Wireless Counselling

Understanding the Love triangle in Wi - Fi Networks

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Meraki Escalations

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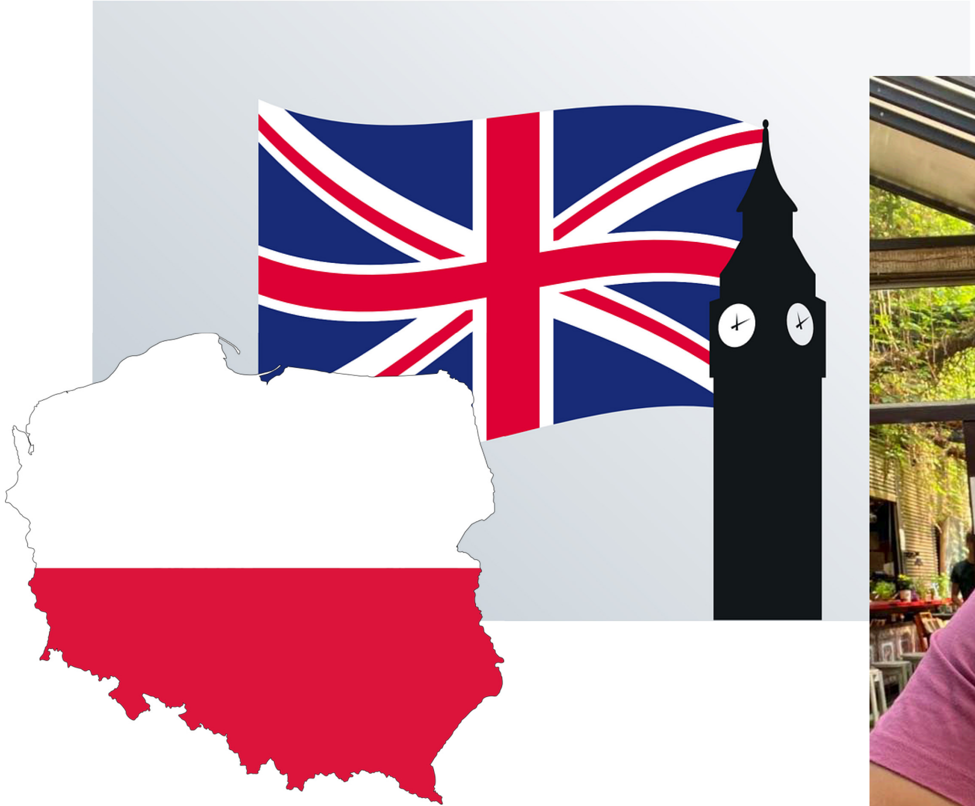
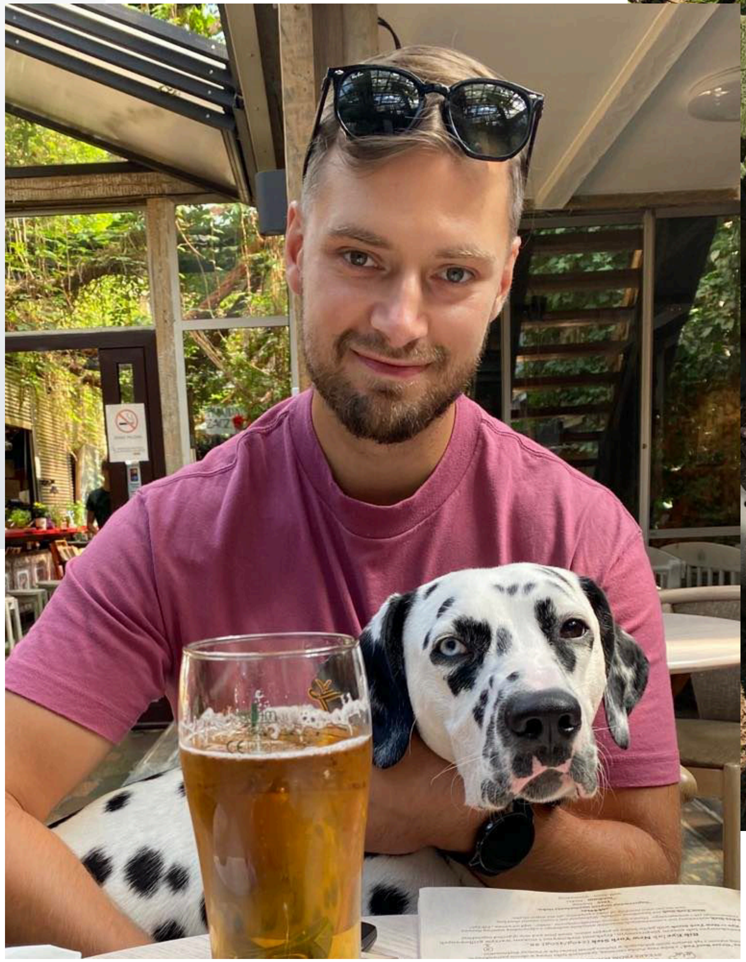
Who is this guy?

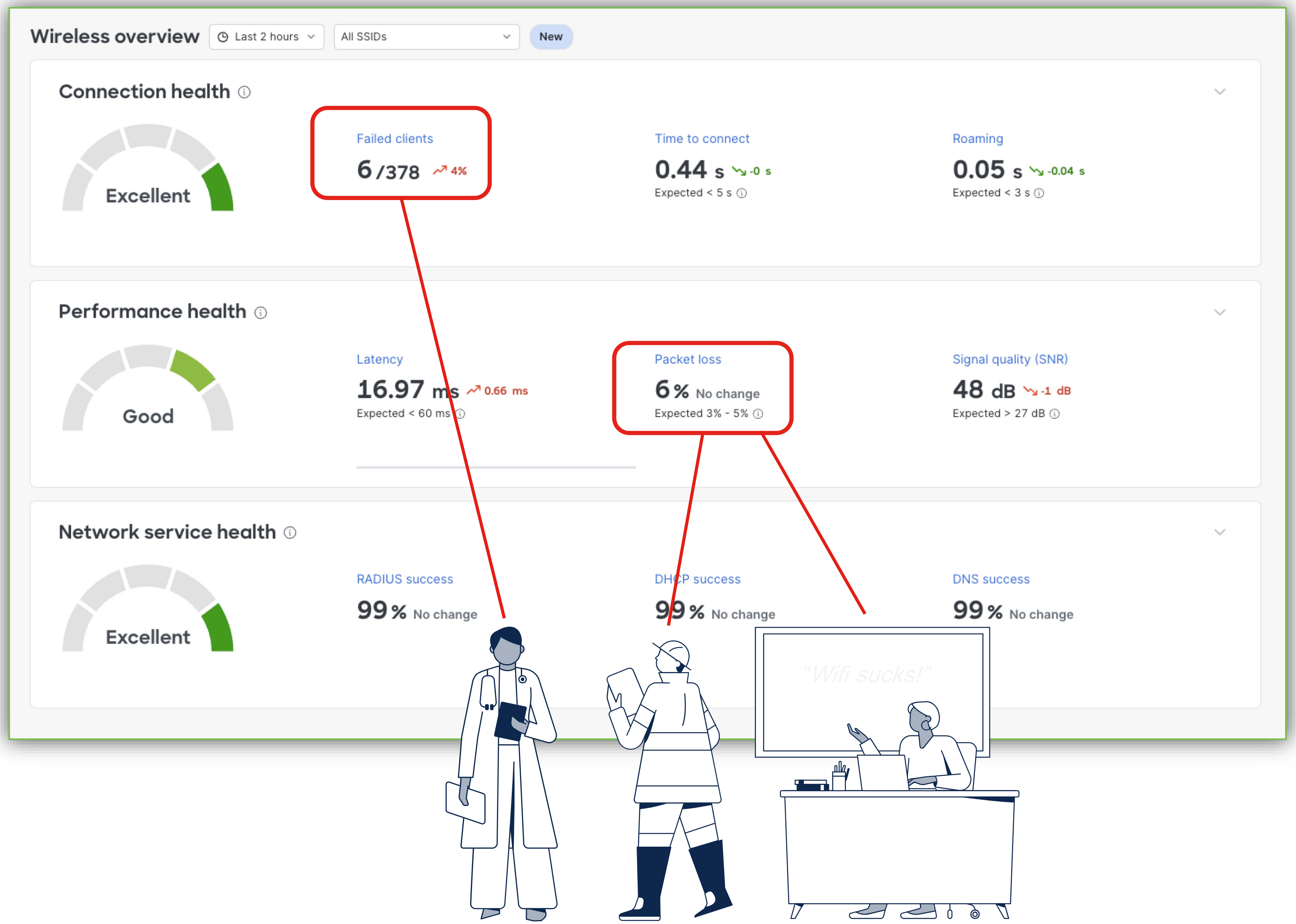




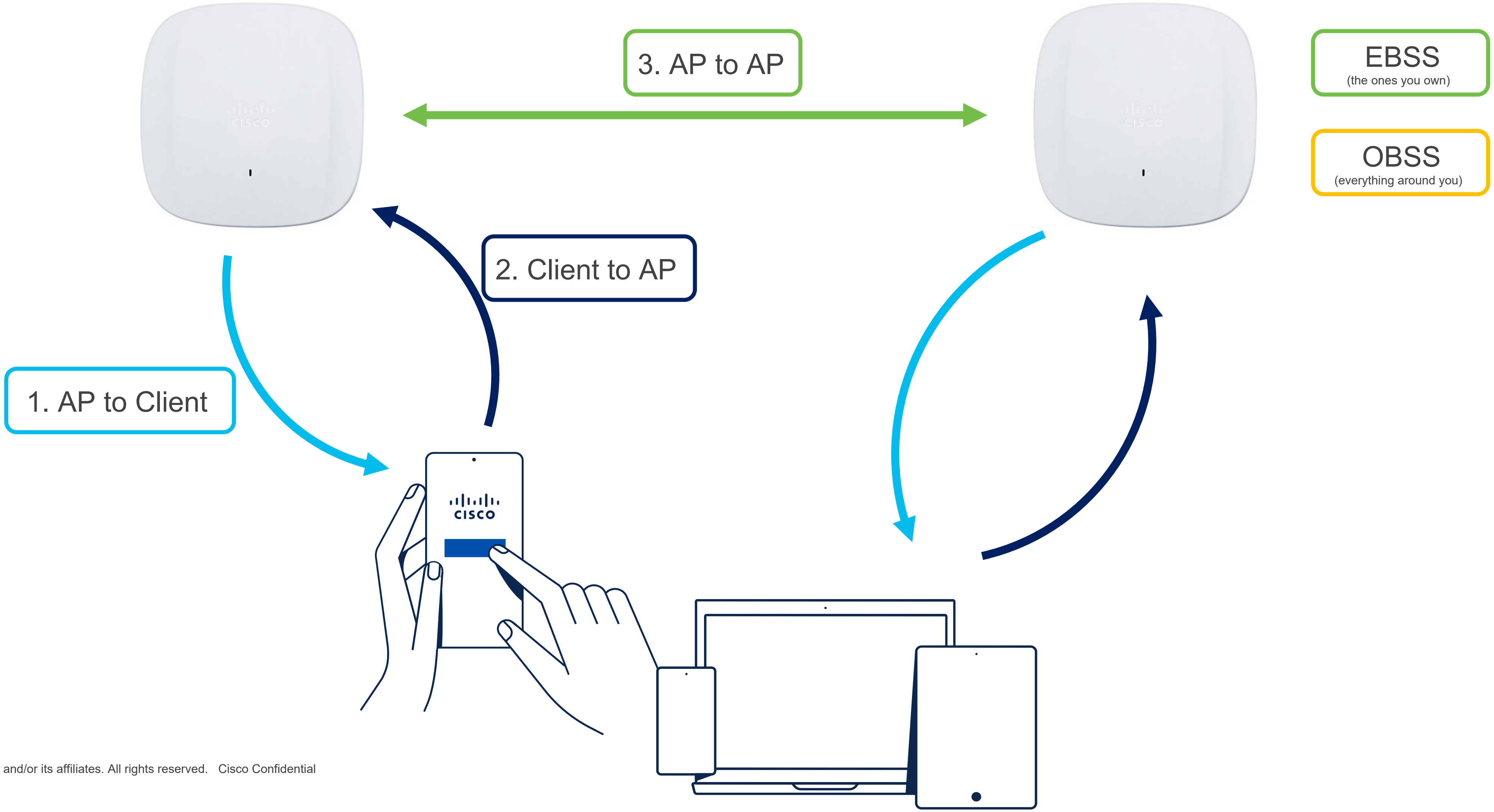
Agenda

- Identify key relationships in Wireless
- Define everyone’s responsibilities
- Real life examples

Good wireless is more than high RSSI

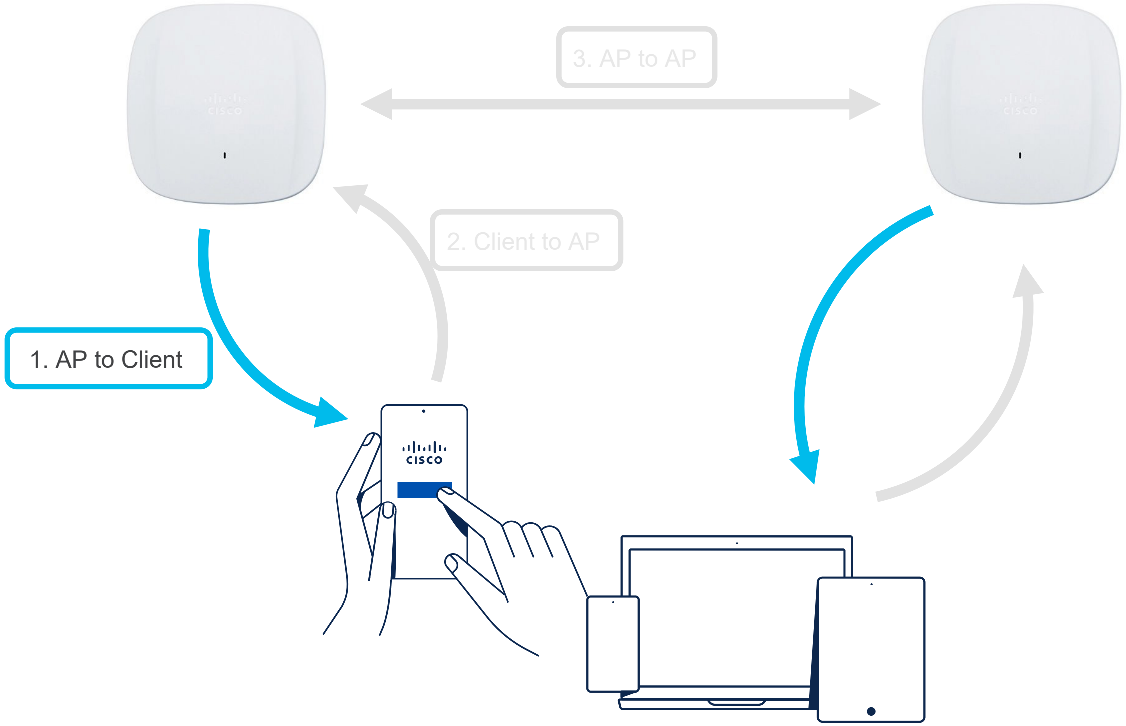


How many Wireless relationships do we see?



AP is the one ”wearing the trousers”

- Usually mounted above client devices
- Very sensitive to environment around it
- Control freak
- Must obey by the same rules as others
- Highly customizable
  - Different antenna types and capabilities
  - TX power
  - Data rates
  - Channel assignment
  - More advanced options
    - RX- SOP, 11k/v…



Client is the “submissive” one

- Less powerful
- Only sees what’s around it
- Power mode may dictate its operations
- Not as customizable in most cases
- High reliance on vendor docs
- Decides when to roam

Trigger threshold

This is the minimum signal level a client needs to maintain a connection.

iPhone, iPad and iPod touch monitor and maintain the Basic Service Set Identifier (BSSID)’s connection until the Received Signal Strength Indicator (RSSI) exceeds -70 dBm. Then the device scans for roam candidate BSSIDs for the new Extended Service Set Identifier (ESSID).

Bear this in mind when you design wireless cells and calculate their signal overlap. For example, you might design 5 GHz cells that have a -67 dBm overlap. In this case, the device keeps its connection to the BSSID longer than you expect. This is because the device uses -70 dBm as the trigger. If the BSSID's RSSI is greater than -65 dBm, the device prefers a 5 GHz network.

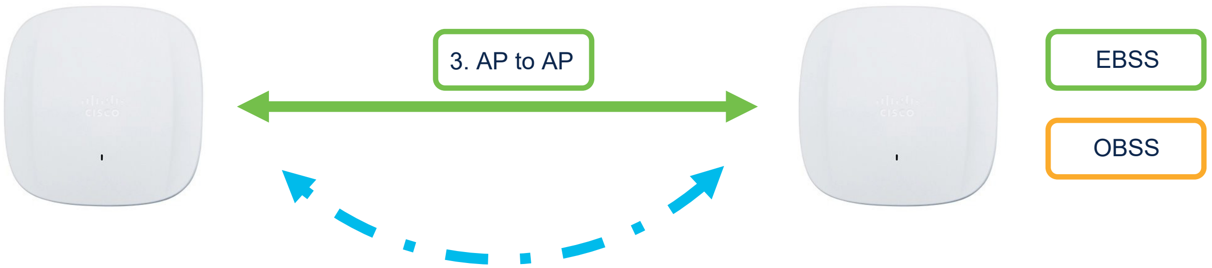
Be sure to use the target device to measure cell overlap. Antennas on a laptop computer are much larger and more powerful than antennas on a smartphone or tablet. So if you use a laptop to measure overlap, iPhones and iPads will have different cell boundaries than you expect.

When the device sends or receives data, it picks target BSSIDs whose RSSI is eight dB or greater than the current BSSID’s RSSI. When the device doesn't send or receive data, use a 12 dB differential.

For example, the RSSI of the current connection might drop to -75 dBm during a Voice over WLAN (VoWLAN) call. When this happens, the device will later search for BSSIDs that have an RSSI of at least -67 dBm.

Other APs are the *family* or the *noisy neighbours*

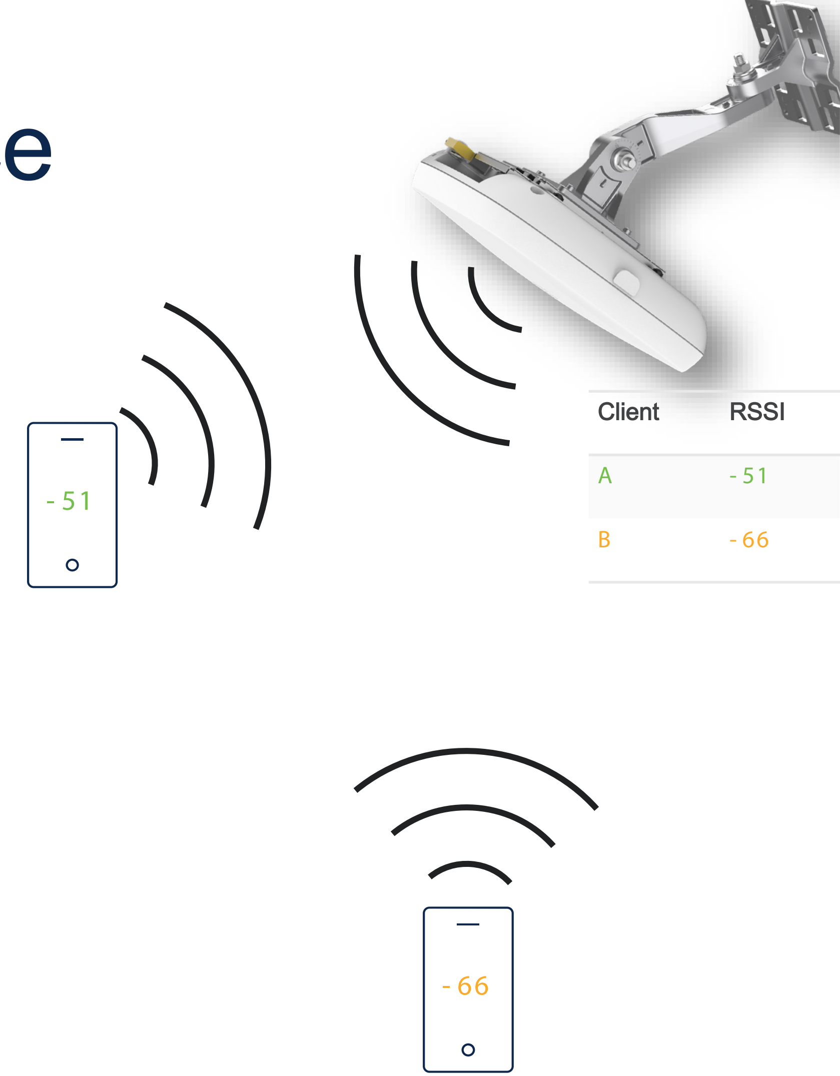
- AP needs to make it work and keep everyone happy
- Over RF
  - How well I can hear APs and on what channels
    - The ones I **want to** care about
    - The ones I **have to** care about
  - Necessary for well functioning RRM
- Over wire
  - Every vendors shares different data in many ways
    - Key management
    - Client information
    - Probably more



Let’s put that into practice

RSSI directly impacts the performance

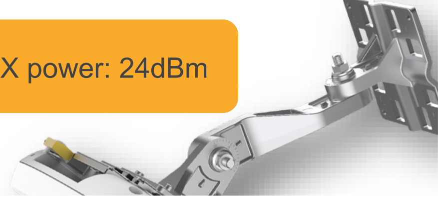
- High RSSI **usually** equals high MCS
  - At least that's the logic
- Well designed network should result with *as equal as possible* RSSI on Client and AP and consistent rates
- RSSI imbalance may result with frequent downshifts and retries
- It is common to see 6 – 15dB difference between AP and client



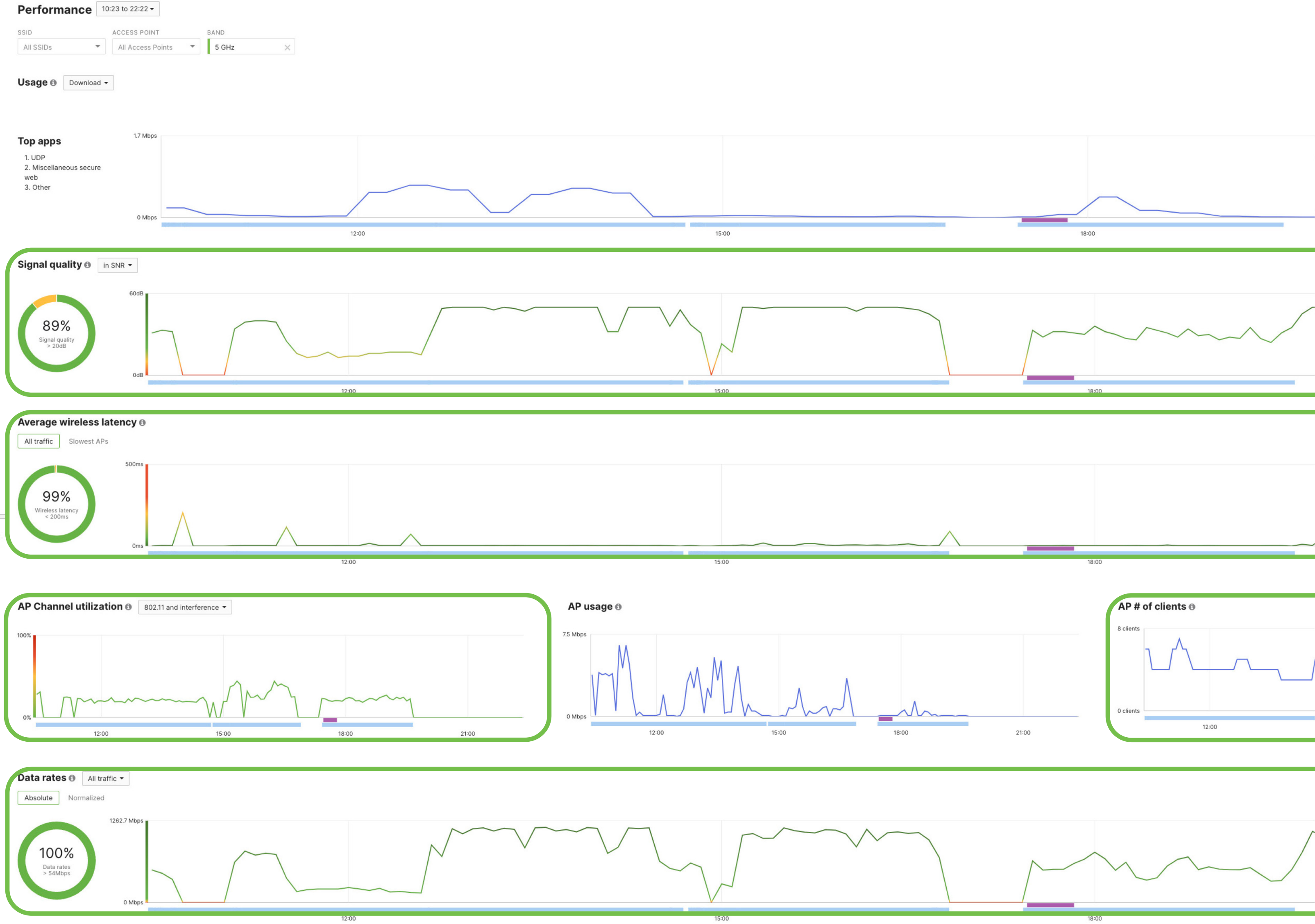
Client	RSSI
A	- 51
B	- 66

Creative config can make things worse

Current TX power: 24dBm



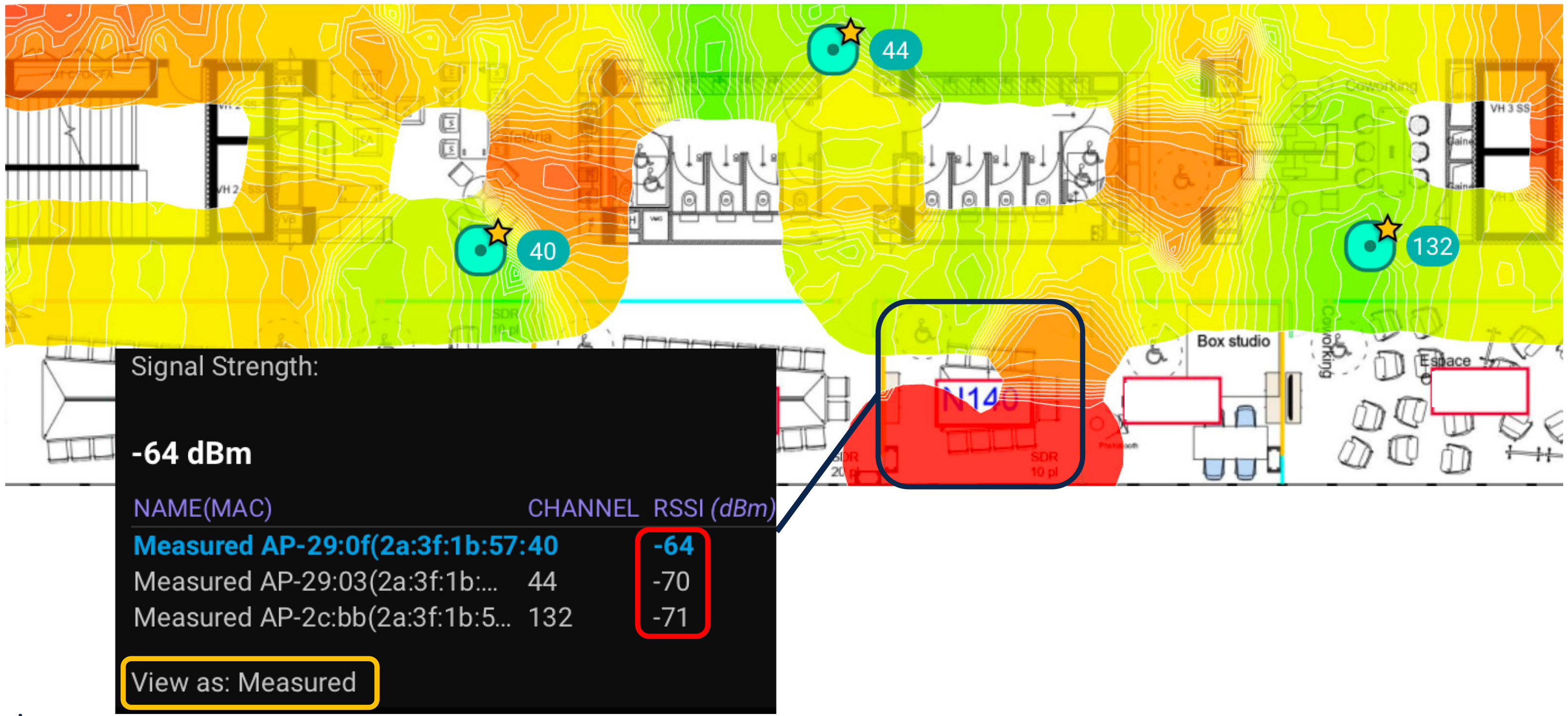
Data Rate	Sequence nu	Info
1080.9	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
1080.9	3313	QoS Data, SN=3313, FN=0, Flags=.p...F.C
1080.9	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
1080.9	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
1080.9	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
1080.9	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
1080.9	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
960.8	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
960.8	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
960.8	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
960.8	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
960.8	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
960.8	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
960.8	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
960.8	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
960.8	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
864.7	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
864.7	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
864.7	3313	QoS Data, SN=3313, FN=0, Flags=.p.R.F.C
24.0		802.11 Block Ack, Flags=........C
24.0		802.11 Block Ack, Flags=........C



APs away from users also has its consequences

QUICK MATHS

- 64 + device offset = average / poor end - user experience



Target power (dBm)	Transmit power (dBm)
8 - 17	8
8 - 17	8
8 - 17	8
8 - 17	8
8 - 17	8
8 - 17	8
8 - 17	8
8 - 17	8
8 - 17	8
8 - 17	8
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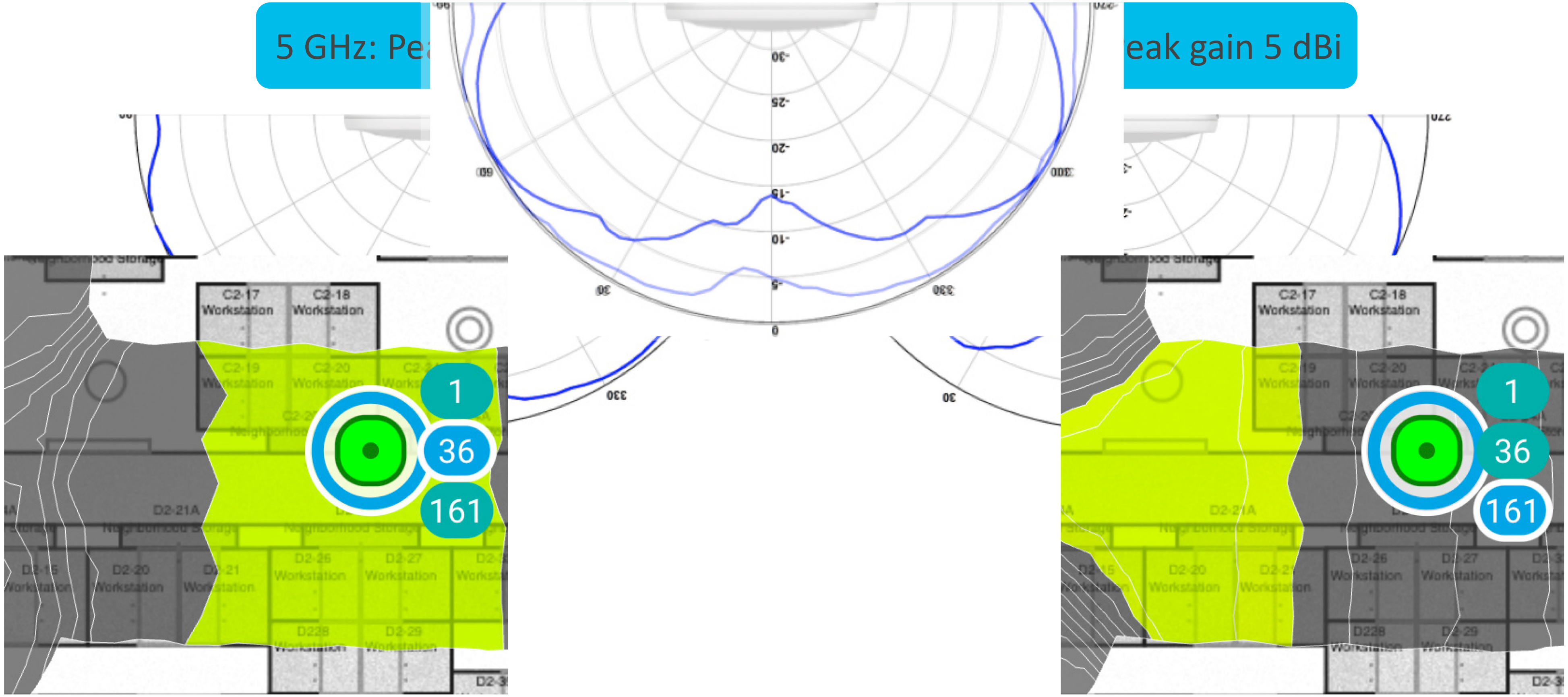
8 - 17	8
8 - 17	8
8 - 17	8
8 - 17	8
8 - 17	8
8 - 17	8

Bad TX will cause capacity imbalance

- Tri- band APs are everywhere
  - Can be used in multiple set ups
  - 5GHz and 6Ghz
  - Dual 5GHz

- Cells should be balanced to keep things sweet
  - It’s not only about the - 7dBm for 2.4GHz
  - It’s also about the antenna gain and pattern

Bad TX will cause capacity imbalance



Bad TX will cause capacity imbalance

RADIO SETTINGS

2.4 GHz: 1 (20 MHz; 2 dBm)

5 GHz: 36 (20 MHz; 2 dBm)

5 GHz: 104 (20 MHz; 7 dBm)

Channel	Current channel width	Signal strength	Port	Tools
36	20	45 dB	—	Ping
36	20	50 dB	—	Ping
104	20	40 dB	—	Ping
104	20	45 dB	—	Ping
104	20	39 dB	—	Ping
104	20	40 dB	—	Ping
104	20	45 dB	—	Ping
104	20	42 dB	—	Ping
104	20	48 dB	—	Ping
104	20	48 dB	—	Ping
104	20	43 dB	—	Ping
104	20	43 dB	—	Ping
104	20	46 dB	—	Ping

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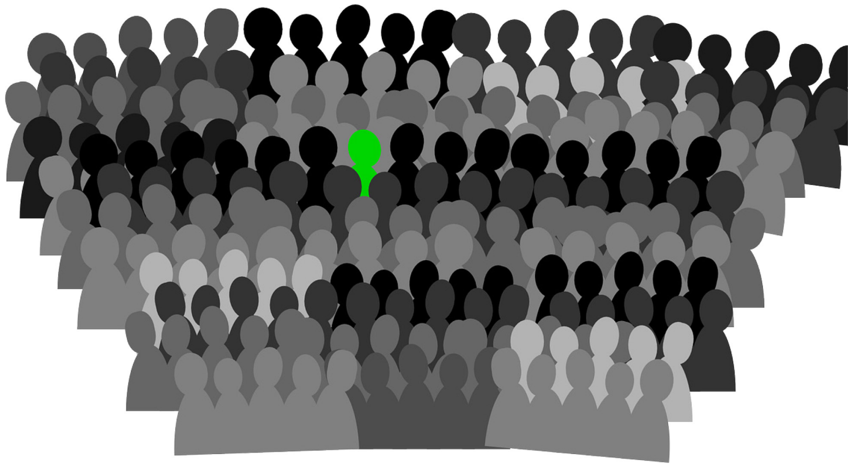
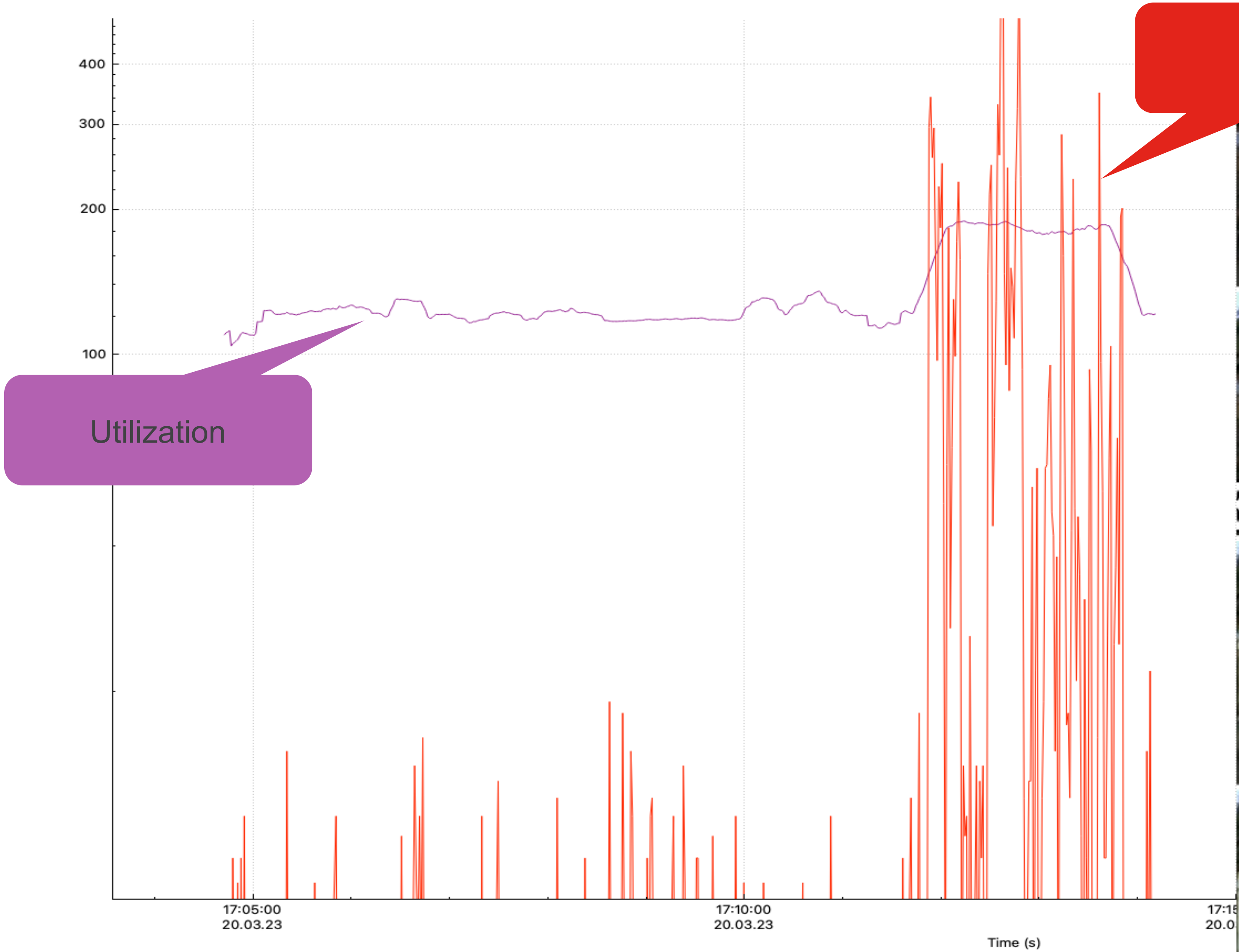
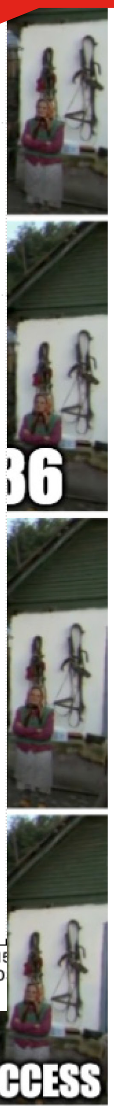
- Wireless is a shared medium
- Devices on ch.36 will have different experience than devices on ch.104



And medium is busy and get’s busier

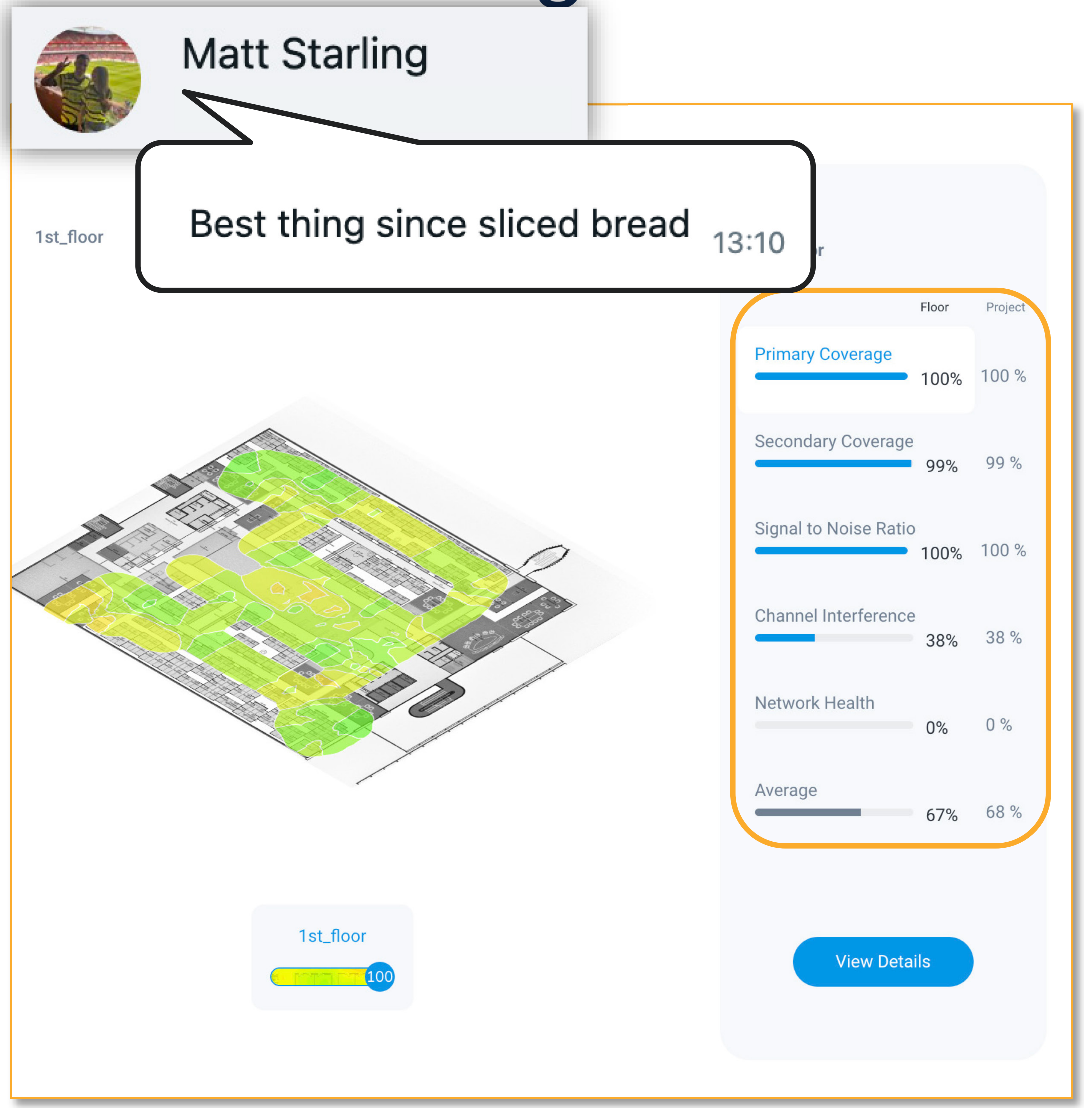


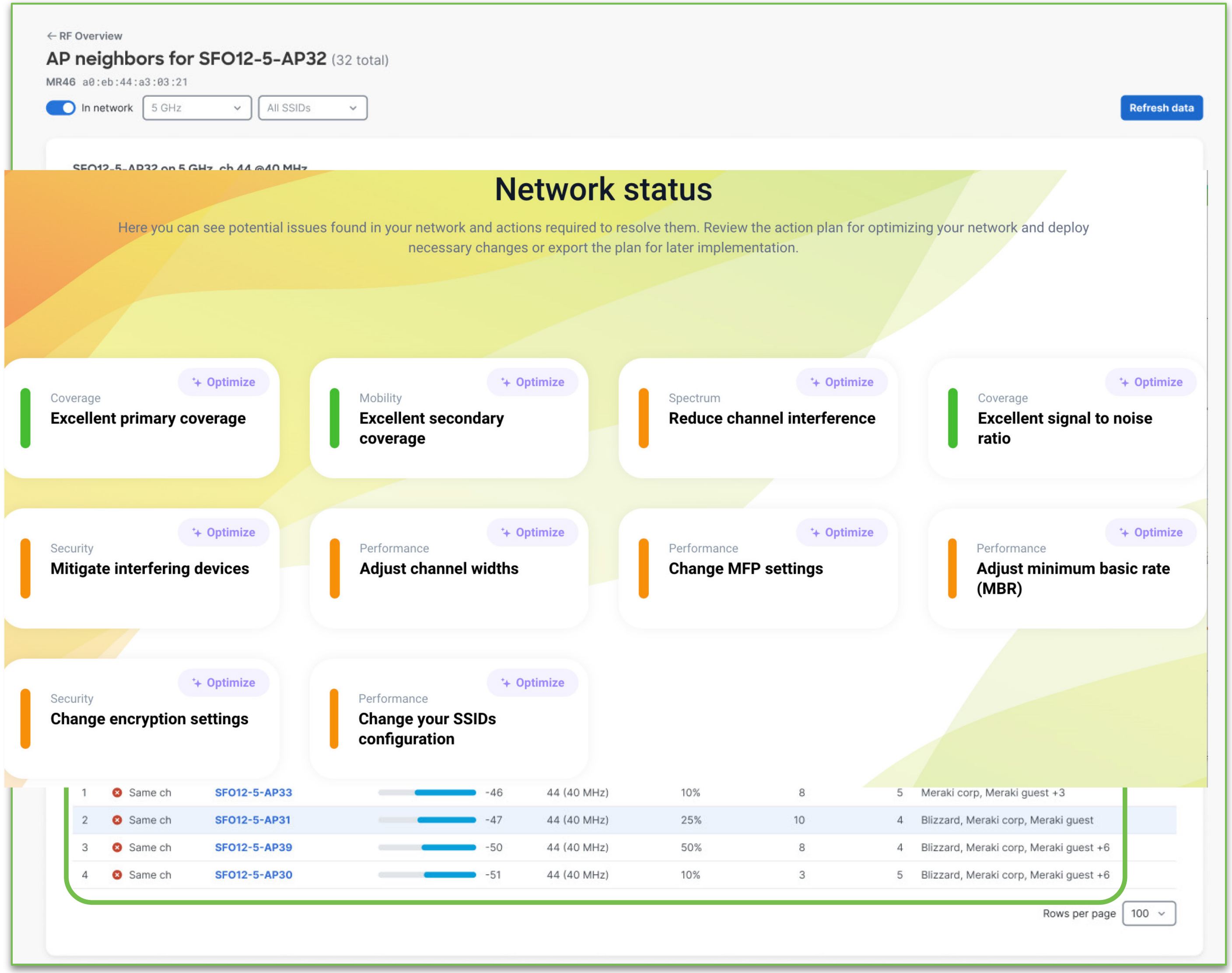


Neighboring networks we don’t control

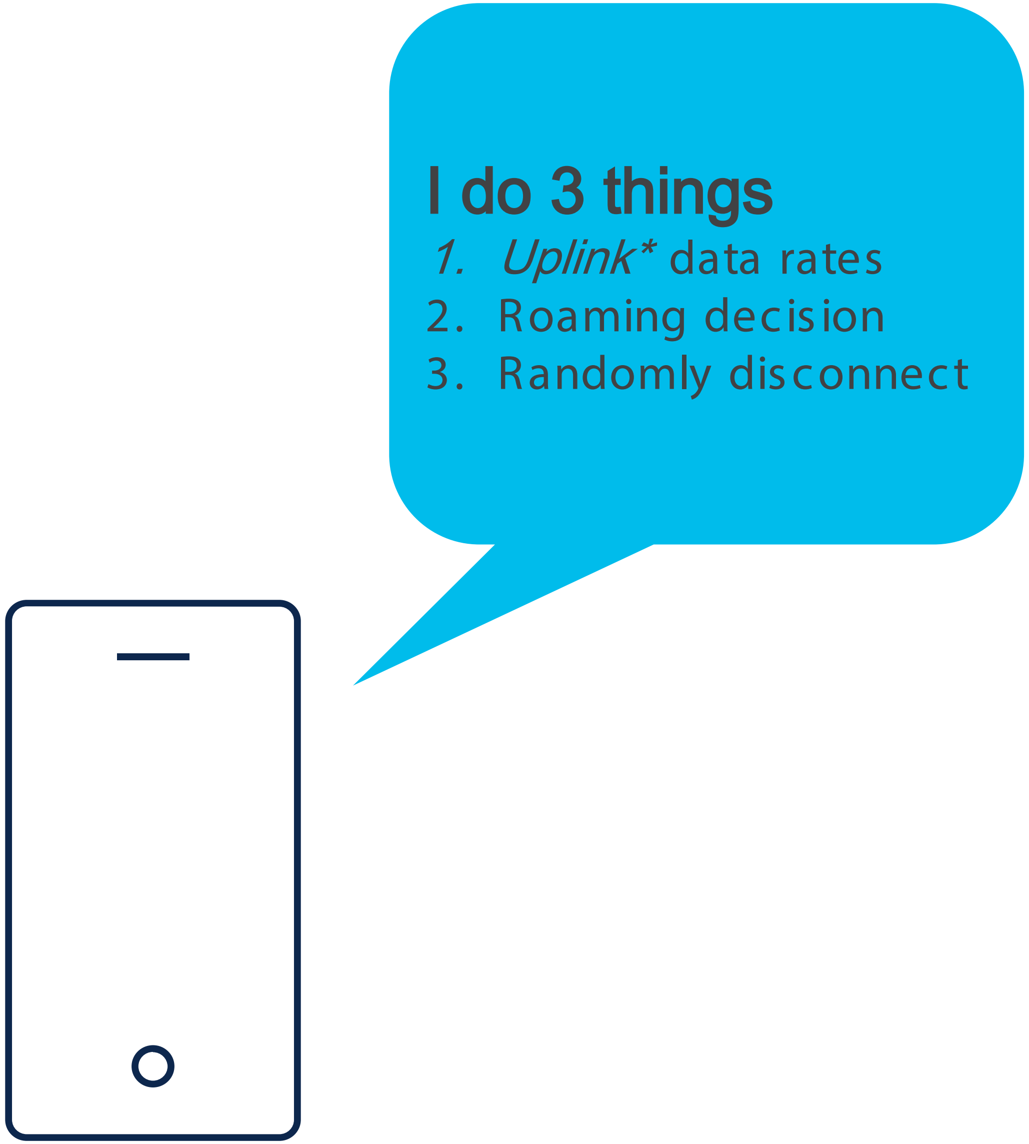
dBm ▾	Channel	Mode
-52	64	802.11ax (802.1x)
-56	64	802.11ax (802.1x)
-61	48	802.11ax (802.1x)
-62	48	802.11ax (802.1x)
-74	44+ (80 MHz)	802.11ax (WPA2)
-74	48	802.11ax (WPA2)
-75	132	802.11ax (802.1x)
-77	36	802.11n (WPA2)
-77	132	802.11ax (802.1x)
-78	36+ (80 MHz)	802.11ax (WPA2)
-78	36	802.11ax (802.1x)
-78	36	802.11ax (802.1x)
-78	36+ (40 MHz)	802.11n (WPA2)
-78	132	802.11ax (802.1x)
-78	136 (40 MHz)	802.11ax (WPA2)
-79	36	802.11ax (802.1x)
-79	36+ (40 MHz)	802.11n (WPA2)
-79	36	802.11ax (open)
-79	132	802.11ax (802.1x)
-80	36+ (80 MHz)	802.11ac (open)
-80	36+ (40 MHz)	802.11ac (WPA2)
-80	36	802.11ax (802.1x)
-80	36	802.11ax (802.1x)
-80	36	802.11ax (802.1x)
-80	52	802.11ax (802.1x)
-80	44+ (80 MHz)	802.11ax (WPA2)
-81	36+ (80 MHz)	802.11ac (open)
-81	36+ (80 MHz)	802.11ac (open)
-81	36	802.11ax (802.1x)
-81	36+ (40 MHz)	802.11ac (WPA2)
-81	36+ (80 MHz)	802.11ac (open)
-81	36+ (80 MHz)	802.11ac (open)
-81	36+ (40 MHz)	802.11ac (WPA2)
-81	52	802.11ax (802.1x)
-81	100	802.11ax (802.1x)
-81	100	802.11ax (802.1x)
-82	36+	802.11a (open)
-82	36+ (40 MHz)	802.11ac (open)
-82	36+ (80 MHz)	802.11ac (open)
-82	36+ (80 MHz)	802.11ac (open)
-82	36+ (80 MHz)	802.11ac (open)
-82	36+ (160 MHz)	802.11ax (WPA2)
-82	36	802.11n (WPA2)
-82	36+ (80 MHz)	802.11ac (open)
-82	36+ (40 MHz)	802.11n (WPA2)
-82	36+ (80 MHz)	802.11ac (open)
-82	36+ (40 MHz)	802.11ac (WPA2)

With the right tools we can manage the spectrum





With RF being optimized, let’s look at client device



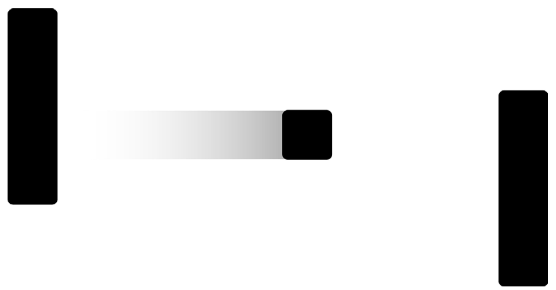
Good roaming makes users happy

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?

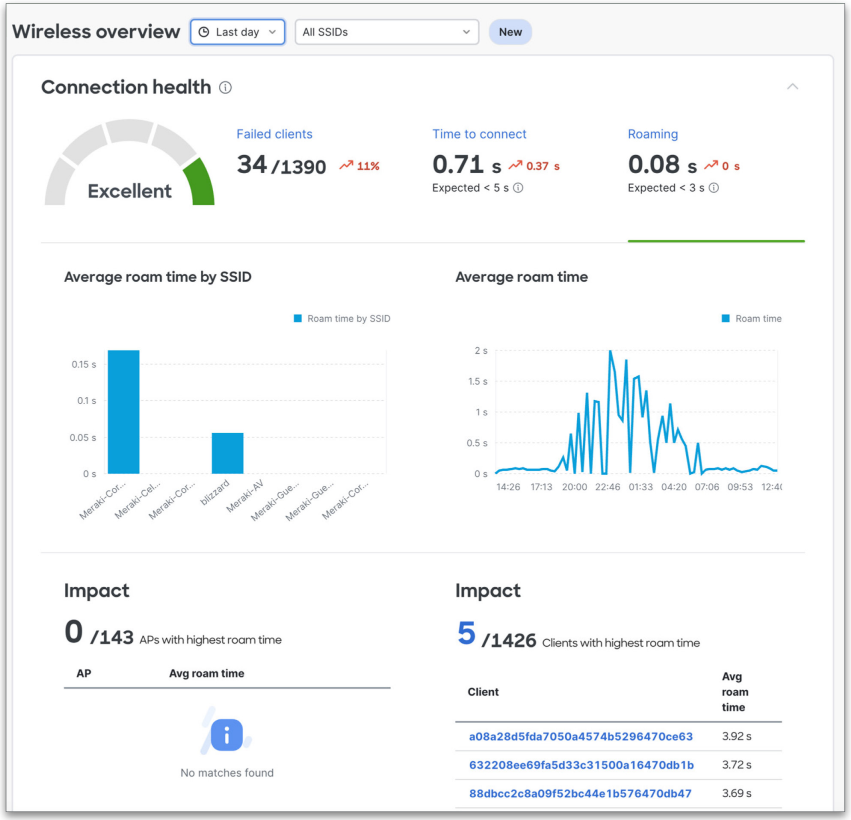
- Might go off channel to look for target APs
  - Time varies on number of channels enabled and supported
- Select the candidate and connect
- Derive PMK and PTK
  - In PSK environments it’s quick
  - In dot1x it varies
    - What EAP type used and connection to AS?
    - What Roaming protocols are used?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

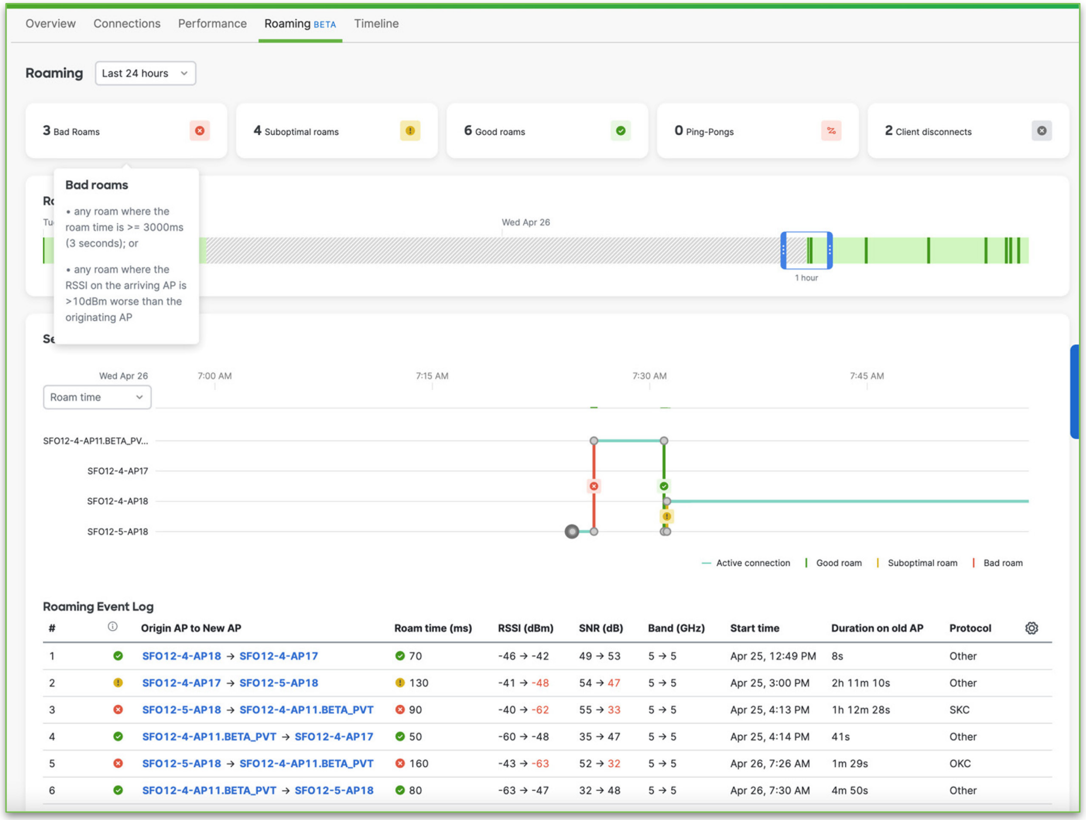


Roaming is complex to troubleshoot and monitor

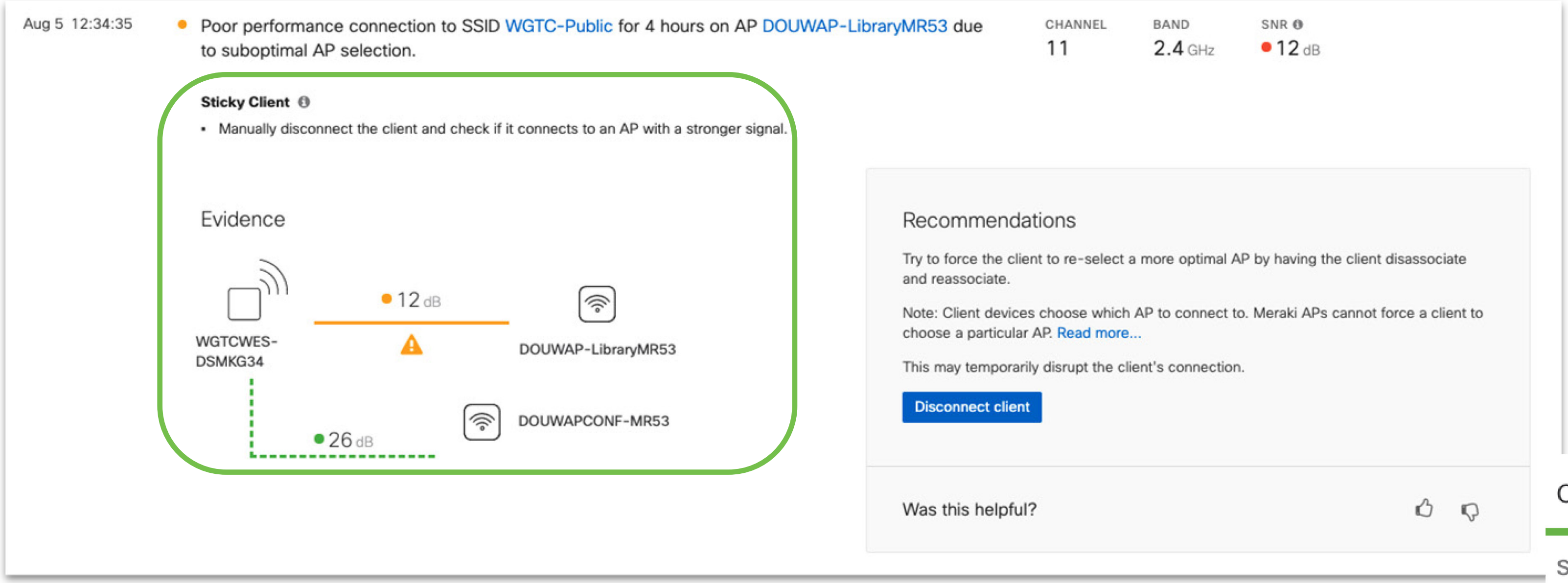
Meraki makes it simple

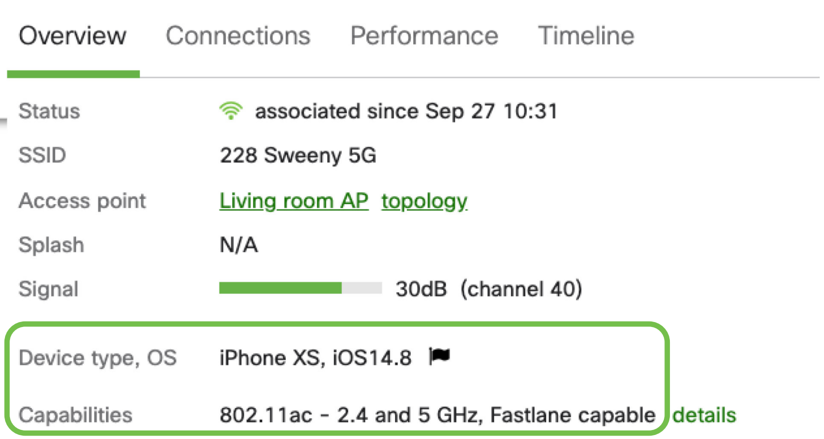
Roaming ~~is~~ was complex to troubleshoot and monitor

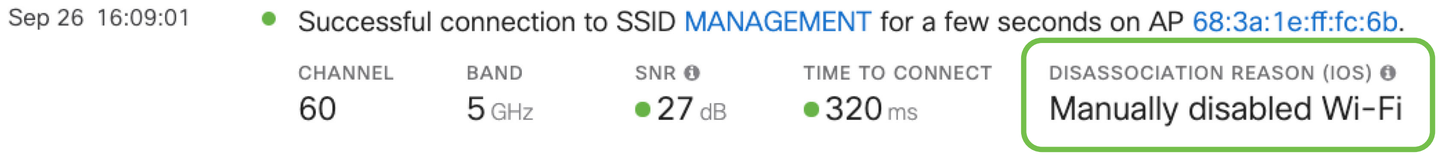




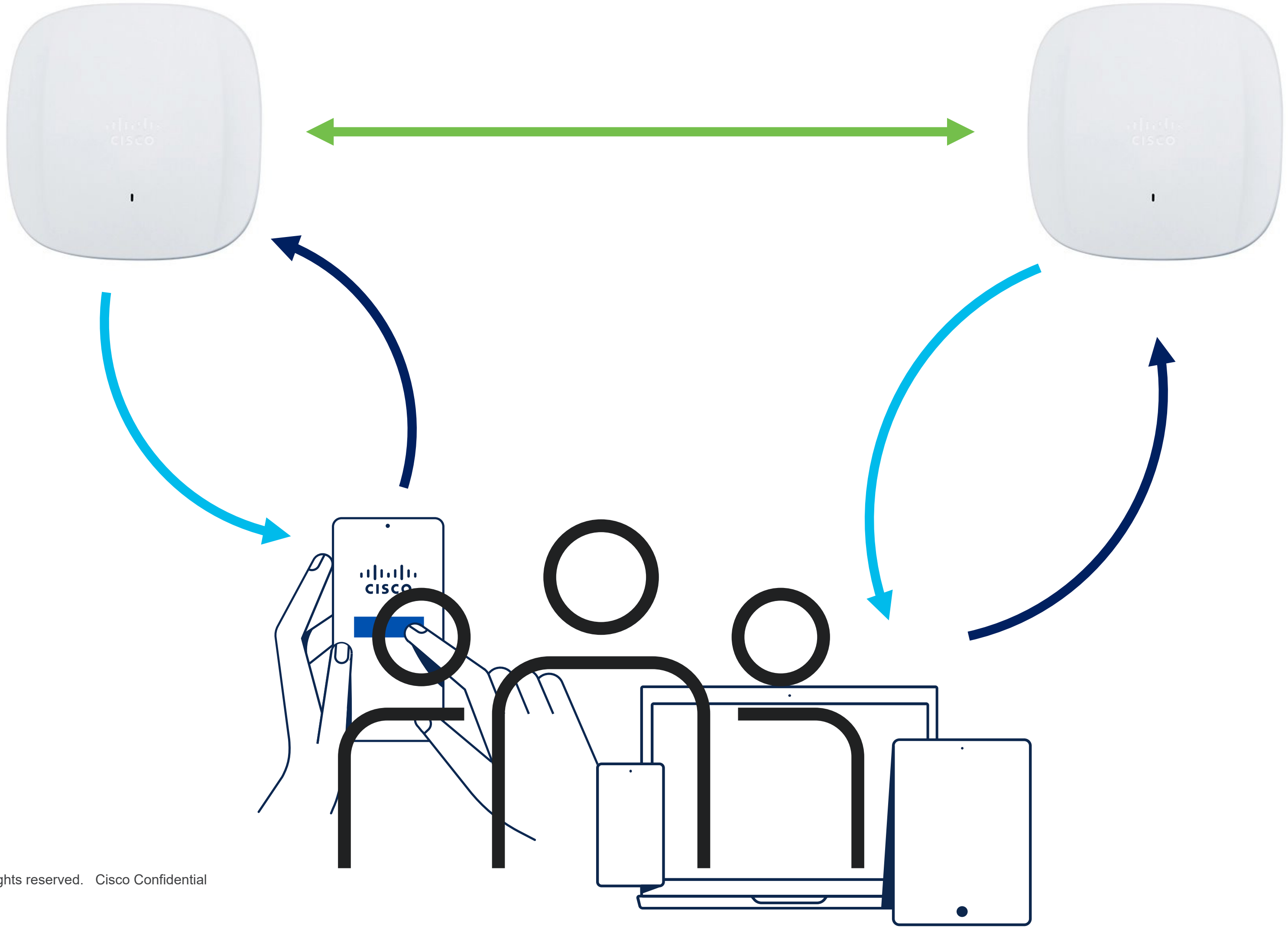
So was retrospective troubleshooting





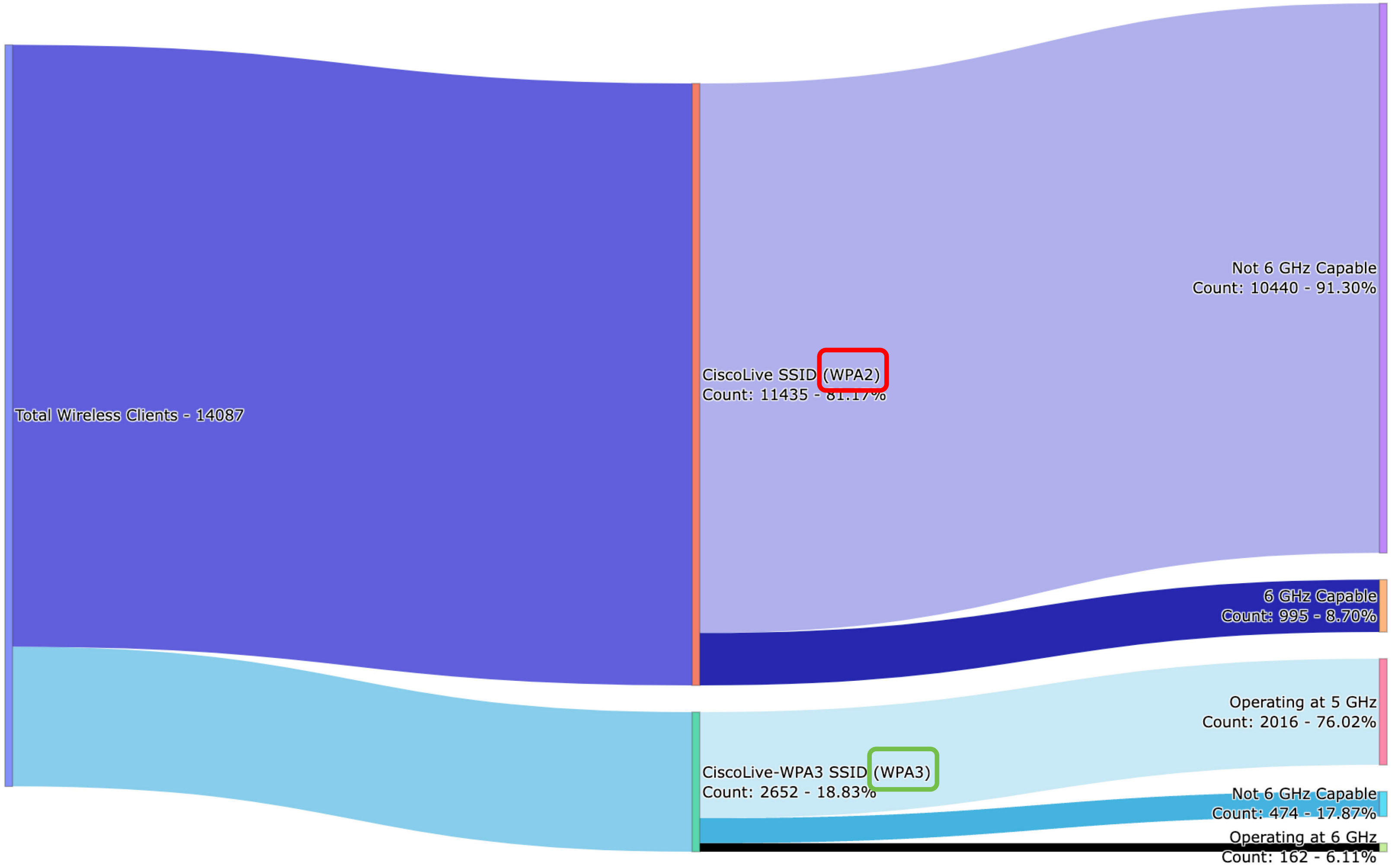


But there is one more



Make the most from latest technologies

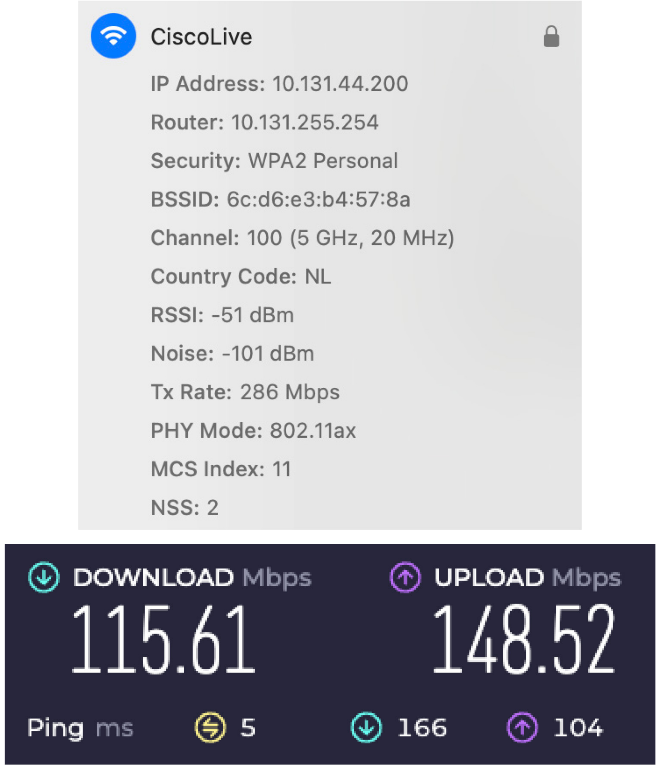
Get on 6GHz

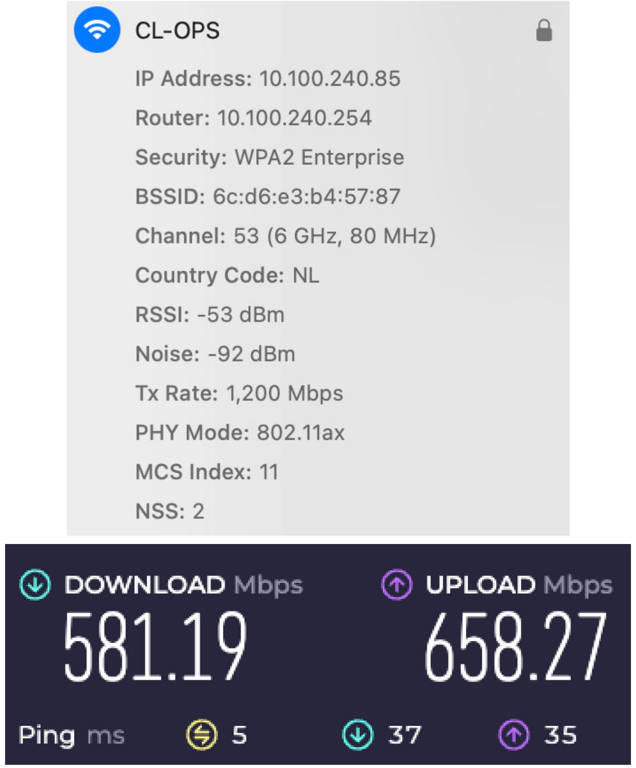


1k 6GHz clients on WPA2

That’s 1000 devices that missed out on 6GHz

Because they used the wrong SSID





The bridge to possible