Deploying High Density 5 / 6 GHz

Tom Hildebrand | Ubiquiti
tom.hildebrand@ui.com | WLPC Slack | LinkedIn

Project Origins

Our pre-sales engineering team was approached by a large customer in Canada.

Annual corporate conference and the venue network was insufficient.

Wanted to stand up and down a new network in about a week.

But not just any network…

A Different Type of End User

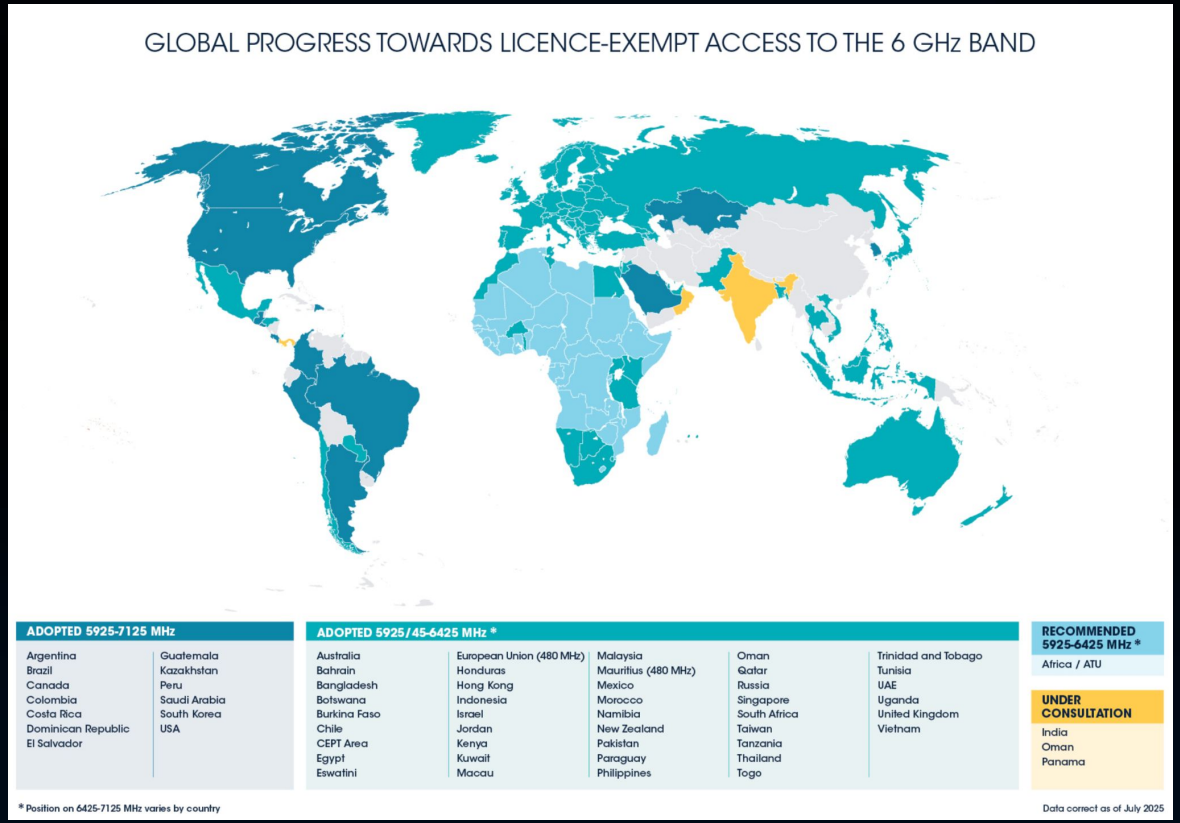
Not just smartphone users!

Programmers and UX designers using hundreds of gigs of data per day, 24/5

Modern clients in the corporate fleet meant we could use 6 GHz at scale.

50/50 split of 6 GHz capable clients.

6 GHz Globally



The Location

A Lot of Customers

6500 people in the main venue and 2000 in an auxiliary building

Design requirement for 15,000 clients, and we blew past that.

17,000 clients on Wi-Fi

27,000 total unique MAC addresses

The Location

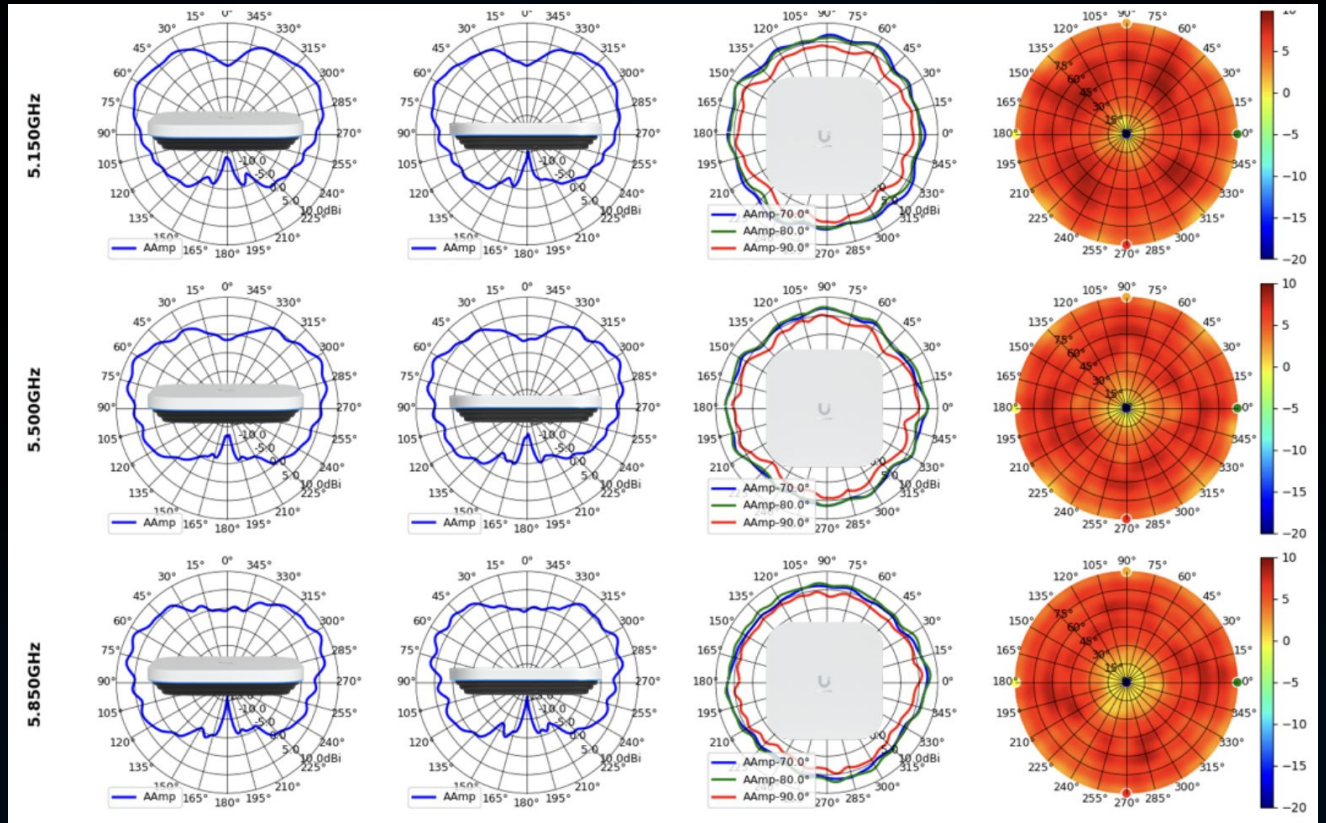
Good News and Bad News

Venue was nice enough to let us disable their APs if we added their SSID to ours.

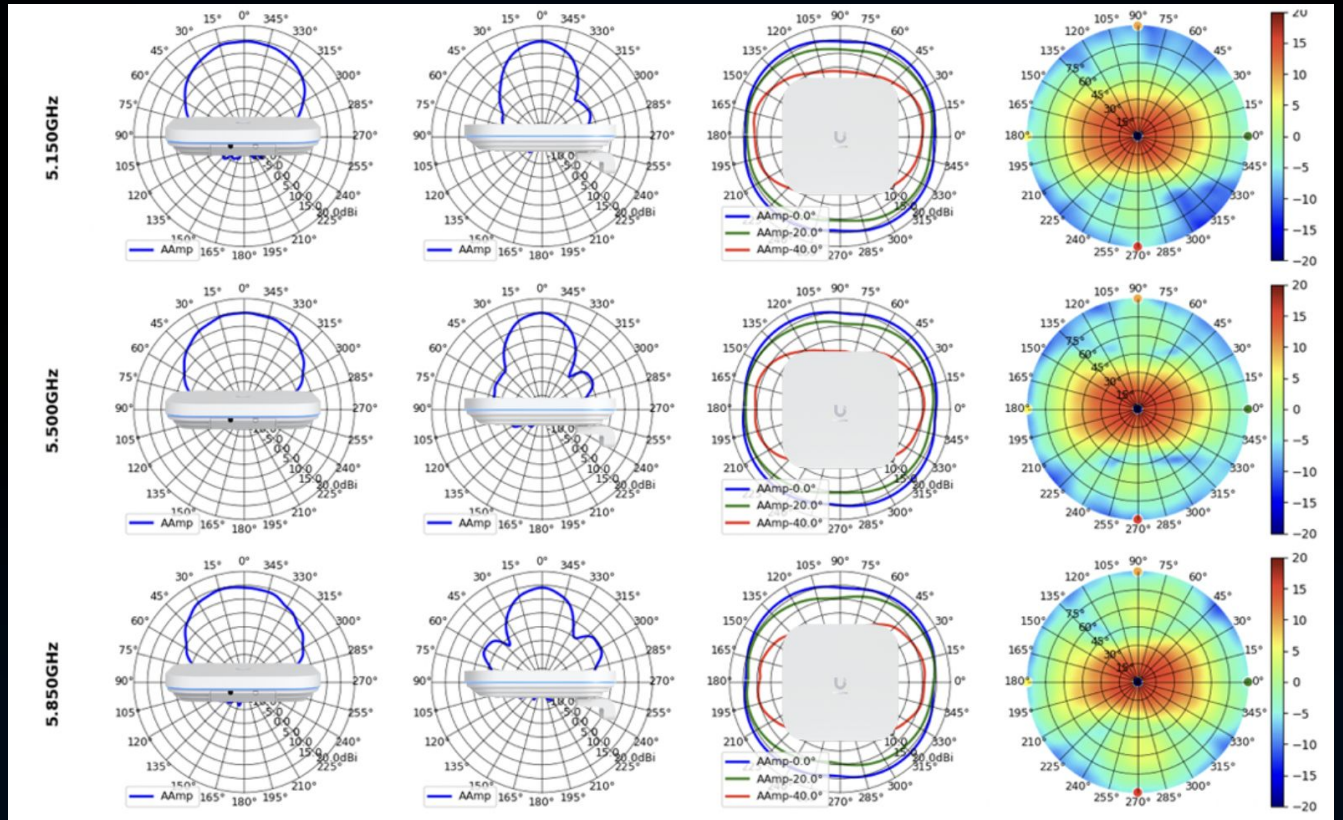
Big open spaces, with concrete floors, with no RF absorbing dividers.

Even with 6 GHz spectrum, how do we make this work?

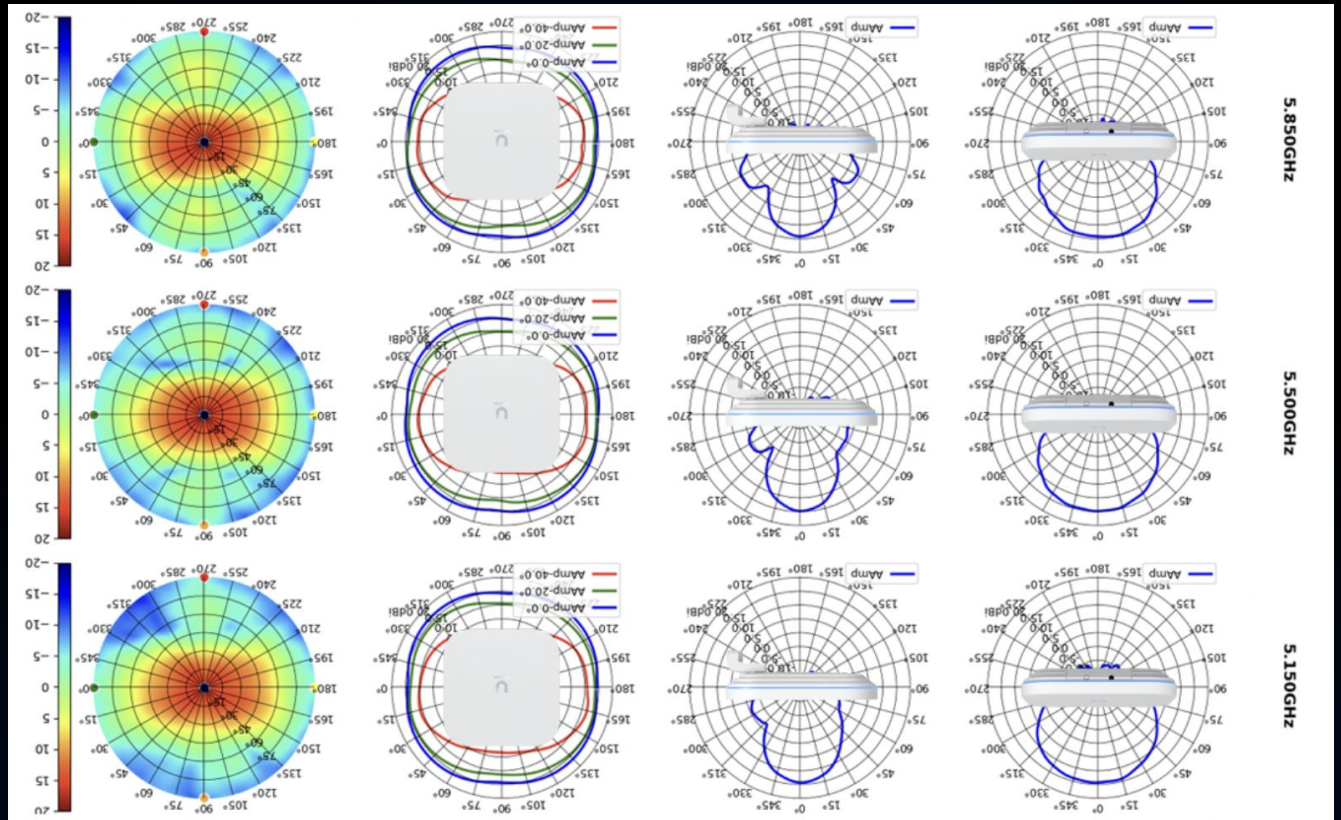
Radiation Patterns



Radiation Patterns



Radiation Patterns



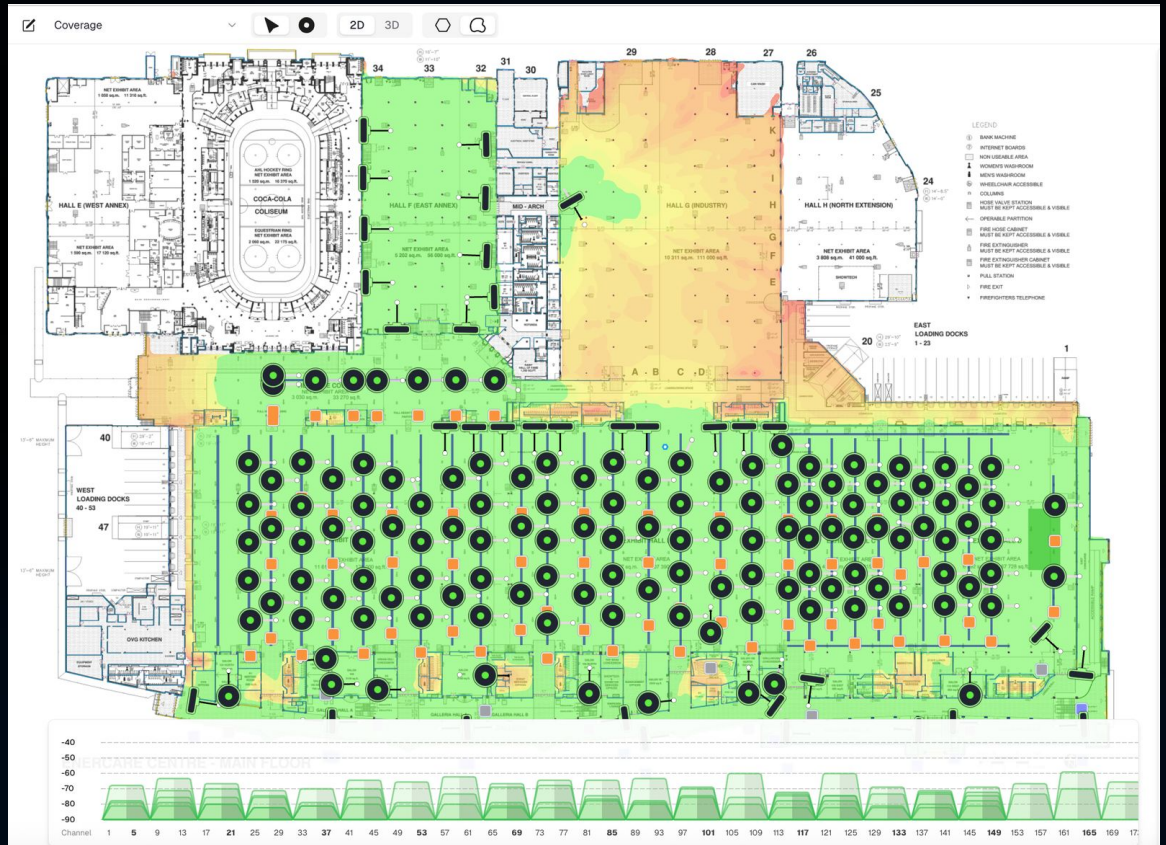
Mounting the APs

Mounting the APs

Directionals on tripods in the halls

Omnis in breakout rooms

The Survey


Coverage
2D
3D
HALL E (WEST ANNEX)
COCA-COLA COLISEUM
HALL F (EAST ANNEX)
MID - ARCH
HALL G (INDUSTRY)
HALL H (NORTH EXTENSION)
EAST LOADING DOCKS 1 - 23
WEST LOADING DOCKS 40 - 53
A - B
C - D
-40
-50
-60
-70
-80
-90
Channel

Channel Utilization

20 MHz channels used on 2.4 GHz, only where needed.

20 MHz channels used on 5 GHz

80 MHz channels used on 6 GHz - Originally surveyed for 40 MHz.

Configuring the SSID

Immediate change: collapse 5 and 6 GHz to a single SSID!

Proxy ARP

Multicast and Broadcast Control / Blocker

High Minimum Data Rates

Client isolation

Minimum RSSI / “Interference Blocker”

Goal: shrink airtime usage per client as much as possible

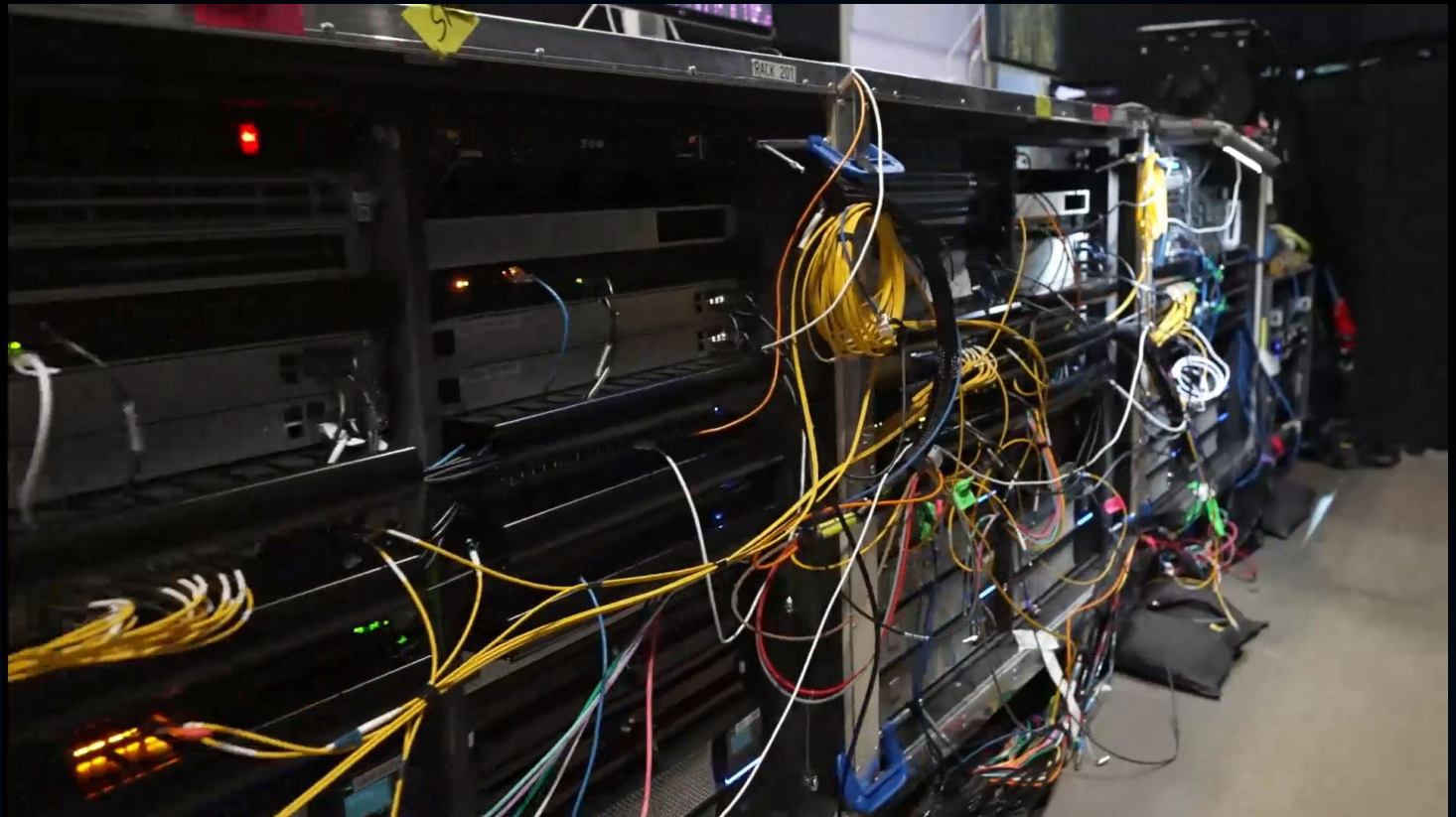
330 APs later… now what?

PoE++ required, how do we deal with the cabling requirements?

We have to coexist with some latency-sensitive traffic: Dante, 100 universes of streaming ACN lighting, and Bolero intercom systems.

Racks behind the scene to racks on the floor to racks on the trusses.

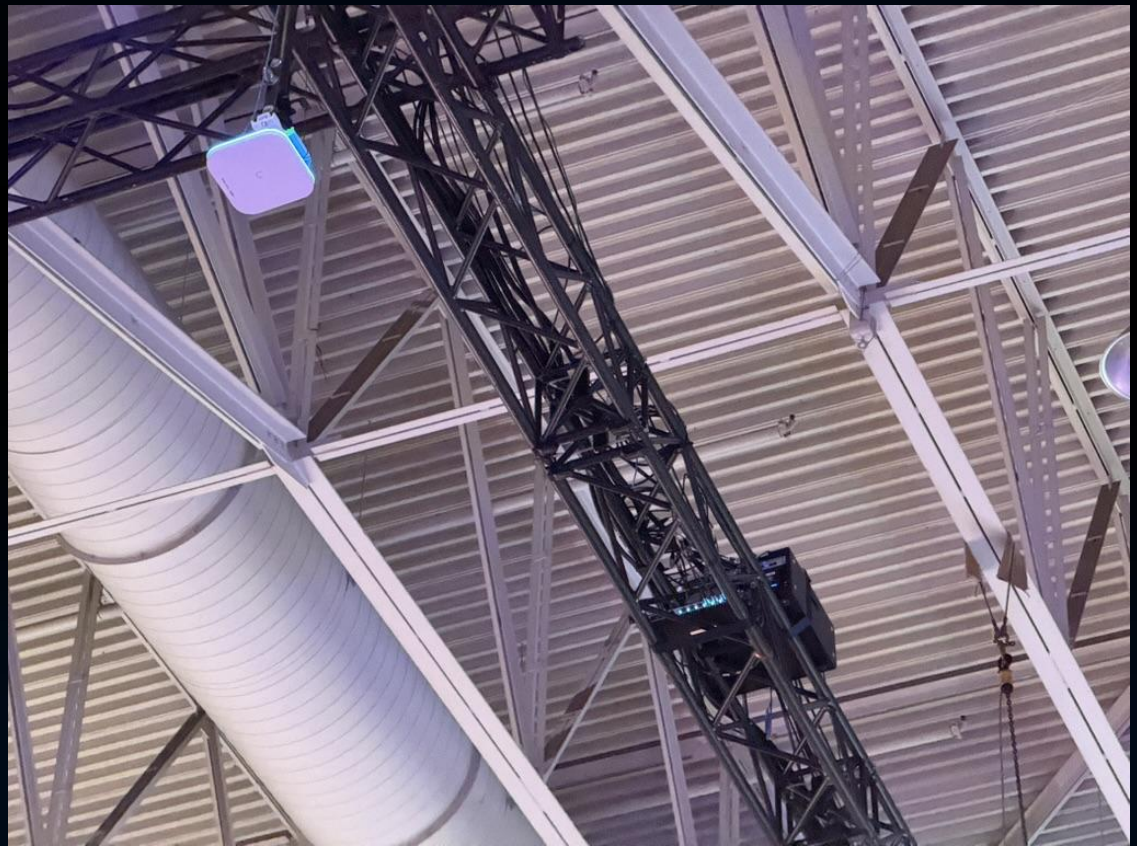
Core Racks



Floor Racks

Truss Racks

Truss Racks



DHCP and WAN

WAN is 3x 10G pipes directly to the Toronto Internet Exchange, from 3 different providers

This was load balanced across 9 separate gateways (plus a cold spare) using RADIUS assigned VLANs assigned at random, with different gateways responsible for each.

3x Aggregation switches to 130x rack switches across the floor and trusses to 880x edge switches (by the end)

Building the NOC

Events like this aren’t just set and forget: you have to have staff on site, both from the customer side and network operations side.

Escalation pathways, who responds to what feedback

Focus vs collaboration spaces within the NOC.

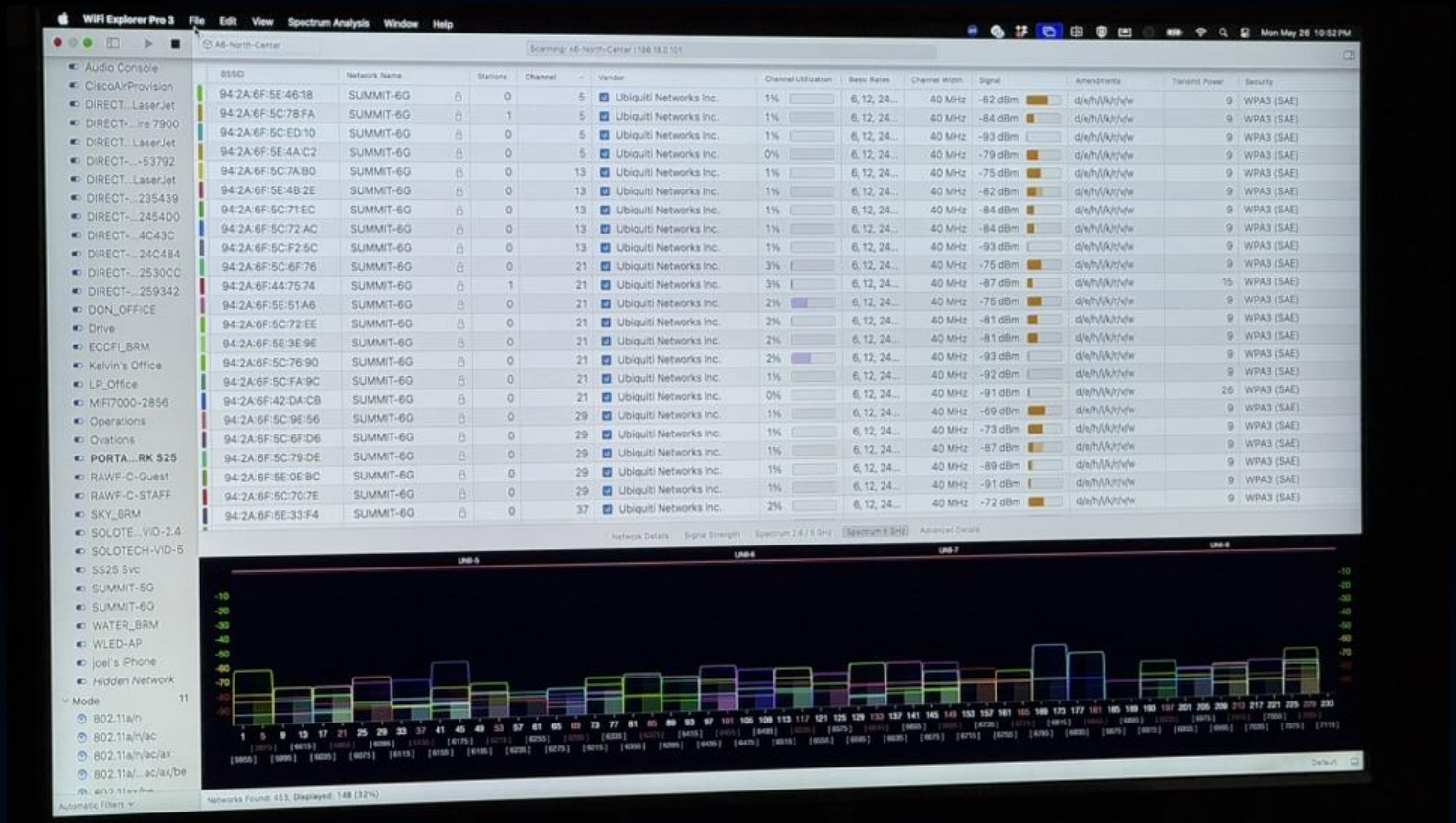
Day 1

People on the ground

Internal reporting on Slack of network issues

Ongoing surveying and verification

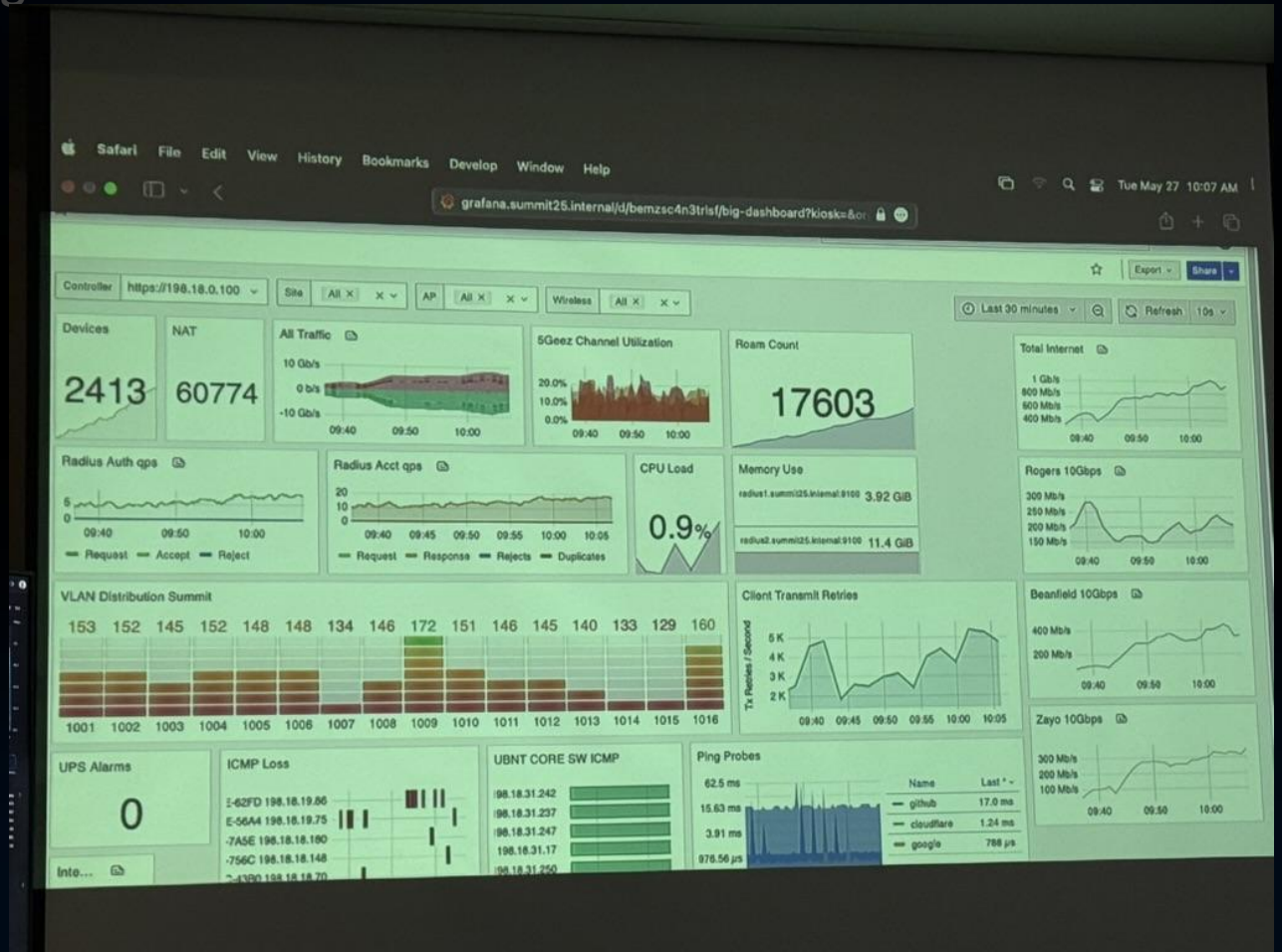
WLPC Prague 2025



Day 2 Changes

Deploy more edge switching to give users the choice of wired vs wireless.

Switch to 80 MHz 6 GHz channels completed.


Safari File Edit View History Bookmarks Develop Window Help
Tue May 27 10:07 AM
grafana.summit25.internal/d/bemzsc4n3trlsf/big-dashboard?kiosk=&or
Controller https://198.18.0.100
Site All
AP All
Wireless All
Export
Share
Last 30 minutes
Refresh 10s
Devices
2413
NAT
60774
All Traffic
10 Gb/s
0 b/s
-10 Gb/s
09:40 09:50 10:00
5Geez Channel Utilization
20.0%
10.0%
0.0%
Roam Count
17603
Total Internet
1 Gb/s
800 Mb/s
600 Mb/s
400 Mb/s
Radius Auth qps
Request Accept Reject
Radius Acct qps
Request Response Rejects Duplicates
CPU Load
0.9%
Memory Use
radius1.summit25.internal:9100 3.92 GiB
radius2.summit25.internal:9100 11.4 GiB
Rogers 10Gbps
300 Mb/s
250 Mb/s
200 Mb/s
150 Mb/s
VLAN Distribution Summit
153 152 145 152 148 148 134 146 172 151 146 145 140 133 129 160
1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016
Client Transmit Retries
Tx Retries / Second
5 K
4 K
3 K
2 K
Beanfield 10Gbps
400 Mb/s
200 Mb/s
Zayo 10Gbps
300 Mb/s
200 Mb/s
100 Mb/s
UPS Alarms
0
ICMP Loss
UBNT CORE SW ICMP
198.18.31.242
198.18.31.237
198.18.31.247
198.18.31.17
Ping Probes
62.5 ms
15.63 ms
3.91 ms
976.56 µs
Name Last *
github 17.0 ms
cloudflare 1.24 ms
google 788 µs

Lessons Learned for Ubiquiti

Making setup easier with an auto RRM.

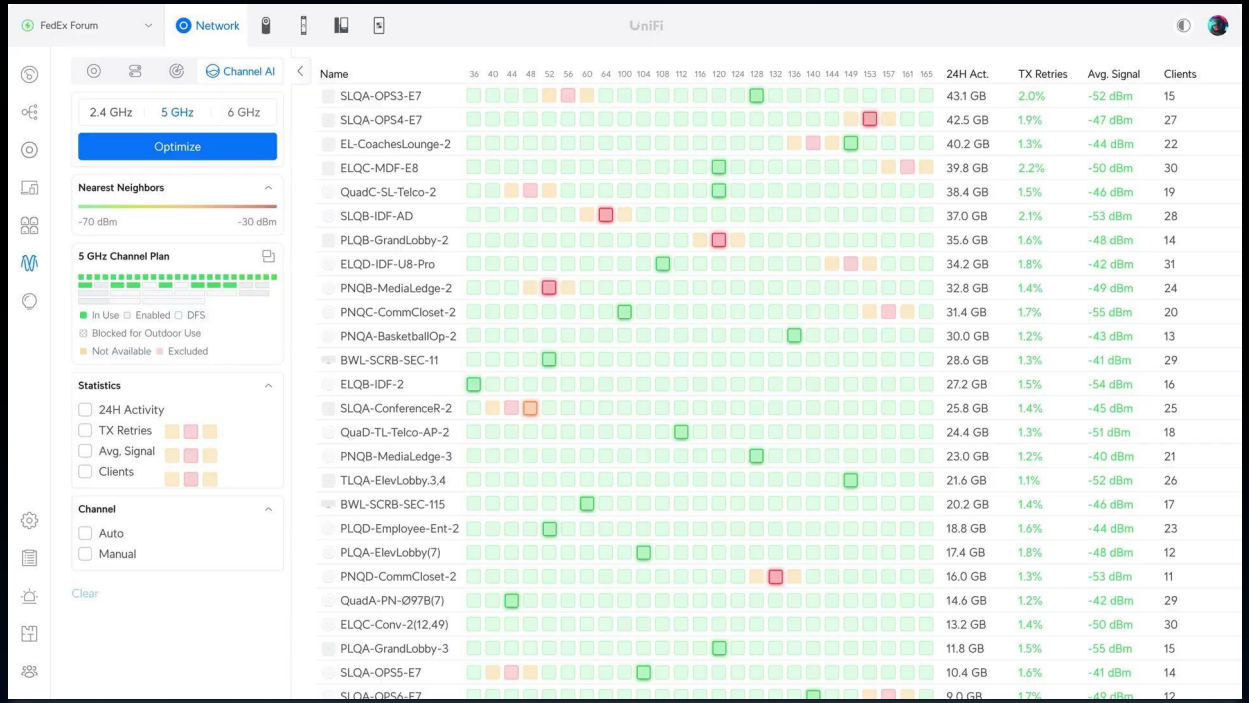
AP name in the beacon frames for easier surveying.

Making non-PSCs easier to select (Pro Installer mode).

Better multicast management, especially over the wire, for AV networks.

Network configuration API for queuing changes.

Channel AI


FedEx Forum
Network
UniFi
Channel AI
2.4 GHz
5 GHz
6 GHz
Optimize
Nearest Neighbors
-70 dBm
-30 dBm
5 GHz Channel Plan
In Use
Enabled
DFS
Blocked for Outdoor Use
Not Available
Excluded
Statistics
24H Activity
TX Retries
Avg. Signal
Clients
Channel
Auto
Manual
Clear
Name
24H Act.
TX Retries
Avg. Signal
Clients
SLQA-OPS3-E7 43.1 GB 2.0% -52 dBm 15
SLQA-OPS4-E7 42.5 GB 1.9% -47 dBm 27
EL-CoachesLounge-2 40.2 GB 1.3% -44 dBm 22
ELQC-MDF-E8 39.8 GB 2.2% -50 dBm 30
QuadC-SL-Telco-2 38.4 GB 1.5% -46 dBm 19
SLQB-IDF-AD 37.0 GB 2.1% -53 dBm 28
PLQB-GrandLobby-2 35.6 GB 1.6% -48 dBm 14
ELQD-IDF-U8-Pro 34.2 GB 1.8% -42 dBm 31
PNQB-MediaLedge-2 32.8 GB 1.4% -49 dBm 24
PNQC-CommCloset-2 31.4 GB 1.7% -55 dBm 20
PNQA-BasketballOp-2 30.0 GB 1.2% -43 dBm 13
BWL-SCRB-SEC-11 28.6 GB 1.3% -41 dBm 29
ELQB-IDF-2 27.2 GB 1.5% -54 dBm 16
SLQA-ConferenceR-2 25.8 GB 1.4% -45 dBm 25
QuaD-TL-Telco-AP-2 24.4 GB 1.3% -51 dBm 18
PNQB-MediaLedge-3 23.0 GB 1.2% -40 dBm 21
TLQA-ElevLobby.3,4 21.6 GB 1.1% -52 dBm 26
BWL-SCRB-SEC-115 20.2 GB 1.4% -46 dBm 17
PLQD-Employee-Ent-2 18.8 GB 1.6% -44 dBm 23
PLQA-ElevLobby(7) 17.4 GB 1.8% -48 dBm 12
PNQD-CommCloset-2 16.0 GB 1.3% -53 dBm 11
QuadA-PN-Ø97B(7) 14.6 GB 1.2% -42 dBm 29
ELQC-Conv-2(12,49) 13.2 GB 1.4% -50 dBm 30
PLQA-GrandLobby-3 11.8 GB 1.5% -55 dBm 15
SLQA-OPS5-E7 10.4 GB 1.6% -41 dBm 14
SLQA-OPS6-E7 9.0 GB 1.7% -49 dBm 12

Key Metrics

Client Scale

Support Over
28,000
Unique MAC Addreses

27,000
Unique Clients

WiFi Coverage

Coverage Area
38,700+ m²
(416,00+ ft²)

Rapid Deployment

Infrastructure deployed within
5 Days
and efficiently dismantled post-event

<1ms Latency

To Critical Services

150 TB

Total Transferred
Over The 4-Day Event

8 Gbps

Sustained During Peak Usage Periods;
~3 Gbps average sustained throughput

30 Gbps

Total WAN
Capacity Available

Conclusion

Same techniques to survey for a conference as for an office.

Directional antennas overhead are great for open, high density areas.

Remember the relationship between TX power and channel width for 6 GHz.

Preserve airtime as much as possible through SSID configuration and hardwiring.

Don’t forget the human, collaborative element.