



Optimalizujte svou existující Wi-Fi a šetřete svůj čas

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11.7.2023

Pain points with enterprise Wi-Fi: Expectations vs. reality

Expectations* about Wi-Fi



- It's plug and play
- Gigabit speeds
- Always full bars
- Seamless experience

*Based on marketing and home experience.



Reality** of Wi-Fi



Nature of RF

- Dynamic
- Interference
- Noise
- Lots of users
- ...

- RF tuning required for optimal performance
- 10 Mbps? Lucky you!
- Sticky clients
- Bad client drivers
- Random disconnects

**Enterprise network experience.

- it works on my
computer

- yes but we are
not going to give
your computer to
the client

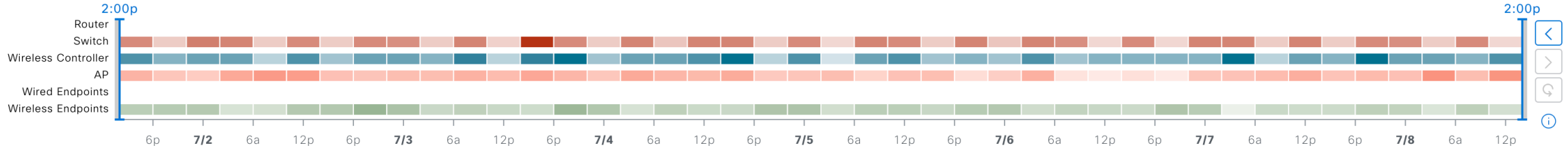


Agenda

- Zkušenosti s optimalizací sítě
- Novinky v bezdrátových sítích

Vylepšení RF parametrů

Issues ▾ **Events**



Events (18531) ⓘ

Category Type **Devices** Endpoints Router: 0 Switch: 5794 Wireless Controller: 2630 **AP: 10107**

ⓘ Multiple selection for device family filter is not supported for Event counts more than 5K

📄 Export ⚙️

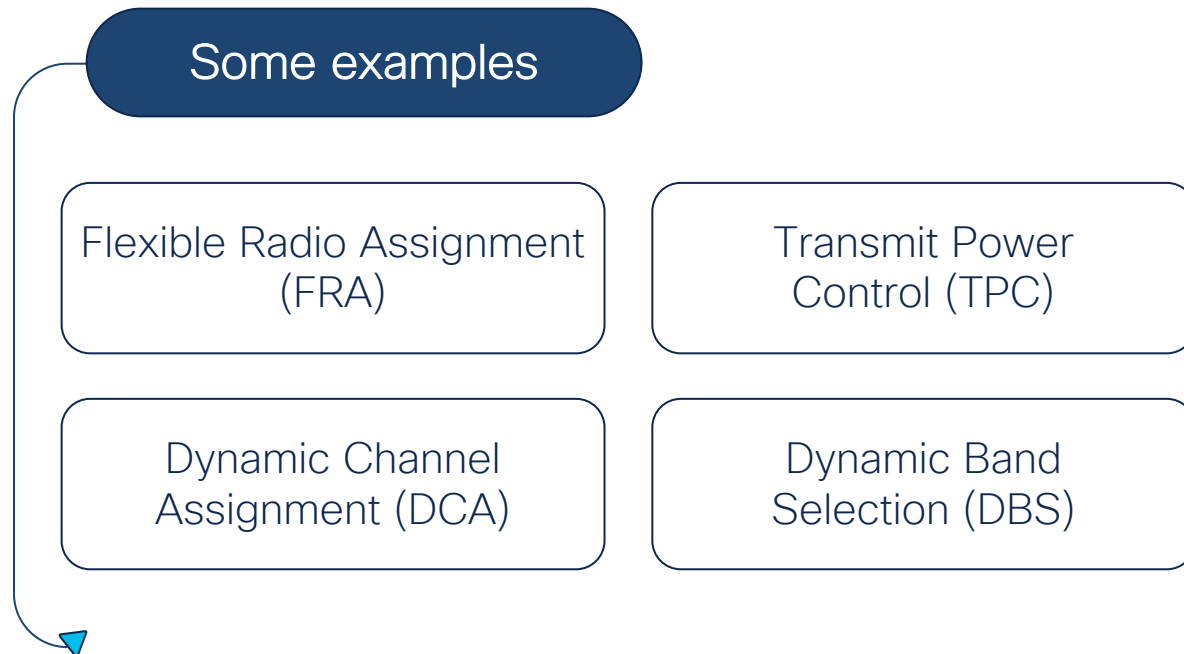
🔍 Filter Table 🔽

0 Selected

<input type="checkbox"/>	Event Name	Status	Timestamp ▾	Device Name	Event Type	Device IP
<input type="checkbox"/>	Tx Power Change	●	Jul 8, 2023 3:01:09.236 PM		Device Event	10.10.40.183
<input type="checkbox"/>	Tx Power Change	●	Jul 8, 2023 3:01:09.233 PM		Device Event	10.10.40.92
<input type="checkbox"/>	Tx Power Change	●	Jul 8, 2023 3:01:09.231 PM		Device Event	10.10.40.228
<input type="checkbox"/>	Tx Power Change	●	Jul 8, 2023 3:01:09.230 PM		Device Event	10.10.40.50
<input type="checkbox"/>	Tx Power Change	●	Jul 8, 2023 3:01:09.229 PM		Device Event	10.10.40.14
<input type="checkbox"/>	Radio recovered from internal failure	●	Jul 8, 2023 3:00:44.598 PM		Device Event	10.10.40.207

What is radio resource management?

RRM is a Wireless Controller (WLC) feature that automatically optimizes wireless configurations to improve wireless performance.



The Benefits of AI-Power

First steps towards an intelligent autonomous network!

Maximize

efficiency with AI-driven
optimizations

Reduce

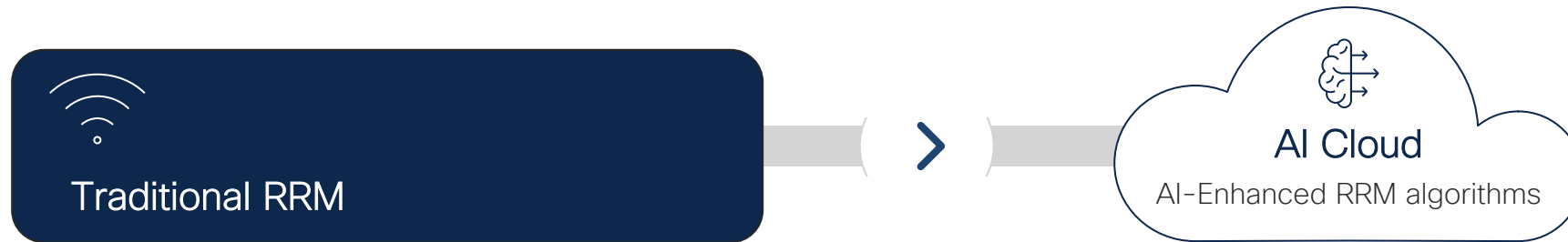
Interruptions with AI-
Channel Planning
by up to 50%

Minimize

channel changes
in busy hours

AI-Enhanced RRM is much better than traditional RRM

Easy Configuration, Complete Visibility, Improved Serviceability



Optimizations are reactive and limited by WLC resources.



Optimizations are proactive and powered by Cisco's AI Cloud.

Configurations require tuning by wireless experts.



Configurations are simplified and have AI-assisted recommendations.

Visibility into RRM decisions and benefits are limited.



Visibility into RRM decisions, per-site RF Analysis, recommendations and impacts on a dashboard.

Troubleshooting requires CLI access and knowledge of debug commands.



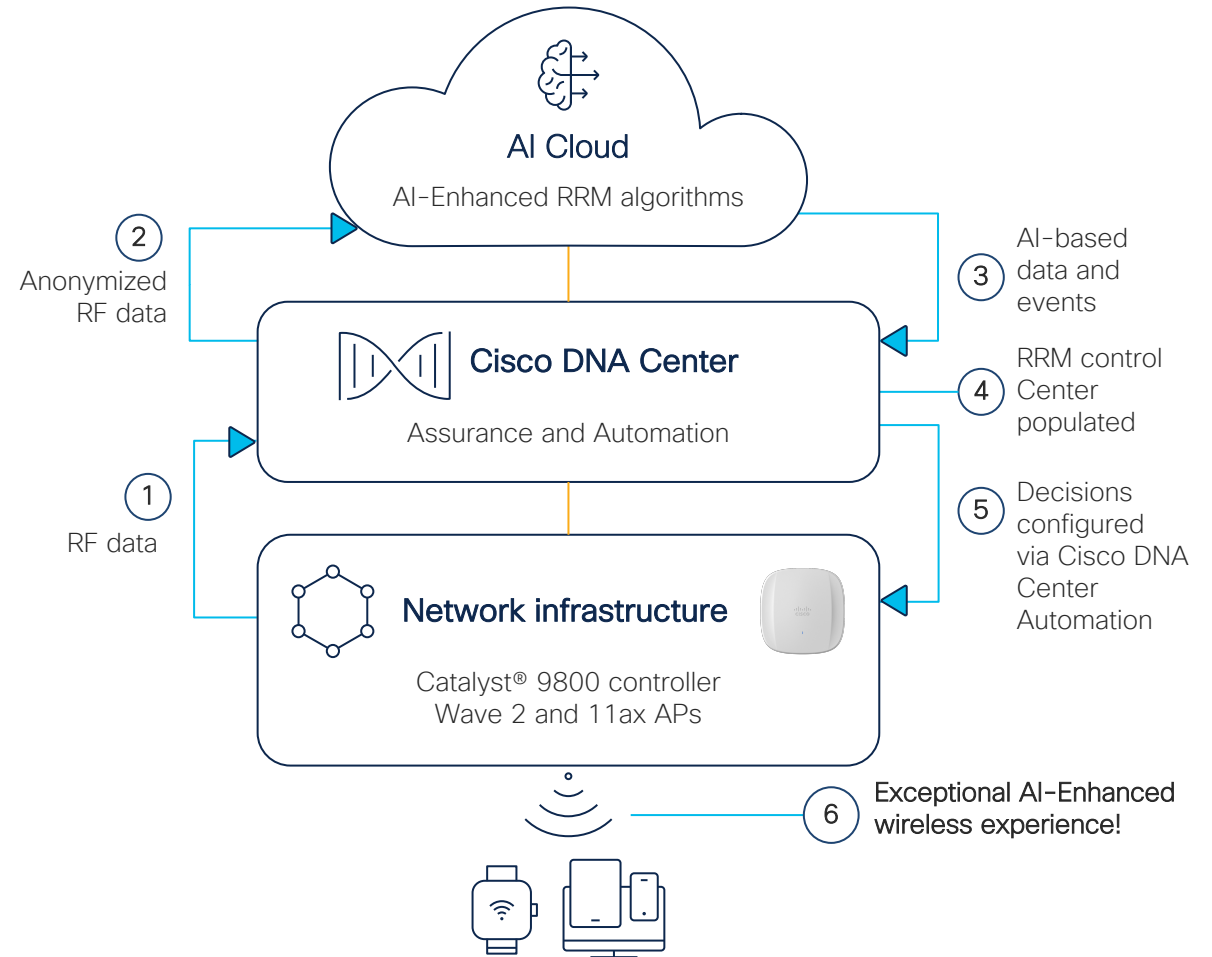
Troubleshooting made easy with a 30-day time travel and ability to download all CLI in a zip file.

AI-Enhanced RRM architecture and data flow

AI-Enhanced RRM is built into Cisco's AI Cloud.

AI processes 2 weeks of RF data to discover patterns.

Proactive optimizations make Wi-Fi exceptional.



Customer quantifiable benefits

AI-Enhanced RRM adds undeniable value to production networks

Deployment highlights

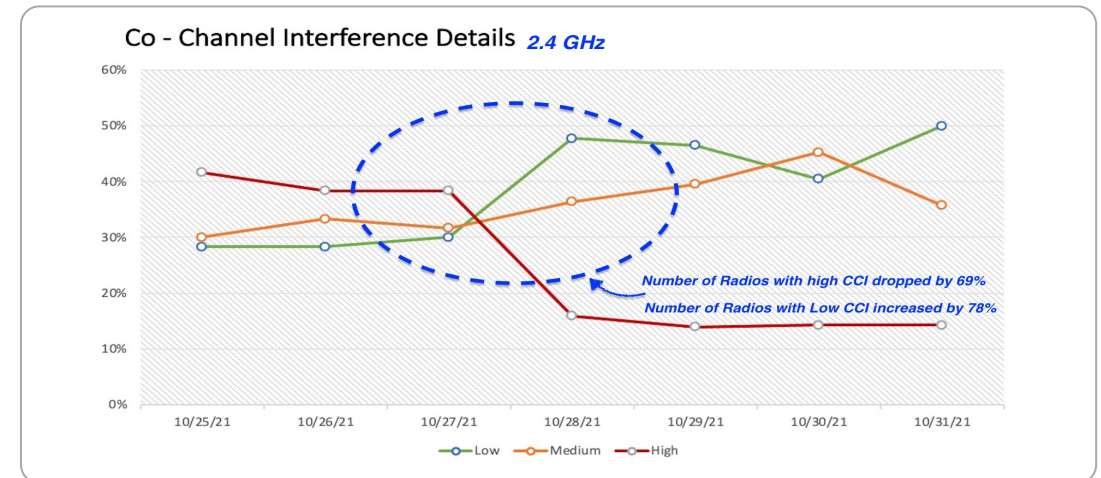
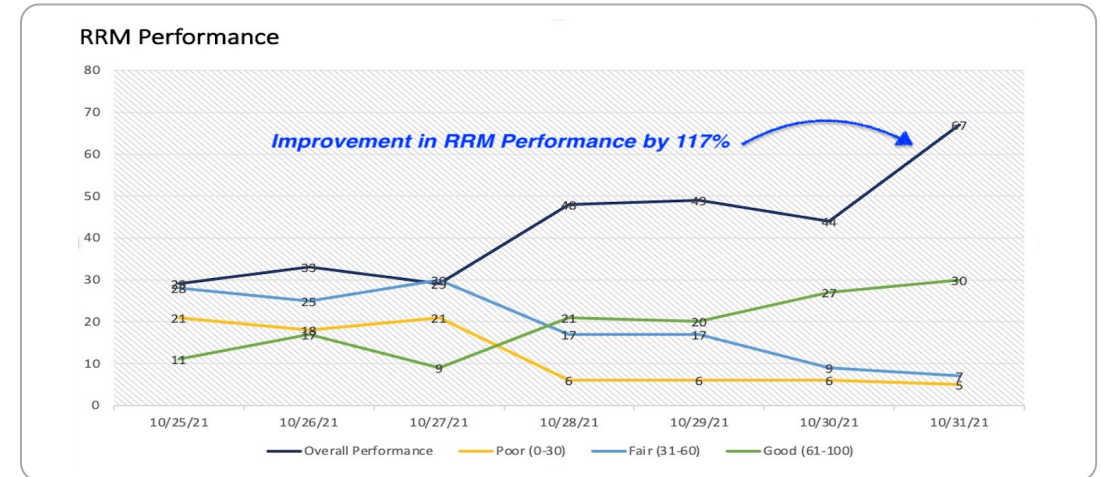
- Location: University building
- Network: 63 APs in high density
- Client count: Peak 639, average 430, 90% are on 5 GHz

Before AI-Enhanced RRM

- 2.4-GHz pain point: High interference
- 5-GHz pain point: Low capacity, since 90% of endpoints are there

After AI-Enhanced RRM

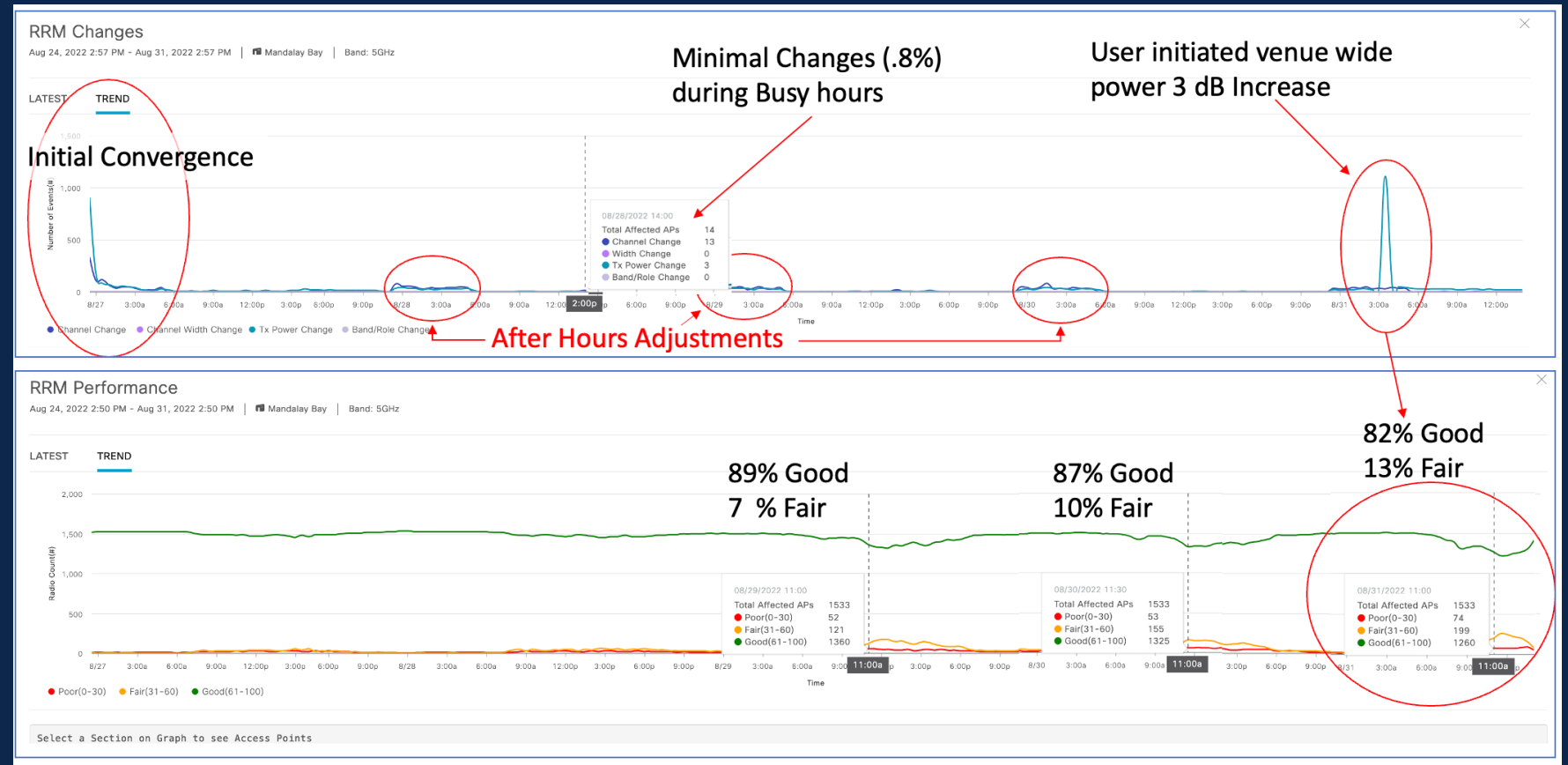
- Optimization: 61% of 2.4-GHz radios changed to dual 5 GHz or monitor mode
- 2.4-GHz outcome: Co-Channel Interference (CCI) dropped by 33% for 2.4 GHz
- 5-GHz outcome: 5 GHz improved with an increase of 8 dB in Signal-to-Noise Ratio (SNR)



How AI-Enhanced RRM Optimized Impact Wi-Fi

RRM Changes and Performance

- Initial Convergence within 6 Hours
- Changes made at night (less than 2% of made during the day)
- Health stayed above 85% (very good with load)
- Network Admins made manual Power changes - AI-Enhanced RRM reverted as it had less optimal results.



Leave Wireless Optimization to AI-Enhanced RRM!

- Motivation:

- On Third Day - NOC admins made config changes at off-hours to increase radio cell size to match configurations with last years' RF profile.

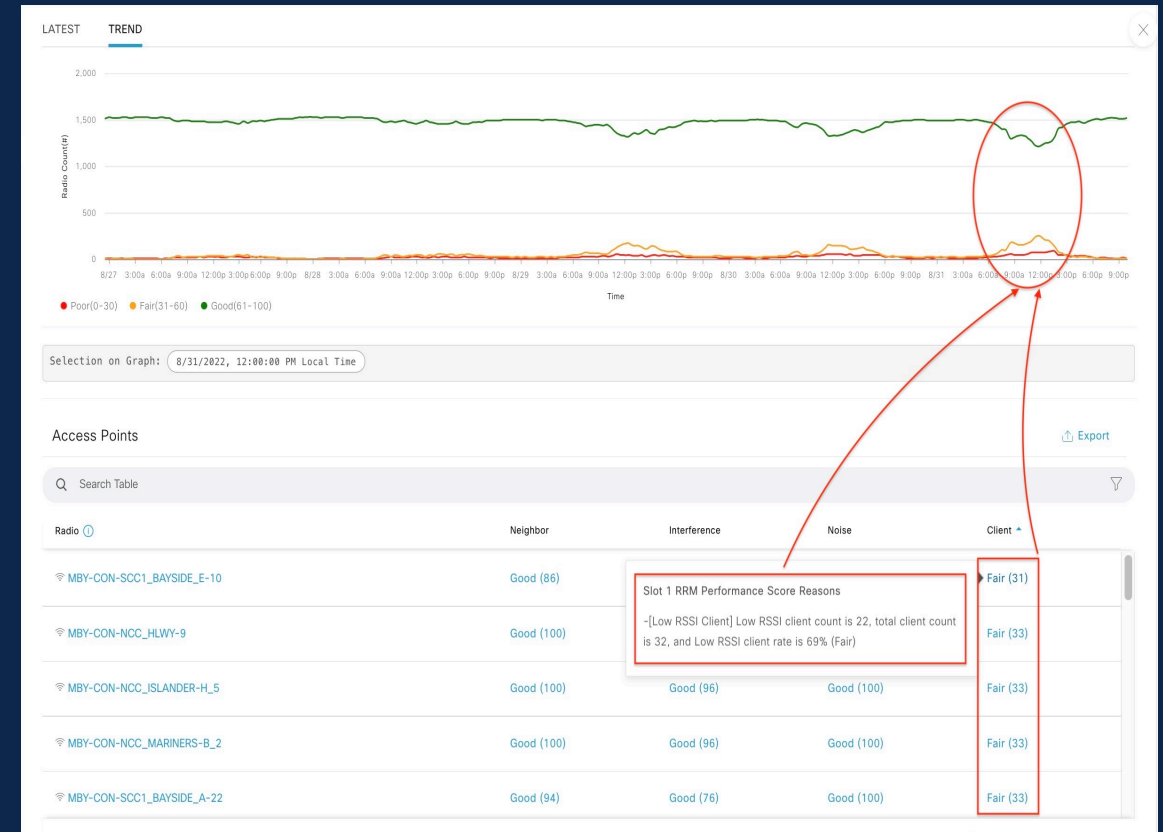
- Resulting Impact:

- Detrimental impact to the wireless performance
 - 74% of the radios increase Tx Power by 3dB
 - Co-Channel interference increased by 8%
 - Performance dropped 9% due to increased sticky clients
- AI-Enhanced RRM reverted the changes.

Co-Channel Interference



RF Performance



Recommended Software and hardware support matrix

Cisco IOS® XE WLC software

17.9.3 and later

Cisco DNA Center software and licensing

2.3.3.7 (No Wi-Fi 6E Support) or 2.3.5 (Wi-Fi 6E support)
with Cisco DNA Advantage license

Cisco® access point hardware

Wave 1 (those supported on 17.9.3), all Wave 2 and Catalyst® 11ax and 6E access points

Cisco IOS XE WLC hardware

Catalyst 9800-CL

Catalyst 9800-L

Catalyst 9800-40

Catalyst 9800-80

Refer to the [Cisco AI-Enhanced RRM Deployment Guide](#) for detailed instructions.

Integrating Meraki's Auto RF with AI-Enhanced RRM

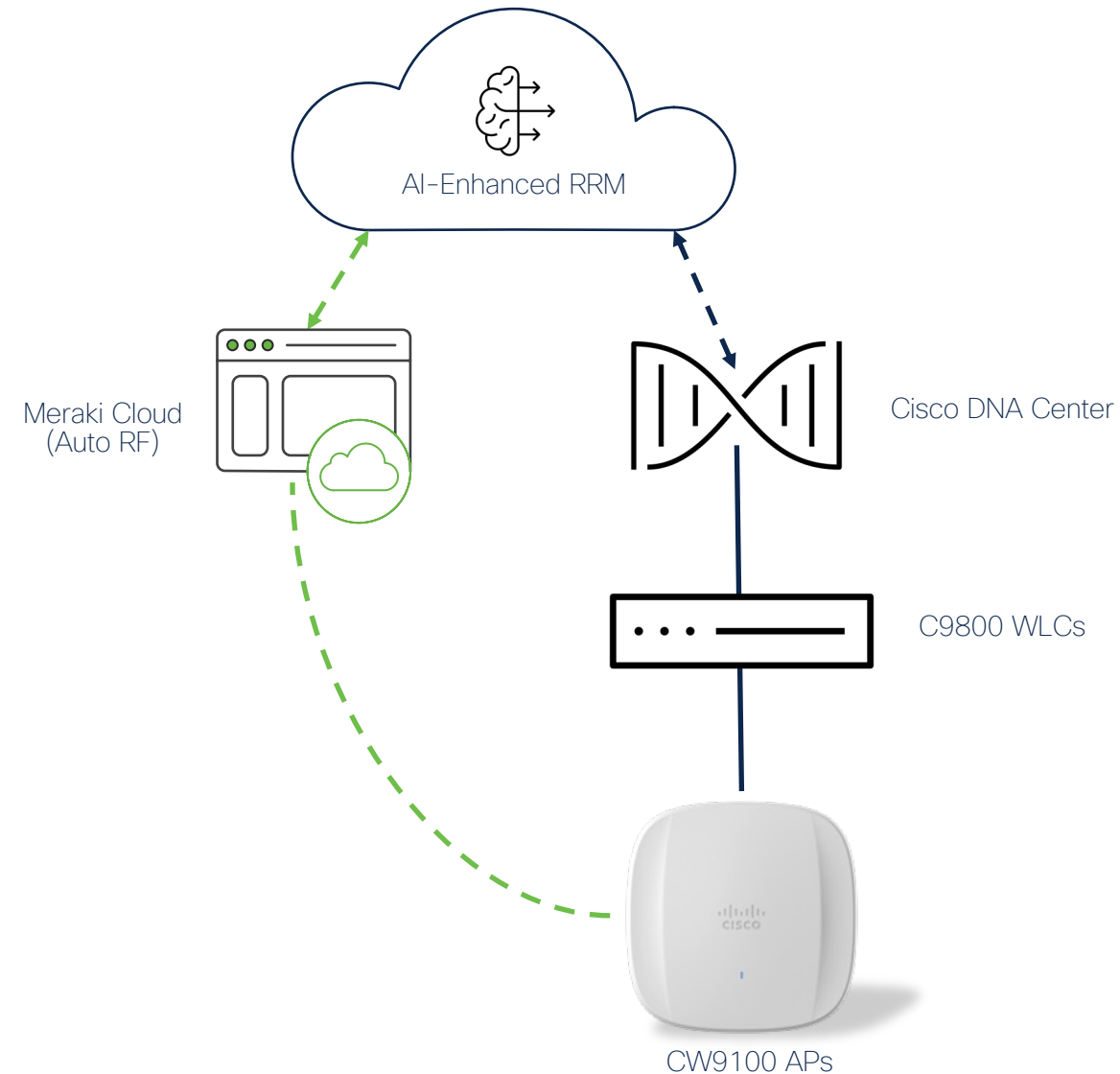
Driving Cisco Meraki's RF Excellence Towards an Enterprise Vision

RRM Vision

Cisco Wireless deployments regardless if it's Cloud or on-prem, must have capability to support wireless deployments of any scale and complexity.

Benefits and Outcomes

Customers will get a unified, predictable and consistent RF automation and recommendations engine in hybrid as well as cloud or on-prem deployments



Vyhledávání klíčových událostí

Overall Health Overview

LATEST TREND

Wireless Clients

96% i
Healthy

TOTAL: 1,699 i

Active: 1,470 | Inactive: 211 | New: 18 i

1.5K
Active
Clients

28 Not Onboarded

1,442 Onboarded

Good Connectivity 96%

Authentication 1.09% -
DHCP 0.27% -
Other 0.54% -
Fair Connectivity 2% -

[View Details](#)

Wired Clients

95% i
Healthy

TOTAL: 136

Connected: 136 | No Data: 0 i | New: 0 i

136
Connected
Clients

7 Not Onboarded

129 Onboarded

Good Connectivity 95%

DHCP 5.15% ■

[View Details](#)

Site Analytics – Client Health Dashboard

Site Analytics [Settings](#)

Select a KPI to filter the content below

🌐 Onboarding Attempts ⓘ

76%  (76%)

🌐 Onboarding Duration ⓘ

98%  (98%)

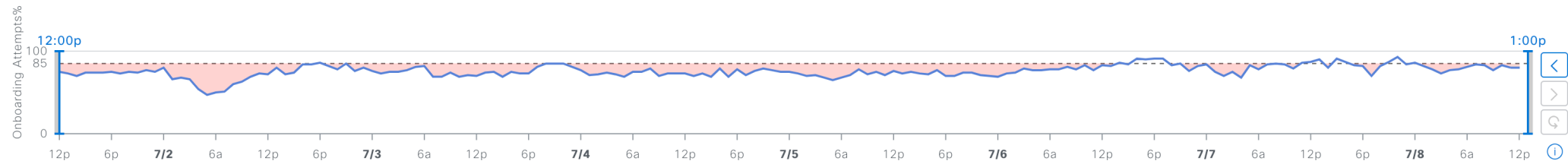
📶 Connection Speed ⓘ

--

🌐 Roaming Attempts ⓘ

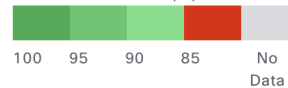
98%  (98%)

Onboarding Attempts



Sites (2)

KPI Value (%) ⓘ



Onboarding Attempts ▲

Onboarding Duration

Connection Speed

Roaming Attempts

Roaming Duration

Coverage

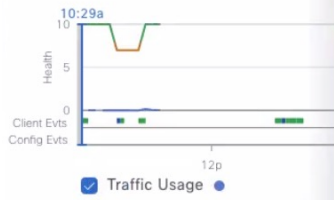
Violation Count ⓘ



New Client 360 KPIs

Client / Client 360

24 Hours



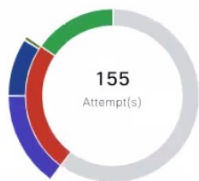
CLIENT DETAILS

Device: Apple-Device OS: Macintosh; Intel
Connected Network Device: [Redacted] SSID: [Redacted]

Summary

- Onboarding failed during DHCP
- Onboarding failed during Authentication
- Onboarding failed during Association
- Roaming failed during Authentication
- Poor Wi-Fi experience - high
- Poor Wi-Fi experience - low

Onboarding



View Details

Connectivity May 1, 2023 10:29 AM - May 2, 2023 10:29 AM Location: Select Location

RF QUALITY



TRAFFIC

RETRIES: 16.58% of the data traffic
DATA RATE: 99% of the time is Good

Legend: % of the time is Poor (Red), % of the time is Good (Green)



Legend: Retries Of this Client, Attempts of all clients in location, AP Associations of this client

Event Viewer

Current Data Selected: Location - Select Location Type - Connectivity Retries May 1, 2023 10:29 AM - May 2, 2023 10:29 AM

Export

May 2, 2023

>	● INTRA-WLC Roaming	10:18:18.538 AM - 10:18:20.710 AM
>	● DHCP	10:18:16.263 AM
>	● Onboarding	10:18:14.738 AM - 10:18:16.242 AM
>	● INTRA-WLC Roaming -- Incomplete	10:18:09.218 AM - 10:18:14.734 AM
>	● Onboarding	10:18:05.194 AM - 10:18:06.932 AM
>	● Onboarding -- Incomplete	10:15:47.328 AM - 10:16:41.755 AM
>	● Onboarding -- Incomplete	10:15:46.004 AM - 10:15:47.325 AM
>	● IP Learning	10:13:42.945 AM - 10:15:43.292 AM
>	● Onboarding -- Incomplete	10:13:36.308 AM - 10:13:42.943 AM

Total: 343 Events

INTRA-WLC Roaming

May 2, 2023 10:18:20 AM

Detailed Information

Status:

● Success

Details:

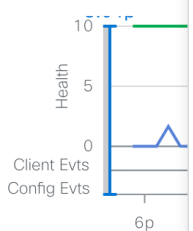
- WLC Name
- User Name
- IPv4
- Mac Address
- WLAN
- Radio
- VLAN ID/VNID
- AUTH Server

Maximum up to 10 KPIs can be selected at a time

Reset Selection



Client / User 3



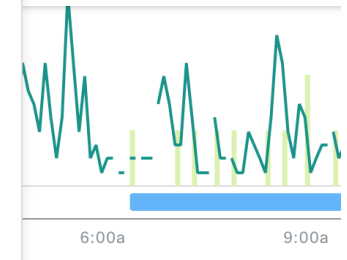
- Client Data
- Health
 - RSSI
 - SNR
 - Data Rate
 - Retries

- Access Points
- Health
 - CPU
 - Memory
 - Interference
 - Retries
 - Noise
 - Air Quality
 - Channel Utilization
 - Client Count
 - Tx Errors
 - Rx Errors
 - Tx Rate
 - Rx Rate
 - Tx Power
 - Port Utilization
 - Errors/Discards

- Wireless Controller
- Health
 - Memory
 - Client Count
 - AP Count

- Switches
- Health
 - Tx Utilization
 - Rx Utilization
 - Tx Errors
 - Rx Errors
 - Tx Discards
 - Rx Discards

- Network Services
- AAA Transactions
 - AAA Latency
 - DHCP Transactions
 - DHCP Latency



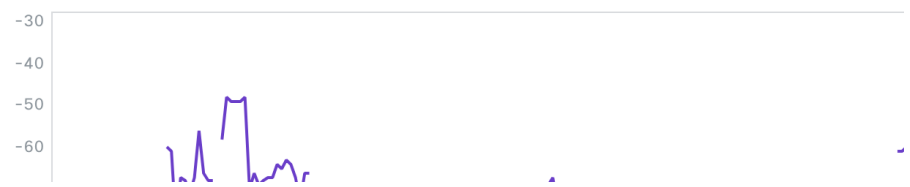
this client

2023 3:04 PM

46
Attempt(

View Details

Client RSSI Trendline



- AP- [Grey Box]
- AP- [Grey Box]
- AP- [Grey Box]
- Multiple APs Connected

● High Threats

● Honeypot (13)

Threats (588)





Threat Level	MAC Address	Vendor	Type	Source/Target	Detecting AP	Detecting AP Site	RSSI (dBm)	SSID	Clients	Containment Status	Last Reported
High	3C:E5:A6:1D:EF:70	Hangzhou H3C Technologies Co., Limited	Honeypot	-			-88		0	Open	Apr 11, 2022 03:46 pm
High	C6:AD:34:48:C4:B9	Routerboard.com	Honeypot	-			-84		7	Open	Apr 11, 2022 03:49 pm
High	4E:5E:0C:1C:C7:5C	Routerboard.com	Honeypot	-			-66		249	Open	Apr 11, 2022 03:41 pm
High	2E:C8:1B:43:67:ED	Routerboard.com	Honeypot	-			-89		0	Open	Apr 11, 2022 03:30 pm
High	4E:5E:0C:66:D3:F3	Routerboard.com	Honeypot	-			-66		235	Open	Apr 11, 2022 03:51 pm
High	C8:B5:AD:03:6E:C0	Hewlett Packard Enterprise	Honeypot	-			-89		2	Open	Apr 11, 2022 03:44 pm
High	4A:8F:5A:0F:CE:3A	Routerboard.com	Honeypot	-			-77		1	Open	Apr 11, 2022 03:49 pm

588 Records

 Show Records: 100 | 1 - 100 | 1 2 3 4 5 6

Site: Global

 Jul 8, 2023 12:35 PM - Jul 8, 2023 3:35 PM
 🕒 Last 3 hours
🔄 Refresh

Threats (3)



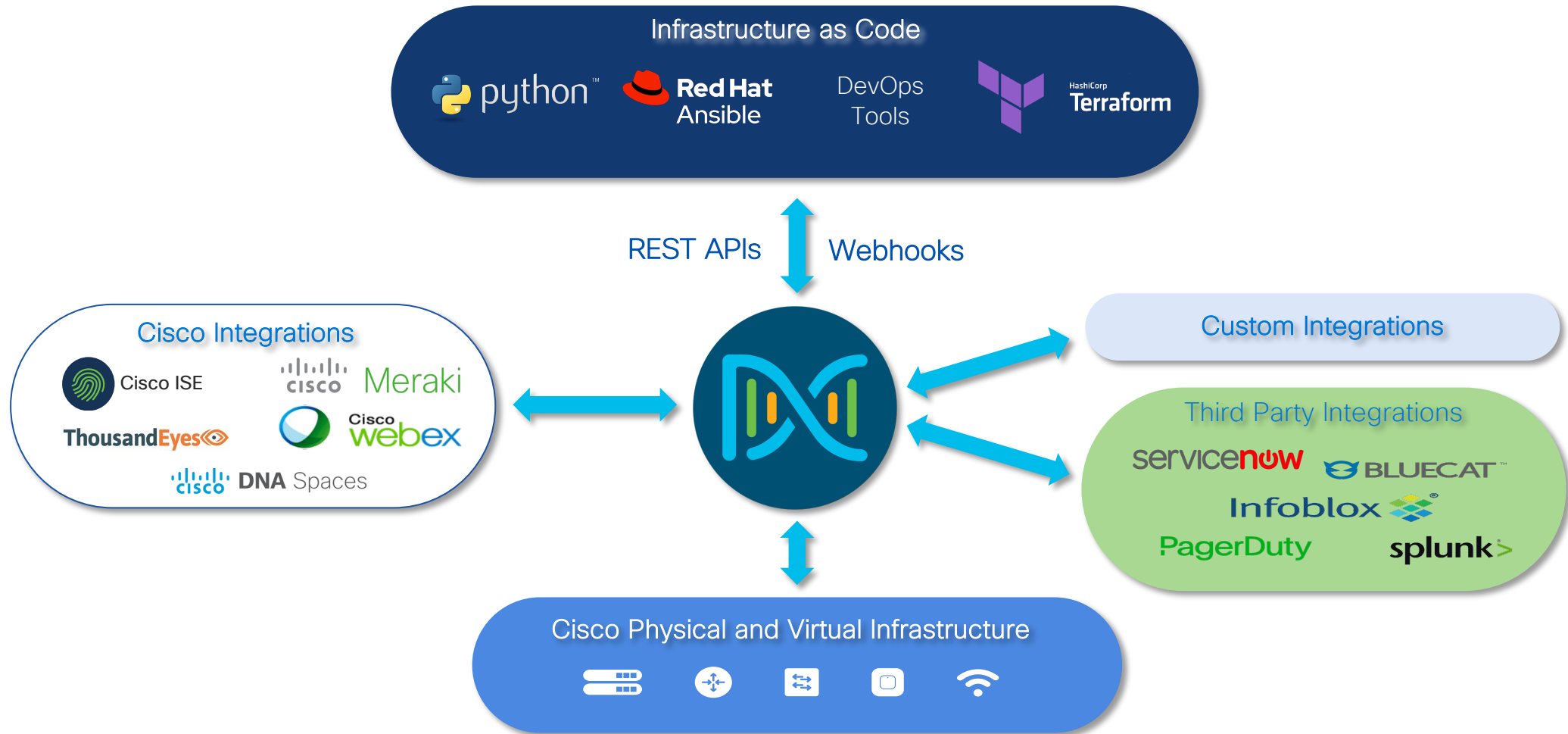
Type X

Threat Level X



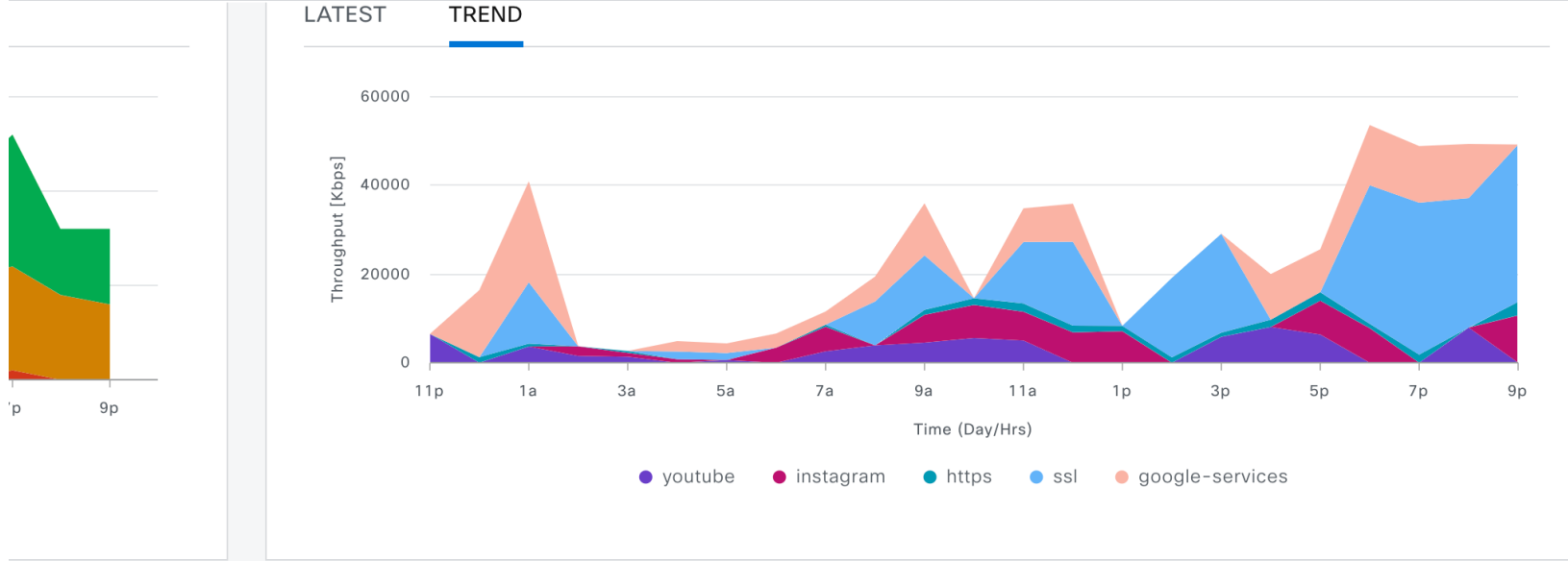
Threat Level	MAC Address	Type	Source/Target	Detecting AP	Detecting AP Site	RSSI (dBm)	SSID	Clients	Containment Status
High	3C:CD:57:94:33:FF	Rogue on wire	-			-51	Budoucnost patří aluminui!	3	Open
High	00:EB:D8:23:94:F1	Rogue on wire	-			-42	iPhone_8_256GB	2	Open
High	F8:D1:11:25:2F:32	Rogue on wire	-			-52	WiFi	-	Open

Cisco DNA Center Platform

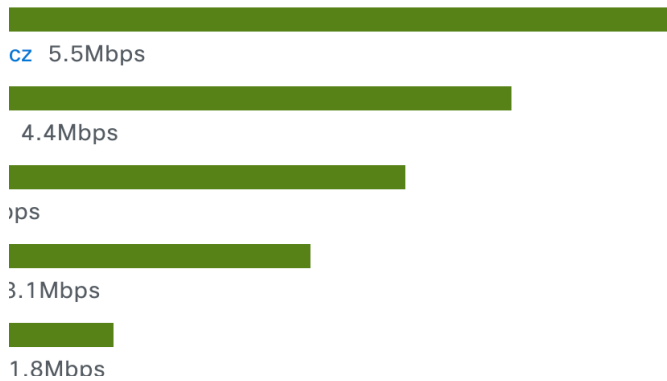


Analýza aplikací

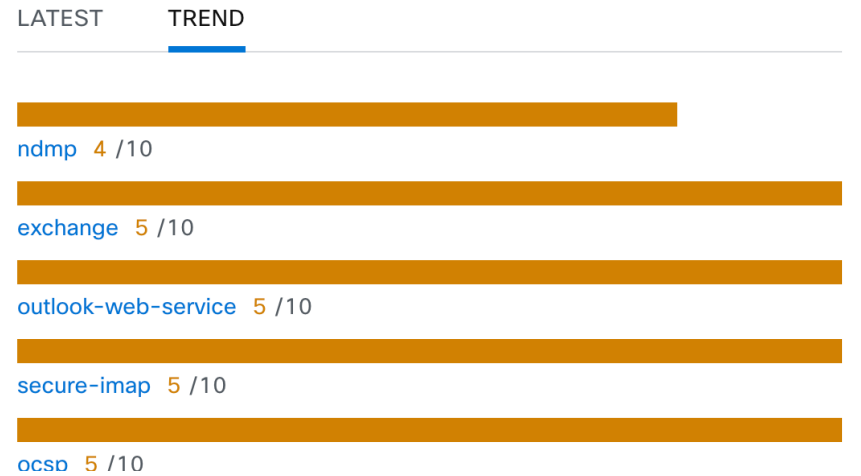
AI Analytics ▾



ts by Throughput



Worst Applications by Health 📘



Exporters



App Health: 6

Traffic Class: transactional-data

[Go to Device 360](#)

Usage: 2.2GB

Avg Throughput: 133.9Kbps

Packet Loss: 5 %

Jitter: --

Latency

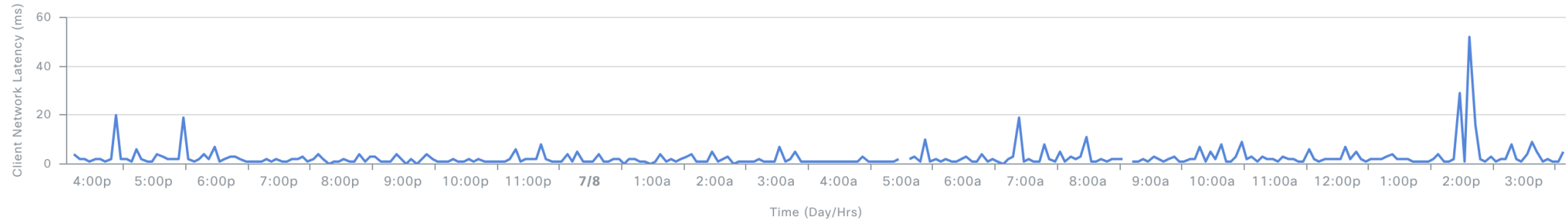


Usage

Threshold: 240 msec

Time (Day/Hrs)

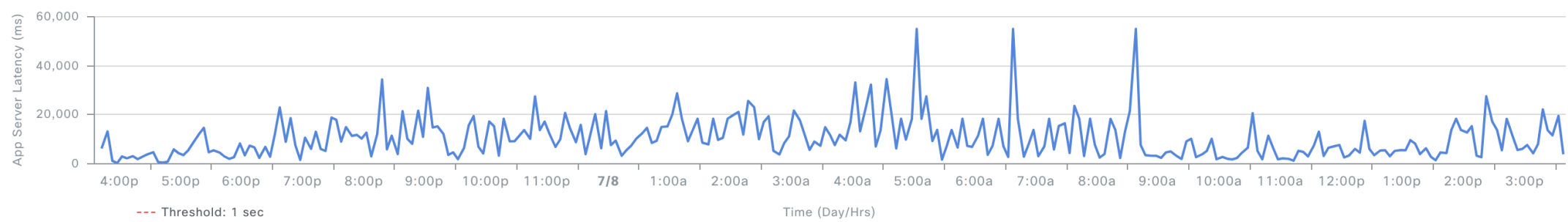
Client Network Latency



Server Network Latency



Application Server Latency



AppX: Microsoft Teams integration Client 360

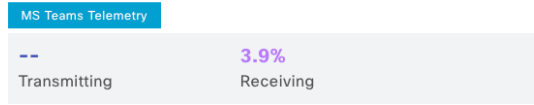
Meeting Name	MS Teams Score	Network APM Score	Duration	Start Time	End Time	Status	Meeting Type	Participants (#)
cisco lightt2 participated in a peer-to-peer call	10	10	00:05 h	May 16, 2022 9:10 AM	May 16, 2022 9:15 AM	Ended	Peer To Peer	2
cisco lightt2 participated in a peer-to-peer call	7	6	00:05 h	May 16, 2022 9:03 AM	May 16, 2022 9:08 AM	Ended	Peer To Peer	2
cisco lightt2 participated in a peer-to-peer call	7	6	00:05 h	May 16, 2022 8:49 AM	May 16, 2022 8:54 AM	Ended	Peer To Peer	2

CISCO LIGHTT2 PARTICIPATED IN A PEER-TO-PEER CALL

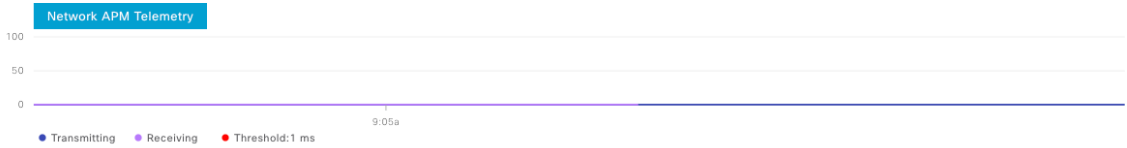
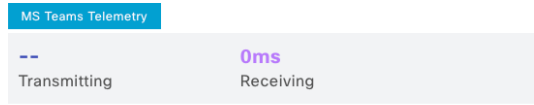
Audio Quality Video Quality Share Quality

7/10 MS Teams Score
6/10 Network APM Score
ASR1K_Site2.cisco.com , ISR4K_Site3.cisco.com Exporters

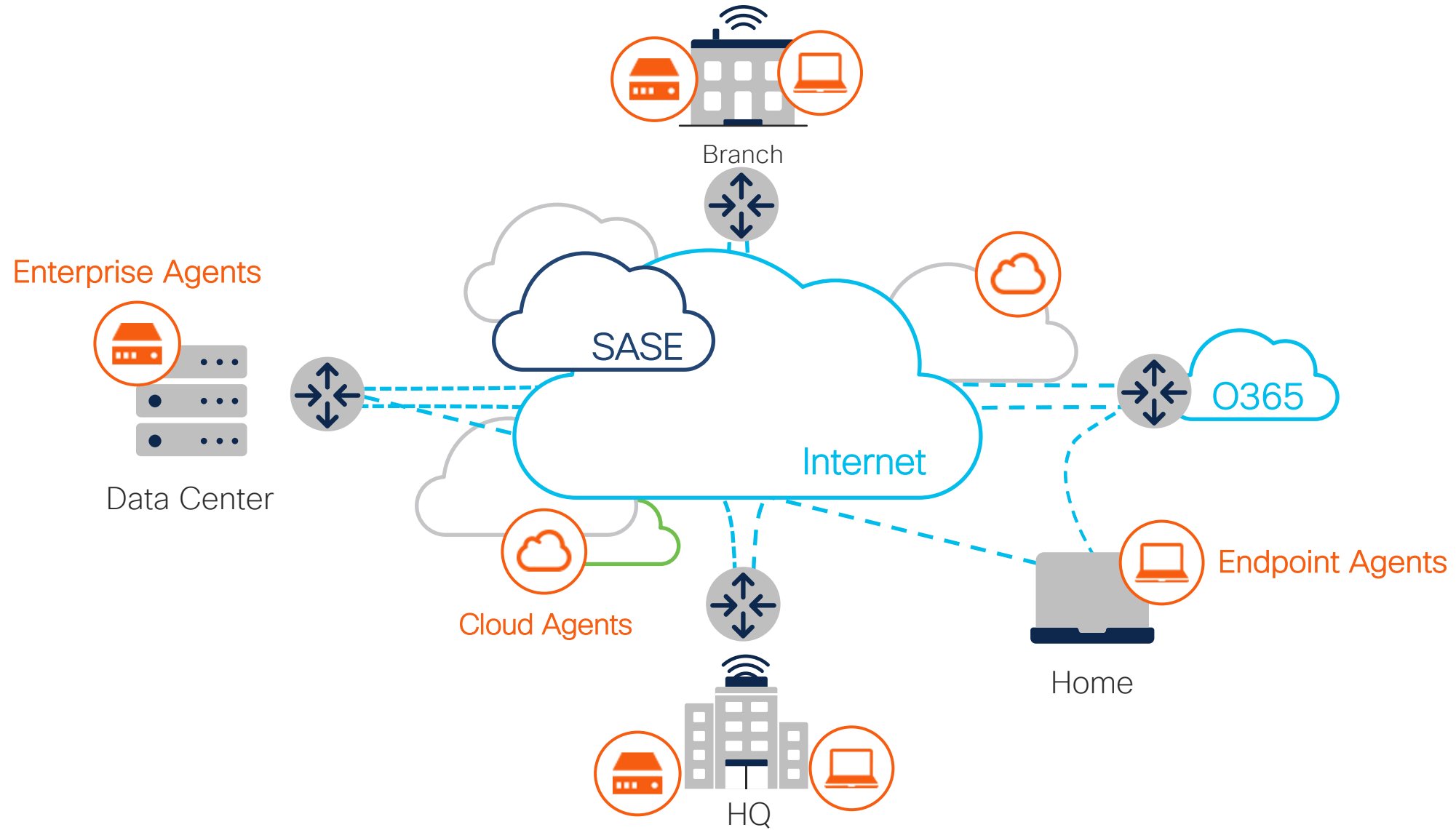
Packet Loss



Jitter



ThousandEyes



Novinky v řešení Cisco Catalyst

Data quality is a Billion dollar industry

Highly performant models requires high quality data with precise annotations

scale

sama

appen

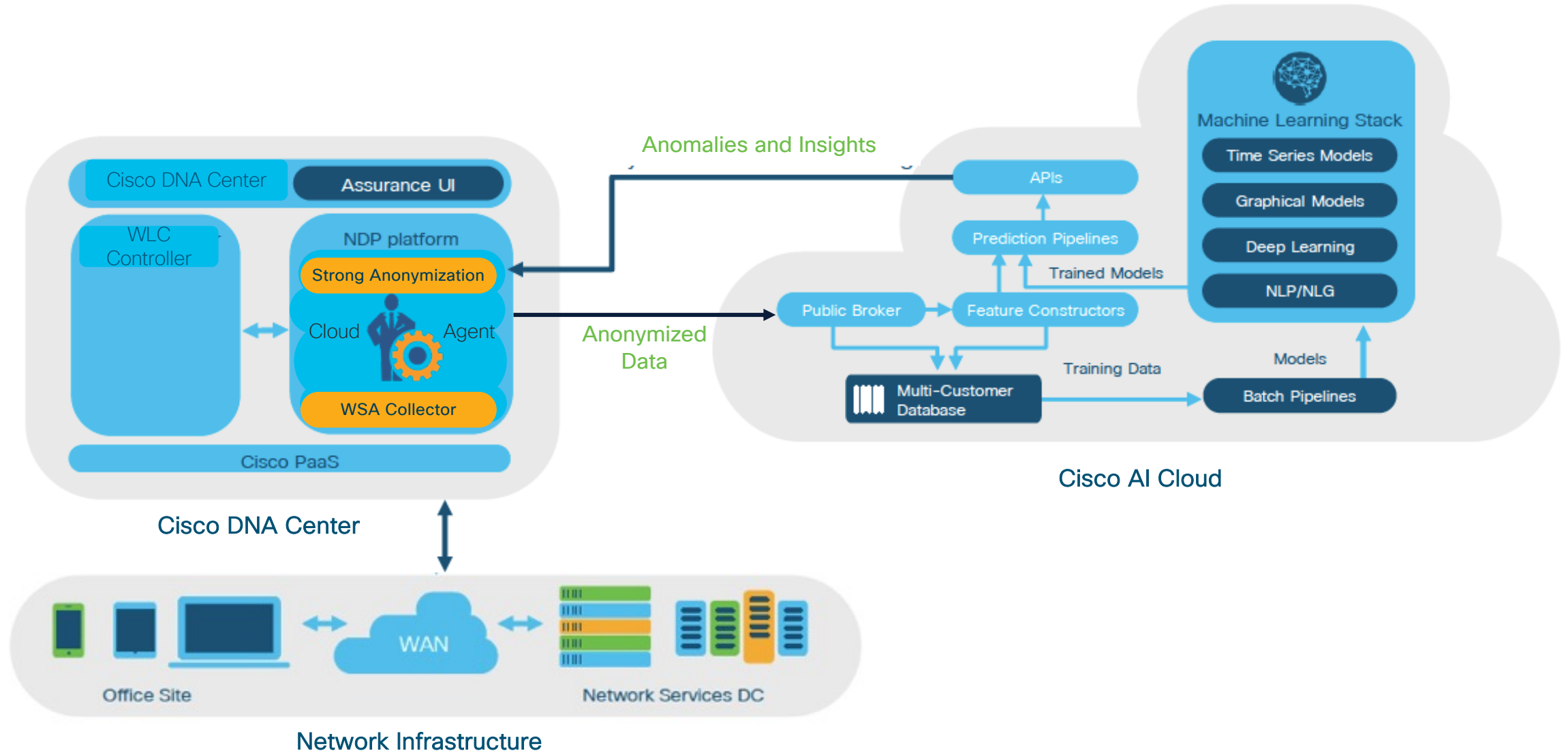
Better Data.
Better AI.

High-Quality
Training Data

World-Class
Training Data

ML nástrahy demo

Cisco AIOps Architecture



AI issues in issues dashboard

Open Resolved Ignored

Global 7 Days

Most Impacted Areas

San Jose

211 P2 1998 Open

San Francisco

166 P2 3493 Open

SITE-6Zc_

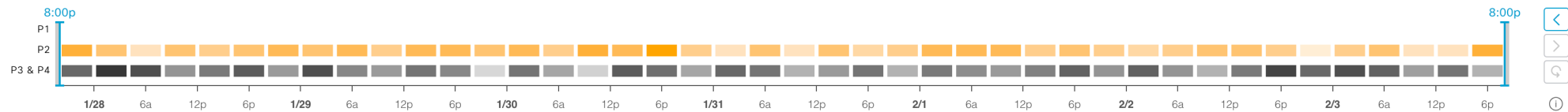
8 P2 10 Open

SITE-6Zc_

8 P2 10 Open

SITE-dGLo

7 P2 10 Open



Total Open: 5735

All P1: 0 P2: 447 P3: 5288 P4: 0

AI-Driven: 78

AI issues tab

Jan 27, 2021 8:00 PM - Feb 3, 2021 8:00 PM

Filter

Export

Priority	Issue Type	Device Role	Category	Issue Count	Site Count (Area)	Device Count	Last Occurred Time
P2	Radio High Utilization (5GHz)	ACCESS POINT	Utilization	377	2	9	Feb 3, 2021 7:20 PM
P2	AI Drop in total radio throughput	ACCESS POINT	Application	20	3	--	Feb 3, 2021 7:30 AM
P2	AI Excessive failures to connect - High deviation from baseline	WIRELESS	Onboarding	29	3	--	Feb 2, 2021 8:36 AM
P2	AI Excessive time to get an IP Address - High deviation from baseline	WIRELESS	Onboarding	12	0	--	Feb 1, 2021 11:45 AM

Extending visibility to Legacy and 3rd Party

Today¹

CY23

500 +

3rd Party

Inventory

Topology

SWIM

Inventory

Topology

1: Cisco DNA Center Version 2.3.4.1 and above
2: DNA device support does not alter or extend the device EoX timeline.

Flexible device ordering during SWIM upgrade

Challenge

- As a network administrator, I need flexibility in upgrading software images on my devices either sequentially or parallelly and also to abort image upgrades if upgrade fails on one of the devices.

Use Case

- User shall have option to select SW image upgrade order and be able to decide the sequence of operations for error handling

Details

- Support flexible device ordering (parallel /sequential) for upgrades
- Ability to move devices from Parallel upgrade to sequential upgrade process
- Ability to “abort/ continue on failure” of image upgrade in sequential activation order.

Workflows -> Image Update

The screenshot shows the 'Activation Order' section in the Cisco DNA Center Image Update workflow. It features a header with the title 'Activation Order' and a descriptive paragraph: 'You can use the filters to sort the devices and move them in either parallel activation order or sequential activation order. Once the devices are sorted you can reorder the devices in the sequential order'. Below this, there are two tabs: 'Parallel Activation Order' (which is selected and highlighted with an orange box) and 'Sequential Activation Order'. A search bar is present above a table of 3 selected devices. A button labeled 'Move to Sequential Update Order' is also highlighted with an orange box. The table has columns for Device Name, IP Address, Site, Device Series, Device Role, Device Tag, Current Image, Update Image, Update Support, and Comment. The data rows show three Cisco ASR 1000 Series Border Routers with IP addresses 48.2.3.21, 48.2.3.22, and 48.2.3.23, all with 'NA' for update support and 'Upgrade' as the comment.

The screenshot shows the 'Activation Order' section in the Cisco DNA Center Image Update workflow, now set to 'Sequential Activation Order'. The 'Parallel Activation Order' tab is unselected, and the 'Sequential Activation Order' tab is selected and highlighted with an orange box. A new section titled '3 devices in sequential order' is highlighted with an orange box, containing a toggle for 'Abort on Update Failure' (which is currently turned off) and a note: 'If update fails for any of the device, subsequent devices in sequential order will not be considered for update.' Below this, there is a search bar and a table with 0 selected devices. A button labeled 'Move to Parallel Update Order' and a 'Reorder list' button are visible. The table has columns for Device Name, IP Address, Site, Device Family, Device Role, Device Tag, Current Image, Update Image, Update Support, and Comment. The data rows show two Cisco ASR 1000 Series Border Routers with IP addresses 48.2.3.21 and 48.2.3.22, both with 'NA' for update support and 'Upgrade Readiness Report' as the comment.

Client 360- Latency per Client data

Challenge

- When Client is reporting Connectivity or Slowness issue, as a Network admin I would like to view and understand overall experience of that client for given time range and check its Latency across access categories and correlate if this issue is because of any problem in Network Devices or Network Services.

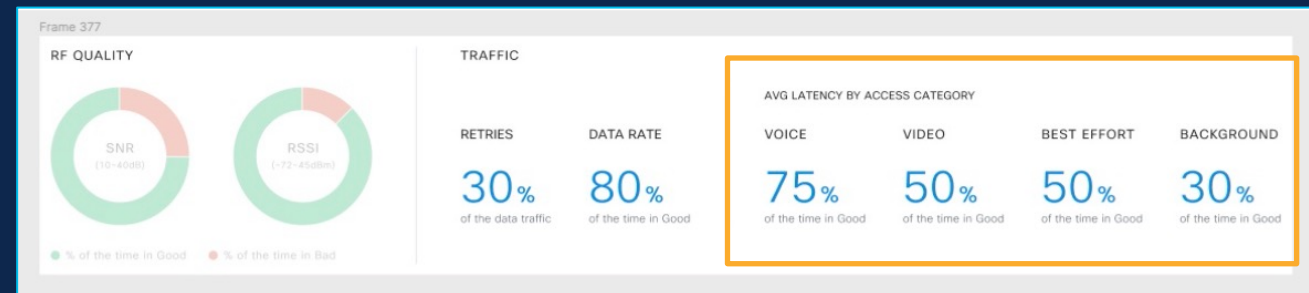
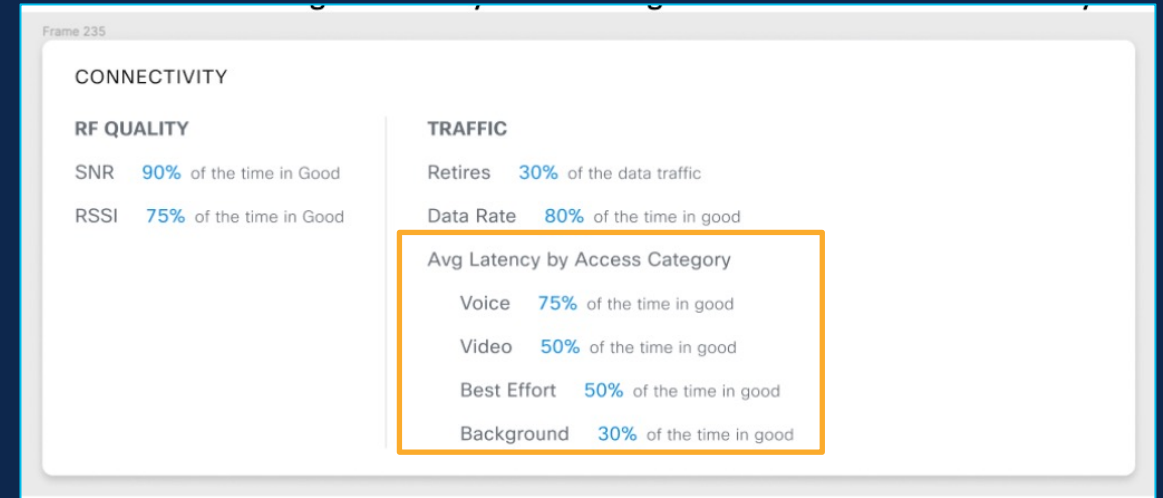
Use Case

- New Client latency Stats added to Client360 page under overall Summary. This will help customer to debug and correlate the Client connectivity and slowness issue.

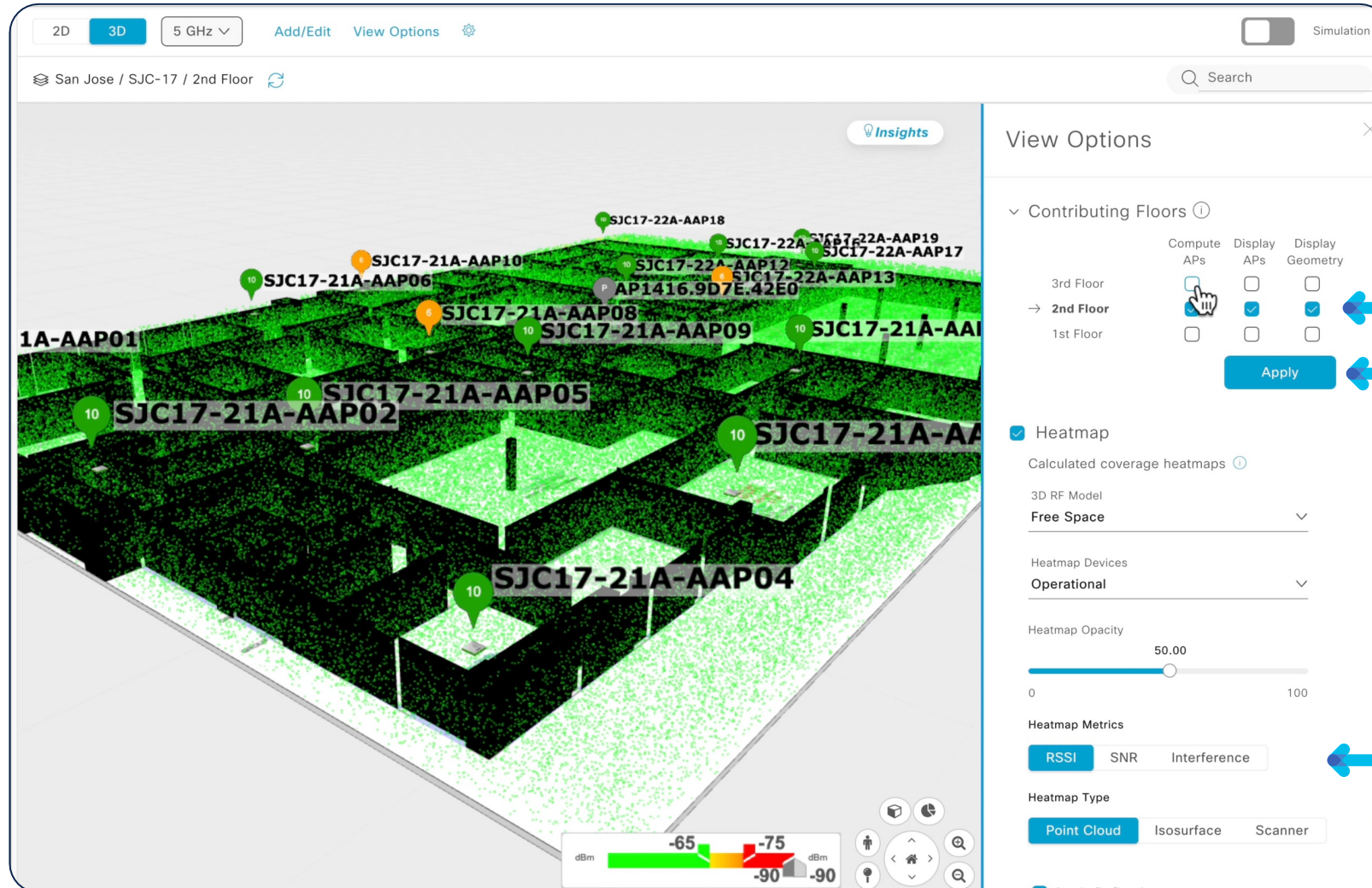
Details

- Ability to list client latency by access category on Client 360 screen
- Trendline to view the latency per client by category and band
- Client Latency stats comes every 5mins from AP to Controller and Cisco DNAC receives the data using "ClientRfStats" event

Assurance -> Dashboard -> Health -> Client



Wireless 3D Analyzer Multi-floor RF Penetration and Inter-floor Leakage



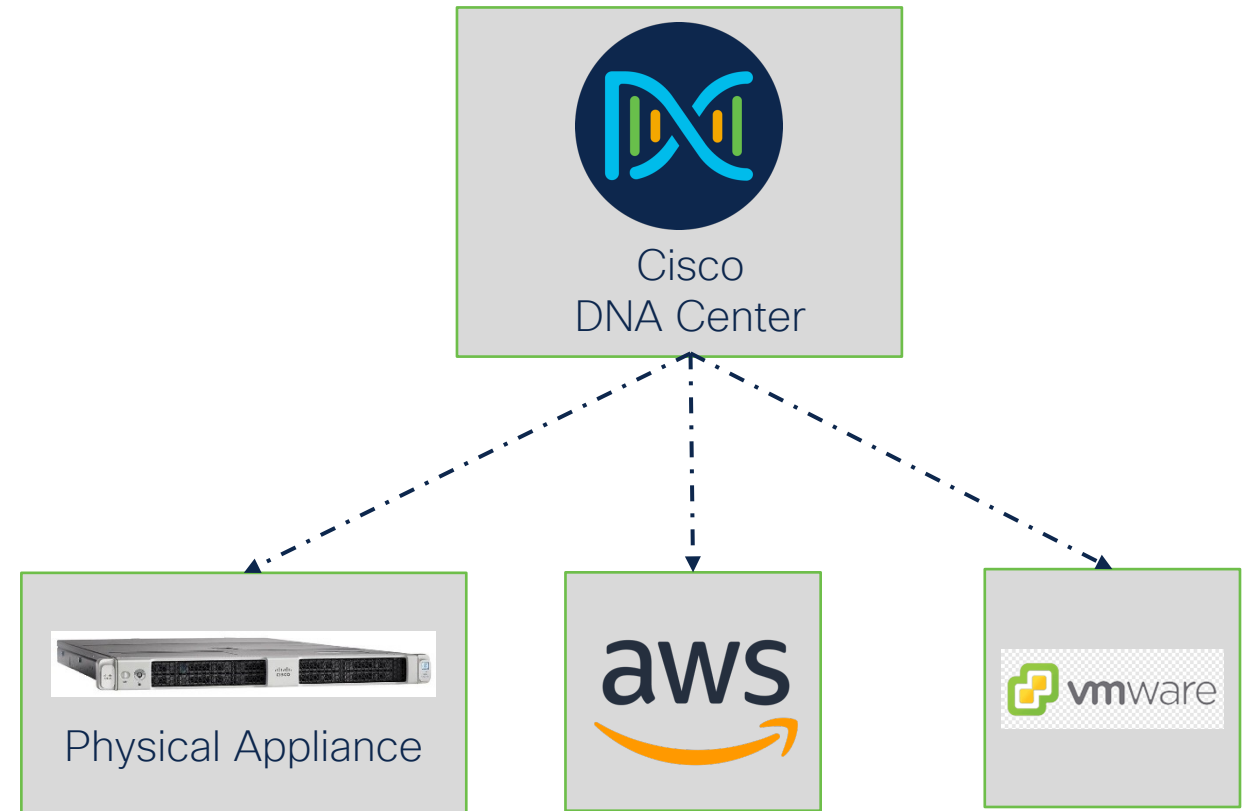
1 Select Floors Above & Below

2 Hit Apply

3 Select Leakage

Cisco DNA Center on ESXi Form Factor

- 1** Virtual Appliance running on customer's ESXi
- 2** Feature Parity and Upgrade Process same as Physical Appliance
- 3** Cisco DNA Center VA Cost - \$0
TAC/CX Support (Optional) - \$5000/VA/Year
- 4** VMware Licensing (customer)



Cisco Catalyst 9166D Access Point

Expanding Wi-Fi 6E to advanced RF environments



Cisco® Catalyst® 9166D

Directional, Tri-Radio with 12 Spatial Streams!



Penta-Radio Architecture

1. 2.4 GHz : 4x4:4SS
2. 5 GHz : 4x4:4SS
3. 6 GHz : 4x4:4SS (XOR to 5GHz)
4. Dedicated tri-band auxiliary radio
5. 2.4 GHz IoT Radio

Directional antenna architecture

- 2.4+5 GHz: 6 dBi gain (70x70 deg), 6 GHz: 8 dBi (60x60)*
- Same X,Y as CW9166I – and only 0.1cm taller!
- Wide support for pan/tilt combinations
- Accelerometer to determine AP tilt†



Internet of Things Capabilities

- Built-In Environmental Sensors
- USB port with 4.5 W power output

*2/5/6 mode

† SW support post-FCS

Transition ext. antenna deployments to 6E





Simple and clean installation – no antenna cables

C9800/DNA or Meraki Cloud

*2/5/6 mode

† SW support post-FCS

Software Support

Access Point	AP Mode	Cisco URWB	Cisco WGB
 IW9167E	Yes	Yes	Yes
 IW9167I	Yes		
 IW9165E		Yes	Yes
 IW9165D		Yes	

Wave1 AP support in 17.9.X & 17.12.X



Disruption free upgrade path to Wi-Fi6/6E



AP 1700, 2700, 3700
EOVSS/LDOS Apr 30,2024



AP 1572
EOVSS/LDOS Nov 30,2025

Why are we doing this

To simplify migration of legacy APs (Wave1) to current generation Wi-Fi 6/6E APs for customer impacted by supply chain delays, **no extension in life cycle**

What is new

- EOVS extended to LDOS . No change in LDOS dates
- Wave1 APs support in 17.9 release train starting 17.9.3
- Wave1 APs support extended to 17.12.x

What is supported

- Wave1 APs would operate with 17.9.3 & 17.12.x based WLC
- Solution matrix will be compatible with 17.9 release

What is unchanged

- Wave1 AP EOSM & LDOS dates
- Wave1 feature support (same as 17.3)
- April 2024 is LDOS, **need to continue update plans**

C9800-CL Private Cloud Ultra Low Template

What is supported?

FlexConnect, Local Switching only

Full feature parity with other deployment templates unless otherwise stated

Supported Hypervisors*

VMWare ESXi

KVM

NFVIS

Microsoft Hyper-V

(*) Public Cloud support on roadmap

Max APs Supported

100

Max Clients Supported

1000

vCPUs

2

Memory

4 GB

Storage

16 GB

Today's Wireless AIOps Focus Areas

By focusing on optimizing client experience, AIOps becomes a powerful user-centric solution!

Unified AI Engine (Cloud and on-prem)

The largest data-lake with the most sophisticated RF engine in the industry to easily handle the most demanding wireless deployments.

ClientOS Insights and Analytics

Leveraging Cisco's unique partnerships with Apple, Intel and Samsung to provide unique insights and analytics to help customers delineate between client vs network issues.

Optimize, Predict and Self-Heal

Providing AI-driven insights, recommendations, and automated actions to ensure a seamless wireless experience for any sized deployment.

