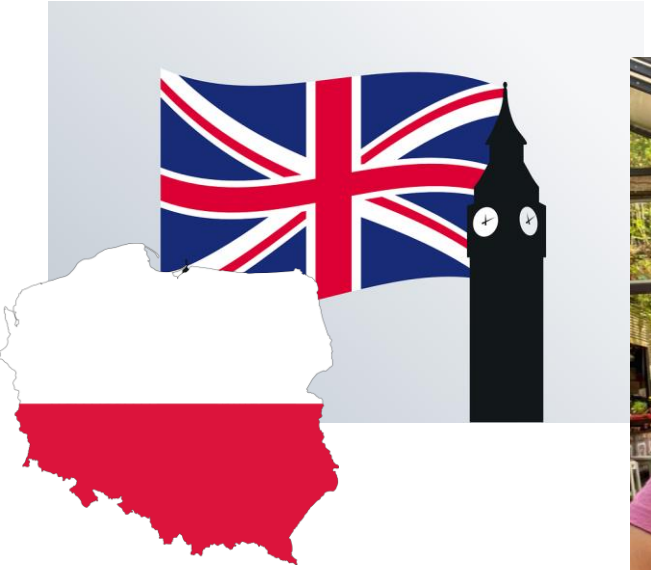
Meraki Wireless from a Troubleshooter perspective

Jakub Talalaj - Technical Leader at Meraki Escalations
@jaktalal

BRKEWN-2399



Who is this guy?









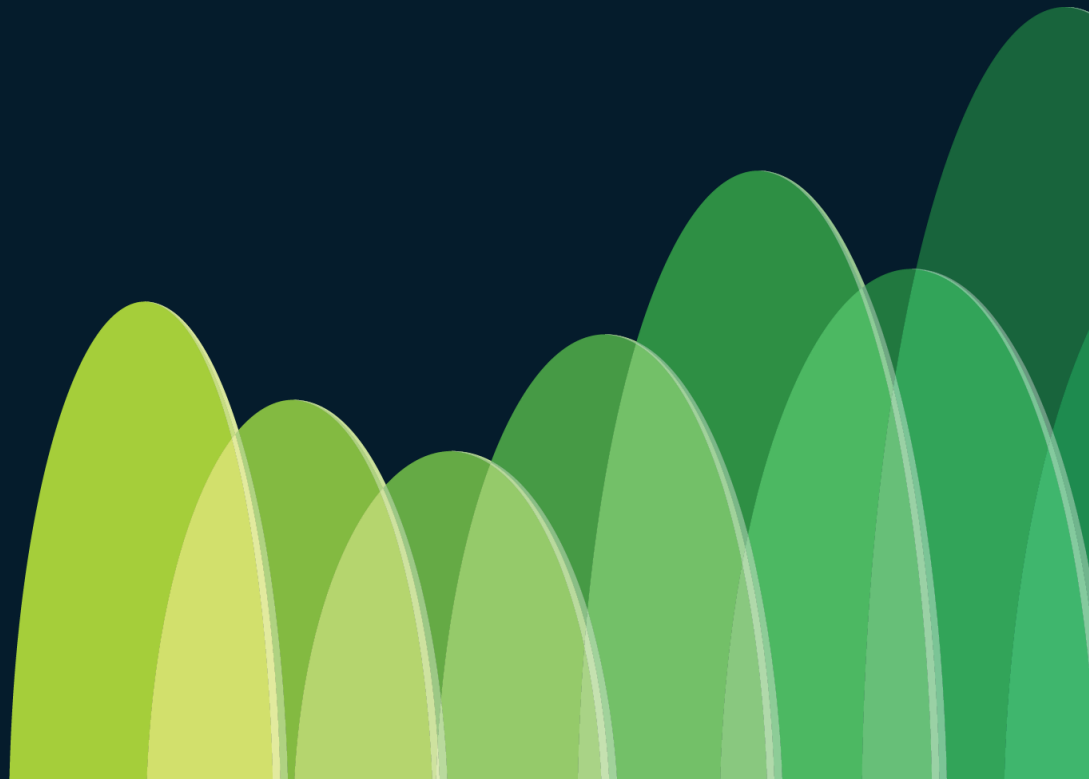
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Agenda

- Troubleshooting mindset
- Common problems and troubleshooting
  - AP Cloud join and management
  - Client join
  - Performance

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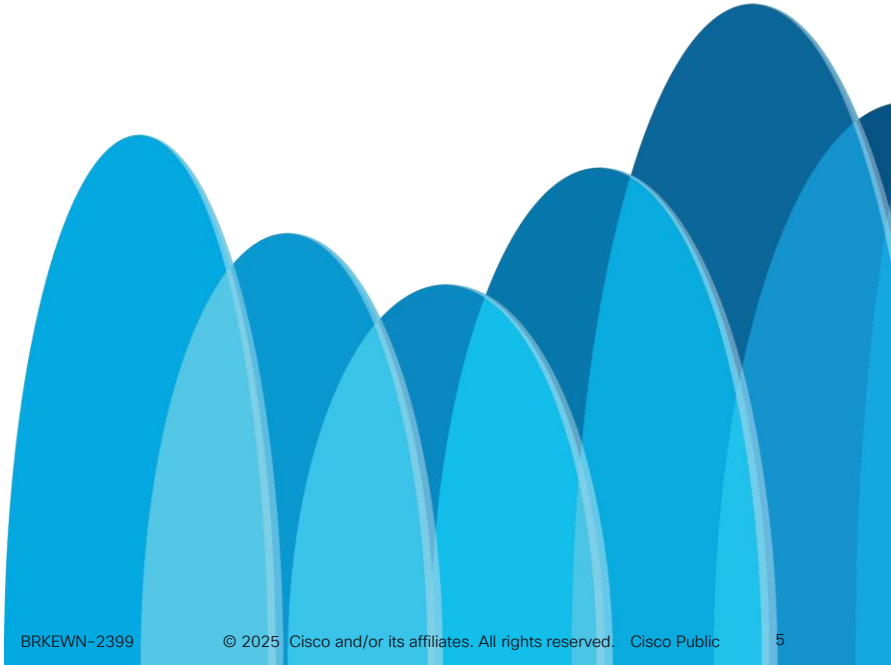
Troubleshooting mindset



cisco Live!

“WiFi does not work”

Every User. Everywhere



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Problem resolution is only as effective as the description

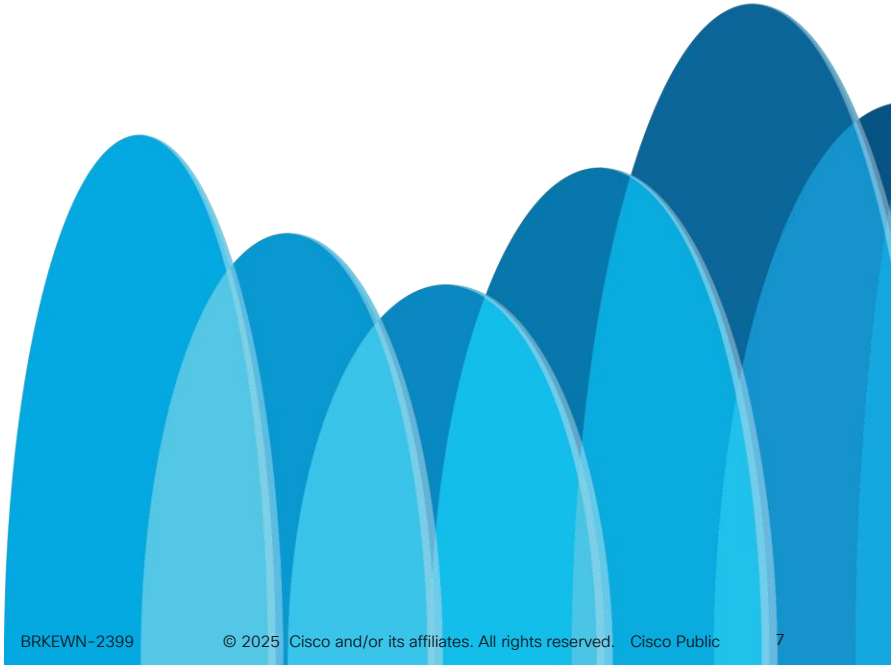
- *”Wireless is un-usable in the meeting room”*
- *“Choppy voice, pixelated video”*
- *“Everything is slow”*
- *“Random disconnects”*
- *“Unable to connect”*

- Sticky client
- Oversubscription / lack of capacity
- High number of APs
- High cell-overlap, CCI
- Hidden node
- Infrastructure weirdness

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“It must be a problem with Meraki.”

Every Customer



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Asking the right questions will get you closer

What is the **problem**?

What **device type** and **SSID** is impacted?

Provide **recent examples** (device details, timestamp, define user activity)

Does it affect particular **location** at particular **time**s?

What is the **most important least capable device**? What is the **mission critical application**?

What is the **business impact**?

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If you can describe the problem in one sentence, You will Fix it

But how often are you able to get a problem statement like this?

“WiFi does not work”  *“Cisco 840 running 1.9(1) fails to FT Roam between CW9166I running MR29.7.1”*

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Escalation principles

No pcaps = didn't happen

Trust but verify

In data we trust



Eyes in the back of your head

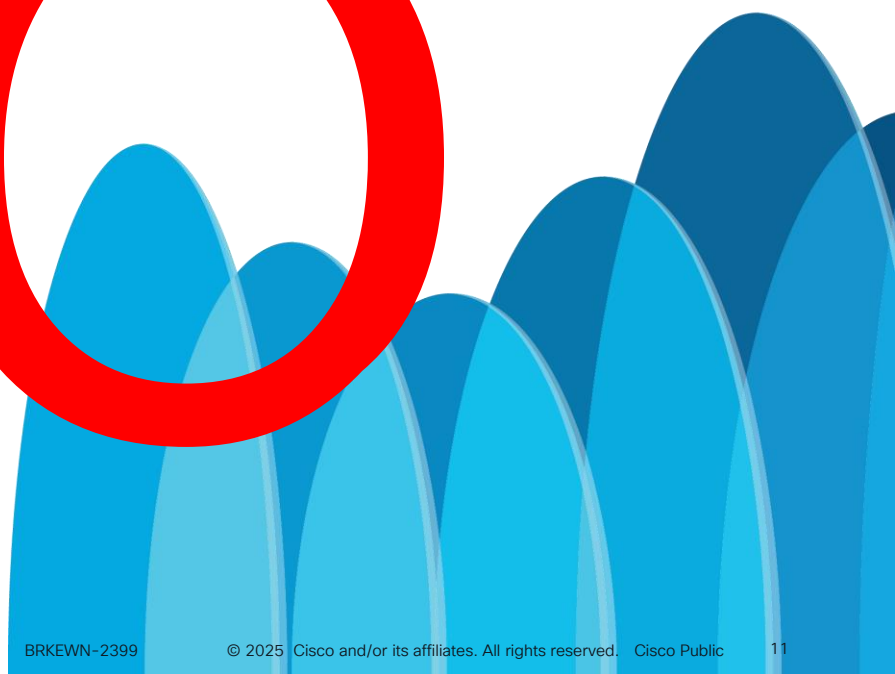
Behind every data there is a story

5 min workaround beats 1 hour of troubleshooting

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Can AI replace a problem solver?

NO



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AI will help but never replace

AI Capabilities

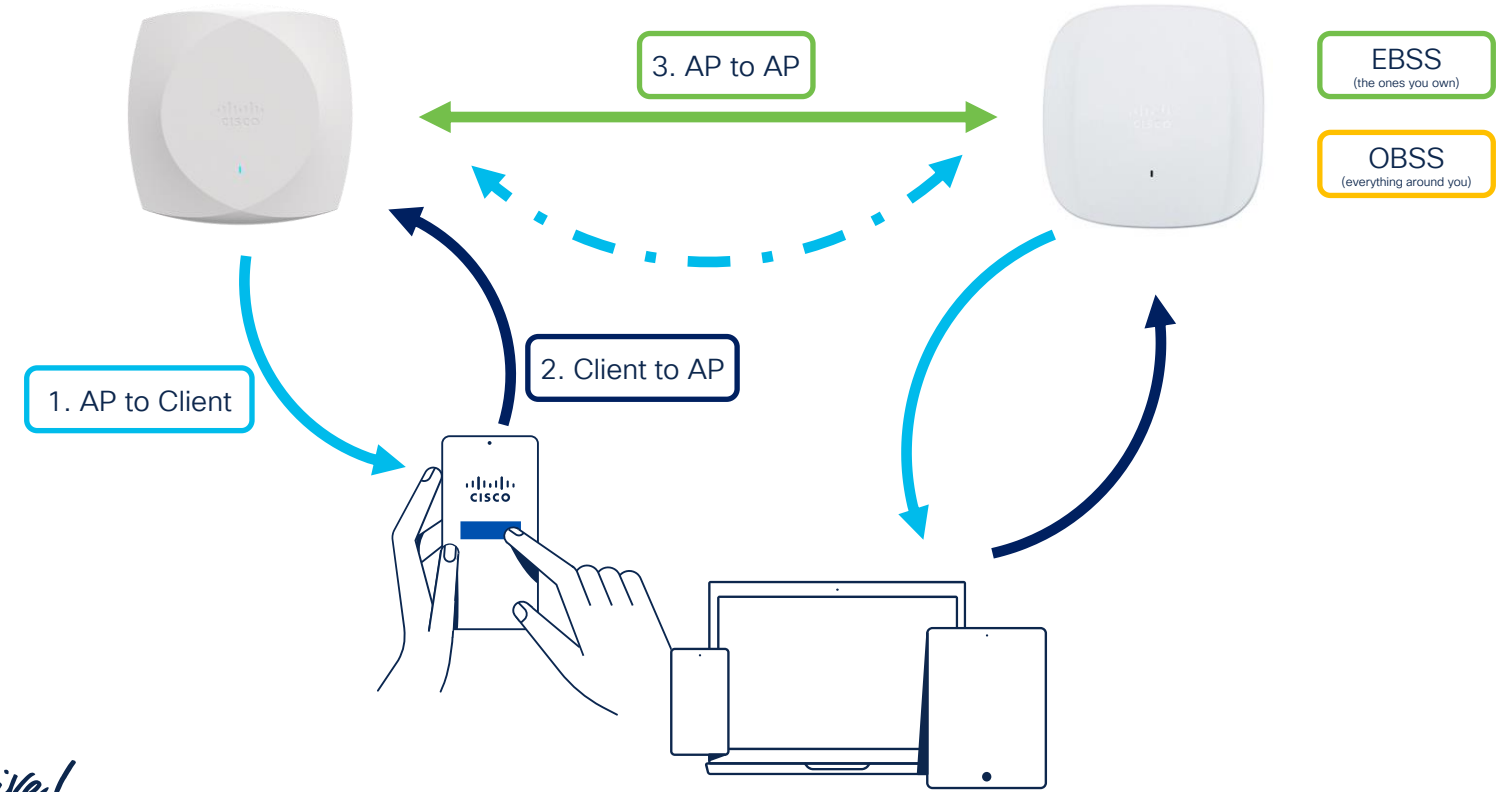
- Data analysis
- Efficiency
- Consistency

Human capabilities

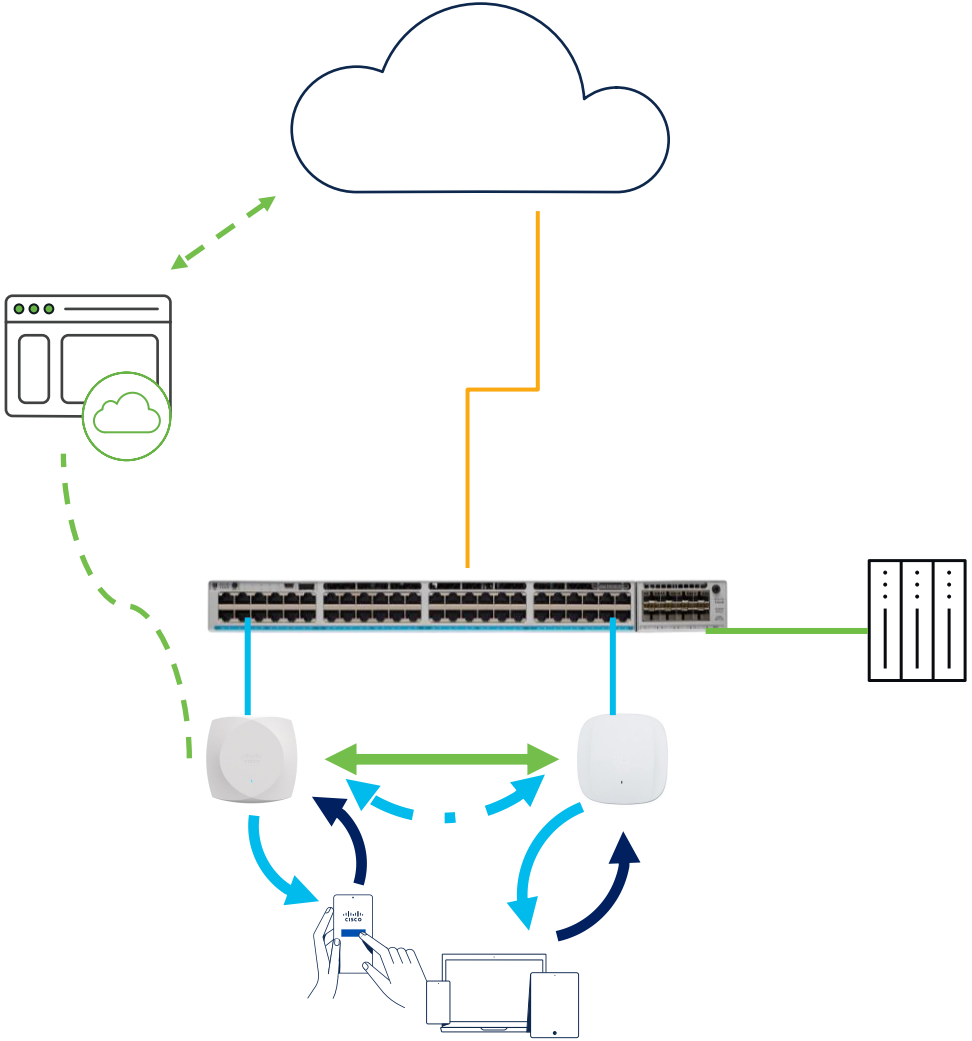
- Creativity
- Intuition
- Complex Understanding
- Adaptability

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How many points of troubleshooting do we see?

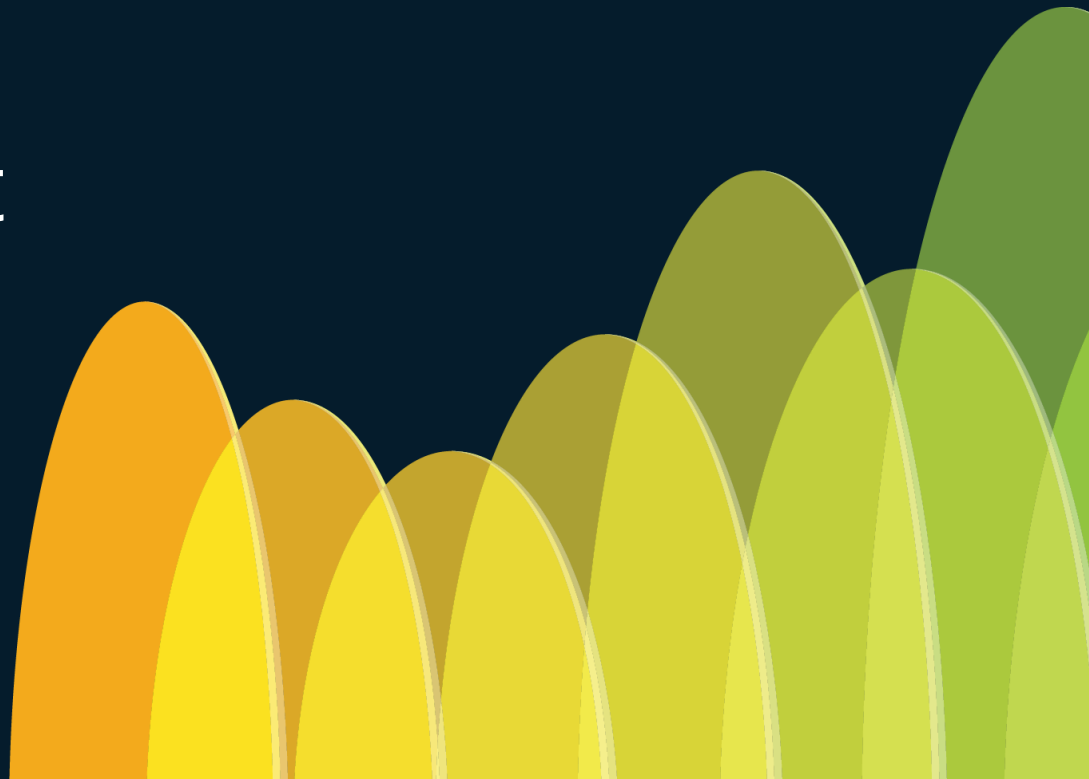


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AP management plane



cisco Live!

AP not coming online in the dashboard

AP is physically online but does not register with cloud



Ok, let’s check a few things



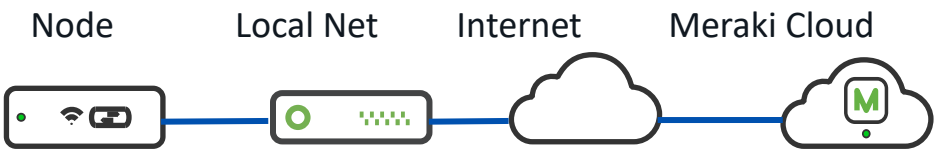
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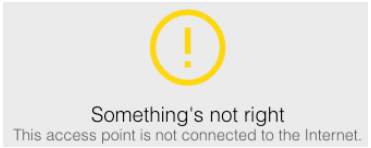
Couple of basic checks can save you a case

- Port config
- Power
- IP
- Routing (LAN and WAN)
- Firewall info page
- Anything interesting above L4

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Checks





Port status	Port Up
Power	802.3at
IP address	Using 10.10.10.10
GW communication	GW 10.10.10.1 reachable
DNS resolution	DNS resolution successful
NTP communication	Using NTP a.b.c.d
Public IP communication	Public IPs reachable
Meraki Cloud communication	Meraki Cloud Unreachable

Node is failing to communicate with IP 209.x.x.x UDP/TCP port 7351/443, ensure your firewall is not blocking this traffic.

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Firewall info page provides everything your device needs to become green

Source IP ▲	Destination IP	FQDN	Ports	Protocol	Direction	Description	Devices using this rule
Your network(s)	64.62.142.12/32, 158.115.128.0/19, 209.206.48.0/20, 216.157.128.0/20		7351, 9350-9381	UDP	outbound	Meraki cloud communication, VPN registry	Access points, Cameras, MX Security Appliance, Switches
Your network(s)	0.0.0.0/0	api.meraki.com	443	TCP	outbound	API Requests	
Your network(s)		cloud-meraki-asn.amp.cisco.com	443	TCP	outbound	Advanced Malware Protection (AMP) Lookups	MX Security Appliance
Your network(s)		cloud-meraki-est.amp.cisco.com	443	TCP	outbound	Advanced Malware Protection (AMP) Enrollment	MX Security Appliance
Your network(s)	158.115.128.0/19, 209.206.48.0/20, 216.157.128.0/20	syslog.log-ingester.emea.production.insight.meraki.com	443	TCP	outbound	Insight data collection	MX Security Appliance
Your network(s)	209.206.48.0/20	registry.meraki-applications.com	443	TCP	outbound	Meraki Container Registry	MX Security Appliance
Your network(s)	17.0.0.0/8		443, 2195-2196, 5223	TCP	outbound	iOS Systems Manager communication	Systems Manager
Your network(s)	0.0.0.0/0		5228-5230	TCP	outbound	Android Systems Manager communication	Systems Manager
Your network(s)	198.27.154.14/32, 13.251.22.225/32, 18.139.30.19/32, 52.64.93.238/32, 13.237.212.134/32, 13.215.192.136/32, 52.76.93.162/32, 18.153.157.174/32, 3.125.165.17/32, 3.64.43.250/32, 3.120.110.72/32, 3.70.89.174/32, 3.134.137.203/32, 3.12.119.245/32, 3.13.96.175/32, 3.20.198.200/32, 3.132.164.124/32, 3.141.76.140/32, 18.189.238.176/32, 3.12.45.197/32, 3.13.41.11/32, 35.83.73.230/32, 35.166.60.8/32, 34.208.168.67/32, 35.83.153.224/32, 35.167.61.13/32, 44.228.122.230/32, 34.211.166.40/32, 52.43.10.180/32, 35.84.224.170/32, 52.24.202.158/32, 34.218.6.117/32, 34.211.165.157/32, 35.164.43.196/32, 52.40.228.109/32, 54.212.241.230/32, 54.200.126.77/32, 54.213.72.213/32, 52.37.59.221/32, 35.160.113.242/32, 35.155.128.150/32, 54.184.179.181/32, 44.237.182.41/32, 52.89.0.105/32, 35.85.66.39/32, 158.115.128.0/19, 209.206.48.0/20, 216.157.128.0/20		443, 30001	TCP	outbound	Camera streaming proxy	Cameras
Your network(s)	0.0.0.0/0, 2606:6940:0000:0000:0000:0000:0000:0000/32, 2606:7bc0:0000:0000:0000:0000:0000:0000/32, 2620:012f:c000:0000:0000:0000:0000:0000/44		80, 443	TCP	outbound	Systems Manager agent communication, Splash pages, MV cloud archive, Meraki cloud communication	Access points, Cameras, MX Security Appliance, Switches, Systems Manager
Your network(s)	158.115.128.0/19, 209.206.48.0/20, 216.157.128.0/20		80, 993, 7734, 7752, 60000-61000	TCP	outbound	Backup Meraki cloud communication, Backup configuration downloads, Measured throughput to dashboard.meraki.com, Backup firmware downloads, Mac/Windows remote desktop, Mac/Windows agent communication	Access points, Cameras, MX Security Appliance, Switches, Systems Manager
Your network(s)	8.8.8.8/32		8888	UDP	inbound	802.1X with customer-hosted RADIUS	Access points

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Connectivity (UTC-8)	Local IP	Public IP
	10.92.128.32	50.216.
	10.92.129.166	50.216.
	10.92.128.31	50.216.
	10.92.128.99	50.216.
	10.92.128.53	50.216.
	10.92.128.228	50.216.
	10.92.128.95	50.216.
	10.92.176.212	50.216.
	10.92.176.213	50.216.
	10.92.176.206	50.216.

Are there other Meraki devices that are healthy in your network?



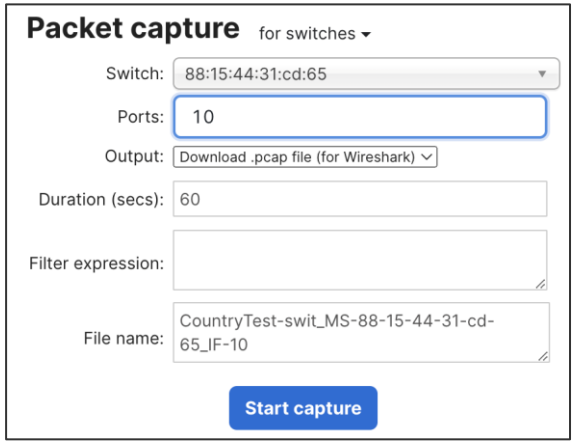
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Dashboard Connectivity Troubleshooting

If the offline node is connected to an online Meraki node.

Basic Network Check

- Power status
- Port status
- VLANs
- IP status (static / DHCP)
- DNS
- NTP
- Internet reachability
- Meraki Cloud reachability
- SSL inspection



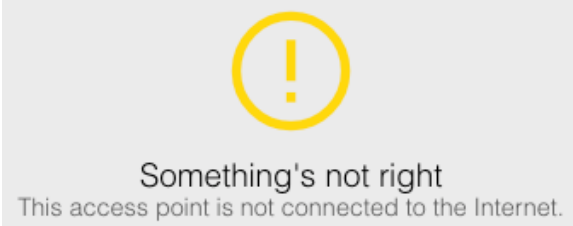
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Dashboard Connectivity Troubleshooting

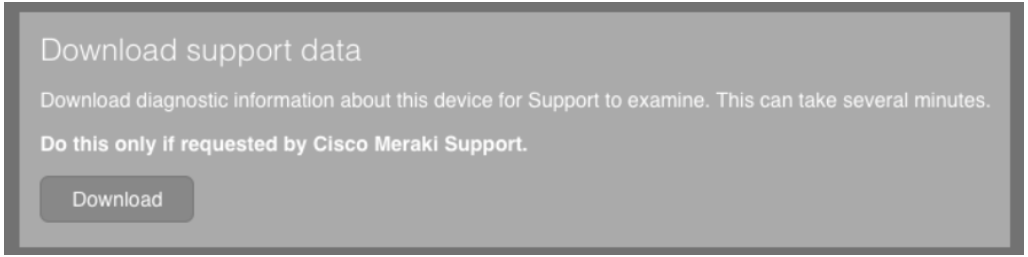
If the offline node is NOT connected to an online Meraki node and the user was able to open the LSP.

Basic Network Check

- Power status
- Port status
- VLANs
- IP status (static / DHCP)
- DNS
- NTP
- Internet reachability
- Meraki Cloud reachability
- SSL inspection



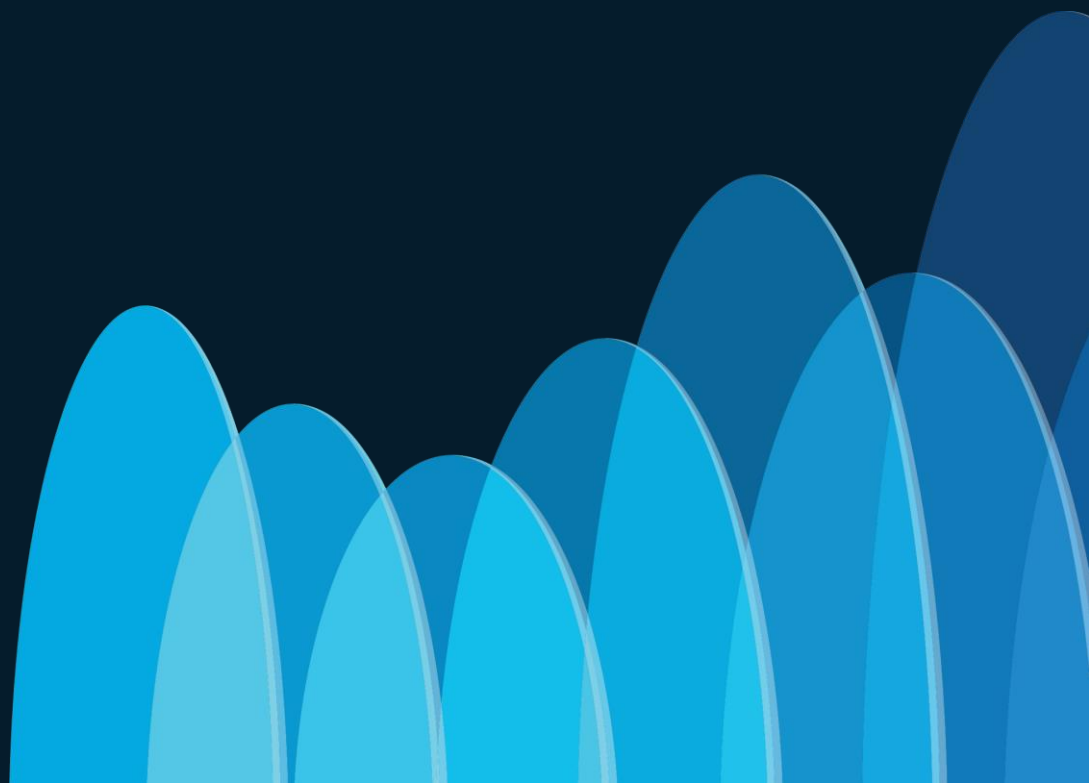
Support asks for OOB logs / support bundle



- The user send the file
- NSE (Network Support Engineer) decrypts the file
- NSE navigate through all the files and try to make sense of the logs

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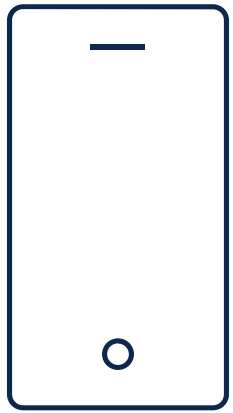
Client join



What is client responsible for?



1. AP Selection
2. Association and Auth
3. *Uplink** data rates
4. Roaming decision
5. Randomly disconnect



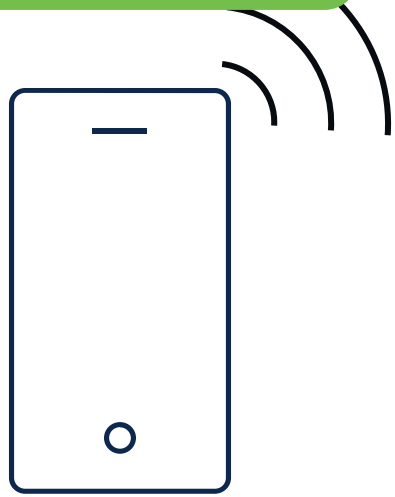
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Associate and Authenticate
- Compatibility
- Authenticate
- Handshake

Select the AP candidate
- RSSI / SNR
- Band
- Channel width
- Security
- Load



Get IP and enjoy
- IP
- ARP
- DNS

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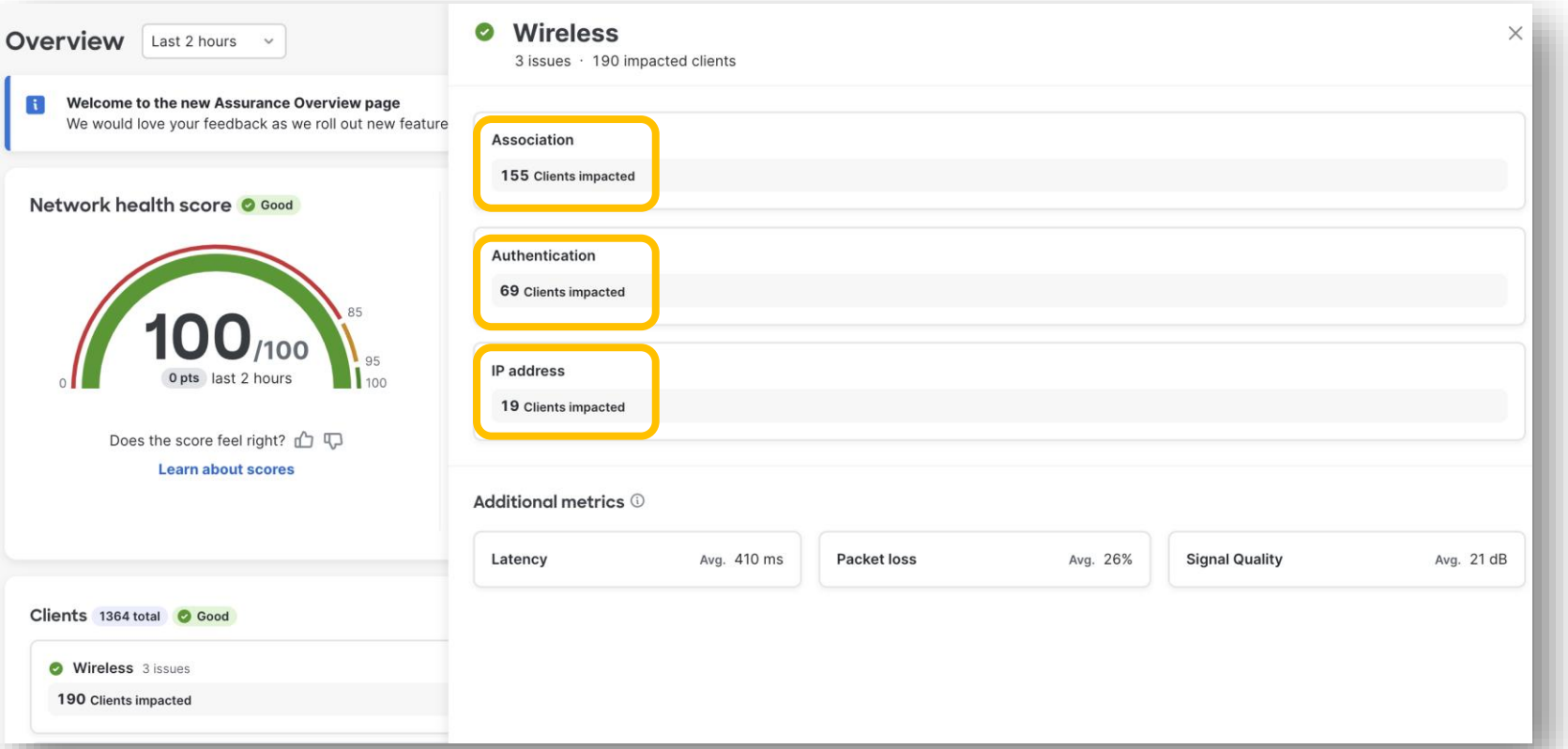
Common problem example





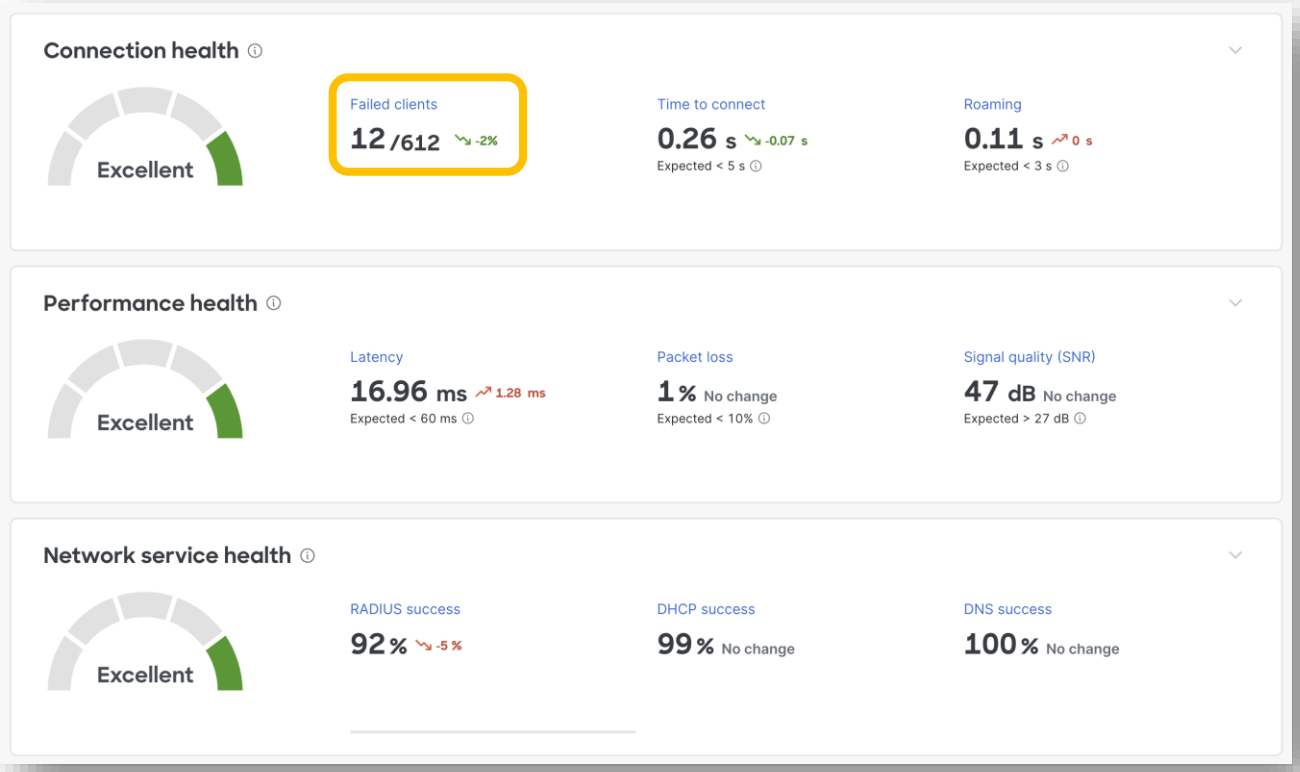
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Assurance overview shows network state



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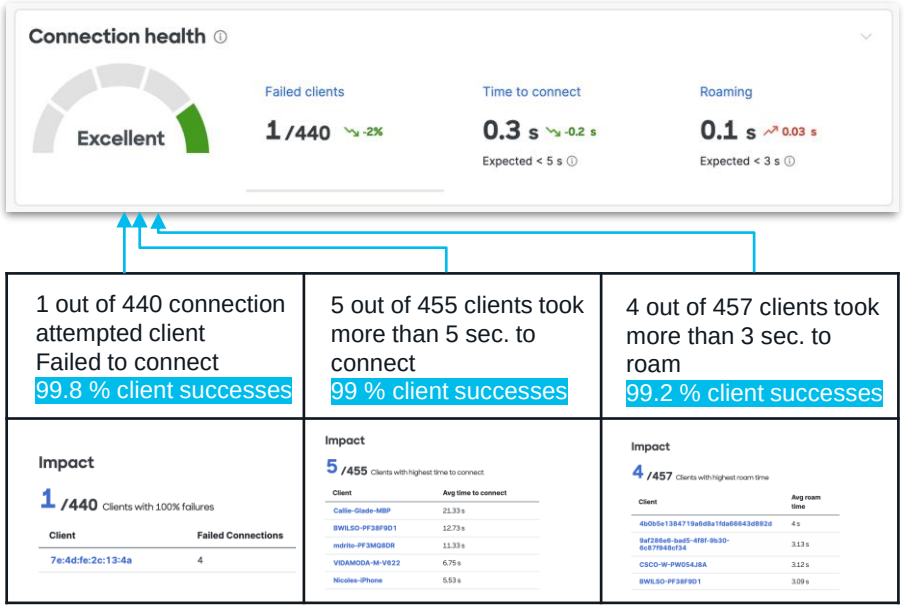
Wireless Health Overview will guide you



- Every number has a story to tell
- Click to unleash the insights
- Health metric is always based on Client Count Ratio
- It will always cherry-pick the most impacted clients

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And will give you insights that you need



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Common problem example

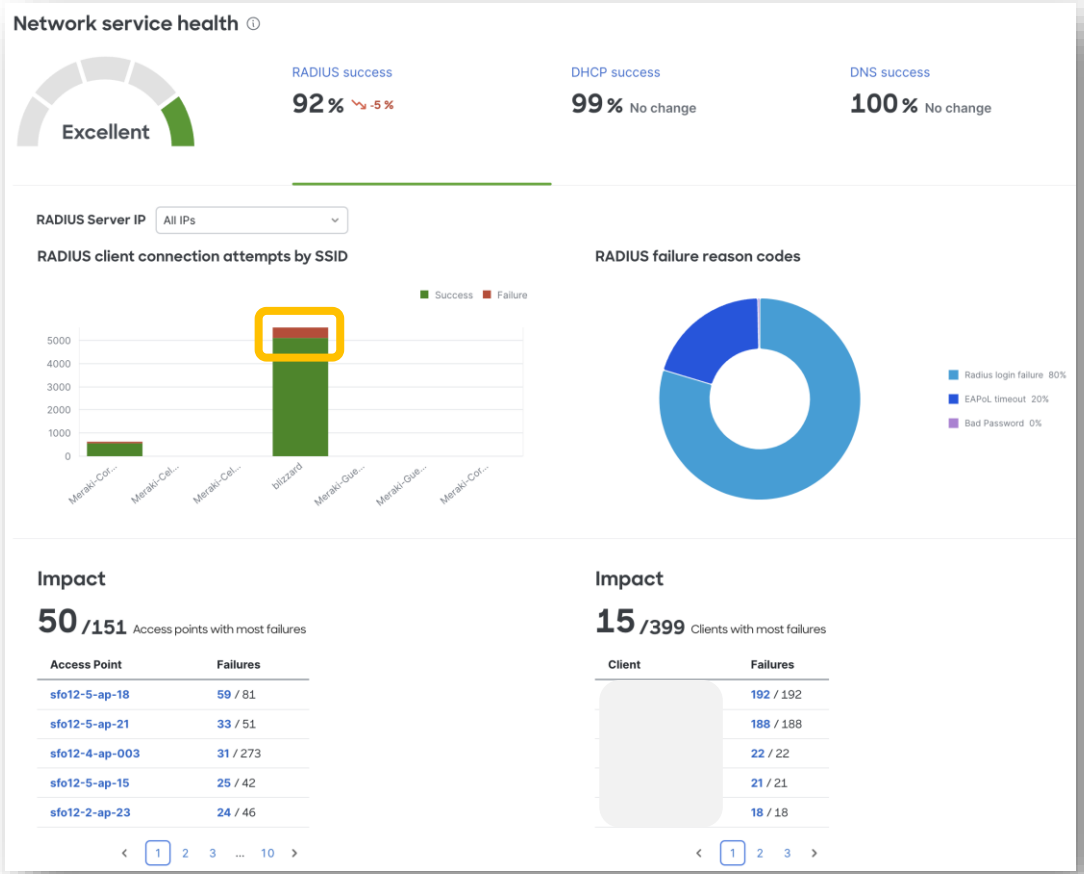
It seems that all .1x SSIDs are facing this problem



It seems that only handful of devices failed to connect over the past 2 hours – do you have more details?

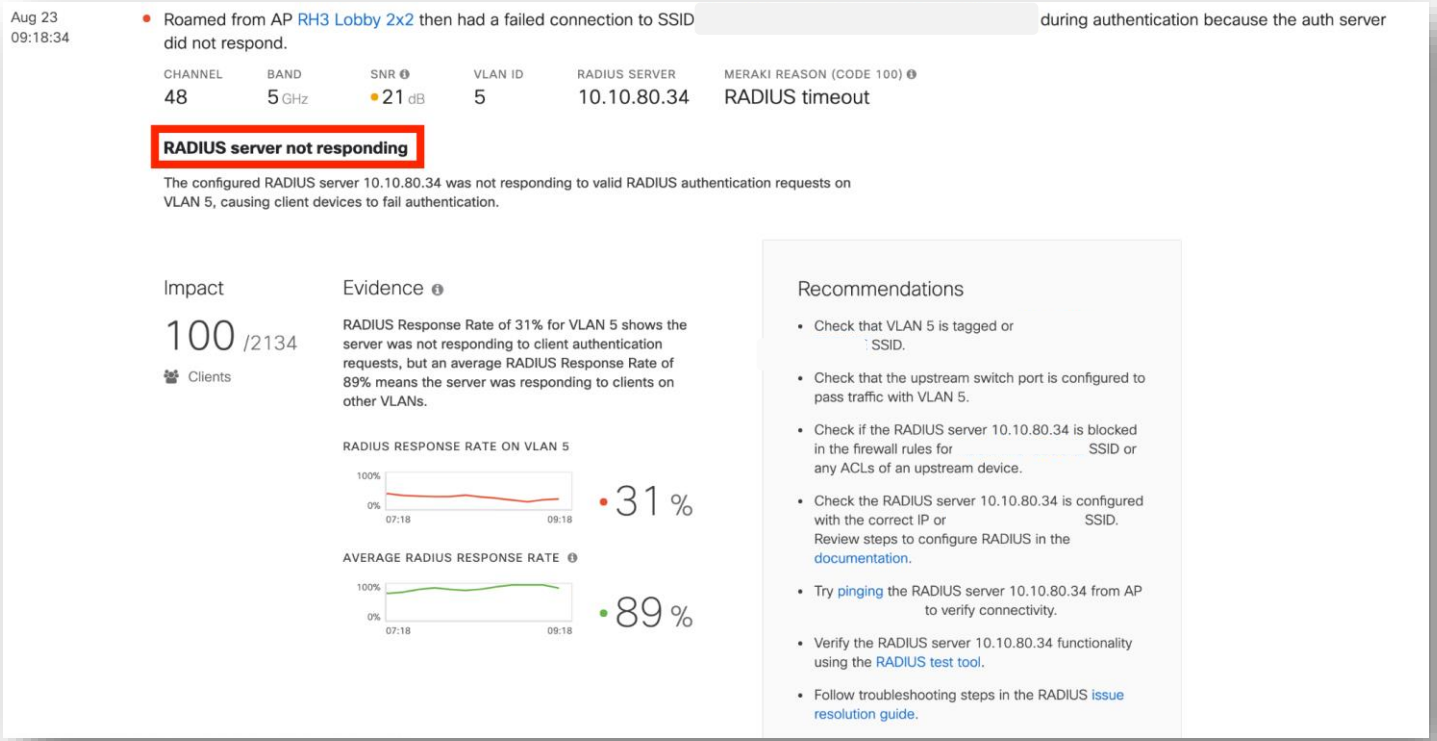


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- Look at all Radius connections per SSID
- Filter per Radius IP to better scope
- Select sample client to investigate the timeline

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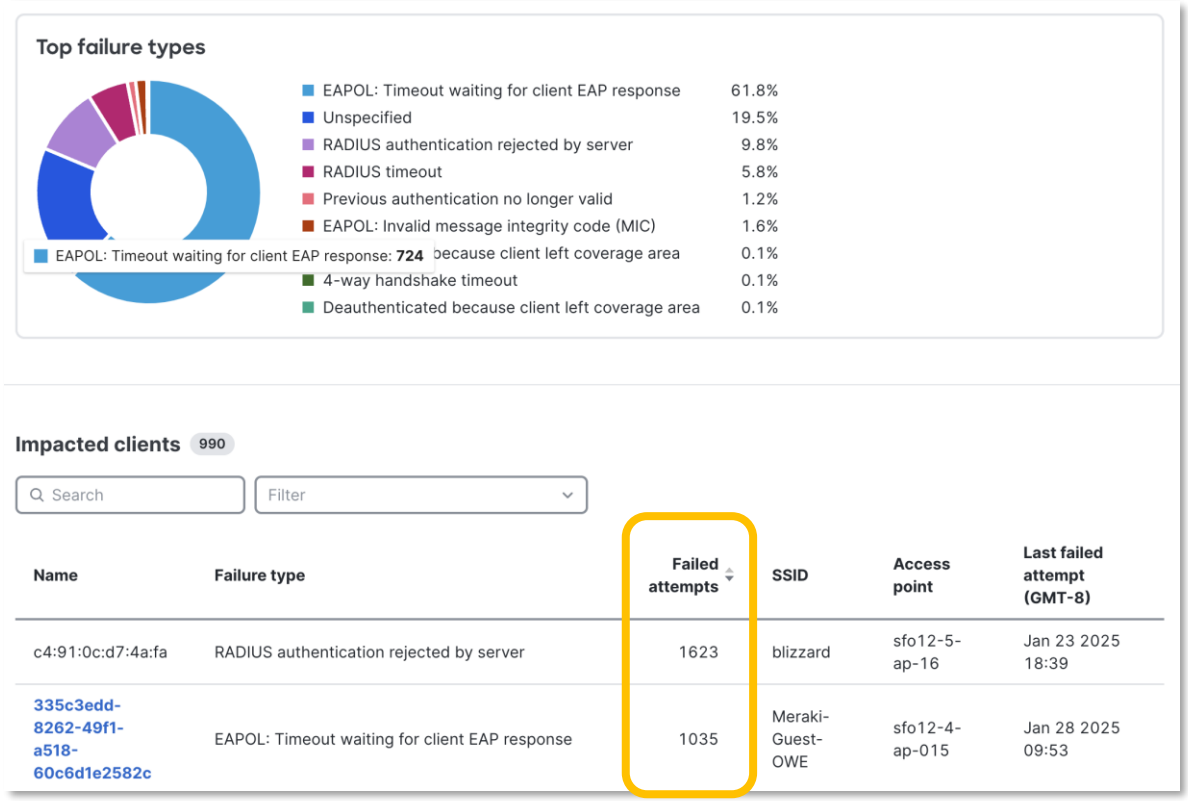
- Looks like server does not want to speak to the AP

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You can find some interesting data on those pages



You can find miss-behaving clients or bad actors

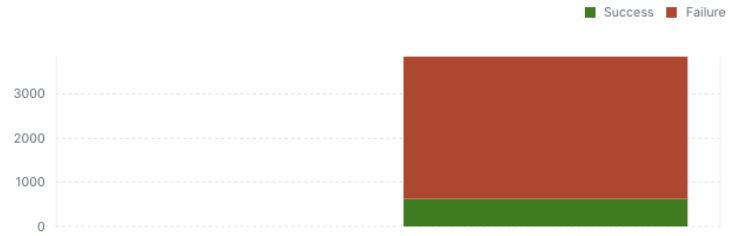


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You can find miss-behaving clients or bad actors

RADIUS Server IP: All IPs

RADIUS client connection attempts by SSID



RADIUS failure reason codes



Impact

31 /118 Access points with most failures

Access Point	Failures
070	521 / 531
067	513 / 532
043	397 / 408
·028	240 / 240
·027	198 / 198

Impact

4 /233 Clients with most failures

Client	Failures
Android	3176 / 3176
ca:44:d6:6d:05:e8	7 / 7
92:09:ae:7f:59:02	5 / 5
P24-9FCW600856N	2 / 10

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Common problem example

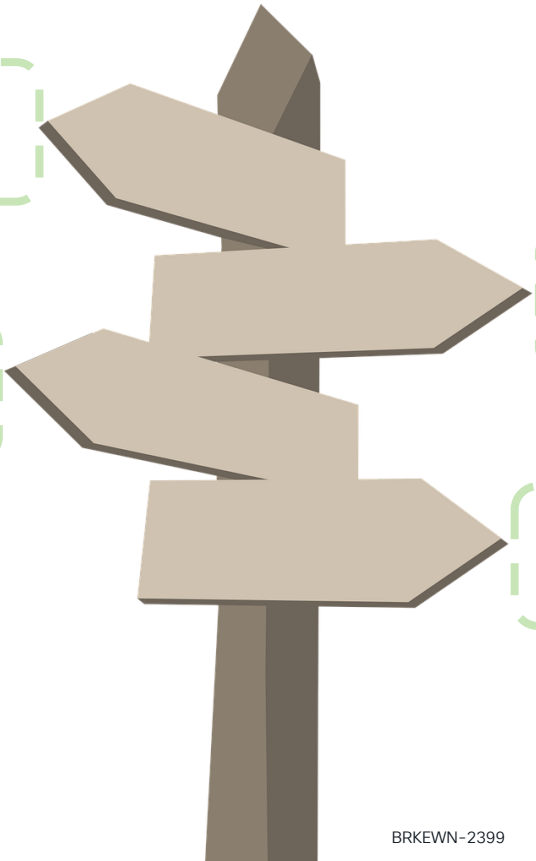


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With the details we can go multiple directions

Client details page > Timeline

Network Wide > Event log



Wireless Health > Connection Log

PCAPS

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Network Wide > Event log

Feb 12 14:51:42	sfo12-5-ap-38-elev	Meraki-Corp	RAYILAM-M-PX6K	802.11	802.11 disassociation	802.11_reason_code = undefined
Feb 12 14:51:42	sfo12-5-ap-38-elev	Meraki-Corp	RAYILAM-M-PX6K	802.11	802.11 disassociation	client not responding
Feb 12 14:51:35	sfo12-4-ap-041-elev	Meraki-Corp	RAYILAM-M-PX6K	802.1X	RADIUS response	radio: 2, vap: 0, group: « hide rtt 0.015 ms attr 11
Feb 12 14:51:35	sfo12-4-ap-041-elev	Meraki-Corp	RAYILAM-M-PX6K	802.11	802.11 association	channel: 133, rssi: 16, band: 6

Wireless Health > Connection Log

Connection start time ▼	Client device	Access point	SSID	Failure stage	Failure reason
Wed Feb 12, 2025, 14:55:16	RAYILAM-M-PX6K	sfo12-4-ap-041-elev	Meraki-Corp	Authentication	auth_mode='wpa3-802.1x' vlan_id='132' radius_proto='ipv6' radius_ip='fd0a:9b09:1f7::1812:0' reason='eapol_timeout' reassoc='1' roam_ap='6A:49:B2:3F:E0:B0' radio='2' vap='0' channel='133' rssi='15'

Client details page > Timeline

Feb 12 14:51:35

Roamed from access point sfo12-5-ap-38-elev then had a failed connection to SSID Meraki-Corp on access point sfo12-4-ap-041-elev during authentication because the client did not provide credentials.

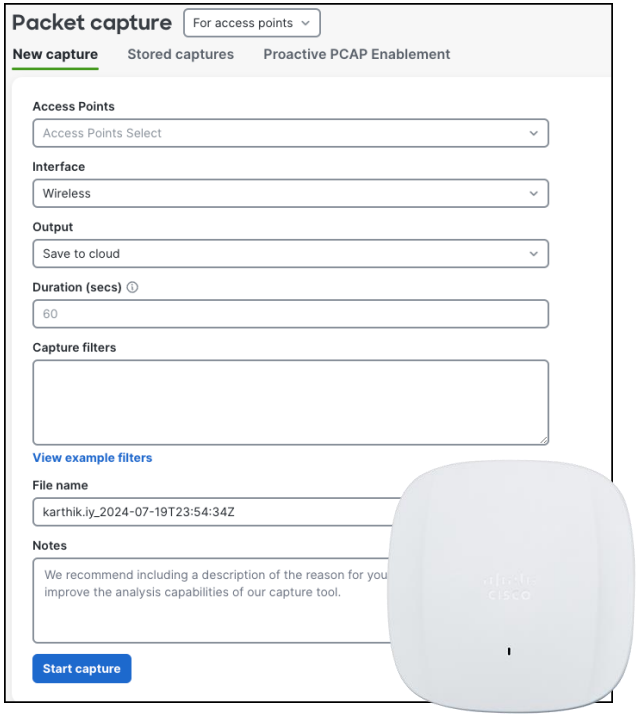
Packet capture

CHANNEL	BAND	SNR	VLAN ID	RADIUS SERVER	MERAKI REASON (CODE 101)
133	6 GHz	15 dB	132	fd0a:9b09:1f7::1812:0	EAPoL timeout

Download packet capture | View in packet viewer

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AP captures are the present and future

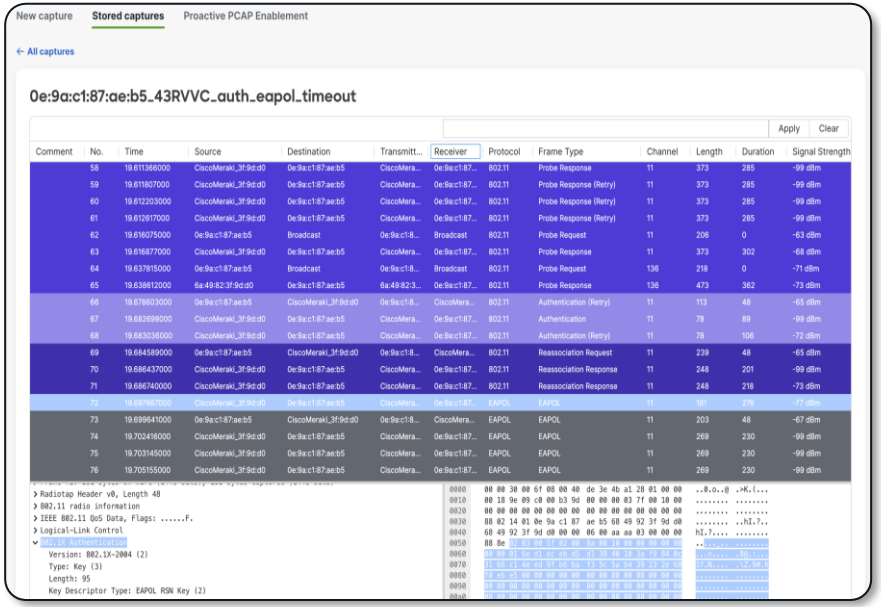


- Simple and convenient (remote/proactive)
- Decrypted
- Highest likelihood of capturing all Data frames (OFDMA/MIMO/High)
- Bi-directional

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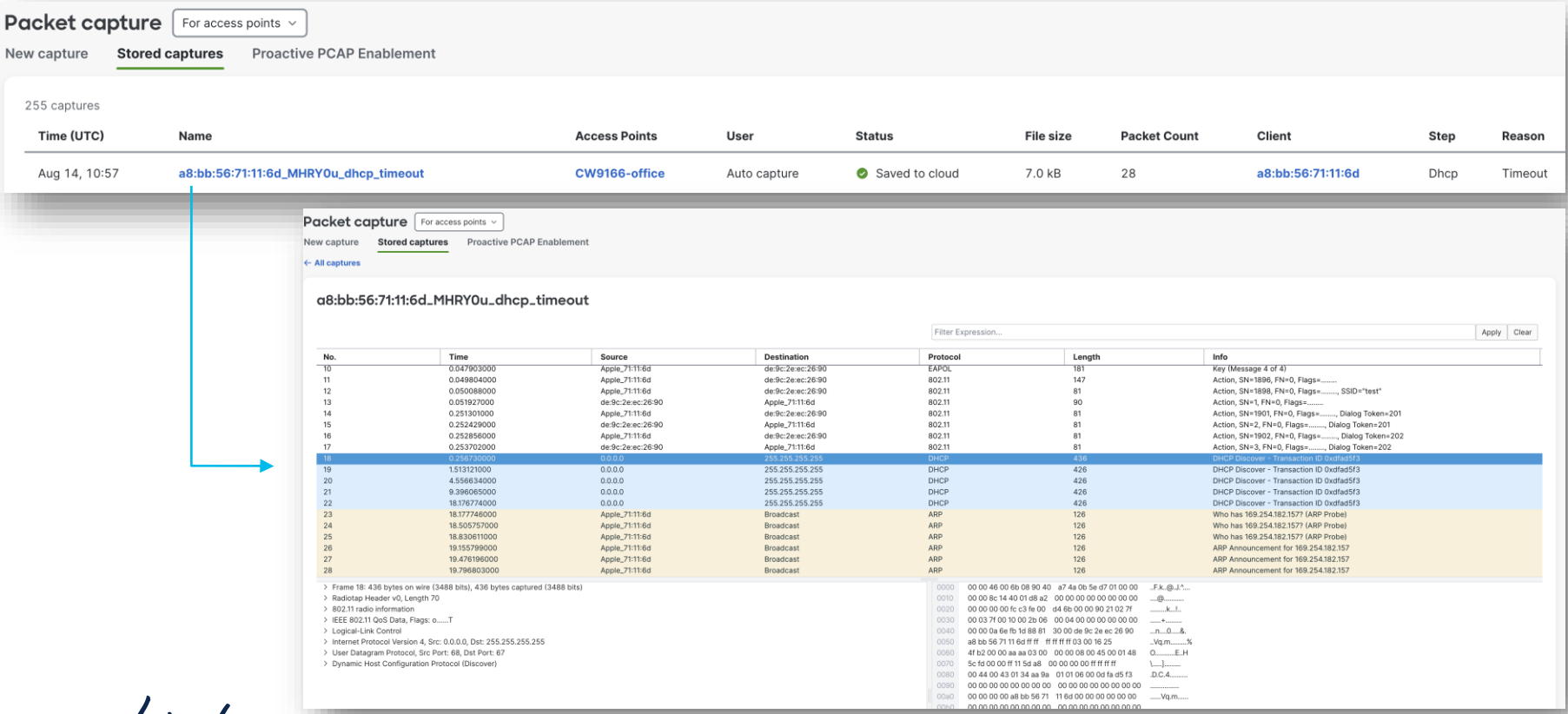
Proactive Captures when the future becomes the present

- Automated Packet Capture upon client connection or roaming failure
- Native Packet Analyzer integration



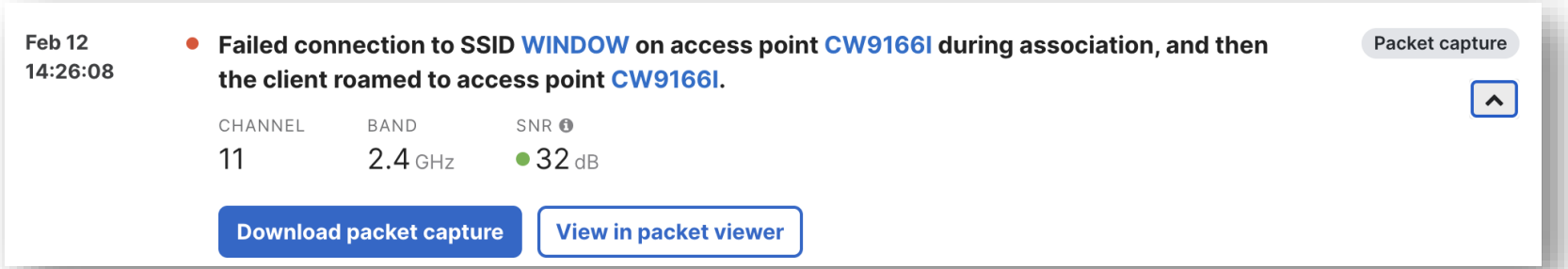
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Pro-Active Cloud Packet Capture



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Timeline will provide the pcap automatically



Open locally on your device

View in the dashboard

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Common problem example

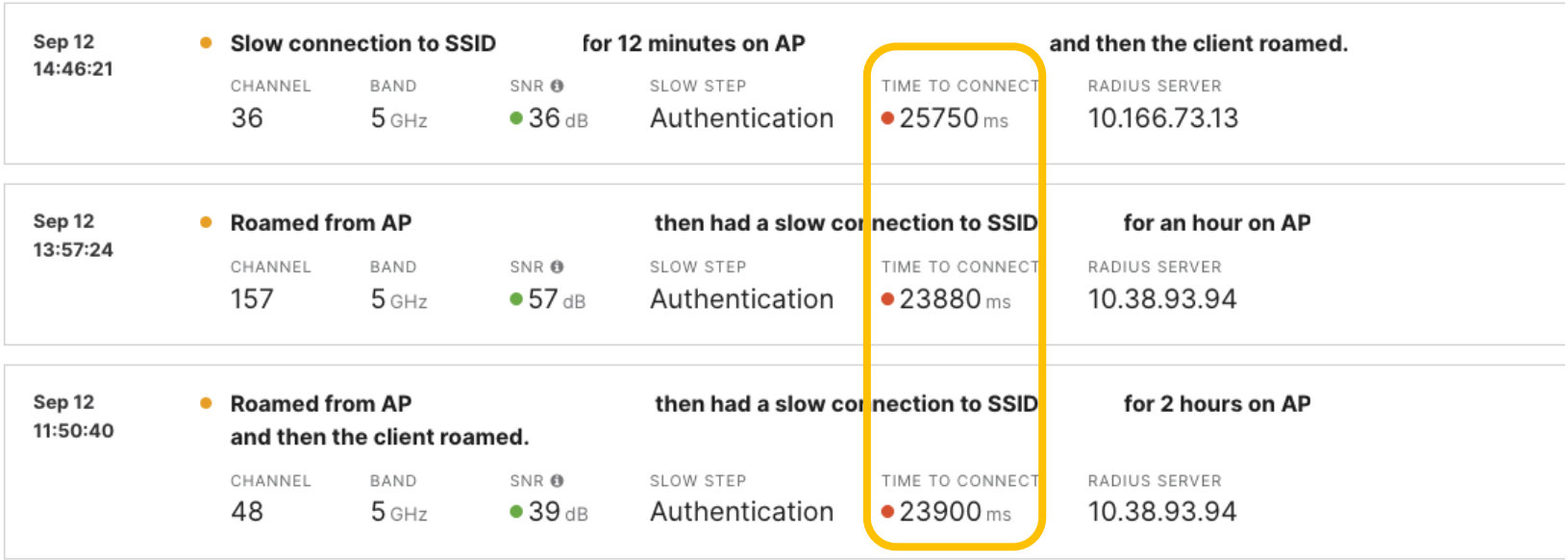
CEO can connect but when moving there is a drop



Ok, let's look at roaming data



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Roaming event log

#	Origin AP to New AP	Roam time (ms)	RSSI (dBm)	SNR (dB)	Band (GHz)	Start time
1	04 → 02	24,130	-37 → -54	58 → 41	5 → 5	Sep 12, 9:59 AM
2	02 → 14	1,680	-56 → -55	39 → 40	5 → 5	Sep 12, 10:02 AM
3	14 → 04	2,070	-55 → -34	40 → 61	5 → 5	Sep 12, 10:57 AM
4	04 → 08	23,900	-32 → -54	63 → 41	5 → 5	Sep 12, 11:51 AM
5	08 → 04	23,880	-53 → -38	42 → 57	5 → 5	Sep 12, 1:57 PM
6	01 → 04	1,640	-60 → -33	35 → 62	5 → 5	Sep 12, 2:56 PM
7	14 → 04	2,160	-60 → -36	35 → 59	5 → 5	Sep 12, 4:30 PM
8	04 → 04	1,650	-42 → -35	53 → 60	2.4 → 5	Sep 12, 4:34 PM

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Common problem example



802.11r (FT) won't hurt

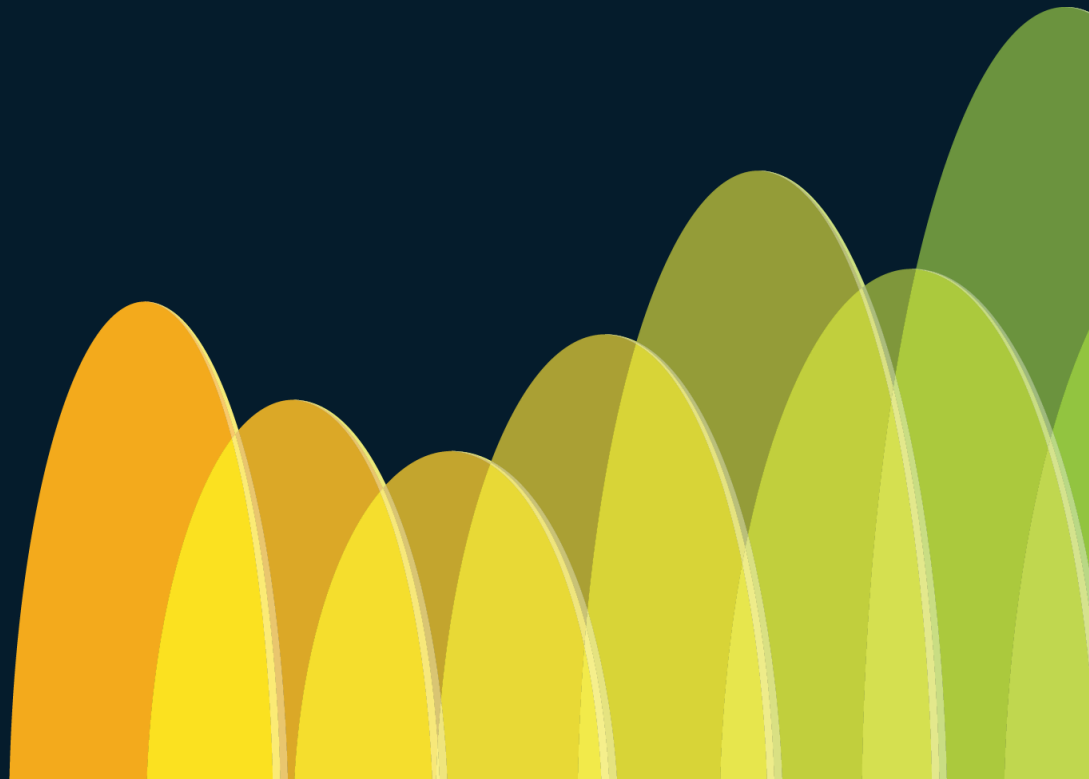


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Apr 5 16:30:10	Client [redacted] roamed from AP [redacted] then had a successful connection to SSID [redacted] for 6 minutes.	CHANNEL 64	BAND 5 GHz	SNR 42 dB / TIME TO CONNECT 3060 ms
Apr 5 16:24:45	Client [redacted] roamed from AP [redacted] then had a successful connection to SSID [redacted] for 2 hours.	CHANNEL 64	BAND 5 GHz	SNR 50 dB / TIME TO CONNECT 3200 ms
Apr 5 16:21:46	Client [redacted] had a successful connection to SSID [redacted] for 2 hours.	CHANNEL 64	BAND 5 GHz	SNR 52 dB / TIME TO CONNECT 2840 ms
Apr 5 16:21:45	Client [redacted] had a successful connection to SSID [redacted] for 18 minutes.	CHANNEL 64	BAND 5 GHz	SNR 42 dB / TIME TO CONNECT 3510 ms
Apr 5 16:18:25	Client [redacted] had a successful connection to SSID [redacted] for 3 hours.	CHANNEL 64	BAND 5 GHz	SNR 51 dB / TIME TO CONNECT 3660 ms
Apr 5 16:16:53	Client [redacted] had a successful connection to SSID [redacted] for 4 hours.	CHANNEL 64	BAND 5 GHz	SNR 51 dB / TIME TO CONNECT 2540 ms
Apr 5 16:16:42	Client [redacted] had a successful connection to SSID [redacted] for 3 hours.	CHANNEL 64	BAND 5 GHz	SNR 52 dB / TIME TO CONNECT 2670 ms
Apr 5 16:16:11	Client [redacted] had a successful connection to SSID [redacted] for 2 hours.	CHANNEL 64	BAND 5 GHz	SNR 50 dB / TIME TO CONNECT 3840 ms

Apr 7 18:21:15	Client [redacted] roamed from AP [redacted] then had a successful connection to SSID [redacted] for a few seconds.	CHANNEL 40	BAND 5 GHz	SNR 47 dB / TIME TO CONNECT 110 ms
Apr 7 18:20:11	Client [redacted] roamed from AP [redacted] then had a successful connection to SSID [redacted] for 15 minutes.	CHANNEL 40	BAND 5 GHz	SNR 54 dB / TIME TO CONNECT 50 ms
Apr 7 18:19:45	Client [redacted] had a successful connection to SSID [redacted] for 6 minutes.	CHANNEL 40	BAND 5 GHz	SNR 53 dB / TIME TO CONNECT 360 ms
Apr 7 18:19:39	Client [redacted] roamed from AP [redacted] then had a successful connection to SSID [redacted] for 11 minutes.	CHANNEL 40	BAND 5 GHz	SNR 55 dB / TIME TO CONNECT 560 ms
Apr 7 18:19:12	Client [redacted] roamed from AP [redacted] then had a successful connection to SSID [redacted] for 16 minutes.	CHANNEL 40	BAND 5 GHz	SNR 53 dB / TIME TO CONNECT 560 ms
Apr 7 18:19:07	Client [redacted] had a successful connection to SSID [redacted] for a few seconds.	CHANNEL 40	BAND 5 GHz	SNR 53 dB / TIME TO CONNECT 10 ms
Apr 7 18:19:06	Client [redacted] roamed from AP [redacted] then had a successful connection to SSID [redacted] for 10 minutes.	CHANNEL 40	BAND 5 GHz	SNR 51 dB / TIME TO CONNECT 540 ms
Apr 7 18:19:00	Client [redacted] had a successful connection to SSID [redacted] for 9 minutes.	CHANNEL 40	BAND 5 GHz	SNR 49 dB / TIME TO CONNECT 640 ms

Client experience



cisco Live!

There are usually 3 reasons for bad user experience



RF / Design

Limited RF Coverage

Extended RF Coverage

Co-Channel Interference

Oversubscription

Data rate downshifts

Retries



Channel changes

RRM channel changes

DFS



Roaming

Slow roam

Frequent roams

Sub-optimal roams

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Common problem example

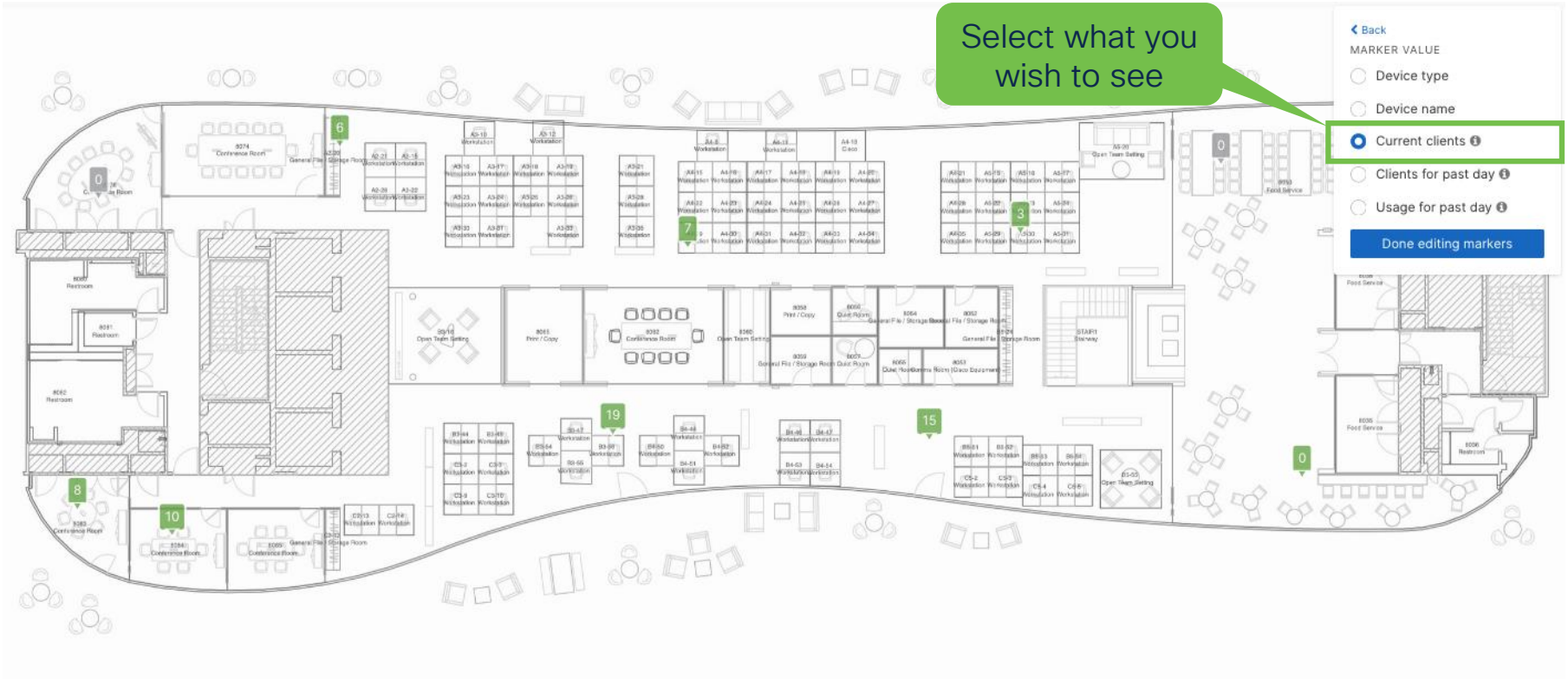
Some users report slow connections



Specific location?



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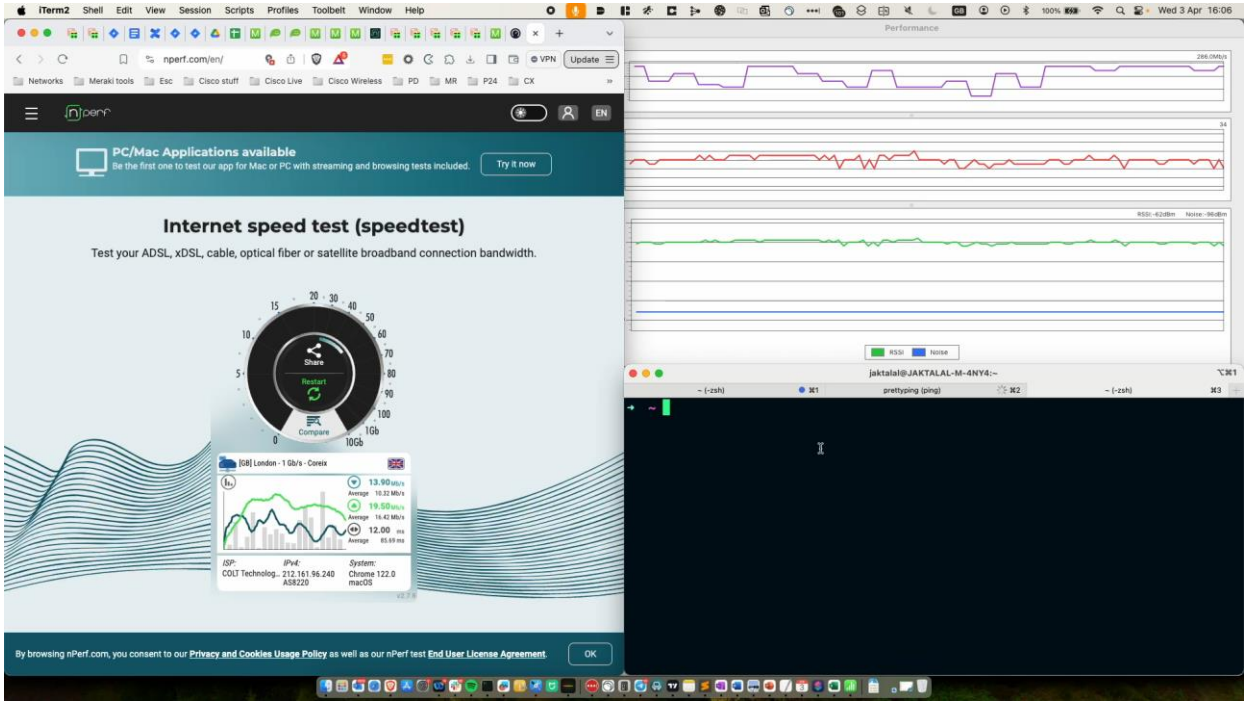


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Production hours test



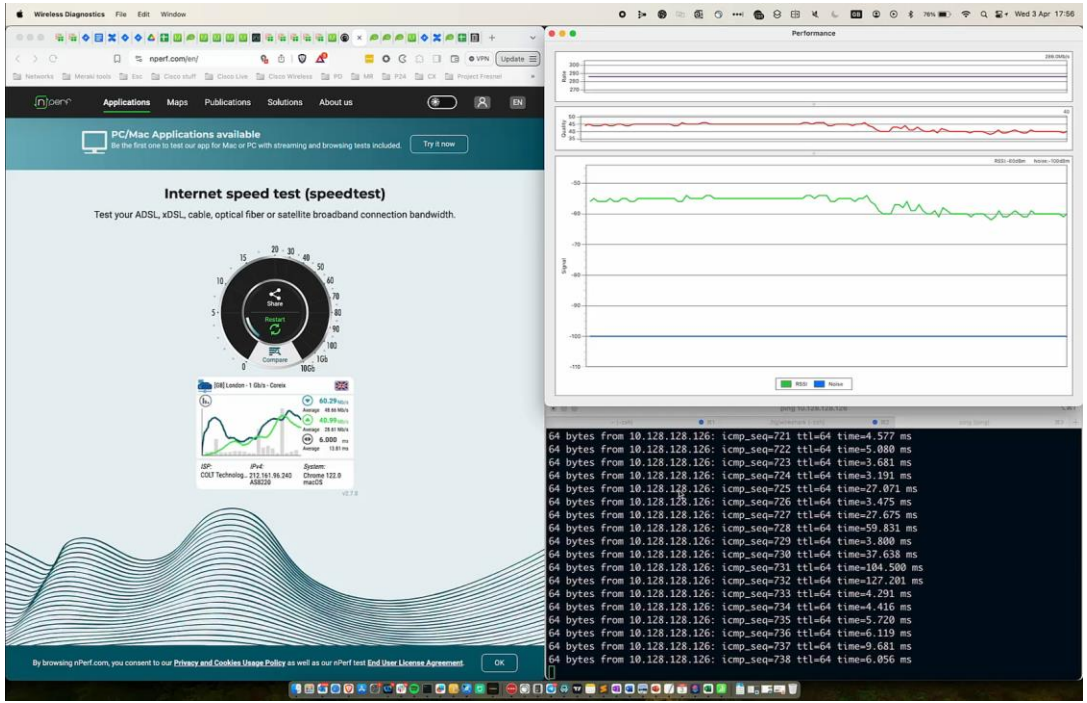
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Common problem example



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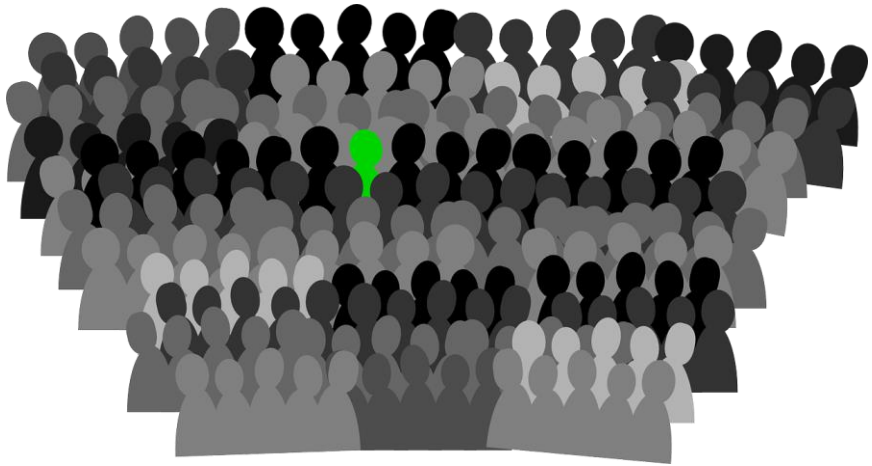
6PM test



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Inadequate cell size triggers inadequate experience

- Poor distribution of clients
  - Wireless is a shared medium
    - 49 clients may suffer
    - 5 clients will have better experience
- Bad placement
- Very broad TX power range
- Challenging environment
  - When you see glass, think reflections
  - And bleeding



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6 clients
41 clients
22 clients
17 clients
5 clients
8 clients
AP08
AP10
AP04
AP07
5 clients
11 clients
AP01
AP09
49 clients
AP05
AP06
3 clients
AP02
5 clients
9 clients
AP11
AP03
AP12
49 clients
7 clients
AP01
AP02
4 clients
15 clients
18 clients
9 clients
10 clients
AP06
AP08
AP10
AP03
AP04
16 clients
4 clients
5 clients
AP05
AP07
AP09

Common problem example

40 clients per AP should be fine?



Yes but there is one more thing



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Same channel on strongest neighbors will cause performance issues



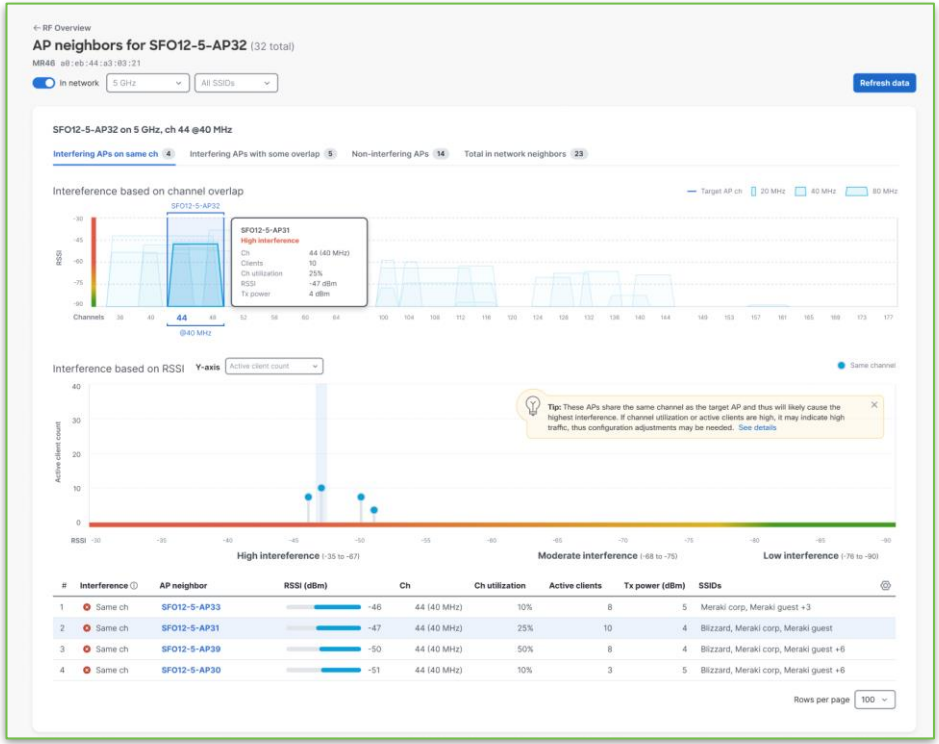
Map view under radio settings



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AP Neighbor allows to identify RF conditions

- Make sure 5GHz band to run 20Mhz Ch. Width
- Next-Generation AP RF Neighbor view
- Highlight the impact of Co-Channel Interferers
- Visualize Channel Overlapping with Ch. Width view
- Consolidate Single AP with Multiple SSIDs
- Continue real-time monitoring of RF Spectrum Analysis and current Ch. Utilization



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Common problem example

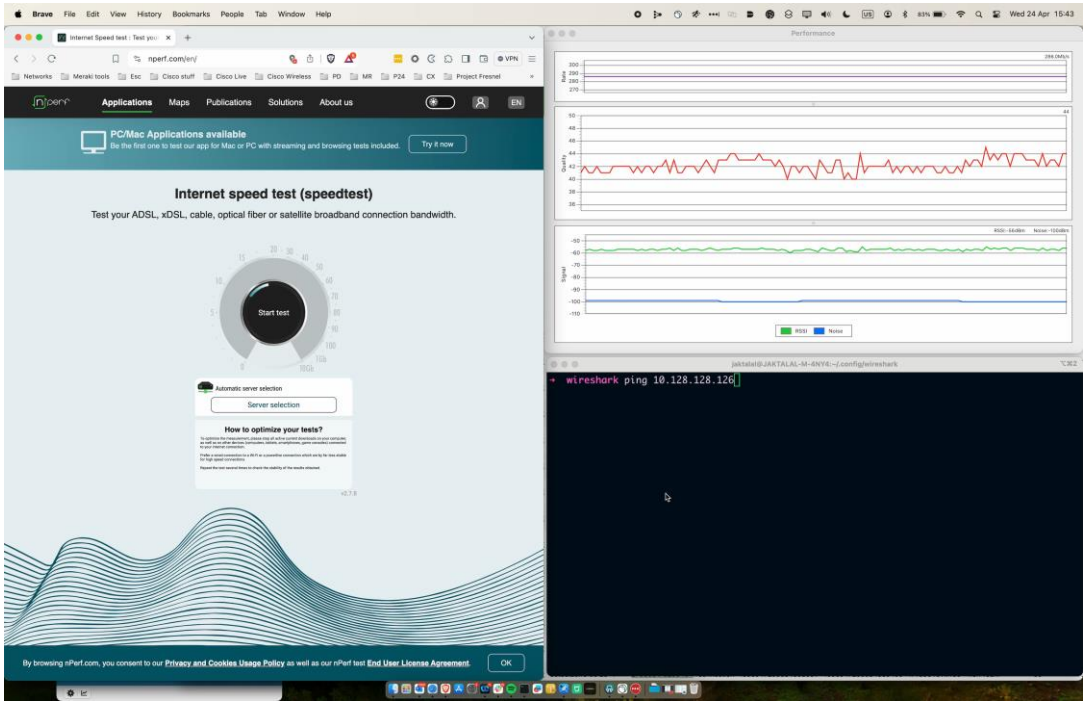
We forgot to revert config after some tests



They share the same channel. We should look at the radio config and placement.

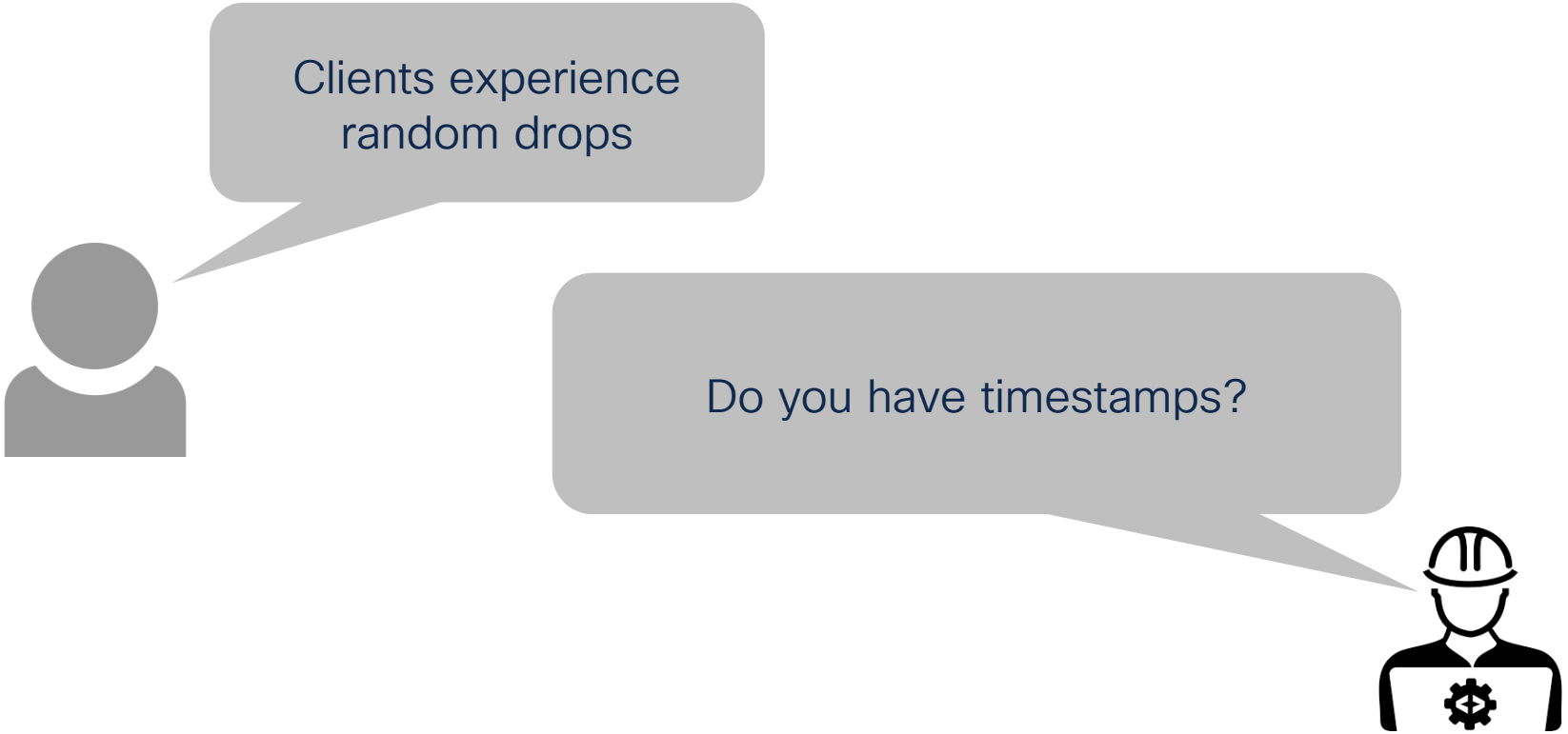


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Common problem example



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Clients connection can be disrupted by multiple factors

- Channel changes

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Why would AP change channel during production?

RRM to improve experience

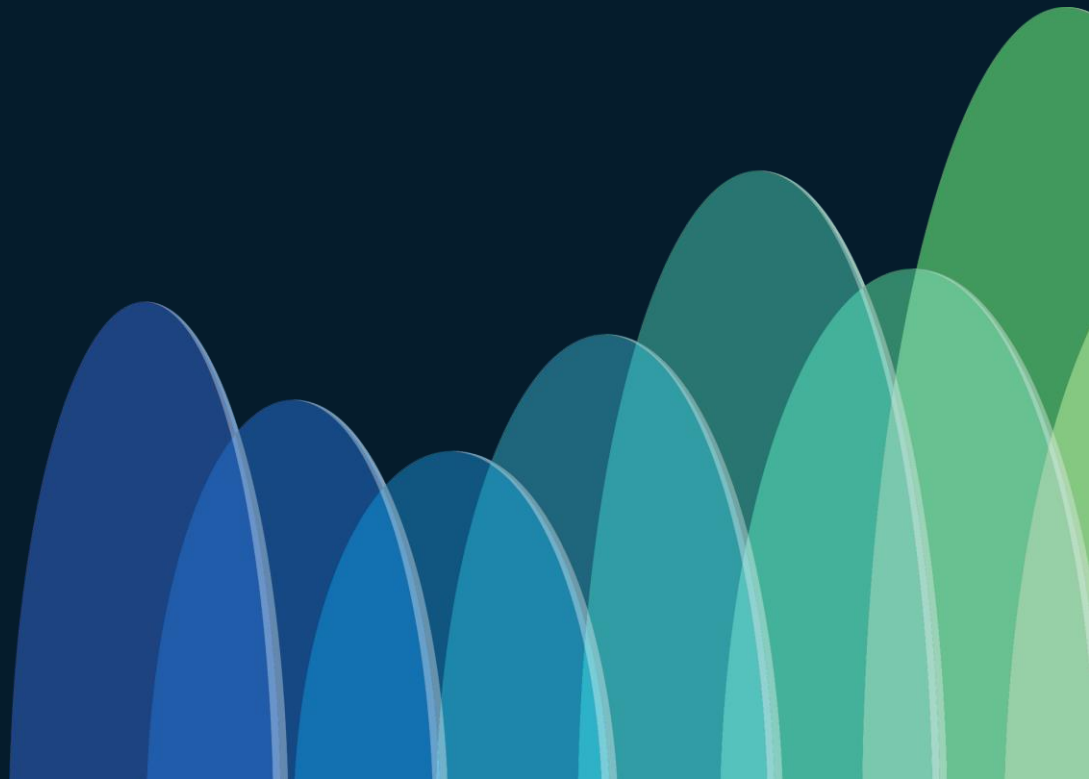
Time (GMT)	Access point	SSID	Client	Category	Event type	Details
Feb 12 23:06:12	UK_EPREDWAP05-014			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 23:06:12	UK_EPREDWAP03-012			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 23:06:12	UK_EPREDWAP03-012			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 23:06:12	UK_EPREDWAP02-012			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 23:06:12	UK_EPREDWAP01-014			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 23:06:12	UK_EPBLUEWAP07-004			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 22:06:06	UK_EPREDWAP05-014			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 22:06:06	UK_EPREDWAP08-014			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 22:06:06	UK_EPREDWAP03-012			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 22:06:06	UK_EPREDWAP04-016			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 22:06:06	UK_EPBLUEWAP04-013			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 22:06:06	UK_EPREDWAP03-013			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 22:06:06	UK_EPBLUEWAP07-004			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 22:06:06	UK_EPREDWAP05-010			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 22:06:06	UK_EPREDWAP09-010			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 21:06:12	UK_EPREDWAP05-014			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 21:06:12	UK_EPREDWAP01-019			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 21:06:12	UK_EPREDWAP04-011			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 21:06:12	UK_EPREDWAP04-016			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 21:06:12	UK_EPREDWAP02-008			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 21:06:12	UK_EPREDWAP05-017			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 21:06:12	UK_EPBLUEWAP03-012			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 21:06:12	UK_EPREDWAP05-010			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 20:06:09	UK_EPBLUEWAP07-005			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 20:06:09	UK_EPREDWAP05-010			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 20:06:09	UK_EPREDWAP03-017			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 20:06:09	UK_EPREDWAP05-009			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 07:02:29	UK_EPREDWAP05-008			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 06:01:44	UK_EPREDWAP01-019			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »
Feb 12 05:01:40	UK_EPREDWAP02-002			AI-Enhanced RRM	AI-Driven Channel Change	Auto Channel Update more »

DFS because **it has to**

Time (JST)	Access point	SSID	Client	Category	Event type	Details
Feb 13 08:45:13	JTANDMERWTN1611			DFS	DFS event detected	band: 5, channel: 120, radio: 1
Feb 13 08:31:33	JTANDMERWTN1509			DFS	DFS event detected	band: 5, channel: 136, radio: 1
Feb 13 08:26:16	JTANDMERWTN1504			DFS	DFS event detected	band: 5, channel: 116, radio: 1
Feb 13 08:21:14	JTANDMERWTN1505			DFS	DFS event detected	band: 5, channel: 132, radio: 1
Feb 12 15:10:31	JTANDMERWTN1608			DFS	DFS event detected	band: 5, channel: 120, radio: 1
Feb 12 15:01:48	JTANDMERWTN1604			DFS	DFS event detected	band: 5, channel: 128, radio: 1
Feb 12 14:56:17	JTANDMERWTN1603			DFS	DFS event detected	band: 5, channel: 52, radio: 1
Feb 12 13:53:56	JTANDMERWTN1511			DFS	DFS event detected	band: 5, channel: 112, radio: 1
Feb 12 13:08:29	JTANDMERWTN1614			DFS	DFS event detected	band: 5, channel: 128, radio: 1
Feb 12 11:51:55	JTANDMERWTN1503			DFS	DFS event detected	band: 5, channel: 56, radio: 1
Feb 12 11:30:06	JTANDMERWTN1621			DFS	DFS event detected	band: 5, channel: 108, radio: 1
Feb 12 11:00:19	JTANDMERWTN1601			DFS	DFS event detected	band: 5, channel: 104, radio: 1
Feb 12 09:58:40	JTANDMERWTN1503			DFS	DFS event detected	band: 5, channel: 52, radio: 1
Feb 12 09:58:19	JTANDMERWTN1612			DFS	DFS event detected	band: 5, channel: 104, radio: 1
Feb 12 09:58:17	JTANDMERWTN1610			DFS	DFS event detected	band: 5, channel: 124, radio: 1
Feb 12 09:56:53	JTANDMERWTN1613			DFS	DFS event detected	band: 5, channel: 100, radio: 1
Feb 12 09:56:05	JTANDMERWTN1611			DFS	DFS event detected	band: 5, channel: 64, radio: 1
Feb 12 09:37:22	JTANDMERWTN1510			DFS	DFS event detected	band: 5, channel: 116, radio: 1
Feb 12 09:31:46	JTANDMERWTN1508			DFS	DFS event detected	band: 5, channel: 136, radio: 1
Feb 12 09:17:22	JTANDMERWTN1502			DFS	DFS event detected	band: 5, channel: 120, radio: 1
Feb 12 09:10:56	JTANDMERWTN1605			DFS	DFS event detected	band: 5, channel: 112, radio: 1
Feb 12 08:49:31	JTANDMERWTN1523			DFS	DFS event detected	band: 5, channel: 60, radio: 1
Feb 12 08:20:53	JTANDMERWTN1504			DFS	DFS event detected	band: 5, channel: 100, radio: 1
Feb 12 08:20:51	JTANDMERWTN1501			DFS	DFS event detected	band: 5, channel: 56, radio: 1
Feb 12 08:08:33	JTANDMERWTN1512			DFS	DFS event detected	band: 5, channel: 140, radio: 1
Feb 10 18:31:16	JTANDMERWTN1506			DFS	DFS event detected	band: 5, channel: 140, radio: 1
Feb 10 16:44:27	JTANDMERWTN1601			DFS	DFS event detected	band: 5, channel: 64, radio: 1
Feb 10 14:57:26	JTANDMERWTN1610			DFS	DFS event detected	band: 5, channel: 116, radio: 1
Feb 10 12:45:31	JTANDMERWTN1612			DFS	DFS event detected	band: 5, channel: 52, radio: 1
Feb 10 11:56:19	JTANDMERWTN1621			DFS	DFS event detected	band: 5, channel: 140, radio: 1

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What about those channel changes?



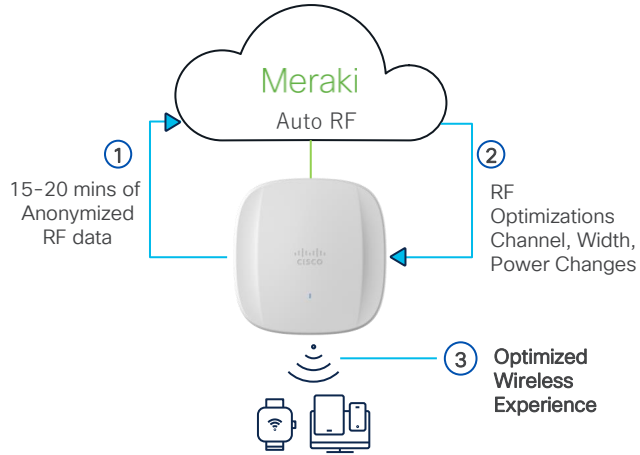
What is Meraki's Auto RF?

Auto RF is Cisco Meraki's radio resource management (RRM) solution that optimizes wireless configurations using 15-20 mins of RF data (Snapshot-based) to improve RF performance.

Supported RRM Services

- Dynamic Channel Assignment (DCA)
- Dynamic Band Selection (DBS)
- Transmit Power Control (TPC)

Topology



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Understand RRM operations before tuning

- Auto RF cares about many metrics
  - Usage demand
  - Airtime availability
  - Channel utilization
- Changes may occur every 15 minutes
  - Neighboring APs may end up on same frequency
- Select the right channels for your network
- Set the channel width that you wish
  - Every time you double width, you increase the noise



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Capabilities that AI-Enhanced RRM will bring to Meraki!

Wireless Client Disruption

RRM Services Ready at Any Scale

Supports RRM services, DCA, DBS, TPC, FRA, and AP zone-level configurations for deployments of all sizes and use cases.

Trend, Reward, Client-Based RRM

Uses AI to optimize based on historical trends, RF performance, and client-side telemetry.

After Hours RF Tuning

Defers optimizations after peak hours to minimize disruptions but uses peak hour data for relevance to clients' activity times.

AI-Enhanced RRM



Trust & Visibility

RF Visibility Widgets

Provides org-to-AP level visibility of RF health, RRM changes, co-channel interference, etc.

RF Insights and Recommendation

AI reviews customer config against intended outcomes and provides insight recommendations to ensure goals are met.

Predictive RF Simulator

Uses historical data to predict outcomes of RRM config changes, giving admins peace of mind before applying them.

Config Simplification

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Understand **why** changes are made

AI-Driven Channel Change	Auto Channel Update « hide	
	New_Channel	53/20
	Old_Channel	53/80
	Band	6
	Radio	2
	Event_Reason	-Channel bandwidth quality is improved 23 percent -Channel width is decreased to reduce co-channel interference

AI-Driven Tx Power Change	Tx power reduced to decrease network interference « hide	
	Old_Power	7
	New_Power	4
	Radio	1
	Event_Reason	-Tx Power is changed to 4 dBm from 7 dBm -Old Tx Power 7 dBm is higher than optimal Tx Power 4 dBm -Channel Max Power is 24 dBm and TPC threshold is -70

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To CSA or not CSA

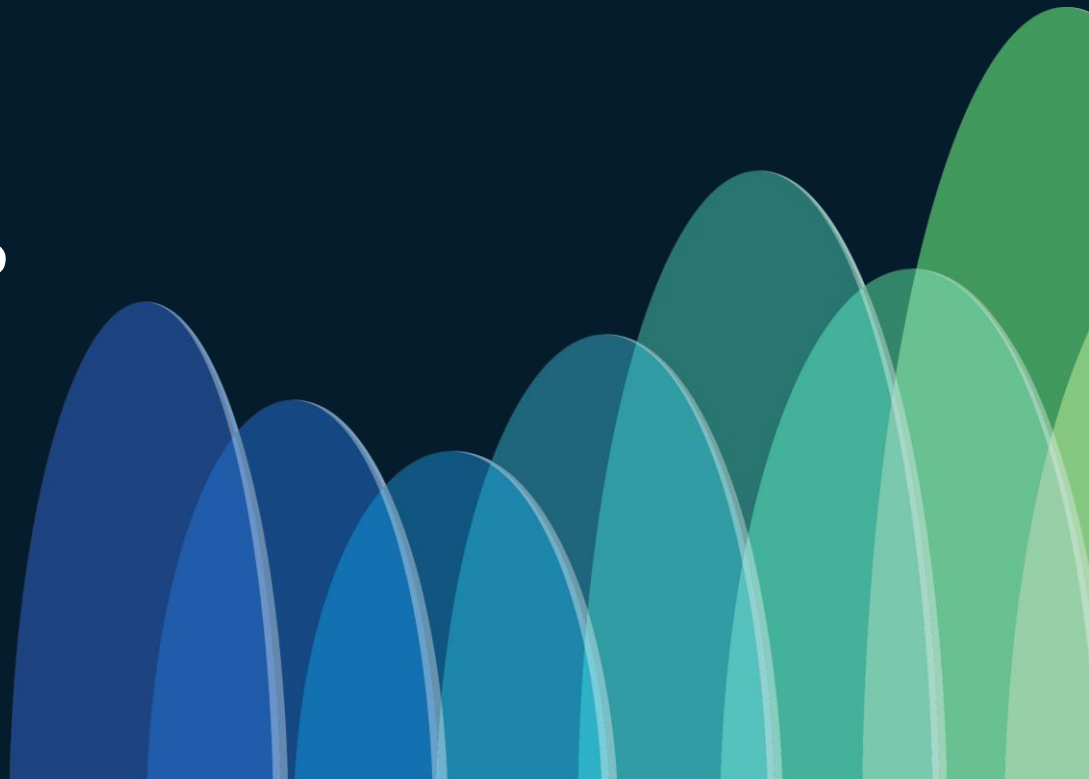
- Channel Switch Announcement tells clients about the new frequency
  - Some may follow
  - Some may ignore
- Used by Auto RF, AI RRM or DFS

```
Tag: Channel Switch Announcement Mode: 0, Number: 36 , Count: 15
    Tag Number: Channel Switch Announcement (37)
    Tag length: 3
    Channel Switch Mode: 0
    New Channel Number: 36
    Channel Switch Count: 15
```

Time	Type	Frame Type	Channel Switch Count	Channel
0.000000	Management frame	Beacon	15	44
0.000098	Management frame	Neighbor Repor…	15	44
0.102367	Management frame	Beacon	14	44
0.204766	Management frame	Beacon	13	44
0.307295	Management frame	Beacon	12	44
0.409614	Management frame	Beacon	11	44
0.512000	Management frame	Beacon	10	44
0.614368	Management frame	Beacon	9	44
0.716867	Management frame	Beacon	8	44
0.819228	Management frame	Beacon	7	44
0.921632	Management frame	Beacon	6	44
1.023986	Management frame	Beacon	5	44
1.126471	Management frame	Beacon	4	44
1.228856	Management frame	Beacon	3	44
1.331246	Management frame	Beacon	2	44
1.433604	Management frame	Beacon	1	44
1.461755	Management frame	Beacon		36

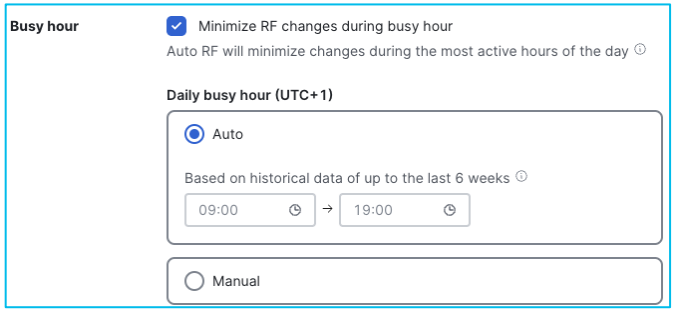
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Can I reduce Auto RF activity?

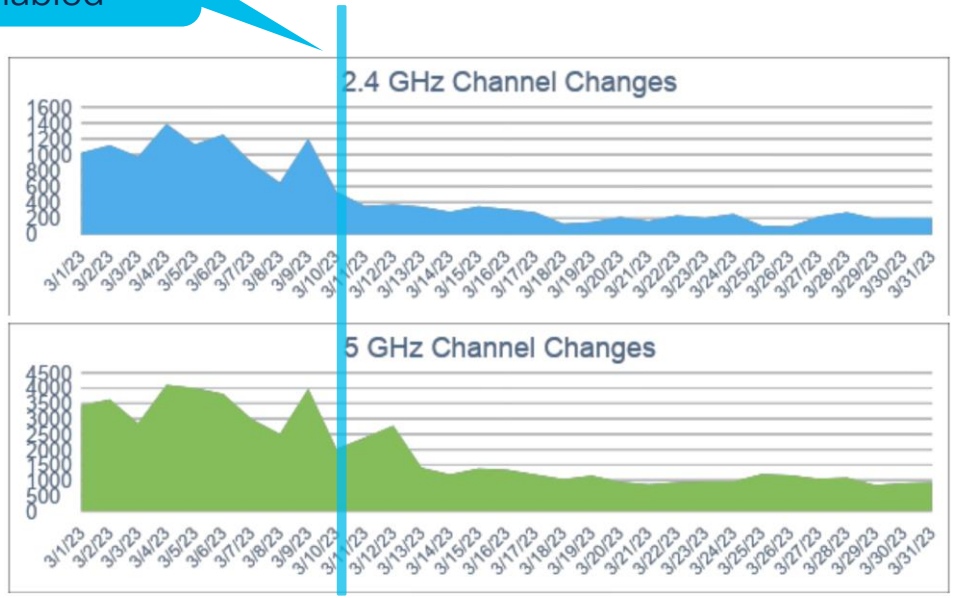


Busy hour to the rescue

AutoRF can still change channels during busy hour

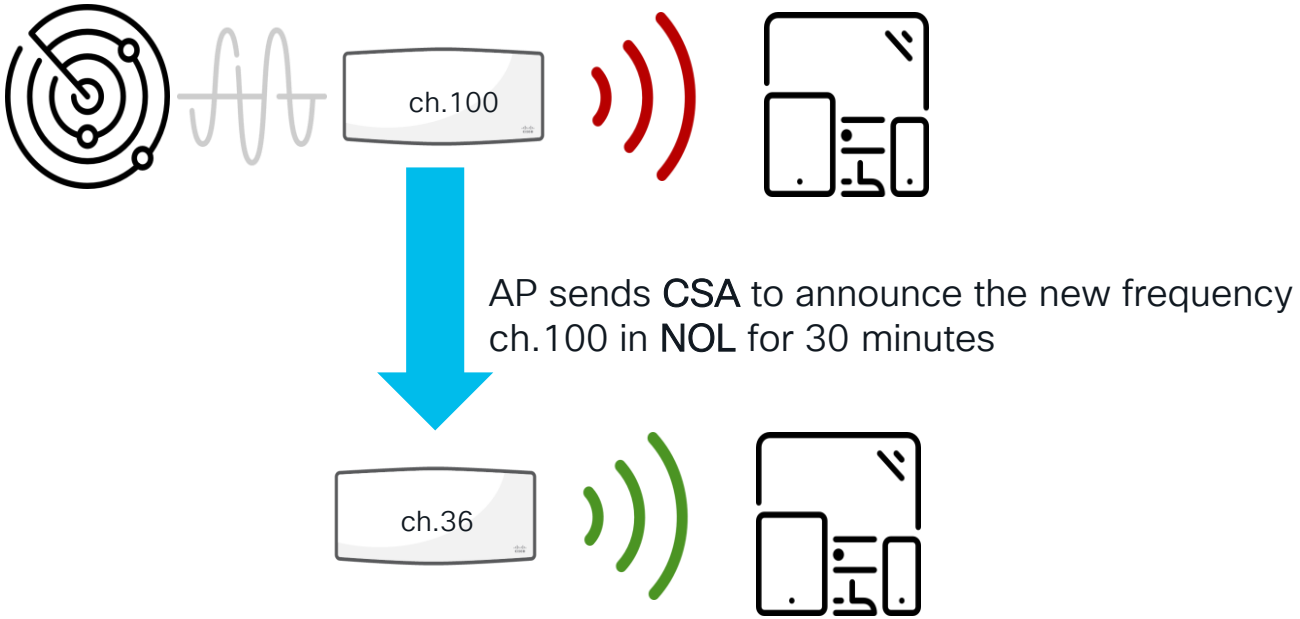


Busy hour enabled



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Planning with radars in mind will set you for success



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Planning with radars in mind will set you for success



- **If no active clients on 5GHz radio**, then
- ch.100 is under NOL for 30 minutes

1. After NOL expires
2. Go off-channel to ch.100
   - When off-channel it won't serve clients / transmit / receive etc.
3. CAC for 60 seconds
4. If no radar pulses, start to serve clients / transmit / receive etc.

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Planning with radars in mind will set you for success



- **If active clients on 5GHz radio**, then
- ch.100 is under NOL for 30 minutes

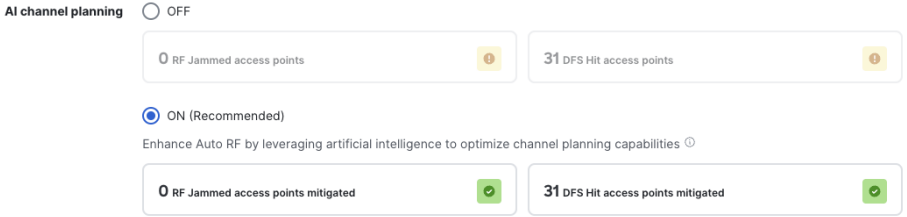
1. After NOL expires
2. **12 hours** back off timer
3. Go off-channel to ch.100
   - When off-channel it won't serve clients / transmit / receive etc.
4. CAC for 60 seconds
5. If no radar pulses, start to serve clients / transmit / receive etc.

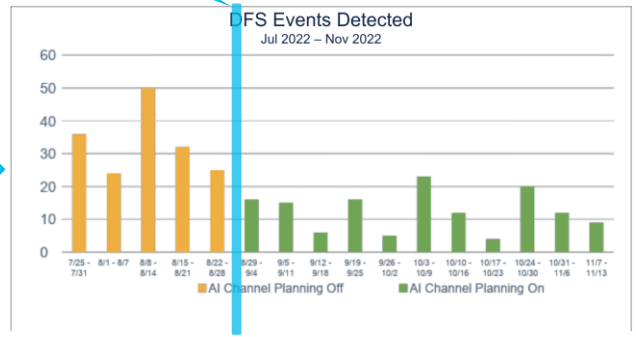
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AI channel planning to the rescue

Verify your environment
You may end up with very few channels available

AI channel plan enabled





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AI channel planner in the nutshell

Channels that face a DFS or channel jammed event with will be put on an avoid list starting at severity 6

Avoid List – Channels on this list won't be used; after the period, it'll be added to the monitor list with the same severity

Monitor List – If a DFS or jammed channel event occurs, the channel is added to the avoid list and the severity is increased.

Severity	Avoid Period	Monitor Period
6	1 Day	1 hour
5	2 Days	2 hours
4	4 Days	3 hours
3	8 Days	4 hours
2	14 Days	5 hours
1	30 Days	6 hours

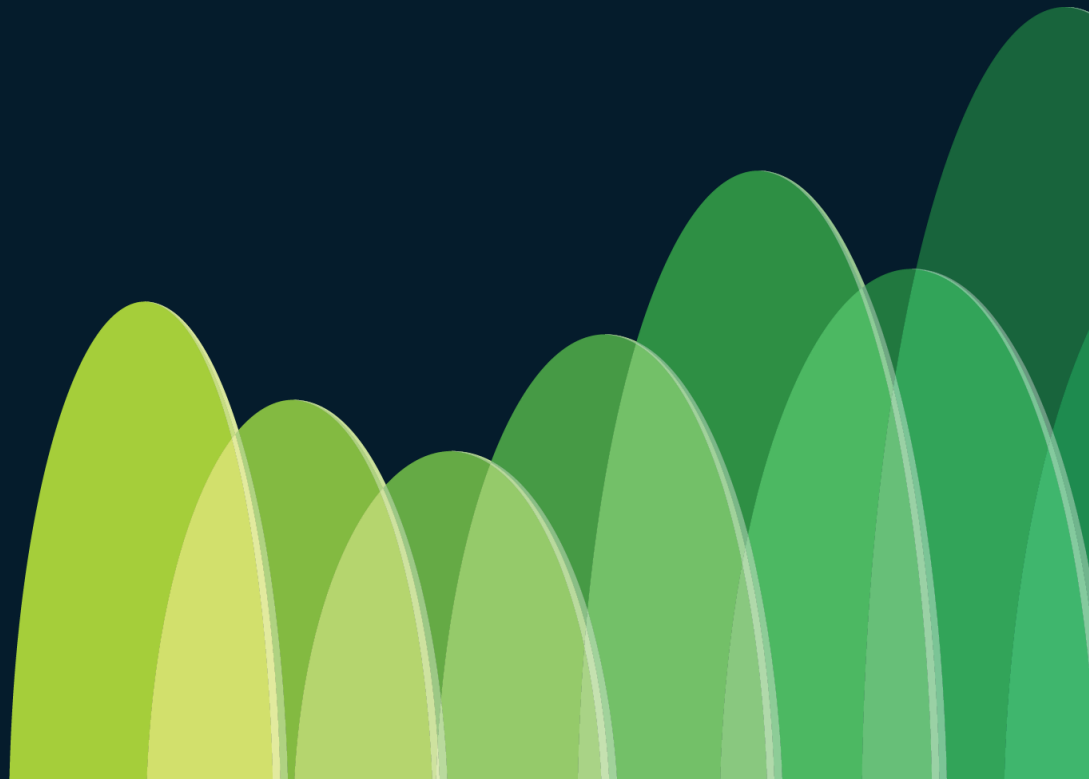
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Clients connection can be disrupted by multiple factors

- Channel changes
- Roaming

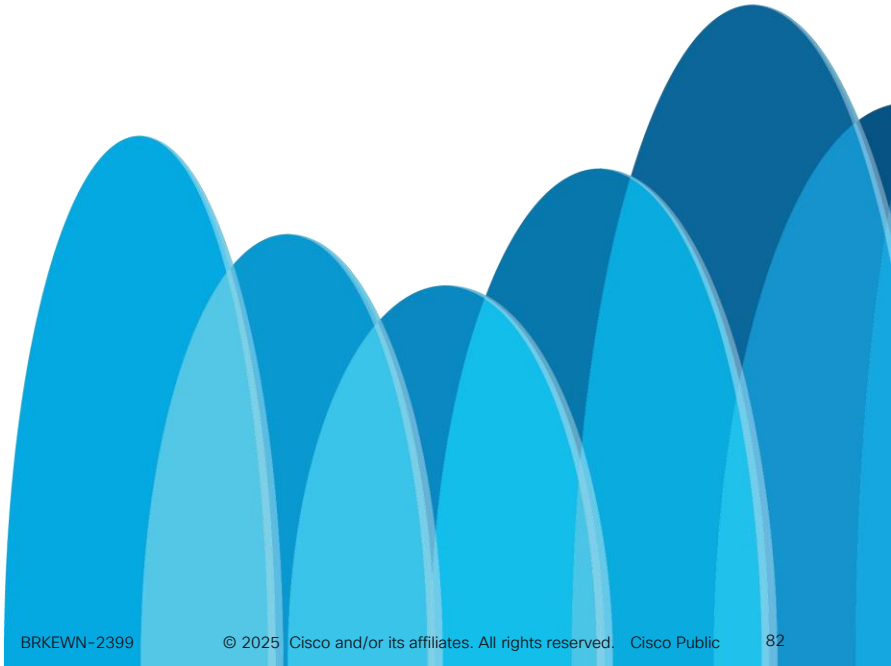
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So let's talk about roaming



“Roaming is a client device decision.”

Every Wireless Engineer

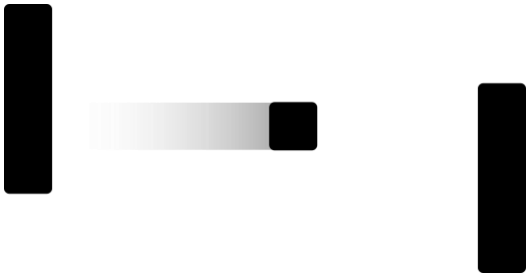


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Is roaming that destructive?

It depends

- Every time client roams there are few things happening
  - Might go off channel to look for target APs
    - Time varies on number of channels enabled and supported
  - Derive PMK and PTK
    - In PSK environments it’s quick
    - In dot1x it varies
      - What EAP type used and connection to AS?
      - What Roaming protocols are used?
      - *Enterprise voice requires <= 150ms transition times*



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Good roaming makes users happy

What can trigger a roam?

- Client is between 2+ high coverage cells
- AP triggered
  - Auto RF, DFS
- AP encouraged
  - 11k/v
- Client triggered
  - Device movement, driver logic

What happens behind the scenes?

- Might go off channel to look for target APs
  - Time varies on number of channels enabled and supported
- Select the candidate and connect
- Derive PMK and PTK
  - In PSK environments it’s quick
  - In dot1x it varies
    - What EAP type used and connection to AS?
    - What Roaming protocols are used?
    - *Enterprise voice requires <= 150ms transition times*



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There are good and bad roams

Good roam

- Fast transition times
  - OKC/SKC = 150-300msec
  - 802.11r = ~90 msec
  - Adaptive 11r = ~80 – 150 msec
    - Depending on the client
- Intra-band*
- Better RSSI
  - Higher rates

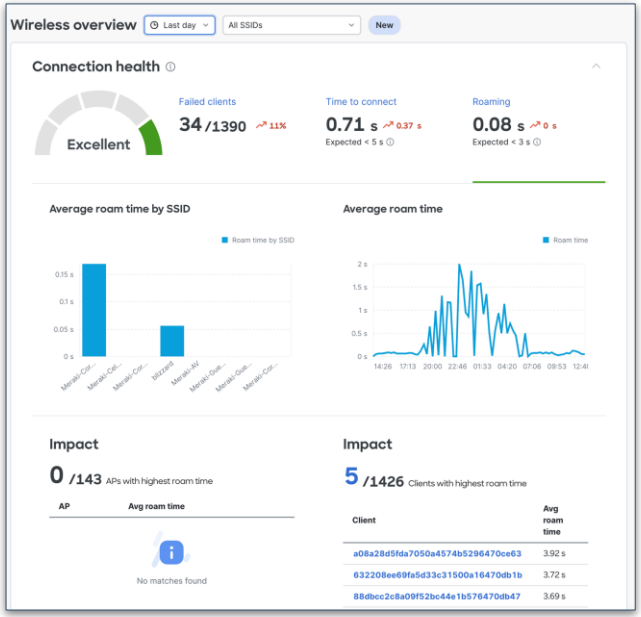
Bad roam

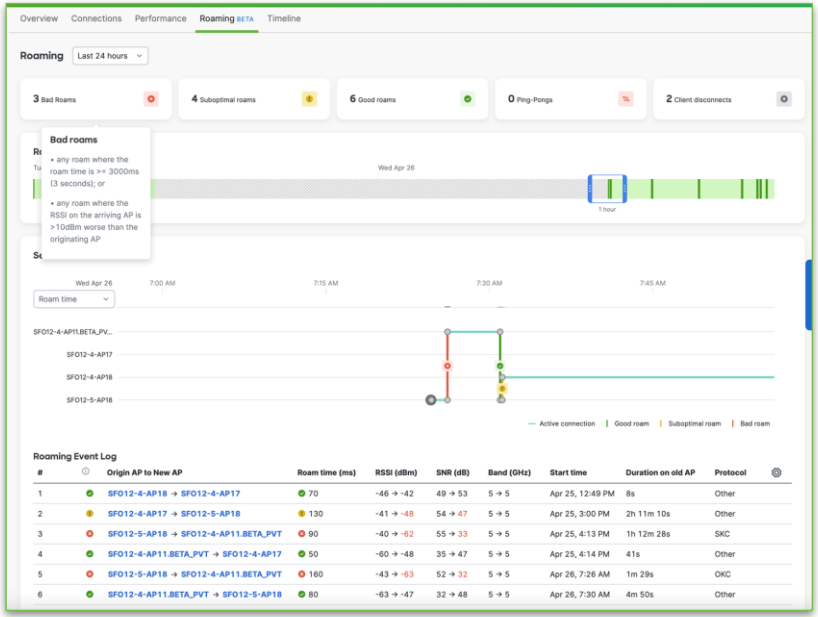
- Transition takes seconds
  - No roaming protocol for dot1x SSID
- Ping-pong between APs
- Intra-band
- Low RSSI
- No roaming
  - Sticky client

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Roaming ~~is~~was complex to troubleshoot and monitor

Meraki makes it simple

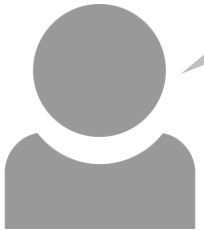




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Common problem example

We no longer have disconnects but poor performance came back



Let’s review the RF config



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Wireless audit cheat sheet

TX power range defined vs used	Channels and bands used	Data rates and SSID consolidation	Advanced tuning	RF Environment
How well APs hear others define what TX they use	Are APs well balanced across channels or majority on non-DFS (5GHz) or PSC (6GHz)? Do you use 20 / 40 / 80 / 160 MHz ?	There is usually opportunity to increase You don't need all of them ☺ + disable meshing	RX-SOP – avoid sticky clients and reduce advertised utilization	How your APs behave with your APs and your neighbors?

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5 GHz

Access point name	Channel ▲	Ch. Width (MHz)	Target power (dBm)	Transmit power (dBm)
lon11-8-ap-03	36 (Auto)	20	3 - 14	3
lon11-8-ap-01	40 (Auto)	20	3 - 14	3
lon11-8-ap-08	44 (Auto)	20	3 - 14	3
lon11-8-ap-06	48 (Auto)	20	3 - 14	3
lon11-8-ap-05	64 (Auto)	20	3 - 14	3
lon11-8-ap-09	64 (Auto)	20	3 - 14	3
lon11-8-ap-07	100 (Auto)	20	3 - 14	3
lon11-8-ap-04	116 (Auto)	20	3 - 14	3
lon11-8-ap-10	136 (Auto)	20	3 - 14	3
lon11-8-ap-02	140 (Auto)	20	3 - 14	3

- Almost 0 channel reuse
- All APs on lowest TX power
- They hear each other well
- Do they provide enough power when people are in the office?

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6 GHz

Access point name	Channel ▲	Ch. Width (MHz)	Target power (dBm)	Transmit power (dBm)
Ion11-8-ap-02	5 (Auto)	80 (Auto)	8 - 30	14
Ion11-8-ap-08	5 (Auto)	80 (Auto)	8 - 30	14
Ion11-8-ap-06	21 (Auto)	80 (Auto)	8 - 30	14
Ion11-8-ap-09	21 (Auto)	80 (Auto)	8 - 30	14
Ion11-8-ap-04	37 (Auto)	80 (Auto)	8 - 30	14
Ion11-8-ap-03	53 (Auto)	80 (Auto)	8 - 30	14
Ion11-8-ap-07	69 (Auto)	80 (Auto)	8 - 30	14
Ion11-8-ap-05	85 (Auto)	80 (Auto)	8 - 30	14
Ion11-8-ap-10	85 (Auto)	80 (Auto)	8 - 30	14
Ion11-8-ap-01	85 (Auto)	80 (Auto)	8 - 30	14

- 11dB stronger
- PSC bias
- Channel reuse is higher
- 80MHz channel width

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Band selection

All SSIDs | Per SSID

Name	2.4 GHz	5 GHz	Band steering
[redacted]	☑	☑	☐
	☑	☑	☐
	☑	☐	☐
	☑	☑	☐
	☑	☑	☐
	☑	☑	☐

Show disabled SSIDs

Minimum bitrate configuration

○ Per band

Set the minimum bitrates for the 2.4 & 5 GHz radios separately below.

◉ Per SSID

Set the minimum bitrates per SSID

SSID name	Min bitrate
[redacted]	11
	11
	5.5
	11
	11
	11

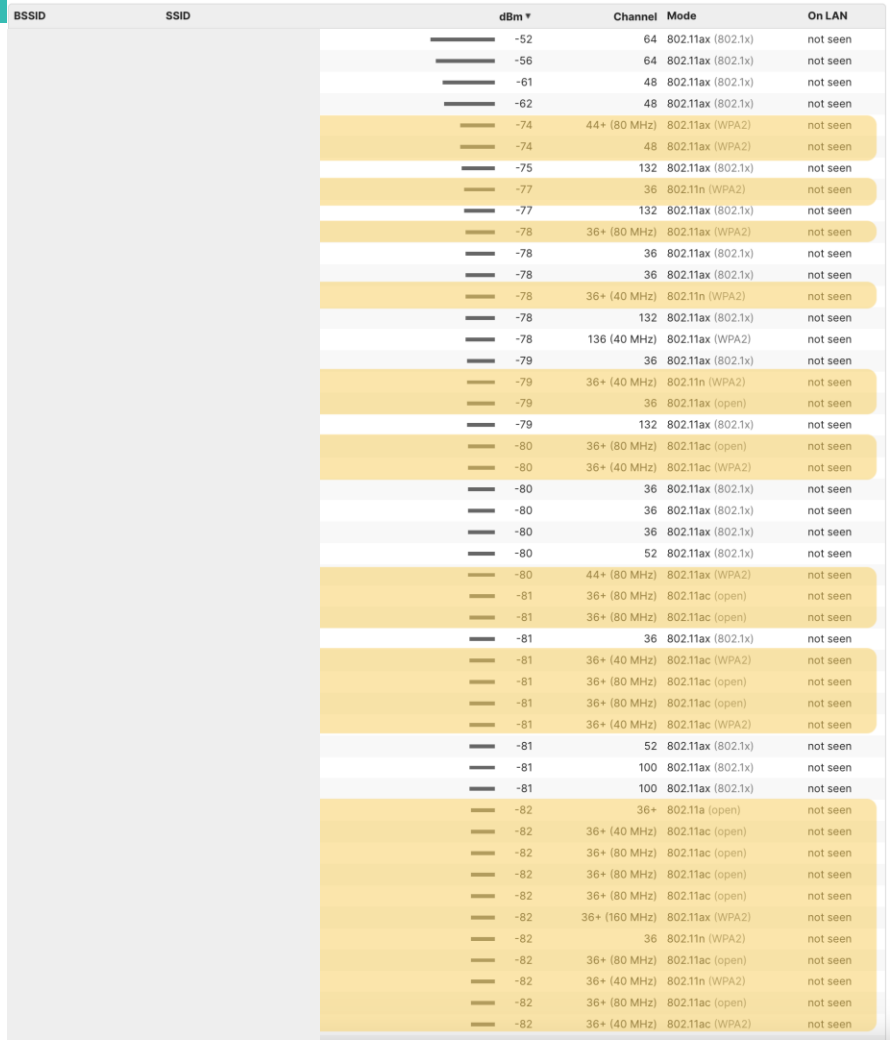
Show disabled SSIDs



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You are never alone

- All picked up within CCA threshold
- Nearby network occupying entire UNII-1
- Auto RF or RRM will try it's best to optimize
  - Every optimization attempt results with channel switch



BSSID	SSID	dBm	Channel	Mode	On LAN
		-52	64	802.11ax (802.1x)	not seen
		-56	64	802.11ax (802.1x)	not seen
		-61	48	802.11ax (802.1x)	not seen
		-62	48	802.11ax (802.1x)	not seen
		-74	44+ (80 MHz)	802.11ax (WPA2)	not seen
		-74	48	802.11ax (WPA2)	not seen
		-75	132	802.11ax (802.1x)	not seen
		-77	36	802.11n (WPA2)	not seen
		-77	132	802.11ax (802.1x)	not seen
		-78	36+ (80 MHz)	802.11ax (WPA2)	not seen
		-78	36	802.11ax (802.1x)	not seen
		-78	36	802.11ax (802.1x)	not seen
		-78	36+ (40 MHz)	802.11n (WPA2)	not seen
		-78	132	802.11ax (802.1x)	not seen
		-78	136 (40 MHz)	802.11ax (WPA2)	not seen
		-79	36	802.11ax (802.1x)	not seen
		-79	36+ (40 MHz)	802.11n (WPA2)	not seen
		-79	36	802.11ax (open)	not seen
		-79	132	802.11ax (802.1x)	not seen
		-80	36+ (80 MHz)	802.11ac (open)	not seen
		-80	36+ (40 MHz)	802.11ac (WPA2)	not seen
		-80	36	802.11ax (802.1x)	not seen
		-80	36	802.11ax (802.1x)	not seen
		-80	36	802.11ax (802.1x)	not seen
		-80	52	802.11ax (802.1x)	not seen
		-80	44+ (80 MHz)	802.11ax (WPA2)	not seen
		-81	36+ (80 MHz)	802.11ac (open)	not seen
		-81	36+ (80 MHz)	802.11ac (open)	not seen
		-81	36	802.11ax (802.1x)	not seen
		-81	36+ (40 MHz)	802.11ac (WPA2)	not seen
		-81	36+ (80 MHz)	802.11ac (open)	not seen
		-81	36+ (80 MHz)	802.11ac (open)	not seen
		-81	36+ (40 MHz)	802.11ac (WPA2)	not seen
		-81	52	802.11ax (802.1x)	not seen
		-81	100	802.11ax (802.1x)	not seen
		-81	100	802.11ax (802.1x)	not seen
		-82	36+	802.11a (open)	not seen
		-82	36+ (40 MHz)	802.11ac (open)	not seen
		-82	36+ (80 MHz)	802.11ac (open)	not seen
		-82	36+ (80 MHz)	802.11ac (open)	not seen
		-82	36+ (80 MHz)	802.11ac (open)	not seen
		-82	36+ (160 MHz)	802.11ax (WPA2)	not seen
		-82	36	802.11n (WPA2)	not seen
		-82	36+ (80 MHz)	802.11ac (open)	not seen
		-82	36+ (40 MHz)	802.11n (WPA2)	not seen
		-82	36+ (80 MHz)	802.11ac (open)	not seen
		-82	36+ (40 MHz)	802.11ac (WPA2)	not seen

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Air Marshal enables you to monitor RF trends

And is a great story-teller

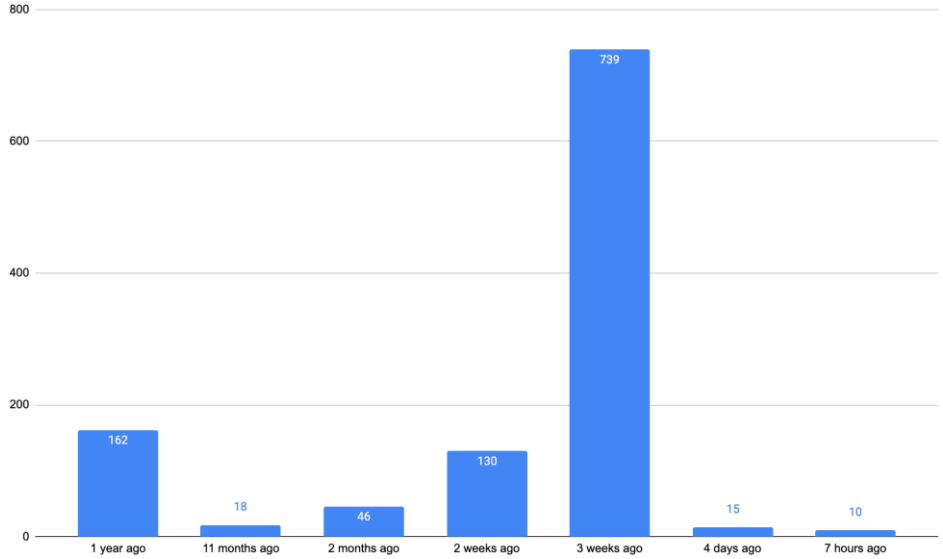
Last seen	First seen	Manufacturer	Channels	Broadcast MACs
2 days ago	2 days ago	Ruckus Wireless	11	80:bc:37:4a:ea:e1
4 days ago	4 days ago	Shenzhen iComm...	36	30:8e:7a:c5:f2:56
1 day ago	2 days ago	SHENZHEN RF-LINK...	1	c4:6e:7b:a0:c4:83
2 days ago	4 days ago	HUNAN FN-LINK Technology	6	68:4e:05:f7:dd:55
2 days ago	2 days ago	Shenzhen Feitengyun...	6	34:20:03:e1:9a:31
4 days ago	4 days ago	70mai	11	44:27:f3:b0:4b:fe
6 days ago	6 days ago	Spreadtrum...	1	40:45:da:53:34:d2

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Air Marshal enables you to monitor RF trends

First seen	Num APs	Manufacturer	Broadcast MACs
3 weeks ago	75	Ruckus Wireless	fc:5c:45:93:ce:cd (and 74 others)
3 weeks ago	74	Cisco Systems	e4:4e:2d:f3:f5:01 (and 73 others)
2 weeks ago	72	Cisco Systems	00:a3:8e:f3:bb:80 (and 71 others)
3 weeks ago	63	Cisco Systems	e4:4e:2d:f3:f5:03 (and 62 others)
1 year ago	51	Cisco Systems	72:97:41:48:2f:f4 (and 50 others)
1 year ago	49	Sagemcom Broad	6a:97:41:15:7f:8a (and 48 others)
3 weeks ago	43	Ruckus Wireless	38:ff:36:20:8b:ac (and 42 others)
3 weeks ago	37	Ruckus Wireless	fc:5c:45:54:33:58 (and 36 others)
3 weeks ago	36	Ruckus Wireless	fc:5c:45:14:91:39 (and 35 others)
3 weeks ago	35	Ruckus Wireless	fc:5c:45:93:ce:c8 (and 34 others)
3 weeks ago	35	Ruckus Wireless	38:ff:36:5f:fb:5c (and 34 others)
3 weeks ago	34	Cisco Systems	e4:4e:2d:f3:f5:05 (and 33 others)
2 weeks ago	34	Ruckus Wireless	38:ff:36:df:fb:5d (and 33 others)
3 weeks ago	31	Ruckus Wireless	fc:5c:45:14:91:38 (and 30 others)
3 weeks ago	30	Ruckus Wireless	34:20:e3:17:80:08 (and 29 others)
3 weeks ago	29	Ruckus Wireless	34:20:e3:57:80:08 (and 28 others)
3 weeks ago	28	Cisco Systems	2c:1a:05:18:df:4b (and 27 others)
3 weeks ago	24	Ruckus Wireless	8c:7a:15:d9:e5:b8 (and 23 others)
3 weeks ago	23	Ruckus Wireless	38:ff:36:61:e9:9d (and 22 others)
3 weeks ago	22	Ruckus Wireless	38:ff:36:1f:fb:5d (and 21 others)
1 year ago	18	Cisco Systems	2c:33:11:ab:f9:6e (and 17 others)
1 year ago	18	Meraki	ea:cb:bc:49:35:26 (and 17 others)
1 year ago	16		06:ff:02:a3:2c:a0 (and 15 others)
2 months ago	16	Ruckus Wireless	fc:5c:45:a7:e8:3c (and 15 others)
2 months ago	15	Ruckus Wireless	fc:5c:45:67:e8:3c (and 14 others)
2 months ago	15	Ruckus Wireless	fc:5c:45:27:e8:3c (and 14 others)
3 weeks ago	12	Ruckus Wireless	38:ff:36:21:80:09 (and 11 others)
3 weeks ago	11		72:d7:9a:7a:47:a2 (and 10 others)
3 weeks ago	11	Ruckus Wireless	38:ff:36:a1:80:09 (and 10 others)
3 weeks ago	11		ba:b0:24:c0:55:bf (and 10 others)
3 weeks ago	11	TP-Link	b4:b0:24:c0:55:c3 (and 10 others)
3 weeks ago	11	Ruckus Wireless	38:ff:36:e1:9a:6c (and 10 others)
7 hours ago	10		06:ff:02:3a:c0:92 (and 9 others)
1 year ago	10	Cisco Systems	00:fe:c8:73:85:9e (and 9 others)
11 months ago	10	Ruckus Wireless	fc:5c:45:1a:a3:cc (and 9 others)
2 weeks ago	9	Ubiquiti	56:d9:e7:f4:78:67 (and 8 others)
3 weeks ago	9	Ubiquiti	f4:92:bf:ac:24:ed (and 8 others)
2 weeks ago	8	Meraki	8a:15:04:84:a5:80 (and 7 others)
11 months ago	8	Cisco Systems	00:fe:c8:5d:89:bc (and 7 others)
4 days ago	8		02:92:bf:11:0f:f0 (and 7 others)
3 weeks ago	8		f6:92:bf:9c:24:ed (and 7 others)
3 weeks ago	8	SKY UK	b0:3e:51:85:31:2e (and 7 others)

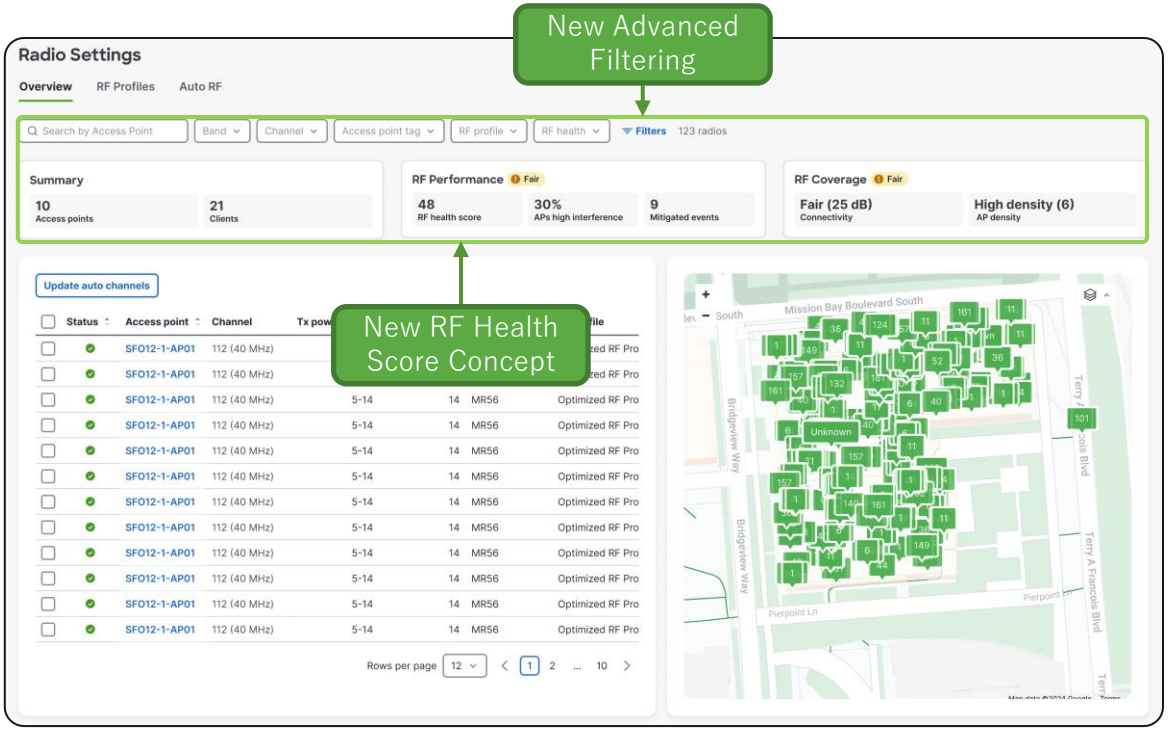




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RF Summary Bar in Radio Settings

- Understand RF Performance at-a-glance per network
- RF health score considers all critical RF metrics
- Mitigated events shows benefits of AI Channel Planning
- New discovery workflow with advanced filtering

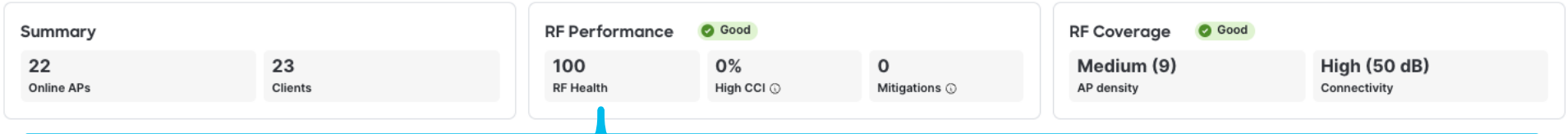


Same AI engine with similar visibility as Catalyst Center's AI-RRM Control Center!

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RF Health reports the worst metric

And there are quite a few of them



- Co-Channel Neighbor Utilization
- Co-Channel Overlapping
- Noise Side Channel
- Noise Same Channel
- Co-Channel Interference
- Adjacent Channel Interference
- Low SNR Clients
- Radio Utilization
- Other Interferers

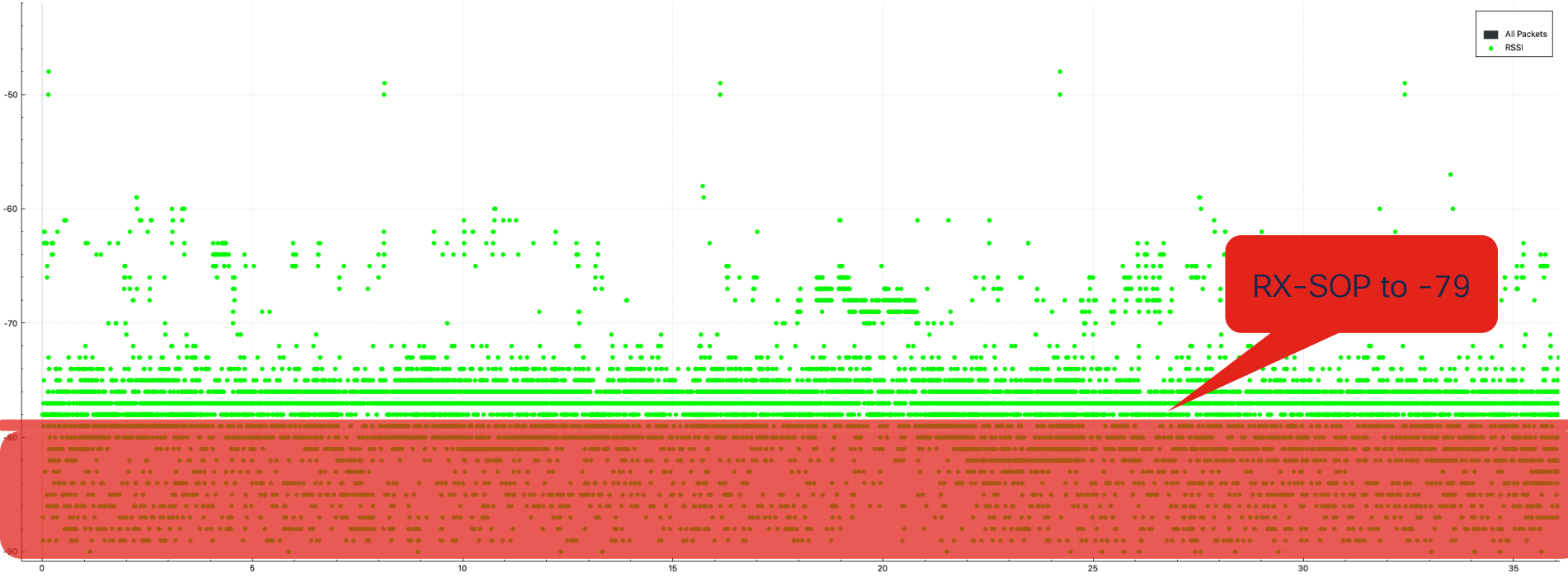
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RX-SOP - double edged sword

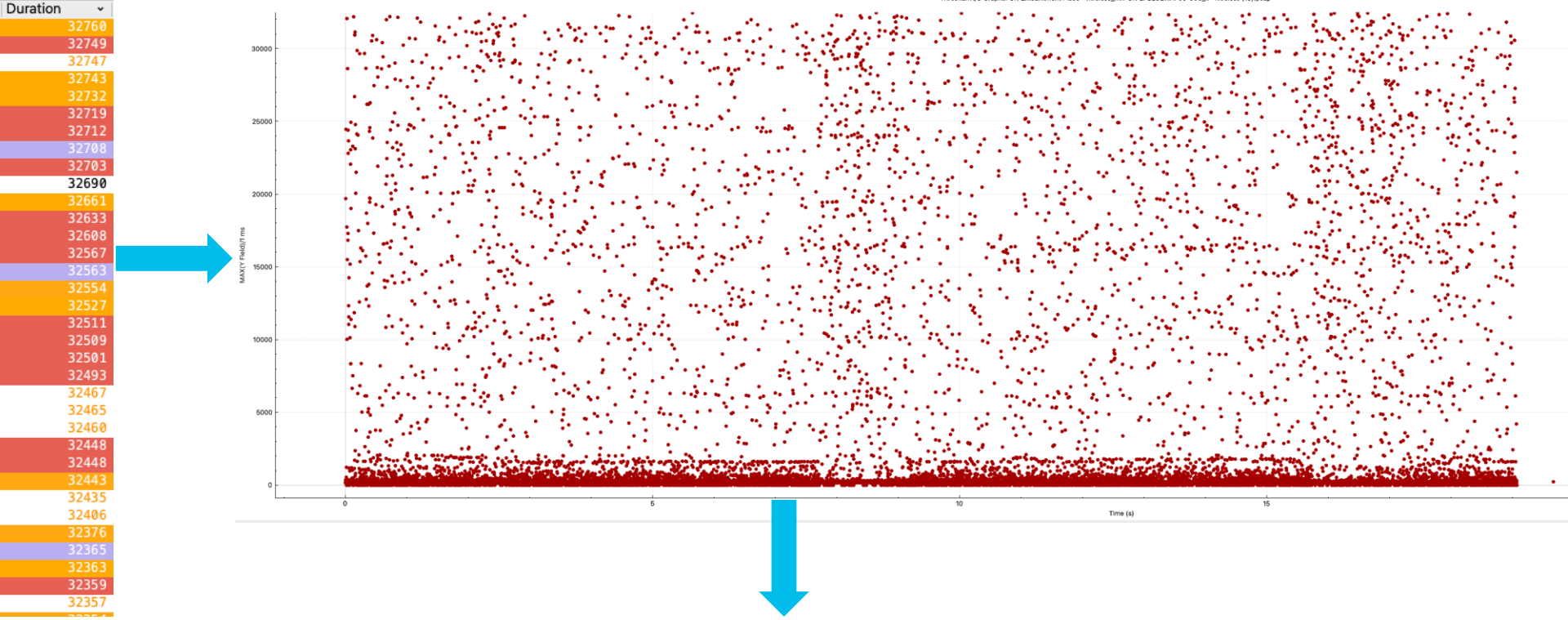
- You can control receive sensitivity of the radio
- AP will ignore any traffic beyond specific threshold
  - Default is very high
  - Too low will cause random client disconnections
- It will allow AP to transmit more often
- VTP of WLANs ☺

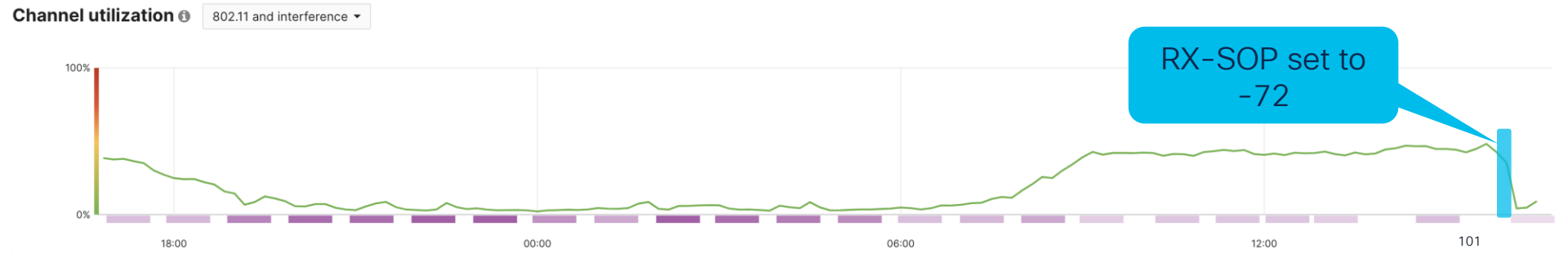


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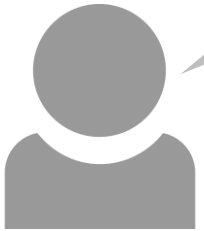
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Duration
32760
32749
32747
32743
32732
32719
32712
32708
32703
32690
32661
32633
32608
32567
32563
32554
32527
32511
32509
32501
32493
32467
32465
32460
32448
32448
32443
32435
32406
32376
32365
32363
32359
32357
MAX(Y Field)/1 ms
30000
25000
20000
15000
10000
5000
0
0
5
10
15
Time (s)


Channel utilization
802.11 and interference
RX-SOP set to -72
100%
0%
18:00
00:00
06:00
12:00
101

Common problem example

We optimized but one area still reports sporadic issues



Time to review RF – maybe there is something in the air



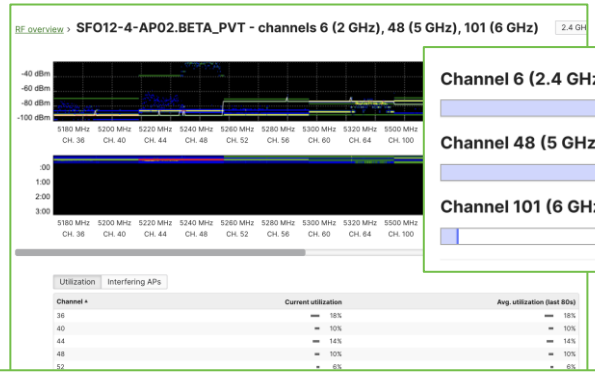
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Monitor RF Channel Utilization

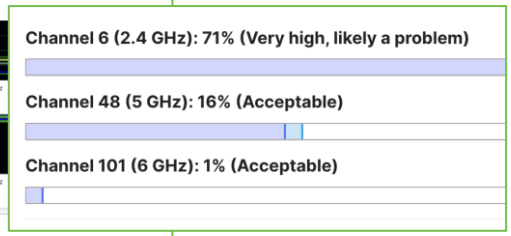
Both Real Time and Trending View

AP Level View

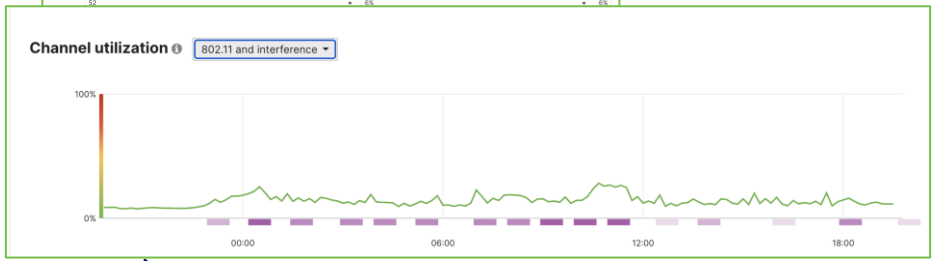
Monitor > RF Spectrum



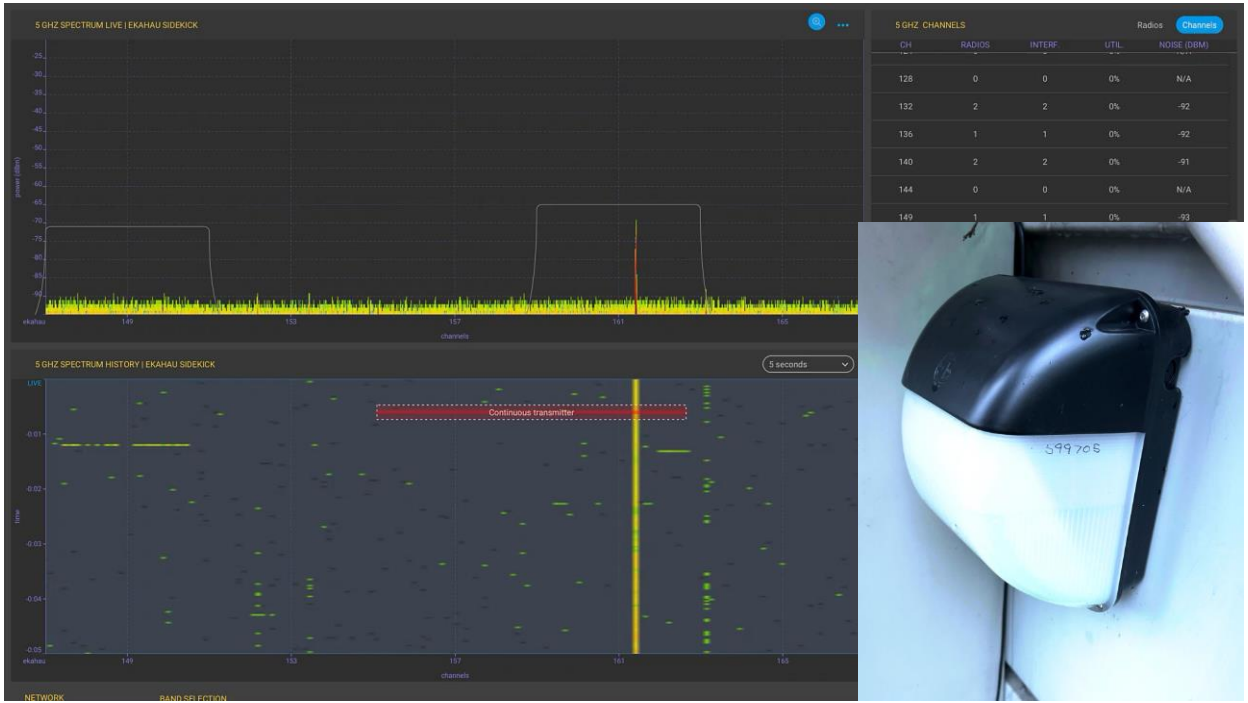
Live Ch. Utilization



Ch. Utilization Trend



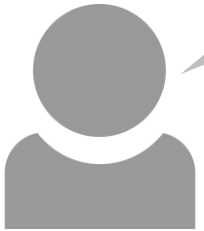
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Common problem example

RF is fixed but we are still not quite happy with the performance



Maybe it’s not the wireless issue after all?



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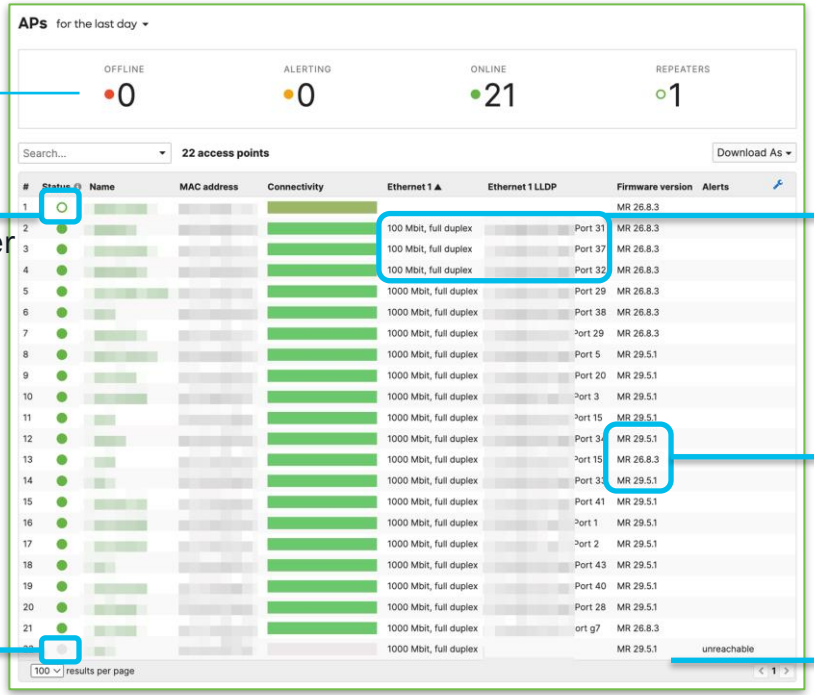
Wireless is not always the problem

Most discovered AP issues in MR networks

No Newly offline device

AP become Repeater

Dormant AP
Offline for > 7 Days



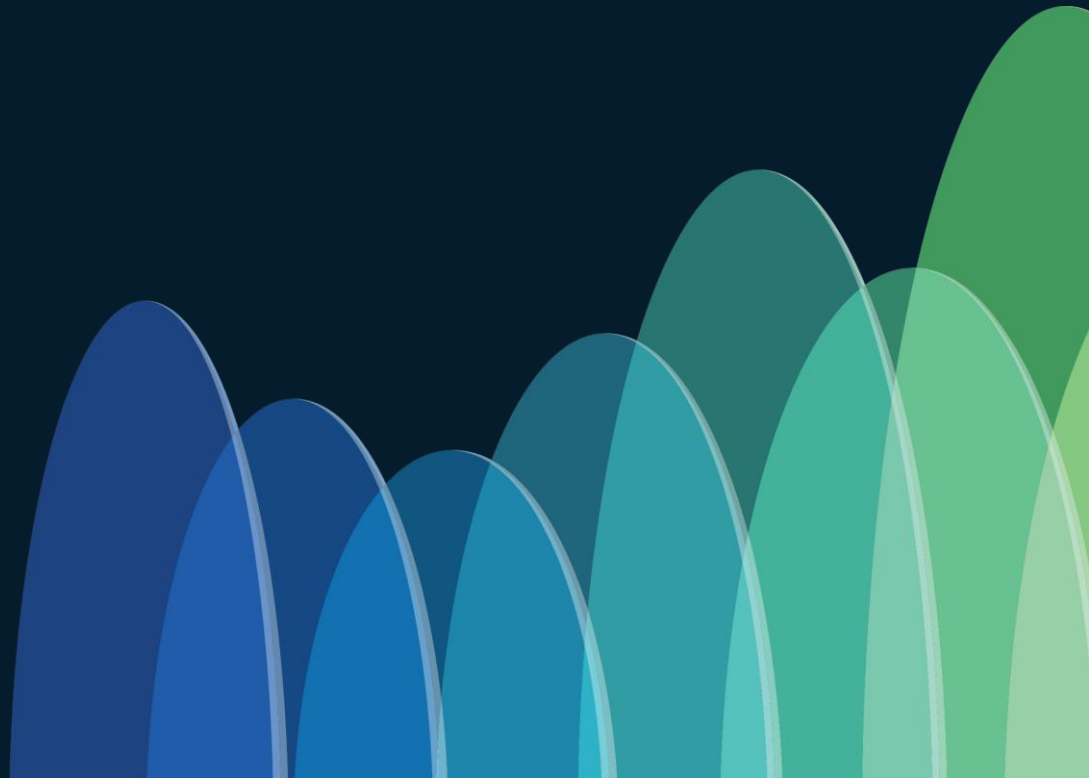
Connected as full duplex
but 100 Mbps speed
→ Check Switch Port Config

Multiple
SW versions are being used

Unreachable

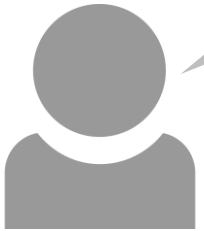
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2 weeks later...



Common problem example

APs are randomly dropping offline – one by one and don't come back



Can you inspect them?



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Webex App

Questions?

Use the Webex app to chat with the speaker after the session

How

1. Find this session in the Cisco Events mobile app
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3. Install the Webex app or go directly to the Webex space
4. Enter messages/questions in the Webex space

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Content Catalog

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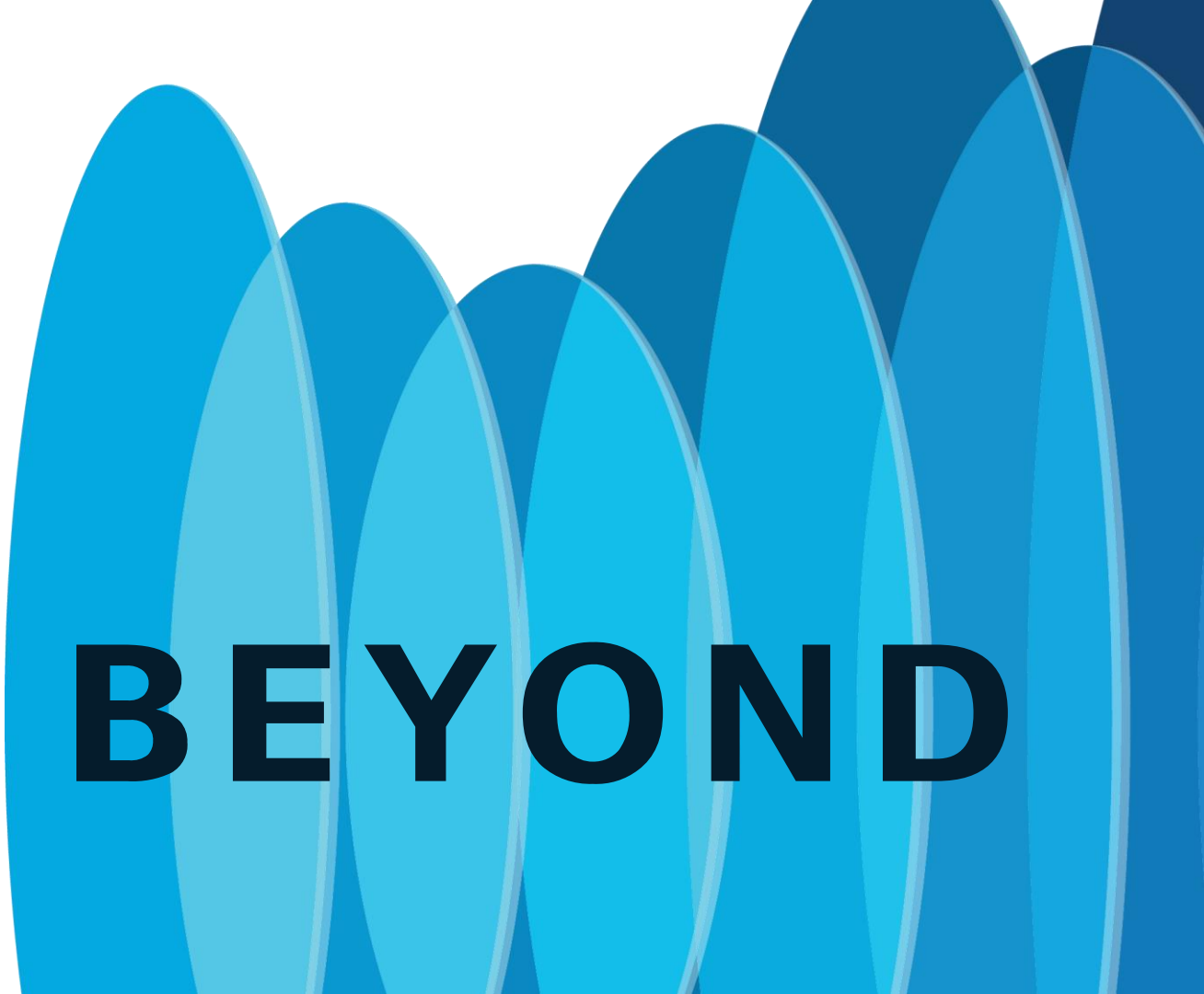
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GO BEYOND