AI Wireless Operation

When AI meets Cisco Meraki Wireless

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Session ID: BRKEWN-2039

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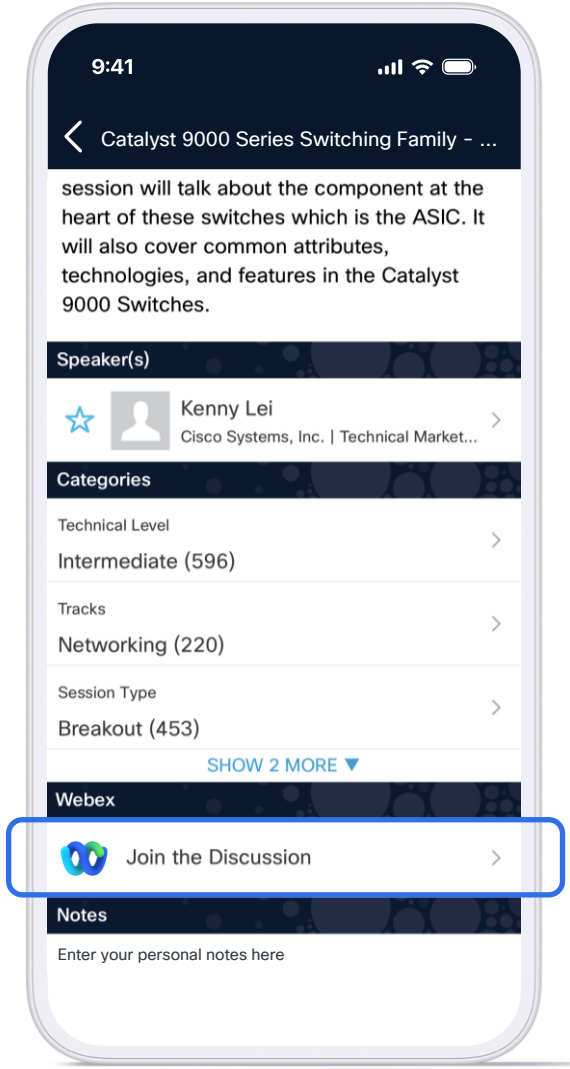

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Agenda

01 Meraki Assurance Overview

02 Client Assurance

03 Wireless Device Assurance

04 RF Optimization

05 AP Refresh/Deployment

06 AI Assistant for Wireless

07 Conclusion

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Meraki Assurance Overview

Four Stage of Assurance

Baseline and Detect

Monitor end-to-end digital experience from critical vantage points

Localize and Diagnose

Visualize, localize, and diagnose across every network segment

Mitigate and Remediate

Closed-loop actions across digital domains and teams

Predict and Optimize

Forecast disruptions, optimize path, and plan connectivity and migrations

Assurance

Reactive monitoring

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Executing Against Our Assurance Vision

Across and within network domains

Baseline and Detect

- Internet Insights
- Enterprise Insights
- Endpoint Insights
- Cloud Insights AWS | Azure
- Mobile Insights Android
- Industrial Routing

Localize and Diagnose

- Path Visualization
- Configuration Correlation
- Site-wide Views
- **Intelligent PCAP**
- Enterprise Traffic
- **Org-wide Views**
- **Client-side Views**

Mitigate and Remediate

- Remediation Workflows
- 3rd Party Shared Insights
- Cross Domain Assurance

Predict and Optimize

- Predictive Path Recommendation
- **Wireless Channel Optimization**
- Security Policy Validation
- Capacity Planning & Benchmarking

- Existing use case
- New | Cisco Live

AI-Powered Assurance

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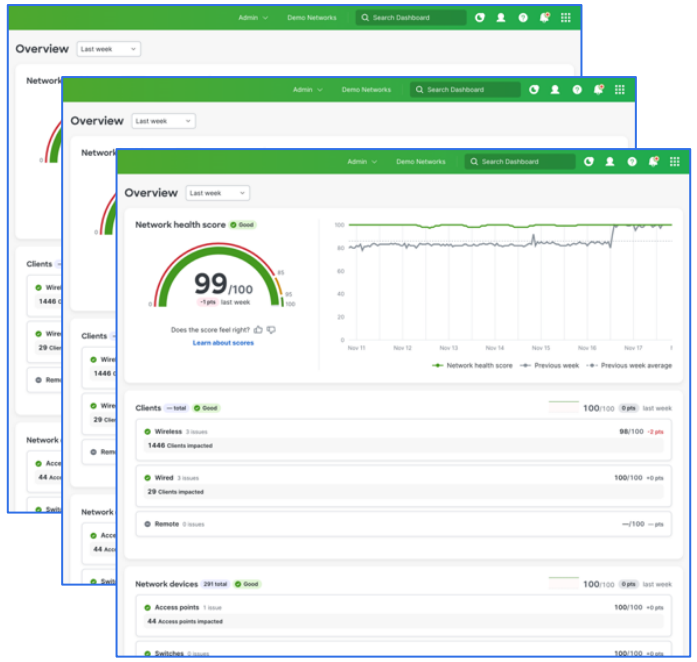
Expanded Org-level assurance view

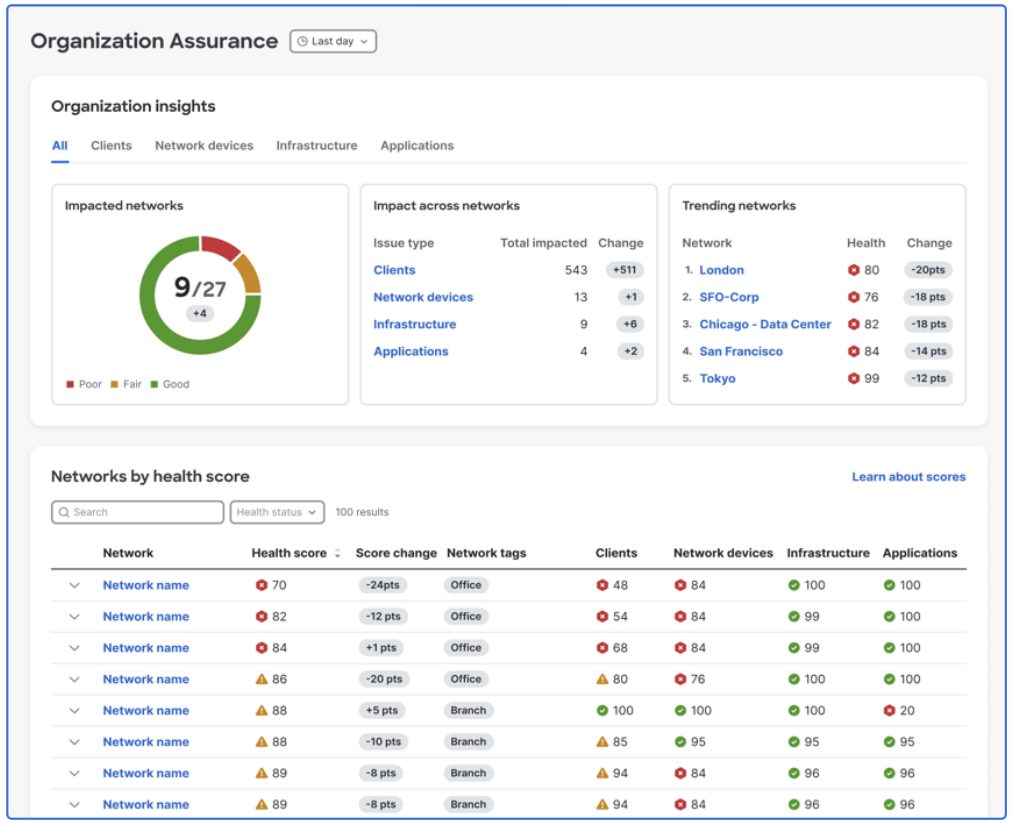
Network-wide Assurance



Network to -> Client or Device-level drill down

Org-wide Assurance

Production Beta



Org-level discovery workflow

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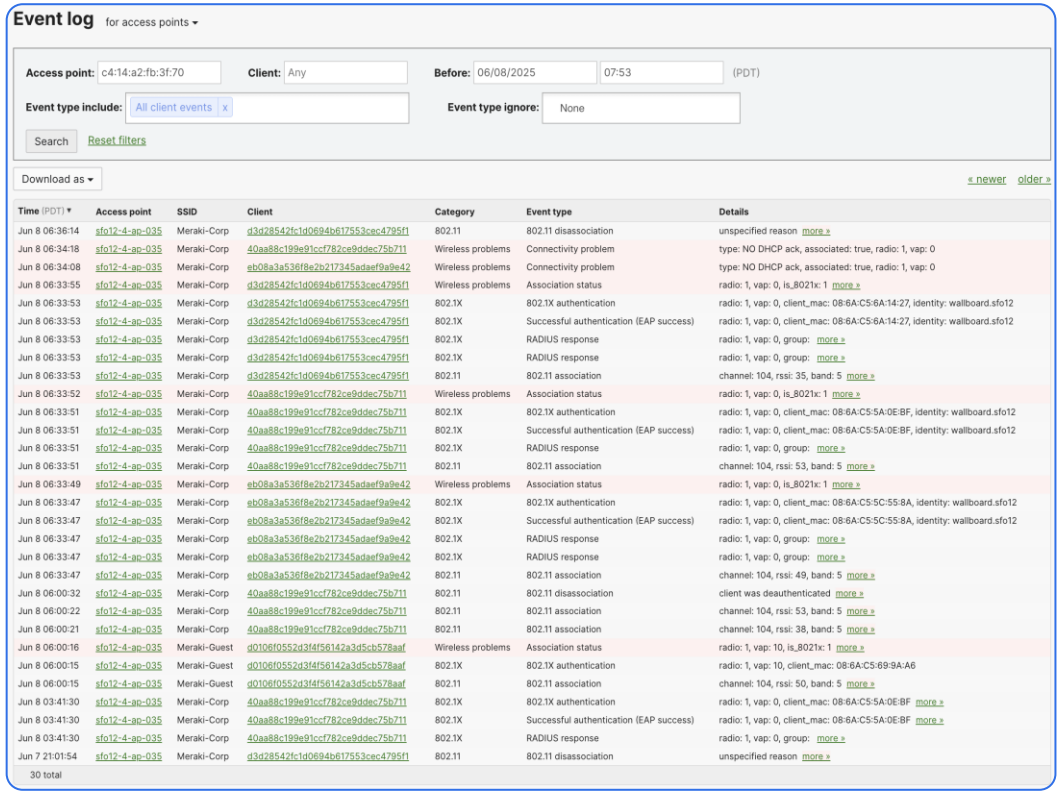
Client Assurance

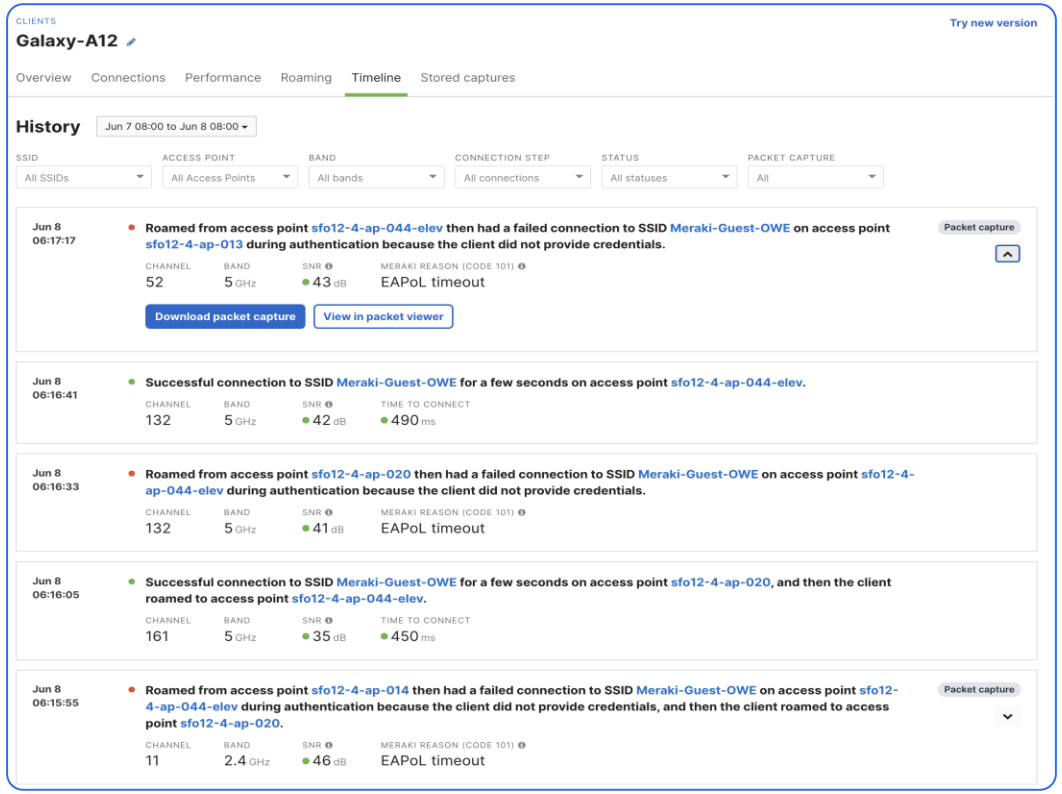
Client Event evolved overtime for explainability and correlated insights

Event log – catch all events



- Raw client event log
- Most detailed, Expert tool

Client Timeline – descriptive client event logs



- Various type filters
- Highlight the reason code and RF condition
- Proactive Packet Capture integrated

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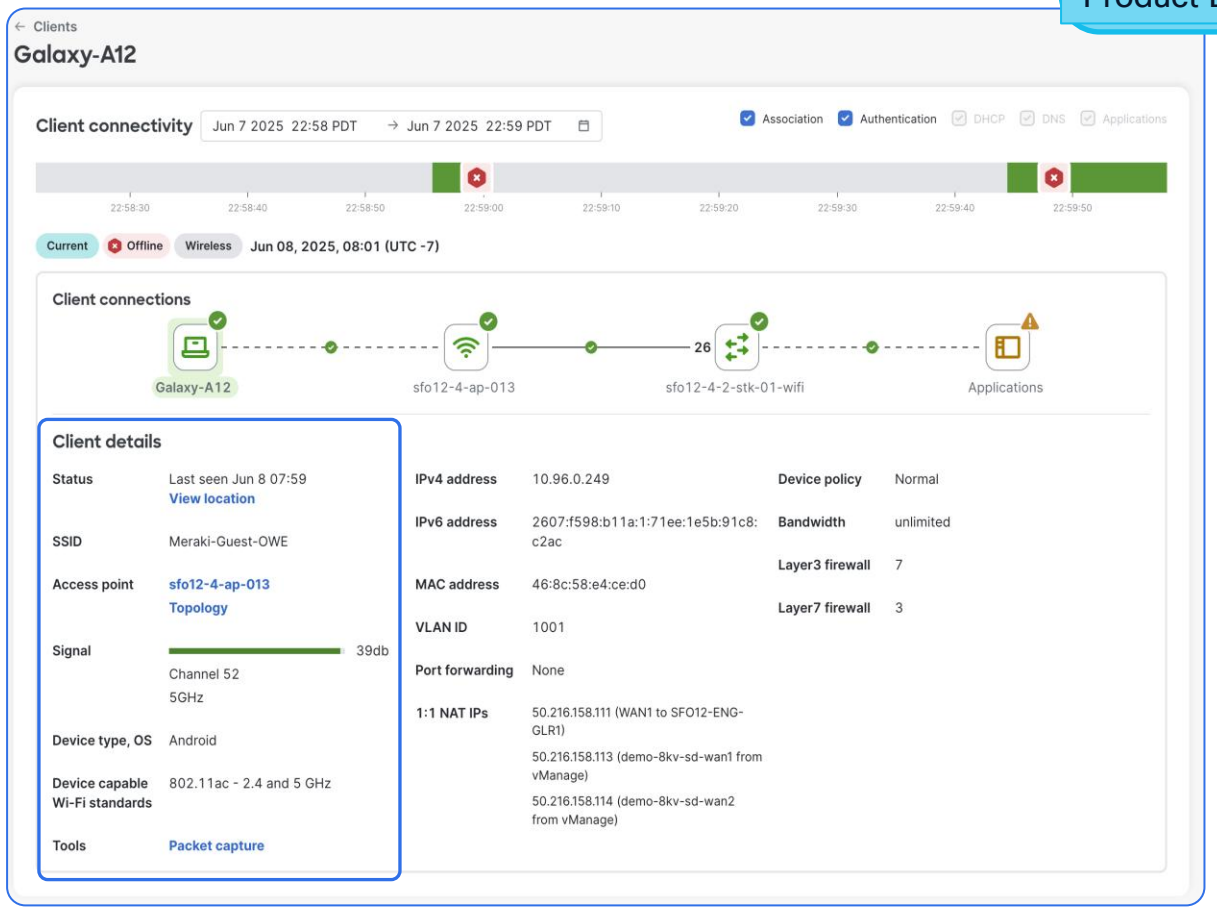
Client 360 – Brings all the internetworking level timeline view to the forefront of the client page



Layer 2 Connectivity Layer 3 Network info Network Policy

Product Beta

Client 360 for Meraki Dashboard

- Client Connection and session time of
- Network-wide client experience with timeline
- E2E network correlation and Topology
- Client connection details
- Easy chronical navigations of failed event
- Click to Zoom in
- Integrated Tools access (e.g Packet capture, Ping)

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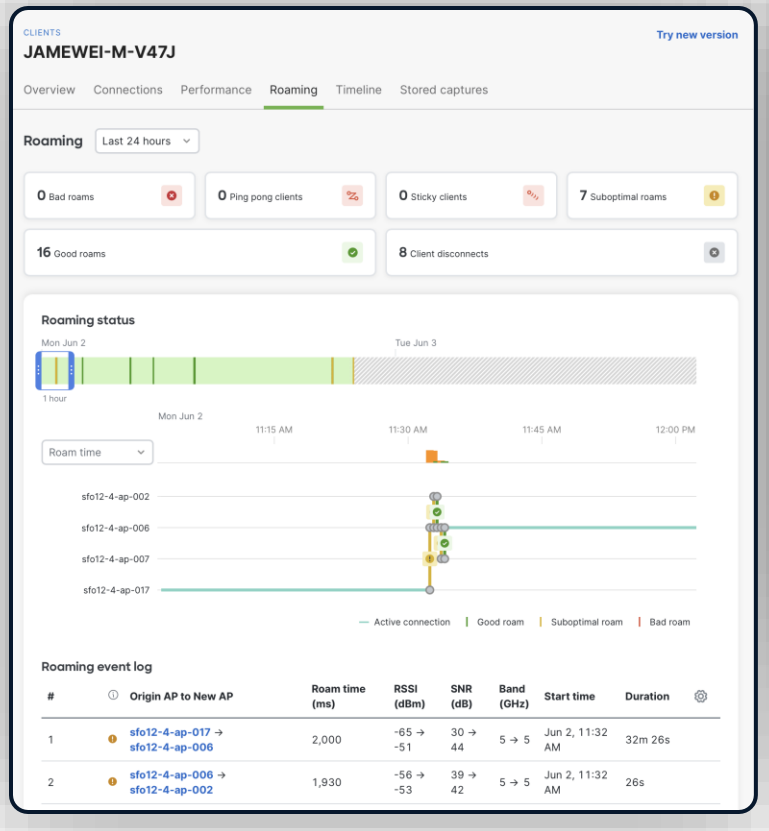
Roaming Analytics

Tools for per-device and network-wide troubleshooting



Per-Client Roaming Timeline

Network-wide Roaming Health

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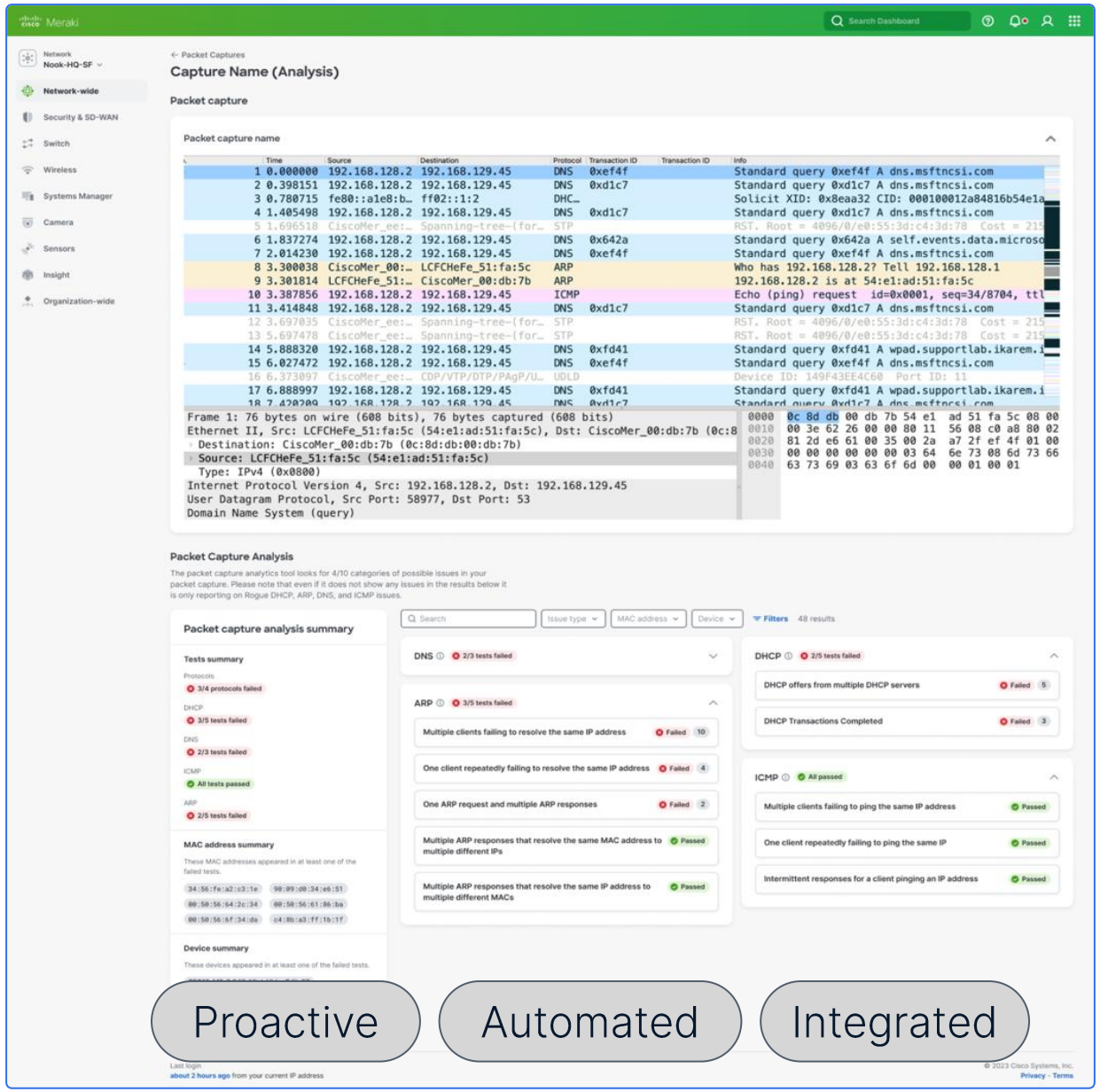
Intelligent Capture

Next Generation Packet Capture Solution for Wired and Wireless



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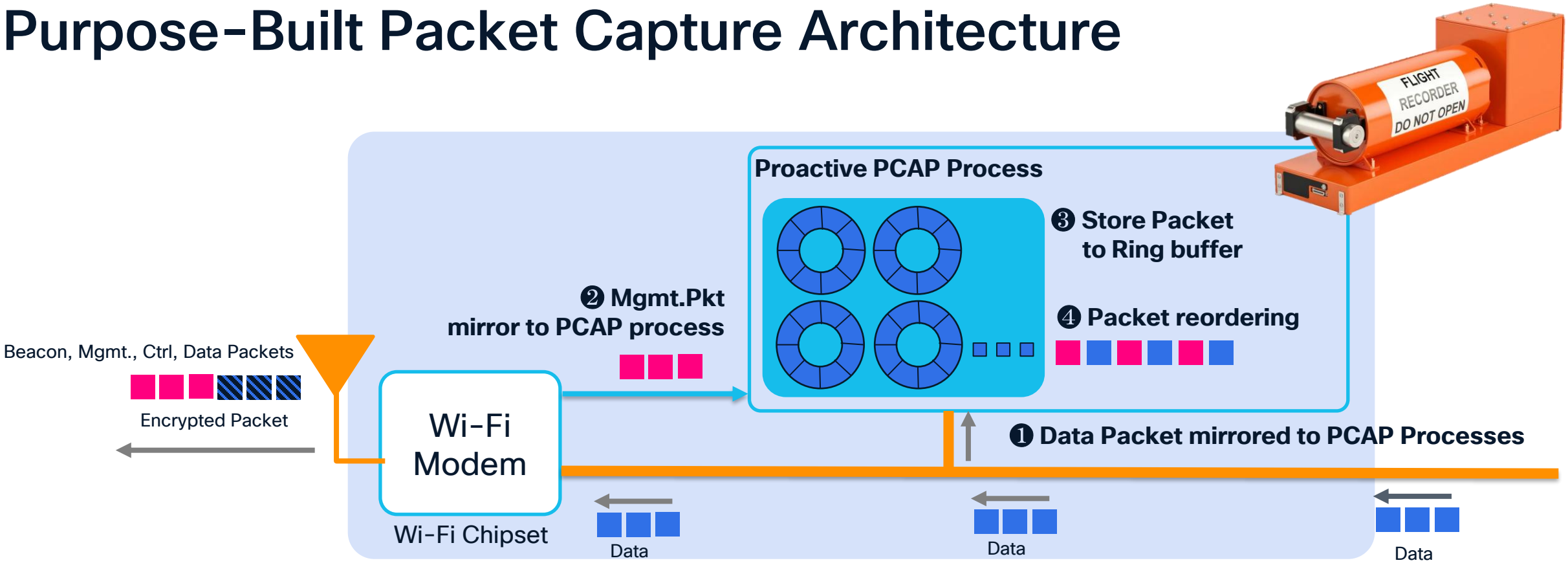
Purpose-Built Packet Capture Architecture



- Packet Capture doesn't change AP or radio mode and continue to serve client without any performance impact
- Management Frames from modem gets replicated and copied back into PCAP Buffer
- Resequencing packet capture frame between Data Frame and Management frame in the right order
- Per-Client Ring Buffer for Proactive PCAP enabled concurrent packet capture

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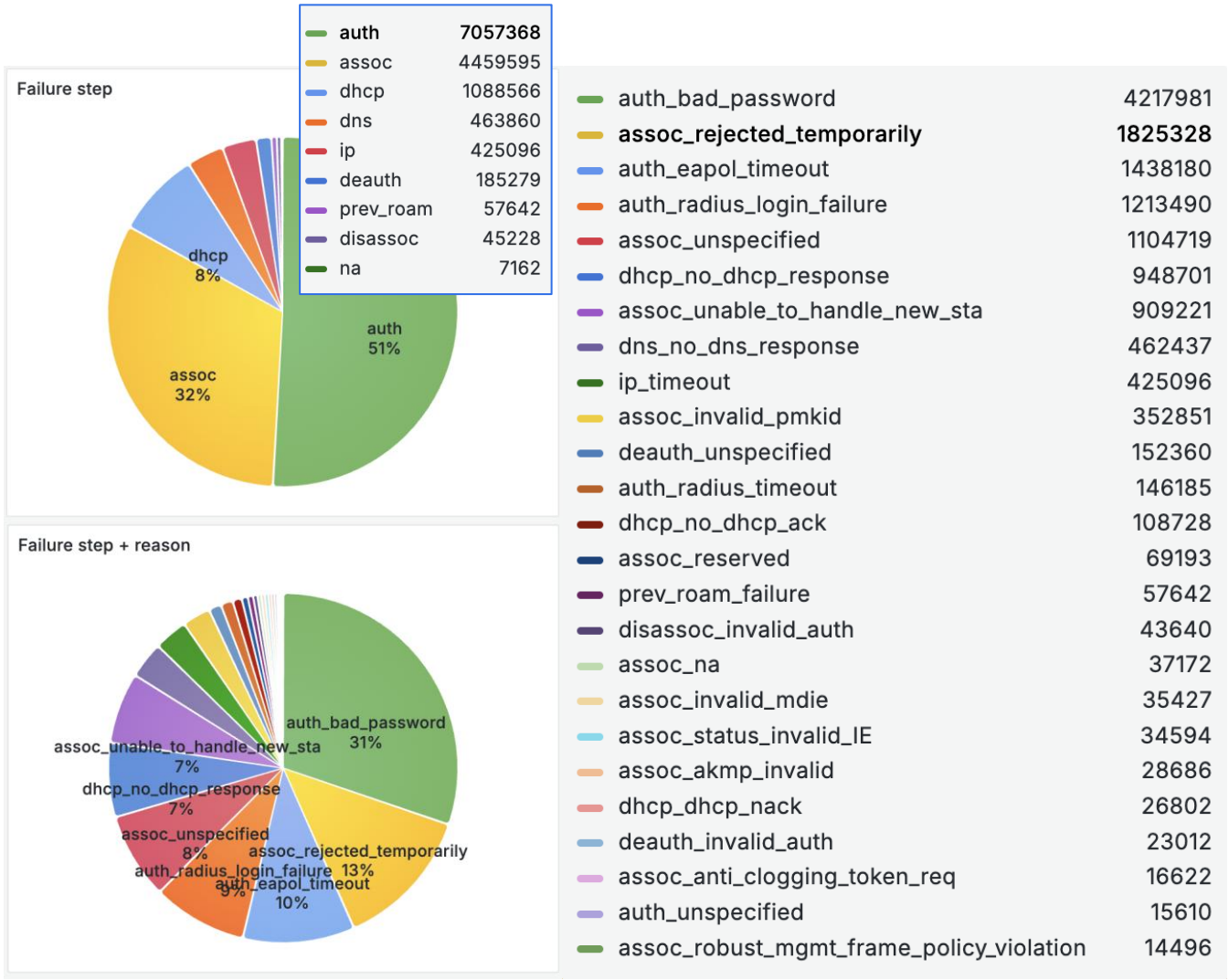
Proactive Packet automatically take a PCAP on all of client failures conditions



Proactive PCAP automatically collect Wireless PCAP All the time at every connection failure

including “unknown failure” cases

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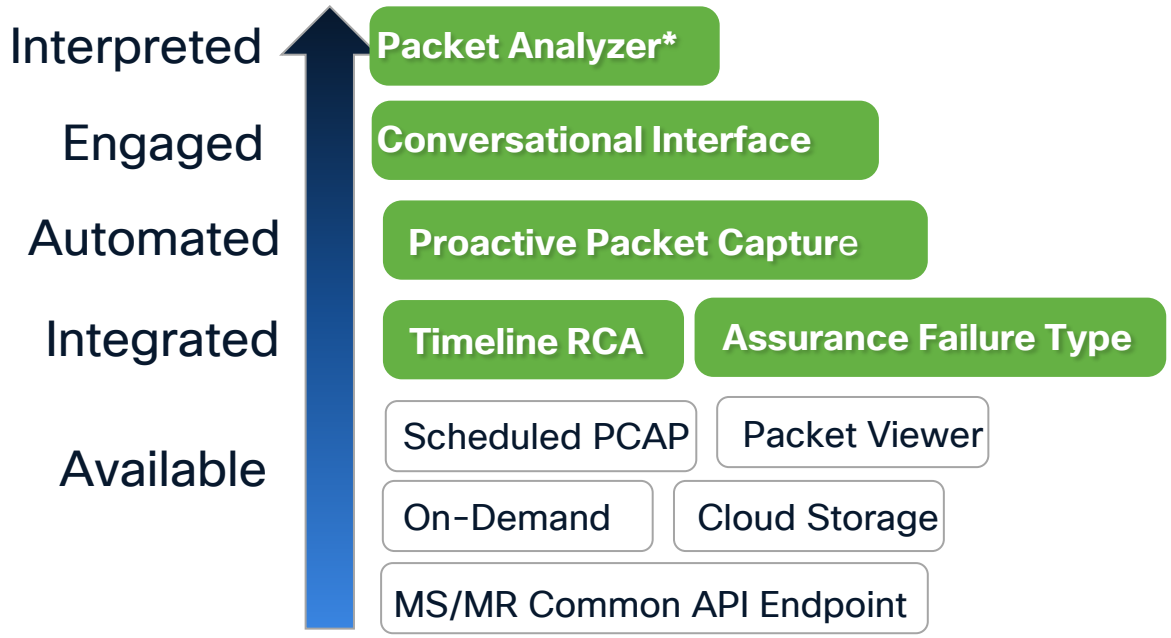
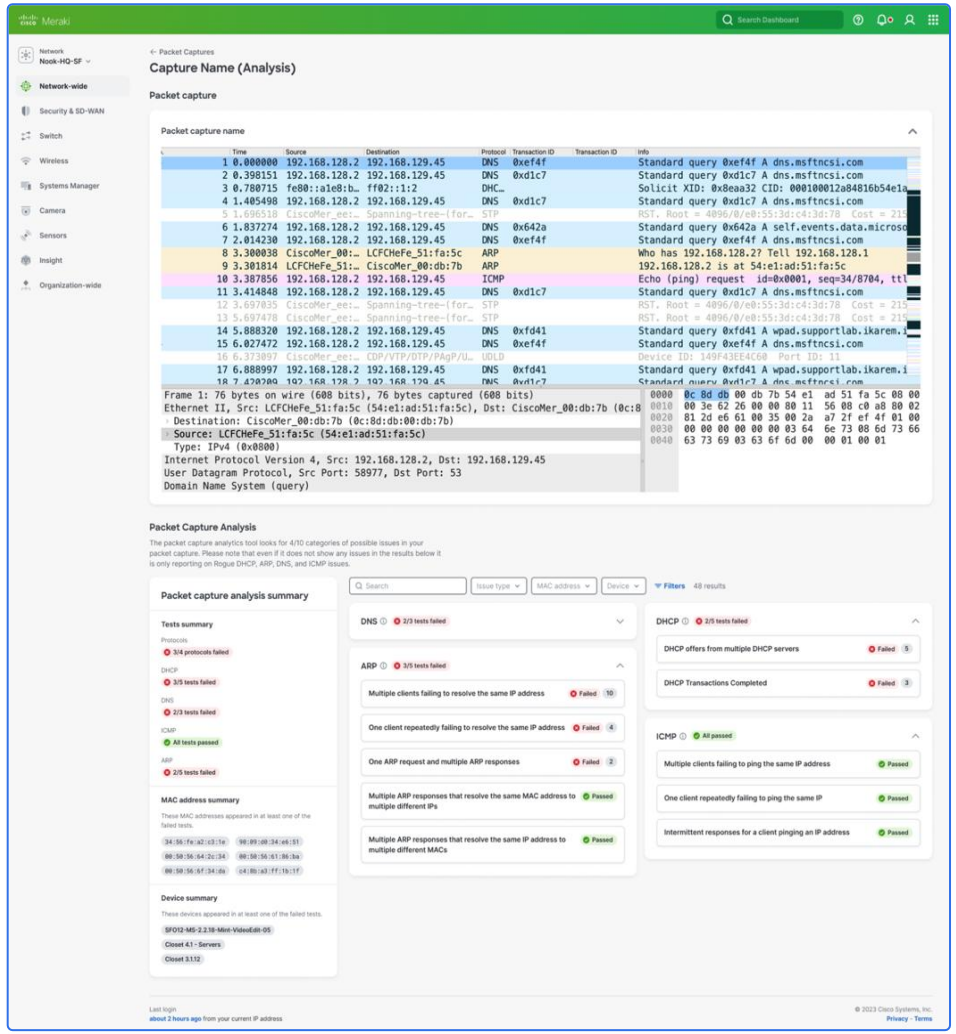
Intelligent Capture - MR





- Every client connection failure condition leaves Packet as evidence
- PCAP Analyzer shows exact reason why client failed to connect

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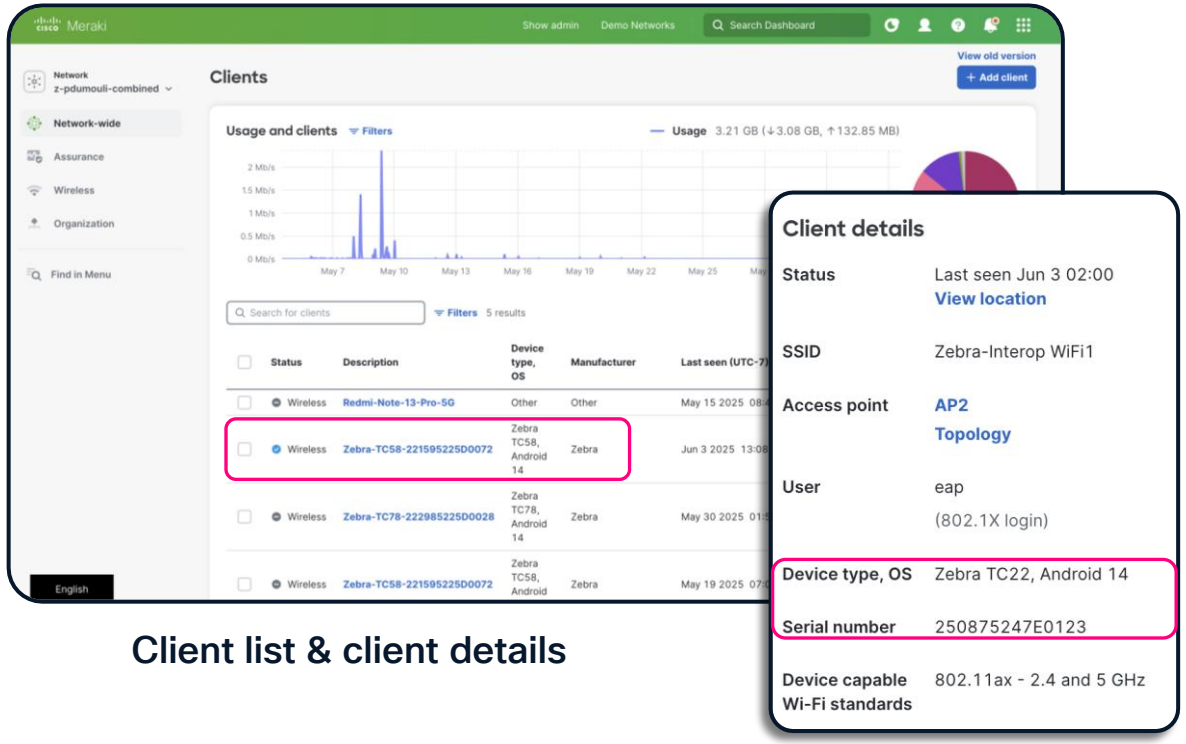
Zebra Client Details

New integration includes:

- Device model
- OS
- Manufacturer
- Serial number
- Disconnect reason codes



Client list & client details

Timeline view

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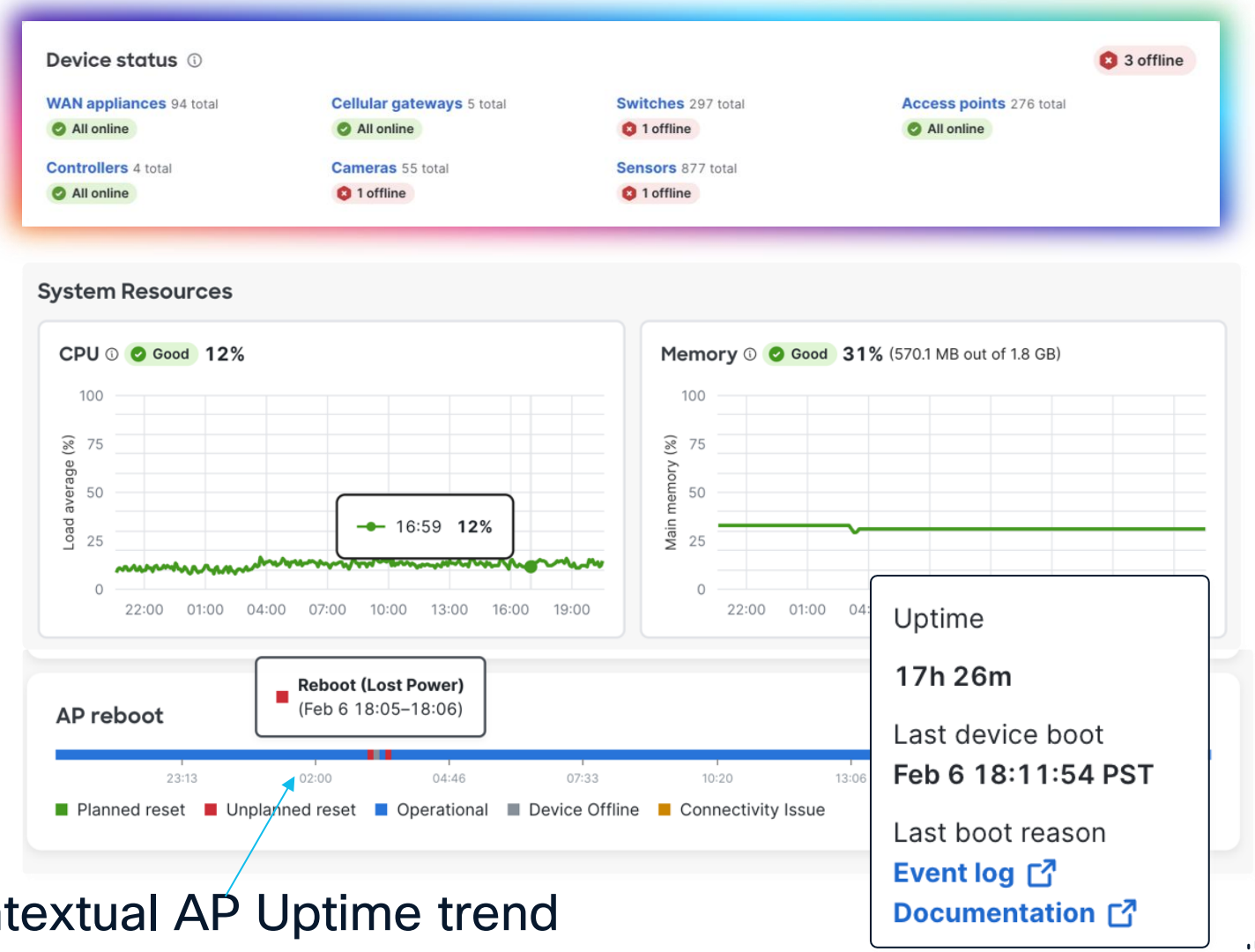
Demo – Client Assurance

Wireless Device Assurance

AP Device Health
Don’t forget the basic

- Device availability
- CPU and Memory utilization - latest & trend
- Detect Memory leak or CPU spikes
- PoE / Power monitoring
- Build your Own Dashboard, Org-Wide API Ready!

  /organizations/{organizationId}/wireless/devices/system/cpu/load/history



Contextual AP Uptime trend

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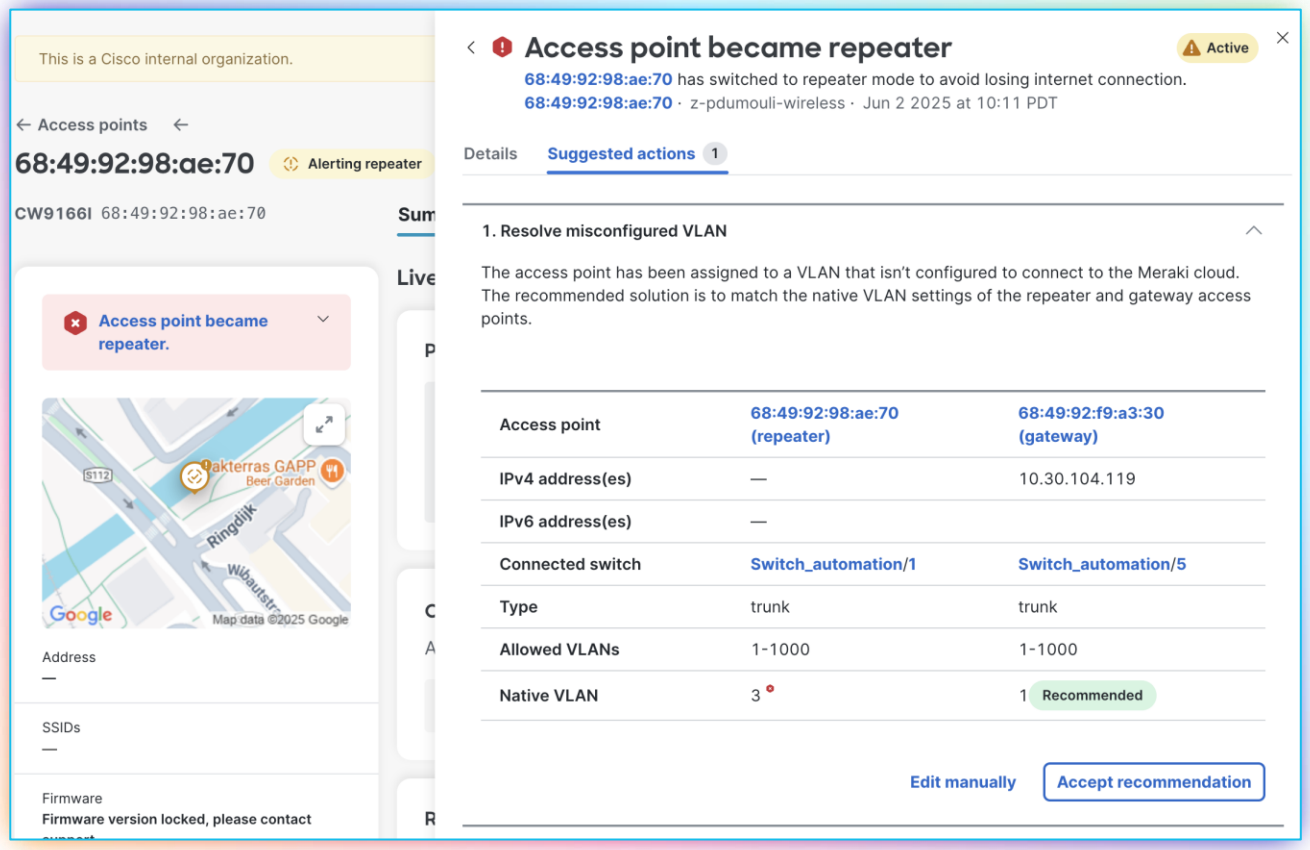
AP Alert Root Cause Analysis



- Detect AP which became repeater.
- RCA Engine lists all the possible scenario and provides active RCA steps to corresponding root cause.
  - Lost gateway connectivity
  - DHCP doesn't serve IP address to it's wired uplink port
  - Config change (Config management)
  - AP firmware mismatch
  - Last resort, force AP reboot

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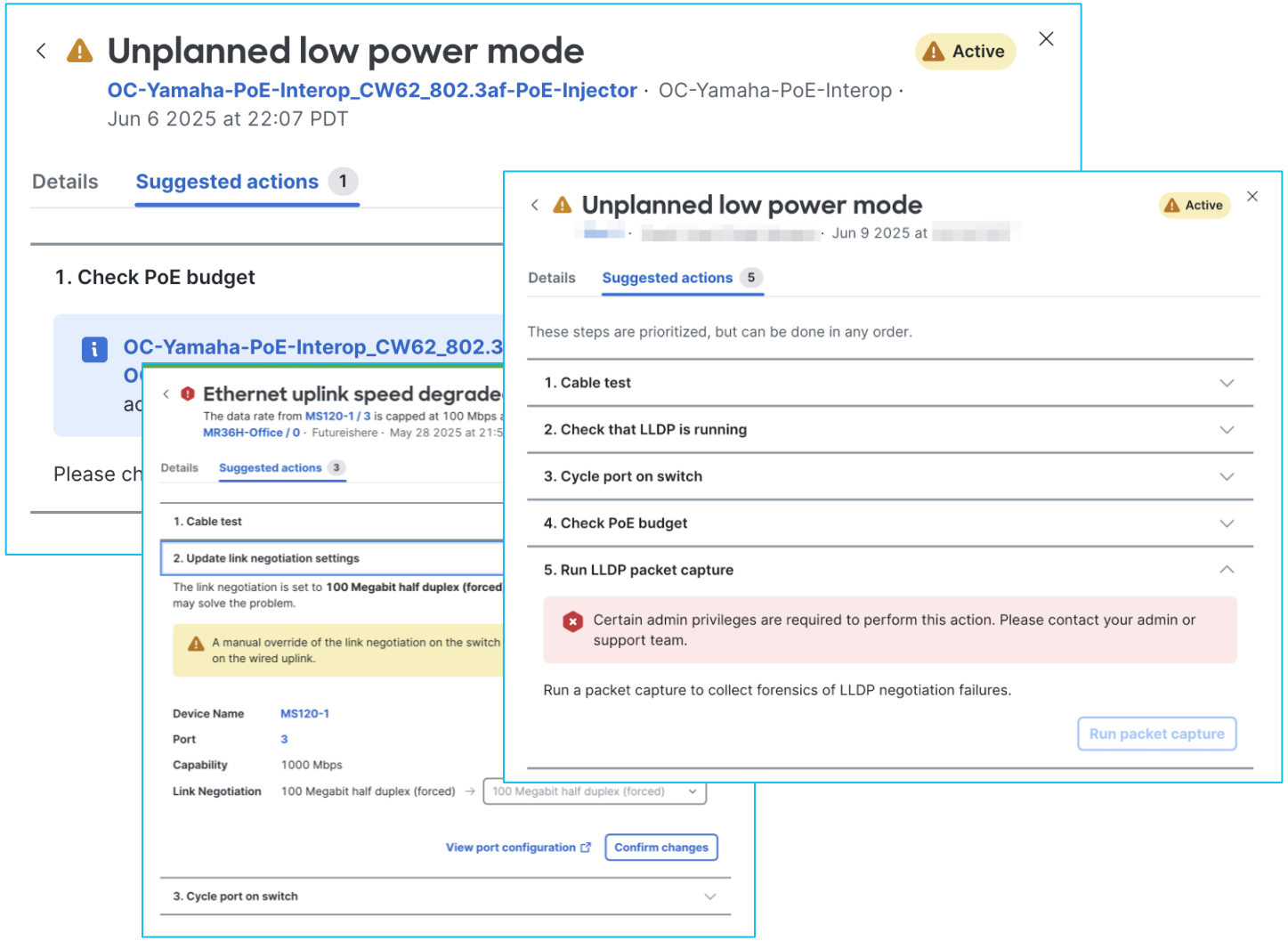
Suggested actions for assisted device alert remediation



RCA Framework features

- Automated RCA workflows eliminated unlikely root causes
- Support MS Switches for integrated remediations steps
  - Cable test
  - Switch port config check
  - PoE type check
  - Port cycle
  - LLDP packet capture
- 3rd Party switch LLDP Packet Analysis

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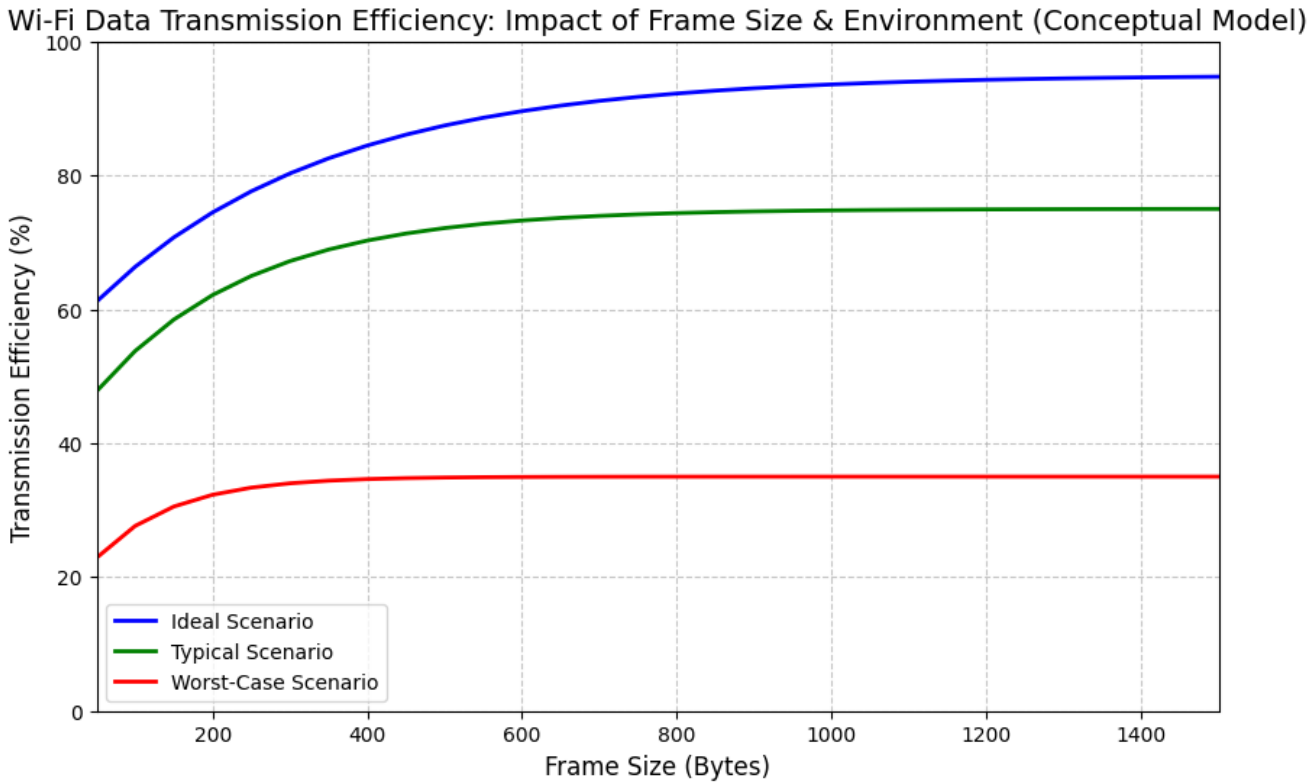
Demo – Device Assurance

RF Assurance

How’s my Wi-Fi doing? It depends...

Wireless performance are depending on many factors as Wi-Fi relies on transport conditions and clients that are unique on each type

- Uncertainly of transport quality
- Over the air resource availability
- Varied client capabilities



Wi-Fi Performance is determined many factors and there is no single rule of thumbs

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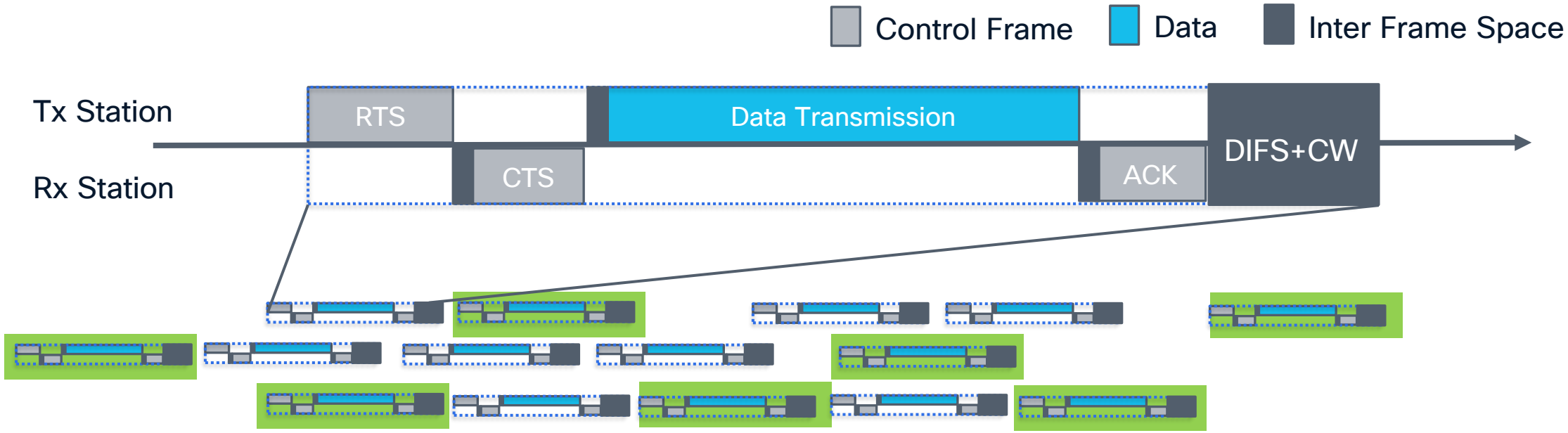
Wi-Fi designed to avoid collision, higher the Channel utilization goes, longer the waiting time has become



- Wi-Fi designed as CSMA/CA system – Carrier Sense Multiple Access / Collision Avoidance
- Half-Duplex system, Tx and Rx can't happen same time
- Overhead can be anywhere between 20% to 80%, average ballpark of 40-50%

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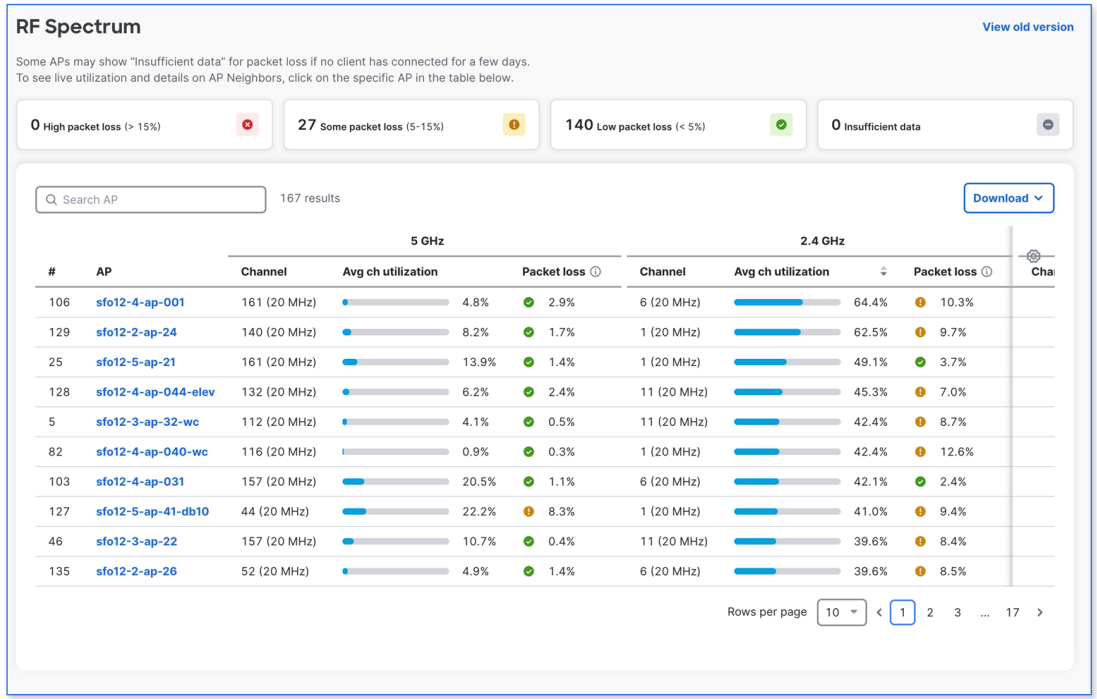
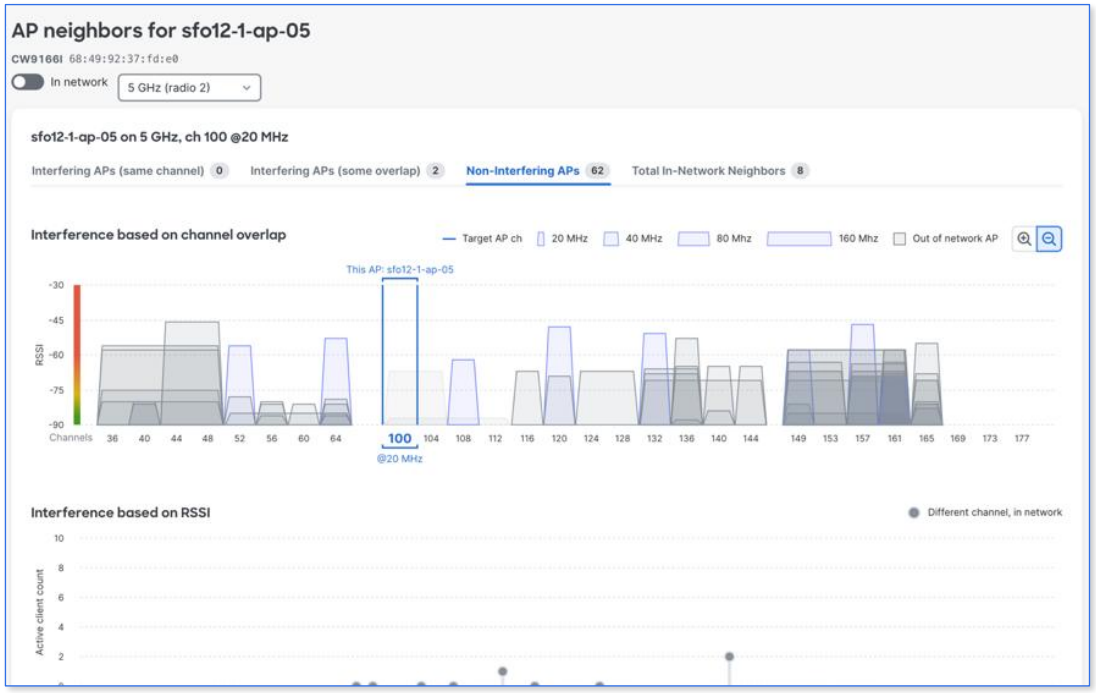
RF Spectrum evolved to provide both top-down discovery as well as bottom-up real-time RF neighbors

Long-term, trend-based Top-N list view



- Monitor RF Utilization and Packet Loss
- Proactive, discovery workflow to detect AP with persistent problem

Real-time RF Neighbors



- Full-channels Wi-Fi analyzer while AP is in service using scanning radio
- Offers workflow from RF health and RF overview list

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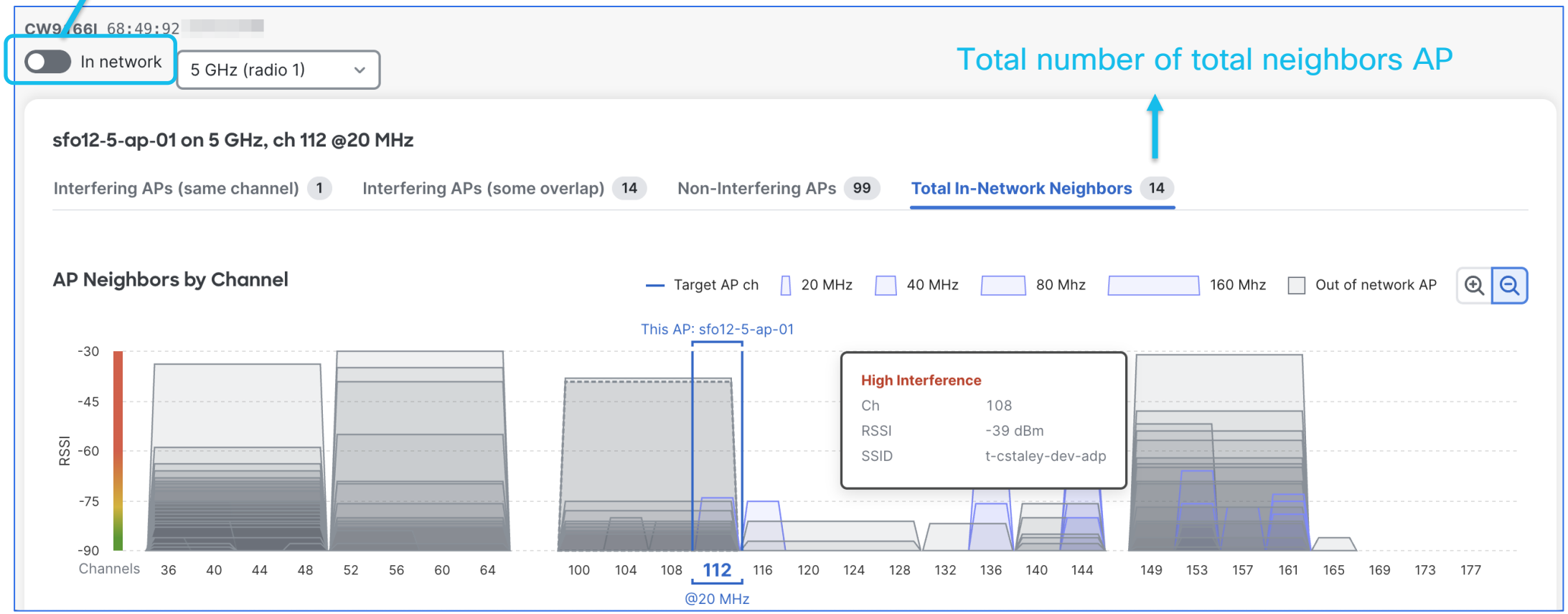
AP neighbor view makes remote troubleshooting easy and powerful – Whole band scanning and real-time updates

In network toggle to enable/disable neighboring, out of network APs/BSSIDs



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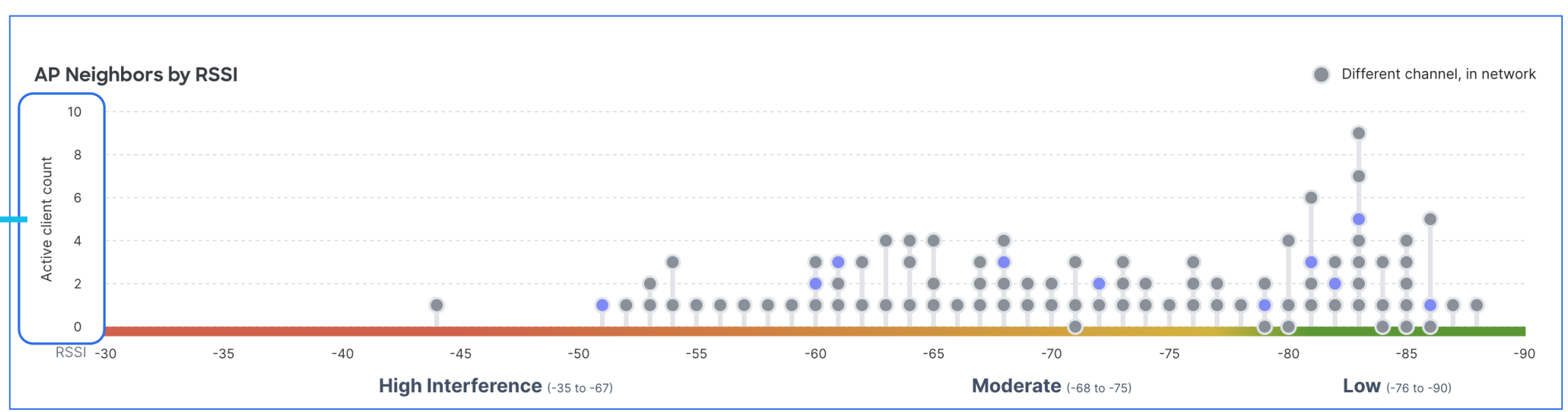
AP neighbor view makes remote troubleshooting easy and powerful – AP Neighbors by RSSI

Shows neighboring APs with active clients



- Lists all neighboring APs from current radio
- Not a rogue AP view
- Showing all APs across band
- Client counts shows possible channel consumption contributions

- Lists all neighboring APs from current radio
- Not a rogue AP view
- Showing all APs across band

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AP neighbor view makes remote troubleshooting easy and powerful – AP Neighbors by RSSI

These three tabs are available from In-Network APs

#	Interference	AP neighbor	RSSI (dBm)	Ch	Ch utilization	Active clients	Tx power (dBm)	SSIDs
1	None	32:8d:cb:b3:fa:5c	-30	52 (80 MHz)	—%	0		ericn_mr
2	None	8e:15:54:ab:ac:5c	-31	149 (80 MHz)	—%	0		t-whauser-bri, t-whause
8	None	0e:8d:cb:6d:f2:f2	-54	153 (80 MHz)	—%	0		KEITH_SFO12_MG_WORKBENCH WiFi
9	None	b2:88:91:51:47:a0	-54	153 (80 MHz)	—%	0		COPY THIS NETWORK - wireless WiF
10	None	a6:18:98:00:fb:2a	-59	44 (80 MHz)	—%	0		devel 3 - wireless WiFi
11	None	sfo12-5-ap-02	-61	136 (20 MHz)	5.4%	1	5	Meraki-Corp, Meraki-Guest, avalanche_openroaming, blizzard
12	None	sfo12-5-ap-07	-62	144 (20 MHz)	9.11%	0	5	Meraki-Corp, Meraki-Guest, avalanche_openroaming, blizzard

Interferences type - Overlapping Same ch None

Multiple BSSIDs from same AP are combined

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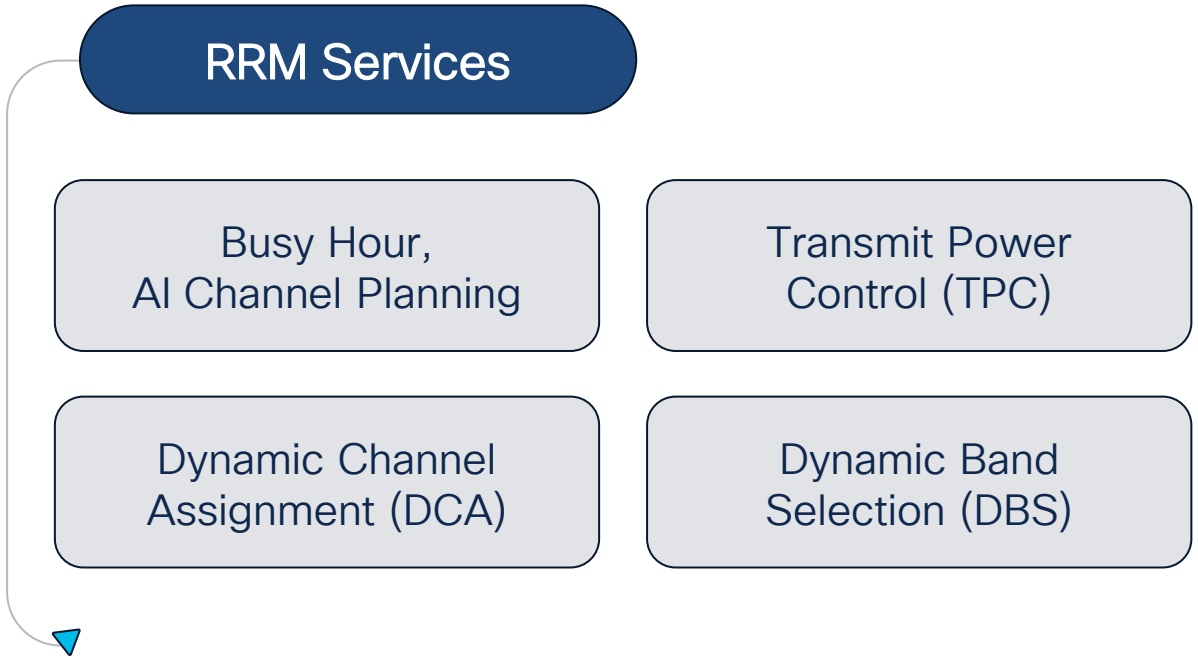
What is radio resource management?

RRM is a Radio config optimization features that constantly update wireless's RF configurations to improve wireless performance.



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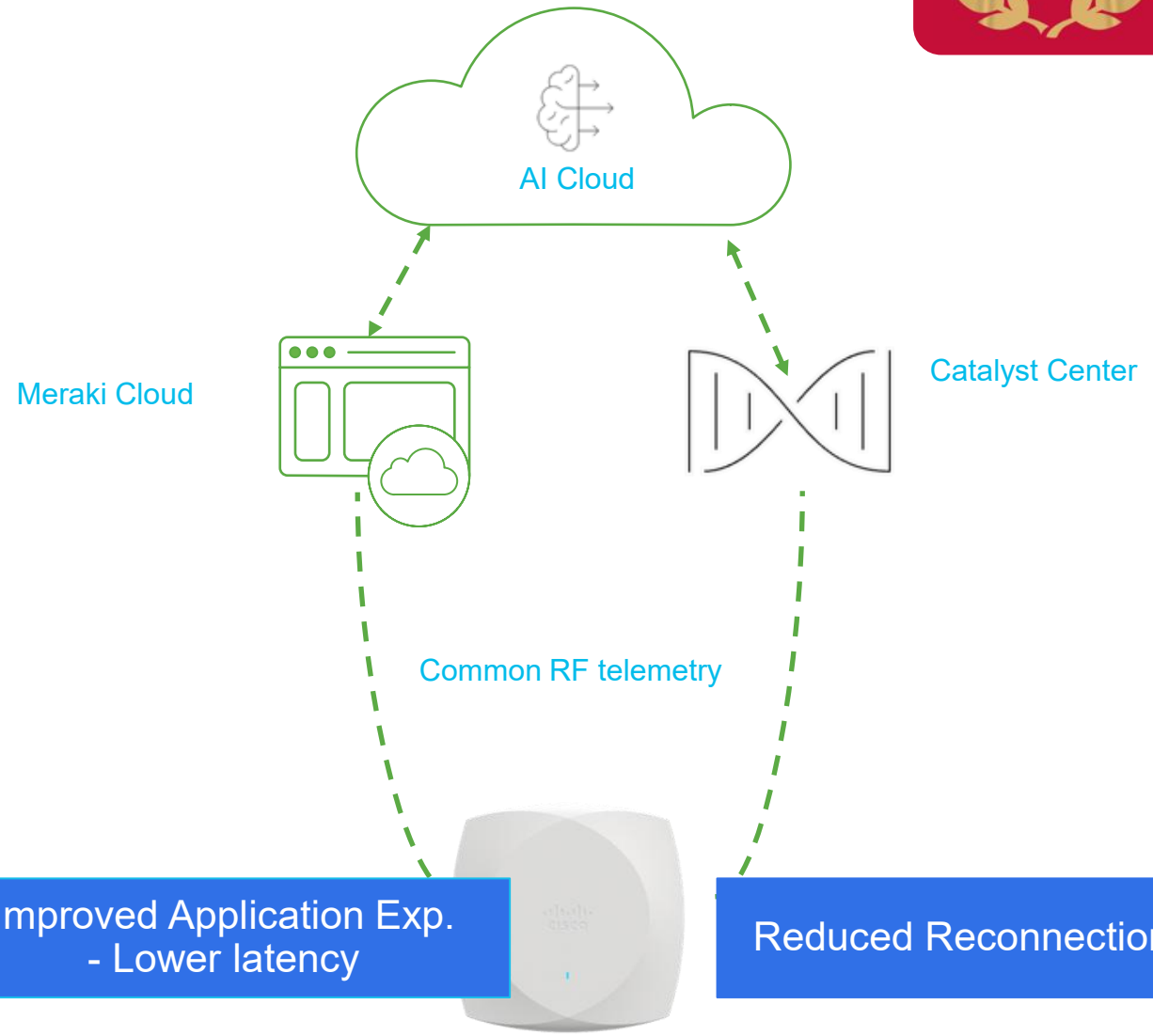
First Unified AI Wireless Service – AI-RRM

Path to autonomous Wi-Fi

RF Intelligence powered by the unified AI cloud

- Interferences reduction
- Reduced Channel Changes
- Client Experience Improvement
- Wi-Fi Performance Improvement



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AI-Enhanced RRM key customer benefits

Better RF, better insights, reduced operational costs and time

AI-driven self-optimizing RF

Leverages machine learning to find patterns and optimize your RF before issues happen.

Measured Improvements in RF KPIs!

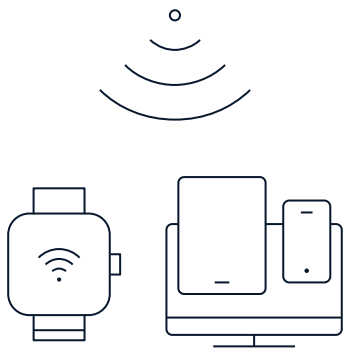
- CCI Reduction: Up to 40%
- SNR Downlink Gain: Up to 7 dB
- RRM Changes Reduction: Up to 75% at busy hours

Performance visibility

Provides per-building visibility into RF health using Wireless Config Analyzer algorithm.

Actionable insights

AI-derived recommendations on RRM setting changes for a more optimal performance.



Complete historical context

Understand exactly what RRM changes occurred at a per-AP level, and how they benefit the network.

Simplified RRM configuration

Complicated traditional RRM configurations are simplified, with policy toggles and thresholds.

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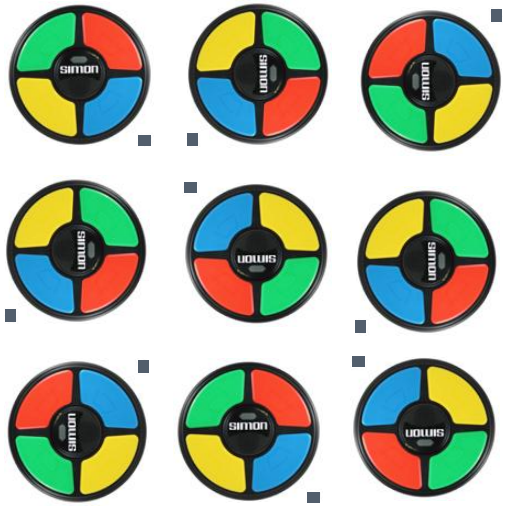
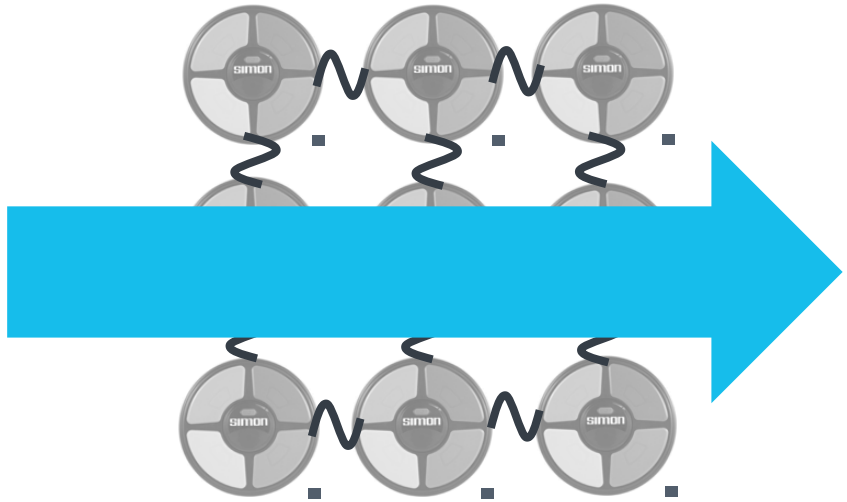
AI-RRM leapfrogs decades of innovations

Gen.1 Per-AP RRM



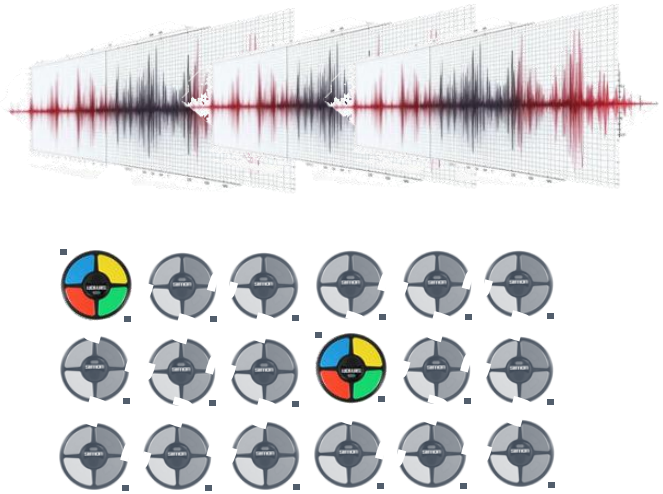
- Each AP makes own RF changes independently, at own timing
- Cascading RF changes could introduce infinite change-loops

Gen.2 Snapshot RRM



- All APs in the same building (RF group) makes RRM decision all at once
- No cascading effect
- 10~15min, short scanning duration for RF change

Gen.3 Trend-based, AI-RRM



- Long-term Trend-based RF telemetry pre-processing
- Minimal RF change from AI Busy Hour
- AI-RRM Dashboard

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AI-RRM AI process pipelines

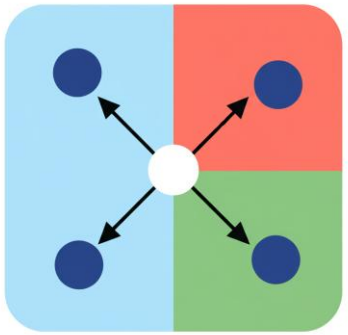
Multi-type data Ingestion

- AP Device Info
- RF Config/Profile
- RF Neighbor info
- Client Telemetry
- RF Events

Normalization

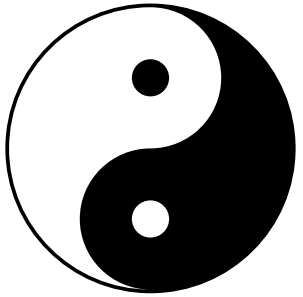
- Baselining
- Remove transient event
- Minimum 2 week of RF telemetry data

Classification



- KNN Classification
- Identify Busy Hour
- Apply different RF optimization weights by busy or non-busy hour
- Per-Network model

Reinforced Learning



- Feedbacks from RF Score
- Updates AI-RRM model using RF evaluations outcome
- Automated & RLHF

Digital Twins

- RF Simulation using Digital Twin
- “What if” results on updated RF config recommendations

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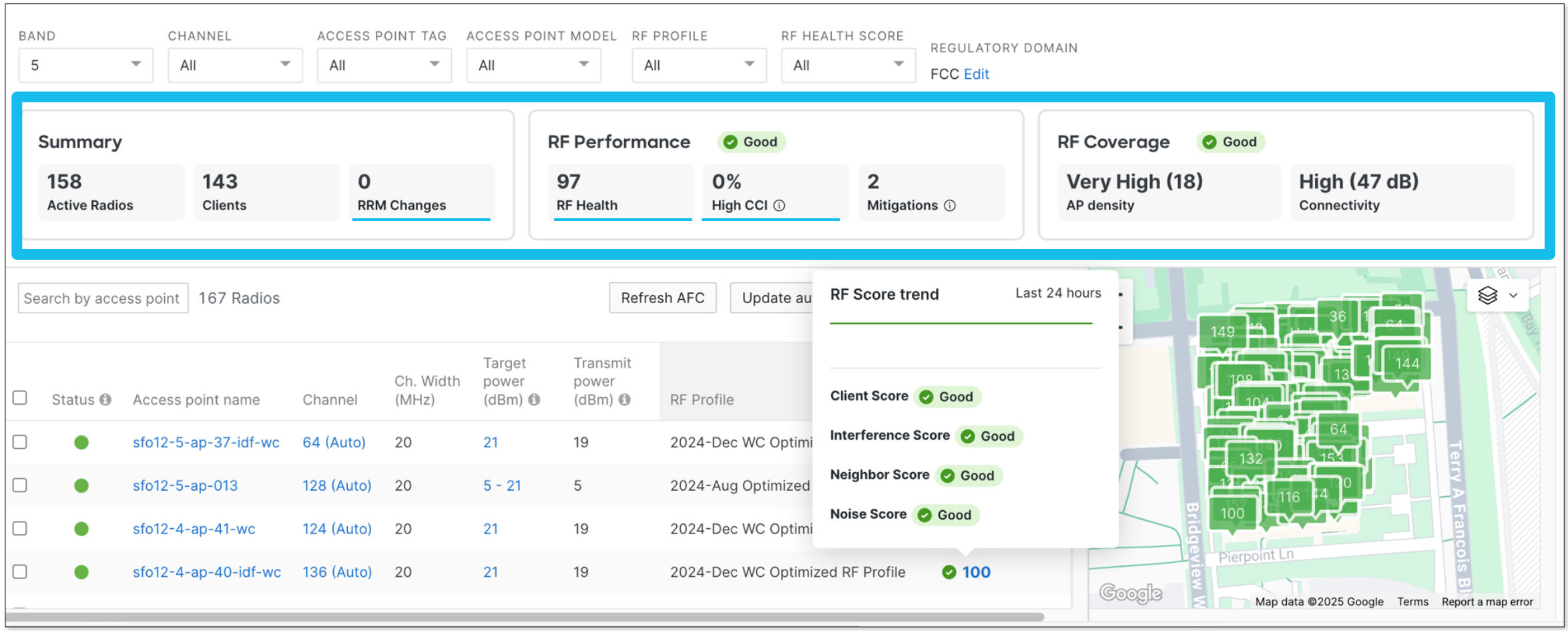
Closed-loop RF configuration and optimization with AI Insight

Connected workflow of radio configure, assess and optimize



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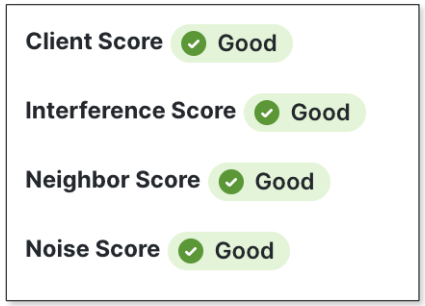
What defines better Wireless Network from the RF Point of view

RF Health

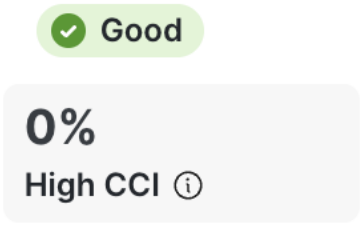
- RF Health algorithm debuted 2018 by Javier Contreras, Principal Engineer from Cisco.
- RF Health calculated from 9 RF metrics, takes worst score from which ever metric – Neighbor, Interference, Noise and Client



Co-Channel Interference

Interference can make your Wi-Fi slow or unreliable. AI-RRM calculated below factors

- Impact Score
- Highest CCI dBm
- Duty Cycle from Interferers

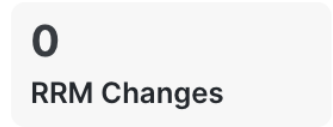


Channel Changes

When AP changes channel, client can follow new AP channel if it supports 802.11h (CSA) and on 5GHz SSID.

If client doesn't support 802.11h, client may experience network delay or disruption

Minimize Ch. Change will avoid sudden wireless connection disruption or delay



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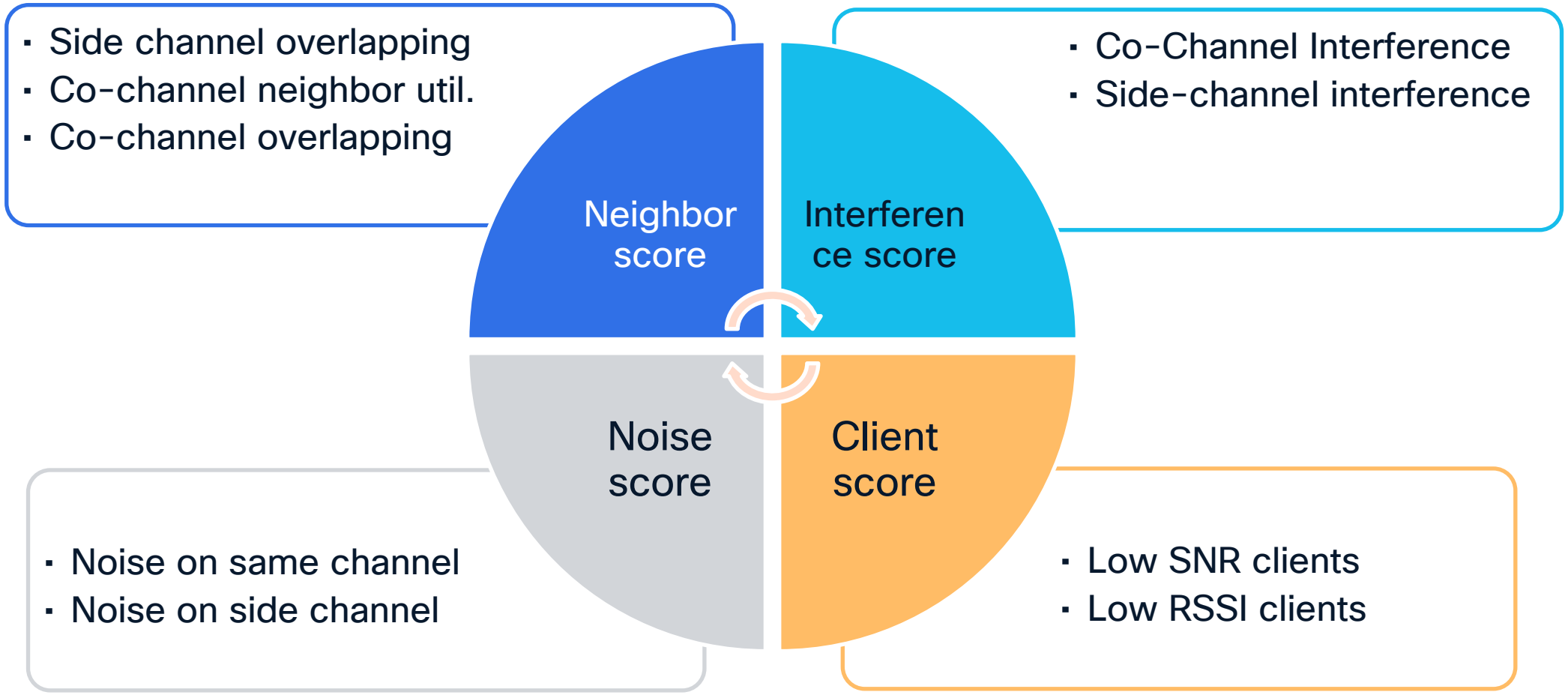
RF Health – Barometers for Over-the-Air RF Spectrum quality assessment tool



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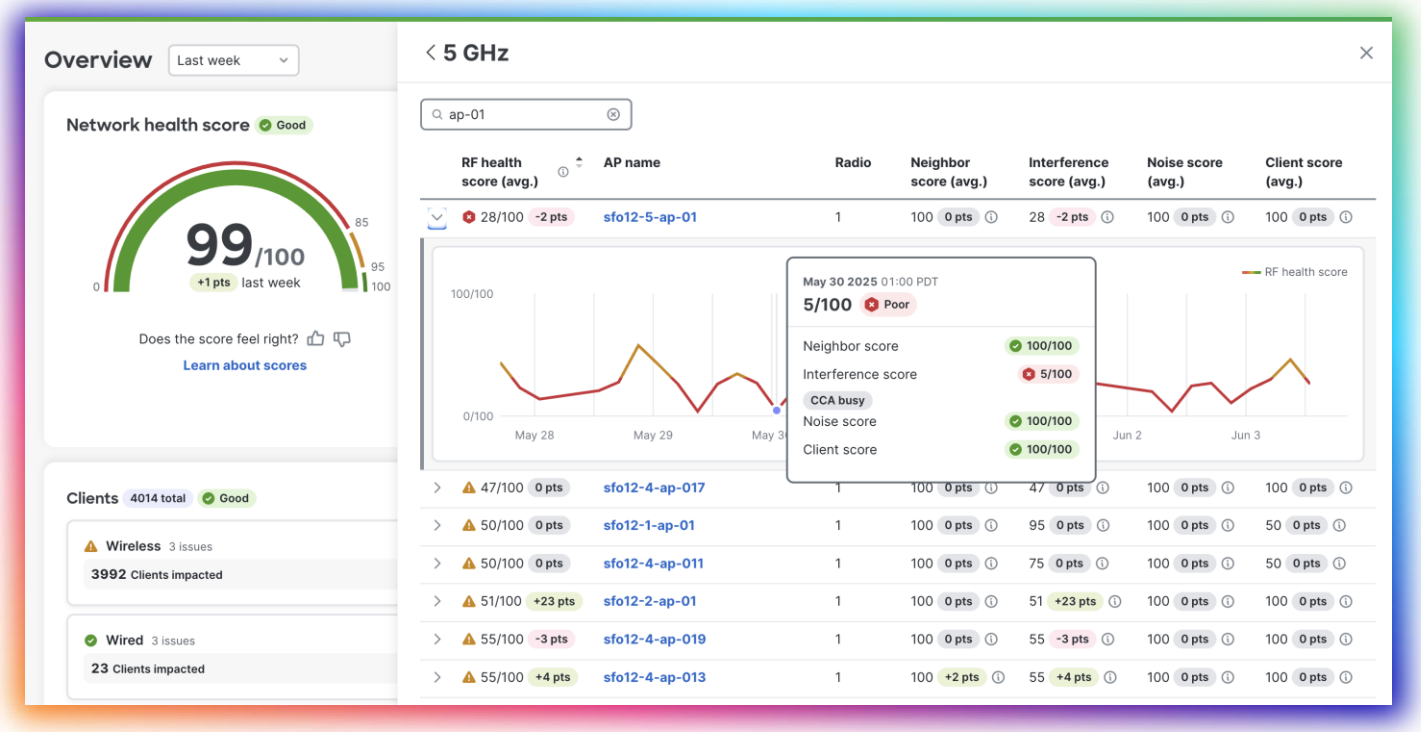
RF Health – Always On Wi-Fi Audit

- Highlights problematic band and point in time view, identify what's the persistent or transient issue
- Provide per-radio RF scoring, the same algorithm used for AI-RRM
- Provides further scoring and insights on critical RF categories -neighbors, interference, noise, and client connectivity



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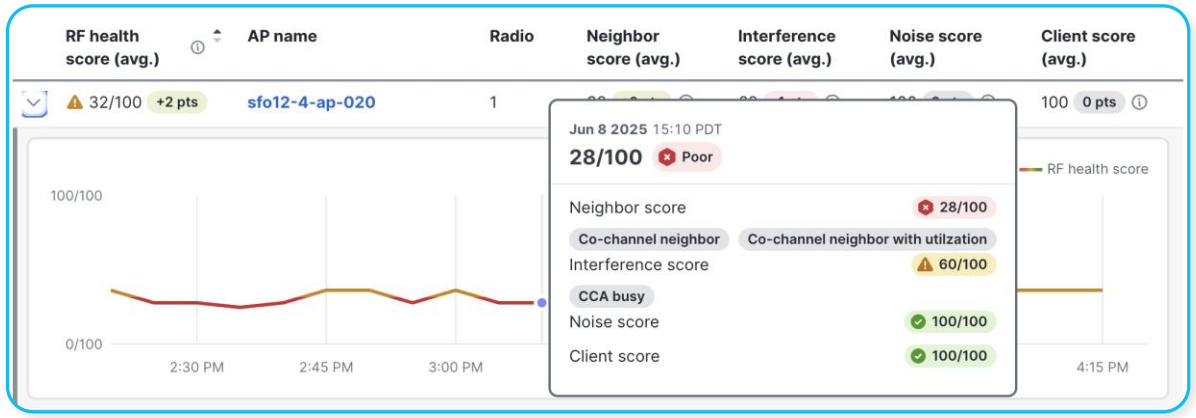
Discover source of interferences and quantify the impact

RF Settings/ Overview

Health score tier

- 61- 100 : Good
- 31- 60 : Fair
- 0- 30 : Poor

Assurance Overview / RF Health



Most common RF score impacting KPI

Reason	Causes
Co-channel neighbors	High channel reuse
Co-channel neighbor with utilization	High ch. reuse with busy neighbor AP
CCA Busy	Too many Rogue APs

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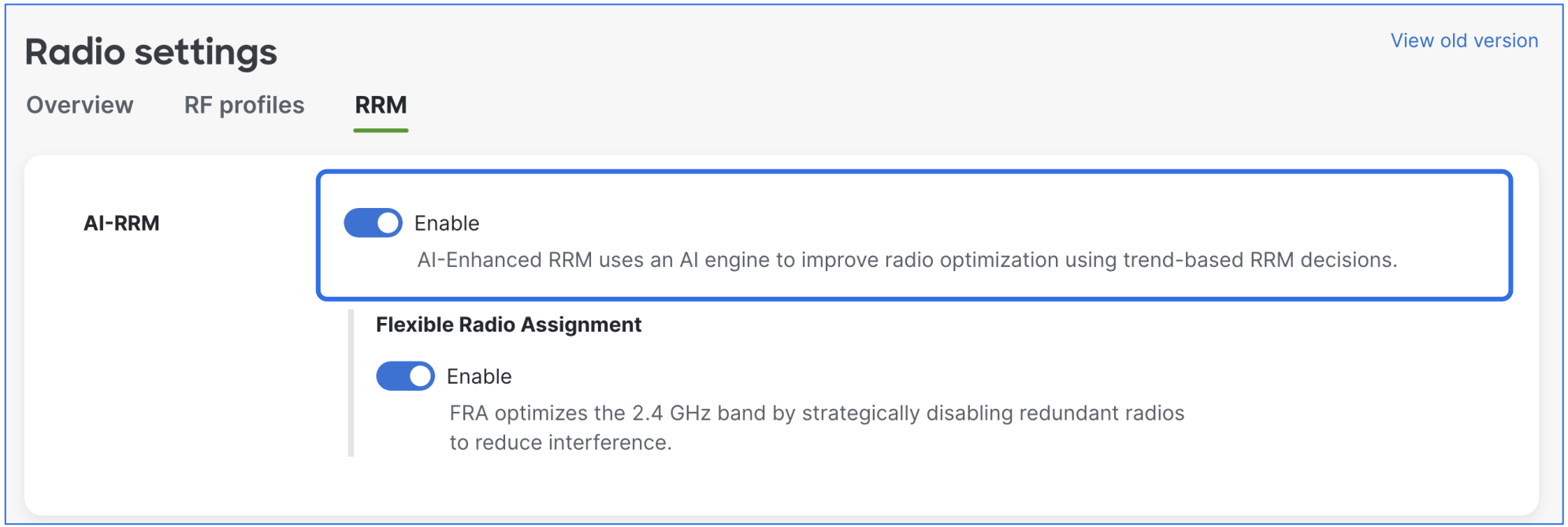
AI-RRM UX/UI Principal
Insanely Simplified, seamless RF Brain transplant



- Just one click to turn on AI-RRM
- Keep Everything else – RF Profiles or any other existing configs “as-is”
- No separate config page or changes required.

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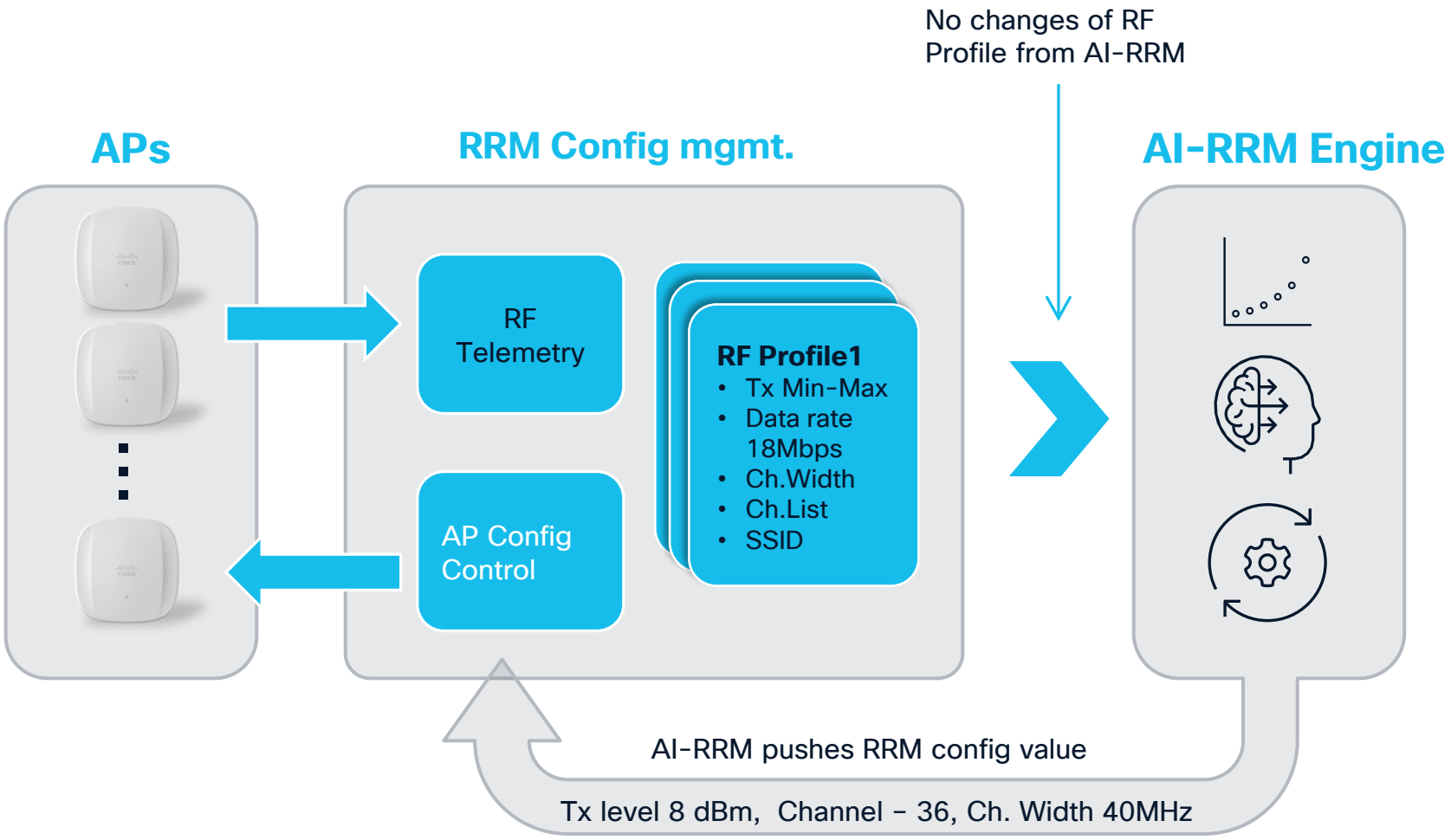
AI-RRM provides superior RF outcome



- No Changes in the existing RF Profile
- AI-RRM optimize RF configuration within the RF profile policy
- RF Health and performance evaluation will happen all the time
- Unlikely scenario, AI-RRM service failure, RF optimization will fall back to traditional RRM

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AI-RRM vs. RRM networks

AI-RRM uses x1,344 times longer RF statistics to determine next best channel

	RF config model	Base RF Optimization	Base RF Optimization duration	Advanced Optimization	Assurance	Architecture	License Tier
AI-RRM	RF Profile	Trend-based	2 Weeks = 20,160 min	• Enhanced Busy Hour • AI Channel Planning • Flexible Radio Assignment	• RF Health • RF Dashboard • Before-After analytics • Peer Comparison	Unified AI-RRM Cloud	• MR-ADV • Advantage Subscription
RRM (autoRF)	RF Profile	Snapshot-based	15 min	• Busy Hour • AI Channel Planning	• RF Health	Meraki Cloud hosted	• MR-ENT • Essential Subscription

- RRM and AI-RRM uses common RF Profile configuration
- Switching between AI-RRM and RRM happens seamlessly
- AI-RRM services is available for MR-ENT customers as a trial services

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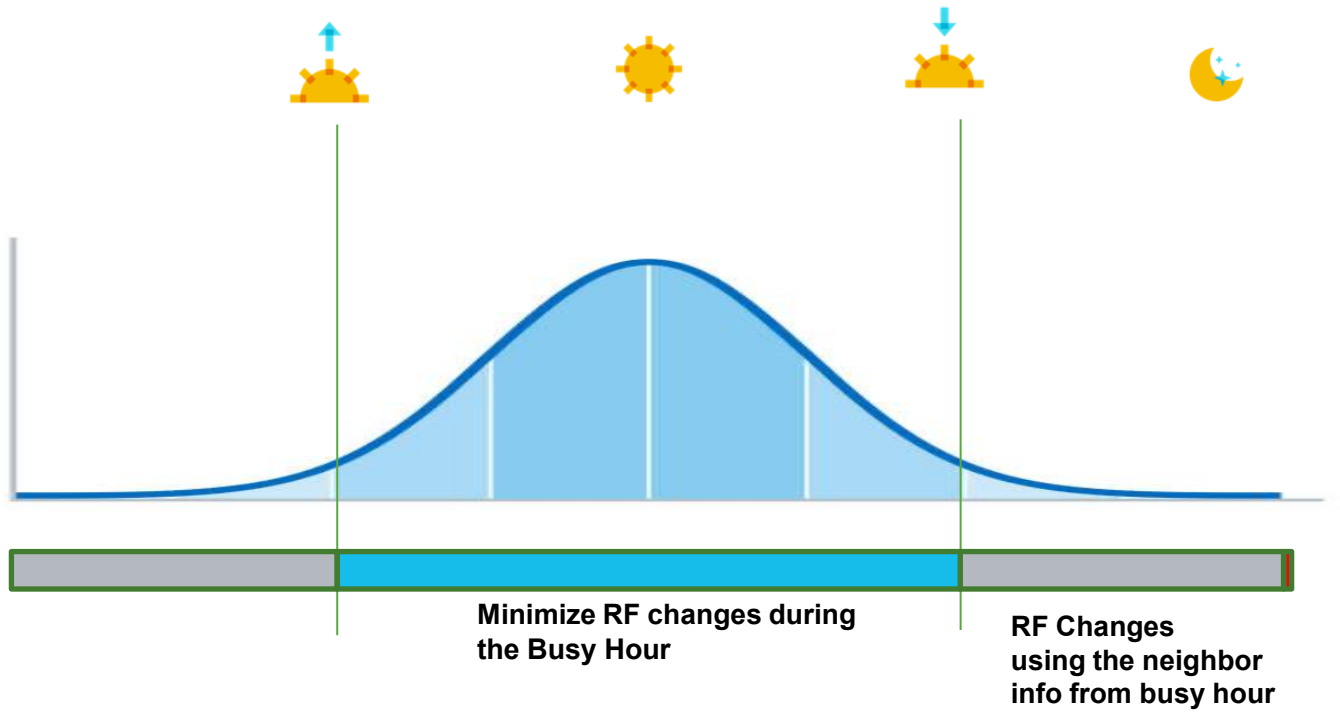
Minimize Channel-Change in Busy Hour

- Busy Hour can be either automatically or manually configured
- Every Changes are done off hour, using busy hour data.
- Avoid client disconnection or roaming due to channel change



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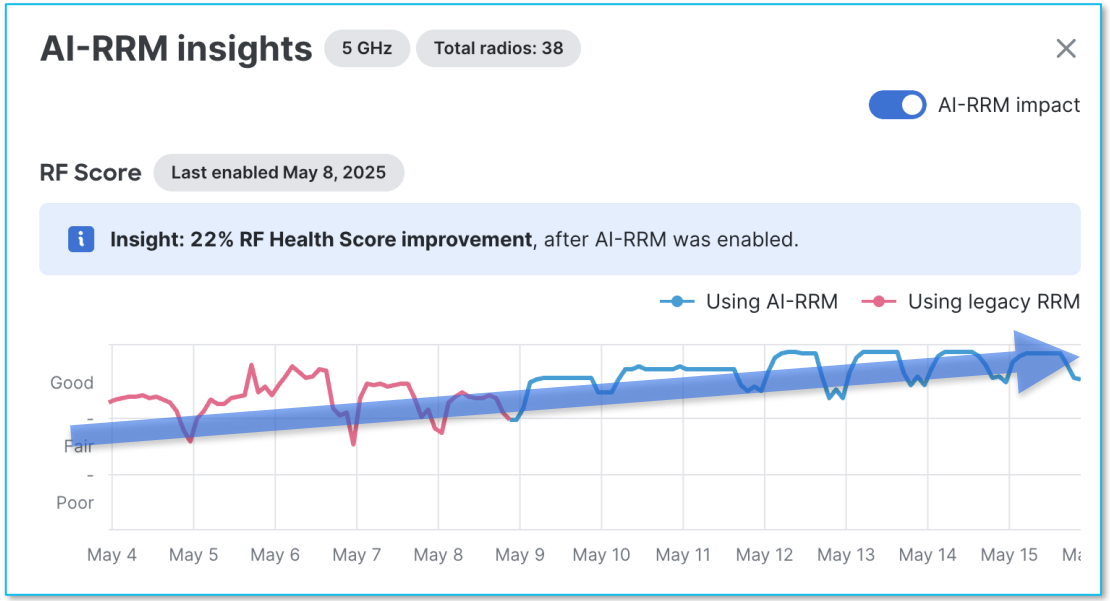
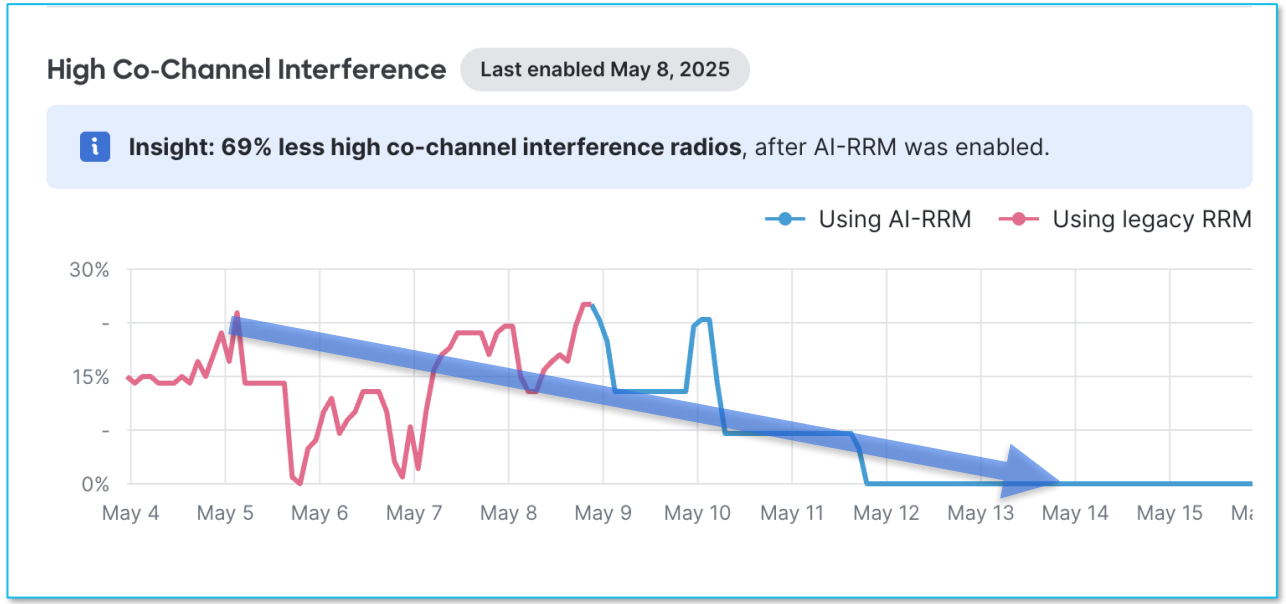
AI-RRM Before & After – Measurable AI Advantage

Typical Network examples with medium network density – (AP Density of 9)

+22% RF health score improvements



-69% less High Co-Channel Interference



Red Before AI-RRM gets enabled, using legacy RRM (autoRF)

Blue After customer enabled AI-RRM

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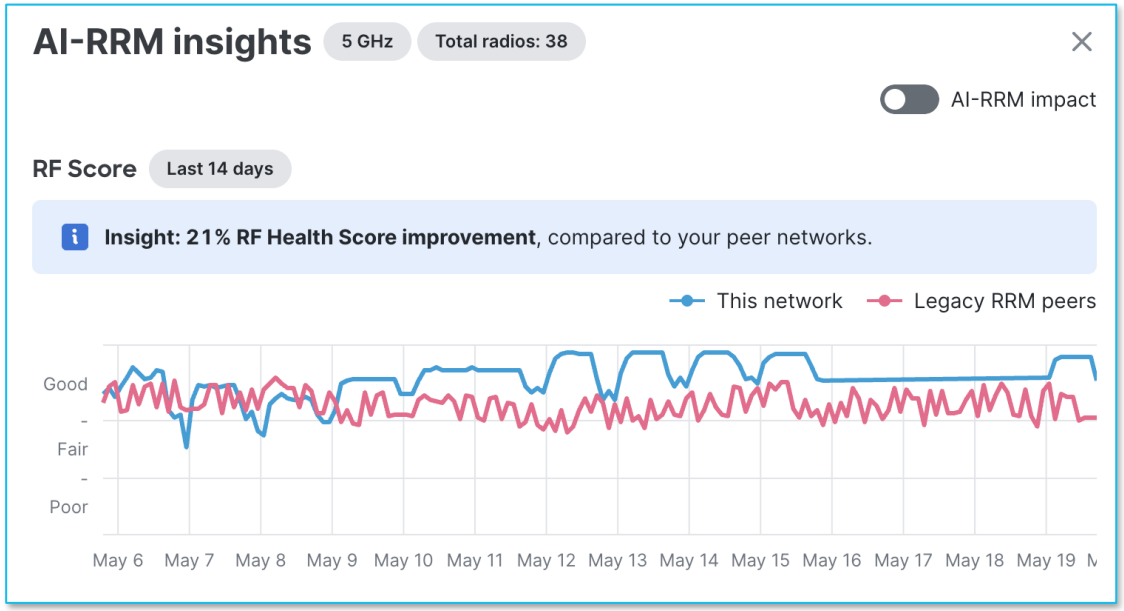
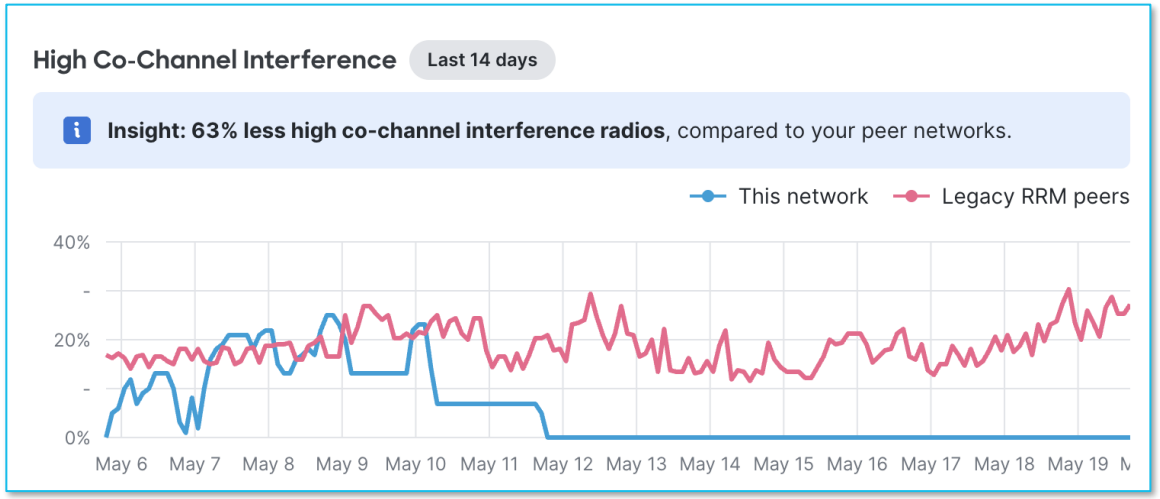
Comparison with peer networks that has same AP density as my network

Typical Network examples with medium network density – (AP Density of 9)

+21% RF health score improvements



-63% less High Co-Channel Interference



Red Before AI-RRM gets enabled, using legacy RRM (autoRF)

Blue After customer enabled AI-RRM

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Demo – RF Optimization

Hitless FW Upgrade

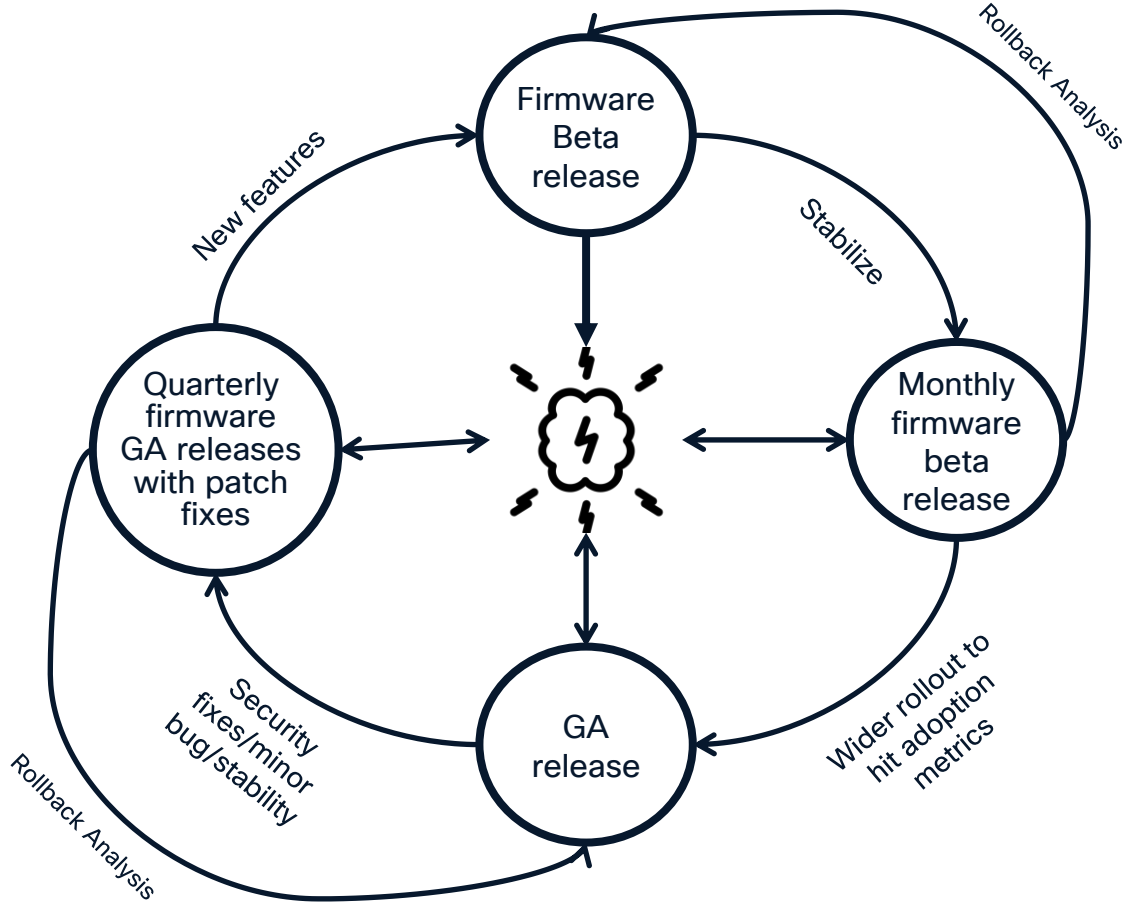
Intelligent Firmware Rollout

Continuous monitoring to ensure quality for customer deployments

Global monitoring
for all deployed firmware

Proactive monitoring
for product stability

Proactive outreach
to resolve issues



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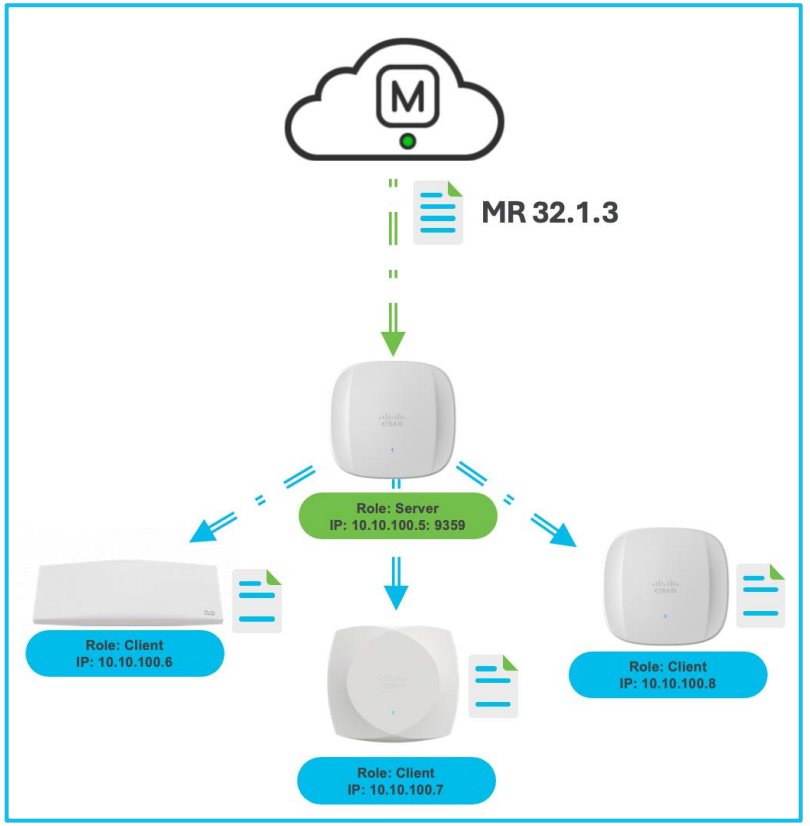
Local Firmware Fetch

Reduce AP Firmware upgrade time by 10x

- Smart Firmware Rollout
- AP Image pre-download
- Automated or Scheduled
- WAN Bandwidth Optimization
- Download AP FW only once per AP, per network
- Avoid downloading same images over the internet dozens to hundreds of time.
- Schedule FW download on non-business hour
- Minimize Maintenance Window
- Reduce the total time to upgrade from few hours to few mins
- Use Smart Firmware Upgrade to automatically cherry pick AP upgrade target



Reduce AP Firmware upgrade time to x10 to x20 times!

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Hitless Software Upgrades

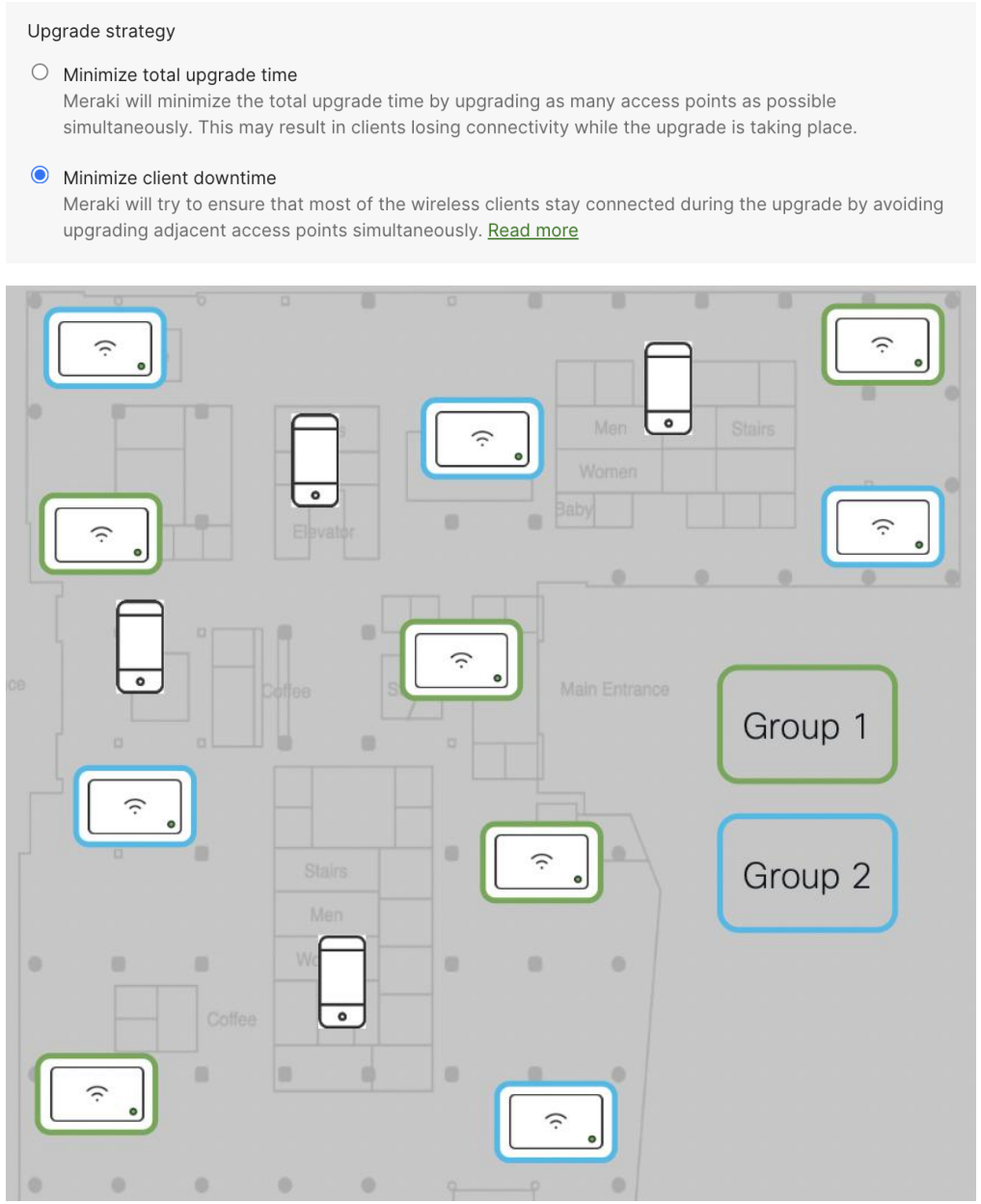
Multi-group Salt-Pepper AP Reload

Any downtime, even if planned, disrupts 24/7 operations and impacts user experience.

- **Upgrade Hold Control**
  APs download but pause upgrade until the dashboard triggers the final step, ensuring they remain in service until safe.

- **Overlap Detection**
  Groups APs based on overlapping coverage, ensuring at least one AP can always serve clients.

- **Smart Scheduling**
  Upgrades APs with the fewest clients first and only when coverage is guaranteed, minimizing forced client roams



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AP Refresh/Deployment

AP provisioning steps for replace/upgrade case

Existing AP Refresh workflow

1. Claim new AP
2. Search claimed AP's installed network
3. Manually assign AP to right network
4. Go to old AP detail page, rename previous AP to old_AP Name
5. Search newly added AP, go to new AP detail page, change default AP to planned AP name
6. Add Tags to AP to assign SSID
7. Go to Configure>RF setting, Assign RF profile to newly added AP
8. Remove old AP from the network
9. Unclaim old AP from inventory to not waste cloud license
10. Connect AP to the network, wait for AP to come up online (DHCP, Cloud connectivity, FW updates)
11. Place AP to the floor using AP auto locate and/or third-party tool (e.g. Ekahau, Hamina)

Repeat all steps for each new AP installation - 100s to 1000s times per network

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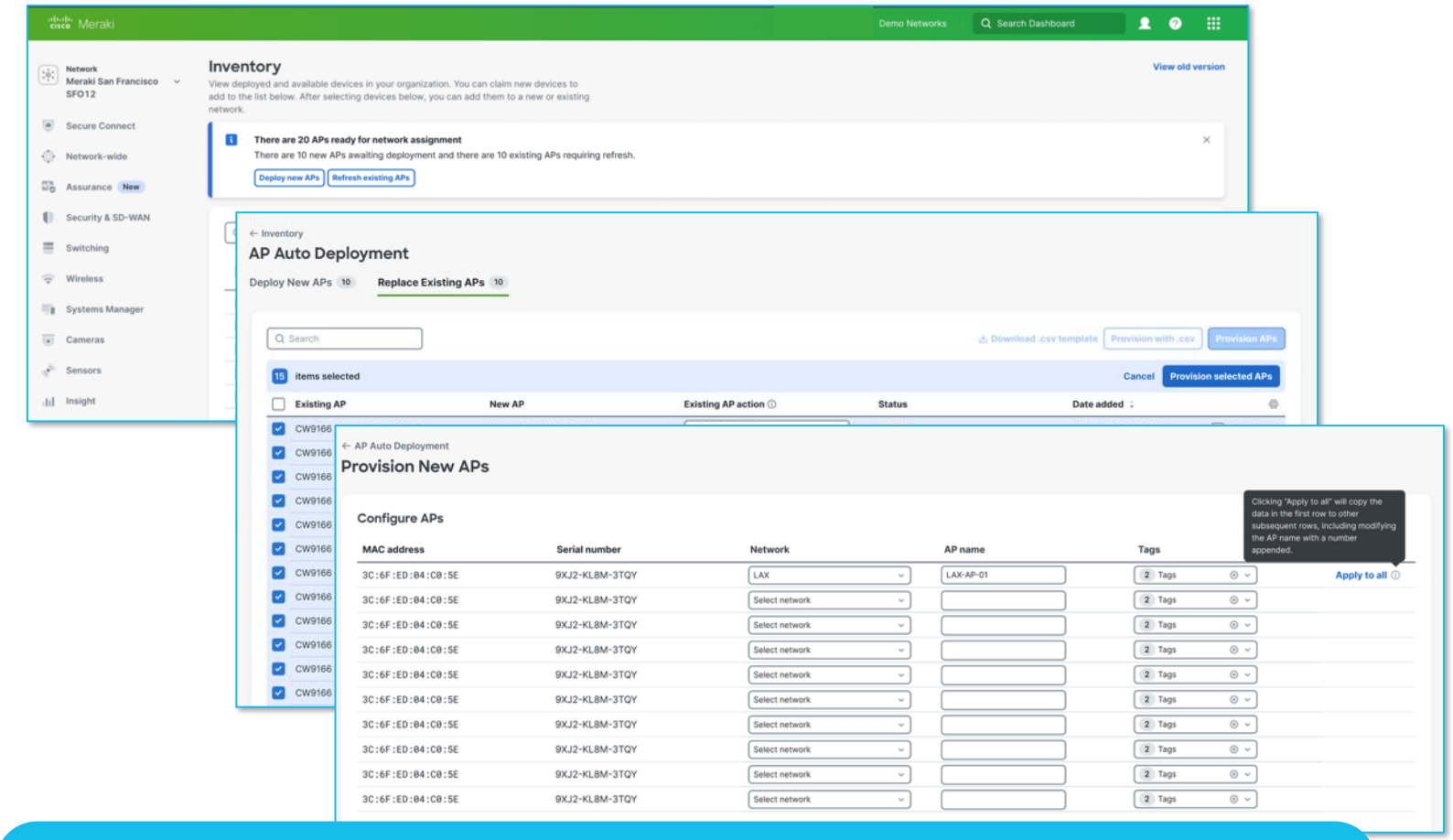
New - AP Zero-Touch Refresh

Green Field

- Bulk AP provisioning workflow
- Bulk provision via CSV & API
- Complete pre-provision prior to physical installation

Brown Field

- Auto network assignment
- Migrates AP configs to new hardware



Reduces upgrade time and costs with workflow

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Simplified AP Provisioning process

New! AP Refresh workflow

1. Claim new AP

Just confirm the AP config migration with a single click

10. Connect AP to the network, wait for AP to come up online (DHCP, Cloud connectivity, FW updates)
11. Place AP to the floor using AP auto locate and/or third-party tool (e.g. Ekahau, Hamina)

Bulk AP provisioning, 1000s of AP configurations in just single click action.

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Demo – AP Zerotouch Refresh

Cisco AI Assistant
- Wireless use-case

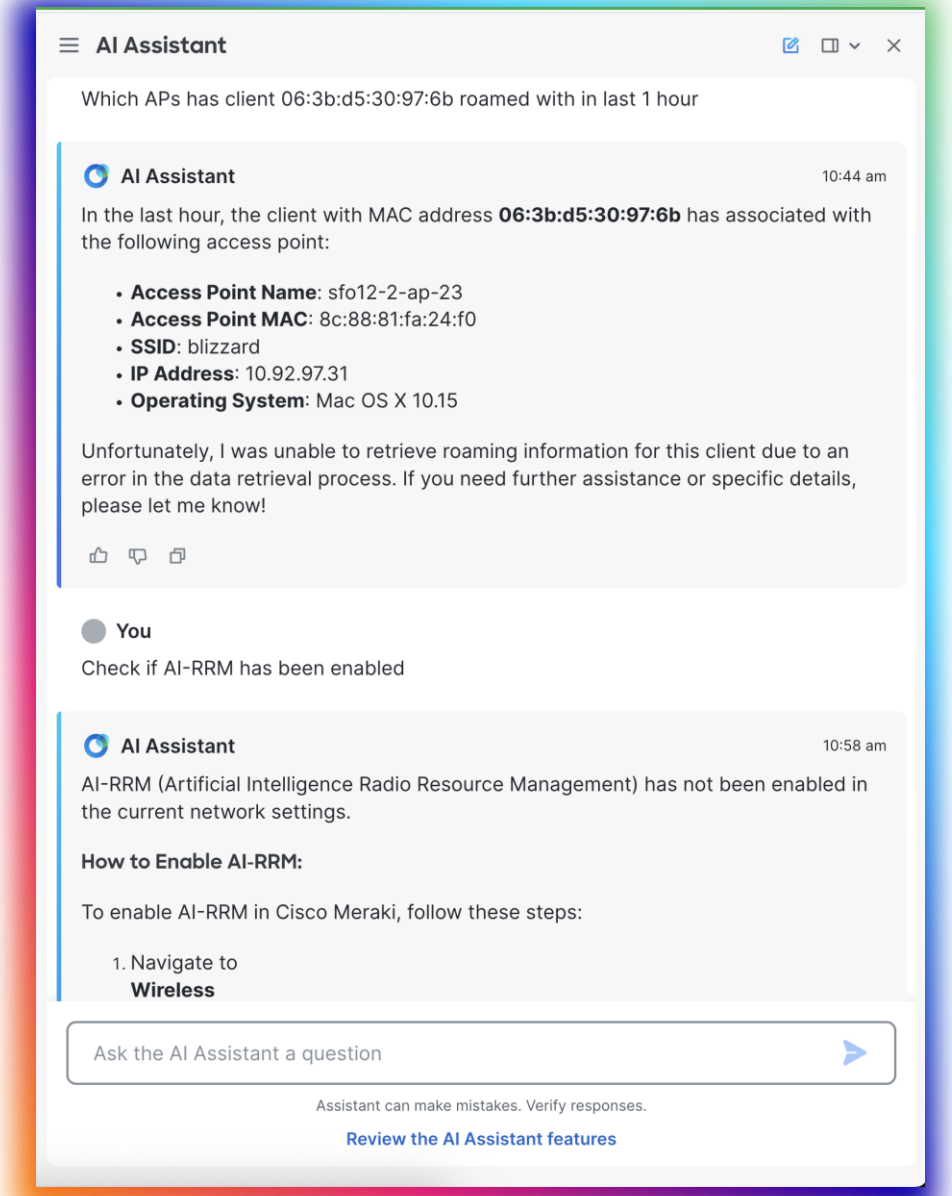
Cisco AI Assistant

Native, GenAI-based Agentic Network Interface

- Understand Wireless, Wired, WAN and Internet networking experience
- Understand unique network contexts such as Network Telemetry, Configuration, Firmware
- Answers dynamic network inquiries and answers
- Dynamic query parameter derivations and composite

Documentation and Best Practice Recommendations

- Acknowledge existing network configuration and provide the best practice network configuration



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Cisco AI Assistant Use-cases

Top-down discovery

- Uncertainly to certain
- Proactive Discovery
- Org-wide or Network-wide inquiries and reply

Bottom-up troubleshooting

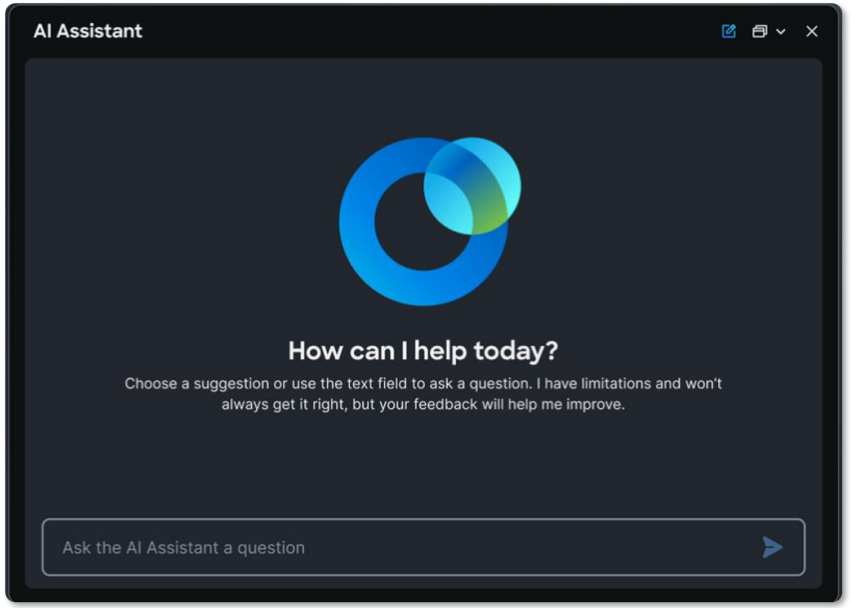
- Notification Driven
- Client Troubleshooting
- Drill-Down deep into the RCA

Monitoring

- Various quires and ad-hoc questions around all things such as inventory, device & Network configuration check, Firmware, device and client log, events, statistics and many more!

Configuration

- Guided workflows by Agentic Intelligence.
- Enable AI-driven multi-step and multi-system Workflows
- All based on Cisco's validated designs.
- Create a WLAN Network to RADIUS configurations



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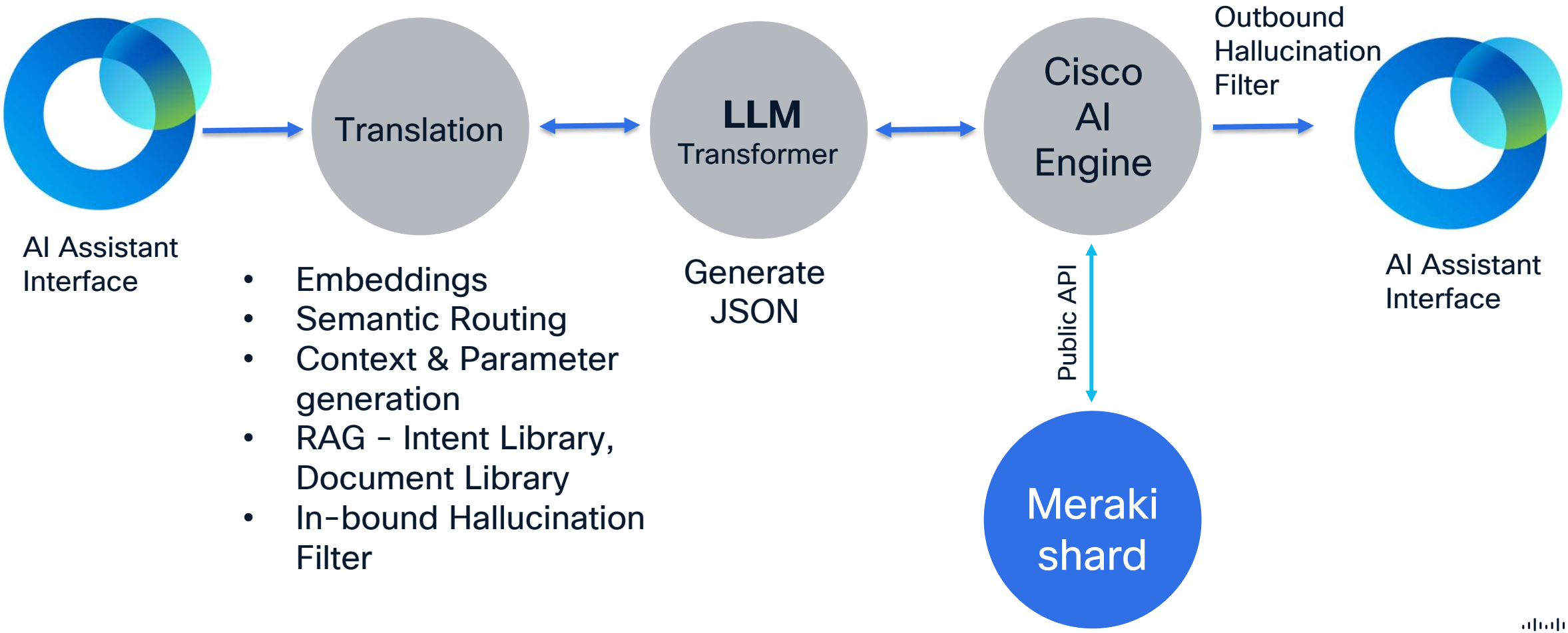
AI Assistant for Networking Architecture
In a nutshell



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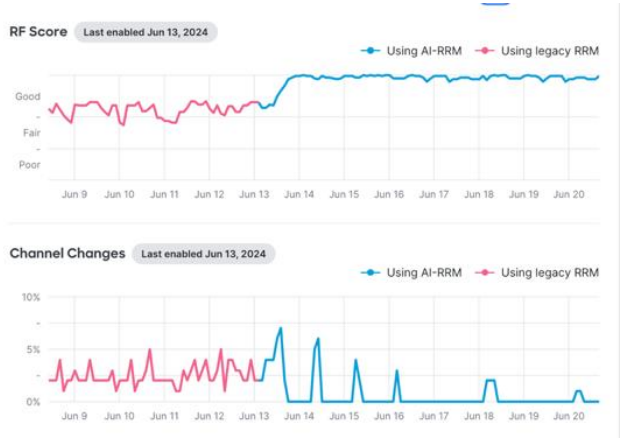
Demo – Cisco AI Assistant

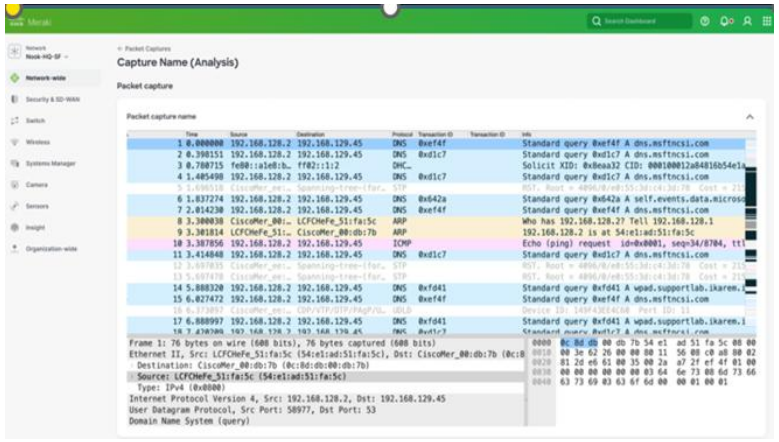
Wireless use-case

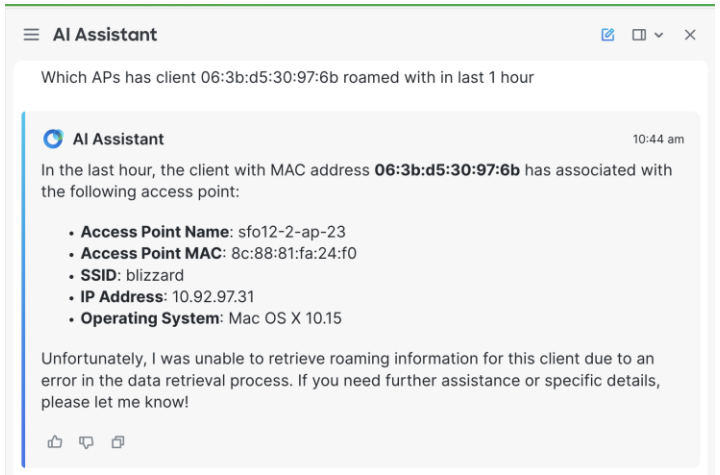
Conclusion

Conclusion: AI Wireless designed to offer productivity operation efficiency



Visible impact of Before & After AI-RRM





AI-RRM

- Using AI to tune and select channels best suited for your network
- Learning your network usage patterns to auto determine busy hours
- Optimizing to enhance client experience

Intelligent Captures

- Complex troubleshooting made simple
- Save expensive issue recreation cycles

AI Assistant

- Conversational Interface.
- Multi-domain Cisco AI Assistant

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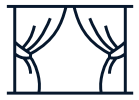

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