



THE WI-FI PERFORMANCE COMPANY

Wi-Fi Performance Monitoring as a Design Tool

#WiFiDesignDay

by Ekahau and Open Reality

About Jim Vajda

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- CWNE #183
- CCNP-Wireless
- Experience in healthcare, K12, higher ed, non-profit, MSP, more
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- Blog: framebyframewifi.net

Wi-Fi Performance Monitoring Systems

- Hardware sensors
 - Active tests
 - Passive tests
- Software agents
 - Client-side data
- Network-as-a-sensor
 - Infrastructure metrics

7SIGNAL Modules



MOBILE EYE™

Background app running on devices

Windows, Mac, Android, iOS

100% software



Adapters & Drivers



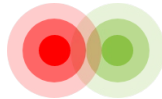
Roaming



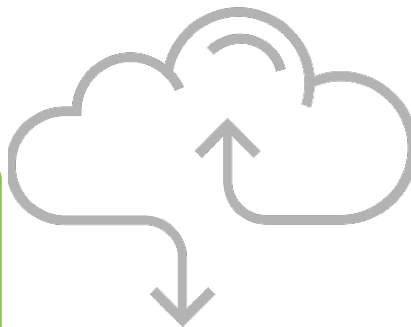
Coverage



Congestion



Radio Frequency & Co-Channel Interference



Dashboards

Performance analytics

Air & device detail



SAPPHIRE EYE™

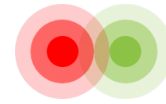
Wi-Fi client sensor

Hardware/software subscription

Spectrum analysis



Network Services



Radio Frequency & Co-Channel Interference



Coverage



Congestion



WLAN Configuration

Disclaimer

- Follow best practices
- Always do site surveys
- Wi-Fi performance monitoring systems can help

WPMS Design Use Cases

- Requirements and Constraints Gathering
 - What are the real clients?
 - What does the RF look like?
- Capacity Planning
 - What data rates do clients and AP's actually use?
- Validation
 - Real client RSSI
 - Client-discovered CCI/ACI
 - Before and After Differences
 - Remote troubleshooting and visibility tools
 - Is it the new WLAN or the clients that are a problem?

Gather Requirements

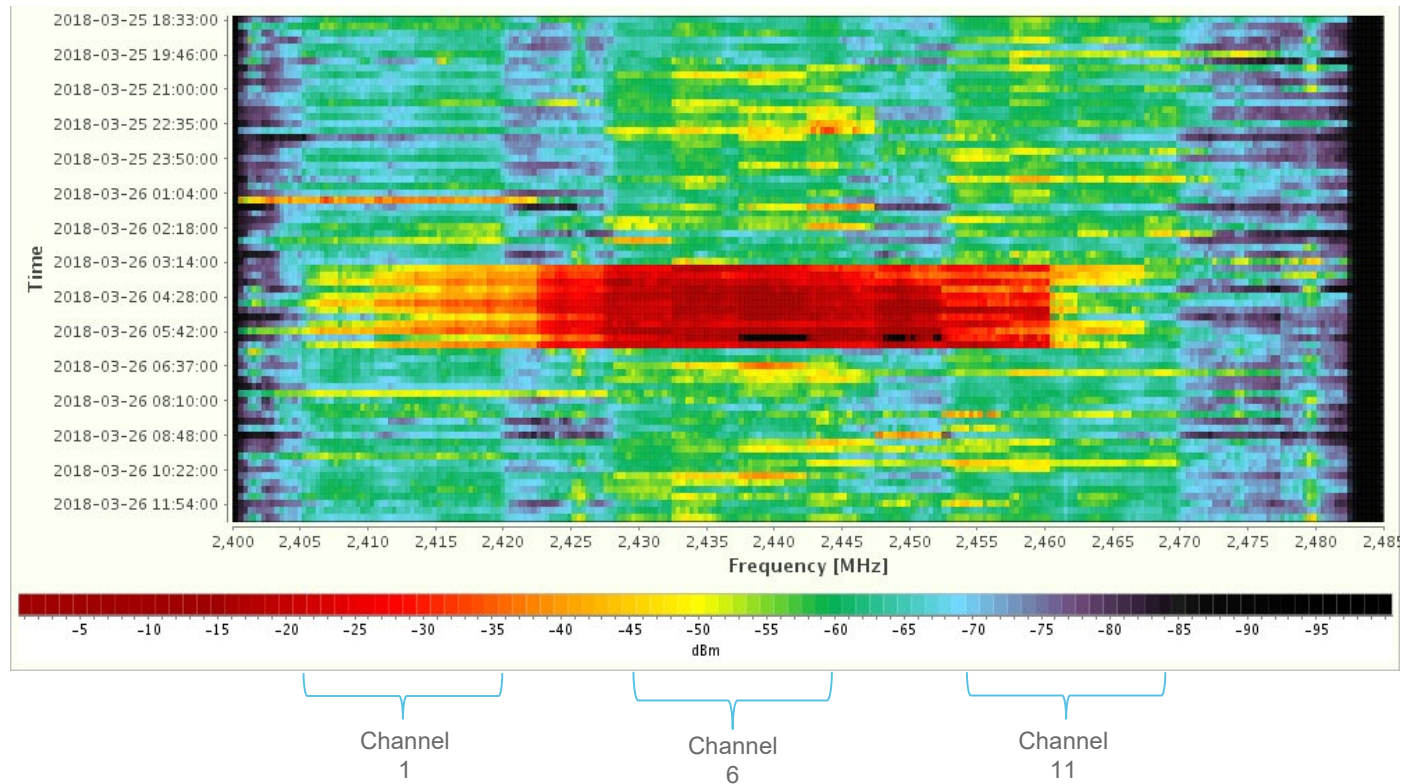
- Existing WLAN upgrade/redesign
 - What are the clients?
 - What is their performance?
- Greenfield
 - What is operating in the RF now?
 - Neighboring WLAN's
 - Long term spectrum analysis
- AP Performance

Client Inventory

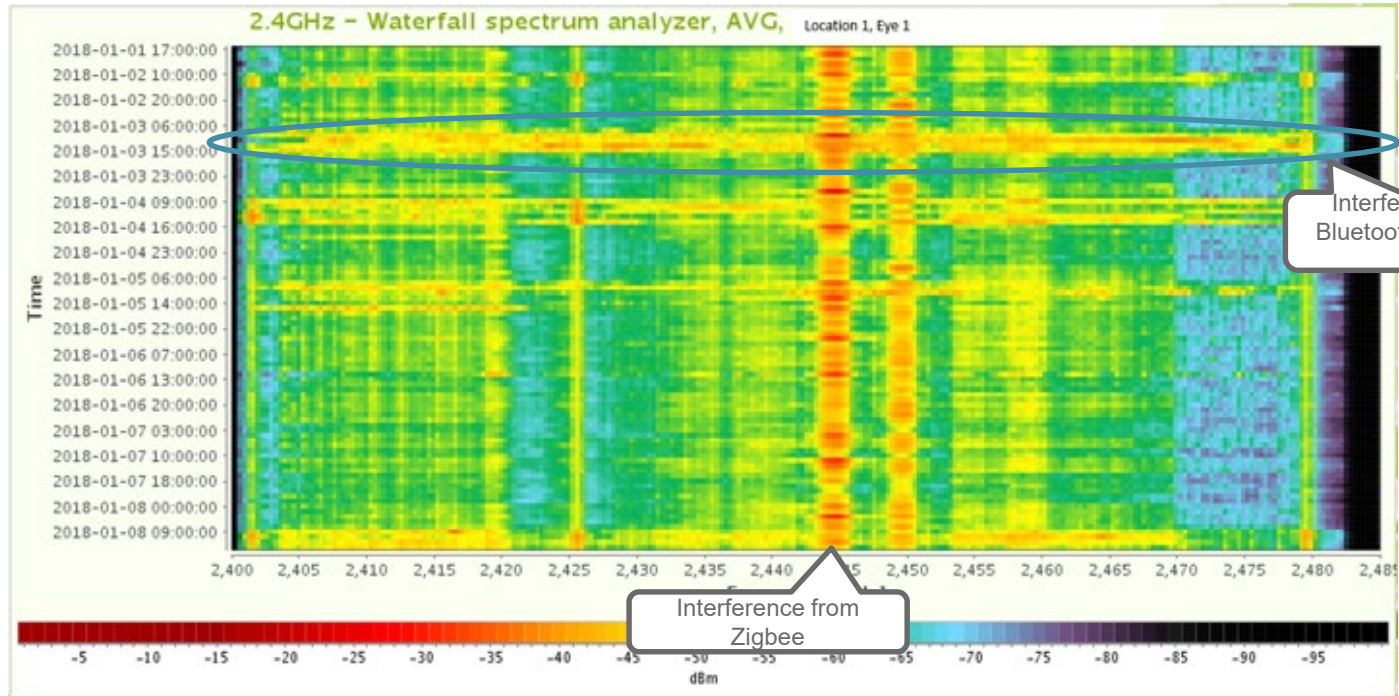
Platform	Make	Model	Adapter	Driver	Unique Devices
Windows					46
	LENOVO				45
		10AAS3R100			21
			Microsoft - Intel(R) Dual Band Wireless-AC 7260	17.15.0.5	16
			Microsoft - Realtek RTL8723BE Wireless LAN 802.11n PCI-E NIC	2023.43.914.2016	3
			Intel - Intel(R) Dual Band Wireless-AC 7260	18.33.13.4	1
			Intel(R) Centrino(R) Wireless-N 2230		1

Old drivers

Long Term Spectrum Analysis



IoT Protocols



Interference from Bluetooth during the day

Interference from Zigbee

Channel 1

Channel 6

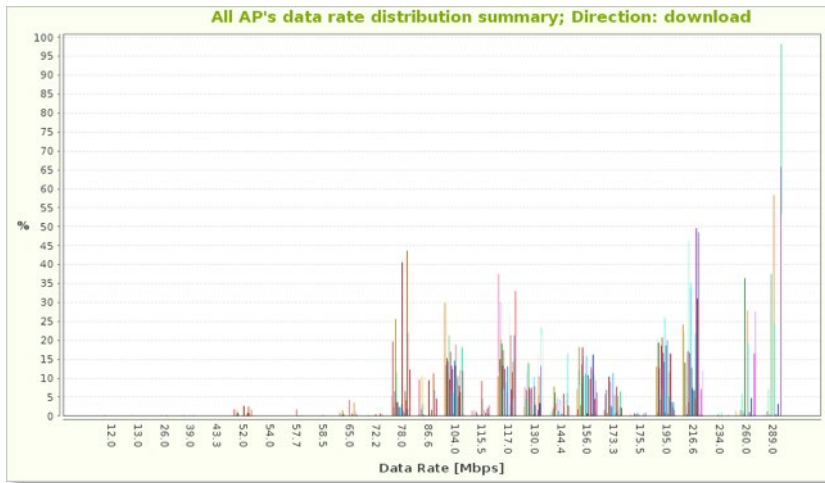
Channel 11

Capacity Planning

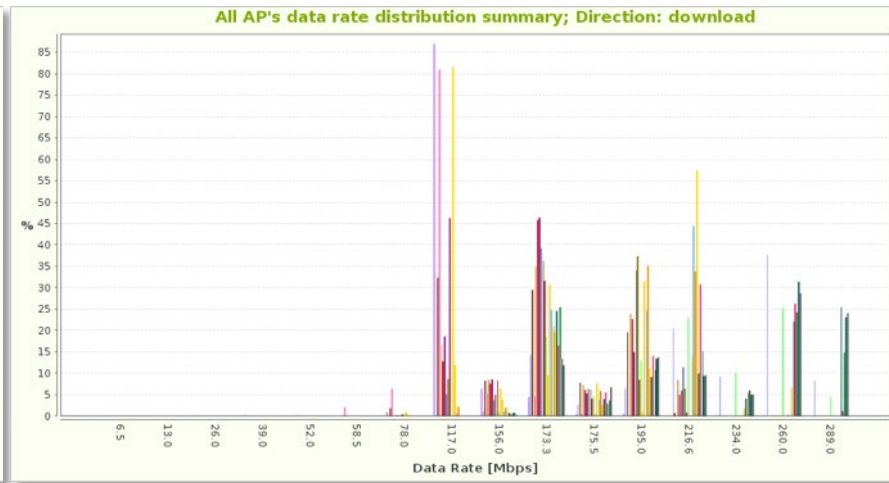
- AP Tx data rates
- Client Tx data rates
- Throughput
- Retry rates
- Airtime

What Datarates do AP's Actually Use?

Last generation 3SS 11ac AP's 5 GHz

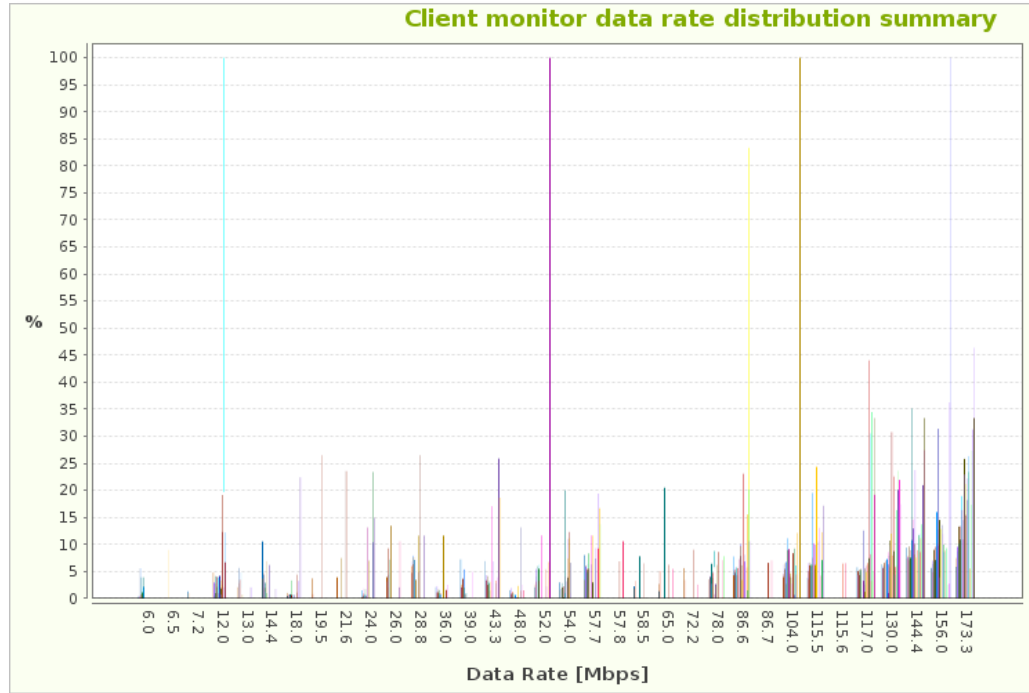


Current generation 3SS 11ac AP's 5 GHz



Same vendor, same AP placement, same sensors, but different AP models can have different dynamic rate switching algorithms.

Real Client Tx Data Rates

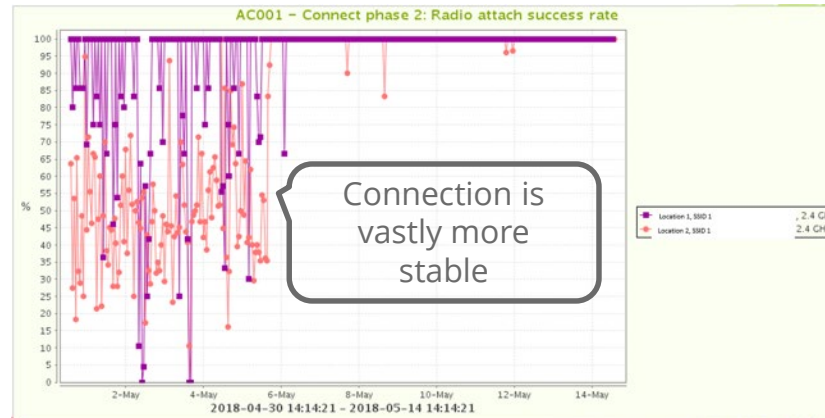
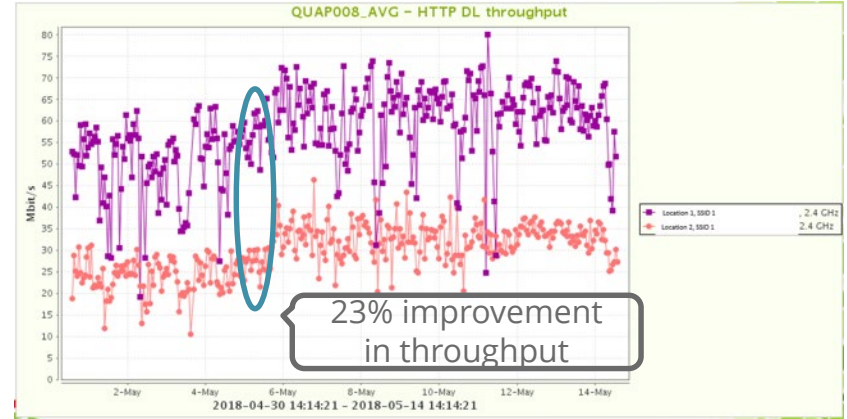
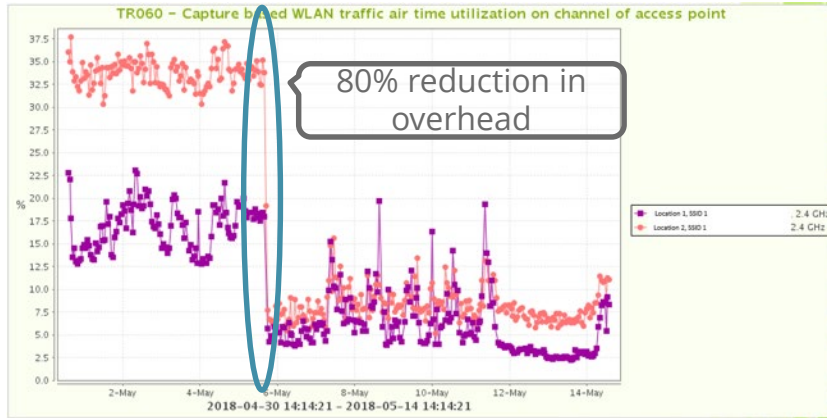


- 3SS 11ac AP
- All 2SS 11ac clients from the same chipset vendor

Validation

- Before and after measurements
- Software agents on local clients can tell you a lot
 - Real RSSI client for coverage, and client variability
 - Client roaming
 - Scan results for CCI/ACI
 - Real client throughput
 - Application reachability and performance
- Deploy portable hardware sensors to iffy areas
 - On-site staff can move them as needed
 - Your toolset, available remotely

Before and After Validation

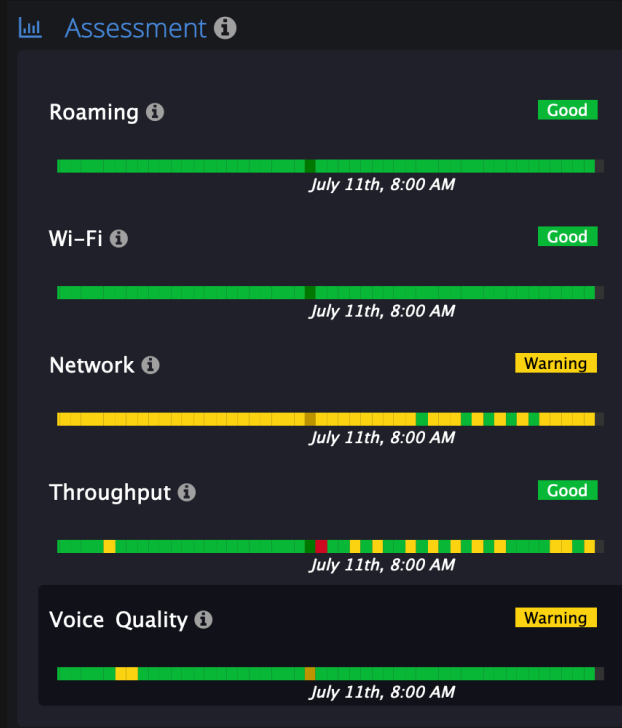


Sapphire Scout

- Small Form Factor hardware sensor
- 802.11ac wave-1 2x2 radio
- Spectrum analyzer!
- OTA packet capture
- Portable
- Plug-n-play
- Coming soon...

Client Experience for Validation

- Remote, scalable visibility into the client experience
- Is everything working?
 - Clients
 - WLAN
 - Network
 - Applications



Individual Client Experience for Validation

Analysis ⓘ

Roaming Wi-Fi Network Throughput Voice

MCS Index ⓘ



Signal-Noise Ratio

signal: -74.57 | noise: -89.63 | ratio: 15.06



Data Rate ⓘ

249.62 Mbps

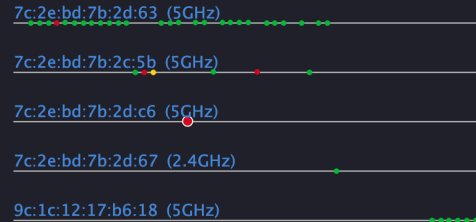


Analysis ⓘ

Roaming Wi-Fi Network Throughput Voice

Roaming History ⓘ

2 SF



Signal Strength (Minimum) ⓘ

-90 dBm



Best Neighboring Access Points ⓘ

-54.5 dBm



7c:2e:bd:7b:2d:67 9c:1c:12:17:b6:10
7c:2e:bd:7b:2d:63



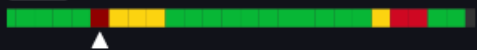
Aggregate Client Experience for Validation

Wi-Fi Performance Timeline ⓘ

Select a Network...

7sCORP

5GHz



Problems by Location ⓘ

Select a location to see all of its clients and problems...

Columbus Office

West Akron Office

Headquarters

Cincinnati Office

Problems by Client ⓘ

Select a client's problem count for details...

Client Name	Roaming	Coverage BETA	Congestion BETA	RF Problem BETA
wangler	0	0	7	0

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Aggregate Client Experience for Validation

Reports

- Select Report -

Jul 5th 9:55AM ~ Jul 12th 9:55AM

7sCORP

Columbus Office

Wi-Fi Client Problems (7sCORP / 5GHz / Columbus Office)

Client Name	Roaming	Coverage	Congestion	RF Problem
AgileJazz-rsw-nmbp.local	0	172	2	0
wangler	0	0	10	0

Aggregate Client Experience for Validation

Coverage ⓘ BETA July 12th, 7:11 AM EDT Critical

A coverage problem is indicated when the client's signal is bad, there is no roaming problem, and no better access point is available - [learn the basics.](#)

Signal	Sticky Factor	Best Neighbor
Critical -78 dBm	0	0 dBm

Network	Channel / Band	BSSID	Client Name
7sCORP	48,80 / 5GHz	84:16:f9:5d:d4:16	AgileJazz-rsw-nmbp.local

Coverage Evaluation Thresholds ▾

	Signal	Sticky Factor	Best Neighbor
Warning	< -70 dBm	0	N/A Or Weaker
Critical	< -75 dBm	0	N/A Or Weaker

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Congestion ⓘ October 17th, 2:24 PM EDT Critical

Congestion is indicated when signal and data rates are good, but throughput is bad - [learn the basics.](#)

Signal	Data Rate	Throughput	Channel Utilization	Client Count
-49 dBm	866.7 Mbit/s	0.72 Mbit/s	6 %	3

Network	Channel / Band	BSSID	Client Name
7sCORP	48 / 5GHz	84:16:f9:5d:d4:16	Wangler

Congestion Evaluation Thresholds ▾

	Signal	Data Rate	Throughput	Sticky Factor
Warning	≥ -60 dBm	> 50 Mbit/s	< 5 Mbit/s	0
Critical	≥ -50 dBm	> 50 Mbit/s	< 2 Mbit/s	0

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Co-Channel Interference

Co-Channel Interference ⓘ November 1st, 3:52 PM EDT

Critical

Two or more APs are interfering with each other by trying to serve clients on the same channel

RSSI By AP / BSSID

Avg. Channel Utilization or Download
Throughput ⬇

Critical (-65 dBm) Sales_Room
(-58 dBm) MtgRoom_B
(-70 dBm) 00:01:02:03:04:05 54 %

Location	Network	Channel / Band	AP Name	Client Name
Headquarters	Corp	153 (80MHz) / 5GHz	Sales_Room	My Laptop

[Co-Channel Interference Evaluation Thresholds >](#)

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Adjacent Channel Interference

Adjacent-Channel Interference ⓘ November 1st, 3:52 PM EDT

Critical

Two or more APs are interfering with each other because their channels overlap

	Channel / RSSI By AP / BSSID	Avg. Channel Utilization or Download Throughput
● Critical	(60, 80Mhz, -65 dBm) Cafe_AP1 (52, 80MHz, -58 dBm) MtgRm_A (64, 80MHz, -70 dBm) 00:01:02:03:04:05	54 %

Location	Network	Channel / Band	AP Name	Client Name
Headquarters	Corp	60 (80MHz) / 5GHz	Cafe_AP1	My Laptop

[Adjacent-Channel Interference Evaluation Thresholds >](#)

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More RF Problems

RF Problem ⓘ BETA June 19th, 9:18 AM EDT Warning

	Signal	Data Rate ⬇	Throughput ⬇	Sticky Factor
● Warning	-50.5 dBm	13 Mbit/s	4.51 Mbit/s	0

Network	Channel / Band	AP Name	Client Name
917ri0583981	149 / 5GHz	FTC339.6f70	FTT3SW010416MW

RF Problem Evaluation Thresholds ∨

	Signal	Data Rate ⬇	Throughput ⬇	Sticky Factor
● Warning	≥ -60 dBm	< 33 Mbit/s	< 5 Mbit/s	0
● Critical	≥ -50 dBm	< 33 Mbit/s	< 2 Mbit/s	0

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Identify Bad Clients

Wi-Fi Client Problems (5GHz / 7SIGNAL Headquarters) ⓘ

Client Name	Roaming	Coverage	Congestion	RF Problem
James-PC	87	99	85	0
JoshLanesDell	42	0	11	0
aab-mb.localdomain	17	0	0	0
BigU-Dell-XPS-15-9570	0	1	55	0
Joe's Work Laptop	20	0	2	0
CAMULLI	3	3	2	0
Tom's Laptop	0	0	3	0
Riegelsberger-PC	1	0	0	0
vickersjames8	0	0	2	0
Tom's iPhone 031D50	0	0	0	0
chriss-Air	0	0	0	0

Ongoing Support and Operations

- Portable sensors can be moved by local staff to problem areas
 - 24/7 visibility
 - Proactive alarms
 - The Wi-Fi engineer's toolset, available remotely
- Software agents for help desk/client visibility
- Network-as-a-sensor for end-to-end visibility



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Thank You