

Como solucionar os problemas de voz e vídeo sobre Wi-Fi



Flavio Correa, Technical Solutions Architect, CCIE Wireless #38913

Leonardo Ferreira, Technical Solution Architect, CCIE #

Wellington Assis, Technical Solution Specialist, CCIE Wireless #60252, CWNE #437

Agenda



- Otimização da Infraestrutura
- Atualização Tecnológica
- Como visualizar e entender os problemas que acontecem na rede da empresa
- Como visualizar e entender os problemas no cenário de trabalho híbrido

Otimização da Infraestrutura

Reclamações Comuns de Voz e Vídeo sobre Wi-Fi

- Minha chamada falha constantemente
- A qualidade da ligação está ruim
- O Microsoft Teams me avisa que a rede está ruim
- A qualidade do vídeo está péssima
- Não consigo usar a rede Wi-Fi neste escritório, prefiro utilizar a rede cabeada, pois esta sim funciona
- Na minha casa eu não tenho problemas

Estamos trabalhando para solucionar !



Usuário Final



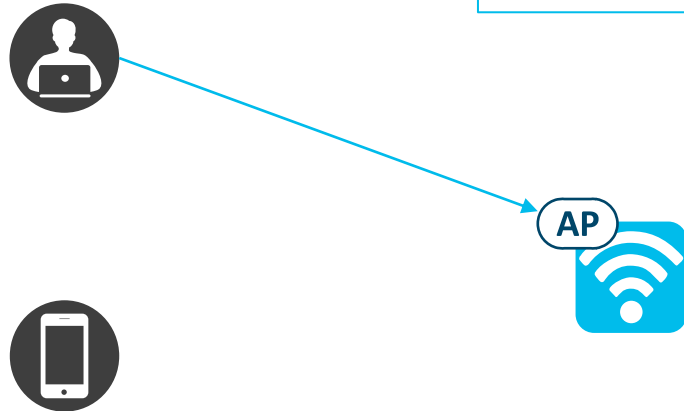
ADM de Rede

Meu Deus, o que eu faço agora? Por onde começar?

1º - Wireless QoS

- Como a rede Wi-Fi é um ambiente compartilhado, a parte de QoS nela opera de uma maneira diferente quando comparamos com a rede cabeada, justamente por ser um ambiente half-duplex onde vários dispositivos estão disputando o mesmo recurso, sendo assim, como priorizar especialmente as aplicações de voz e vídeo?

Sem o 802.11e (QoS over Wireless)



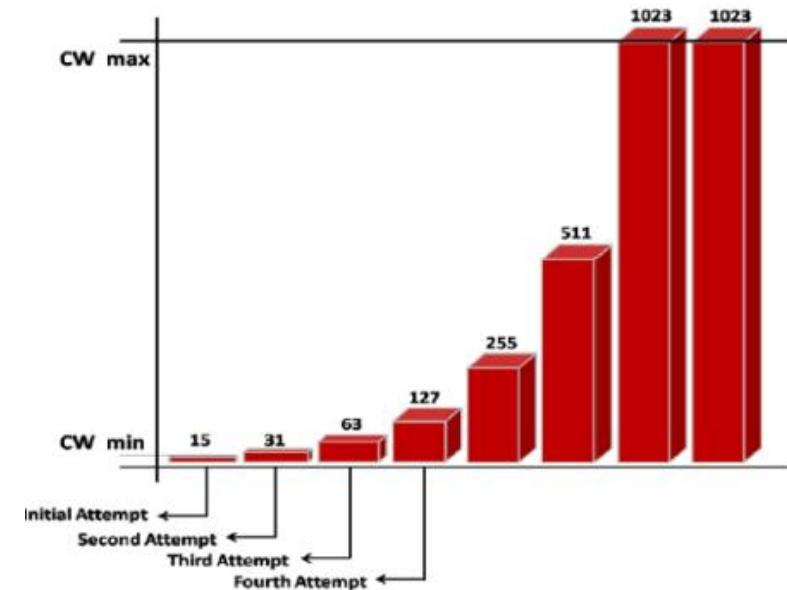
1º Tentativa : Tem alguém transmitindo....Vou aguardar uns 15ms (Sem priorização)

2º Tentativa : Continua tendo gente transmitindo....Vou aguardar uns 31ms

3º Tentativa : Ainda tem gente transmitindo.....Vou aguardar mais 63ms

4º Tentativa : Opa, agora sim não tem mais gente transmitindo, então é a minha vez

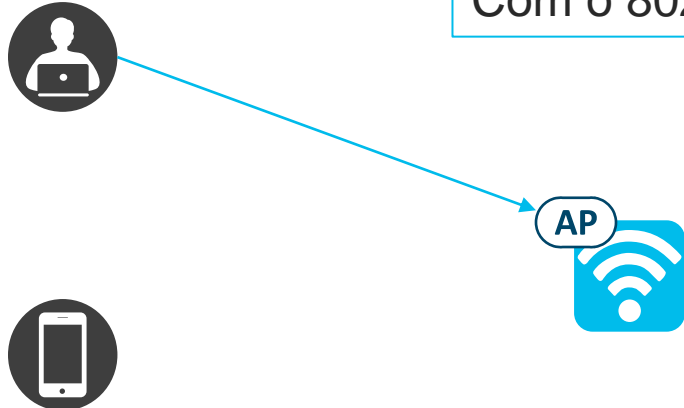
(somatória de tempo de espera até a transmissão = 109ms)



Contention Window/Backoff Timer

Wireless QoS

Com o 802.11e (QoS over Wireless) – Client-to-AP



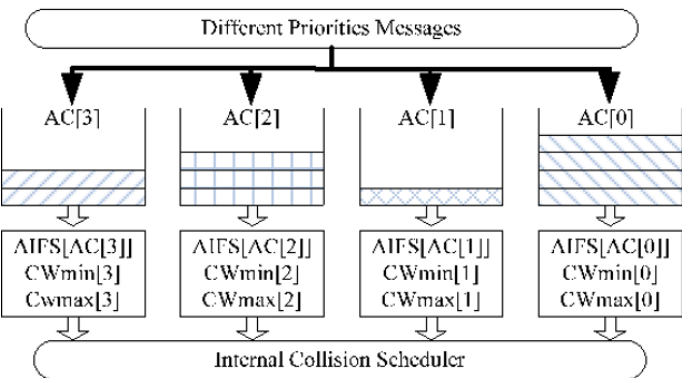
EDCA

AC	AIFSN	CWmin	CWmax
AC_BK	7	aCWmin	aCWmax
AC_BE	3	aCWmin	aCWmax
AC_VI	2	$(aCWmin+1)/2-1$	aCWmin
AC_VO	2	$(aCWmin+1)/4-1$	$(aCWmin+1)/2-1$

Background (AC_BK) → Background
 Best Effort (AC_BE) → Best Effort
 Video (AC_VI) → Video
 Voz (AC_VO) → Voz

- 1º Tentativa : Tem alguém transmitindo....Vou aguarda uns 2ms porque meu tráfego é de Voz (AC_VO)
 - 2º Tentativa : Continua tendo gente transmitindo....Vou aguardar mais 2 ms
 - 3º Tentativa : Opa, agora sim já posso transmitir
- (somatória de tempo de espera até a transmissão = 4ms)

109ms (Sem QoS) vs 4ms com QoS (Voz) - Upload



Wireless QoS

Com o 802.11e (QoS over Wireless) – Client-to-AP



AC	AIFSN	CWmin	CWmax
AC_BK	7	aCWmin	aCWmax
AC_BE	3	aCWmin	aCWmax
AC_VI	2	$(aCWmin+1)/2-1$	aCWmin
AC_VO	2	$(aCWmin+1)/4-1$	$(aCWmin+1)/2-1$

Annotations: A red box highlights the 'AC_VO' row, labeled 'DSCP'. Another red box highlights the 'AC_VO' row, labeled 'UP (802.11e)'. A red arrow points from the 'AC_VO' row to the 'AC_VO' row.

- 1º Tentativa : Tem alguém transmitindo....Vou aguarda uns 2ms porque meu tráfego é de voz
 - 2º Tentativa : Continua tendo gente transmitindo....Vou aguardar mais 2 ms
 - 3º Tentativa : Opa, agora sim já posso transmitir
- (soma de tempo de espera até a transmissão = 4ms)

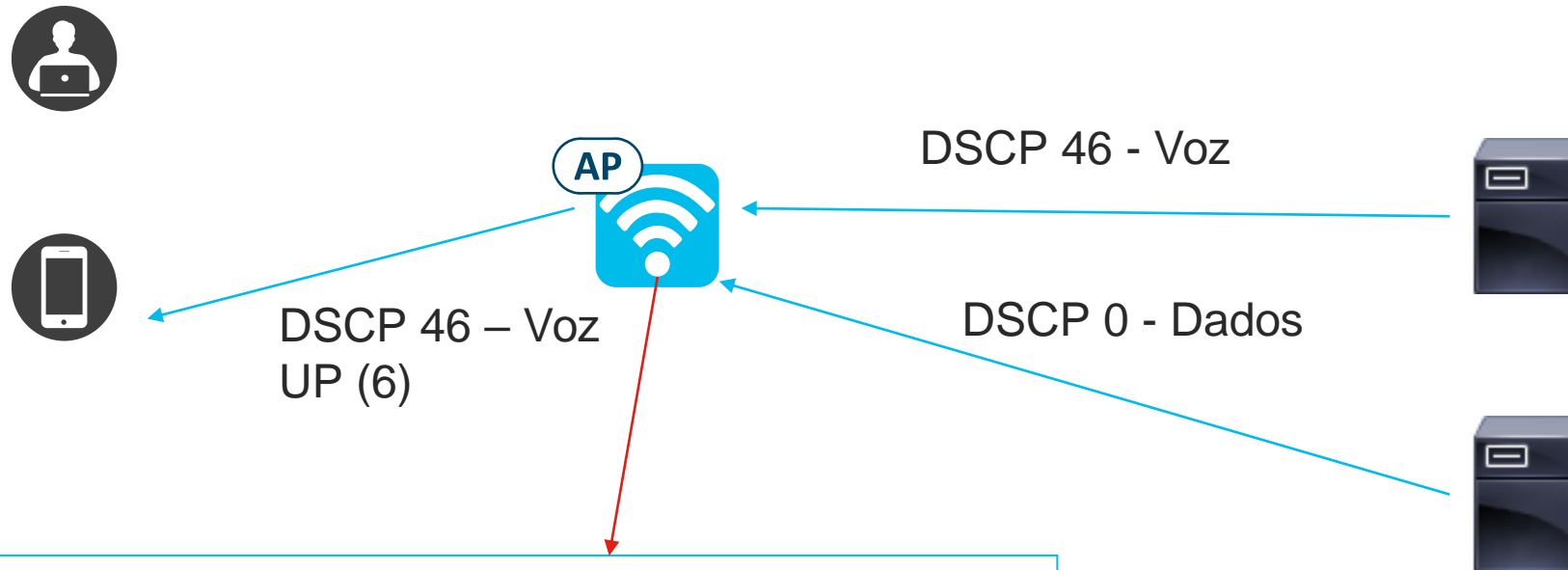
Access Point QoS Translation Values AVVID Traffic Type	AVVID IP DSCP	QoS Profile	AVVID 802.1p	IEEE 802.11e UP
Network control	56 (CS7)	Platinum	7	7
Inter-network control (CAPWAP control, 802.11 management)	48 (CS6)	Platinum	6	7
Voice	46 (EF)	Platinum	5	6
Interactive video	34 (AF41)	Gold	4	5
Streaming video	32 (CS4)	Gold	4	5
Mission critical	26 (AF31)	Gold	3	4
Call signaling	24 (CS3)	Gold	3	4
Transactional	18 (AF21)	Silver	2	3
Network management	16 (CS2)	Silver	2	3
Bulk data	10 (AF11)	Bronze	1	2
Best effort	0 (BE)	Silver	0	0
Scavenger	8 (CS1)	Bronze	0	1

Annotations: Red boxes highlight the 'AVVID IP DSCP' and 'IEEE 802.11e UP' columns. Arrows from these boxes point to the 'Internal Collision Scheduler' label below.

109ms (Sem QoS) vs 4ms com QoS (Voz) - Upload

Wireless QoS

Com o 802.11e (QoS over Wireless) – AP-to-Client

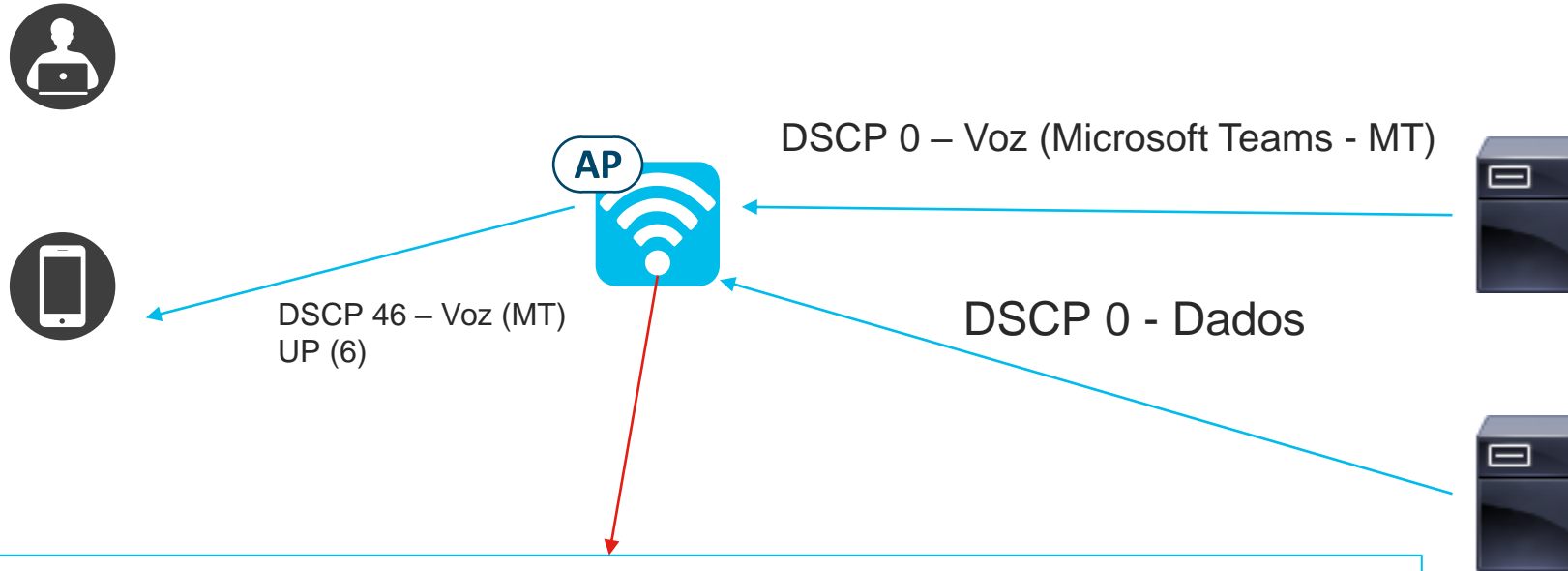


Recebi aqui dois pacotes, sendo um de voz e outro de dados, como o de dados está marcado com DSCP46 vou prioriza-lo na transmissão.

(Lembrando que o AP também aguarda sua vez antes de efetuar a transmissão, ou seja ele também efetuará a contagem com base na marcação)

Wireless QoS - AVC

Com o 802.11e (QoS over Wireless) – AP-to-Client



Recebi aqui dois pacotes, sendo dois deles com marcação de DSCP 0, no entanto tem um deles que a aplicação é o Microsoft Teams, logo vou remarcar e priorizá-lo em minha transmissão

(Lembrando que o AP também aguarda sua vez antes de efetuar a transmissão, ou seja ele também efetuará a contagem com base na marcação)

WLC – EDCA e AVC

- Ajustar o EDCA para Voice & Video ou Fastlane

Configuration > Radio Configurations > Parameters

5 GHz Band 2.4 GHz Band

EDCA Parameters

EDCA Profile: optimized-voice

DFS (802.11h)

Edit NetFlow

Netflow Template: Wireless avc basic

Local Exporter

External Exporter

Collector Address*

Exporter Port*

- Wireless avc basic
- Security
- Capacity Planning
- StealthWatch
- TrustSec IPv4
- TrustSec IPv6
- Encrypted Traffic
- Analytics
- Wireless avc basic

Configuration > Services > NetFlow

Netflow Template	Interfaces/Profiles	Collector	Export Interface IP	Sampling Method	Sampling Range/ACL Name	Exporter Port
<input type="checkbox"/> Wireless avc basic	Not Assigned	10.91.104.105	10.70.0.211	NA	NA	9995
<input type="checkbox"/> Wireless avc basic	avc-tme- profile , default-policy- profile		10.70.0.211	NA	NA	9995

- AVC

Cisco Catalyst 9800-CL Wireless Controller

Application Visibility

Enable AVC: 3

Available (1): default-policy-profile

Enabled (3):

Profiles	Visibility	Collector Address
REQ-TME-Lab_WLAN	<input checked="" type="checkbox"/>	Local <input checked="" type="checkbox"/> External <input type="checkbox"/>
REQ-TME-Lab_WLAN	<input checked="" type="checkbox"/>	Local <input checked="" type="checkbox"/> External <input type="checkbox"/>
REQ-TME-Lab_WLAN	<input checked="" type="checkbox"/>	Local <input checked="" type="checkbox"/> External <input type="checkbox"/>

Configuration > Services > Auto QoS

Auto QoS: Disabled

Policy Name*: qos-rate-limit

Description: Rate-limit-qos

Match Type	Match Value	Mark Type	Mark Value	Police Value (kbps)	Drop	AVC/User Defined	Actions
<input type="checkbox"/> application-group	cisco-jabber	DSCP	46	5000	Disabled	AVC	
<input type="checkbox"/> protocol	apple-pay,box,hulu	None	8		Enabled	AVC	
<input type="checkbox"/> DSCP	46	DSCP	46	5000	Disabled	User Defined	

Class Default

Mark: DSCP, Value: 46, Police(kbps): 5000

Available (3): eogre-policy, eogre-vw-policy

Selected (2): avc-tme, default-policy-profile

2° Endpoint - Microsoft Teams - QoS

Implement Quality of Service (QoS) in Microsoft Teams clients

Article • 08/26/2021 • 4 minutes to read • 9 contributors • Applies to: Microsoft Teams



You can use policy-based Quality of Service (QoS) within Group Policy to set the source port range for the predefined DSCP value in the Teams client. The port ranges specified in the following table are a starting point to create a policy for each workload.

Table 1. Recommended initial port ranges

Media traffic type	Client source port range	Protocol	DSCP value	DSCP class
Audio	50,000–50,019	TCP/UDP	46	Expedited Forwarding (EF)
Video	50,020–50,039	TCP/UDP	34	Assured Forwarding (AF41)
Application/Screen Sharing	50,040–50,059	TCP/UDP	18	Assured Forwarding (AF21)

<https://docs.microsoft.com/en-us/microsoftteams/qos-in-teams-clients>

Endpoint - Webex Teams - QoS

Webex app (Teams) for Windows - UDP Source Port Differentiation **Enabled****

Not Default
Recommended



Attributes	Windows QoS Policy	NOTES
Application name	CiscoCollabHost.exe*	*Application sits in a user directory and Windows QoS Profiles do not recognize %USERPROFILE% variable.
Protocol	UDP	
Source Port Range Audio	52000 to 52099	Workaround: As such one can create a generic QoS profile based on source and destination UDP ports ONLY selecting ANY as the application name.
Source Port Range Video	52100 to 52299	
Destination Port	5004	
DSCP value	46 (EF) Audio / 34 (AF41) Video	

- Create a separate QoS profile for Audio and Video/Share as each have different source port range to mark traffic differently.
- UDP Source Port Differentiation for Windows is enabled by the BU at this time.

****Windows Clients:** UDP Source Port Differentiation Enablement. Contact your local account team if you would like this enabled for your organization. Without enablement Audio and Video/Share cannot be differentiated by Windows QoS Policies (GPO) because the source ports will be the same for audio/video/share.

Endpoint – Google Meeting - QoS

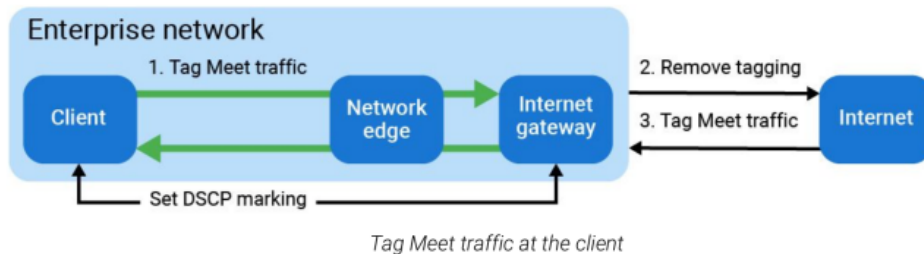
If QoS must be used

If your network is congested and you must secure a certain quality of service (QoS) for Meet, take one of the following actions:

- Add QoS on Meet clients.
- Add QoS at the network edge.

Add QoS on Meet clients

Meet traffic is tagged on the client machines for QoS within the enterprise network. The QoS tags are removed when the traffic is sent to the internet. Incoming Meet traffic is tagged when it enters the enterprise network.



1. Set a DSCP marking through a **Windows QoS Policy** in the Group Policy Management Console. (Identify Meet traffic using Meet's port range.)
2. Remove the DSCP tagging traffic that leaves your internal gateway to the internet.
3. Tag Meet traffic received from the internet. This is the real-time transport (control) protocol (RTP/RTCP) traffic that uses the Meet port ranges.

- For media (audio and video), set up outbound UDP ports 3478 and 19302–19309. If you want to limit the number of Chrome WebRTC ports being used, see [Chrome WebRTC UDP Ports setting](#). Alternatively you can limit those ports via your firewall.

<https://support.google.com/a/answer/1279090?hl=en#zippy=%2Cstep-set-up-outbound-ports-for-media-traffic%2Cqos-best-practices>

Endpoint – Iphone - QoS

Cisco Fastlane MDM settings for Apple devices

You can configure Cisco Fastlane settings for Wi-Fi connections in iPhone and iPad devices and computers enrolled in a mobile device management (MDM) solution. Cisco Fastlane settings device to automatically connect specific apps to Cisco Fastlane networks.

Setting	Description	Required
Cisco Fastlane marking	<p>You can do the following with Cisco Fastlane marking:</p> <ul style="list-style-type: none">• Disable Cisco Fastlane• Allow all apps• Allow only approved apps for audio and video calls. <p>Those apps must be configured to take advantage of Cisco Fastlane on Cisco corporate networks. You install this payload in a configuration profile that allows specific business apps to get priority. The Cisco network looks for these markings and provides the correlated service level.</p>	Yes

5. Optionally, create a QoS profile using Apple configurator or your MDM software and deploy it to the iOS 10 client. The QoS profile needs to match the target SSID name. For example, you can use Apple Configurator 2.3 or later to create a profile on MacOS. In the Wi-Fi section of the profile, you can configure the target SSID and choose which apps should be whitelisted. The example below creates a profile for the Mynet SSID, whitelists Cisco Jabber (Jabber will mark QoS). As Apple Audio and Video Calling is disabled, Wi-Fi calling and Facetime will not mark QoS (disabling Apple Audio and Video Calling is not recommended practice, but an example for the purpose of this guide):

7. Verify that

- iPad and iPhone device running iOS 10 or higher mark QoS for applications in the whitelist, and send traffic for applications outside of the whitelist as best effort or background
- iPad and iPhone device running iOS 10 or higher, marking upstream traffic DSCP 46/UP6, receive downstream traffic also marked DSCP46/UP6, even if ACM is enabled and the iOS 10 client did not request a level of service through TSPEC/ADDTS.
- iPad and iPhone device running iOS 9 or lower may mark upstream traffic. However, returning traffic for the Voice queue will be sent as best effort, following the WMM specification.
- Non-iOS device may mark upstream traffic. However, returning traffic for the Voice queue will be sent as best effort, following the WMM specification, unless the non-iOS device performed an initial ADDTS request that was accepted.
- Regardless of their upstream marking, well-known applications such as Jabber receive the correct (as recommended by RFC 4594 and draft-szigetti-ieee-802-11-01) downstream marking, if Application and Visibility is enabled on the WLAN.
- These verifications are best conducted by capturing the WLAN channel traffic. On a MacOS laptop, you can use a combination of Wireshark to capture frames, and Airtool to configure the channel to capture:

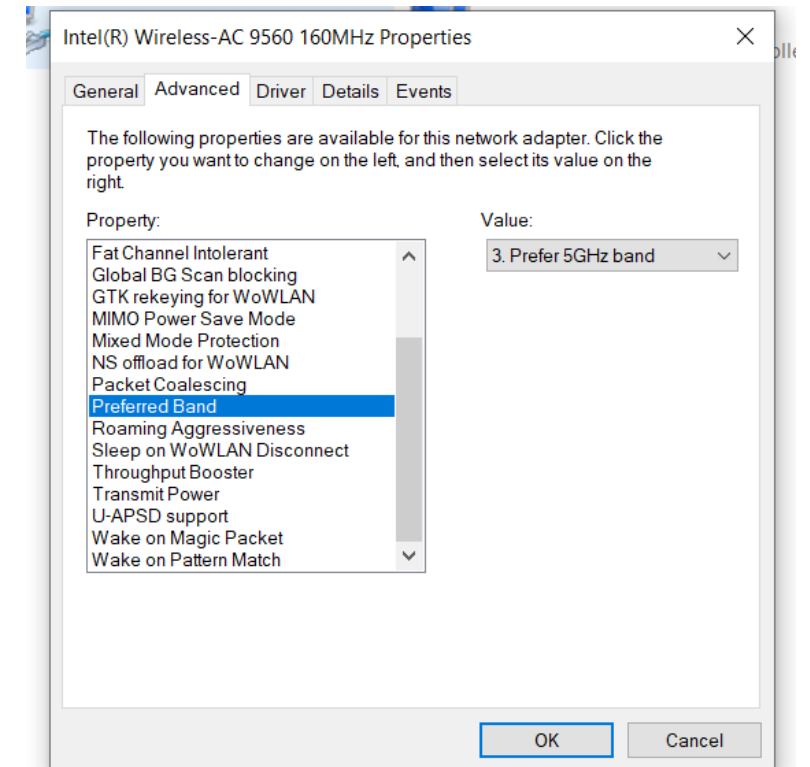
Endpoint – Atualização de Driver e Priorização de 5 GHz

- Driver Recomendado – Dell – Latitude 3420

<input type="checkbox"/>	NOME	GRAVIDADE	CATEGORIA	DATA DO LANÇAMENTO	AÇÃO
<input type="checkbox"/>	Intel AX211/AX210/AX200/AX201/9260/9560/9462 Wi-Fi UWD Driver	URGENTE	Rede	09 May 2022	Download ⓘ
<input type="checkbox"/>	Killer AX1650-1690 and Intel AX211-3165 Bluetooth UWD Driver	URGENTE	Rede	09 May 2022	Download ⓘ
<input type="checkbox"/>	Qualcomm QCA61x4A/QCA9377 Wi-Fi and Bluetooth Driver	RECOMENDADA	Rede	10 May 2022	Download ⓘ
<input type="checkbox"/>	Driver de Wi-Fi e Bluetooth para Realtek RTL8821CE e RTL8822CE	RECOMENDADA	Rede	06 Jan 2022	Download ⓘ
<input type="checkbox"/>	Driver do controlador Ethernet PCIe Realtek	RECOMENDADA	Rede	05 Jan 2022	Download ⓘ
<input type="checkbox"/>	Driver do controlador Ethernet PCIe Intel	RECOMENDADA	Rede	24 Nov 2021	Download ⓘ

<https://www.dell.com/support/home/pt-br/product-support/product/latitude-14-3420-laptop/drivers>

- Priorizar a conexão em 5 GHz



3° – Project for Coverage vs Capacity

- Coverage
 - Distance of a useable transmitted signal
- Capacity
 - Number of devices utilizing X bandwidth concurrently

Coverage can be affected by:

- Antenna type, gain, user station capabilities

Capacity can be affected by:

- Client count, applications and bandwidth requirements, channel planning and channel width, coverage overlap

4° - Capacity Design

“How many clients need how much bandwidth for which applications?” It depends !! Could be 30, or 60 or 100.

APs can logically support 512 client associations

Density

- **Standard** (20-45 clients per AP)
- **High Density** (45-75 devices per AP)
 - Default assumption for design
- **Very High Density** (75-100 devices per AP)
 - Auditorium, Gyms, Cafeterias
- **Ultra High Density** (100+ devices per AP)
 - Stadiums, Arenas

Airtime Consumption

- Bandwidth required / bandwidth capability (i.e. 3Mbps streaming service / 70 Mbps device throughput = 4.2% consumption)
- AP is considered ‘maxed out’ at 80% airtime consumption (e.g. $80 / 4.2 = 20$ clients per radio, or 40 clients per AP)

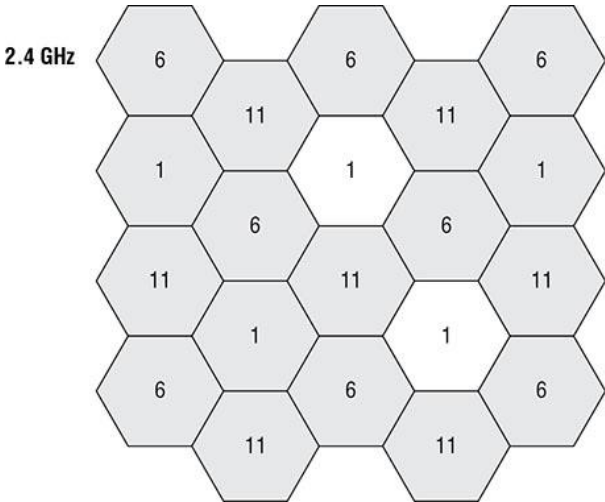
High Throughput - 25 clients is gold standard for higher MCS rates

5° - Channel Design

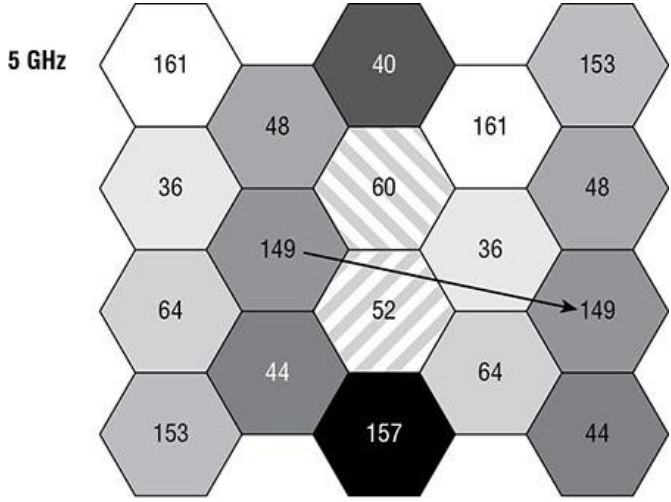
Adjacent Channel Interference
Co-Channel Interference (CCI)

The overlap of frequency use by neighboring channels
The cross-talk of two APs using the same channel near each other

3 Non-overlapping channels



25 Non-overlapping 20 MHz channels 12 Non-overlapping 40 MHz channels



Distance to cell with same channel is at least two cells.

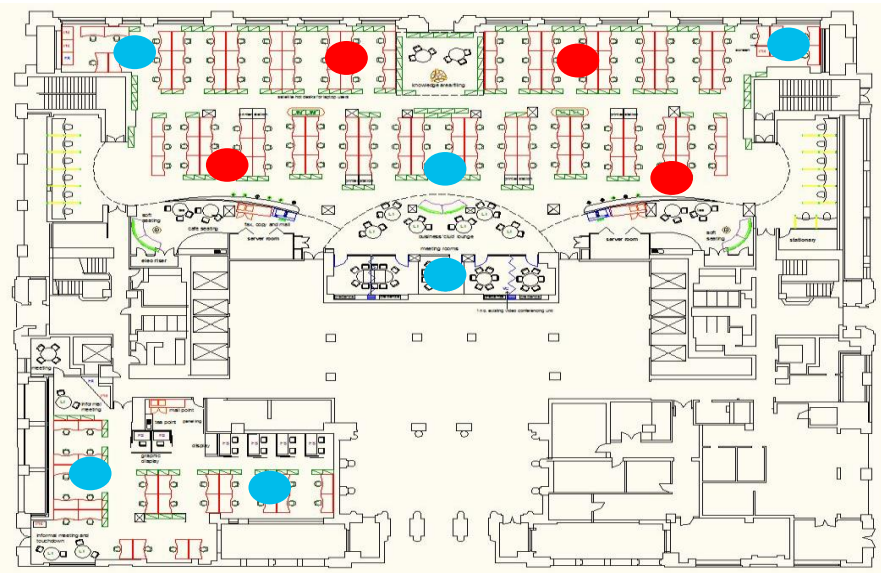
6° - Office Design

Primary Objectives

Coverage or Capacity	Depends (typically capacity)
Signal (RSSI)	Coverage -67 dBm Capacity -65 dBm
SNR	25 (Minimum)
AP Distance	8~12 m
Clients per AP	40
Roaming	Seamless
Data rate	High
Other	Reduce airtime consumption

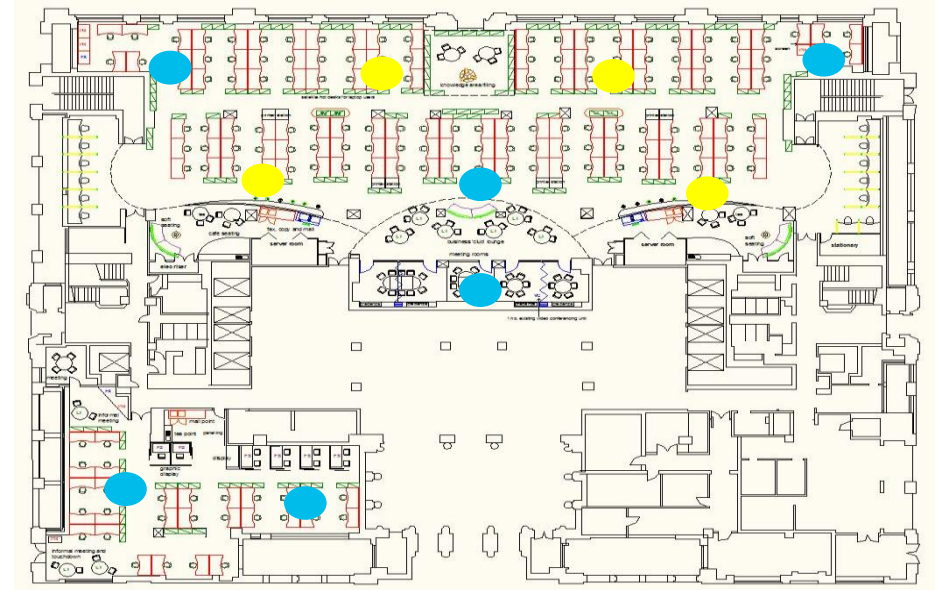
Wi-Fi Design – Best Practices

- ❑ Office High Density Deployments (FRA feature – Highly Recommendable)
 - ❑ For this kind of situation is better for us to use omnidirectional antennas, but adopt some strategies to reduce CCI and increase performance such as Dual 5 GHz APs (High Recommended), reduce tx power level and channel width, allowing better experience
 - ❑ It is highly recommended to prioritize 5 GHz frequency in these environments and if the customer doesn't have an Access Point with Dual 5 GHz support (9120 / 9130), you could disable some radios in 2.4 GHz to reduce CCI in this frequency as well
 - ❑ Remember 2.4 GHz has a wide range much better than 5 GHz and disabling some radios with the correct planning will not generate more issues in the customer's environment and probably will solve them



Without FRA

- 2.4 / 5 GHz
- 5 GHz Only
- Dual 5 GHz



With FRA

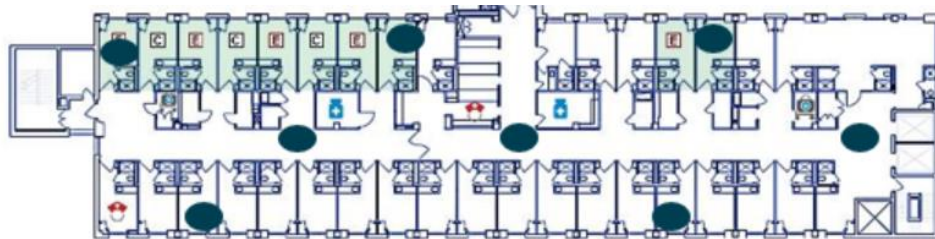
Wi-Fi Design – Best Practices

❑ Triangular vs Linear Distribution

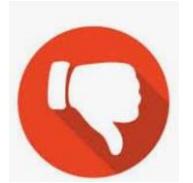


❑ Triangular

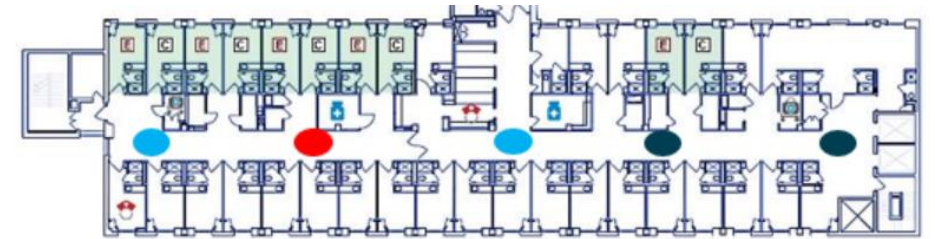
- ❑ It is considered a best practice
- ❑ Ensuring WI-FI coverage even some APs failing
- ❑ Avoid AP power level reduction by Tx Power Algorithm after have been deployed
- ❑ Less interference and better cell overlapping and less roaming issues
- ❑ Avoid coverage fails in strategic areas
- ❑ Better WI-FI devices distribution per AP
- ❑ Used for Location Services



❑ Linear



- ❑ It is not consider a best practice
- ❑ Fails of coverage in rooms because the APs are in the corridors
- ❑ When some AP fails the another will not cover the affected area impacting Wi-Fi network
- ❑ Power level reduction by RRM and Tx Power algorithms because the WLC will detect APs too close each other impacting some areas
- ❑ To maintain the coverage will be necessary to fix the AP power level in higher values creating more CCI between cells impacting the users, also the WLC will not perform your RRM and Tx power algorithms to control channels and power level

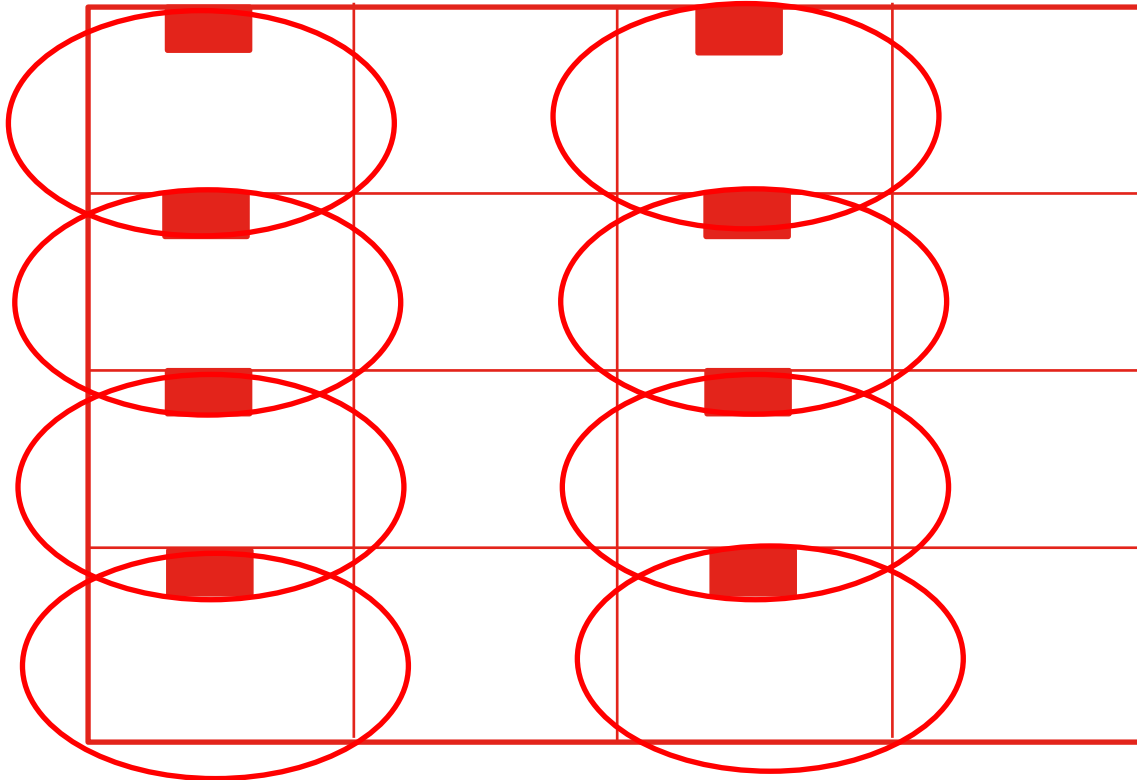


Wi-Fi Design – Best Practices

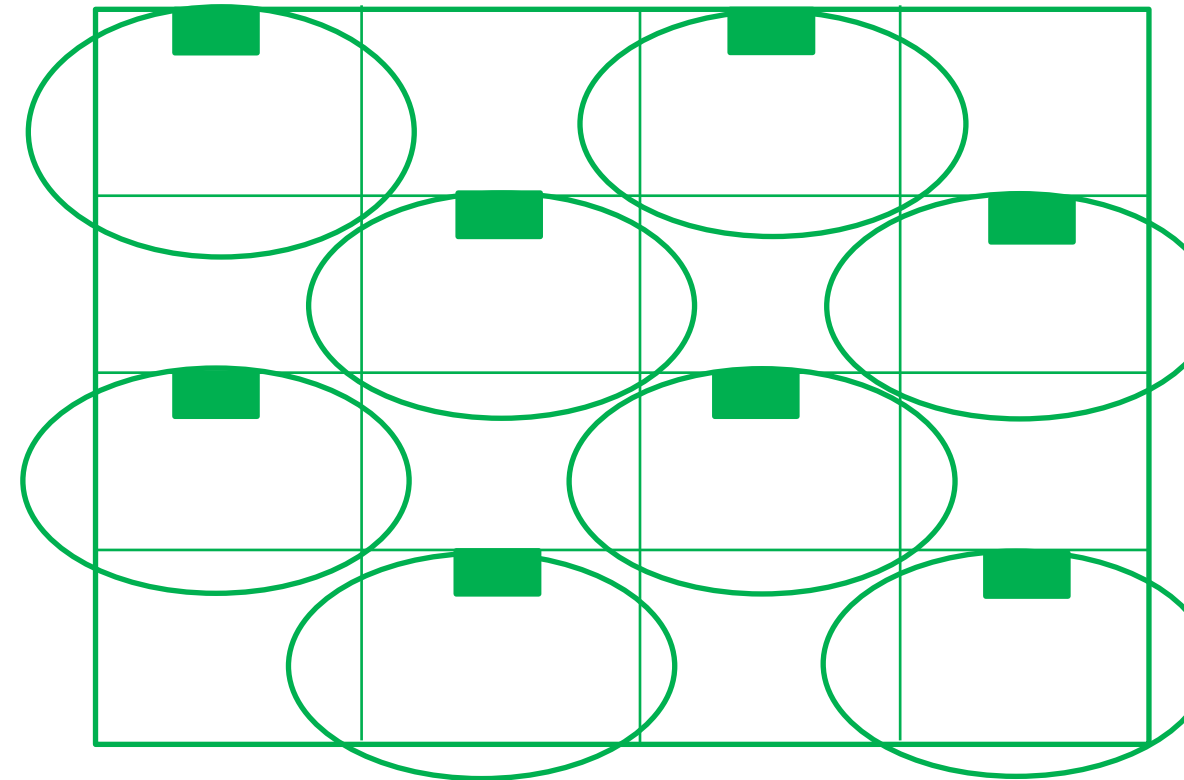
- ❑ Multi-Floor Deployments

- ❑ For multi-floor deployments we should avoid to leave the Access Points installed in the same position (aligned) between different floors because of interference, coverage and RRM issues

❑ Not Recommended Distribution



❑ Recommended Distribution



7° - Roaming

- ROAMING IS PROPRIETARY AND DEVICE DEPENDENT
- Can be influenced by new standards (802.11k and 802.11v)

How roaming works:

1. Device determines if RSSI, noise level, error rates meet roaming thresholds (can be influenced by client roaming aggressiveness)
2. Device sends reassociation request to neighboring AP
Not 'reassociating' to AP, but to the SSID itself
3. Device sends disassociation to current AP
Is a notification, not a request
 - * Deauthentication will also force a disassociation to the AP

Primary vs. Secondary Coverage

Recommended to use 15-30% overlap of -70 dBm coverage cells

Primary - at least -70 dBm

Secondary - within 5 dBm

Fast Secure Roaming

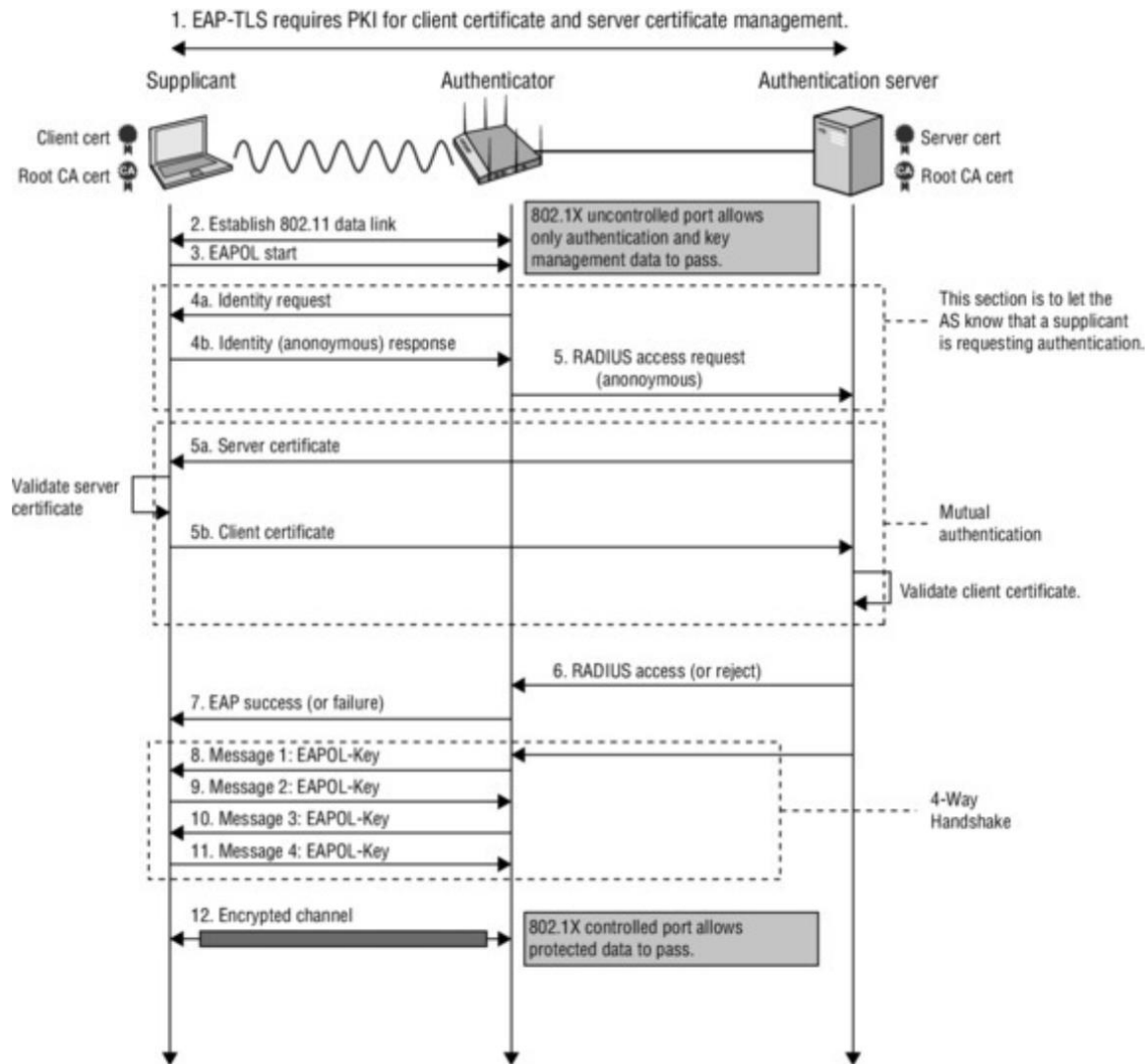
Roaming handoff takes 700ms when using 802.1X (RADIUS)

VoWiFi requires 100-150ms handoff

802.11r defines FT, which reduces roam time

Fast Transition (802.11r)

Traditional Authentication + Roaming (Reauth)



Fast Transition

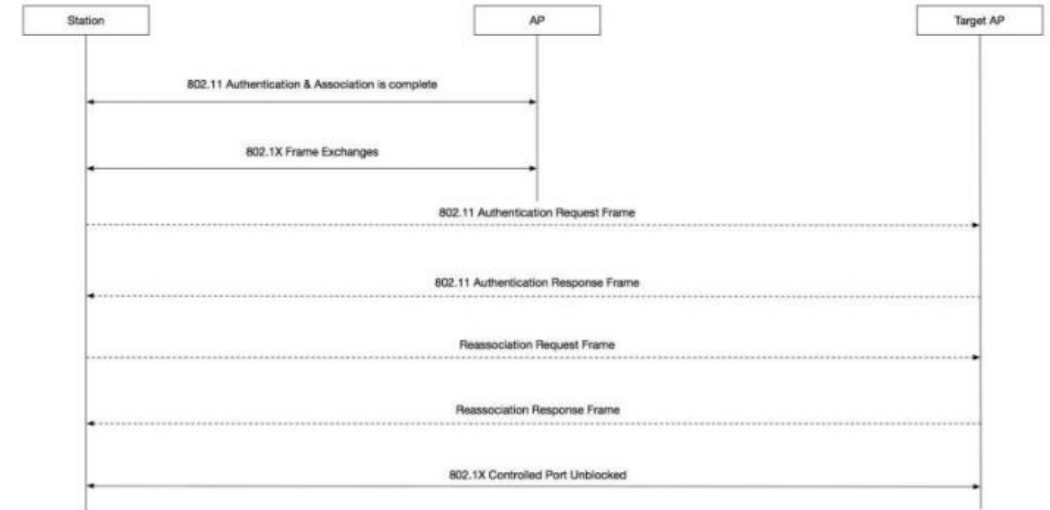


Figure 5.23: FT Over-the-Air frame exchanges

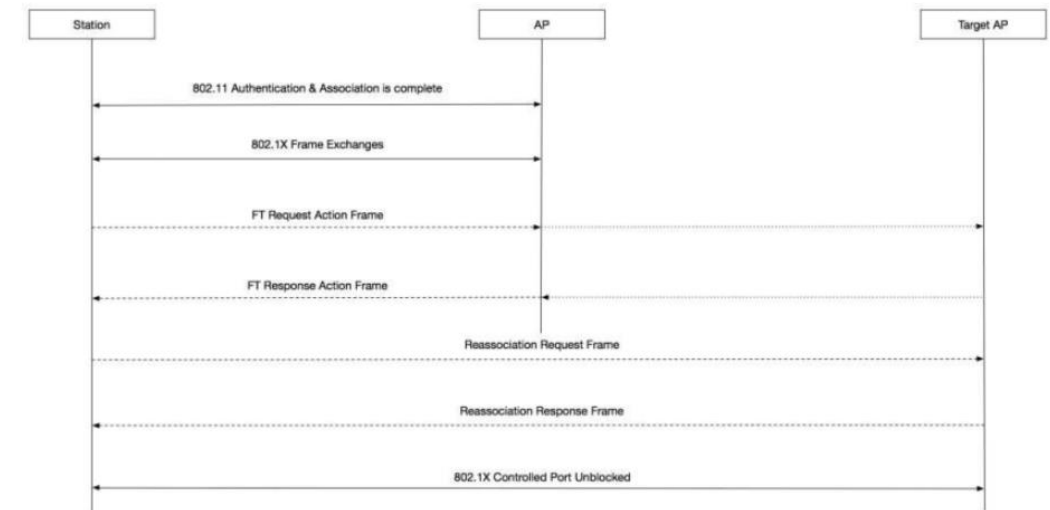


Figure 5.25: FT Over-the-DS frame exchanges

Fast Transition (802.11r) – Supported Devices

Fast Transition – Support – Intel and Apple Devices

Product	802.11k	802.11v	802.11r
Intel® Wi-Fi 6E AX210	Yes	Yes	Yes
Intel® Wi-Fi 6 (Gig+) Desktop Kit	Yes	Yes	Yes
Intel® Wi-Fi 6 AX201	Yes	Yes	Yes
Intel® Wi-Fi 6 AX200	Yes	Yes	Yes
Intel® Wireless-AC 9560	Yes	Yes	Yes
Intel® Wireless-AC 9462	Yes	Yes	Yes
Intel® Wireless-AC 9461	Yes	Yes	Yes
Intel® Wireless-AC 9260	Yes	Yes	Yes
Intel® Tri-Band Wireless-AC 18265	Yes	Yes	Yes
Intel® Dual Band Wireless-AC 8265	Yes	Yes	Yes
Intel® Tri-Band Wireless-AC 18260	Yes	Yes	Yes
Intel® Tri-Band Wireless-AC 17265	Yes	Yes	Yes
Intel® Dual Band Wireless-AC 8260	Yes	Yes	Yes
Intel® Dual Band Wireless-AC 3168	Yes	Yes	Yes
Intel® Dual Band Wireless-AC 3165	Yes	Yes	Yes
Intel® Dual Band Wireless-AC 7265 (Rev. D) ¹	Yes	Yes	Yes
Intel® Dual Band Wireless-N 7265 (Rev. D) ¹	Yes	Yes	Yes
Intel® Wireless-N 7265 (Rev. D) ¹	Yes	Yes	Yes
Intel® Dual Band Wireless-AC 7265 (Rev. C) ¹	No	No	No
Intel® Dual Band Wireless-N 7265 (Rev. C) ¹	No	No	No
Intel® Wireless-N 7265 (Rev. C) ¹	No	No	No
Intel® Dual Band Wireless-AC 3160	No	No	No
Intel® Dual Band Wireless-AC 7260	No	No	No
Intel® Dual Band Wireless-N 7260	No	No	No
Intel® Wireless-N 7260	No	No	No

802.11k and r

- iPhone 4s and later
- iPad Pro and later
- iPad Air and later
- iPad mini and later
- iPad (3rd generation) and later
- iPod touch (5th generation) and later
- Mac computers with Apple silicon

Fast Transition (802.11r) – Configuration

WLANs > Edit 'Corp-Dot1x'

General Security QoS Policy-Mapping Advanced

Layer 2 Layer 3 AAA Servers

Layer 2 Security

MAC Filtering

Fast Transition

Fast Transition

Over the DS

Reassociation Timeout Seconds

Protected Management Frame

PMF

WPA+WPA2 Parameters

WPA Policy

WPA2 Policy

WPA2 Encryption AES TKIP CCMP256 GCMP128 GCMP256

OSEN Policy

Authentication Key Management ¹⁹

802.1X Enable

CCKM Enable

PSK Enable

FT 802.1X Enable

FT PSK Enable

SUITEB-1X Enable

SUITEB192-1X Enable

WPA gtk-randomize State

Mixed mode

Add WLAN

General Security Advanced

Layer2 Layer3 AAA

Layer 2 Security Mode

MAC Filtering

Protected Management Frame

PMF

WPA Parameters

WPA Policy

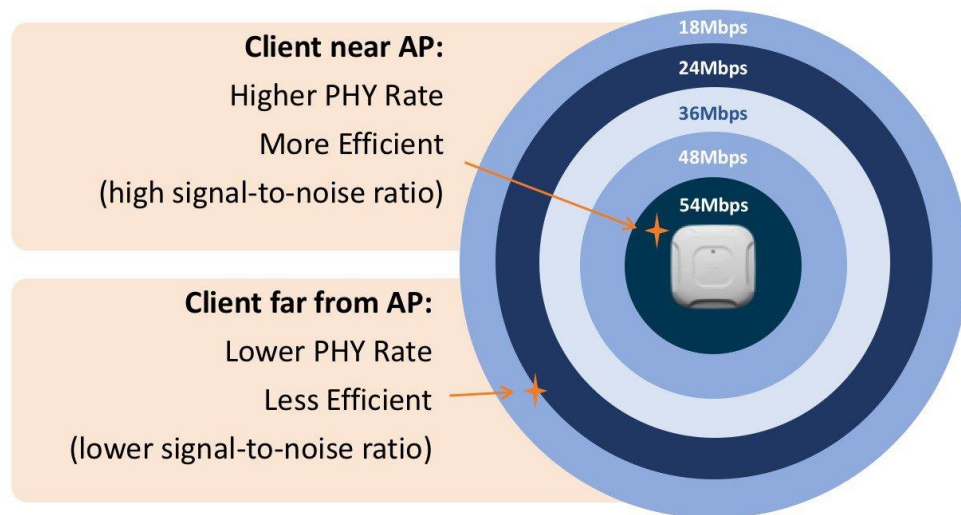
Fast Transition

Over the DS

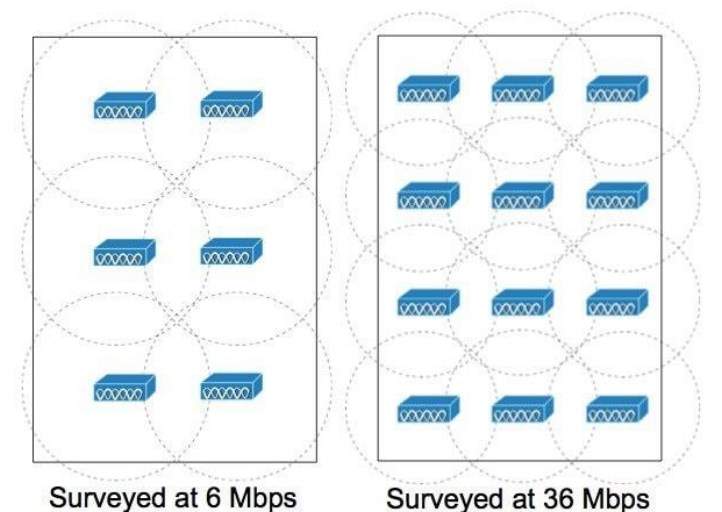
Reassociation Timeout

8º - Operação da Rede Wi-Fi : Data Rates e Área de Cobertura

- ❑ Data rates são os valores de conexão básica que todos os dispositivos devem suportar naquela célula
- ❑ Os data rates são valores que estão relacionados diretamente ao alcance da célula, controlando-as se serão mais compactas ou não
- ❑ Uma célula mais compacta irá performar mais, pois permitirá que apenas usuários com valores maiores de velocidade se conectem a ela; No entanto terá um alcance menor, pois dispositivos que estiverem distantes e não suportem tais velocidades, logo não se conectarão.
- ❑ Uma célula menos compacta irá performar menos, pois permitirá que dispositivos que estejam mais longes do AP possam se conectar, impactando assim os demais que estejam mais próximos a este; Esta célula terá um alcance maior do que a anterior



Speed	Required SNR	AP Sensitivity
1	0	-91
2	3	-91
5.5	6	-91
6	2	-87
11	9	-88
12	6	-86
24	11	-85
36	13	-85
48	17	-78
54	19	-77



Operação da Rede Wi-Fi : Data Rates e Area de Cobertura

- Criação de RF Profile e Customização

Add RF Profile (802.11) | RRM | Advanced

Operational Rates

1 Mbps	Disabled
2 Mbps	Disabled
5.5 Mbps	Disabled
6 Mbps	Disabled
9 Mbps	Disabled
11 Mbps	Disabled
12 Mbps	Mandatory
18 Mbps	Supported
24 Mbps	Supported
36 Mbps	Supported
48 Mbps	Supported
54 Mbps	Supported

802.11n MCS Rates

Enabled Data Rates: [0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31]

Enable	MCS Index
<input checked="" type="checkbox"/>	0
<input checked="" type="checkbox"/>	1
<input checked="" type="checkbox"/>	2
<input checked="" type="checkbox"/>	3
<input checked="" type="checkbox"/>	4
<input checked="" type="checkbox"/>	5
<input checked="" type="checkbox"/>	6
<input checked="" type="checkbox"/>	7
<input checked="" type="checkbox"/>	8
<input checked="" type="checkbox"/>	9

Add RF Tag

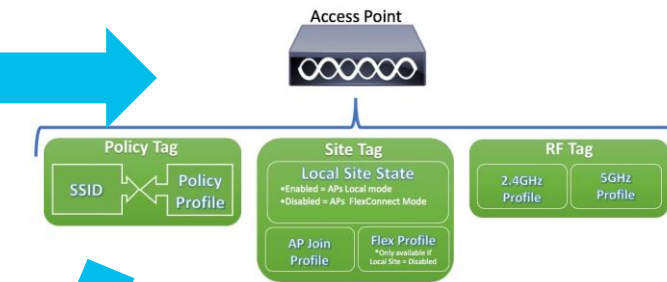
Name*: new-rf-tag

Description: Enter Description

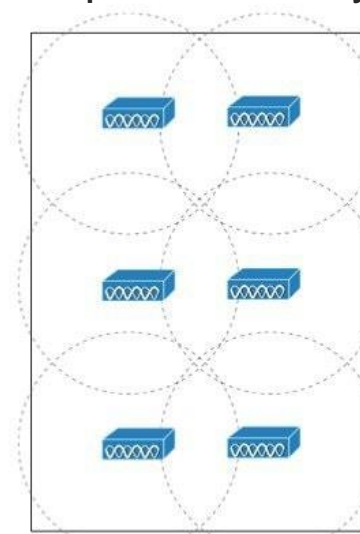
Dot 11a RF Profile: new-11a-rf-prof

Dot 11b RF Profile: Global Config

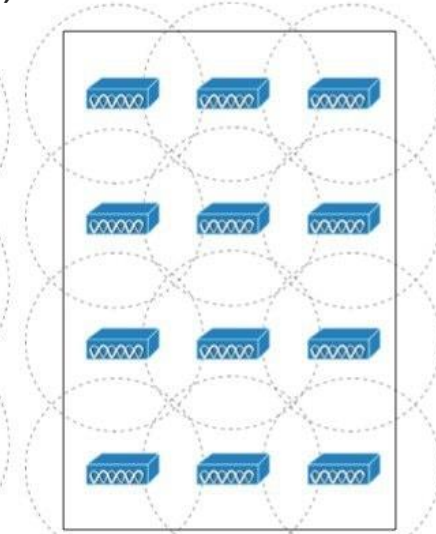
Buttons: Cancel, Save & Apply to Device



- RF Profile 1 (6 Mbps Mandatory)
- RF Profile 2 (36 Mbps Mandatory)



Surveyed at 6 Mbps



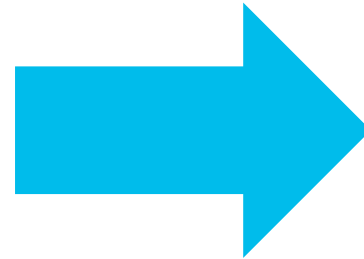
Surveyed at 36 Mbps

9º - Erros Comuns e Recomendação

- ❑ É importante ter conhecimento do padrão de radiação do equipamento para realizar a instalação da forma correta



Instalação Atual



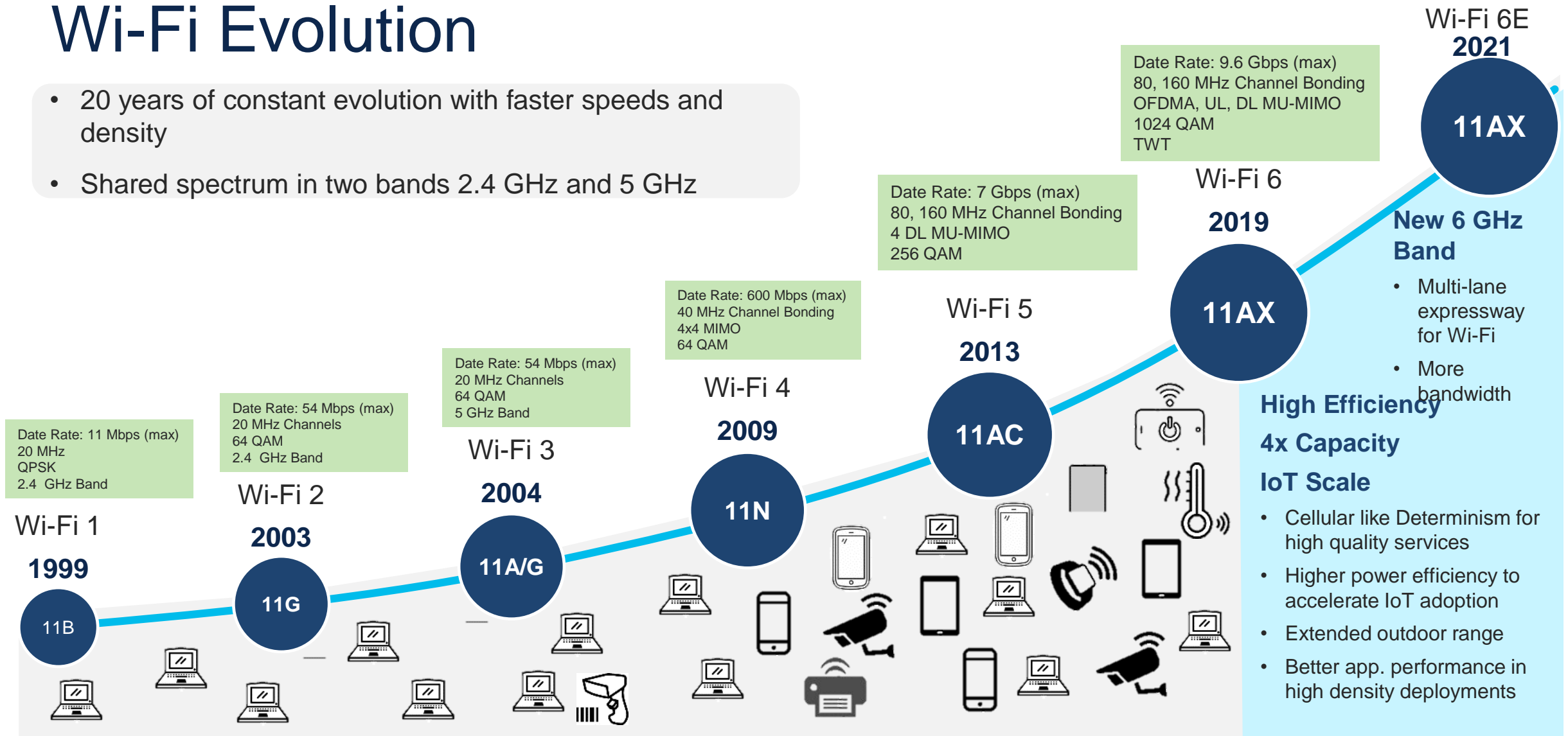
Instalação Correta

Instalação Incorreta

Atualização Tecnológica

Wi-Fi Evolution

- 20 years of constant evolution with faster speeds and density
- Shared spectrum in two bands 2.4 GHz and 5 GHz



High Efficiency
4x Capacity
IoT Scale

- Cellular like Determinism for high quality services
- Higher power efficiency to accelerate IoT adoption
- Extended outdoor range
- Better app. performance in high density deployments

- New 6 GHz Band**
- Multi-lane expressway for Wi-Fi
 - More bandwidth

Wi-Fi 6/6E - Enhancements



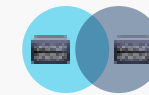
For your reference

Uplink and Downlink Orthogonal Frequency Division Multiple Access (OFDMA): Increases network efficiency and lowers latency for high demand environments



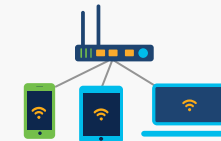
Packet latency improvements

Multi-User Multiple Input Multiple Output (MU-MIMO): allows more data to be transferred at once and enables an access point to transmit to a larger number of concurrent clients at once



Channel Reuse With BSS Color

Parallel processing: enables greater capacity by allowing MU-MIMO and OFDMA to function in UPLINK and DOWNLINK mode



Parallel transmissions

1024 Quadrature Amplitude Modulation Mode (1024-QAM): increases throughput in Wi-Fi devices by encoding more data in the same amount of spectrum



Faster Speed more Radios and 1024 QAM

Target Wake Time (TWT): significantly improves battery life in Wi-Fi devices, such as Internet of Things (IoT) devices



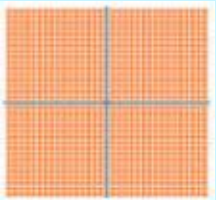
Better Battery Life

Wi-Fi 6E

Wi-Fi 6 and 6GHz are friends

802.11ax

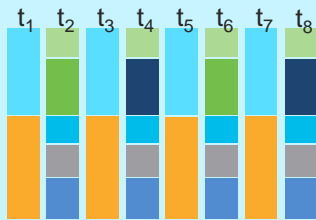
1024 QAM



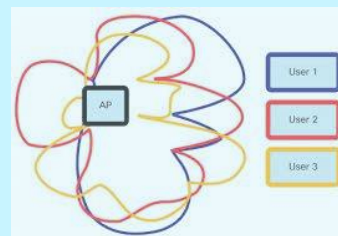
BSS Coloring



OFDMA



DL, UL MU-MIMO



TWT



• Additional Spectrum

- 1200MHz (5.925 GHz to 7.125 GHz) in
- 500 MHz (5.925 GHz to 6.425 GHz) in

• Wider Channels

• Clean RF

• No Slow Devices

• Security Upgrade

• 6 GHz WLAN Discovery

• Air Time Efficiency

6 GHz is the biggest Wi-Fi spectrum expansion ever

Band Channels Bandwidth

2.4 GHz

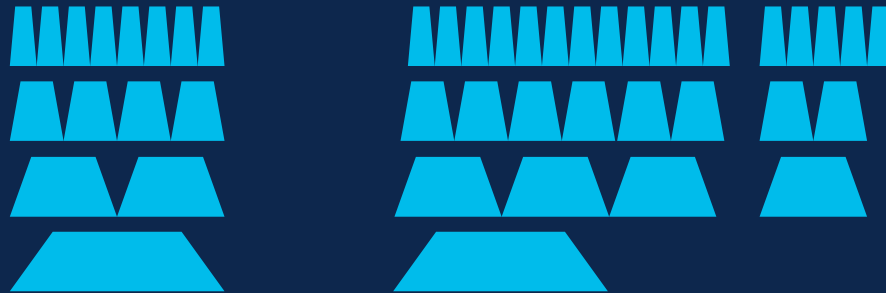
3 20 MHz
1 40 MHz



60 MHz of spectrum and
3x 20-MHz channels

5 GHz

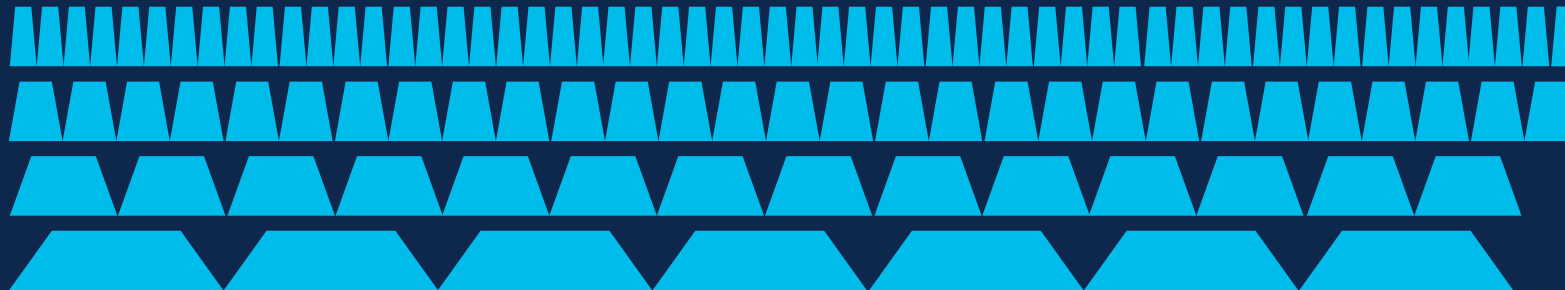
25 20 MHz
12 40 MHz
6 80 MHz
2 160 MHz



500 MHz of spectrum and
25x 20-MHz channels

6 GHz

59 20 MHz
29 40 MHz
14 80 MHz
7 160 MHz



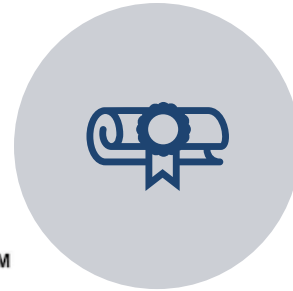
1200 MHz of
spectrum and
59x 20-MHz
channels in US

500 MHz of
spectrum in EU

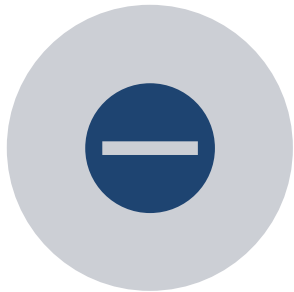
Wi-Fi 6E Security



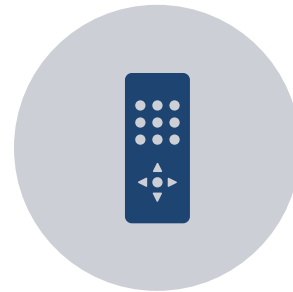
Wi-Fi 6E up levels security with WPA3 and OWE



WPA3 and Enhanced Open Security made mandatory for Wi-Fi 6E certification.



No backward compatibility with Open and WPA2 Security.



Requires Protected Management Frame (PMF) in both AP and Clients.

Deploying and migrating to Wi-Fi 6E

Summary of recommendations, tips, and tricks

<p>Migrating to 6 GHz</p> <p>Top of mind: For brownfield, 1:1 AP replacement. For greenfield, coverage area per AP is now 1500 to 2000 sq ft / 110 to 185 sq m.</p> <p>Legacy clients must still be considered. Shorter distance = Better data rate</p>	<p>Power considerations</p> <p>Recommendation: 802.3bt (Cisco UPOE®) is the suggested power input.</p> <p>802.3at (PoE+) and 802.3af (PoE) are also supported by the Catalyst and Meraki Wi-Fi6E APs.</p>	<p>Security requirements</p> <p>Mandatory: WPA3 is required for Wi-Fi 6E networks to be enabled.</p> <p>WPA3 was not required for prior Wi-Fi generations; hence, it must be top of mind.</p>	<p>Wireless coverage</p> <p>Recommendation: Use Ekahau and iBwave to analyze 6-GHz AP coverage.</p> <p>The 9136 / MR57 are available on Ekahau; as well as a generic 6-GHz AP.</p>
<p>Spectrum considerations</p> <p>Note: Wi-Fi 6E's wider spectrum enables 80/160-MHz channel widths to be viable.</p> <p>Increased spectrum provides better data rates with less co-channel interference.</p>	<p>Multigigabit switching</p> <p>Recommendation: Use a Multigigabit switch with 2.5/5Gbps capability.</p> <p>Better user experiences with speeds beyond 1 Gbps on existing cabling</p>	<p>Cisco DNA Center migration</p> <p>Note: Use AP refresh workflow to replace existing APs managed by Cisco DNA Center.</p> <p>Access point refresh workflow can be found on Cisco DNA Center's guide.</p>	<p>WLAN considerations</p> <p>Note: 8 Wi-Fi 6E SSIDs per AP can be created in Cisco IOS XE Release 17.7.1. Will be raised to 16 SSIDs in a future release.</p> <p>This differs from the 16 SSIDs allowed for the 2.4- and 5-GHz bands.</p>

One Product – Two Management Modes



DNA Persona
C9800 & DNAC Stack



Meraki Persona
MR Dashboard Stack



Cisco Wi-Fi 6E Portfolio

Common Platforms will have CW PIDs

MR and C series APs are not convertible

CW9162



- 2x2 + 2x2 + 2x2
- 2.5 Gbps mGig
- Power Options: PoE, DC Power
- Scanning Radio
- IoT ready + Bluetooth 5.x
- Standard Bracket

CW9164



- 2x2, 4x4, 4x4
- 2.5 Gbps mGig
- Power Options: PoE, DC Power
- Scanning Radio
- IoT Ready + Bluetooth 5.x
- Standard Bracket

CW9166



- 4x4 + 4x4, 4x4 (XOR 5/6)
- 5 Gbps mGig
- Power Options: PoE, DC Power
- IoT ready + Bluetooth 5.x
- Scanning Radio
- Environmental Sensor
- Common XOR Architecture
- Standard Bracket

MR57



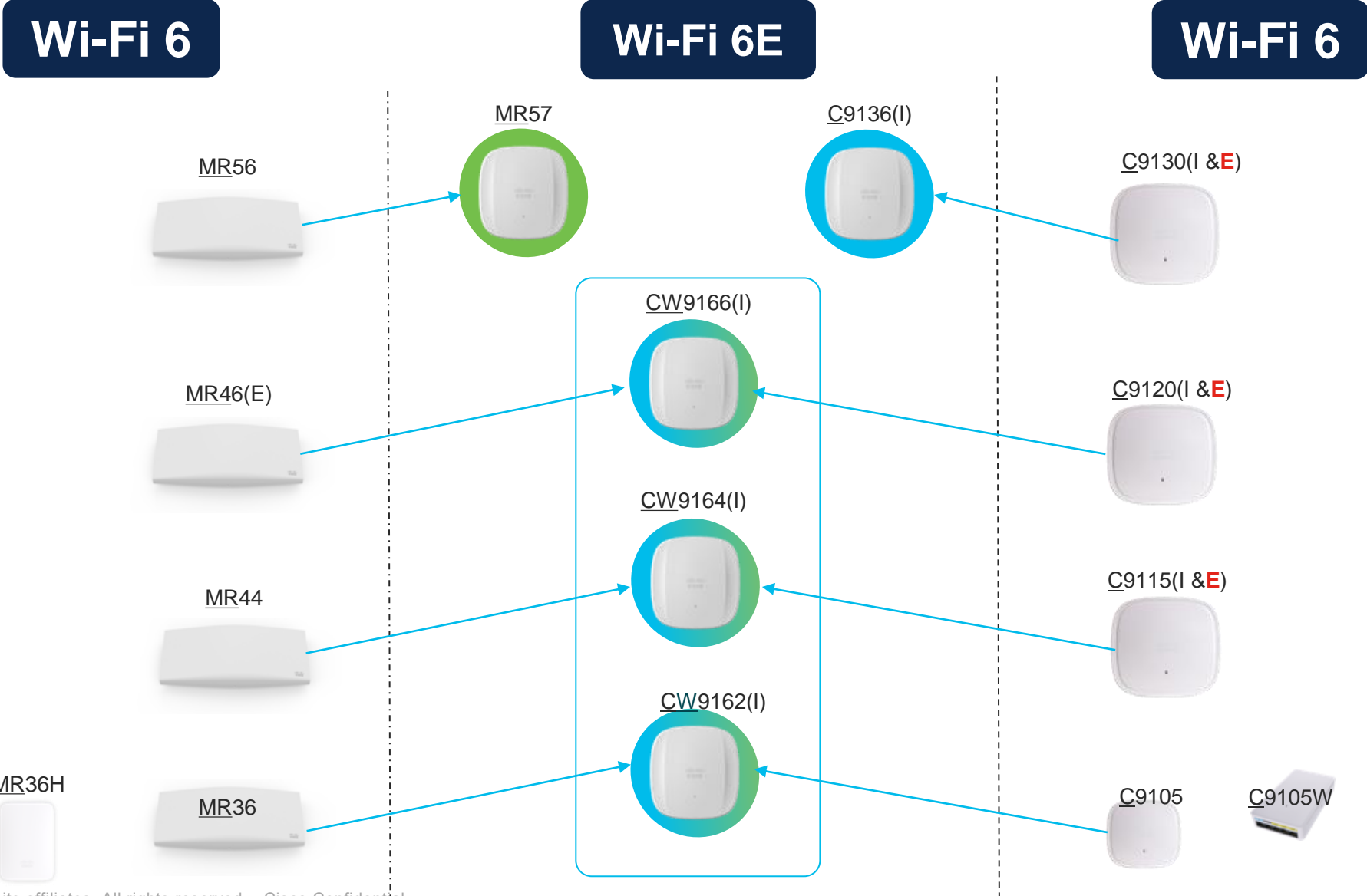
- 4x4 + 4x4, 4x4 (XOR 5/6)
- Dual 5 Gbps mGig with failover
- Power Options: PoE, DC Power
- IoT ready + Bluetooth 5.x
- Scanning Radio
- XOR Architecture (High/Low band)
- Standard Bracket

C9136



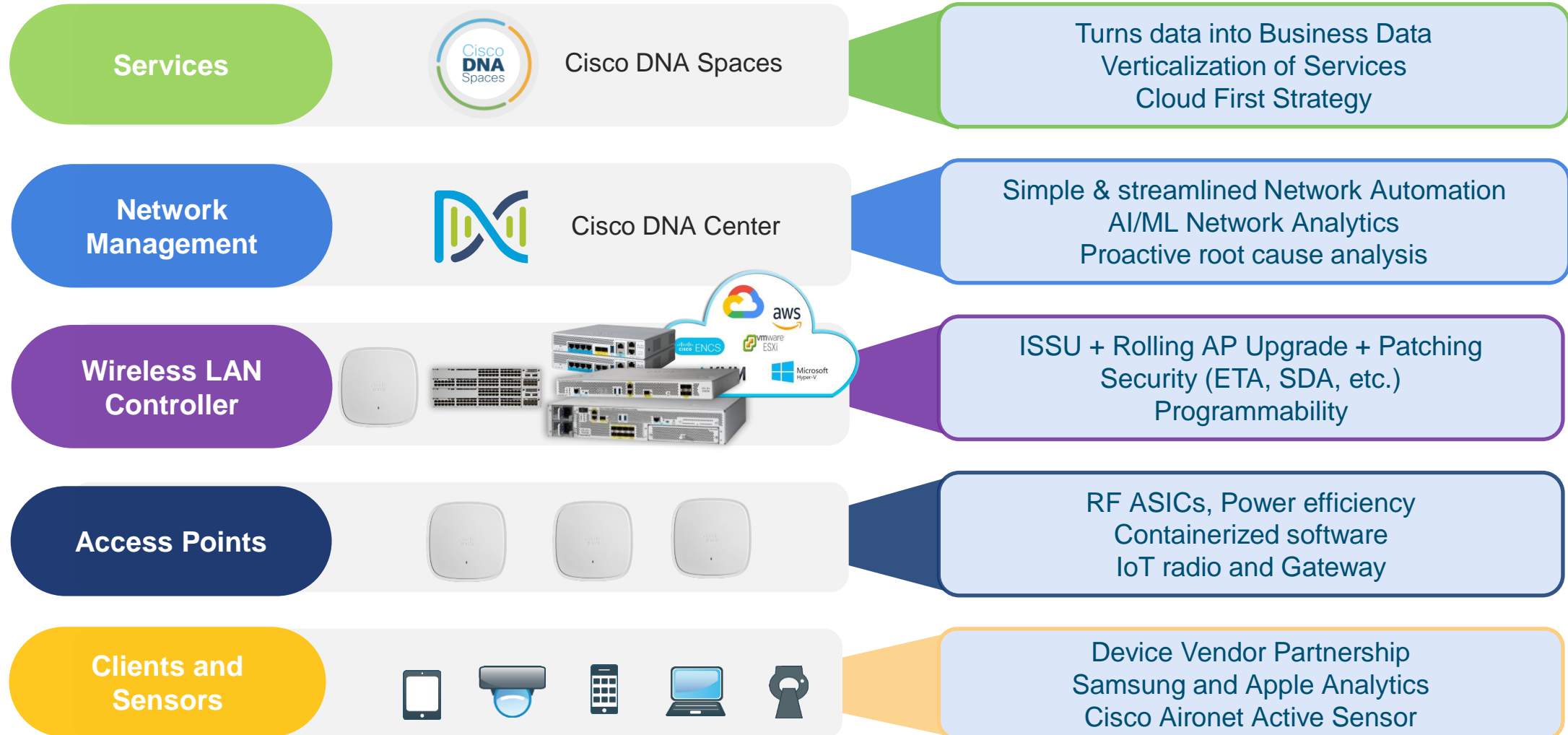
- 4x4 + 8x8 + 4x4 or 4x4+4x4+4x4+4x4
- Dual 5 Gbps mGig with failover
- Power Options: PoE, DC Power
- IoT ready + Bluetooth 5.x
- Scanning Radio
- Environmental Sensor
- XOR Architecture (macro/meso)
- Standard Bracket

Wi-Fi 6 & Wi-Fi 6E Co-Existence



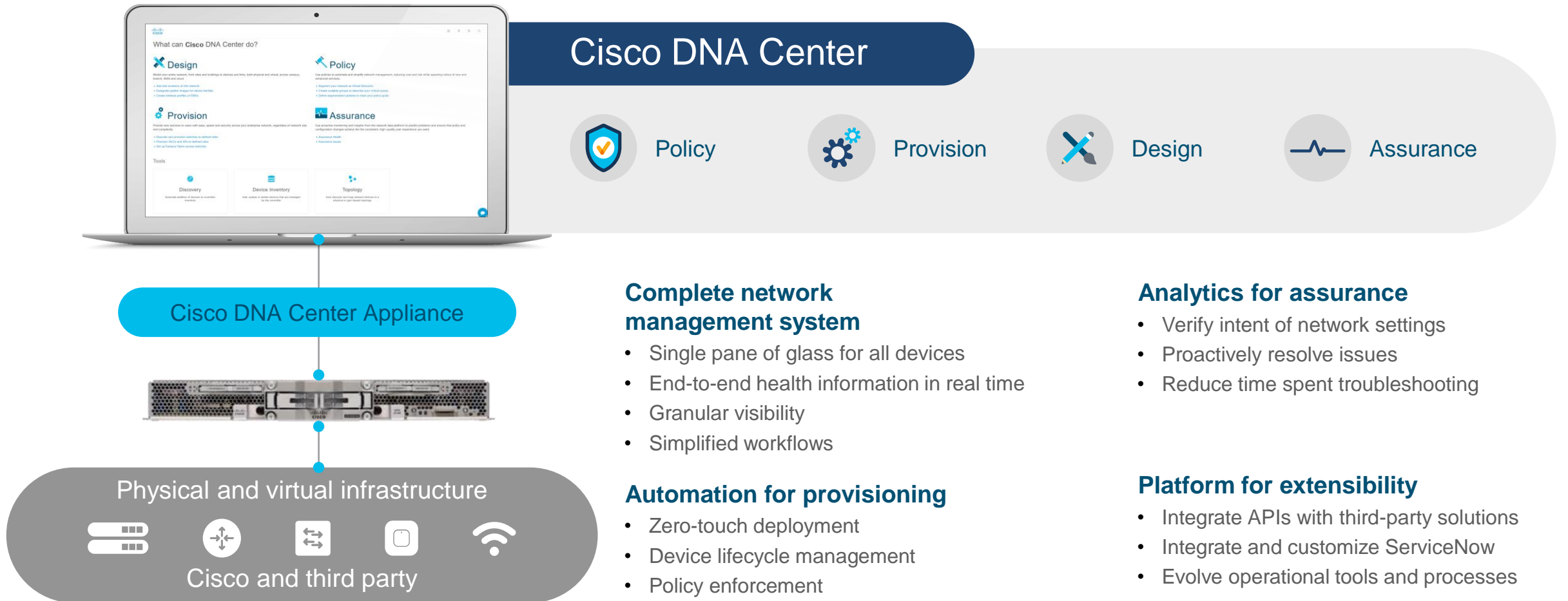
*Visualizando e entendendo
problemas no cenário da
rede da empresa*

Next Generation Wireless Stack



Cisco DNA Center

Central network management system



Cisco Software-Defined Access (SD-Access)

Networking at the speed of software

Before SD-Access (Traditional Network)

- Manual Configuration (VLAN, Trunks, etc) using CLI for Wired and Wi-Fi Network
- No Automation
- VLANs per Floor / per Group
- STP Convergence
- Lack of Visibility

I need to add a new VLAN, so I will need to configure switch core, access switch, trunks, WLC, etc....it will take a long time to deploy



Configure Switch by Switch

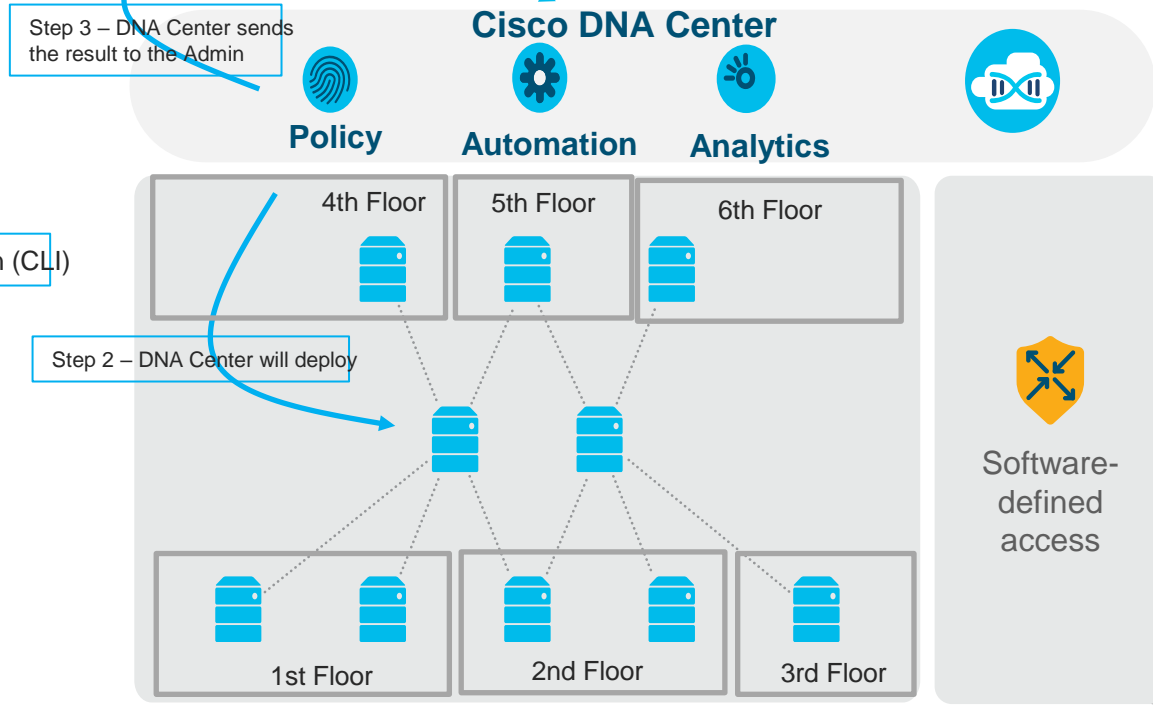
Let me access DNA Center and deploy this new network pool in some clicks for Wireless and Wired



Step 1 - Select your config in DNA-C

After SD-Access

- WLAN and LAN Automation and Config using DNA Center
- No VLAN Trunks
- No STP
- L3 Network (Fabric SDA)
- Visibility and Centralized Policy Management



Step 3 - DNA Center sends the result to the Admin

Cisco DNA Center

Policy Automation Analytics

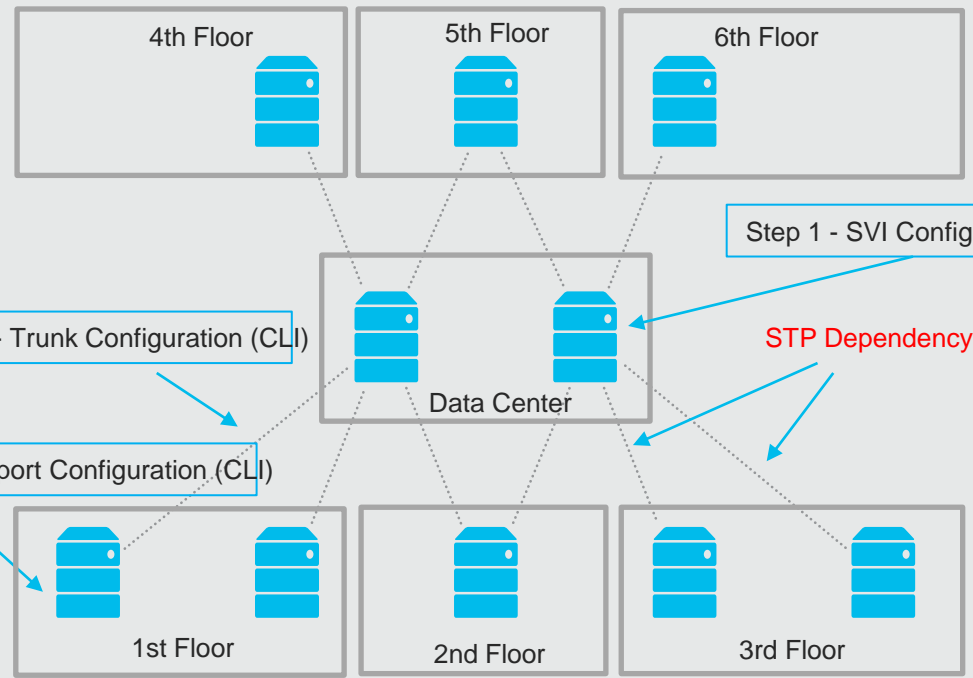
Step 1 - SVI Configuration (CLI)

STP Dependency (CLI)

Step 2 - DNA Center will deploy

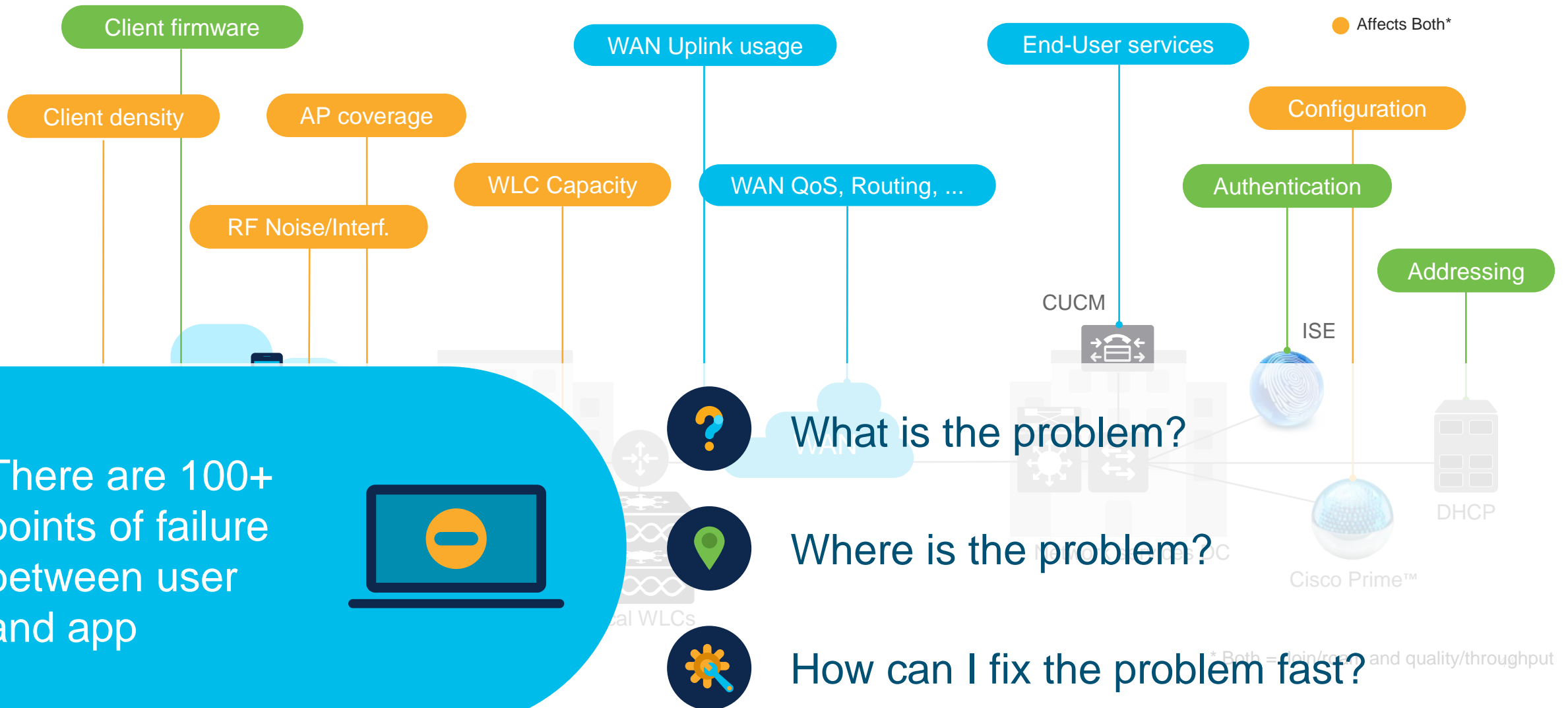
Step 2 - Trunk Configuration (CLI)

Step 3 - Switchport Configuration (CLI)



Network Quality is a Complex, End-to-End Problem

- Affects Join/Roam
- Affects Quality/Throughput
- Affects Both*



Client Tracking

Track VIP clients and subscribe notifications about the tracked clients

- Add Clients to tracked list
- Subscribe to client notifications
- Monitor tracked clients

Cisco DNA Center Assurance / Dashboards / Health

Overall Network **Client** Applications Network Services SD-Access

Client Devices (306) ★ Tracked Clients

LATEST TREND

TYPE **Wireless** Wired OVERALL HEALTH **All** Poor Fair Good Inactive No Data

DATA Onboarding Time >= 10s Association >= 5s DHCP >= 5s Authentication >= 5s RSSI <= -72 dBm SNR <= 9 dB

Export

Search Table

Actions

Identifier	IPv4 Address	Device Type	Health	Tracked	Usage	AP Name	Band	RSSI	Location	Last Seen	Capability
saukuma2	10.32.172.76	OS_X-Workstation	OS_X...	No	5.9 kB	SJC24-11A-AP2	5 GHz	-61 dBm	San Jose/SJ-24/Floor-1	...J-24/Floor-1	11ac
sragubat	10.32.189.145	OS_X-Workstation	OS_X...	No	95.53 MB	sragubat-9105i	5 GHz	-51 dBm	San Jose/OEAP/OEAP	...se/OEAP/OEAP	11ac
alexiflo	10.32.189.45	iPhone 11	iPho...	No	22.69 kB	alexiflo-1815t	5 GHz	-48 dBm	San Jose/OEAP/OEAP	...se/OEAP/OEAP	Unclassified
wtfan	10.32.172.58	Android	Android	No	4.69 kB	SJC24-22A-AP3	5 GHz	-52 dBm	San Jose/SJ-24/Floor-2	...J-24/Floor-2	Wi-Fi 6
USER	10.41.12.214	Sensor-Client-1800S	Sens...	No	53.16 kB	SJC24-11A-AP5	2.4 GHz	-61 dBm	San Jose/SJ-24/Floor-1	...J-24/Floor-1	11ac

Intel Analytics Overview

Background:

- Intel Wi-Fi chipsets make up 90% of enterprise laptops.
- Intel Analytics enables these clients to provide enhanced visibility for faster troubleshooting.

Key Benefits:



Provides Intel client model, driver version, coverage hole reporting, roaming, power type, etc.



No need for client-side agent to provide data.

1. Identifying Bad Drivers
2. Validating New Drivers
3. Identifying Bad Hardware
4. Troubleshooting Roaming
5. Identifying Poor Connectivity
6. Identify misbehaving APs

Day Zero Classification	Dell Inc.
Software Version	99.00.63.01
Device Vendor	Intel
Power Type	AC Powered
Hardware Model	AX200 160MHz

Detail Information Dec 17, 2020 10:16 AM

Device Info Connectivity RF Intel Analytics

Reported Errors

AP	Time
AP9120.1234 6C:B2:AE:C7:AB:00 Report Type: Placeholder	35 minutes ago
AP8888.4302 6C:B2:AE:C7:AB:00 Report Type: Placeholder	1 day ago
AP9300.4595 6C:B2:AE:C7:AB:00	January 4, 2021

Temporary Disconnection Reports

AP	Time
AP9120.1234 6C:B2:AE:C7:AB:00	35 minutes ago
AP8888.4302 6C:B2:AE:C7:AB:00	1 day ago
AP9300.4595 6C:B2:AE:C7:AB:00	January 4, 2021

Low RSSI Reports

AP	Time
AP9120.1234 6C:B2:AE:C7:AB:00 -50 dBm	35 minutes ago
AP8888.4302 6C:B2:AE:C7:AB:00 -50 dBm	1 day ago
AP9300.4595 6C:B2:AE:C7:AB:00	January 4, 2021

Roam Events

January 6, 11:53AM | January 6, 10:00AM | January 5, 9:00AM | January 4, 9:00AM | January 3, 9:00AM

String: AP9120.1234 6C:B2:AE:C7:AB:00 -50 dBm

Reason Code	Selected AP	BSSID	RSSI
	AP9120.1234	6C:B2:AE:C7:AB:00	-34 dBm
	AP9120.1234	6C:B2:AE:C7:AB:00	-34 dBm
	AP9120.1234	6C:B2:AE:C7:AB:00	-34 dBm
	AP9120.1234	6C:B2:AE:C7:AB:00	-34 dBm

Integration with Microsoft Teams

The screenshot shows the Cisco DNA Center interface. At the top left, there is a hamburger menu icon followed by the text "Cisco DNA Center". At the top right, it says "System / Settings". Below the header, there is a search bar containing the text "mic" and a clear icon. Below the search bar, there is a dropdown menu labeled "Results for mic" with a downward arrow. The dropdown menu is open, showing a single item: "Microsoft Teams Integration". To the right of the search bar, the breadcrumb "Settings / External Services" is visible. Below the breadcrumb, the main heading is "Microsoft Teams Integration". Underneath this heading, there is a green-bordered box containing a green checkmark icon and the text "Microsoft Teams integration is currently enabled". Below this box, there is a paragraph of text: "Use this form to configure settings to query Microsoft Teams APIs. After integration, Cisco DNA Center can provide call quality metrics information for Application 360 and Client 360 dashboards." At the bottom of this section, there is a blue button labeled "Delete".

MS Teams – Application 360

Cisco DNA Center

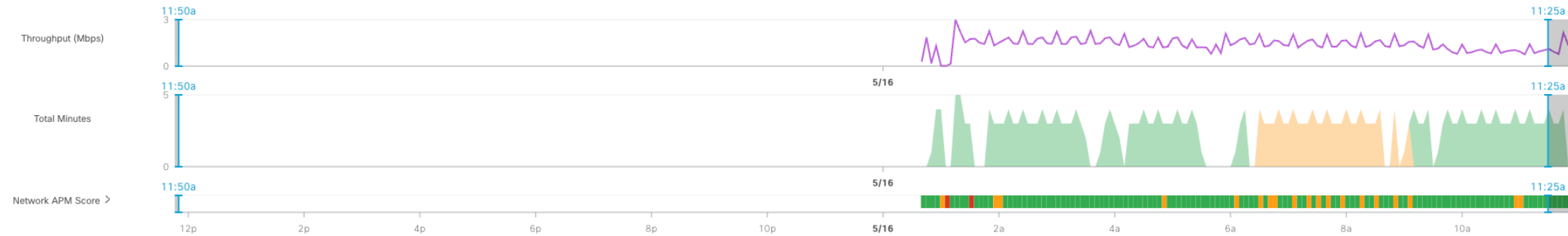


Applications / MS Teams 360

24 Hours Israel/Site1

SUMMARY

13.1	1.5	1	295	112	0
Total Usage (GB)	Avg. Throughput (Mbps)	Active Clients	Good Minutes (#)	Fair Minutes (#)	Poor Minutes (#)



May 16, 2022 2:50 AM - 2:55 AM		MS Teams Meeting Minutes		Health	
Quantity		Good	3	Network APM Score: 10	
Throughput	1.52Mbps	Fair	0	🟢	Audio
		Poor	0	🟢	Video
				🟢	Sharing

*Only metrics with color code contribute to the Health Score

MS Teams – Client 360

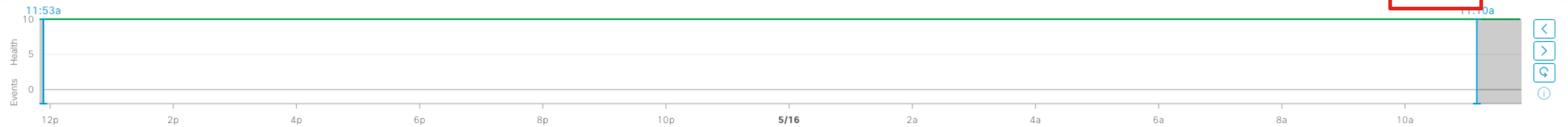
Cisco DNA Center



Client / Client 360

10.10.10.105

24 Hours



10/10 CLIENT DETAILS

May 15, 2022 11:53 AM - May 16, 2022 11:10 AM

Device: -- MAC: 00:50:56:AE:C1:58 IPv4: 10.10.10.105 IPv6: 2001:420:4482:2802:d035:97f2:69d2:7ebc (3 more) L3 Virtual Network: -- L2 Virtual Network: -- VLAN ID: 202 Status: Connected Last seen: May 16, 2022 11:07:00 AM

Connected Network Device: [C9200-L2-SW.cisco.com](#) Port: GigabitEthernet1/0/2 [View All Details](#)

MS Teams – Client 360 Meetings

Application Experience for MS Teams: 10.10.10.105

Meetings (73)

Search Table

From May 15, 2022 to May 16, 2022

Meeting Name	MS Teams Score ⓘ	Network APM Score ⓘ	Duration	Start Time ▾	End Time	Status	Meeting Type	Participants (#)
<input type="radio"/> cisco lightt2 participated in a peer-to-peer call	✓	✓	00:05 h	May 16, 2022 9:10 AM	May 16, 2022 9:15 AM	Ended	Peer To Peer	2
<input type="radio"/> cisco lightt2 participated in a peer-to-peer call	⚠	⚠	00:05 h	May 16, 2022 9:03 AM	May 16, 2022 9:08 AM	Ended	Peer To Peer	2

73 Records

Show Records: 10 ▾

11 - 20

< 1 2 3 4 5 ... 8 >

MS Teams – Meeting Details

The screenshot displays the 'Meeting Details' page for an MS Teams meeting. At the top, a table lists meeting records with columns for Meeting Name, MS Teams Score, Network APM Score, Duration, Start Time, End Time, Status, Meeting Type, and Participants (#). The second record is selected, showing a score of 7/10 for MS Teams and 6/10 for Network APM. Below the table, a red box highlights the meeting name 'CISCO LIGHTT2 PARTICIPATED IN A PEER-TO-PEER CALL'. The interface includes tabs for Audio Quality, Video Quality, and Share Quality. Key performance indicators are shown: MS Teams Score (7/10), Network APM Score (6/10), and Exporters (ASR1K_Site2.cisco.com, ISR4K_Site3.cisco.com). Two graphs are present: 'Packet Loss' showing 3.9% receiving loss and 'Jitter' showing 0ms receiving jitter. Both graphs include a red dashed threshold line.

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	7/10	6/10	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	7/10	6/10	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	7/10	6/10	00:05 h	May 16, 2022 8:49 AM	May 16, 2022 8:54 AM	Ended	Peer To Peer	2

73 Records

Show Records: 10 | 11 - 20 | < 1 2 3 4 5 ... 8 >

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

MS Teams Telemetry: Transmitting --, Receiving 3.9%

Network APM Telemetry: Transmitting --, Receiving 3.9%, Threshold: 0.7 %

Jitter

MS Teams Telemetry: Transmitting --, Receiving 0ms

Network APM Telemetry: Transmitting --, Receiving 0ms, Threshold: 1 ms

3D maps integration with DNA Spaces/CMX

- ❖ Integration of DNA Spaces/CMX data to show clients on 3D maps
- ❖ Clients indicated by “Ball” icon
- ❖ Client details on to which AP it is connected and hyperlink to Client 360 for more details

The screenshot shows the Cisco DNA Center interface in the 'Design / Network Hierarchy' view. The '3D' view is selected, and the map displays a building layout with green ball icons representing clients. A pop-up window for a client with MAC address 14:7D:DA:22:1F:F6 (10/10) is open, showing the following details:

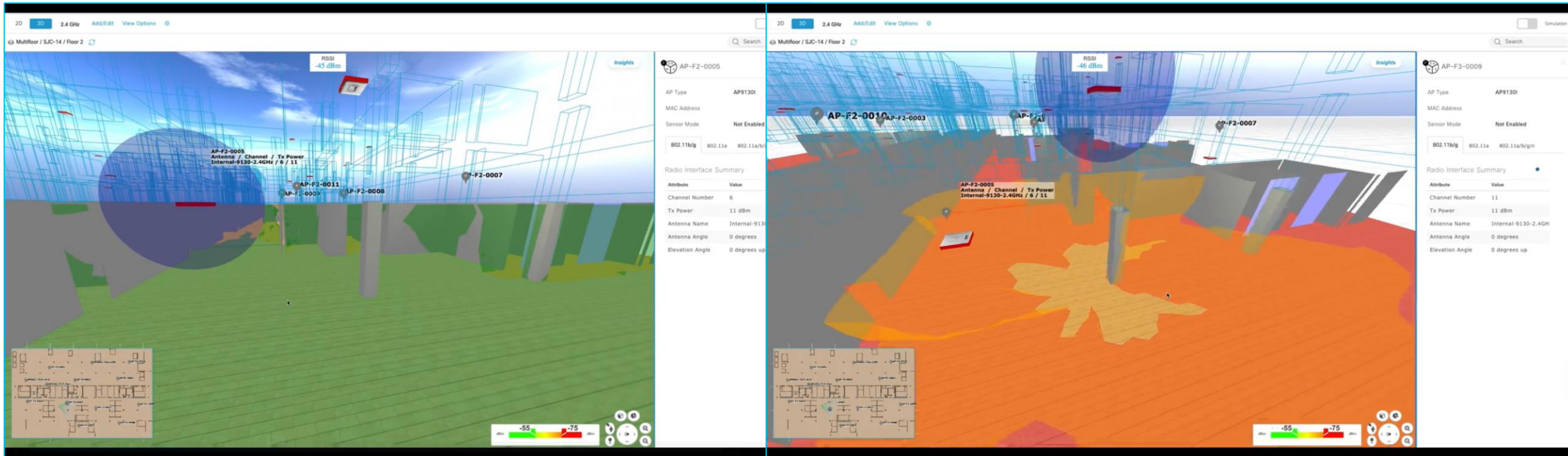
IP Address	20.162.1.3
IPv6 Address	fd0d:20:162:0:1984:cfb9:a7da:a430
	fd0d:20:162:0:4c9:80a:83ee:37af
	fd0d:20:162:0:6c0c:2e27:9e78:699f
	fd0d:20:162:0:d1f8:578:81d:ee9a
	fd0d:20:162:0:e119:5ba:1b8d:e0e0
	fd0d:20:162:0:f110:d92a:71a9:357f
	fd0d:20:162:0:f99c:ce07:52f6:5dc0
	fe80::1430:46bc:dd08:29b8
RSSI	-13 dBm
SNR	83 dB
SSID	open
Band	5 GHz
Data Rate	6.0 Mbps
Associated AP	DC_AP9136.1304
Issue Count	0
Status	associated

Client 360

The interface also shows a sidebar with a search hierarchy, a top navigation bar with '2D', '3D', and '5 GHz' options, and a right-hand panel for 'Devices and Clients' with filters for APs, Planned APs, Sensors, and Clients.

Multi-Floor Penetration

- ❖ Ability to Visualize energy penetration alongside Contributing floors
- ❖ Heatmap metrics shown for RSSI, SNR, Interference and Leakage



Meraki - Rich Contextual alerts

Outcome-focused insights into issues

Wireless onboarding
High bandwidth usage
Application failures

Provide context, **root cause** and
recommendations

Intuitive and easy to configure

Powered by **smart thresholds**

10 clients are affected by poor signal quality within the network

Likely root cause

Sub-optimal RF configuration and/or high noise.

Recommended fixes

Go to the [Radio Settings page](#) to troubleshoot the issue.

Click [here](#) for more supporting documentation.

SNR values

MEDIAN SNR VALUE FOR IMPACTED CLIENTS

• 12 dB

NUMBER OF CLIENTS AFFECTED

• 10 clients

Top 5 access points affected

[Fletcher 3rd Floor Outside Room 315](#)

[Meta Glass Post Office Rear Hallway](#)

[Meta Glass M147 Outdoor Program Office](#)

[Admissions 2nd Floor Beta](#)

[MMC/Development 3rd Floor Office Suites](#)

🔍 Was this alert helpful? [Yes](#) [No](#)

🔊 Didn't find this alert useful? Change your alert settings on the [Network wide alerts page](#).

🗨️ Having trouble? We can help! [Contact support](#).



This email was automatically generated. Please do not reply.

Meraki guided troubleshooting

Solving problems from the Meraki cloud's eye view

- **Root causes analysis** of issues affecting network and app performance
- **Natural-language descriptions** offer clear, concise diagnoses
- **Actionable recommendations** accelerate resolution of issues
- Enriched with **relevant context** for added trust in the Dashboard diagnosis
- Fix sticky clients, detect coverage holes, identify VLAN misconfiguration, and more

AP RHN Lobby 2x2 may not be a valid authenticator in configured RADIUS server

The authenticator may have not been a valid IP address in the RADIUS configuration. RADIUS requests sent by AP RHN Lobby 2x2 were being ignored, since it was not a trusted device to send authentication requests on the network.


Impact

10 / 408
👤 Clients

Evidence


RADIUS Timeout Rate of 51% for AP RHN Lobby 2x2 shows that clients were timing out waiting for the server to respond, but an average RADIUS Timeout Rate of 35% means the server was responding to client requests on other APs.

RADIUS TIMEOUT RATE ON AP RHN LOBBY 2X2



• 51%

AVERAGE RADIUS TIMEOUT RATE



• 35%

Recommendations

- Verify the IP address of [RHN Lobby 2x2](#) is configured as an authenticator for the RADIUS server 10.10.80.34. Review steps to configure RADIUS in the [documentation](#).
- Check that the shared secret configured on RADIUS server 10.10.80.34 is the same as configured on [ASURAMS-SECURE SSID](#).
- Try [pinging](#) the RADIUS server 10.10.80.34 from AP RHN Lobby 2x2 to verify connectivity.

Meraki - Working with technology partners

Exclusive partnerships to provide greater visibility



May 24 20:28:38	<ul style="list-style-type: none"> Successful connection to SSID Corp for a few seconds on AP MR55. 	CHANNEL 36	BAND 5 GHz	SNR ⓘ ● 24 dB	IOS DISASSOCIATION REASON User triggered disassociation
May 24 20:28:00	<ul style="list-style-type: none"> Successful connection to SSID Corp for a few seconds on AP MR55. 	CHANNEL 36	BAND 5 GHz	SNR ⓘ ● 38 dB	IOS DISASSOCIATION REASON Station interface disabled

SSID	ASURAMS-SECURE
Access point	RH5 202 T1 topology
Splash	Not authorized
Signal	<div style="width: 100%; height: 10px; background-color: green;"></div> 35dB (channel 6)
User	tdowdy (802.1X login)
Device type	iPhone 11 Pro, iOS14.6 🇺🇸
Capabilities	802.11ax - 2.4 and 5 GHz, Fastlane capable details

Extended device info, including:

- Device Type
- OS version
- Client network behavior details

*Visualizando e entendendo
problemas no cenário de
trabalho híbrido*

What is Thousand Eyes?

At ThousandEyes - We empower enterprises to see, understand and improve digital experiences over the Internet. We allow you to visualize any network as if it was your own, quickly surface actionable insights, and collaborate and solve problems with your partners.

Value

- Gives customers visibility into both networks they own, and those they don't own or control.
- Measures the health and performance of applications and services while correlating that to the underlying networks responsible for delivering traffic to customers, employees and business partners.
- Rapid identification of fault domain - mean time to innocence
- Allows customers to collaborate uniquely with colleagues, partners and vendors to provide dynamic evidence to improve MTTR.

Delivery

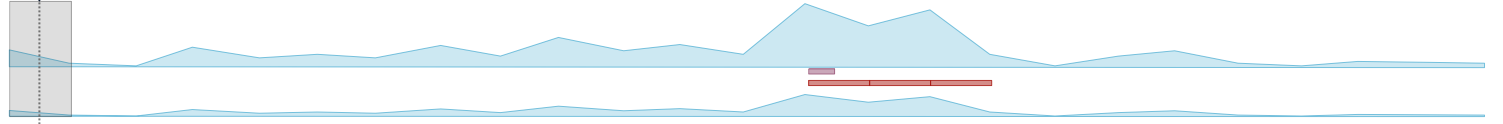
- Provides multiple types of synthetic tests (DNS, Application, Network, Voice, BGP...), from different global vantage points.
 - Cloud - Outside in vantage point (ThousandEyes POPs)
 - Enterprise - Inside out/in vantage point (customer agent)
 - Endpoint - Last mile monitoring (laptop/workstation)
- SaaS platform - Rapid time to value, little overhead cost of ownership
- Open and flexible API for robust integration into customer workflows and platform/process ecosystems

Most Correlated Visibility In One View

Time Correlated

App Experience

- Transaction scripting, page load



HTTP/DNS/RTP Server

- HTTP Availability, response time, throughput



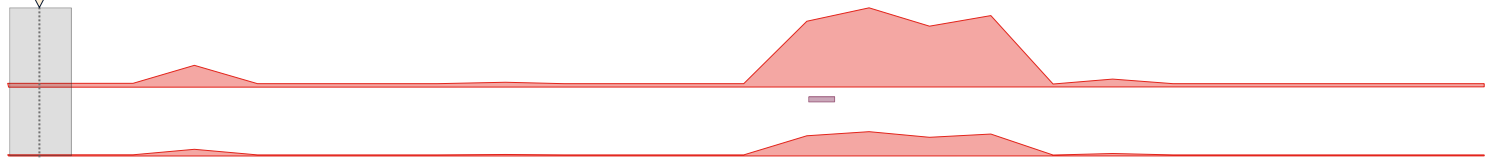
Scope and Domain

- Geo, HTTP phase, errors



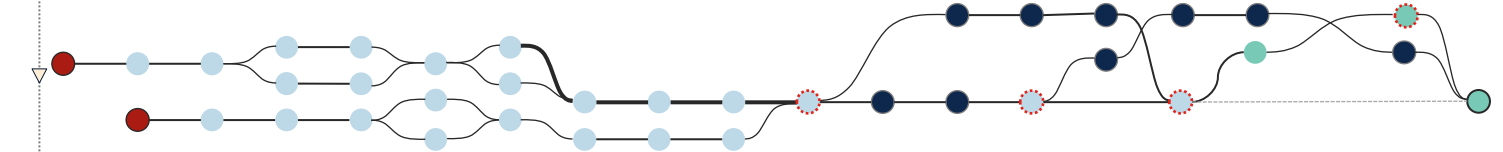
Network Metrics

- Packet loss, latency, jitter



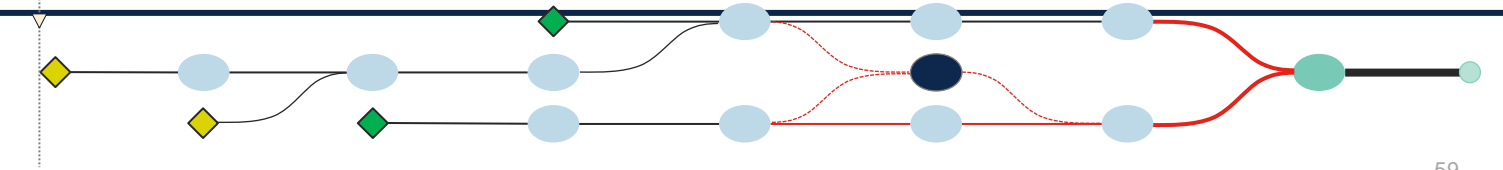
Path Visualization

- Hop-by-hop; multi-point; bidirectional
- Metrics and data per hop
- Integrated Outage Detection



BGP Monitoring

- Reachability, path changes, updates



The ThousandEyes Platform





The bridge to possible