An OT Network Engineer's Guide for MESH, WGB and URWB

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Industrial IoT Solutions Engineer

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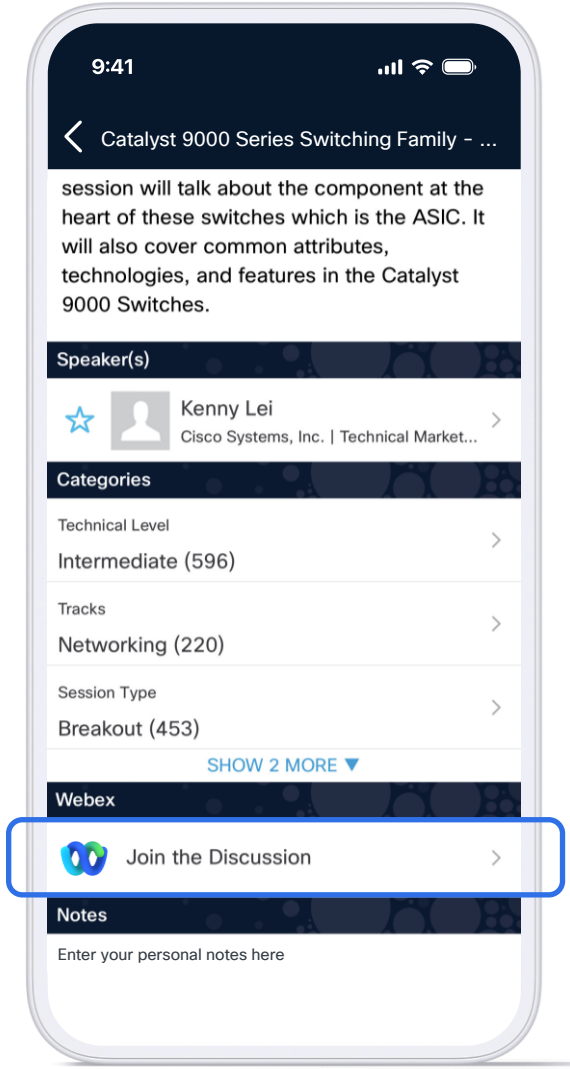
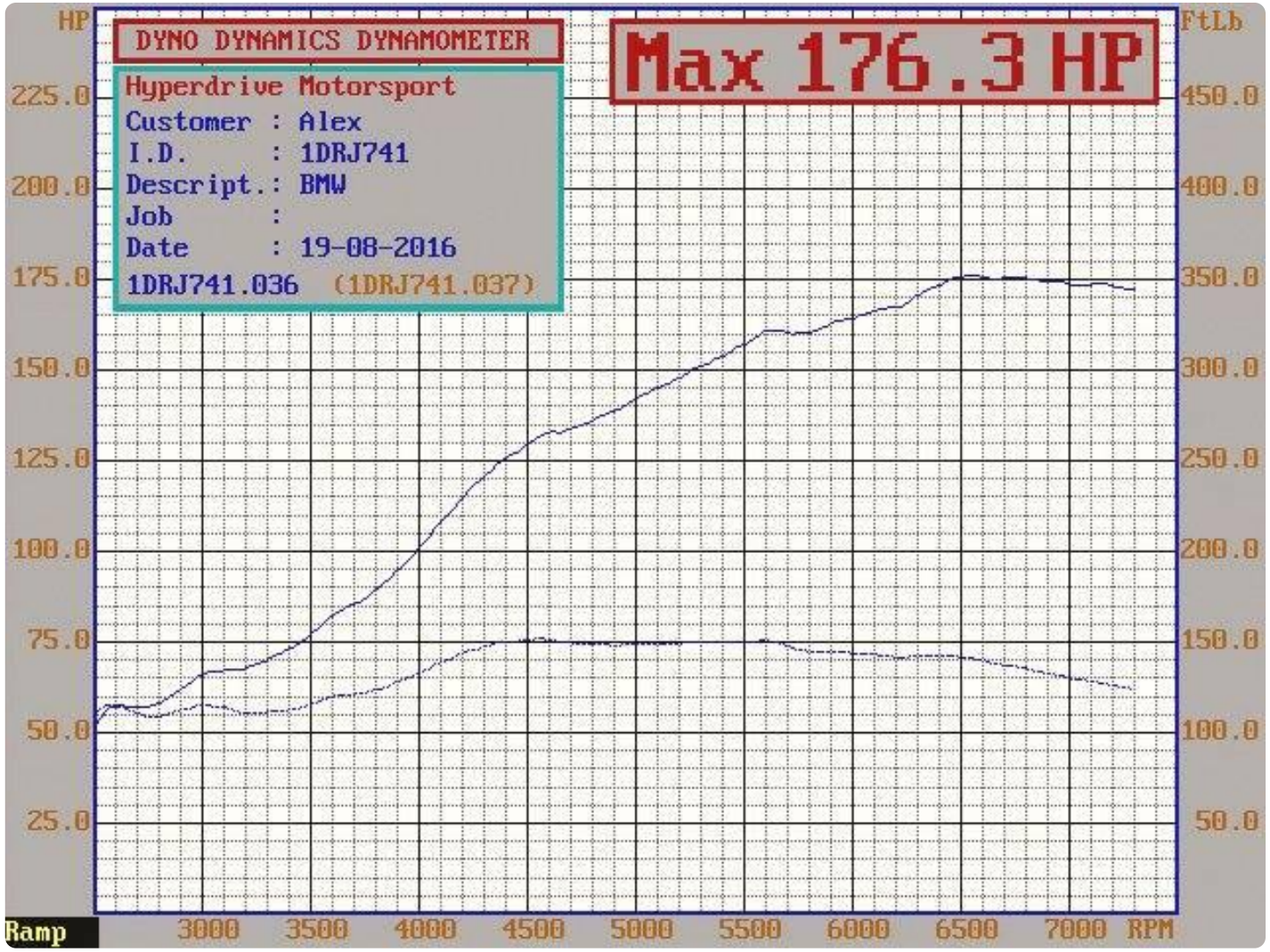


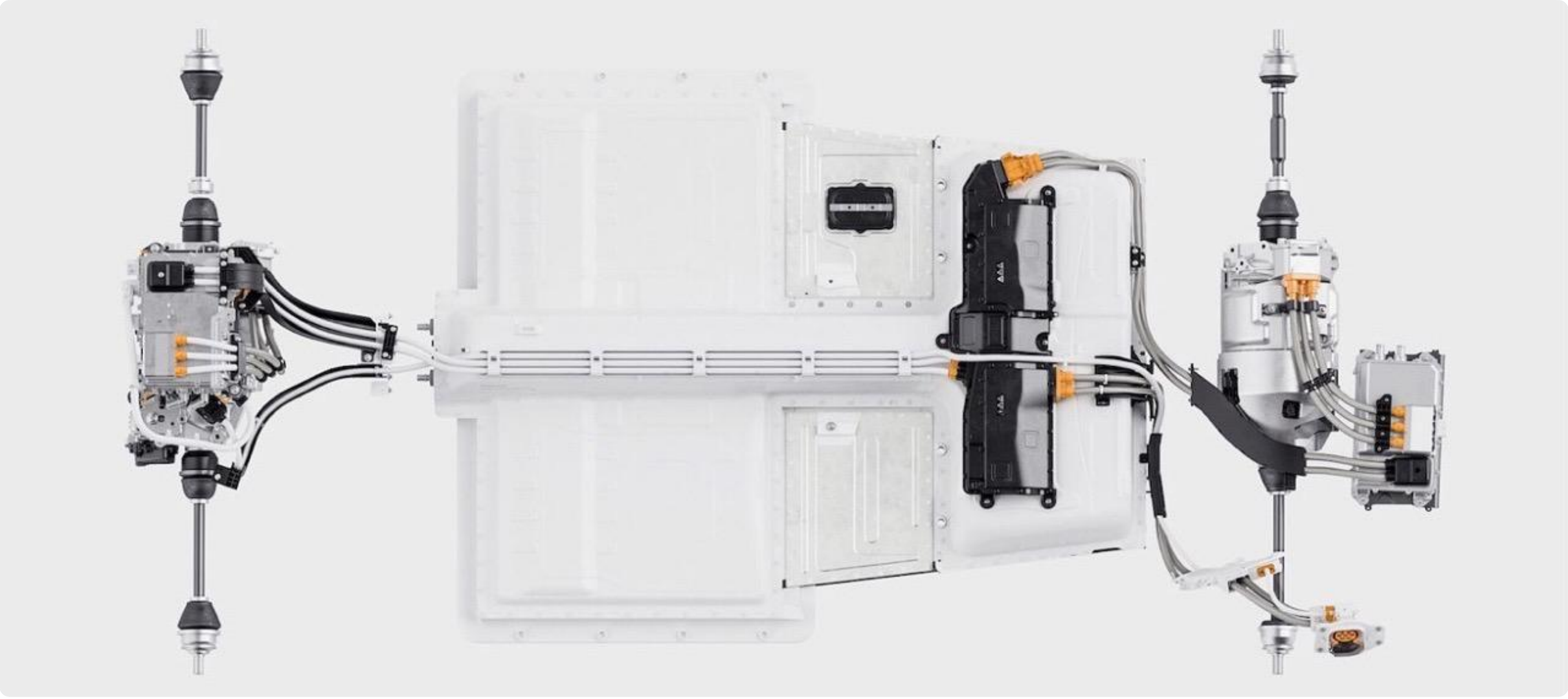
https://ciscolive.ciscoevents.com/ciscolivebot/BRKIOT-2027

Mature Technologies

Lessons in Compromise



Technology Transition



Extending IT to operational environments

- Warehouses
- Distribution Center
- Parking Lots
- Airport
- Port
- Factories
- Utility Substations
- Roadways
- Oil & Gas Refinery
- Mines

Consistent Network Architecture

Agenda

01 Why do we use Mesh & WGB

02 Another way? URWB and WLC's

03 Demonstration

04 Mesh & WGB updates

05 Field test results

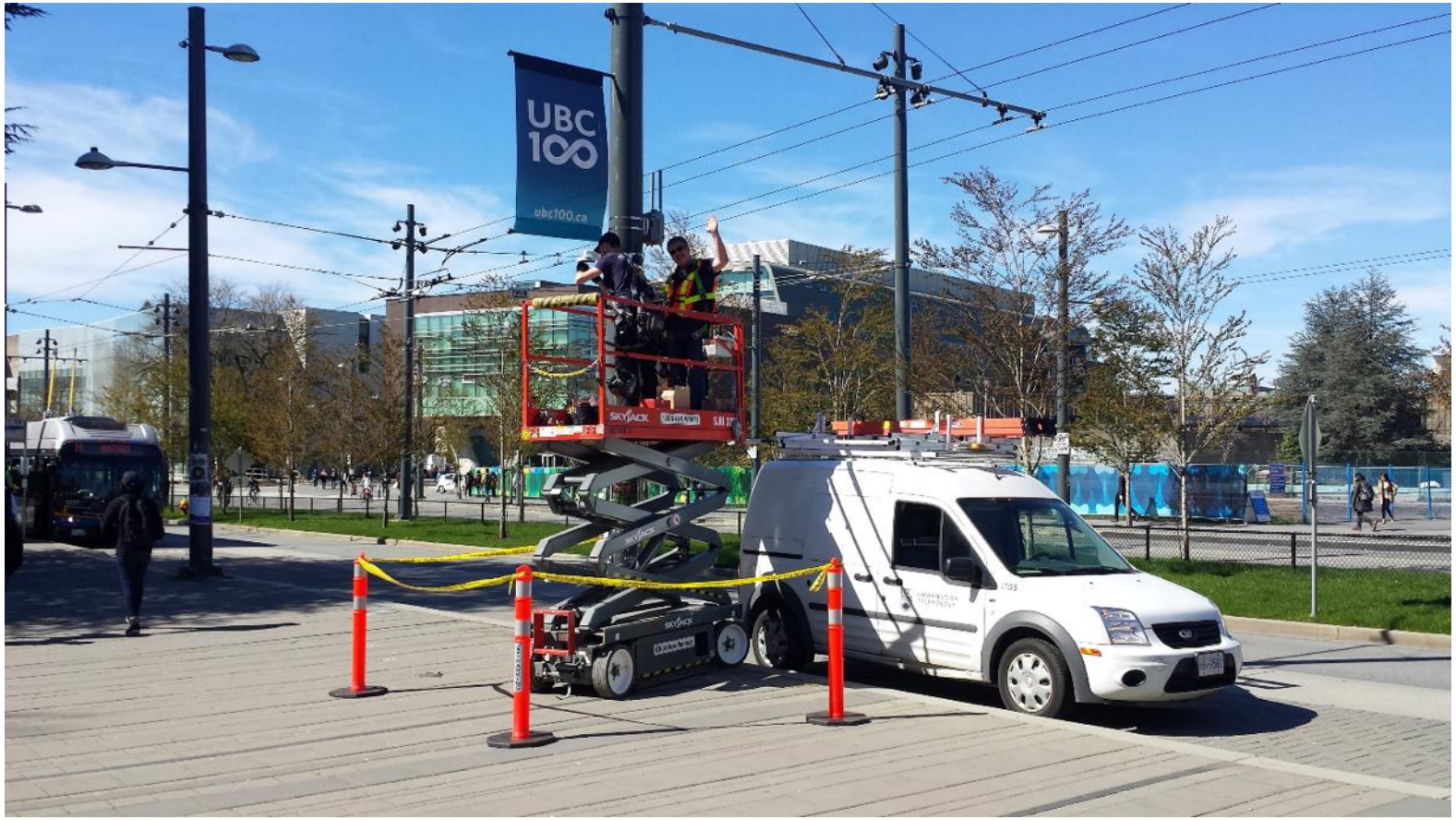
Why Do We Use Mesh & WGB?

Business Demands Drive Expansion

- Need connectivity or services to somewhere or on some thing
- Can’t run fibre, to impractical or expensive
- Same case for copper, although we’ve also got added distance constraints as well
- But … we have wireless right?

Safety Considerations

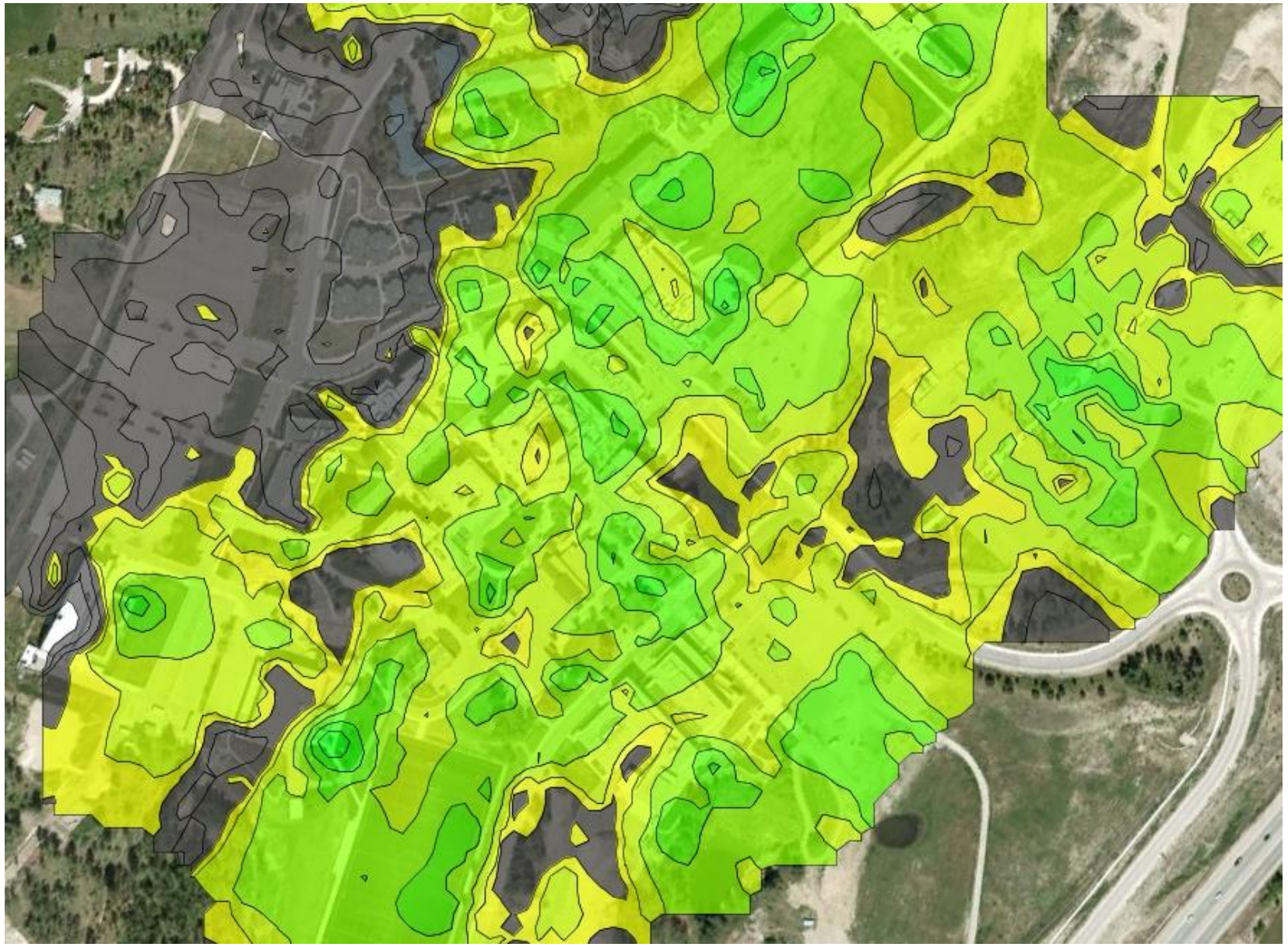
- Eliminate use of ladders where possible and practical.
- Make sure to isolate work area, especially in public spaces where “stuff” dropping can be of concern.
- Working teams proficient and certified with any machinery used to achieve the job safely.



Safety Considerations

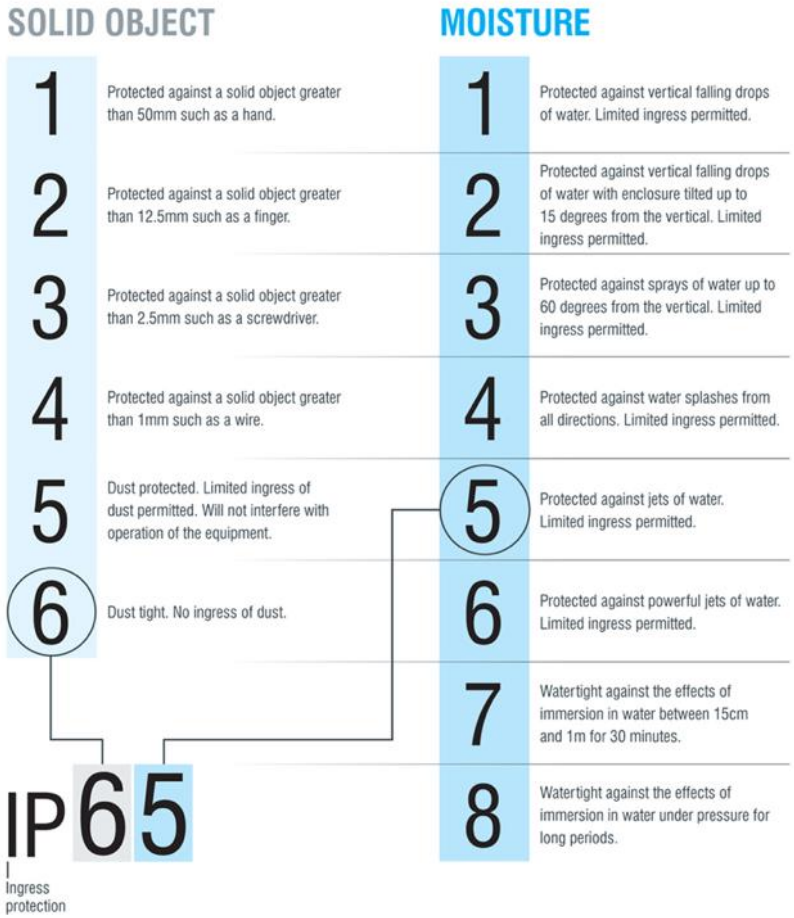
- Working teams familiar with hazardous location requirements
  - Explosive areas
  - Stored potential energy
  - Radiation, incuding RF!!!
  - Autonomous vehicles
  - Confined areas & noxious gasses
- Staff familiarity with all aspects of a solution
  - From Layer 1 – Cables, connectors, tools
  - To Layer 7 – Application characteristics

RF Bleed Considerations



Why do I need an Outdoor AP?

Image Source:
https://bboxblog.files.wordpress.com/2014/10/ipratings2-copy.jpg



Environmental Testing

Hardware Installation Guides

- A hardware deployment guide is published that accompanies each product Cisco makes.
- These guides are specifically helpful in understanding the various mounting brackets and installation options for each product.
- Grounding, lightning protection, antenna configurations and weatherproofing are also covered.

Another Way?

Ultra-Reliable Wireless Backhaul and WLC's!

What if I told you we could do something better than WGB?

Devices could seamlessly roam between wireless APs with zero packet loss, with less latency and jitter

Both ends of the connection are managed in the WLC (and other platforms in the future)

Critical wireless devices could have a redundant connection to two separate APs

The same solution is also capable of point-to-point, point-to-multipoint, and mesh links

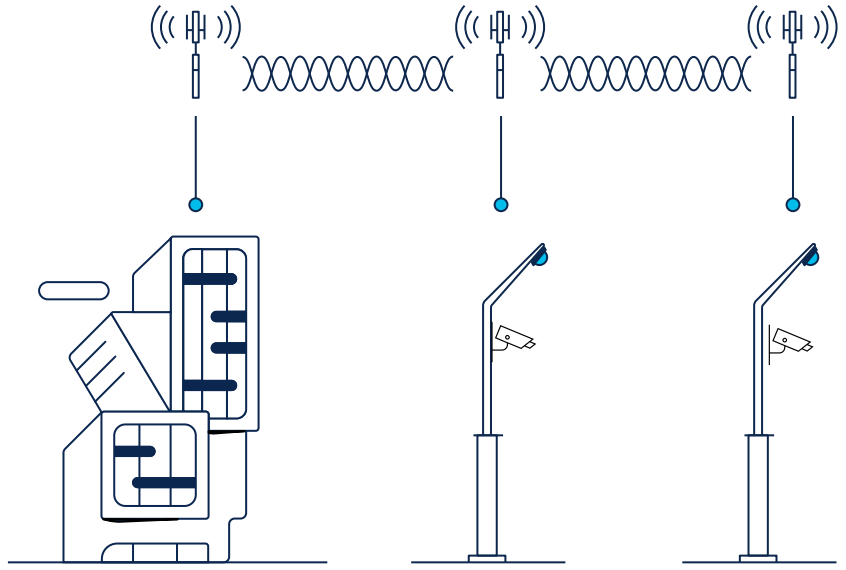
These problems can’t be solved today with Wi-Fi alone.

Enter Cisco URWB.

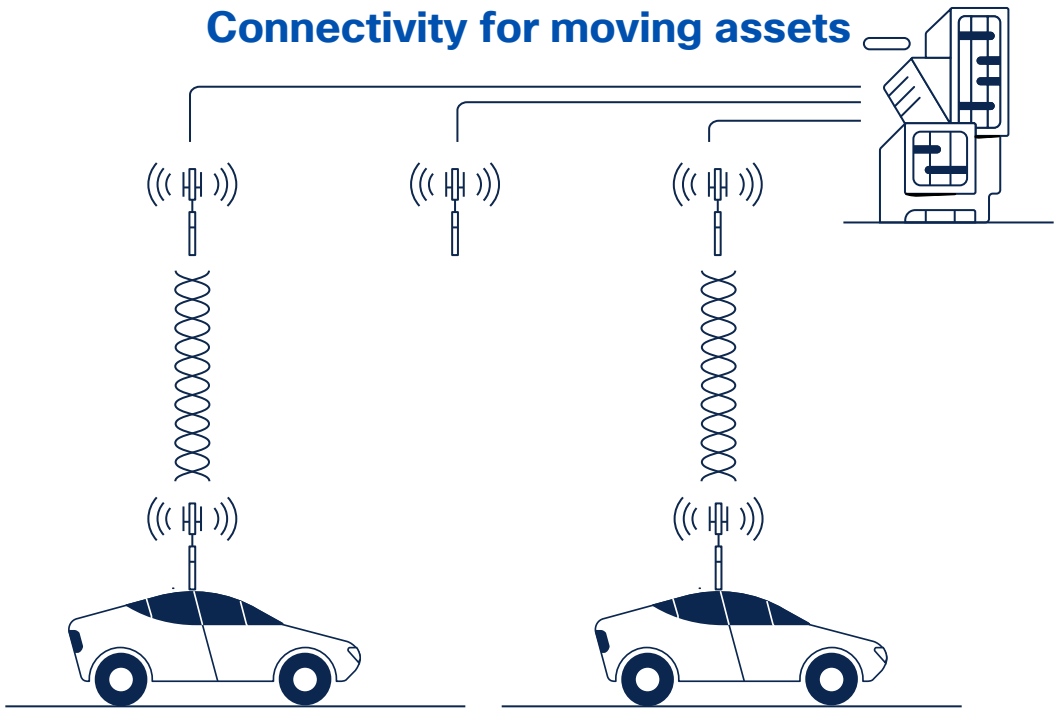
What is URWB?

Reliable fiber-like wireless connectivity, anywhere

Connectivity where fiber isn't available or is too costly



Connectivity for moving assets

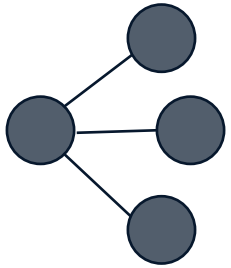


Proven · Deploys like Wi-Fi · Full control of your network · Unlicensed spectrum

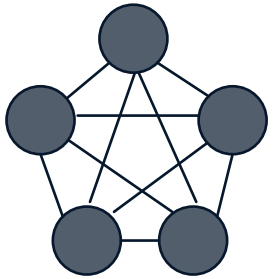
Supports highly flexible wireless architectures

Point to Point

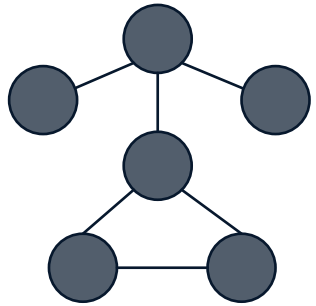
Point to Multipoint



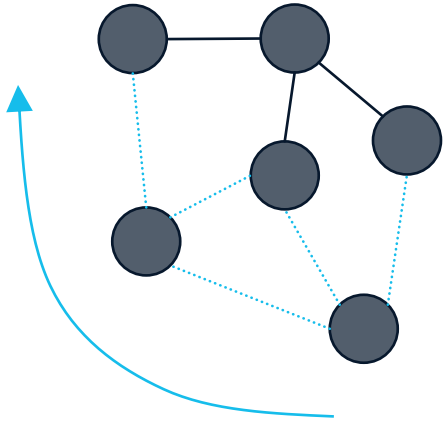
Mesh



Mixed



Mobility



Ultra-Reliable Wireless Backhaul to connect fixed and mobile assets for Ports OTS, T2G, Entertainment, Mining, Smart Cities

The R isn’t Silent

URWB ≠ UWB

UWB is for location awesomeness

URWB is for reliability awesomeness

Common URWB Use Cases

Manufacturing / AGV

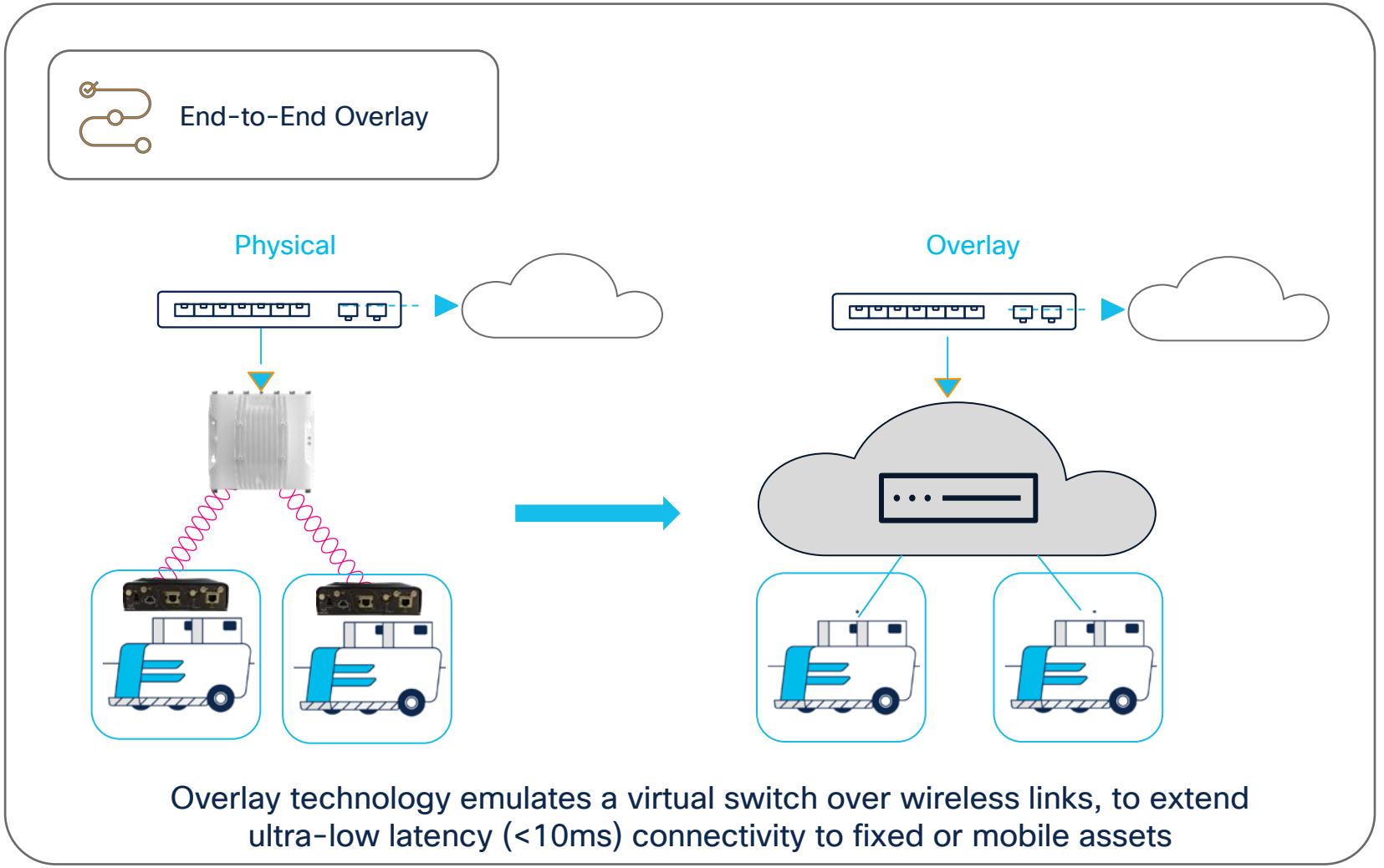
Connected Rail

Intersections and Highways

Mining

What Makes URWB Ultra-Reliable?

- End-to-End Overlay
- Ultra-fast failover
  Carrier-grade availability
- Make-before-break handoff
- Multipath operations (MPO)



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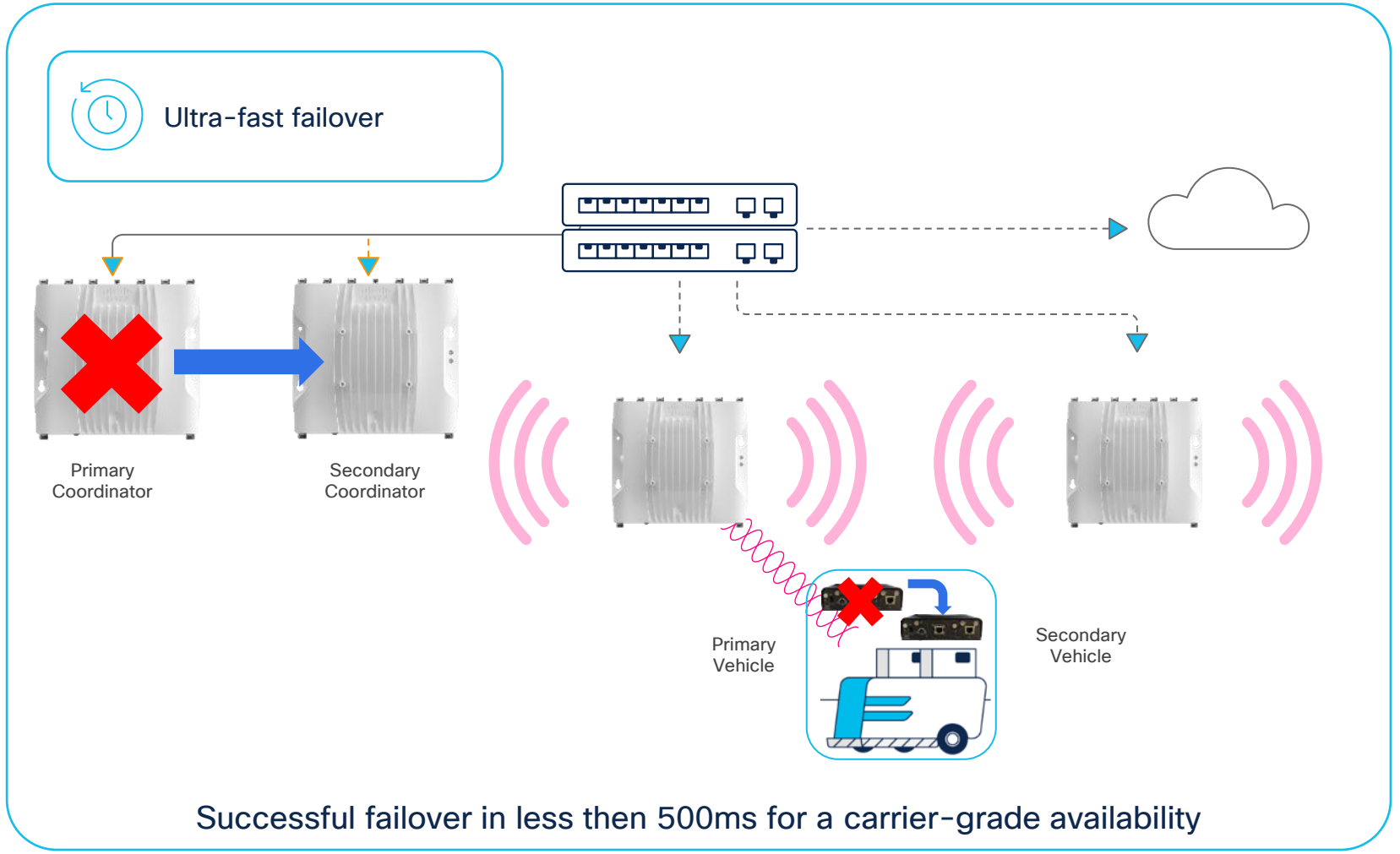

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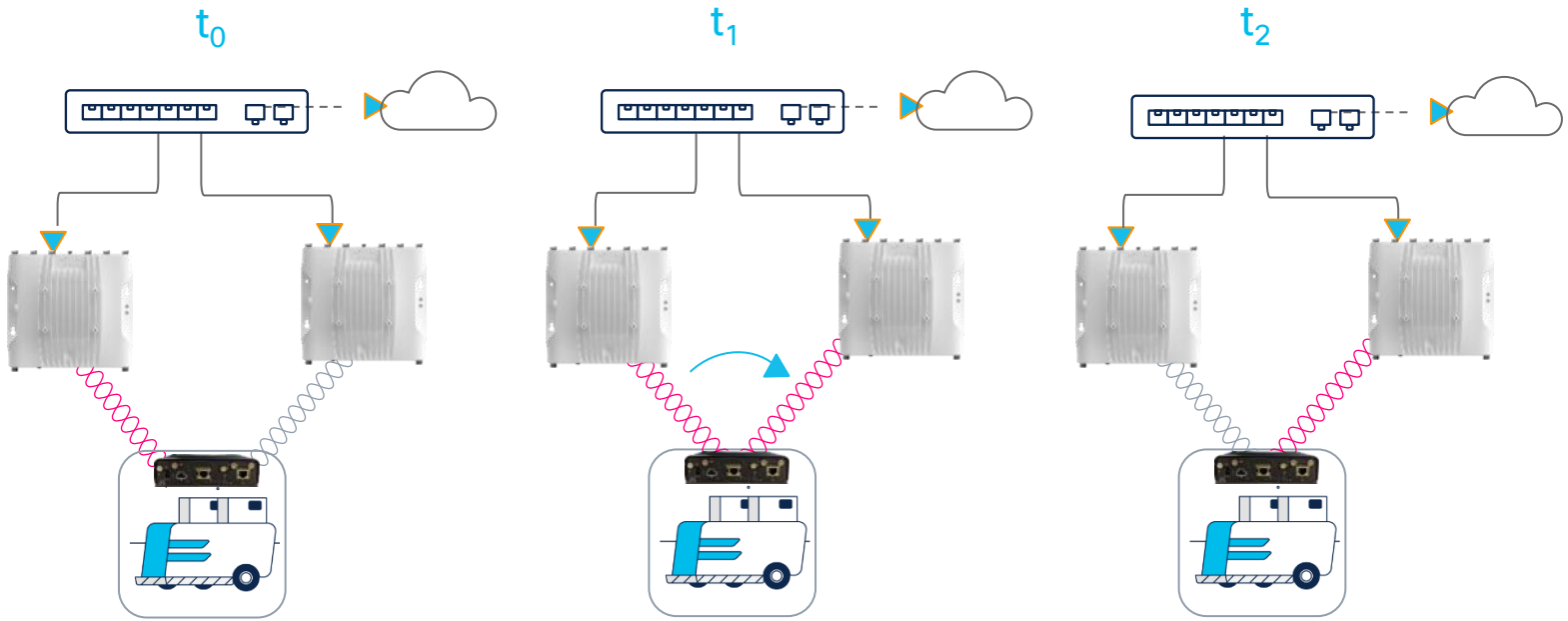
Make-before-break handoff



Make-before-break handoff ensures connectivity is established with a new AP before dropping connectivity from the previous AP

What Makes URWB Ultra-Reliable?

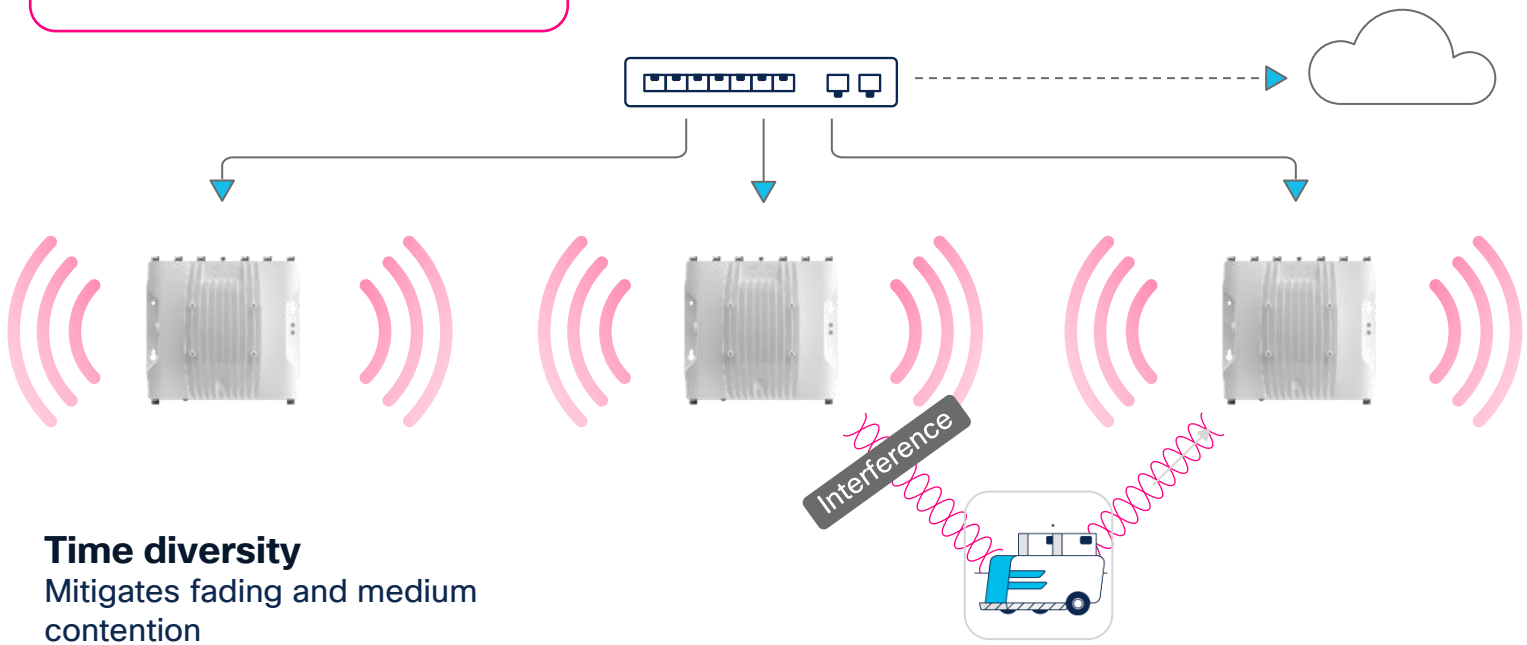
End-to-End Overlay

Ultra-fast failover
Carrier-grade availability

Make-before-break handoff

Multipath operations (MPO)

Multipath operations (MPO)



Time diversity
Mitigates fading and medium contention

Spatial diversity
Mitigates blockages and obstacles

Frequency diversity
Mitigates Interference

MPO duplicates high priority packets over up to 8 different paths on uncorrelated frequencies at the same time to multiple access points

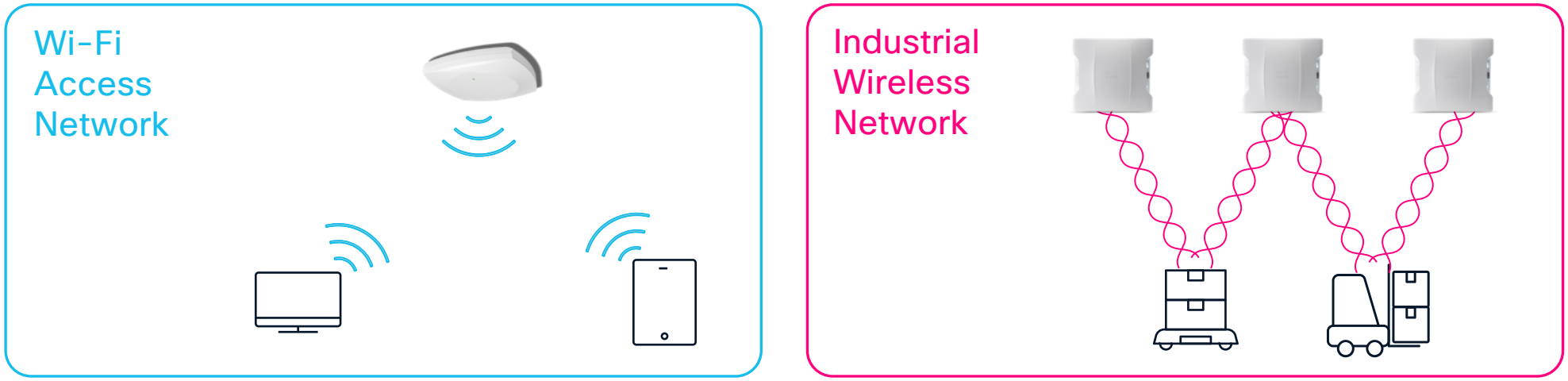
URWB is not Wi-Fi

- Cisco URWB has always been a separate AP software image and only available on IW APs

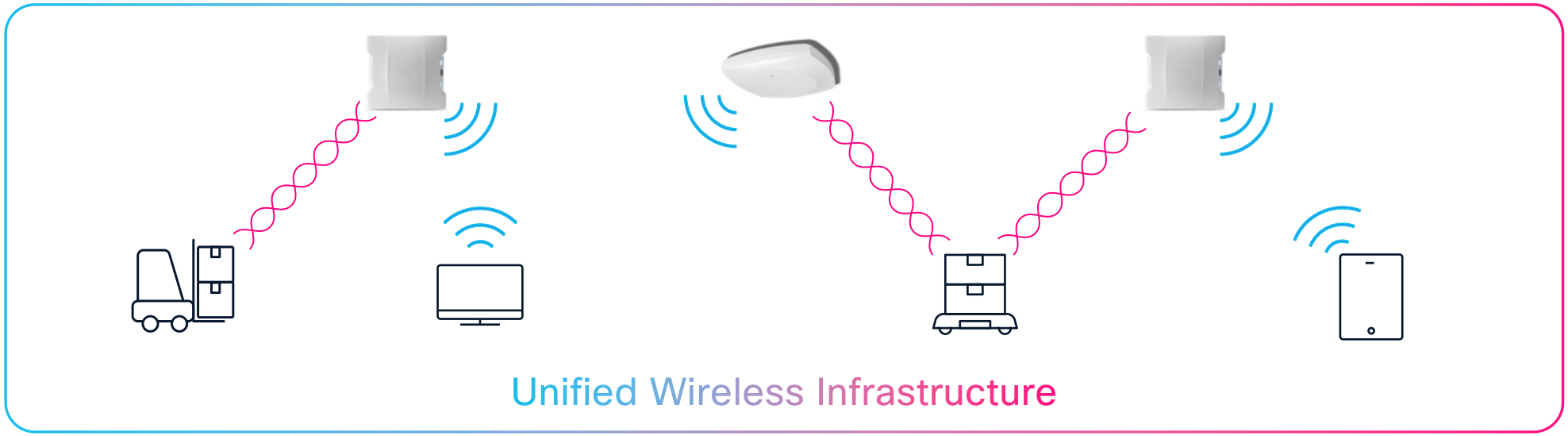
- Customers have historically deployed and managed separate parallel AP infrastructures for URWB and Wi-Fi

Introducing Simultaneous Wi-Fi and URWB

Before



Now

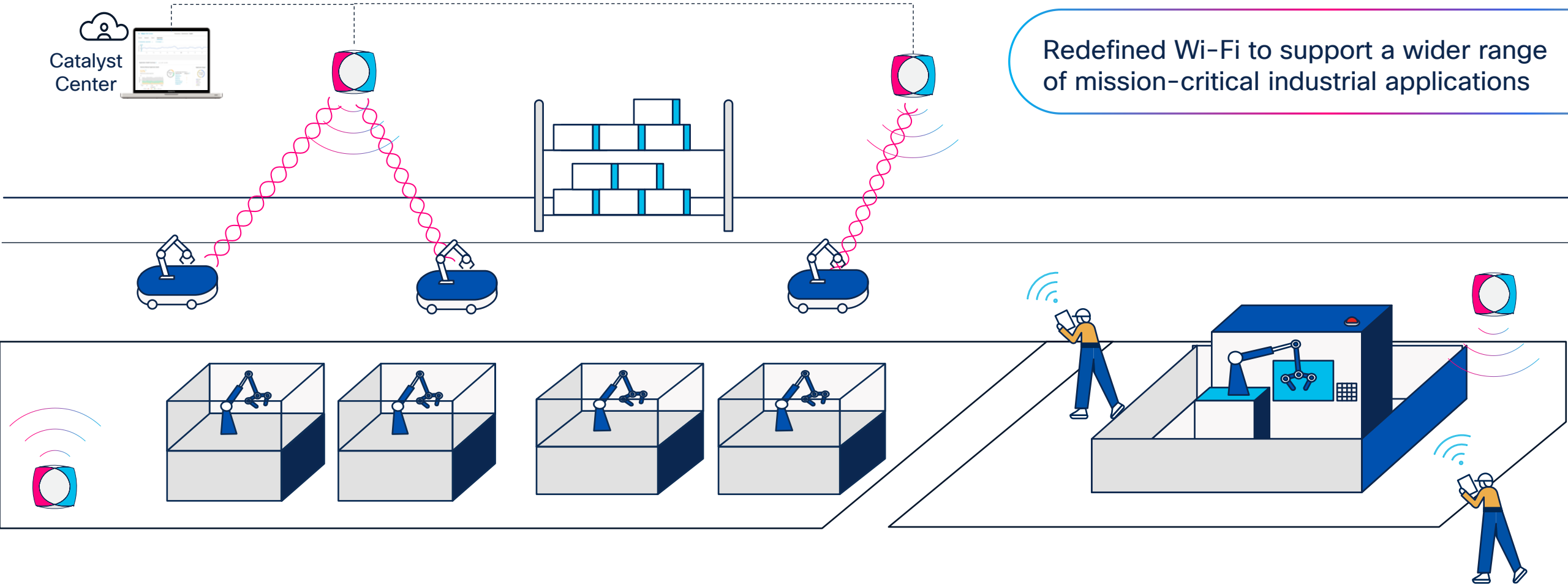


The Best of Both Worlds

URWB and Wi-Fi on the same AP, simultaneously

- Unified software image
  - No need to “dual-boot” separate URWB and Wi-Fi images
- Enablement is per radio/AP and is not a dedicated AP mode
  - URWB can be enabled on APs running Local and FlexConnect mode
- All APs will be managed by WLC (and other platforms in the future)
  - This means WGB use cases fulfilled by URWB will be centrally manageable
- Note: Standalone URWB architecture will continue to be available

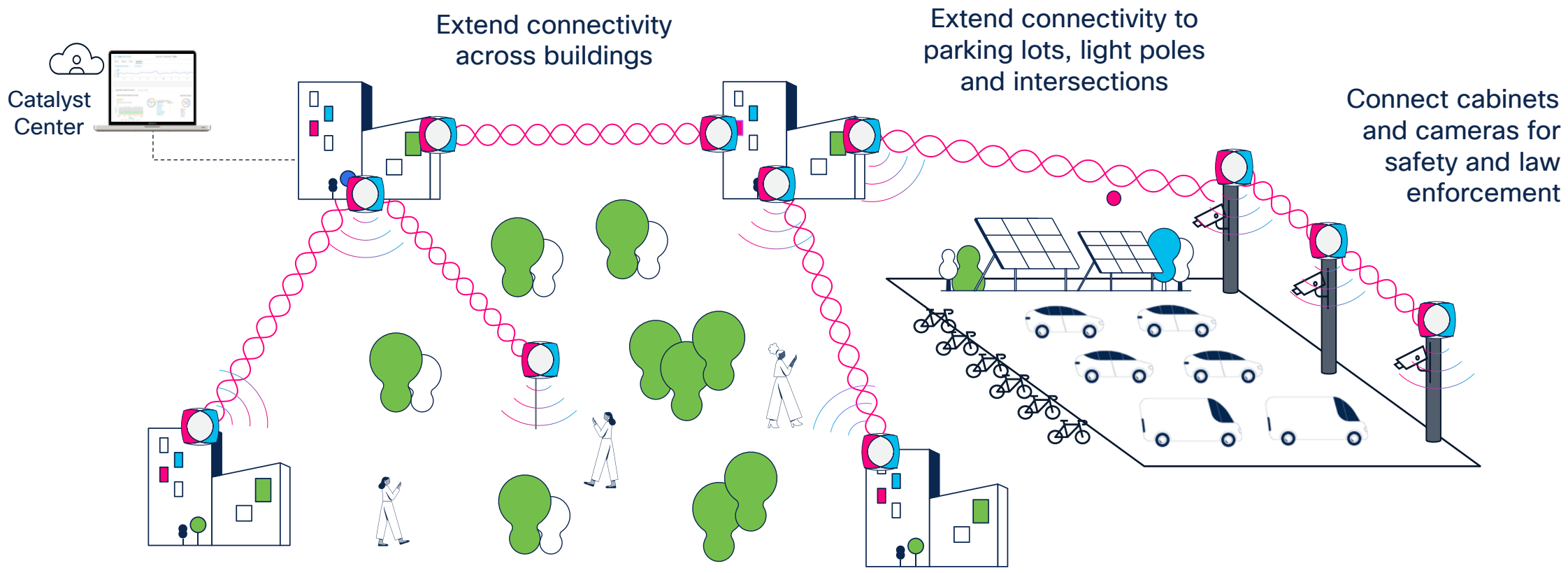
Mobile Example: Mining Autonomy, Manufacturing, Logistics



Redefined Wi-Fi to support a wider range of mission-critical industrial applications

Fixed Example: Extend Mine or Campus coverage

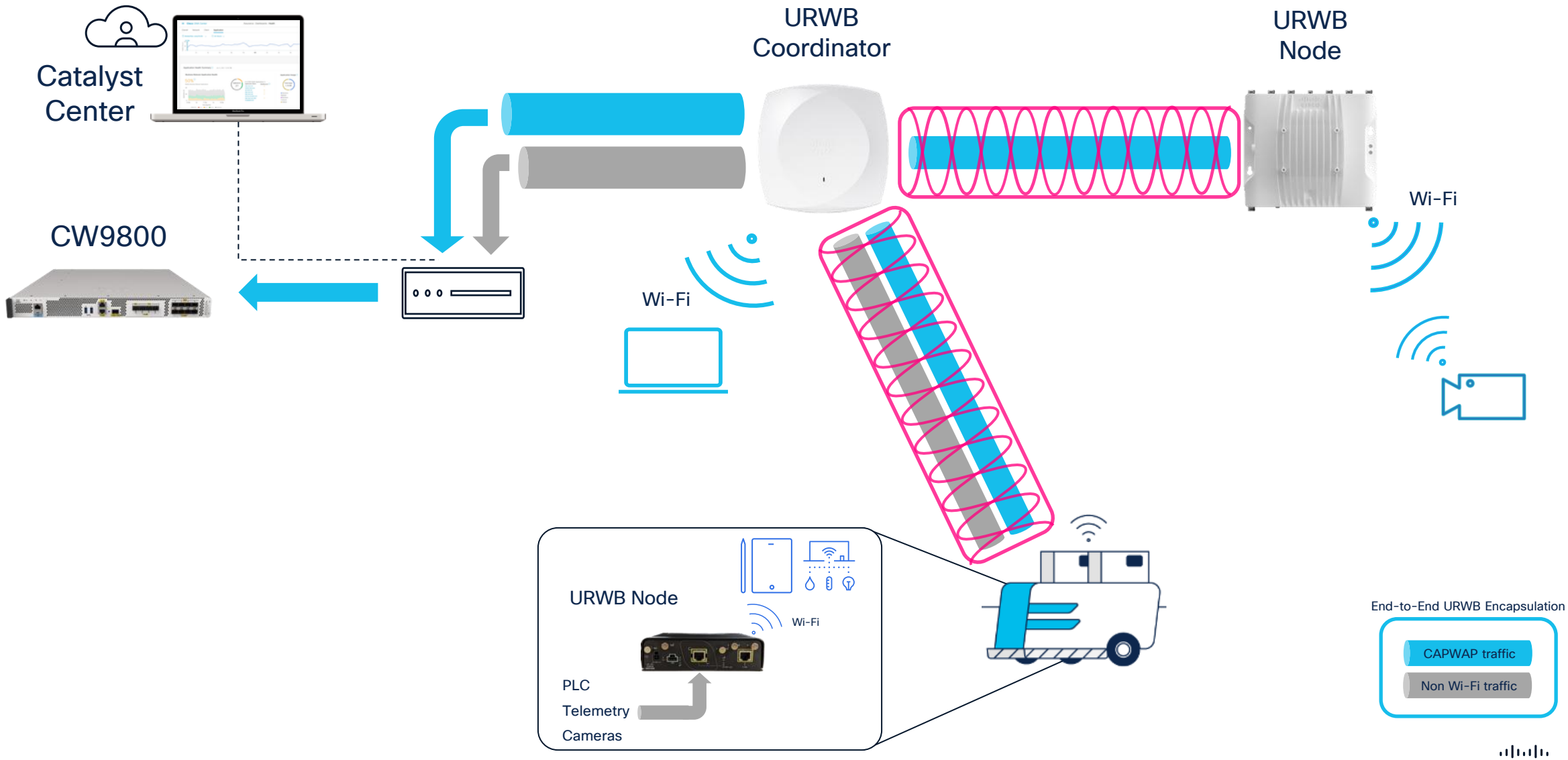
Extend connectivity to places where fiber and copper is not possible or too costly



Terminology

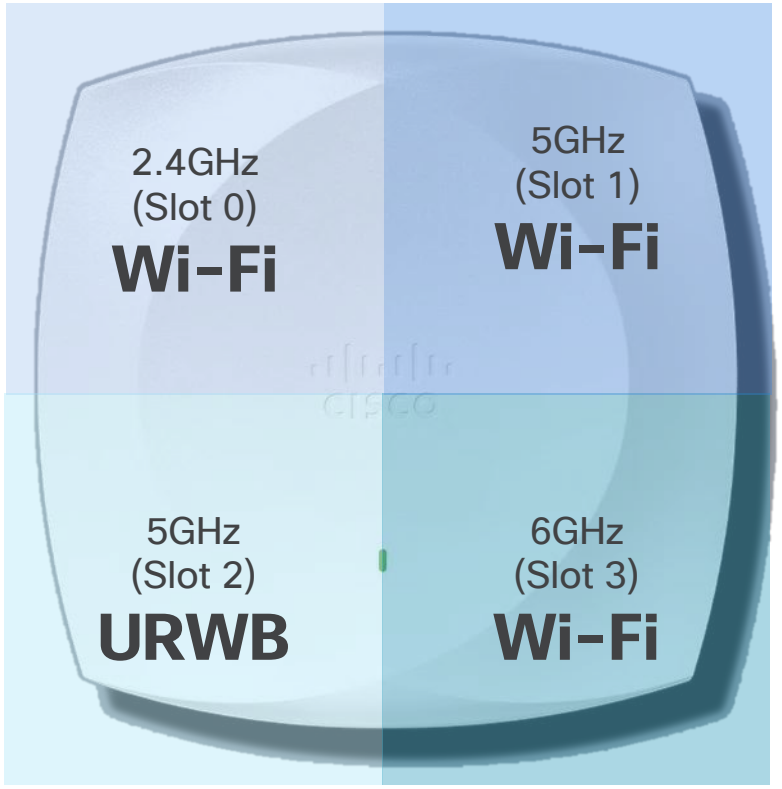
WLC / New Name	URWB Standalone Name
Coordinator	Mesh End or Gateway
Node	Mesh Point
URWB Network Key	Passphrase
Fixed	Fixed
Fixed Point to Multipoint	Fluidmax
Fixed Point to Multipoint Cluster ID	*(New item!)*
Mobility	Fluidity
Mobility Base	Fluidity Infrastructure
Mobility Client	Fludity Vehicle
High Availablity	Fastfail / TITAN
URWB Monitor	FM Quadro
IW Monitor (WLC support due soon!)	IW / FM Monitor

Data plane and traffic flow



Simultaneous URWB + Wi-Fi – Radio Roles

- Role selection is per radio/slot
  - All radio types can do Wi-Fi
  - Only 5GHz and 6GHz supported for URWB
  - URWB is not currently supported on 2.4GHz
  - Feature available from IOS-XE 17.18.1
  - No separate AP mode is necessary
  - Manageable via WLC



Supported Access Points

Wi-Fi 7

CW9176I,
CW9176D1

CW9178I

Focus for 17.18.1
(*Early Release*)

APs with dual-5GHz will allow split roles.
For example: slot1=Wi-Fi, slot2=URWB

Wi-Fi 6E

CW9136I

CW9166I,
CW9166D1

IW9165E

IW9165D

IW9167E
IW9167E-HZ

IW9167I

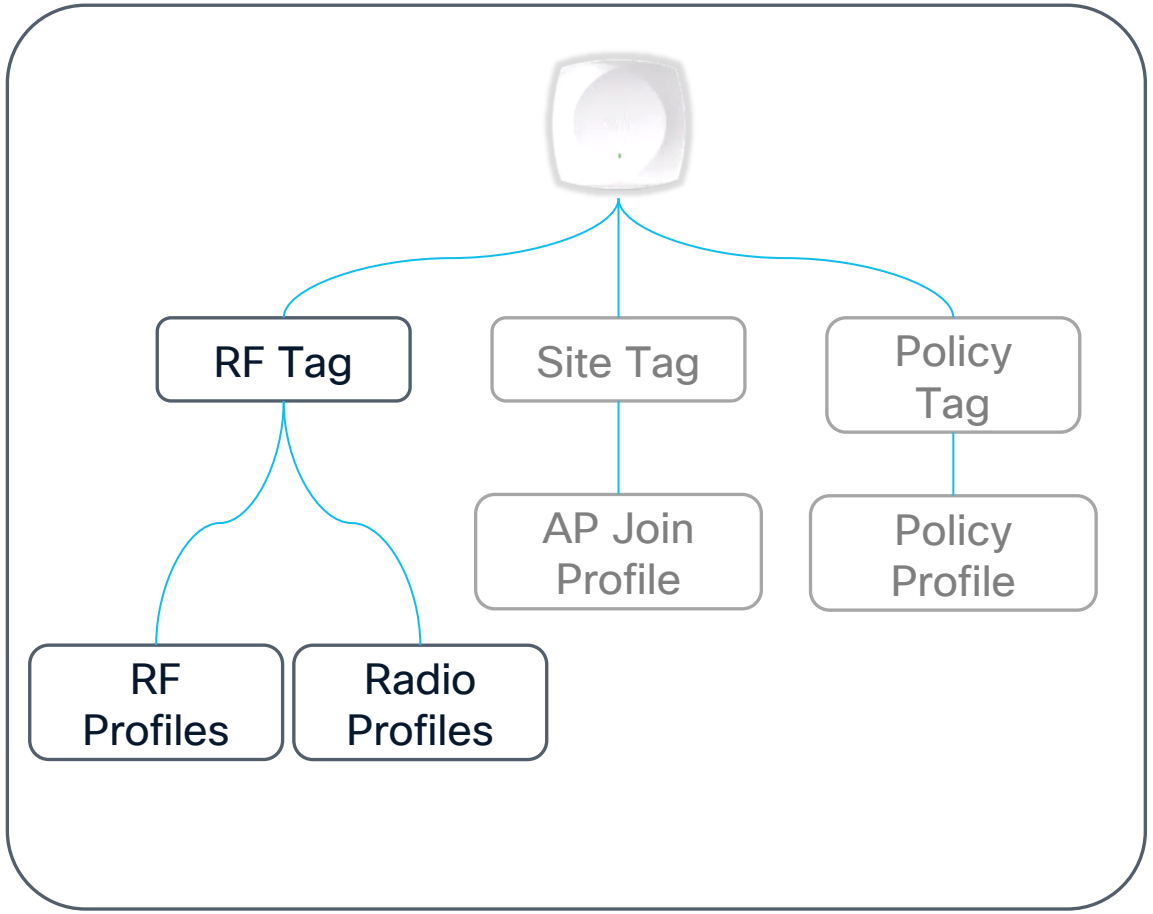
Wi-Fi 6

C9130
(AXE, AXI)

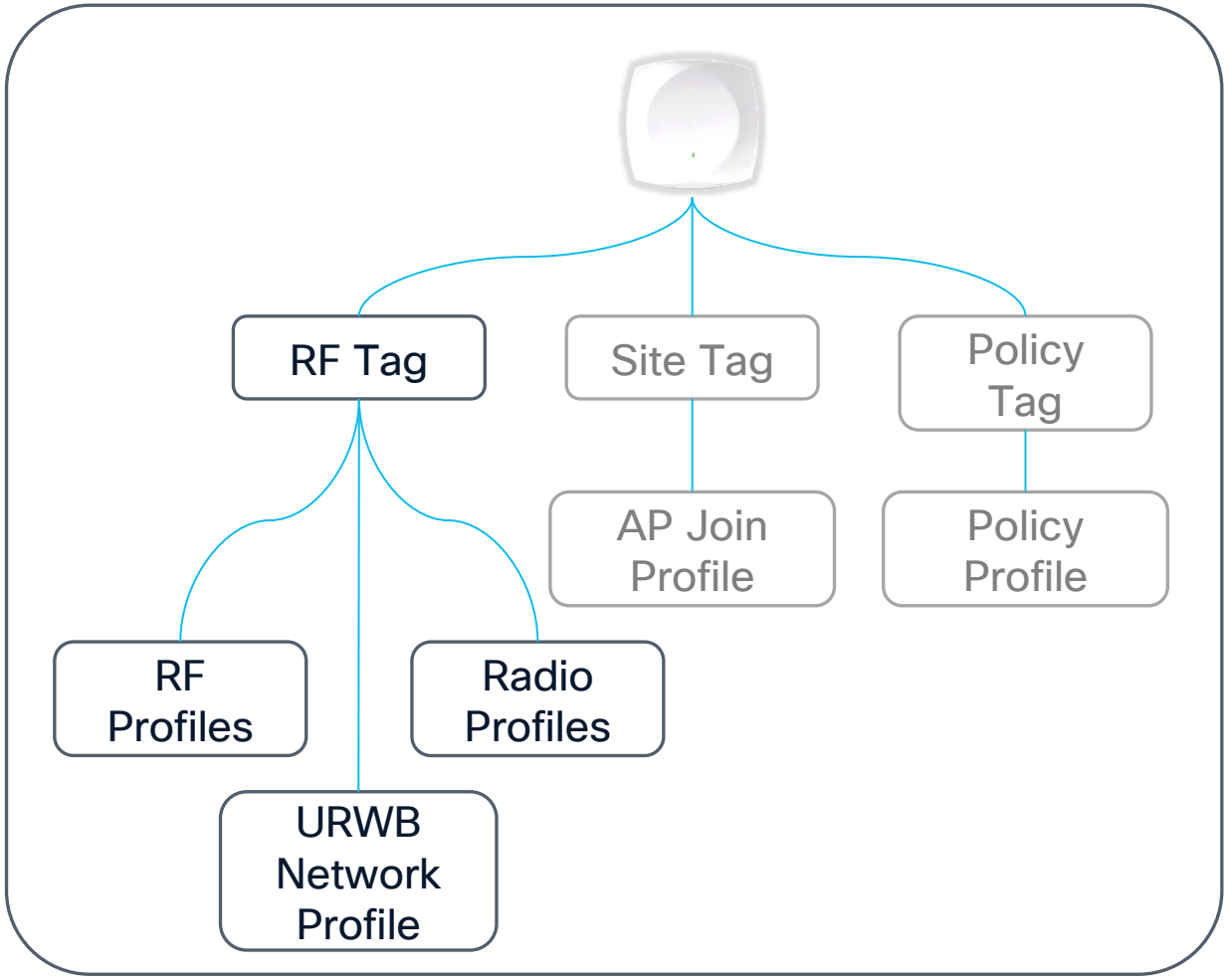
C9124
(AXE, AXI, AXD)

URWB Configuration Model on 9800

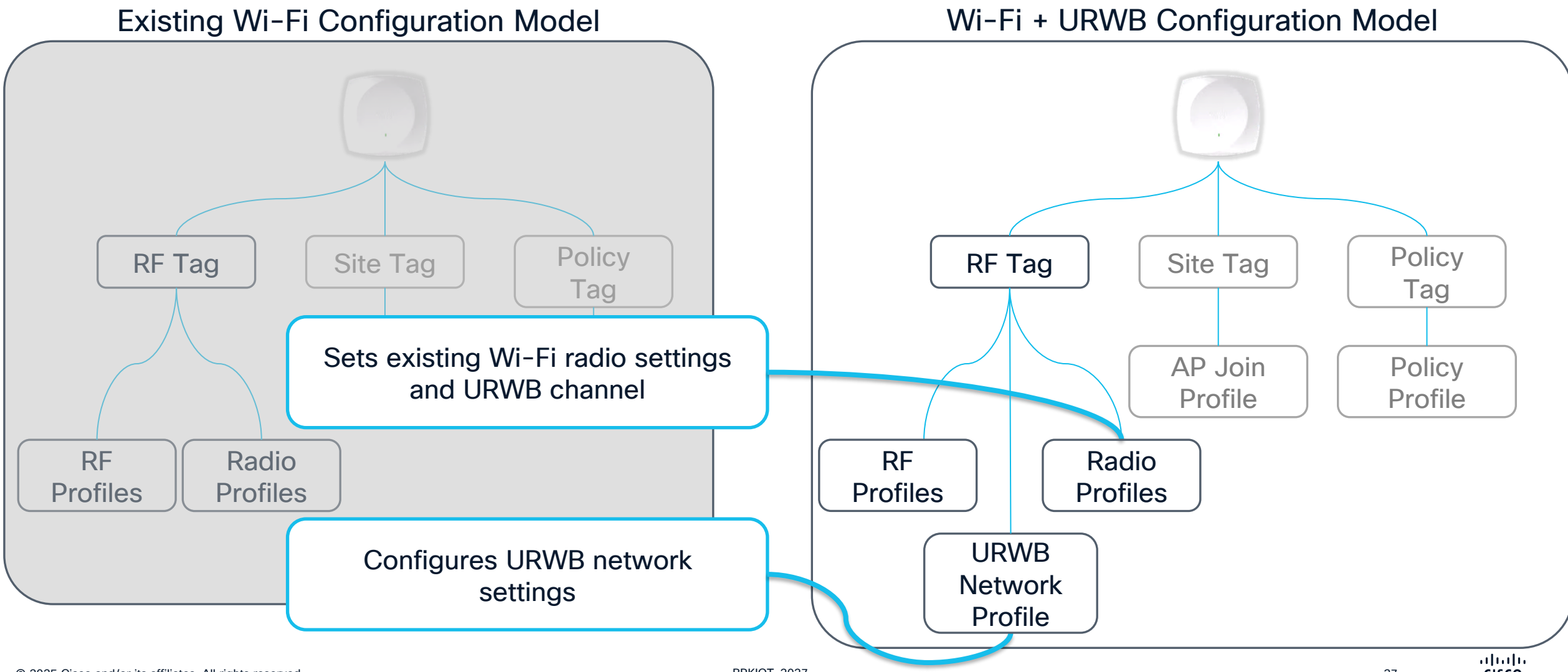
Existing Wi-Fi Configuration Model



Wi-Fi + URWB Configuration Model

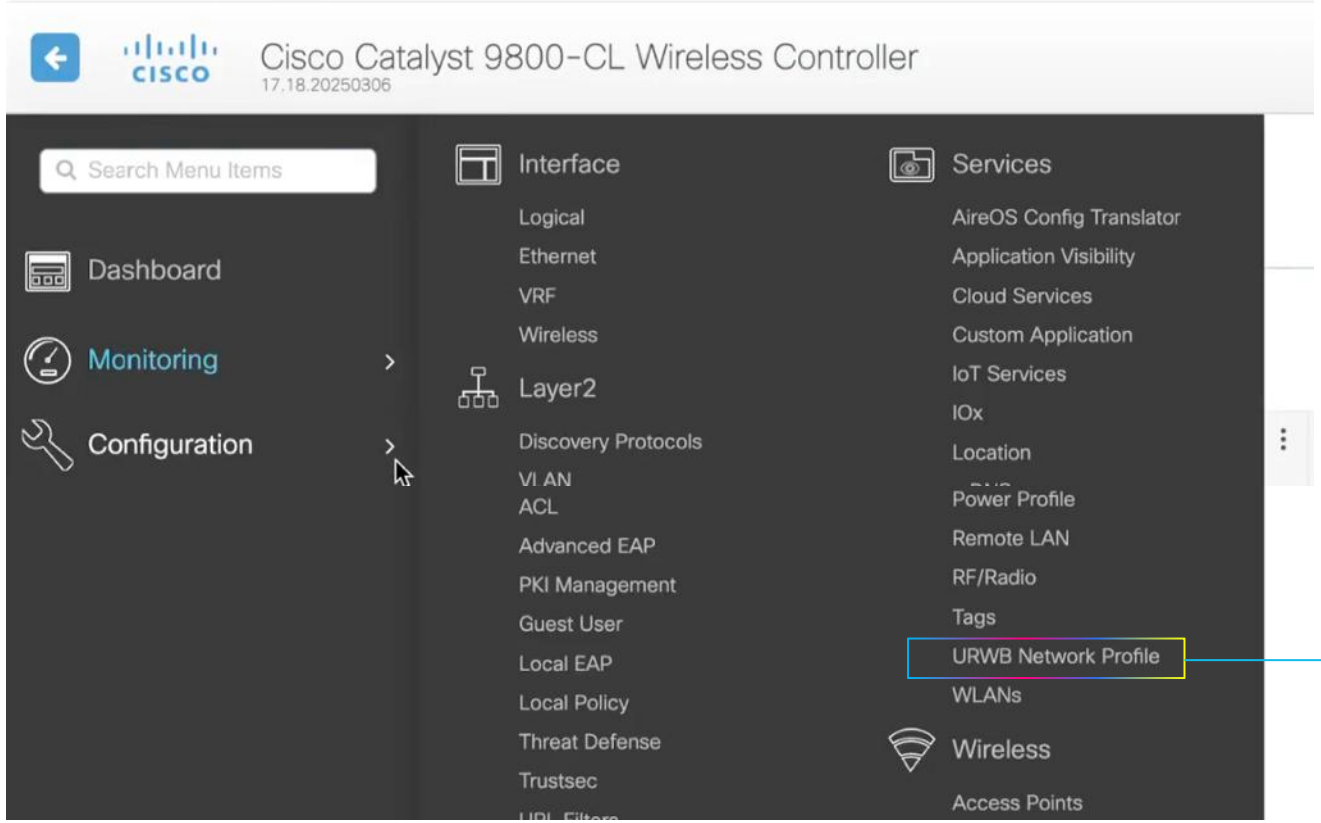


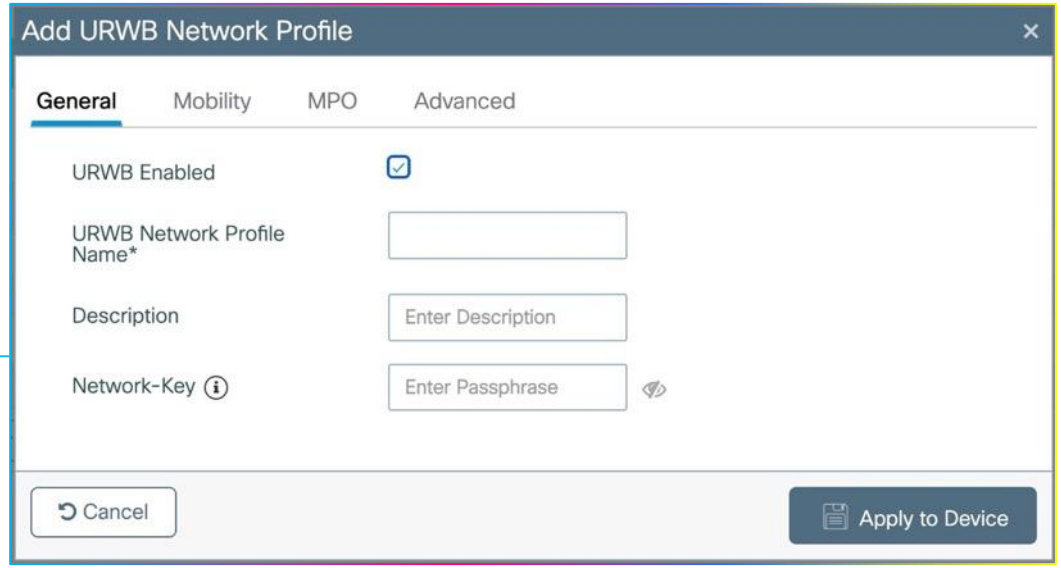
URWB Configuration Model on 9800



Simultaneous URWB and Wi-Fi operations

URWB Configuration on WLC

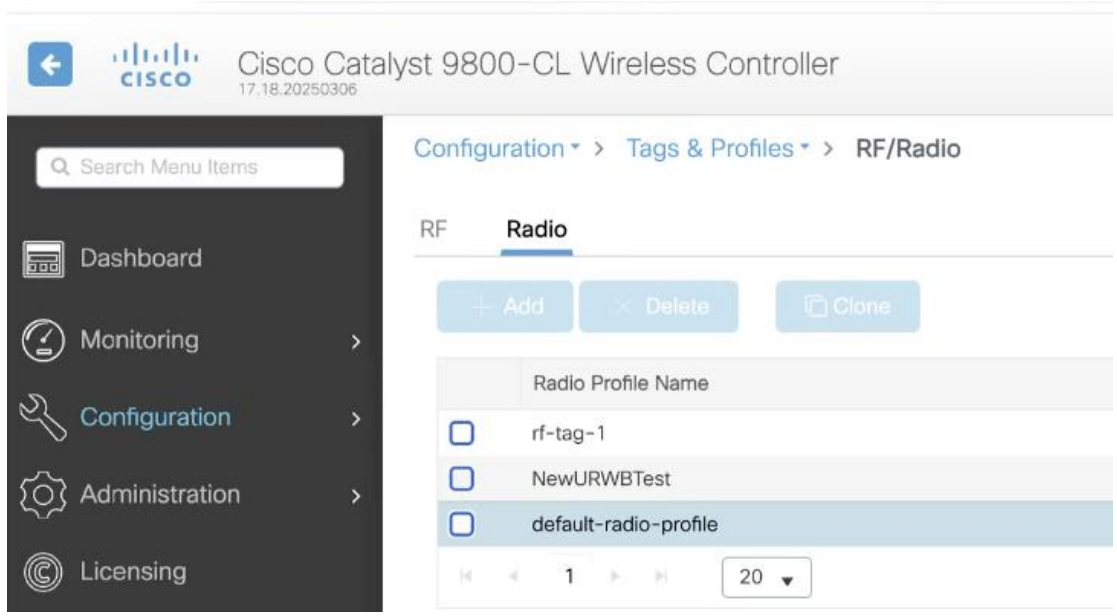


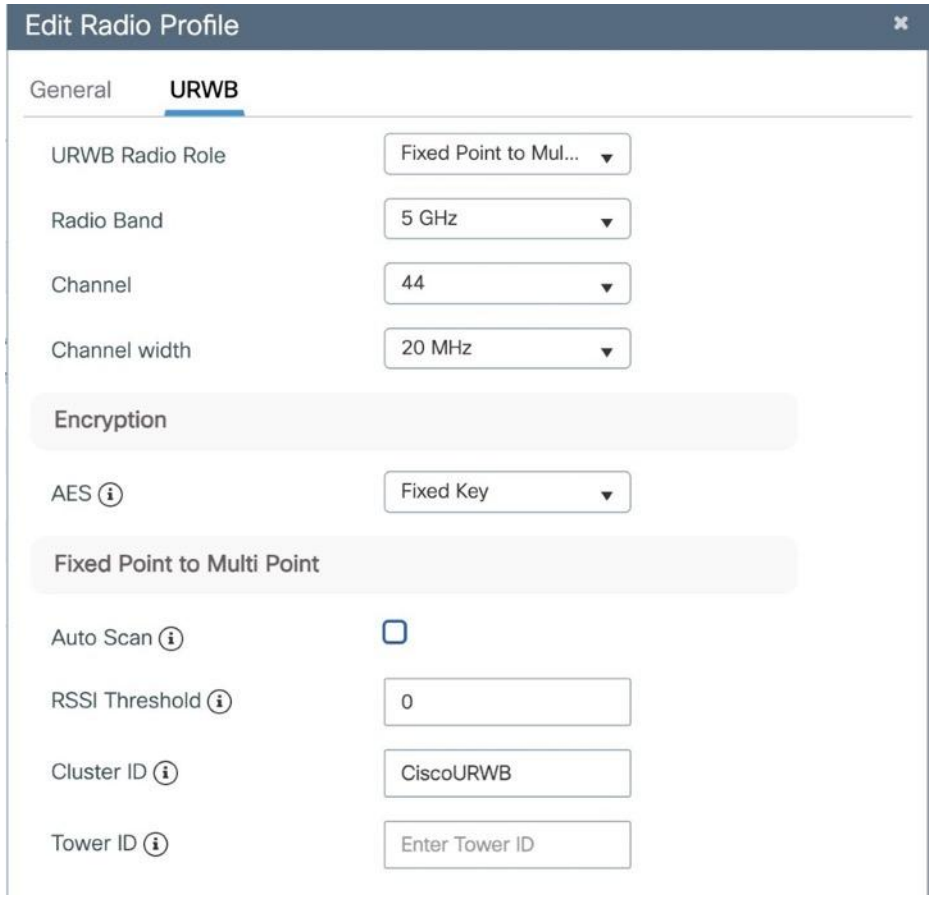


Feature available from IOS-XE 17.18.1 onwards

Simultaneous URWB and Wi-Fi operations

Radio Profiles



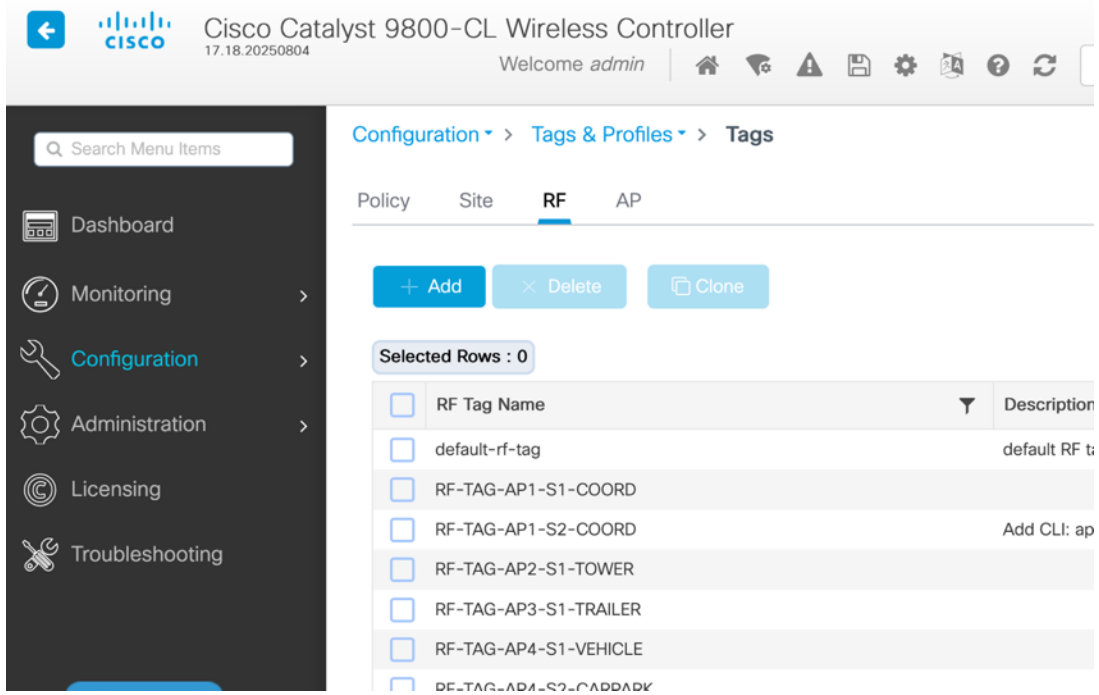


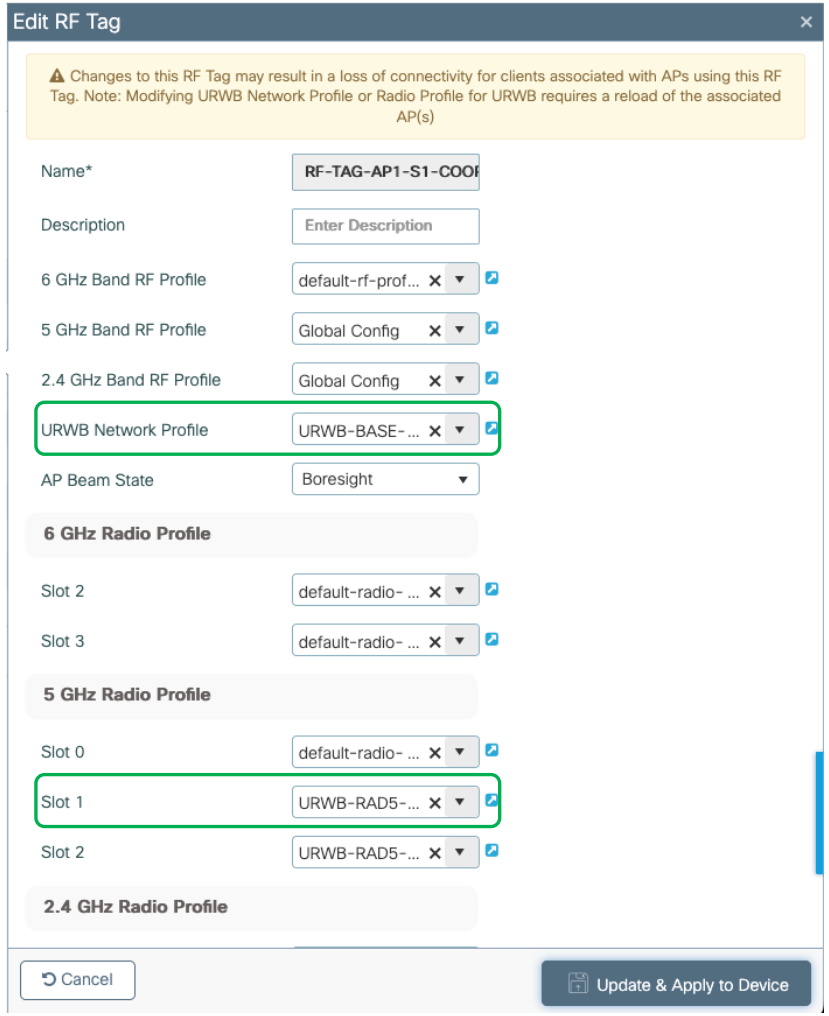
Channel and profile role declaration

Feature available from IOS-XE 17.18.1 onwards

Simultaneous URWB and Wi-Fi operations

Radio Roles & URWB Profile



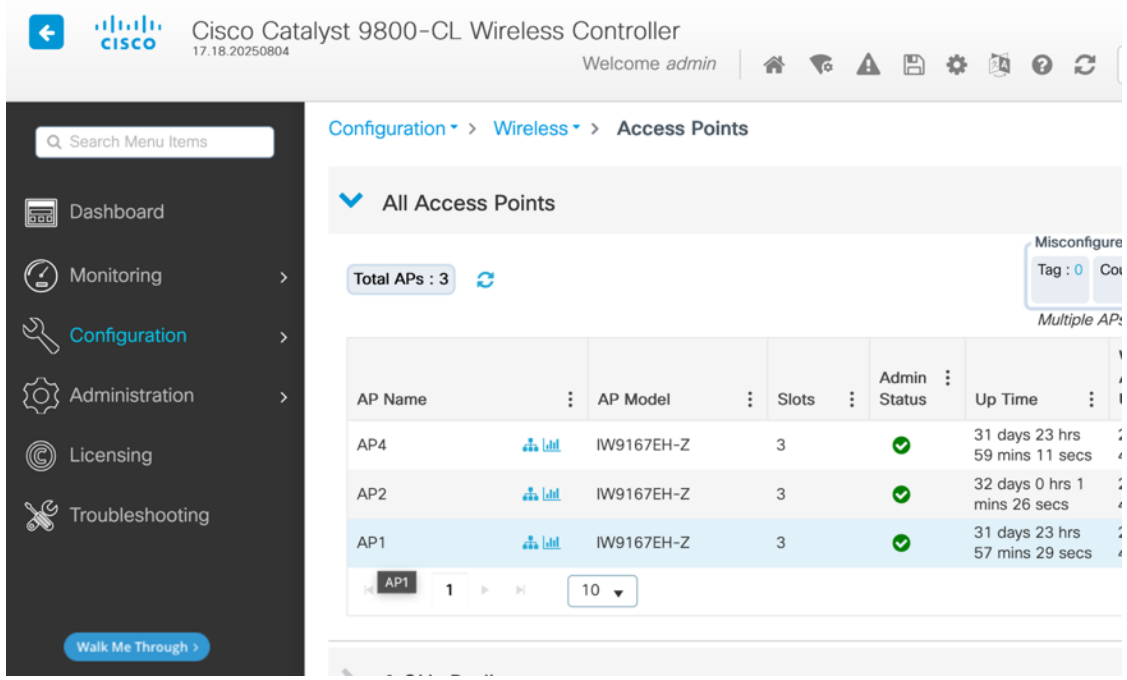


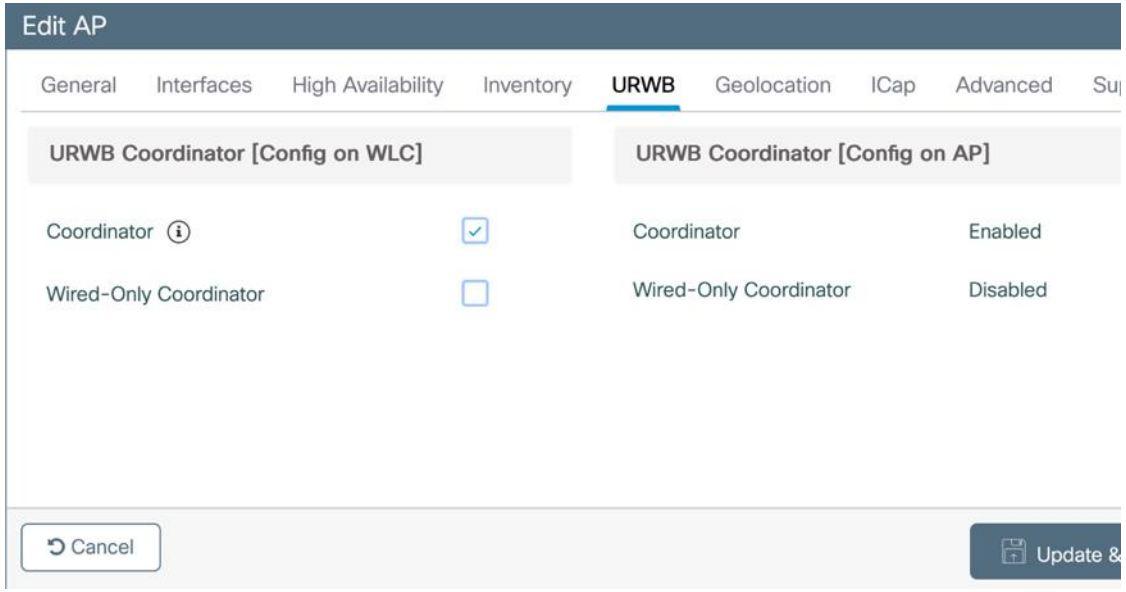
URWB profile & slot declaration for AP

Feature available from IOS-XE 17.18.1 onwards

Simultaneous URWB and Wi-Fi operations

URWB Coordinator Nomination





Electing your Coordinators

Feature available from IOS-XE 17.18.1 onwards

Who can benefit?

- ✓ Customers already using Cisco Wi-Fi, 9800WLC and Catalyst Center, and looking for ultra-reliable wireless connectivity to cover more critical use cases
- ✓ Customers already implementing Wi-Fi Mesh and/or WGB and looking for future-proof wireless network ready for AI and critical applications
- ✓ Customers moving towards converged IT/OT infrastructure and want to extend same visibility and security policies up to the wireless end point
- ✓ Customers who want to optimize their infrastructure and avoid isolated, dedicated OT networks to support connectivity for OT and mission-critical use case
- ✓ Customers who are looking for an easy-to-deploy, easy-to-manage alternative to P5G to cover their mobility use cases

Licensing

URWB functionalities offered as part of the current DNA or Unified Licensing model

	Wi-Fi 6 and Wi-Fi 6E platforms	Wi-Fi 7 platforms
Functionality	**DNA License**	**Unified License**
URWB Fixed Infrastructure (Point-to-point links)	DNA Essentials	Cisco Wireless Essentials
URWB Mobility (Mobile assets)	DNA Advantage	Cisco Wireless Advantage

Design Guidelines for 17.18.1

- L3 Architectures are not supported. All APs in the same URWB network must be in the same layer 2 domain (mostly affects mobility deployments)
- 6 GHz Standard Power (requiring AFC) is not supported on URWB Radios
  - 6GHz LPI for mobile assets is supported in the US (Not AU)
- URWB is limited to two or less 5GHz or 6GHz radios per AP
- SD-Access (Wireless Fabric) is not supported
  - As part of an SDA underlay however, URWB is supported
- URWB only supports one wired network port on each AP
- URWB cannot split VLAN's off at the AP port, switch is required
- IW Monitor has limited support, more WLC support coming in IW Monitor 3.0
- URWB is subject to processing throughput ceilings, varies per platform

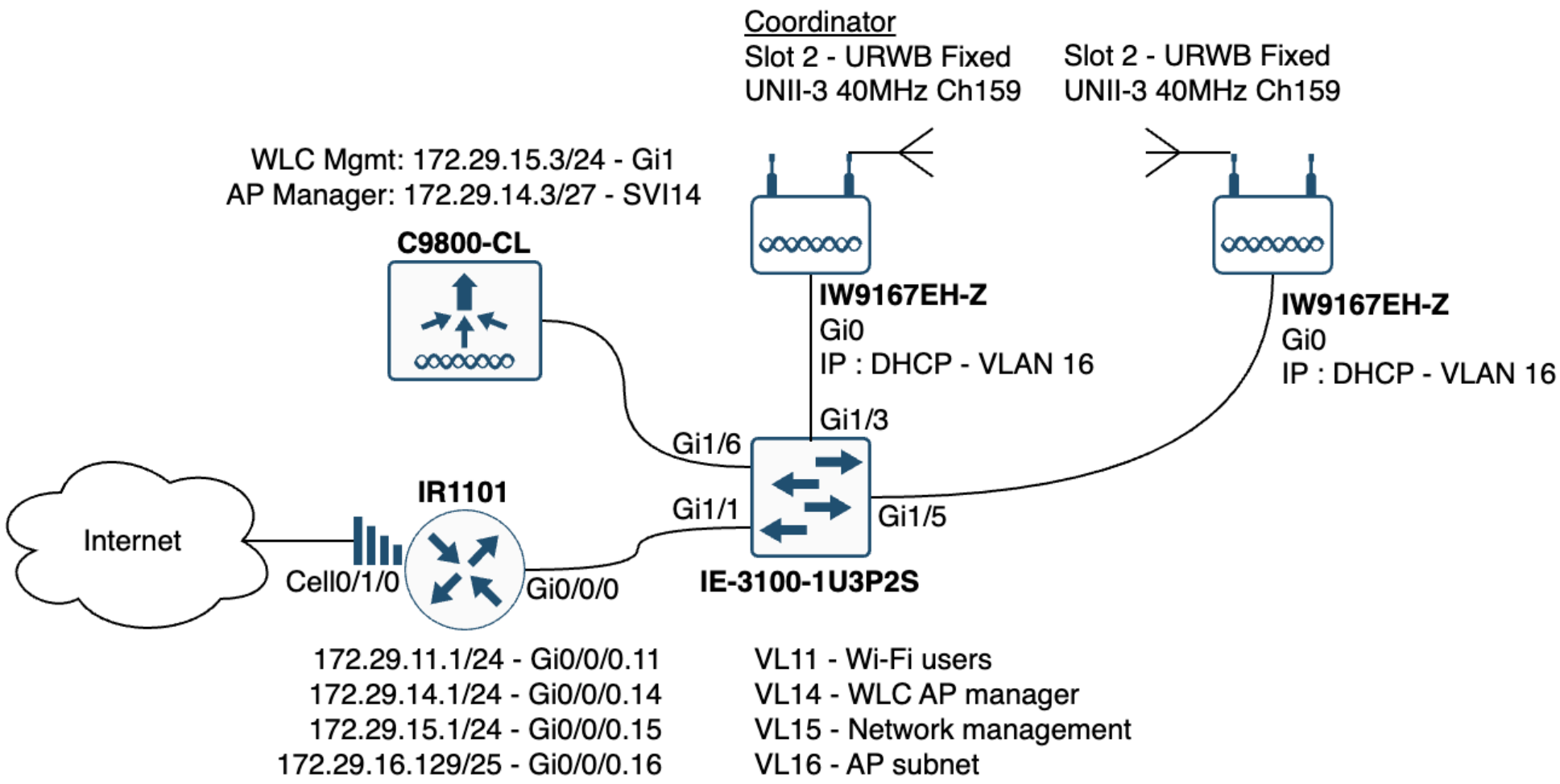
Cisco Simultaneous URWB + Wi-Fi Recap

- Ultra-reliable, low latency connectivity for critical applications
- Zero-loss roaming
- Wi-Fi and URWB are available on the same AP at the same time
- No need for parallel AP infrastructures
- Supports mobile, point-to-point, point-to-multipoint, mesh, or a mix
- Works with APs in Local or FlexConnect mode
- Available starting in 17.18.1 (early release, for PoC and testing)

- All this talk about URWB… Is Mesh and WGB going away?

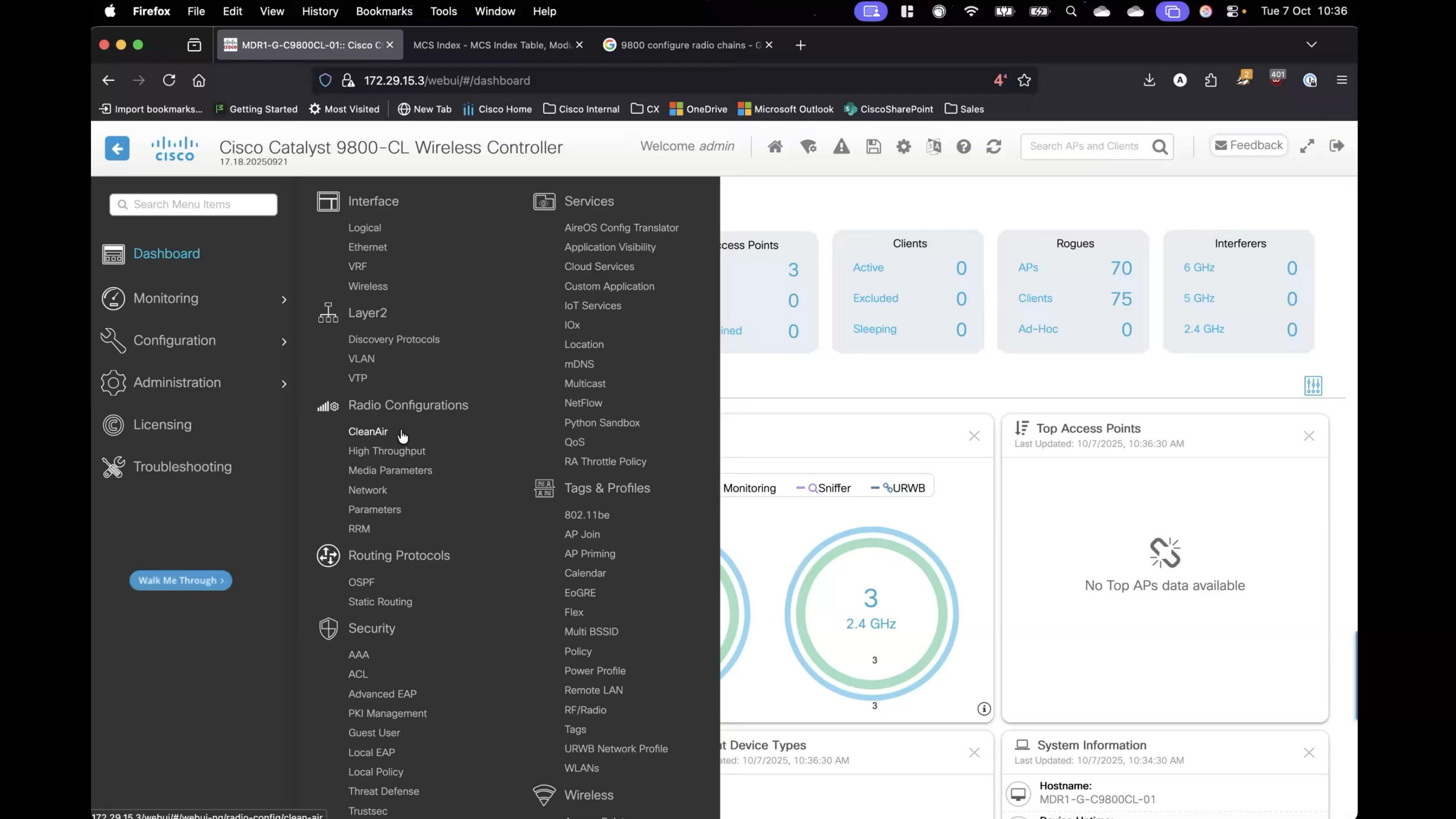
Demo Time!

Provisioning Topology



What’s wrong with this picture?

There are safer ways to cook!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New Tab
Cisco Home
Cisco Internal
CX
OneDrive
Microsoft Outlook
CiscoSharePoint
Sales
Cisco Catalyst 9800-CL Wireless Controller
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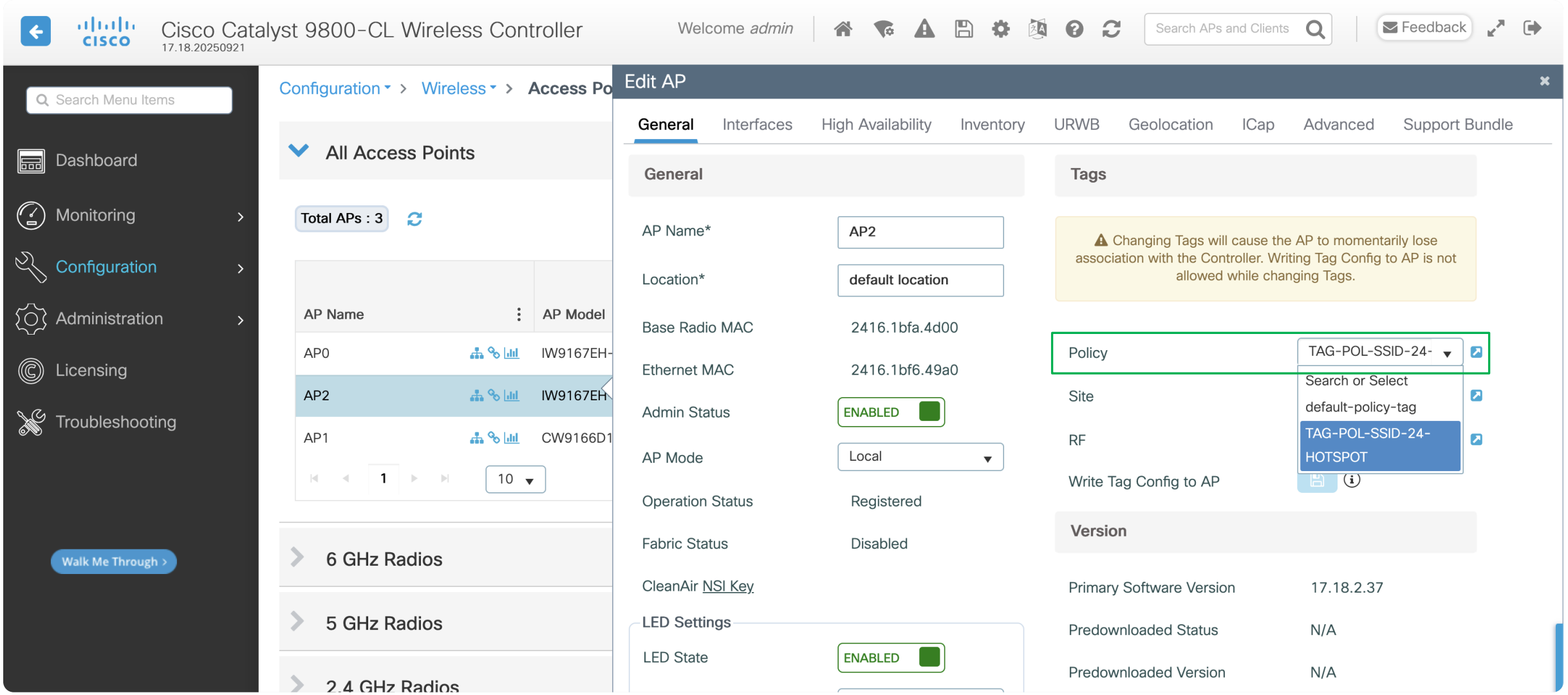
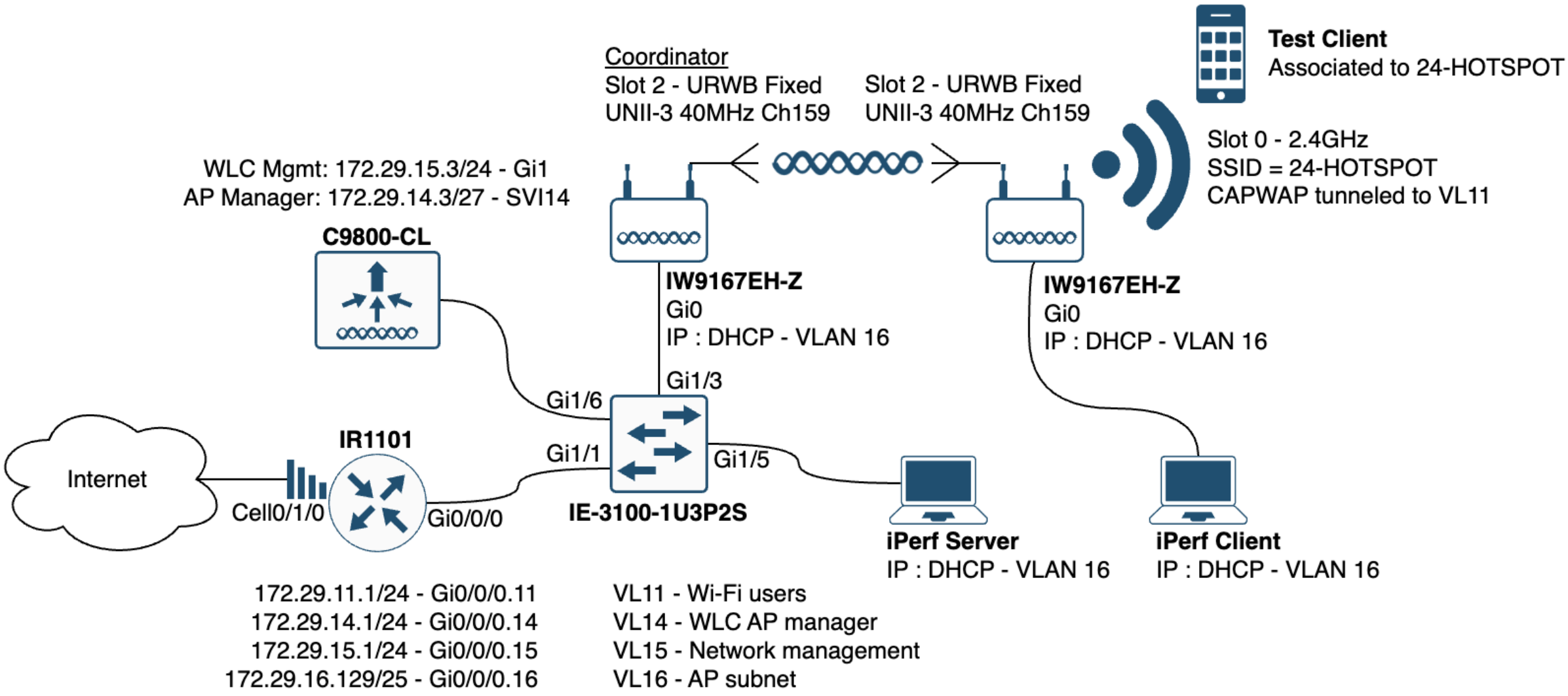
Welcome admin
Search APs and Clients
Feedback
Search Menu Items
Dashboard
Monitoring
Configuration
Administration
Licensing
Troubleshooting
Walk Me Through
Interface
Logical
Ethernet
VRF
Wireless
Layer2
Discovery Protocols
VLAN
VTP
Radio Configurations
CleanAir
High Throughput
Media Parameters
Network
Parameters
RRM
Routing Protocols
OSPF
Static Routing
Security
AAA
ACL
Advanced EAP
PKI Management
Guest User
Local EAP
Local Policy
Threat Defense
Trustsec
Services
AireOS Config Translator
Application Visibility
Cloud Services
Custom Application
IoT Services
IOx
Location
mDNS
Multicast
NetFlow
Python Sandbox
QoS
RA Throttle Policy
Tags & Profiles
802.11be
AP Join
AP Priming
Calendar
EoGRE
Flex
Multi BSSID
Policy
Power Profile
Remote LAN
RF/Radio
Tags
URWB Network Profile
WLANs
Wireless
Clients
Active 0
Excluded 0
Sleeping 0
Rogues
APs 70
Clients 75
Ad-Hoc 0
Interferers
6 GHz 0
5 GHz 0
2.4 GHz 0
Monitoring
Sniffer
URWB
3
2.4 GHz
3
3
Top Access Points
Last Updated: 10/7/2025, 10:36:30 AM
No Top APs data available
Device Types
Last Updated: 10/7/2025, 10:36:30 AM
System Information
Last Updated: 10/7/2025, 10:34:30 AM
Hostname:
MDR1-G-C9800CL-01

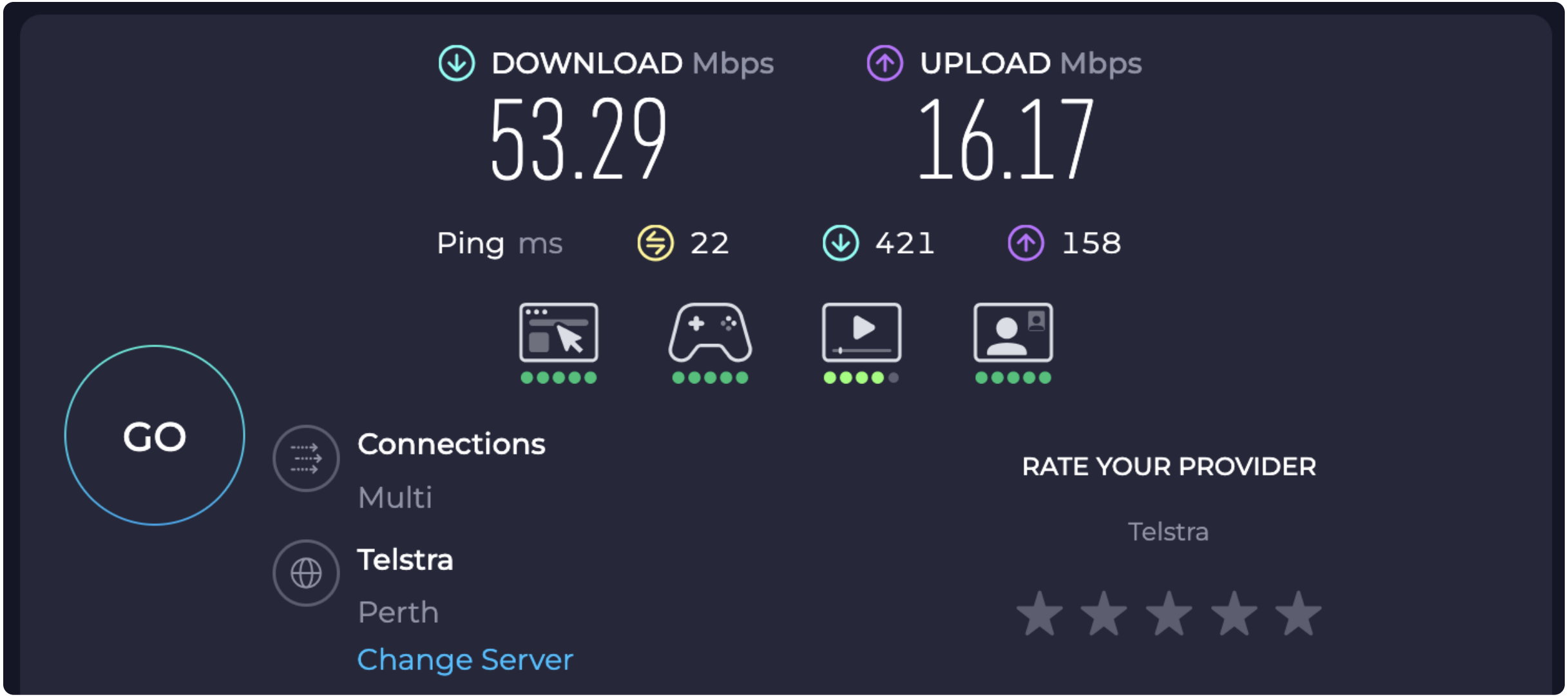
Last step, configure AP's for SSID propagation



Completed State



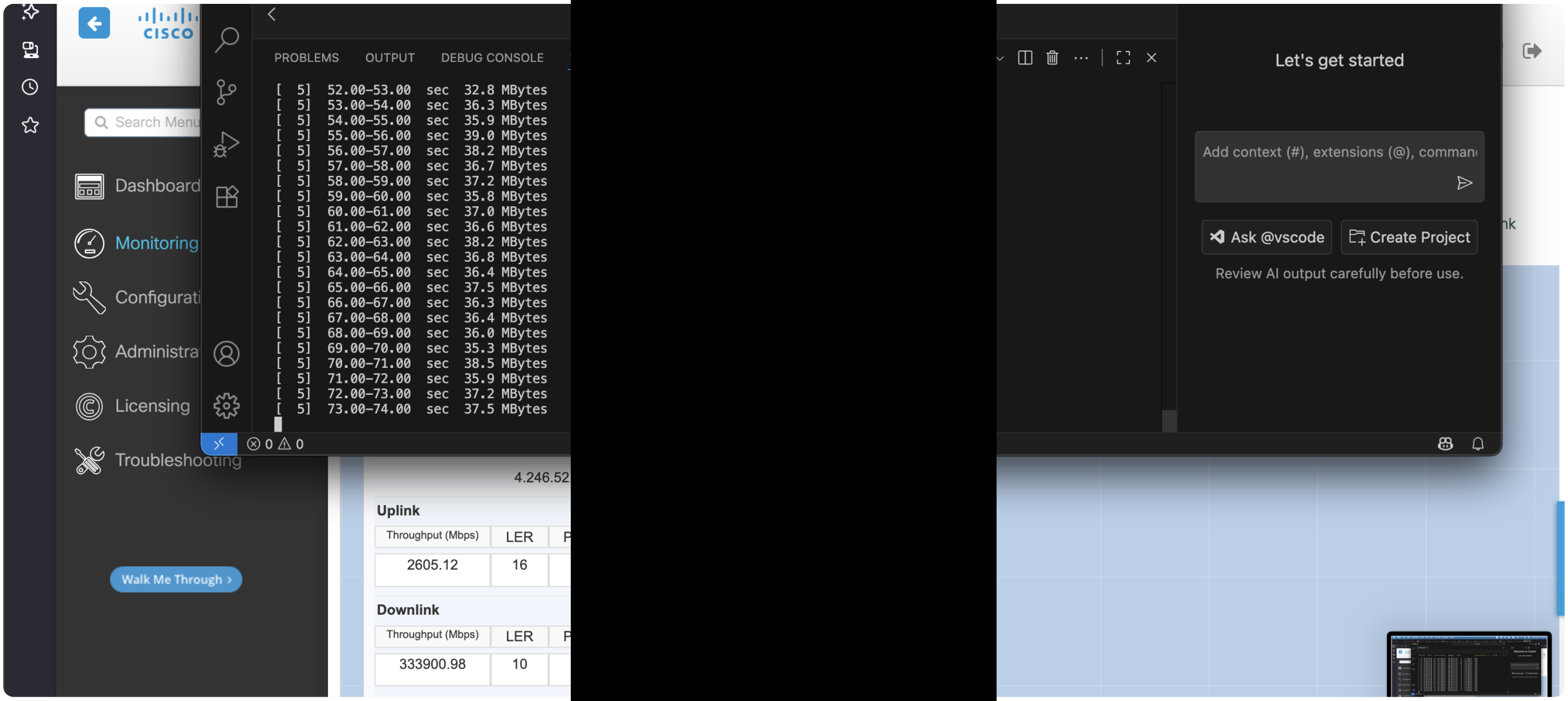
Quick LTE Internet Baseline



Moving outside

Moving outside

Moving outside

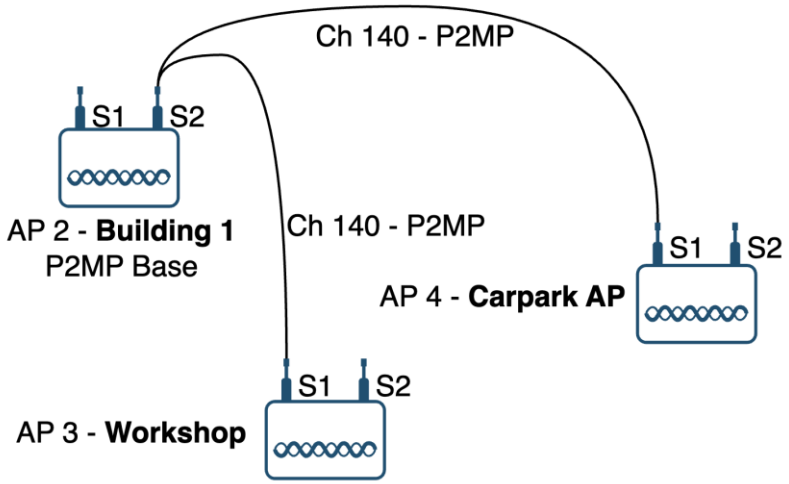


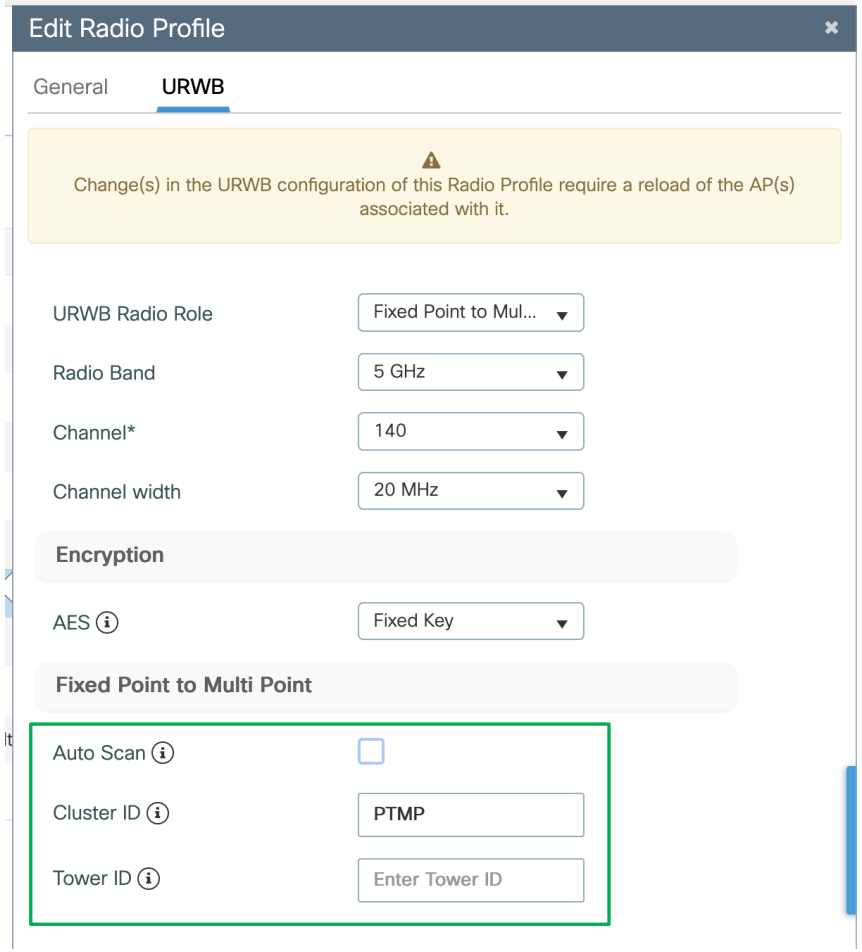
Success!!!

Aaaaand ...

It was delicious!

P2MP Note





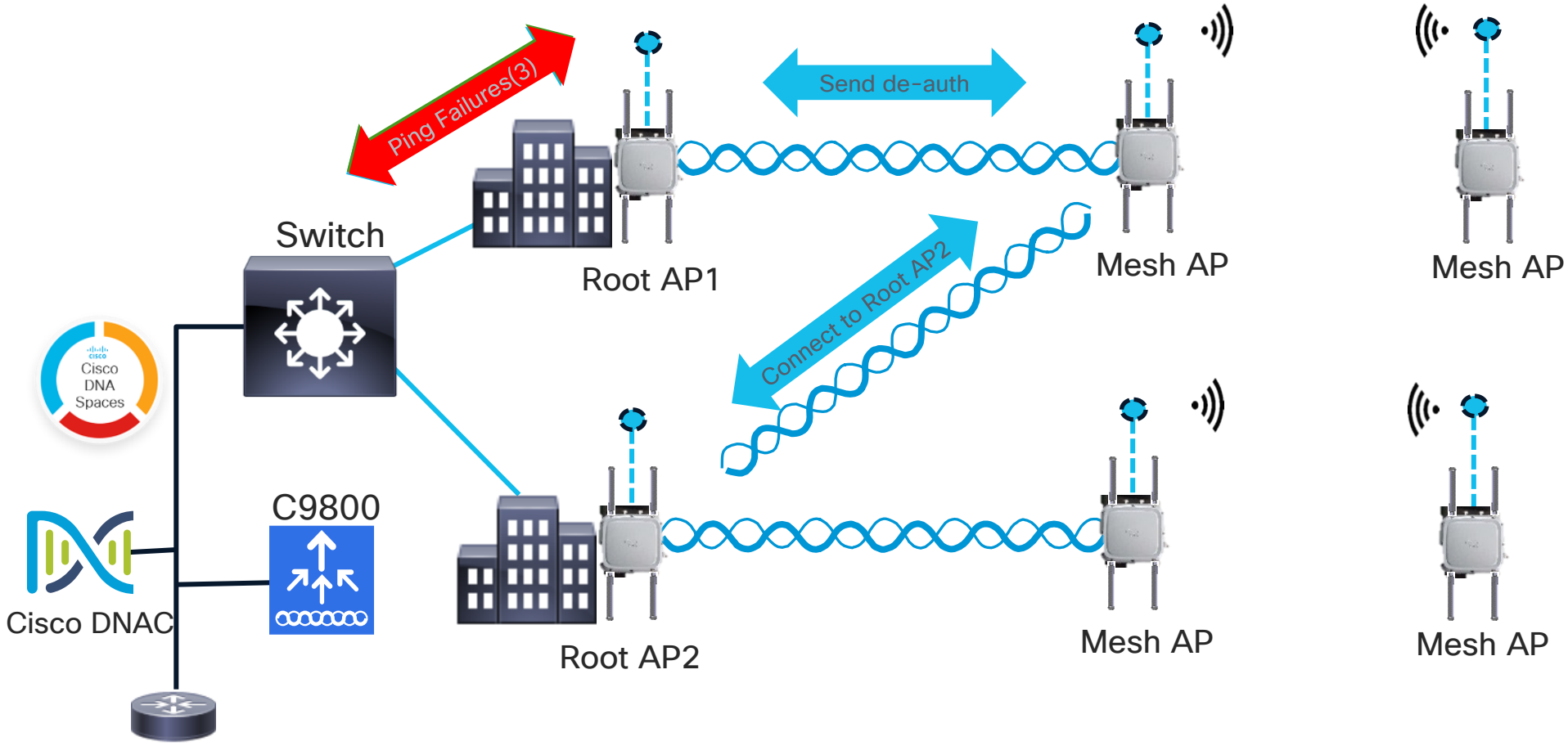

```
PRT3-5-WLC-IOT2#ap name AP2 dot11 5ghz slot 2 urwb ptmp base
```

Recent MESH Improvements

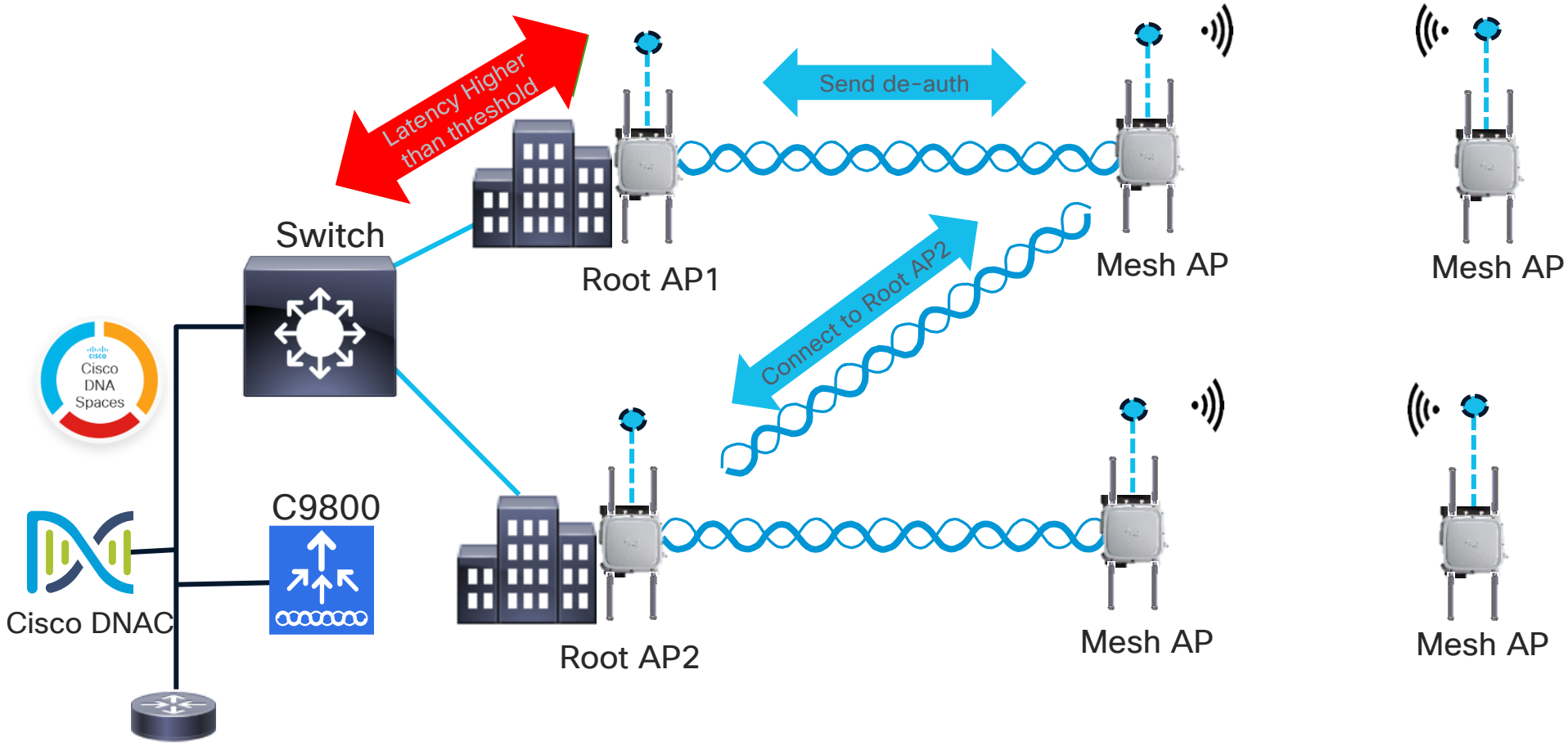
Recent MESH Enhancements

Release	Notable Feature
17.6	**Least congested channel scan on RAP boot-up:** Optimizes the initial channel the MESH starts on, before RRM gets a chance to start running
17.6	**Convergence Time Improvements**
17.7	**Serial Backhaul for 9124**
17.9	**Backhaul RRM Phase 1:** RAPs can change channels while MESH APs are connected
17.9	**Backhaul SNR cutoff lowered to 5dB SNR**
17.9	**Huge throughput increase on Ethernet Bridging (almost double ☺)**
17.12	**AP Boot Time Decrease (RS-232 @ 115,200 Baud)**
17.12	**More MESH OPER STATS in the Yang Model**
17.14	**Backhaul RRM Phase 2:** RAPs take RRM stats from the MAPS in the MESH tree into consideration

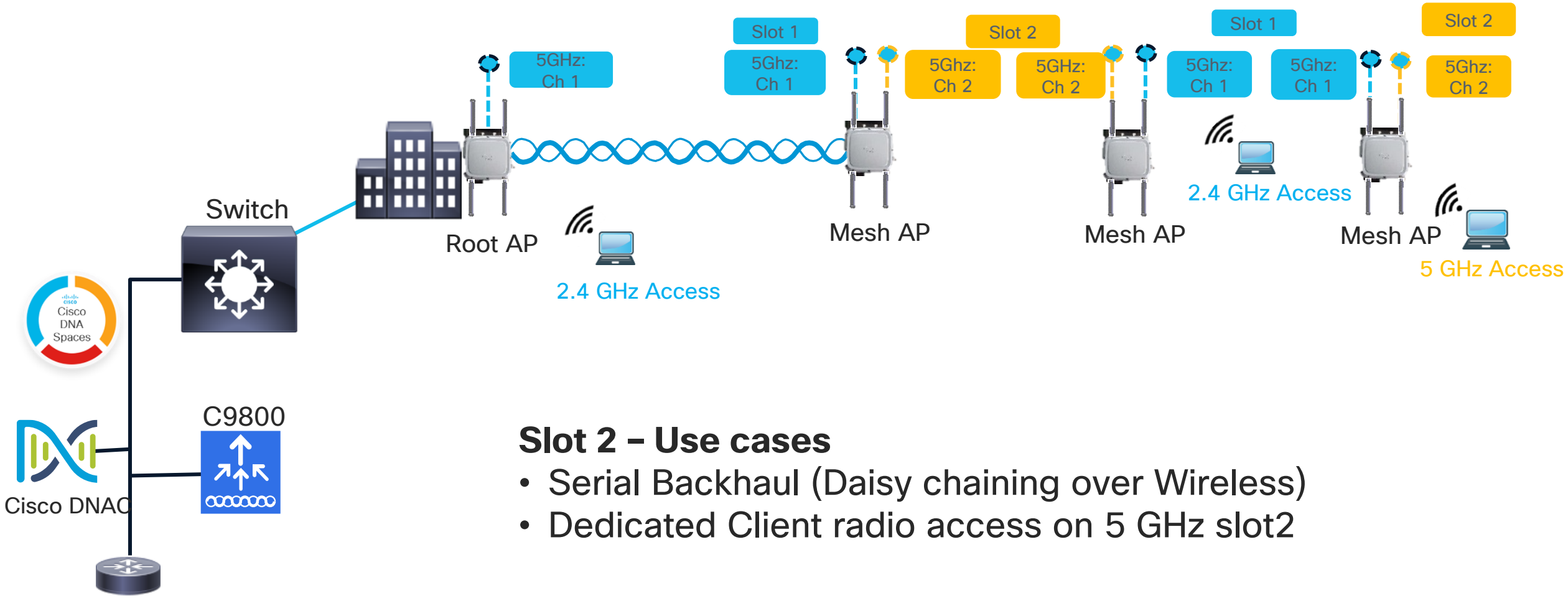
Fast Teardown – Gateway Down



Fast Teardown- Latency High



Solution Overview – Mesh Serial Backhaul

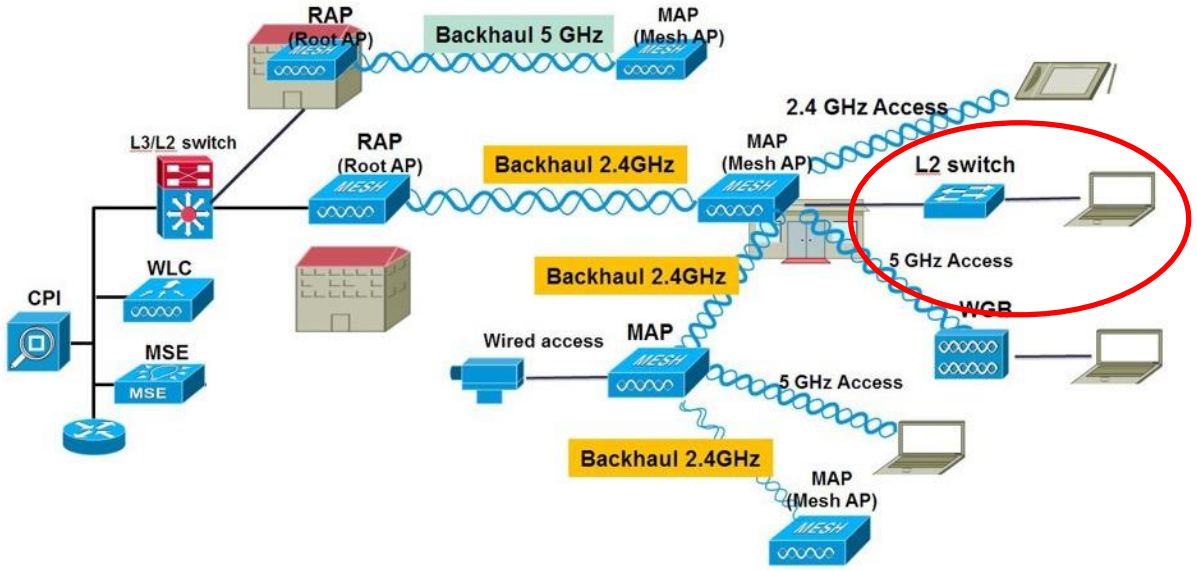


Slot 2 – Use cases

- Serial Backhaul (Daisy chaining over Wireless)
- Dedicated Client radio access on 5 GHz slot2

Recent MESH Fixes Related to MCAST / UNICAST Flooding

Fixed Release	Notable Feature
17.9.5esc +17.12.4	CSCwi42112 – Wired Clients MAC address are being learn from the 9124 MAP port
17.9.5esc +17.12.4	CSCwj34753 - MAP is reflecting back client unicast traffic on the wired port



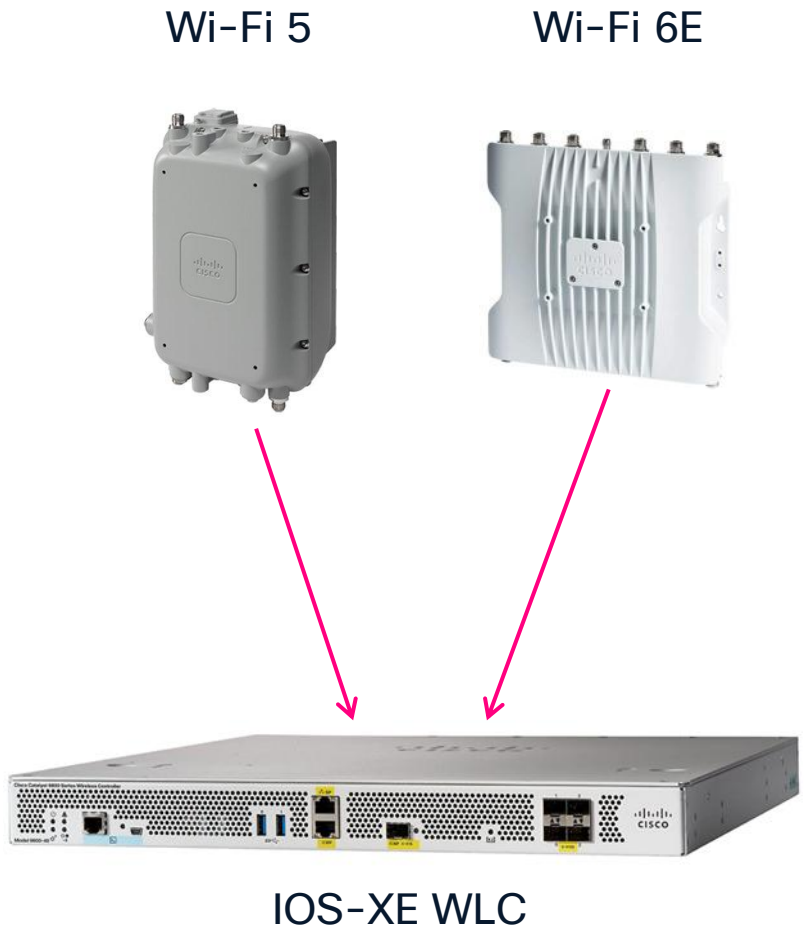
Note:
These are critical fixes to take advantage of if you have a switch operating behind your MAP.

<u>Especially</u> important if you have STP running (TCN's cause a temporary flood of traffic)

IRCM Migration Concepts

- You can do IRCM between AireOS & IOS-XE
- Could an easier way be moving everything compatible to the IOS-XE?

- Wi-Fi 5 AP's supported throughout 17.15, just be mindful of your LDoS dates
- Main benefit, single management plane, one configuration style
- Then plan to swap out Wi-Fi 5 with either 6E or if suitable Wi-Fi 7 units



Recent WGB Improvements

Recent WGB Enhancements

Release	Notable Feature
17.11	**Site survey mode, WGB and UWGB support on IW9167**
17.12	**IAPP Refresh bug, impacting data forwarding post roam**
17.13	**Concurrent 5GHz Radio coordinated hand-off on 9130 & 9124**
17.13	Low Latency profiles for 9165 IOT WGB
17.14	QoS, GPS and SNMP support on 9165 and 9167 WGBs
17.15	**Using the scanning radio on the IW9167 to aid in roaming on 2.4GHz (where we only have a single radio)**
17.16	Wired Port on IW9167E supporting downshift to 10Mbps
17.17	SFP Slot on IW9167E additionally supporting downshift to 10Mbps on suitable GLC-T's
17.18	**Addition of a GUI to make monitoring easier**

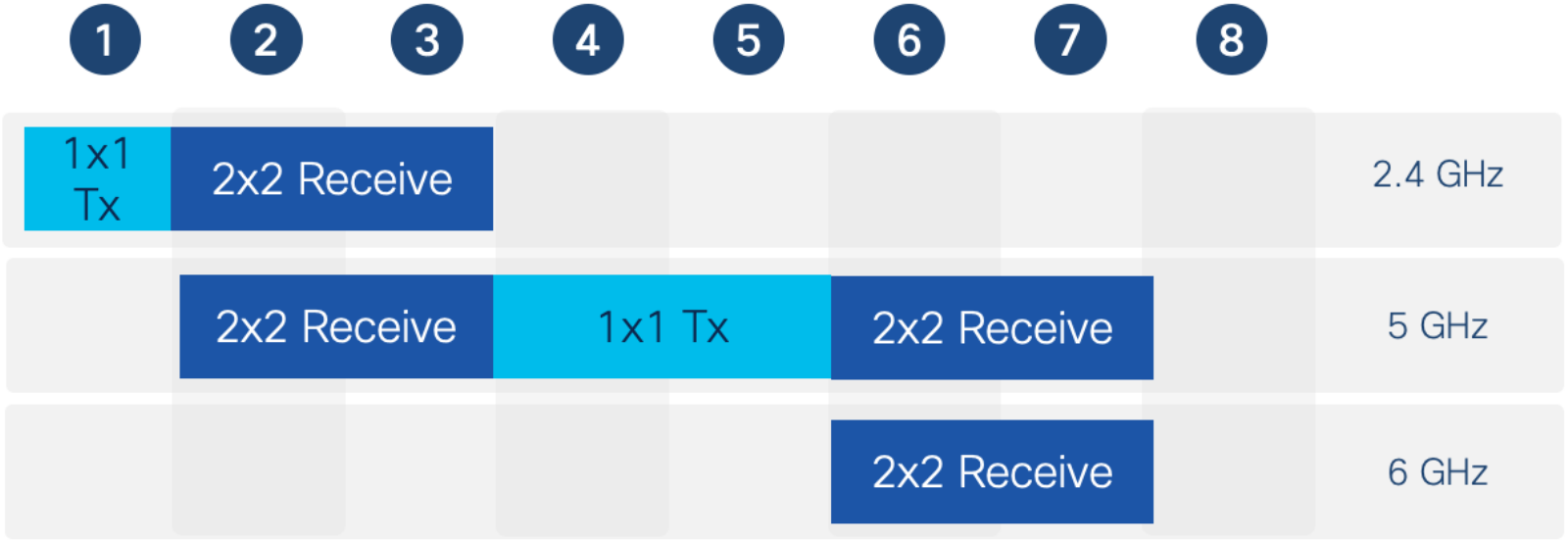
IW9167 as WGB: The scanning radio in action

```
[*05/10/2024 00:44:27.4028] DOT11_UPLINK_EV: RSSI Low(-77)! Parent lost. Roaming triggered.

[*05/10/2024 00:44:27.4028] DOT11_UPLINK_EV: Best ap not available in aux radio scan table

[*05/10/2024 00:44:29.2778] DOT11-UPLINK_ESTABLISHED: Interface Dot11Radio0, Associated To AP KLNK01-A1
CC:DB:93:48:82:E8 [WPA2 FT-EAP]
[*05/10/2024 00:44:29.2798] DOT11-UPLINK_ESTABLISHED: Interface Dot11Radio0, Associated To AP KLNK01-A1
CC:DB:93:48:82:E8 [WPA2 FT-EAP]

[*05/10/2024 00:45:29.2802] DOT11_UPLINK_EV: RSSI Low(-78)! Parent lost. Roaming triggered.

[*05/10/2024 00:45:29.2802] DOT11_UPLINK_EV: Best ap not available in aux radio scan table
```

IW9167 Scanning Radio Ports

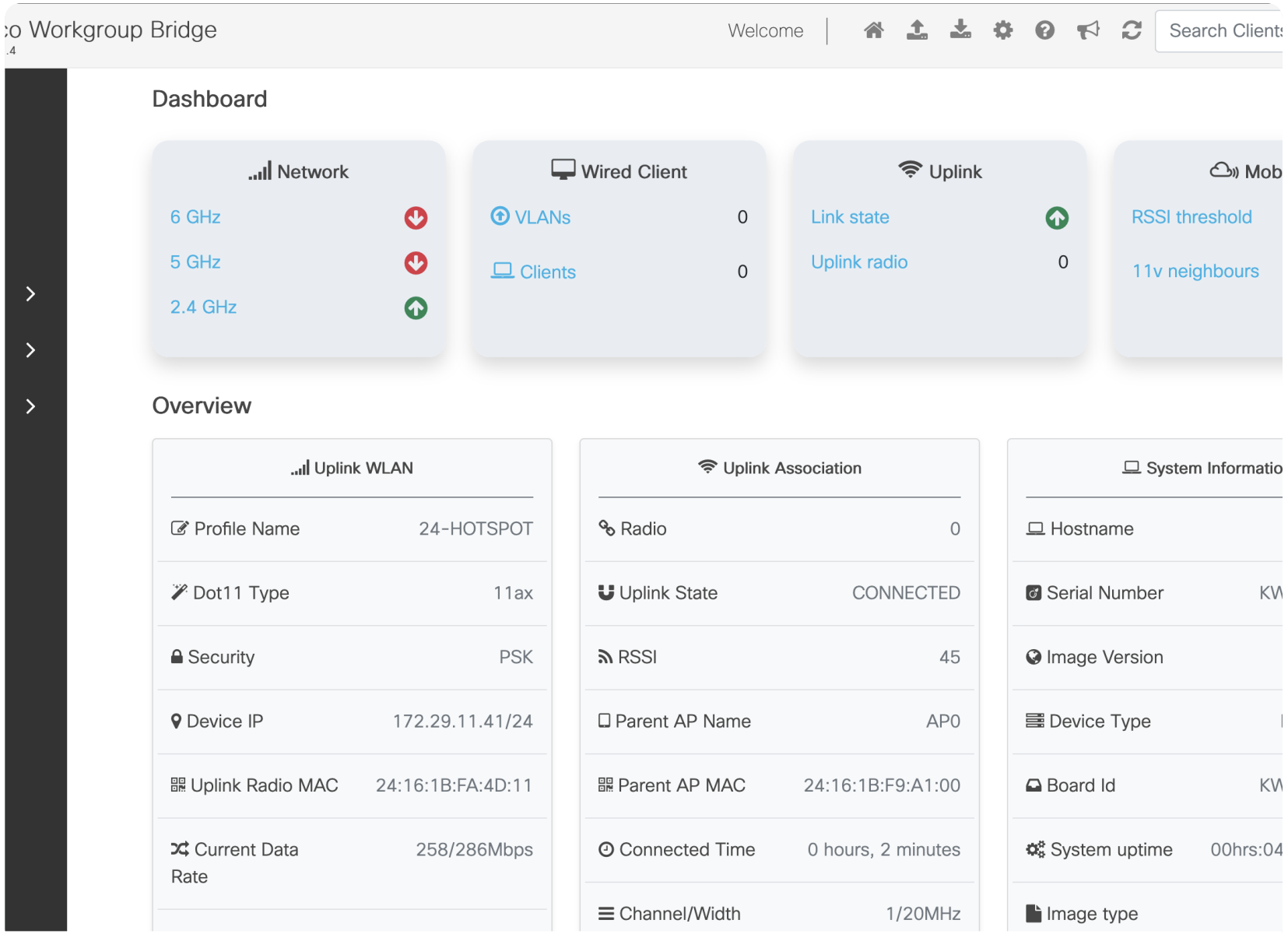
GNSS TNC female antenna port

Self-identifying antenna port



2.4 GHz: 22 dBm Max Tx Power
5 GHz: 18 dBm Max Tx Power

17.18.1 WGB mode has a GUI!

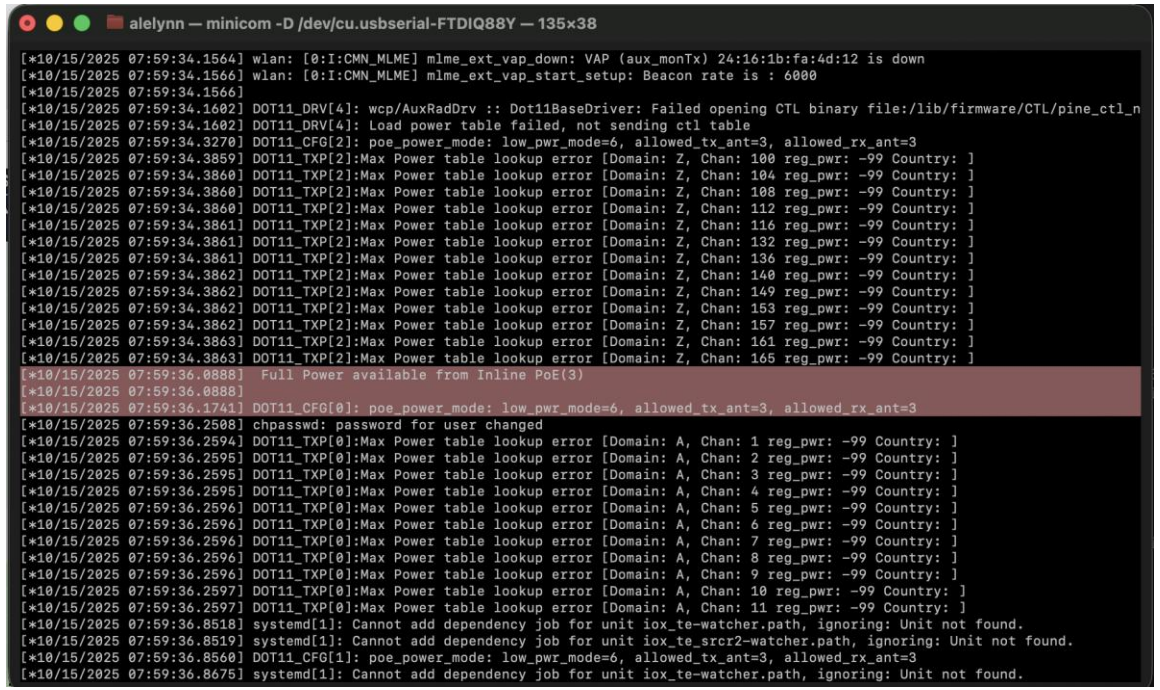


Seriously consider 801.11ax HE in 2.4GHz

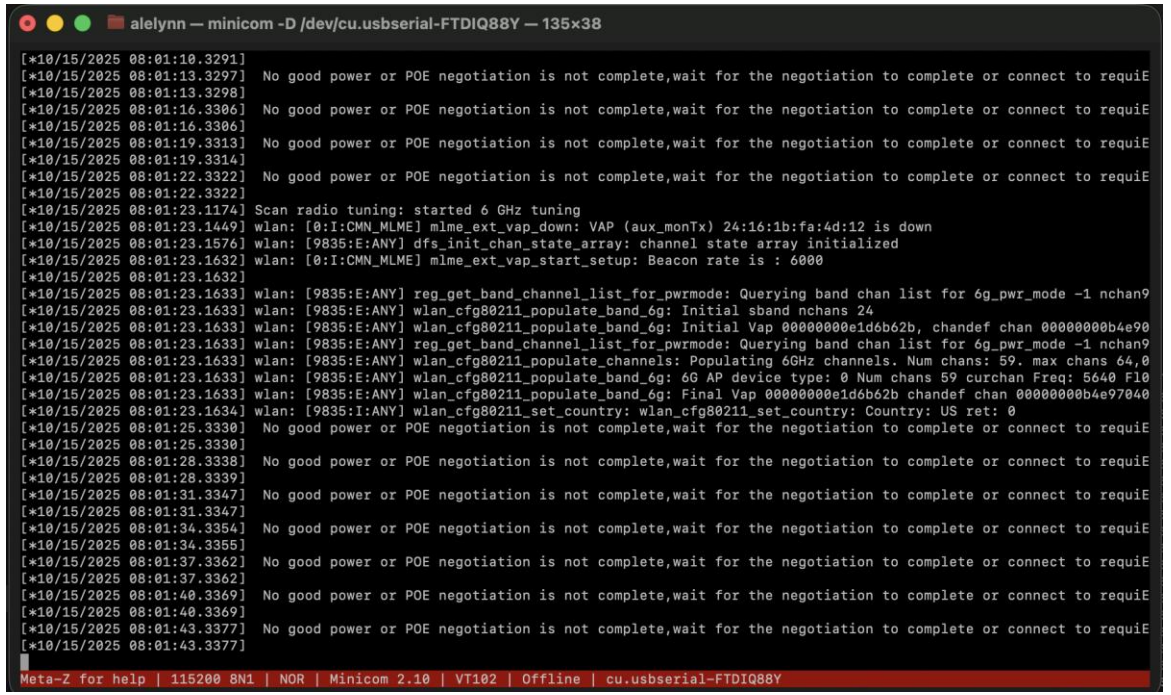
- Explore for WGB's in mesh systems with 2.4GHz access
  - Particularly where the WGB is mobile
- Can you enable 2x2 with 2 spatial streams?
- Strongly recommend leveraging HE MCS rates
- Look at low speed HE MCS 2, 3 for 1SS – Note different modulations!
- Look at low speed HE MCS 2, 3 for 2SS – Same modulations as 1SS
- 802.11ax gives you the chance to push out the Guard Interval to 3200ns
  - But note this is only to be played with in low-speed long distance type applications
- Can you run 4x4:2 implementations? 2 TX chains, but 4 antennas to demodulate?

A Note on PoE Boot Times – IW9167E

With CDP/LLDP (PoE Via switch): 1min 54sec



Without CDP/LLDP (IE an injector only): 3min 12sec



`[*05/07/2024 16:17:32.6353]  No good power or POE negotiation is not complete, wait for the negotiation to complete or connect to required PSE`

Without an injector, you will see this printed on console while we timeout CDP/LLP negotiation.

Sample AP-COS WGB Config (Roaming Tweaks)

```
Rx Beacon Missing Action    : Enable
Rx Beacon Missing Count     : 30
Packet retries Action       : Reconnect
Packet retries Value        : 64
RSSI Threshold Value        : -70 dBm
Threshold timeout           : 20 sec
HSR-Scan status             : Disable
Auth response timeout       : 5000 Msec
Assoc response timeout      : 5000 Msec
WGB channel scan timeout    : 8 Msec
Dhcp response timeout       : 60 Sec
EAP timeout                 : 3 sec
Bridge table aging-time     : 300 Sec
Probe pak data rate type    : NA
Probe pak data rate         : 0
Antenna Band Mode           : Dual
Broadcast tagging           : Disable
Wired Client 802.1x Auth    : Disable
IGMP querier IP address : ::
```

Retries that can trigger an action

You will want to tweak based on your env.

6GHz Outdoors

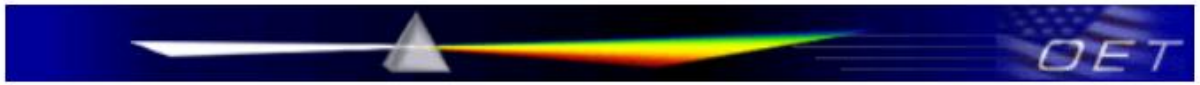
6E (5.925-7.125GHz) FCC Regulatory Recap

Low Power Indoor (LPI)

- must have integrated antennas
- operation on oil platforms, automobiles, trains, maritime vessels and aircraft shall be prohibited
- Must be inside a building

Outdoor (Standard Power APs)

- Requires AFC –internet connected
- Can use external antennas
- Specifically prohibited in certain deployments.



Federal Communications Commission
Office of Engineering and Technology
Laboratory Division Publication

February 4 2021

Part 15 Subpart E U-NII 6 GHz General Guidance Bands 5, 6, 7, 8

4. Standard Power Access Points and Associated Clients (6SD, 6FX, 6FC)

Standard power APs and Fixed clients are prohibited on oil platforms, cars, trains, boats, and aircraft. The operation of transmitters in the 5.925-7.125 GHz band is prohibited for controlling or communicating with unmanned aircraft systems.

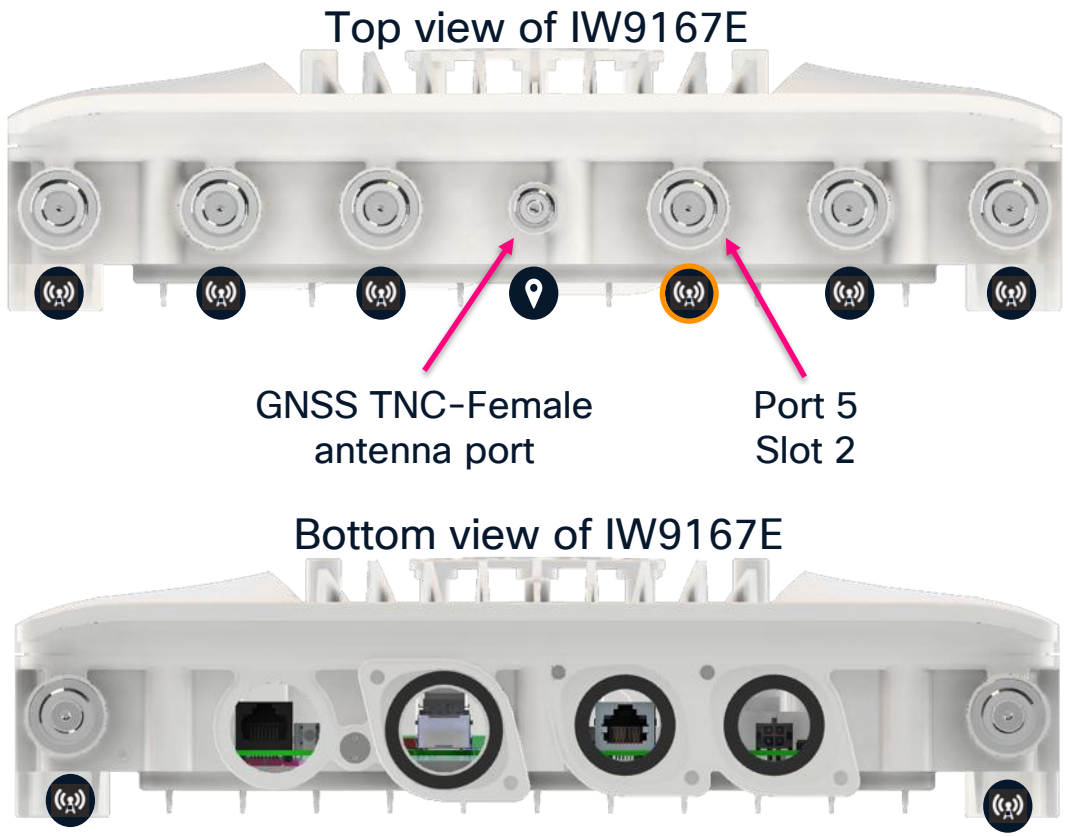
All U-NII devices must have a security description (15.407(i), Device Security) to protect against software modification by unauthorized parties (see KDB 789033).

Label information is required in the exhibit types. ID Label/Location Info FCC ID E-labelling is permitted on devices qualifying for e-labelling.

Anticipated Australian Timeline – LPI & AFC

- LPI permitted in Wi-Fi networks with similar restrictions to FCC
- But no LPI road mapped for URWB in AU in the near term
- AFC anticipated during 2028 in AU
- IW9167E Slot 2 is XOR 5/6GHz
- To be AFC ready for Wi-Fi, you need
  - GPS antenna fitted
  - SIA antennas fitted

IW9167E Access Point
Key Antenna Ports for 6GHz



Field Test Results

The Man Who Could: Ian Procyk, VE7HHS

Cisco Systems (Wireless Guy) 2011–today

GBIT Logistics (IT Consultancy)

Canadian Coast Guard (Telecom)

University of B.C. (WLAN team)

Ham Radio – Licensed 1997 – **VE7HHS**

Run a WISP for EMCOMM (BCWARN.net)

Support many amateur radio clubs / repeater sites

Pitt Lake Boat Launch: A Long, Relatively Straight Road, With Nothing Around!

Rate & Range Testing – Vehicle Side

2513+9124 AXE on Vehicle

What 5.6km away from RAP looks like


VE7SCC
FEATHERLITE

Rate & Range Testing - 9124

Base Station:

- 1x 9124AXE-A UNII-3 TX PWR 1
- 2x 14dBi 5114P2M-N Patches
- Tested out to 5.6km
- Mast @ 10m

On Vehicle:

- 1x 9124AXE-A
- 1x 13dBi patch ANT2513P4M-N

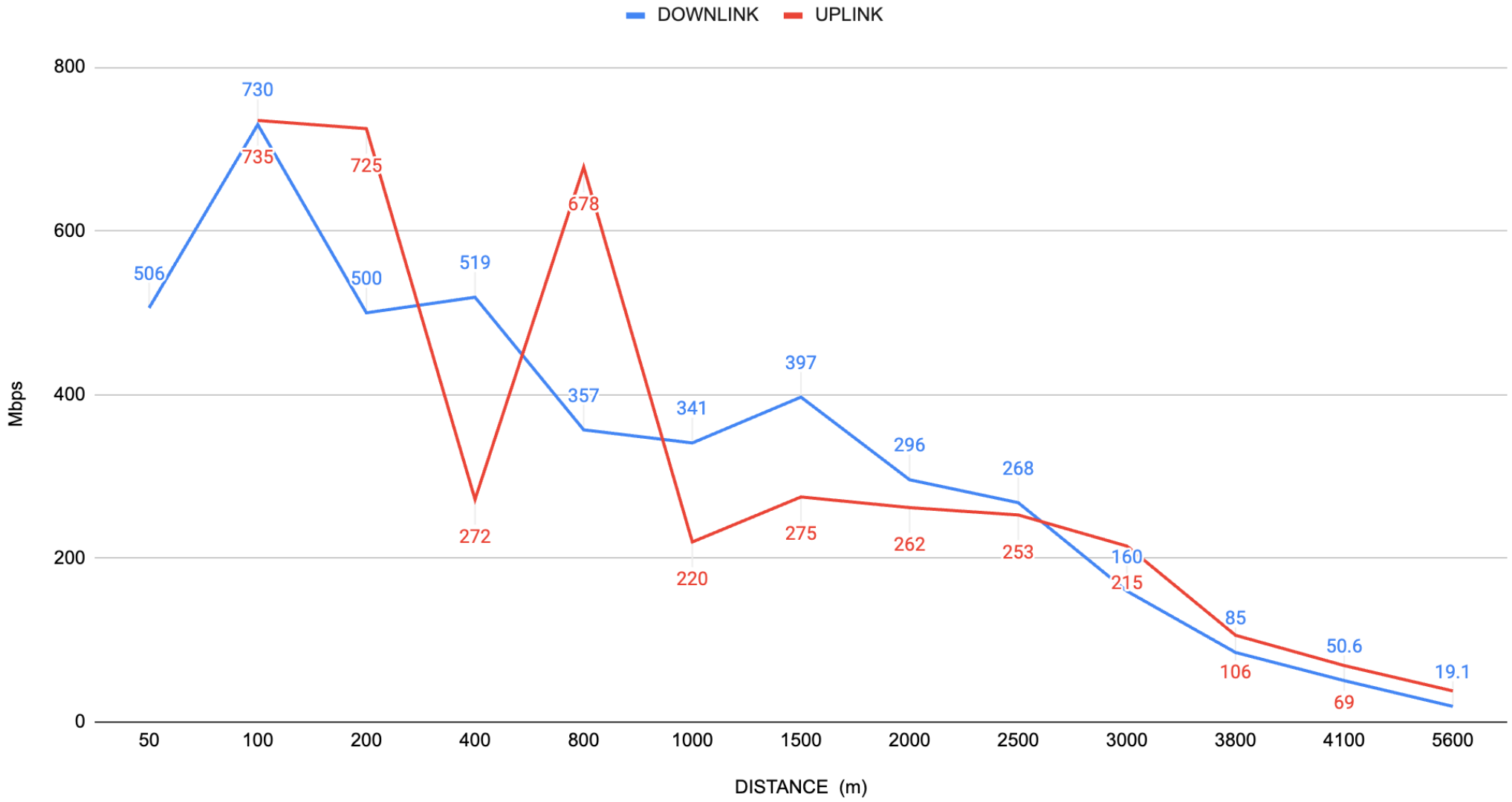
P2P Tests (MESH)
To 5.6km & beyond!

Rate vs Range for P2P RAP<->MAP Data

DISTANCE (Mi)	DISTANCE (m)	TCP UPLINK FROM MAP	TCP DOWNLINK TO MAP	Reported MESH SNR (dB)
0.03	50	735	506	56
0.06	100	725	730	56
0.12	200	272	500	40
0.25	400	678	519	49
0.50	800	220	357	29
0.62	1000	275	341	37
0.93	1500	262	397	37
1.24	2000	253	296	37
1.55	2500	215	268	32
1.86	3000	106	160	25
2.36	3800	69	85	21
2.55	4100	38	50.6	16
3.48	5600	10.4	19.1	12

Rate vs Range For P2P RAP<->MAP

80MHz,UNII-3, 4chains with 2x5114 on RAP and 1x2513 on MAP



How to Look @ MESH SNR / Parent Selection

```
9124AXE-MAP#show mesh adjacency parent

Mesh AWPP Radio adjacency info

Flags: Parent(P), Child(C), Neighbor(N), Reachable(R), CapwapUp(W),

       BlockListed(B), Authenticated(A), HTCapable(H), VHTCapable(V)

       OldParent(O), BGScan(S)

AdjInfo: Radio Backhaul: 1 [48:8B:0A:78:86:31]

Hops to Root: 1

Address           Cost RawCost LinkCost ReportedCost Snr BCount Ch  Width  Bgn Flags: P O C N R W B A H V S Rej

ect reason

4C:A6:4D:23:2A:71 64   80      64       16           56  0      149 80 MHz -   (T/F): T F F T T T F T T T F -
```

How To See Data Rates On AP-COS

HE=11ax

2SS=2 Spatial Streams

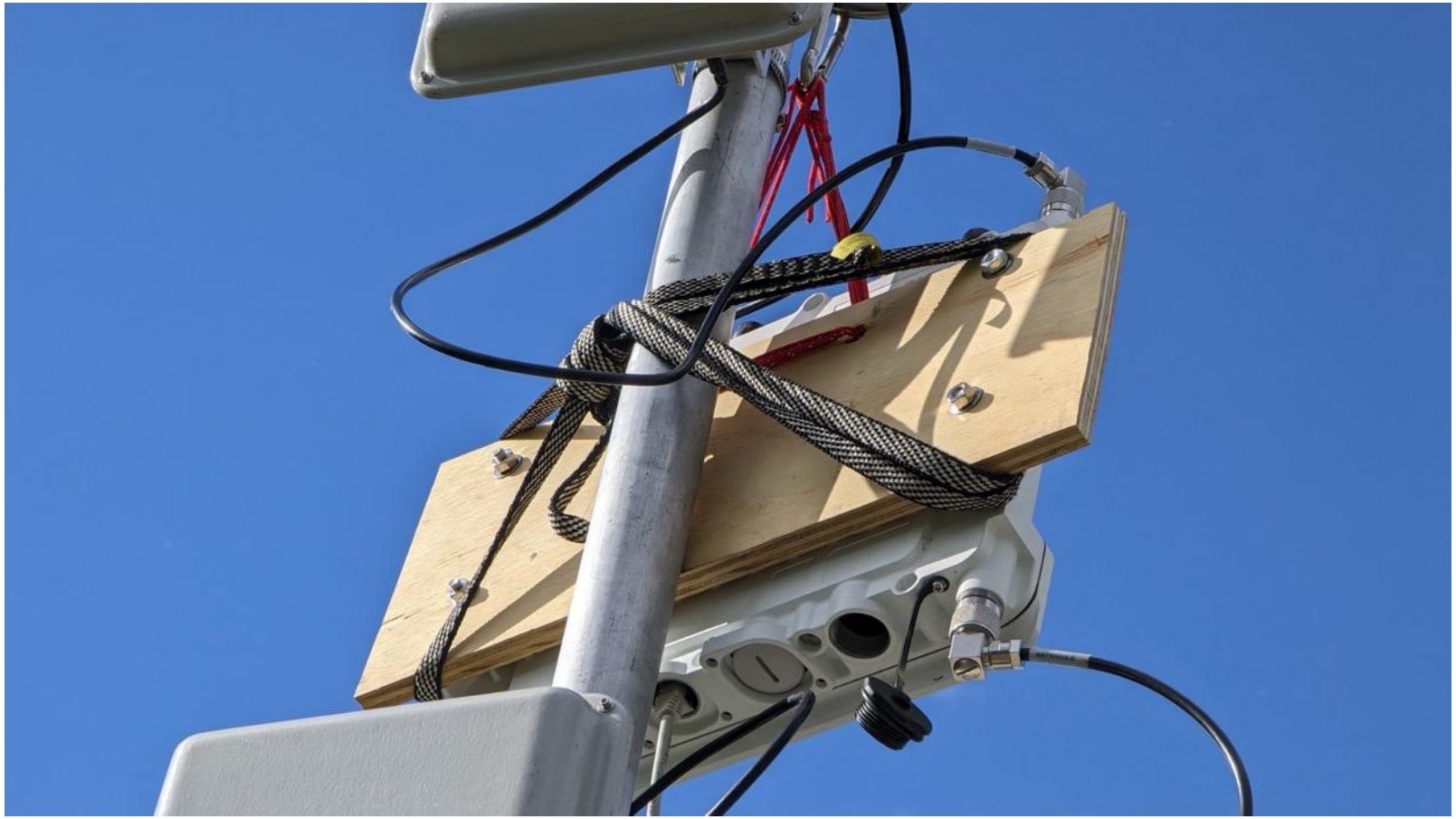
MCS Rate

RSSI

```
9124AXE-MAP#debug dot11 client rate 4C:A6:4D:23:2A:71

May 30 22:03:32 9124AXE-MAP kernel: [*05/30/2024 14:03:32.3860] 4C:A6:4D:23:2A:71     61748      5993     HE-80,2SS,MCS11,GI0.8 (1200)     HE-80,4SS,MCS5,GI0.8 (1152)   -37    54         0
May 30 22:03:33 9124AXE-MAP kernel: [*05/30/2024 14:03:33.3870] 4C:A6:4D:23:2A:71     60660      5813     HE-80,2SS,MCS11,GI0.8 (1200)     HE-80,4SS,MCS5,GI0.8 (1152)   -37    54         89
May 30 22:03:34 9124AXE-MAP kernel: [*05/30/2024 14:03:34.3877] 4C:A6:4D:23:2A:71     61764      5963     HE-80,2SS,MCS11,GI0.8 (1200)     HE-80,4SS,MCS7,GI0.8 (1441)   -36    55         0
May 30 22:03:35 9124AXE-MAP kernel: [*05/30/2024 14:03:35.3886] 4C:A6:4D:23:2A:71     61481      5943     HE-80,2SS,MCS11,GI0.8 (1200)                                   12   -27    66         0
May 30 22:03:36 9124AXE-MAP kernel: [*05/30/2024 14:03:36.3892] 4C:A6:4D:23:2A:71     60896      5786     HE-80,2SS,MCS11,GI0.8 (1200)     HE-80,4SS,MCS7,GI0.8 (1441)   -36    57         0
May 30 22:03:37 9124AXE-MAP kernel: [*05/30/2024 14:03:37.3896] 4C:A6:4D:23:2A:71     60778      5894     HE-80,2SS,MCS11,GI0.8 (1200)                                   12   -27    66         0
```

Note:
If on a MAP, do show mesh-adj parent to see the radio mac being used for backhaul.
Run the above debug on that MAC.

P2P Tests (URWB)
<5.6km | 3.5mi



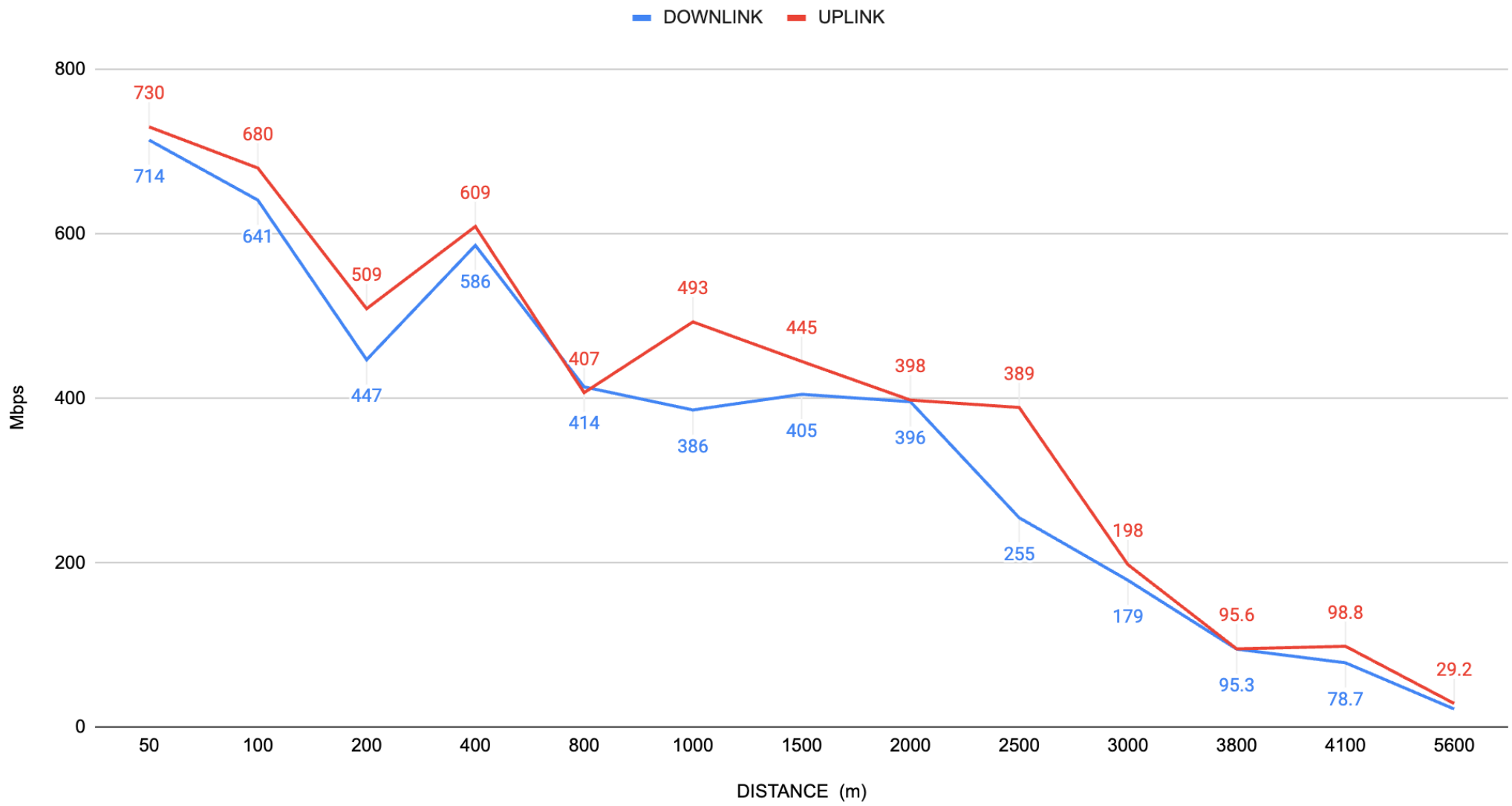
Don’t mind the homebrew bracket ☺

Rate vs Range for P2P URWB /w 9167E

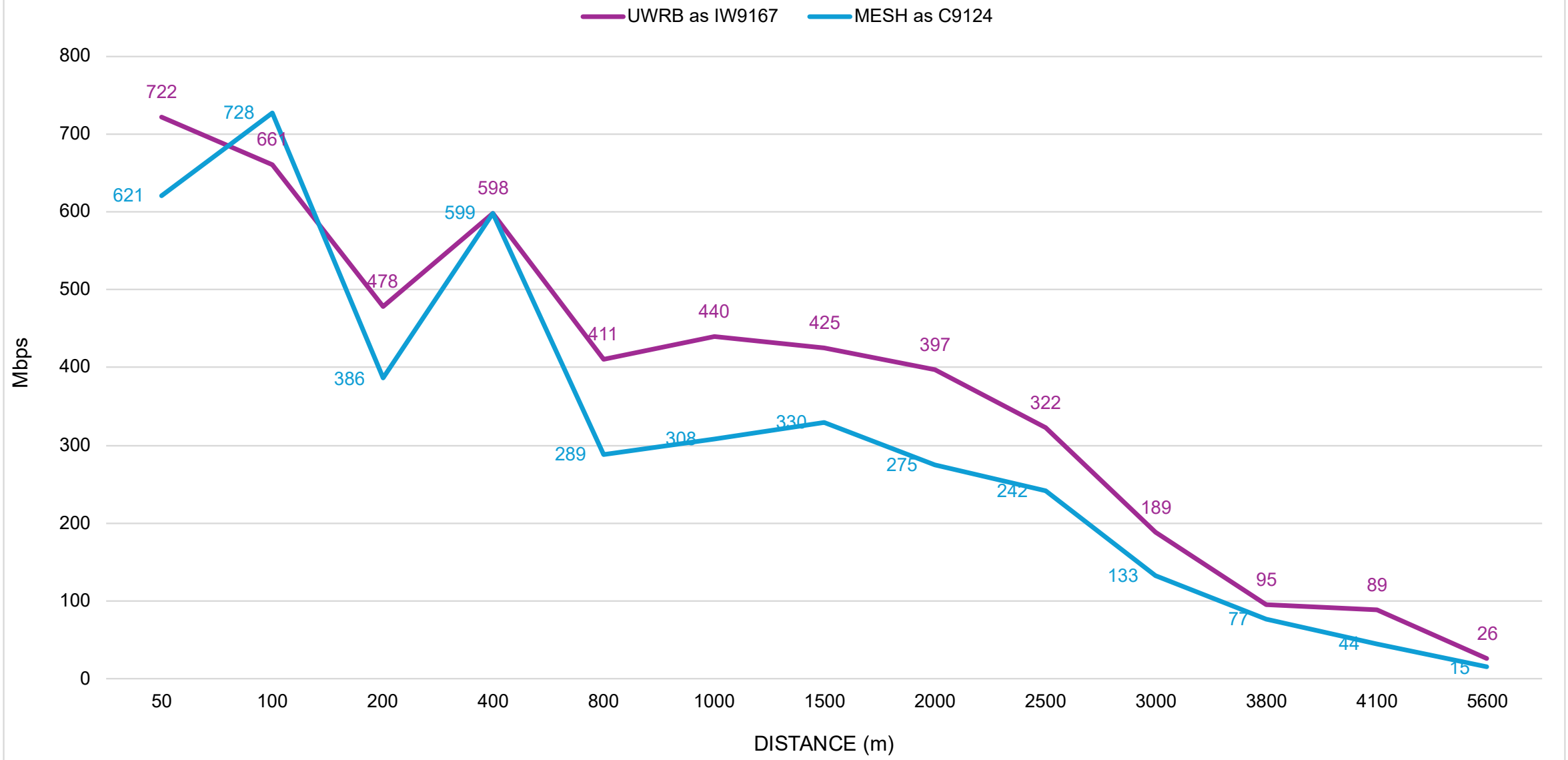
DISTANCE (Mi)	DISTANCE (m)	TCP UPLINK FROM Vehicle	TCP Downlink From Vehicle	SIGNAL LEVEL (dBm)
0.03	50	714	730	-32
0.06	100	641	680	-44
0.12	200	447	509	-43
0.25	400	586	609	-46
0.50	800	414	407	-58
0.62	1000	386	493	-55
0.93	1500	405	445	-57
1.24	2000	396	398	-58
1.55	2500	255	389	-61
1.86	3000	179	198	-71
2.36	3800	95.3	95.6	-75
2.55	4100	78.7	98.8	-77
3.48	5600	22.5	29.2	-81

Rate vs Range For P2P URWB

80MHz,UNII-3, 4chains with 2x5114 on Mesh End and 1x2513 on Mesh Point



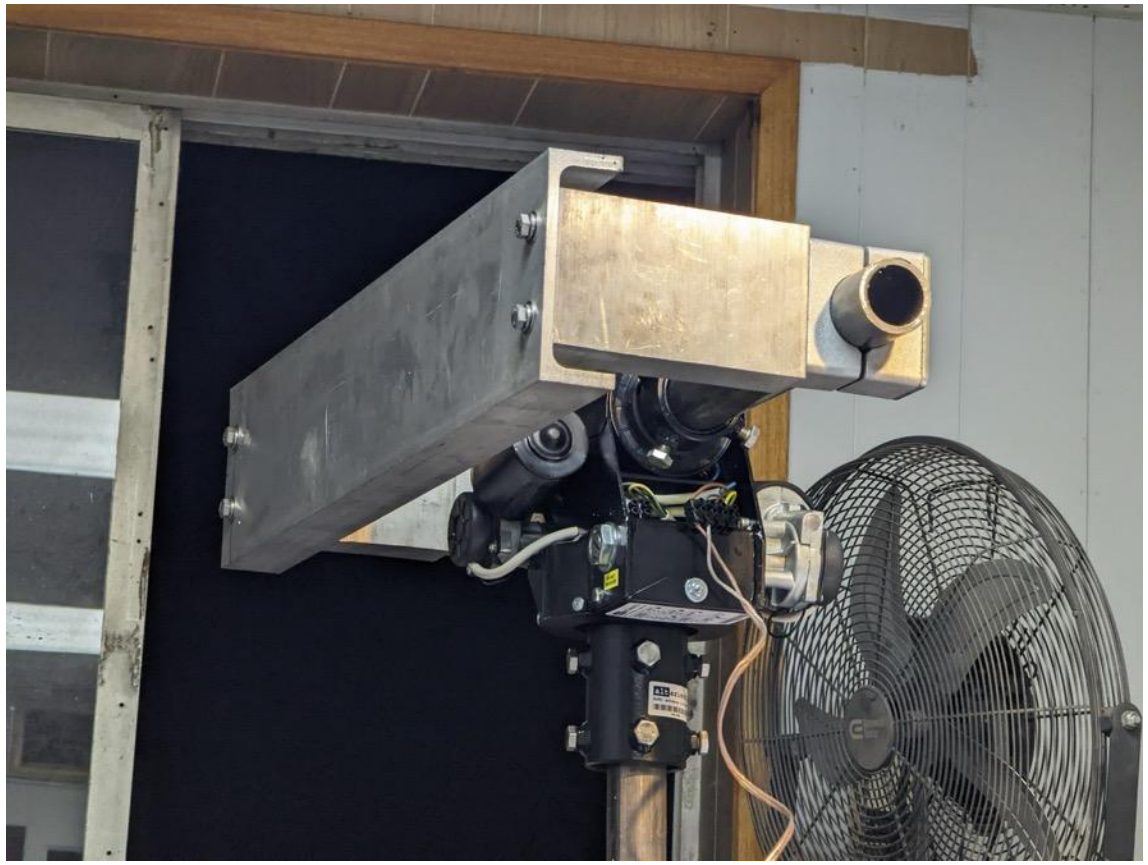
Overlayed Rate vs Range: URWB & Mesh



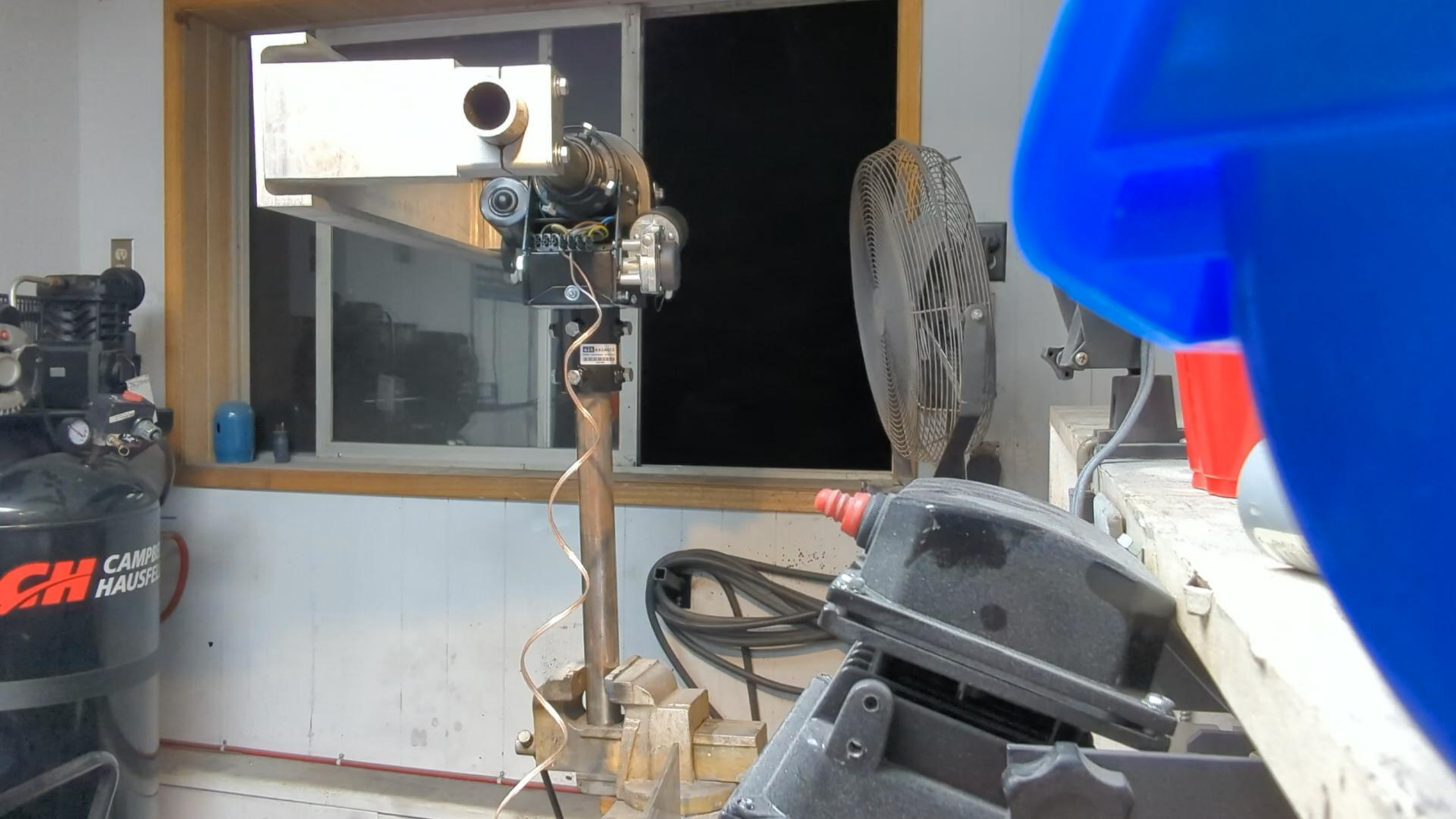
How Far is Too Far?

Building a Pan/Tilt Antenna Positioner

Building a Pan/Tilt Antenna Positioner



Building a Pan/Tilt Antenna Positioner


CAMPBELL
HAUSFELD

Building a Pan/Tilt Antenna Positioner

Building a Pan/Tilt Antenna Positioner

Building a Pan/Tilt Antenna Positioner

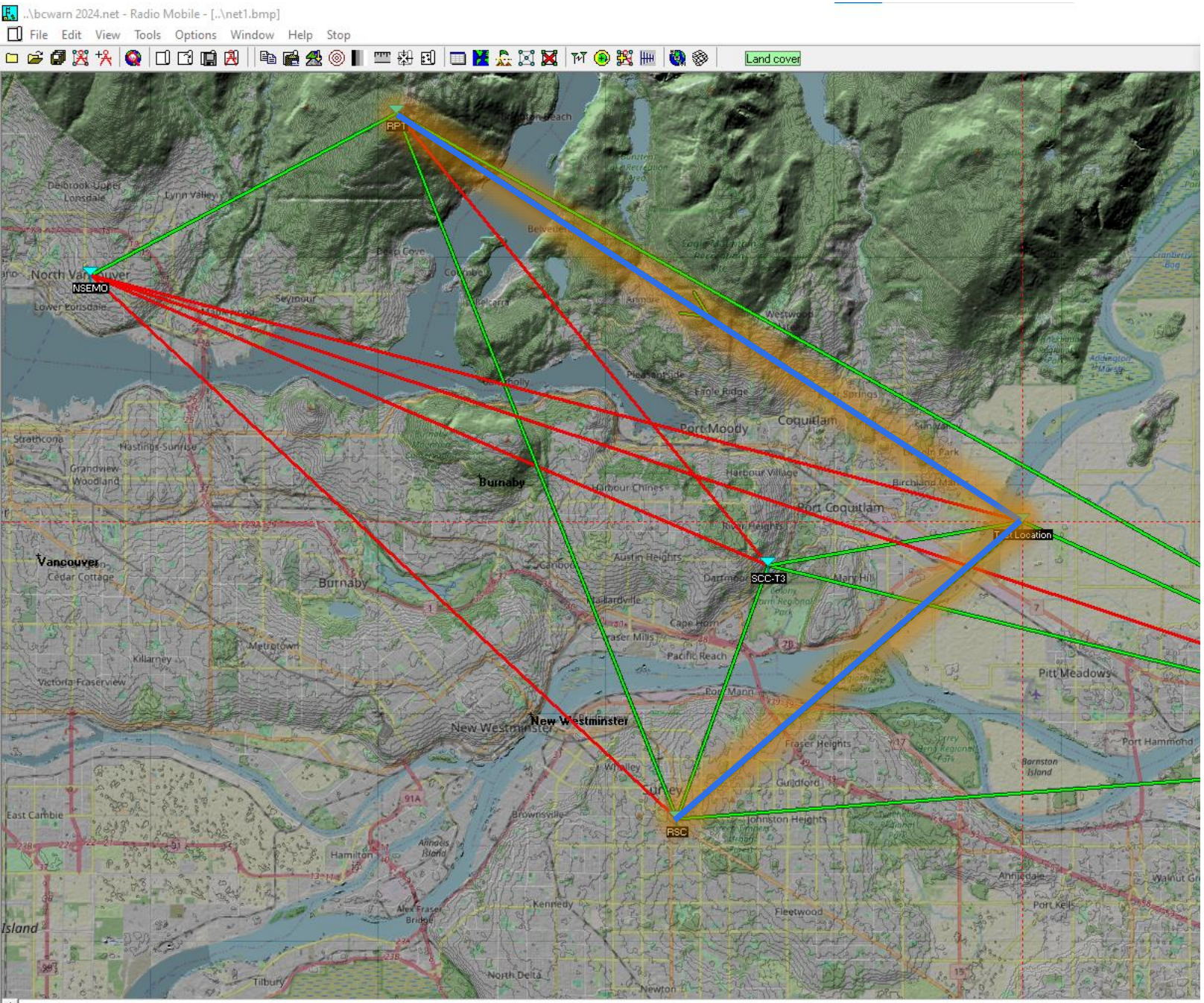
Building a Pan/Tilt Antenna Positioner


CAT
1R-0749
Advanced
CAT
1R-0749

The IW3702 / IW9167E Test Jig

- Magnetic mounted to vehicle
- 4SS setup
- 4x MobileMark OD2’s Rugged 2.4GHz Antenna

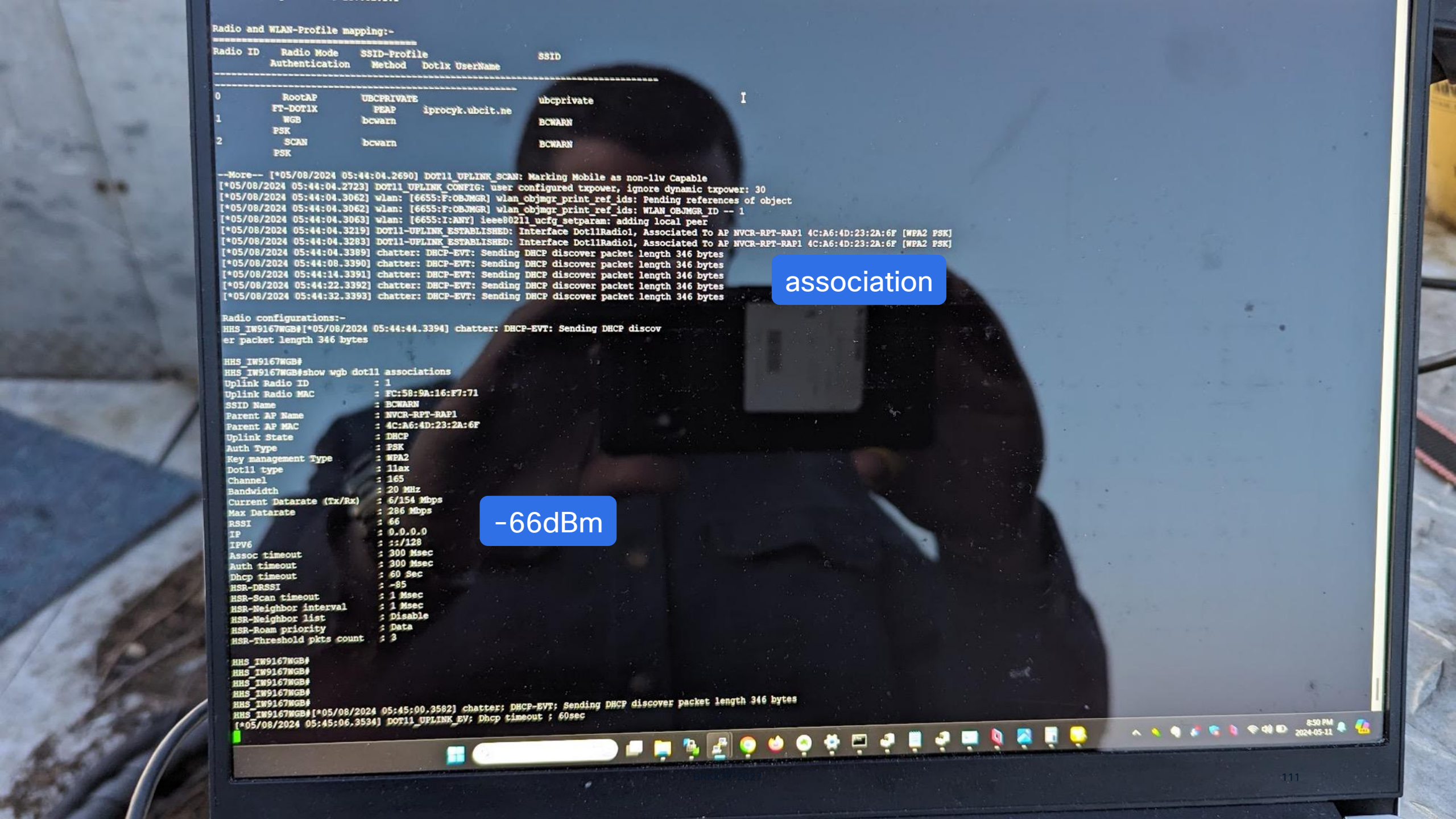
The IW3702 / IW9167E Test Jig

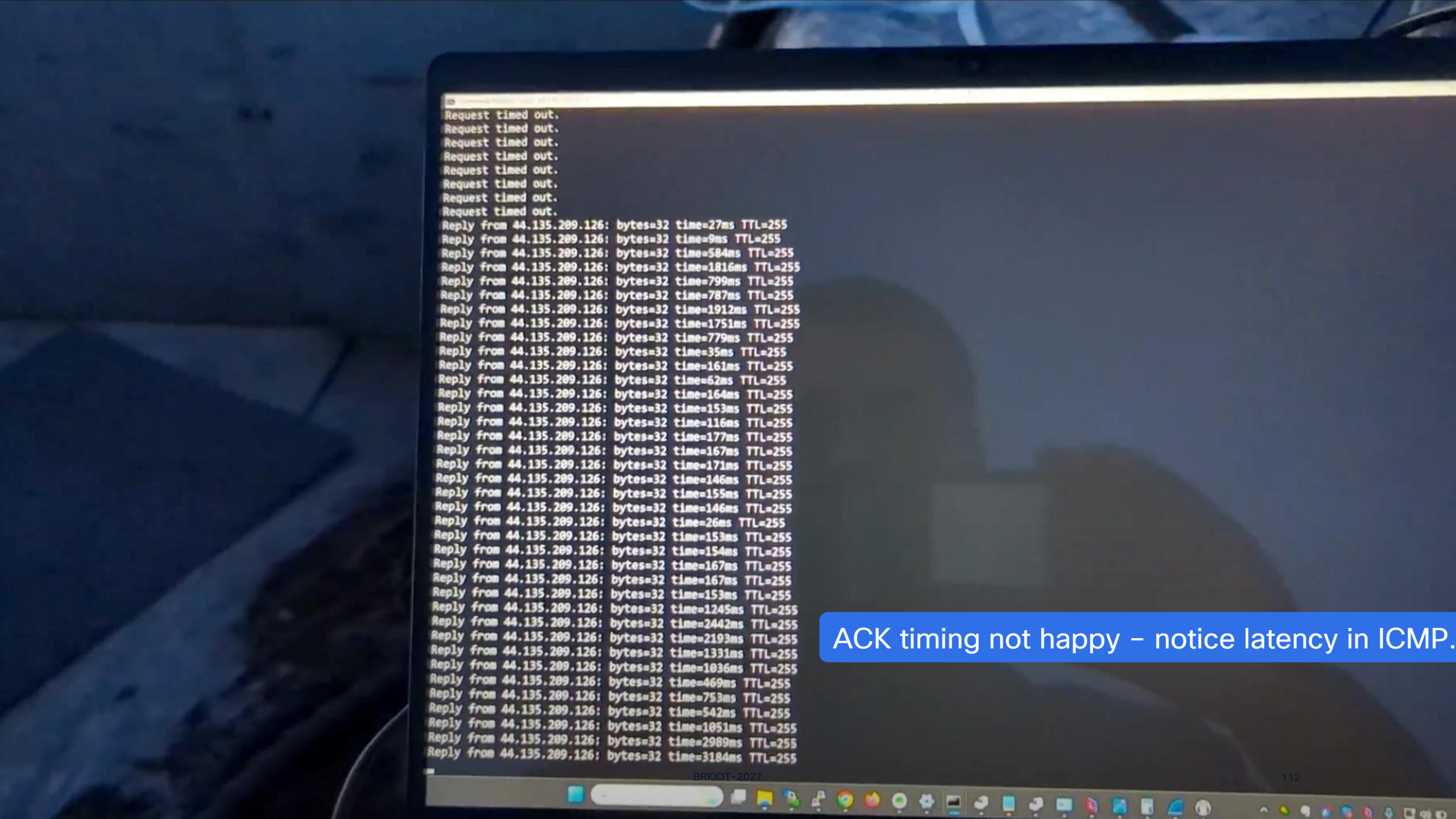

..\bcwarn 2024.net - Radio Mobile - [..\net1.bmp]
File Edit View Tools Options Window Help Stop
Land cover
RPT
NSEMO
SCC-T3
RSC
North Vancouver
Burnaby
Vancouver
New Westminster
Coquitlam
Port Moody
Port Coquitlam
Pitt Meadows
Surrey
49°15'31"N 122°42'38"W x=1047 y=628 Map= 4m Water
49°21'29"N 123°04'00"W X=117 Y=1025 629.9m

A WGB @ 21km from a 9124?

A WGB @ 21km from a 9124?

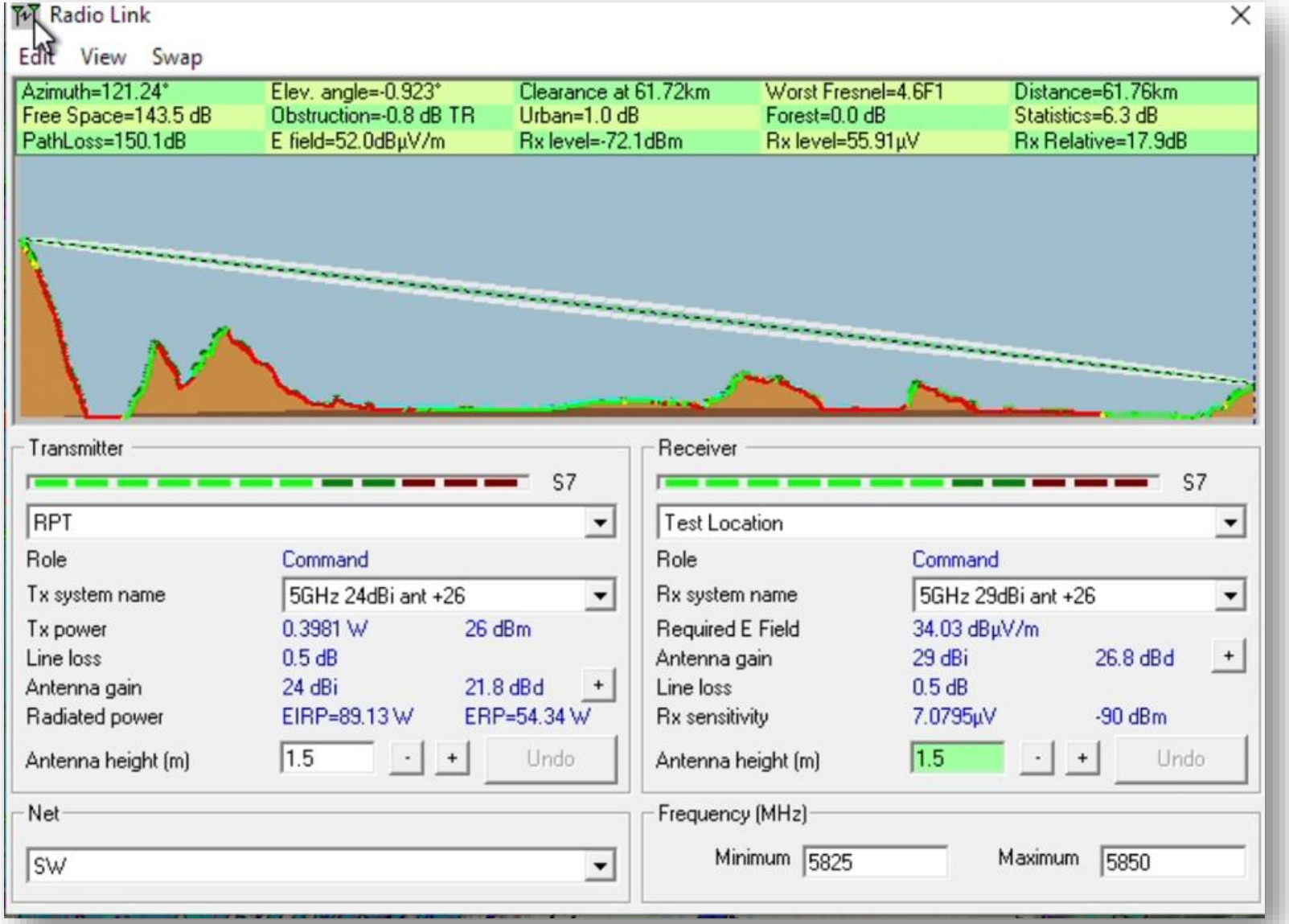
A WGB @ 21km from a 9124?


Radio and WLAN-Profile mapping:-
Radio ID Radio Mode SSID-Profile SSID
Authentication Method Dot1x UserName
0 RootAP UBCPRIVATE ubcprivate
FT-DOT1X PEAP iprocyk.ubcit.ne
1 WGB bcwarn BCWARN
PSK
2 SCAN bcwarn BCWARN
PSK
--More-- [*05/08/2024 05:44:04.2690] DOT11_UPLINK_SCAN: Marking Mobile as non-11w Capable
[*05/08/2024 05:44:04.2723] DOT11_UPLINK_CONFIG: user configured txpower, ignore dynamic txpower: 30
[*05/08/2024 05:44:04.3062] wlan: [6655:F:OBJMGR] wlan_objmgr_print_ref_ids: Pending references of object
[*05/08/2024 05:44:04.3062] wlan: [6655:F:OBJMGR] wlan_objmgr_print_ref_ids: WLAN_OBJMGR_ID -- 1
[*05/08/2024 05:44:04.3063] wlan: [6655:I:ANY] ieee80211_ucfg_setparam: adding local peer
[*05/08/2024 05:44:04.3219] DOT11-UPLINK_ESTABLISHED: Interface Dot11Radio1, Associated To AP NVCR-RPT-RAP1 4C:A6:4D:23:2A:6F [WPA2 PSK]
[*05/08/2024 05:44:04.3283] DOT11-UPLINK_ESTABLISHED: Interface Dot11Radio1, Associated To AP NVCR-RPT-RAP1 4C:A6:4D:23:2A:6F [WPA2 PSK]
[*05/08/2024 05:44:04.3389] chatter: DHCP-EVT: Sending DHCP discover packet length 346 bytes
[*05/08/2024 05:44:08.3390] chatter: DHCP-EVT: Sending DHCP discover packet length 346 bytes
[*05/08/2024 05:44:14.3391] chatter: DHCP-EVT: Sending DHCP discover packet length 346 bytes
[*05/08/2024 05:44:22.3392] chatter: DHCP-EVT: Sending DHCP discover packet length 346 bytes
[*05/08/2024 05:44:32.3393] chatter: DHCP-EVT: Sending DHCP discover packet length 346 bytes
association
Radio configurations:-
HHS_IW9167WGB#[*05/08/2024 05:44:44.3394] chatter: DHCP-EVT: Sending DHCP discov
er packet length 346 bytes
HHS_IW9167WGB#
HHS_IW9167WGB#show wgb dot11 associations
Uplink Radio ID : 1
Uplink Radio MAC : FC:58:9A:16:F7:71
SSID Name : BCWARN
Parent AP Name : NVCR-RPT-RAP1
Parent AP MAC : 4C:A6:4D:23:2A:6F
Uplink State : DHCP
Auth Type : PSK
Key management Type : WPA2
Dot11 type : 11ax
Channel : 165
Bandwidth : 20 MHz
Current Datarate (Tx/Rx) : 6/154 Mbps
Max Datarate : 286 Mbps
RSSI : 66
-66dBm
IP : 0.0.0.0
IPV6 : ::/128
Assoc timeout : 300 Msec
Auth timeout : 300 Msec
Dhcp timeout : 60 Sec
HSR-DRSSI : -85
HSR-Scan timeout : 1 Msec
HSR-Neighbor interval : 1 Msec
HSR-Neighbor list : Disable
HSR-Roam priority : Data
HSR-Threshold pkts count : 3
HHS_IW9167WGB#
HHS_IW9167WGB#
HHS_IW9167WGB#
HHS_IW9167WGB#
HHS_IW9167WGB#
HHS_IW9167WGB#[*05/08/2024 05:45:00.3582] chatter: DHCP-EVT: Sending DHCP discover packet length 346 bytes
[*05/08/2024 05:45:06.3534] DOT11_UPLINK_EV: Dhcp timeout : 60sec

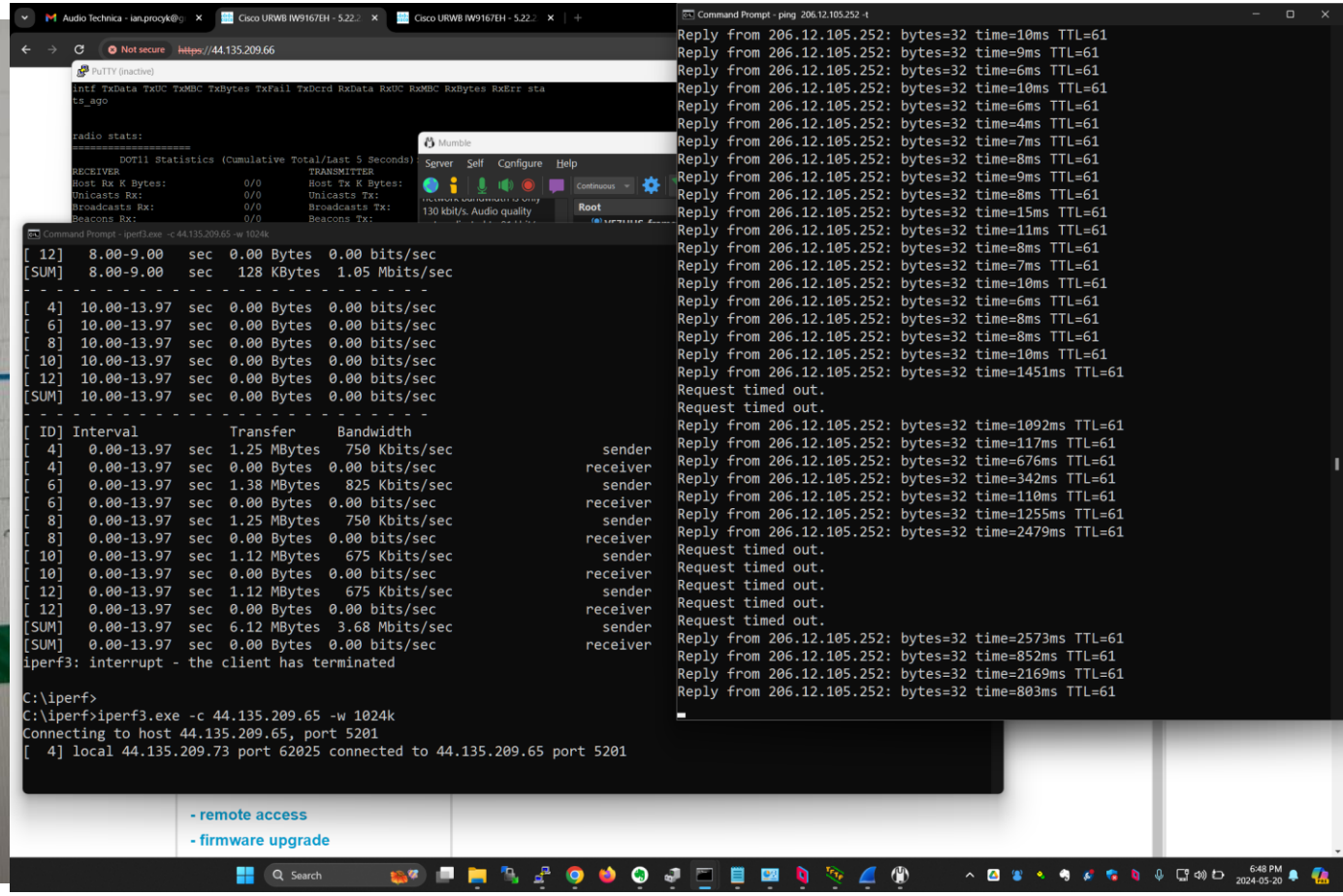


ACK timing not happy – notice latency in ICMP.

How About @ 62km?



Lots of signal – but barely any packets...



Summary

AP platform vs capability matrix

Platform	CAPWAP AP	MESH	WGB	WLC URWB	SA URWB
IW9167E				17.18>	
IW9167I	17.12>			17.18.2	
IW9165E (no 2.4GHz)	17.14>		17.13>	17.18>	
IW9165D (no 2.4GHz)	17.14>			17.18.2	
C9115					
C9120					
C9124					
C9130				17.18.2	
C9136				17.18.2	
CW9166				17.18.2	
CW9176,9178				17.18>	

What have we learned?

- Continued wireless evolution, driven by business demands
- URWB and CAPWAP coexist in the same infrastructure today
- Performed a URWB+WLC configuration deep dive
- Existing Mesh and WGB investments still being enhanced
- Reinforcing the realities of physics through Field Tests
  - *Just because you can, doesn't mean you should!!!*

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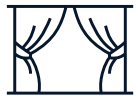

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