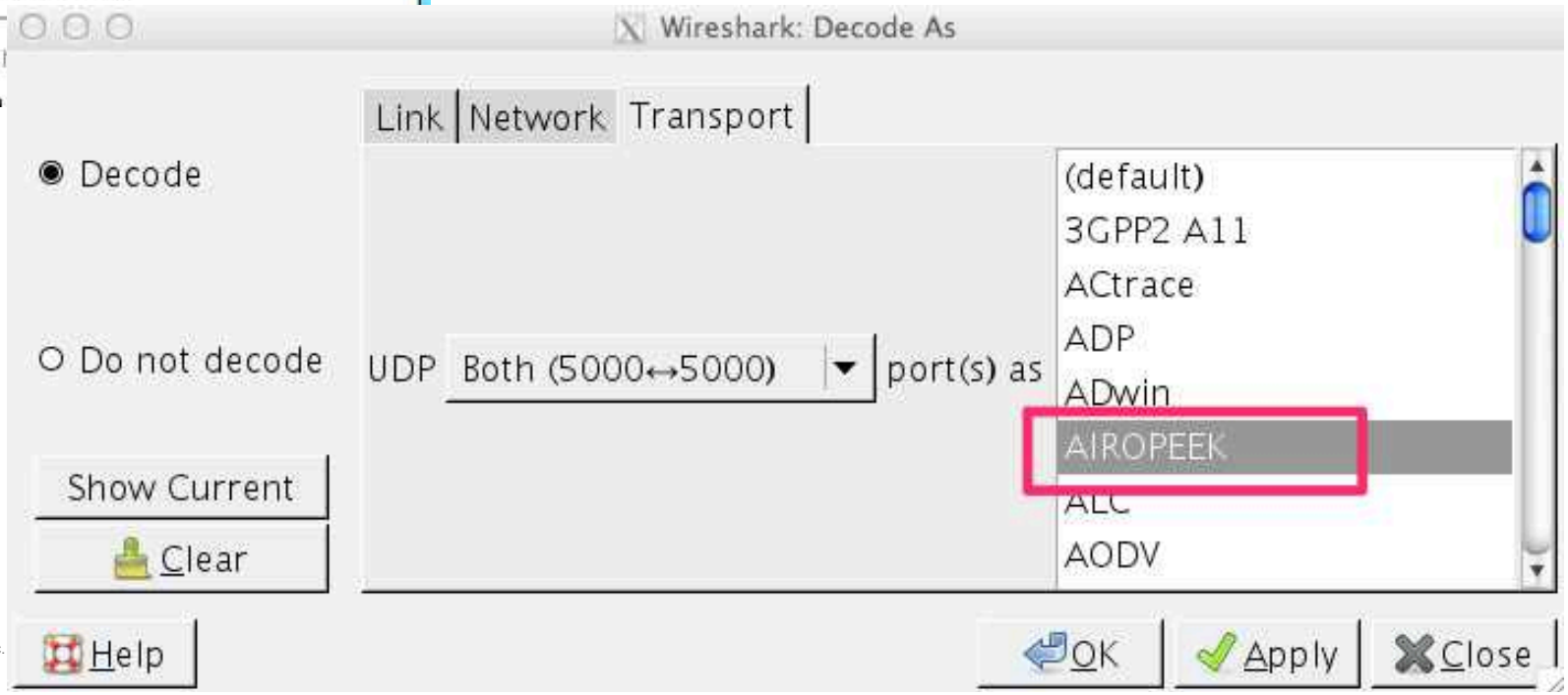
Set-up computer as receiver

- **Decode as AIROPEEK**



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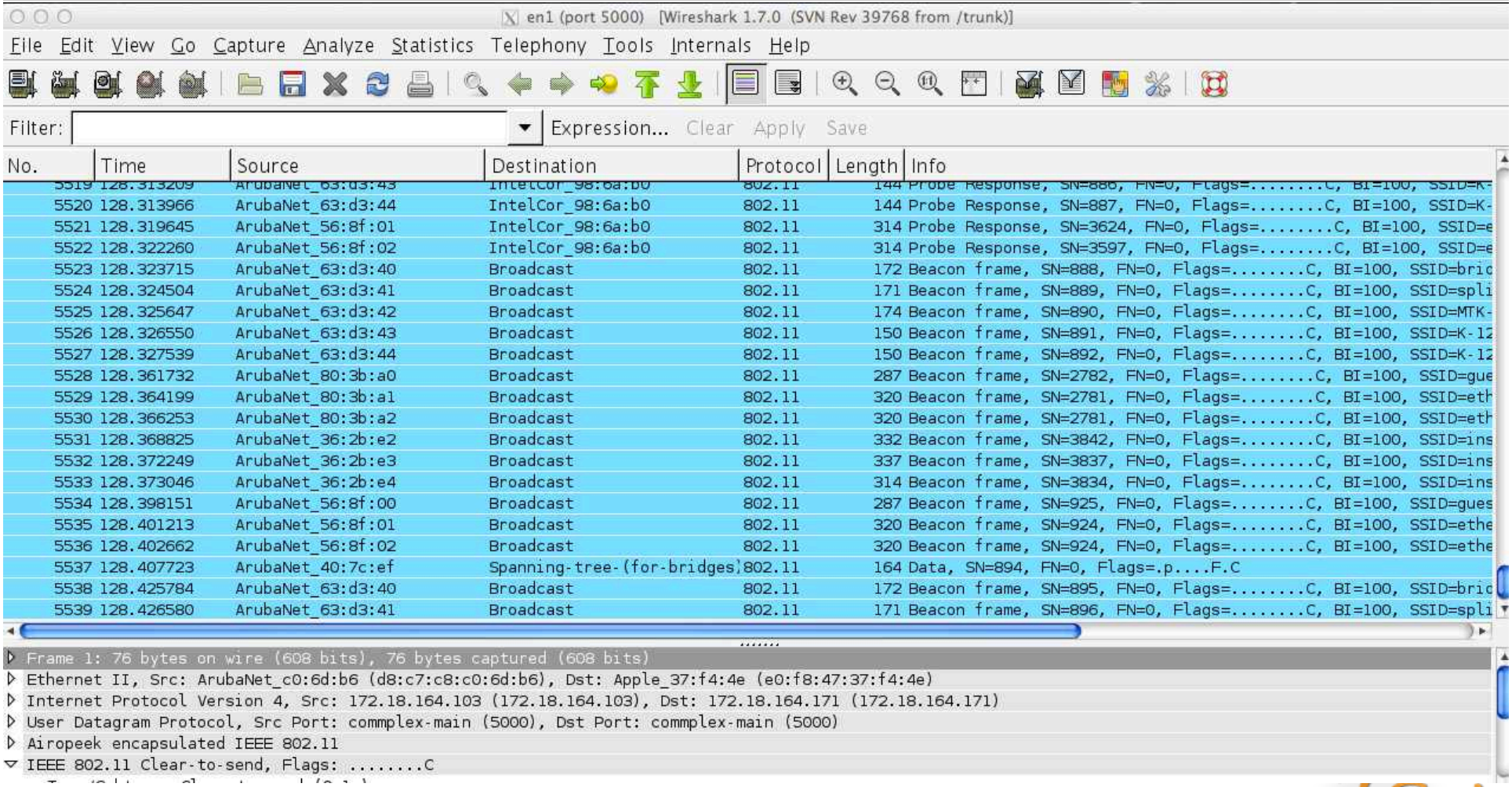
Packet Capture



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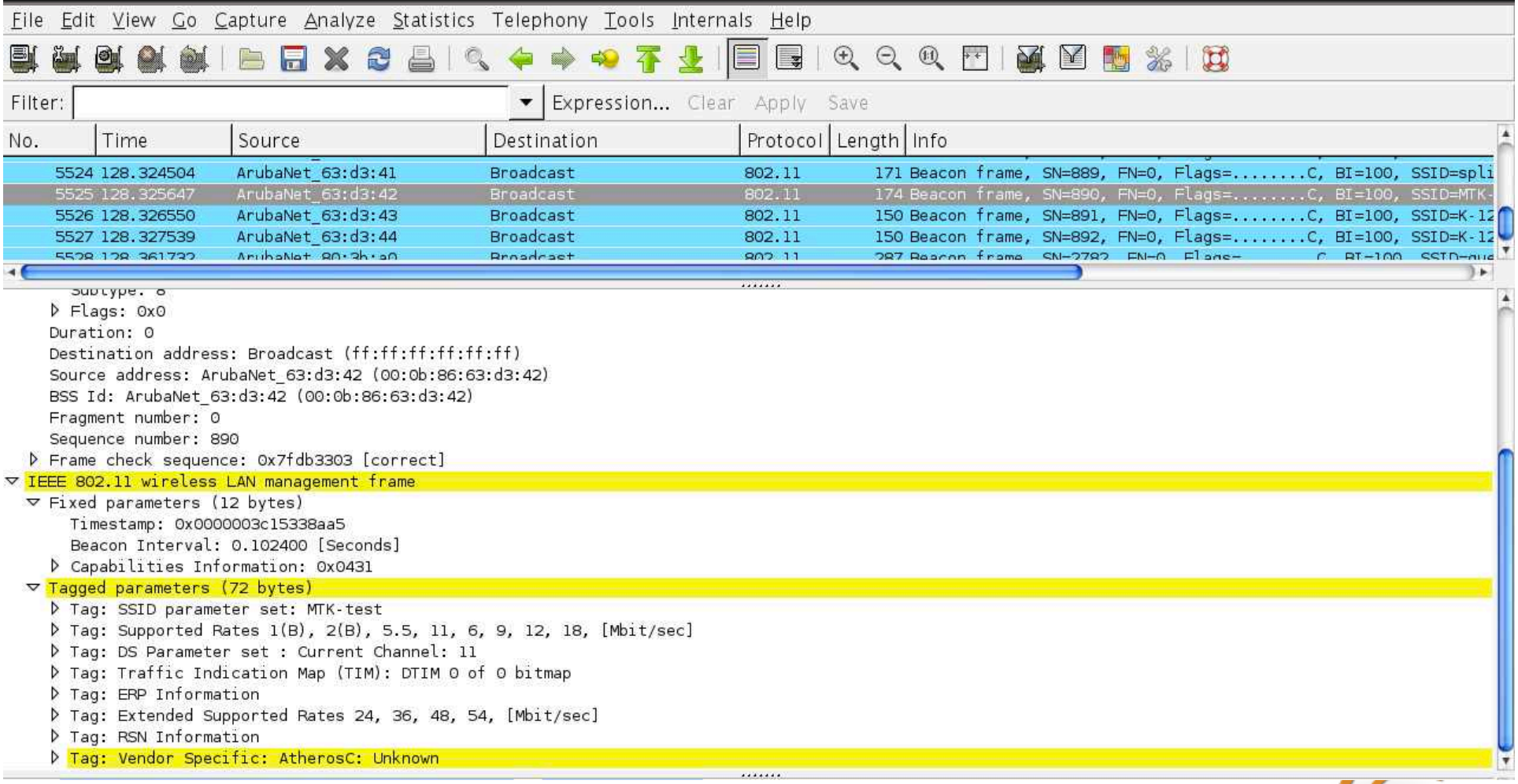
Packet (beacon)



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Starting PCAP from CLI

- **Example**
  1. The AP-105 has an IP address of 172.18.163.144
  2. There is a laptop with IP address 172.18.164.171 and has Wireshark 1.7.0 and listening on port 5000
  3. The syntax specifies 1 for the last value because it is telling the AP to send the frames in AIROPEEK pcap format.

```
(Aruba3600) #pcap raw-start 172.18.164.144 172.18.164.171 5000 1
pcap-id:1
```

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Useful Wireshark Display Filters

- **Show only 802.11 traffic**
  - wlan
- **Show 802.11 traffic to/from a client**
  - wlan.addr==<mac address>
- **Hide (or show) beacon frames**
  - wlan.fc.type_subtype != 0x08 / wlan.fc.type_subtype == 0x08
- **Show management frames for a specific SSID**
  - wlan_mgt.ssid == “SSID_NAME”
- **Show everything except beacon and ACK frames**
  - (!wlan.fc.type_subtype == 0x08) && (!wlan.fc.type_subtype == 0x1d)

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