

INTUITIVE

Cisco *live!*

5-8 March 2019 • Melbourne, Australia

#CLMEL

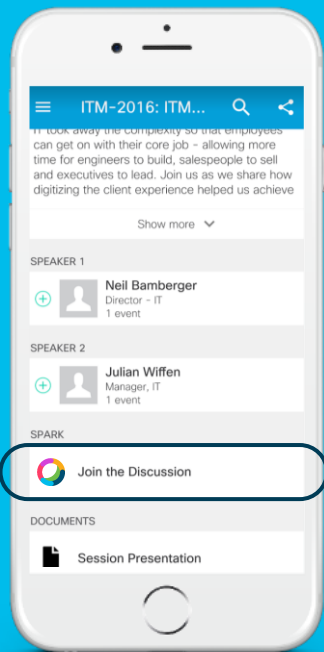


High Density, High Capacity Network Design with Cisco Meraki Wireless

Scott Williamson – Meraki CSE
BRKCRS-2231



INTUITIVE



cs.co/ciscolivebot#BRKCRS-2231

Cisco Webex Teams

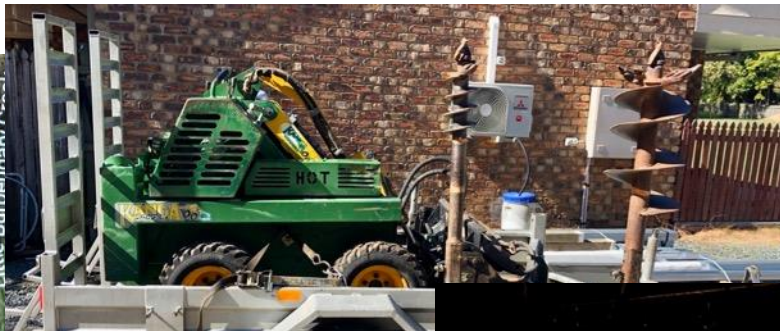
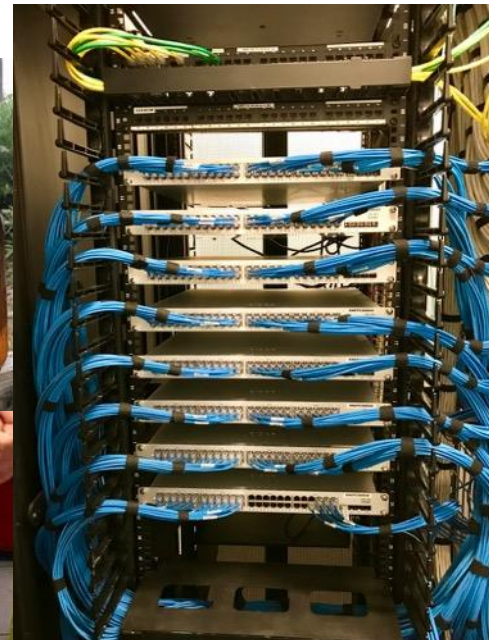
Questions?

Use Cisco Webex Teams (formerly Cisco Spark) to chat with the speaker after the session

How

- 1 Open the Cisco Events Mobile App
- 2 Find your desired session in the “Session Scheduler”
- 3 Click “Join the Discussion”
- 4 Install Webex Teams or go directly to the team space
- 5 Enter messages/questions in the team space

Who Am I



Cisco *live!*

#CLMEL

© 2019 Cisco and/or its affiliates. All rights reserved. Cisco Public

#MerakiMission

Fun, interactive mission to learn about Meraki Cloud
Live!

MISSION 2

- Participate in one of our Cisco Meraki [breakout sessions](#)
 - Get a stamp at the end of the session
 - Go to Reinvent the Network Meraki demo to claim your prize. A limited-edition Meraki backpack
- *Limited to the first 30 participants

SECURITY IS FOUNDATIONAL	DEVNET ZONE	WISP
-----------------------------	-------------	------

Full details here: <https://merakiatciscolive.splashthat.com/> *Cisco employees are not eligible.



High Density, High Capacity Network Design with Cisco Meraki Wireless

Scott Williamson – Meraki CSE
BRKCRS-2231



#CLMEL



INTUITIVE

Agenda

- What is Meraki, Recap and Products
- High Capacity: what it is, why it matters
- Breaking it down - The Tech
- What's new for high capacity networks
- How to make life Simpler, Simple is GOOD!
- Bringing it all together - Dashboard
- Q & A

Cisco Meraki

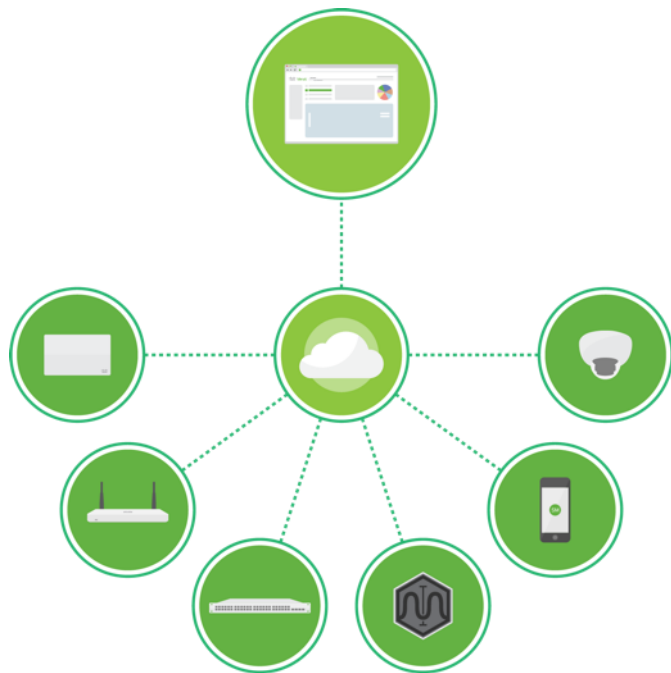
*Who are we and
what do we do?*



Simplifying powerful technology,
to free passionate people to focus on their mission and
reach groups previously left in the darkness.

Technology that simply works

Simplifying across IT with cloud management



A complete cloud managed IT solution

Wireless, switching, security, SD-WAN, communications, Unified Endpoint Management (UEM), and security cameras

Integrated hardware, software, and cloud services

Leader in cloud-managed IT

Among Cisco's fastest growing portfolios

390k+
Unique
customers

5M+
Meraki devices
online

30M+
API calls per
day

Out-of-band cloud management

Intuitive

- Simple browser-based dashboard
- Cloud-hosted centralized management platform

Scalable

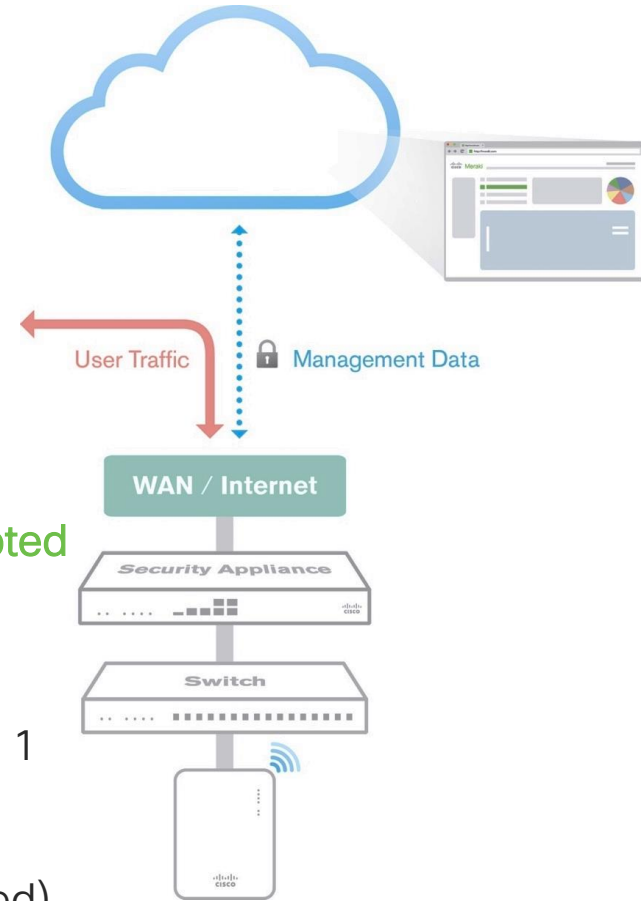
- Unlimited throughput, no bottlenecks
- Add devices or sites in minutes

Reliable

- Highly available cloud with multiple data centers
- **Network functions even if connection to cloud is interrupted**
- 99.99% uptime SLA

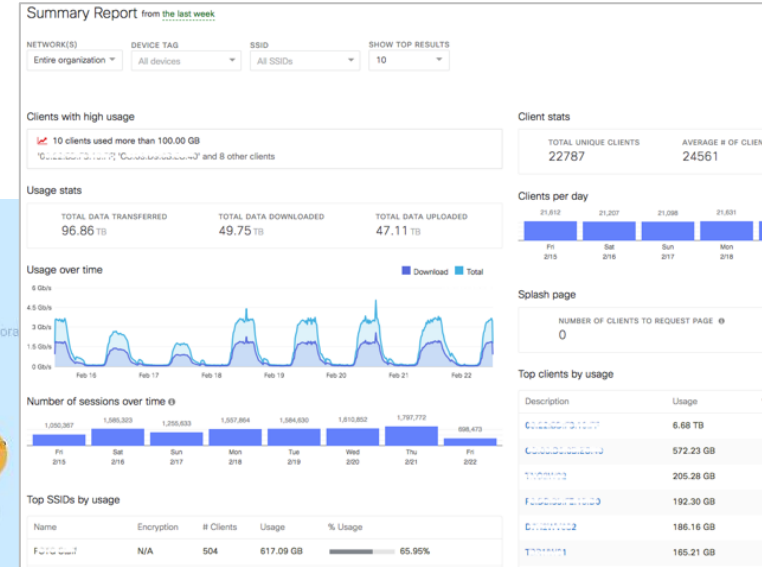
Secure

- **No user traffic passes through Meraki cloud**
- Can fully support a HIPAA / PCI compliant network (level 1 certified)
- Third party security audits, daily penetration testing
- Automatic firmware and security updates (user-scheduled)



Easiest solution to deploy, manage, and maintain

- Plug-and-play deployment, scale rapidly
- Manage your networks from anywhere
- Centralised, end-to-end visibility and control
- Actionable insights from embedded analytics

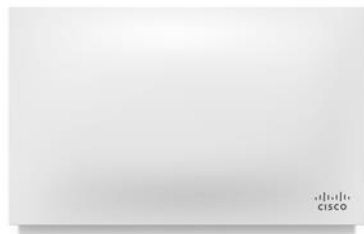


Rapid Feature Velocity



Simple, All-inclusive Licensing

A Meraki solution includes a 1:1 ratio of hardware and licenses



hardware

+



license

Licensing is required and includes:

- All features included as standard, no per-feature licensing
- Centralized management and network-wide visibility and control
- Seamless firmware and security updates
- 24/7 Enterprise Support
- NBD advance hardware replacement

Lifetime warranty (Some exceptions such as outdoor APs)

The cloud license represents the total cost of ownership for all of your Meraki devices



Our Commitment
Simplifying powerful technology,
to free passionate people to focus on their mission and
reach groups previously left in the darkness.
You Your duty
Your Company/Customer

Technology that simply works

High Capacity Challenges

It starts with Clients

4 devices per user

Lots of Guests

Wireless First

1080P

Collaboration Tools

4K

Where is the Ethernet

Hot Desking

Online Training Videos

Why is this slower than Home

Everything's in the Cloud

Higher order BW contention

It starts with Clients

4 devices per user

Lots of Guests

1080P

MORE

slow

Faster

Higher contention

More What?

- More Clients
- More Bandwidth per Client
- More AP's for more Bandwidth per client (or less clients per AP)
- More Radios per AP
- More Bandwidth per AP
- More Power per AP
- More APs per Switch (Less cabling to clients)
- More Bandwidth per Switch

What's your space and challenges

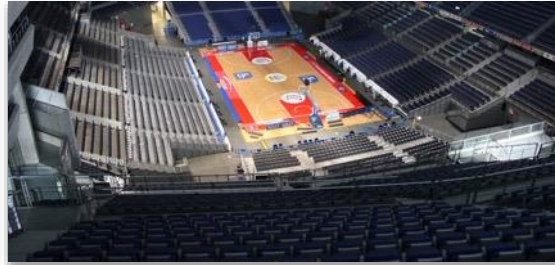
Classrooms / Auditoriums



Pfeiffer University

- Laptop + smartphone per student or 1:1 ipad initiatives
- Classroom collaboration
- Interactive video education

Stadiums / Arenas



WiZink Center

- Crowded arenas
- Noisy RF floor
- Fan / vendor engagement
- Next-gen, location-aware experiences

Enterprise Campus



Meraki Office (SF)

- Voice-over-WiFi
- Video conferencing / Telepresence
- Large conference rooms
- 2-3 devices per employee
- Noisy RF floor

Challenges for High Capacity

Spectral Efficiency



Wi-Fi performance continues to be a challenge in high client density situations due to
CSMA/CA

Increased Capacity



Virtual/Augmented Reality and 4K/8K video needs higher throughput

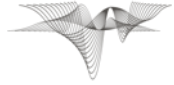
Better Power Management



Standard was not designed for IoT use cases and did not consider power limitations

High capacity, high complexity

Technical challenges



RF is an unbounded medium, so can't control signal pathways or collisions



Half-duplex halves performance of each active client



Finite number of non-overlapping channels limits usable spectrum



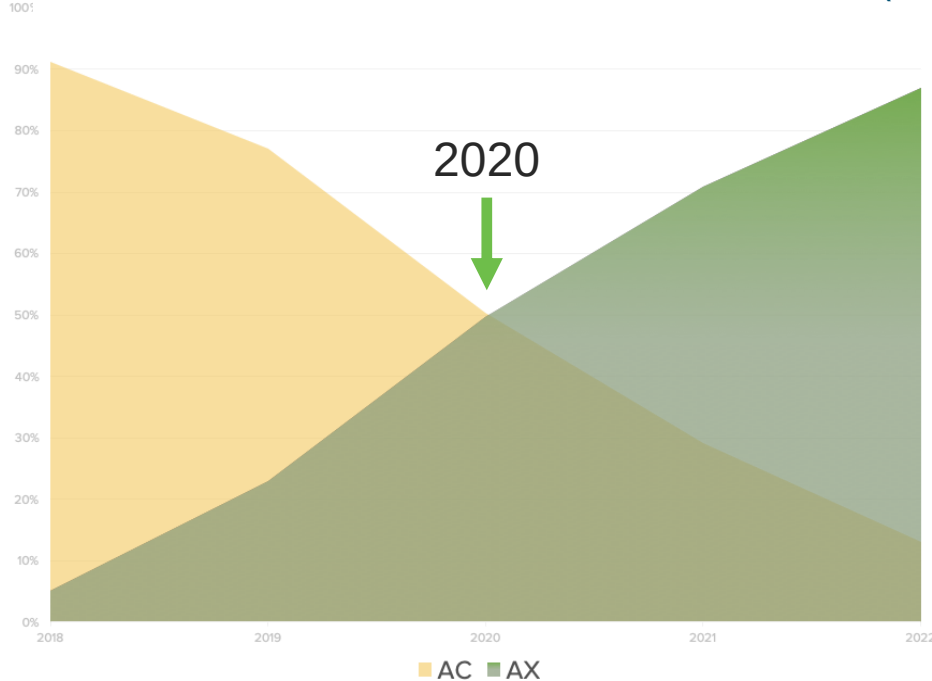
Additional SSIDs add RF overhead, contribute to interference



Sticky clients can ruin the experience for all

The rise of AX access points

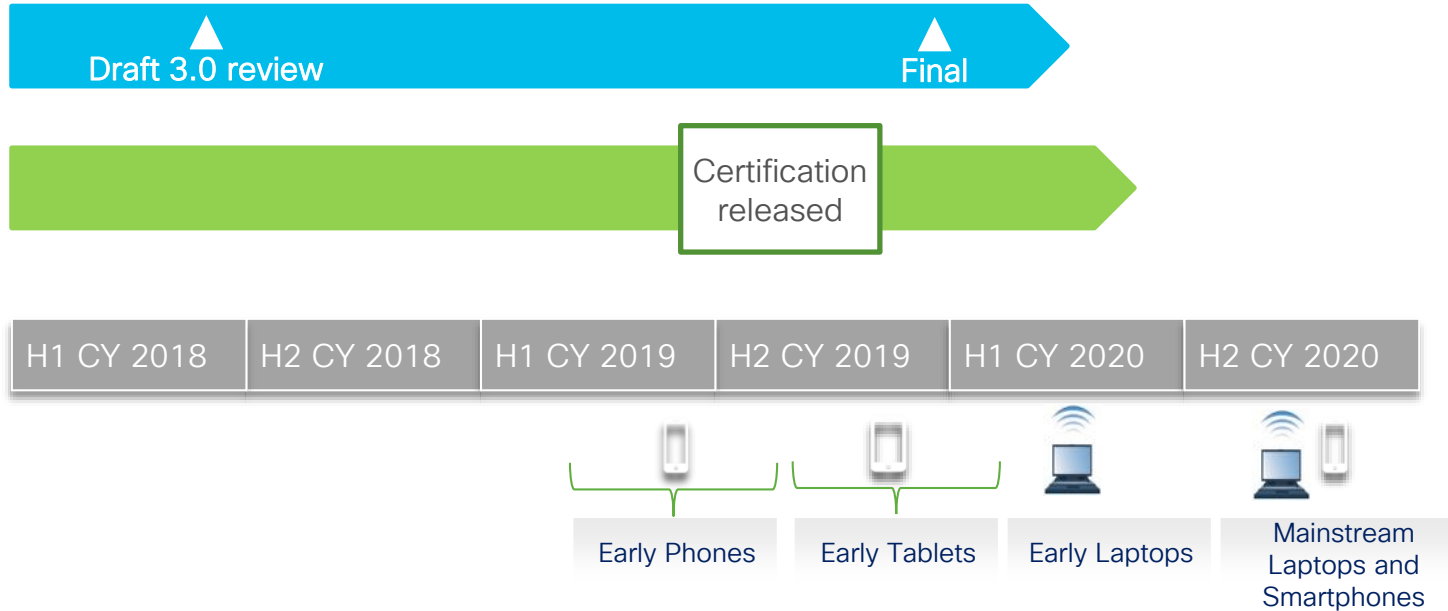
WLAN Market Forecast 2018 – 2022 (Dell'oro)



Dell'oro Group: Wireless LAN Five Year Forecast Report, 2018-2022

- AX access points (Wi-Fi 6) will continue to arrive next year across the entire industry.
- Analysts expect AX access points will comprise the majority of AP sales by 2020.
- AX access points will dominate the market by 2022.

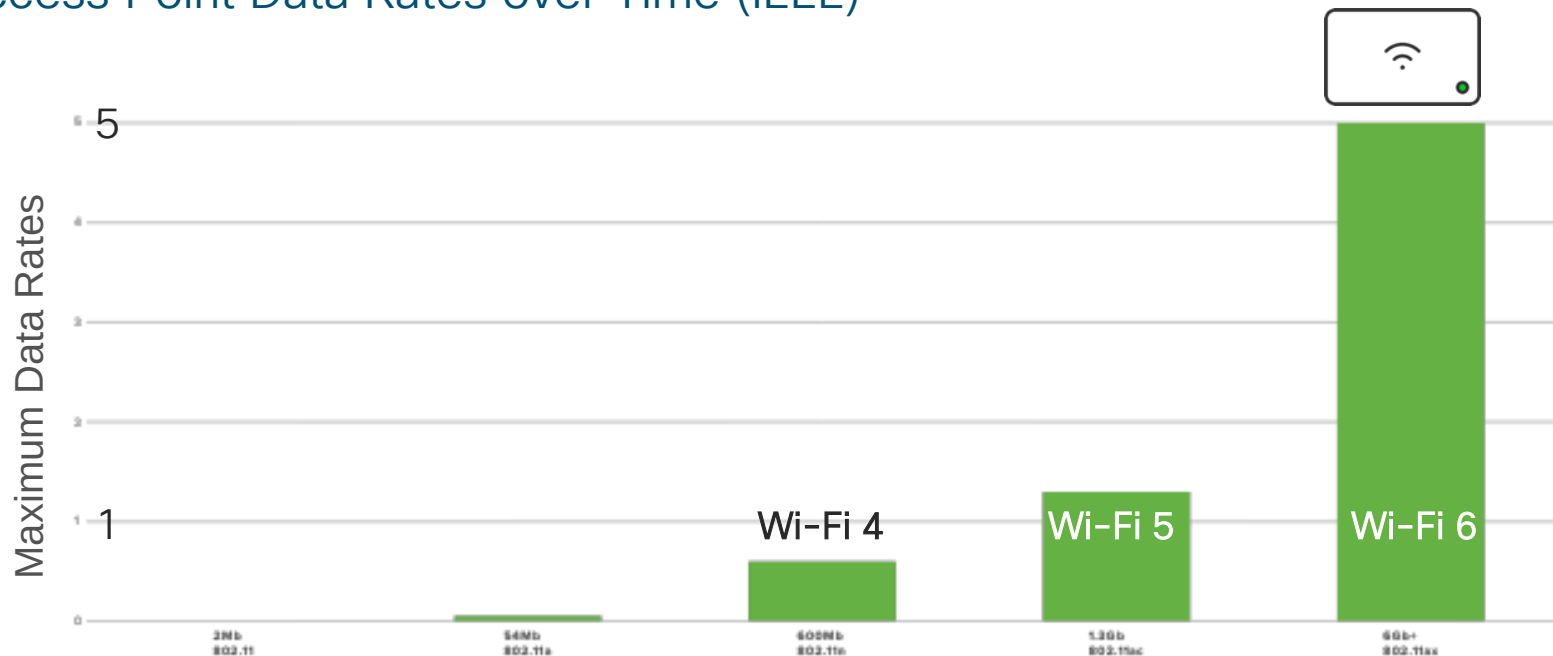
AX Timeline



The pace of 802.11ax will pick up in later this year and even stronger in 2020

Prepare for AX with Meraki Switches

Access Point Data Rates over Time (IEEE)



AP data rates have increased on wired networks over time
to generate greater network traffic

Source: IEEE: History of Access Point Rates

Prepare for AX with Meraki Switches

Ac

What's in a name?

New nomenclature	Sample User Interface Symbol	Standard Name
Wi-Fi 6		802.11ax
Wi-Fi 5		802.11ac
Wi-Fi 4		802.11n

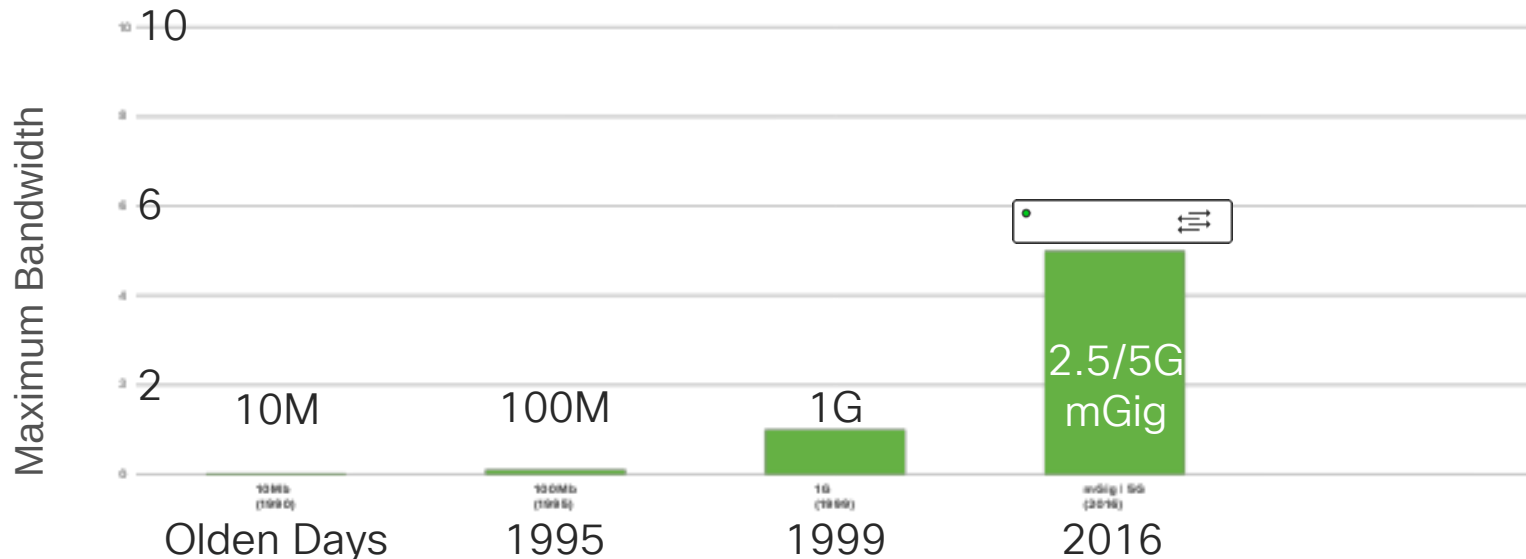


AP data rates have increased on wired networks over time
to generate greater network traffic

Source: IEEE: History of Access Point Rates

Prepare for AX with Meraki Switches

LAN bandwidth over Time (IEEE)

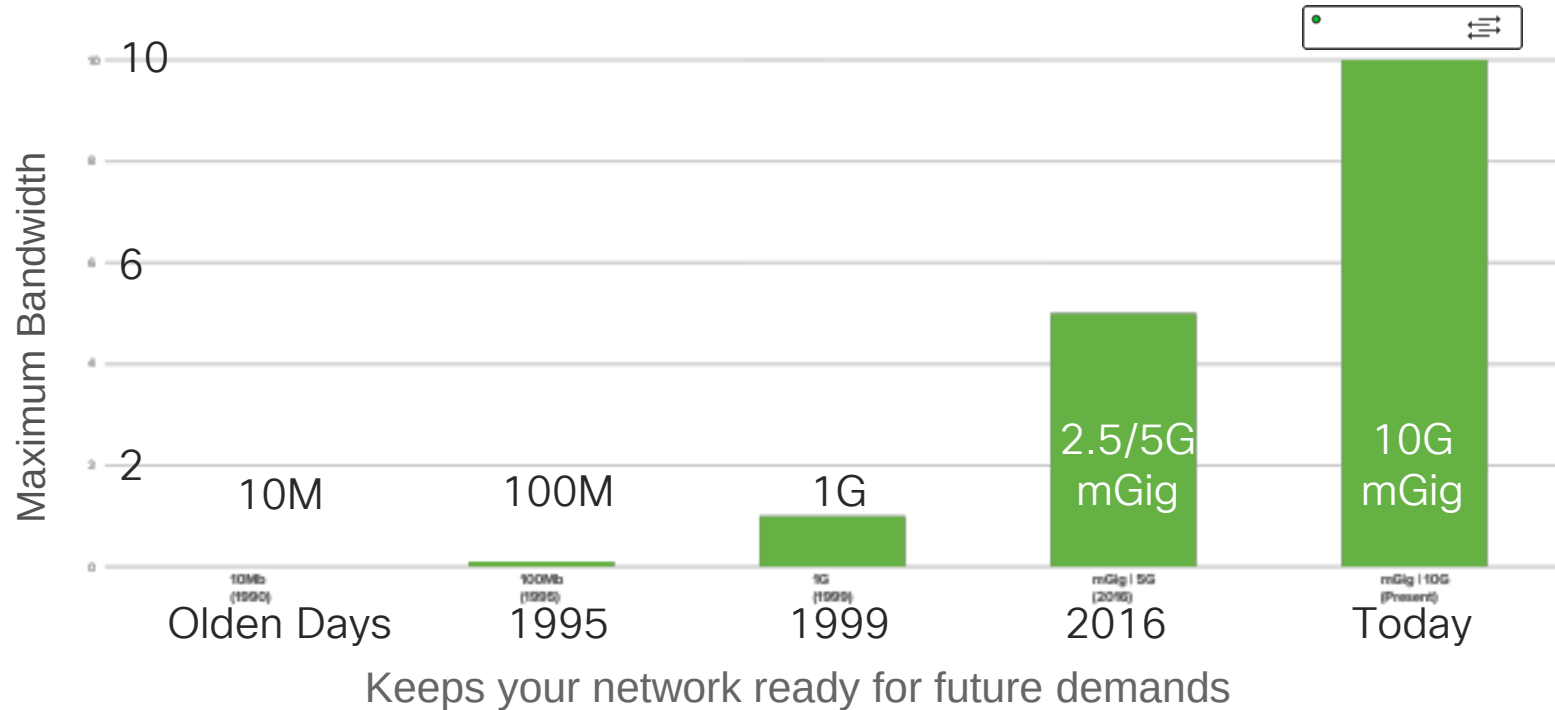


LAN bandwidth needs to keep pace with increasing throughput from APs

Source: IEEE: History of LAN bandwidth

Prepare for AX with Meraki Switches

LAN bandwidth over Time –Now with mGig (IEEE)



Source: IEEE: History of Access Point Rates

It starts Is Your

Devices per user

1080P

Lots of Guests

Network

Training Videos

Every

High

Ready

Attention

Cisco live!

#CISLIVE

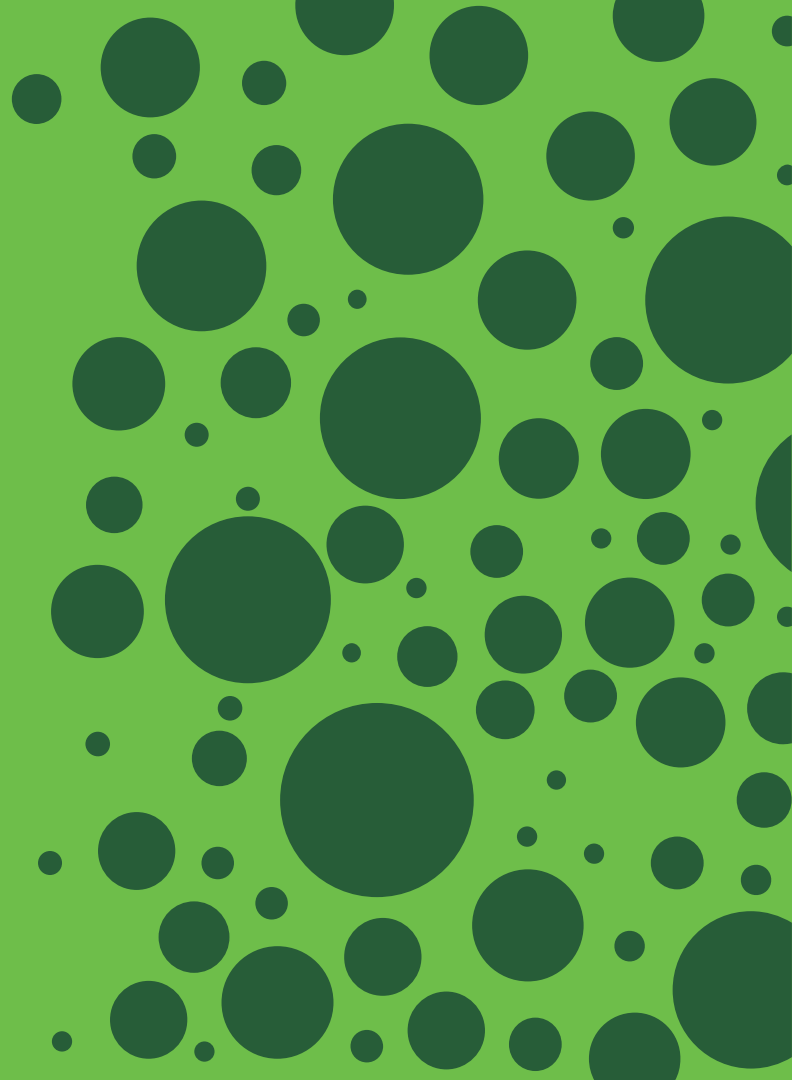
BRKRG-22

© 2013 Cisco and/or its affiliates. All rights reserved. Cisco Public

30



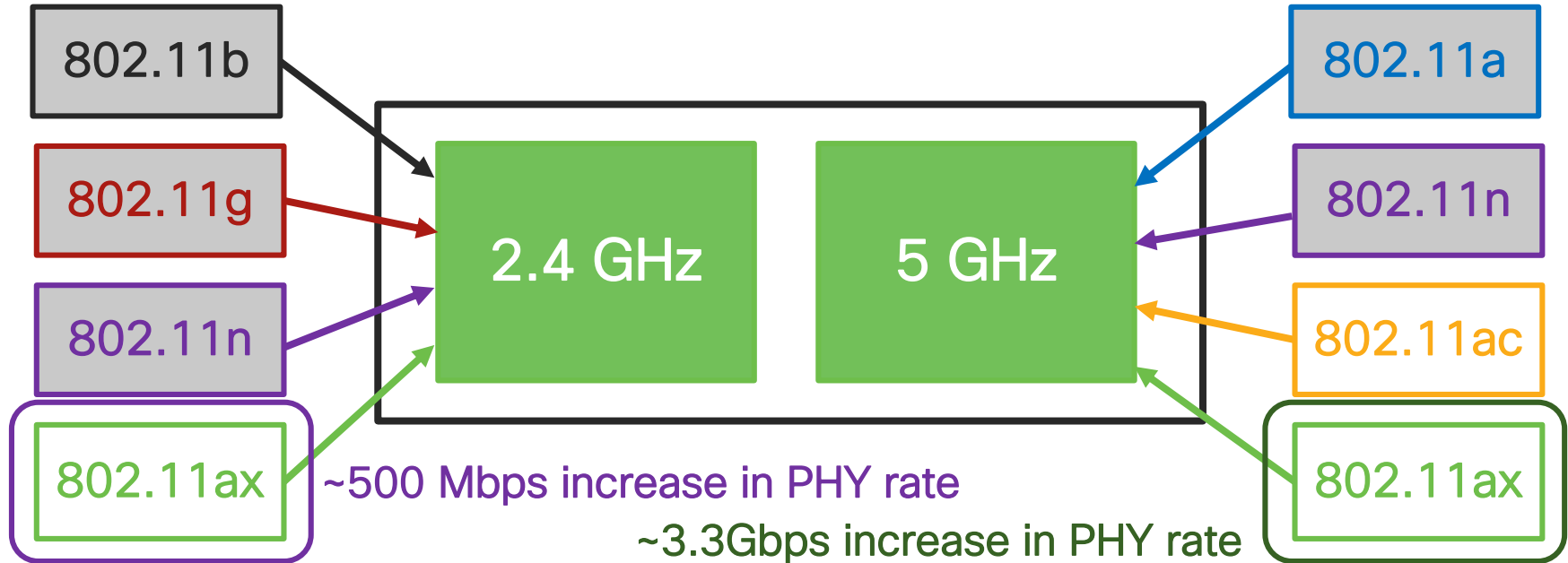
*Lets understand
the Tech*



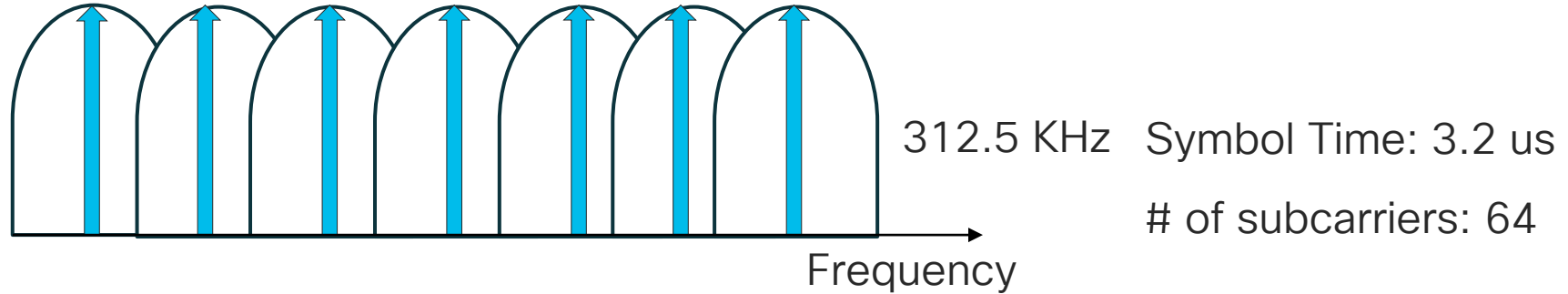
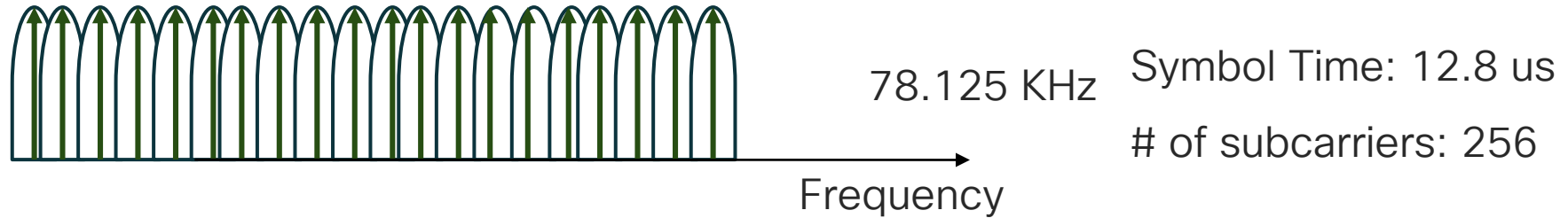
AX – What's this garbage and why



Band Support



Higher Capacity: Sub-Carrier Spacing

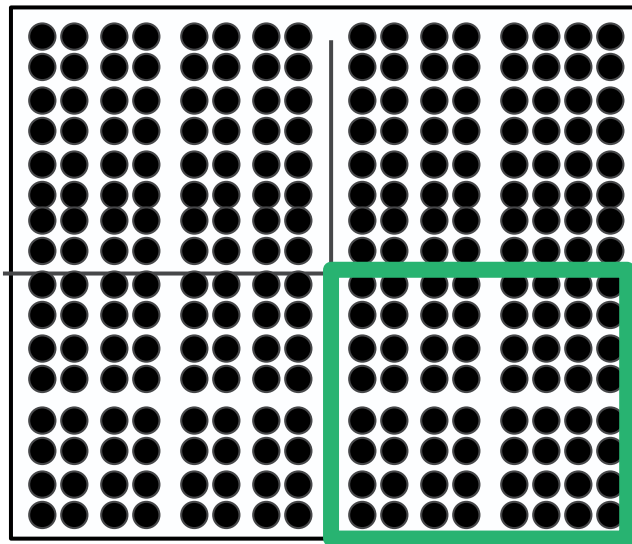


NEW: Pilot Sub-carriers used for synchronization between TX/RX

32% improvement in throughput due to increase in # of sub-carriers

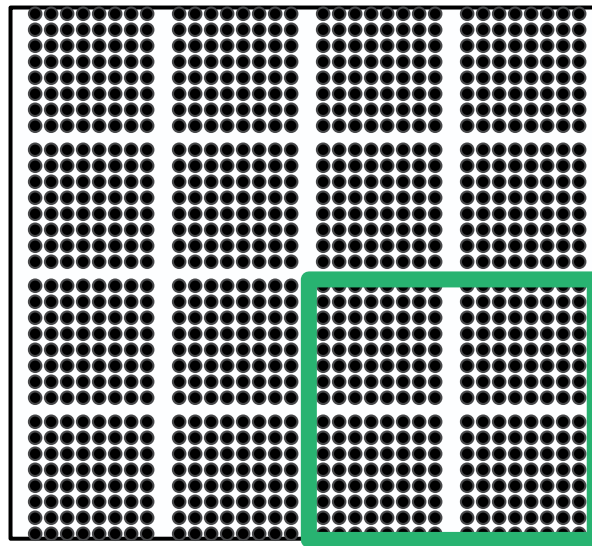
Higher Capacity: 1024 QAM

802.11ac 256 QAM



64 points per quadrant
each point represents 8 bits

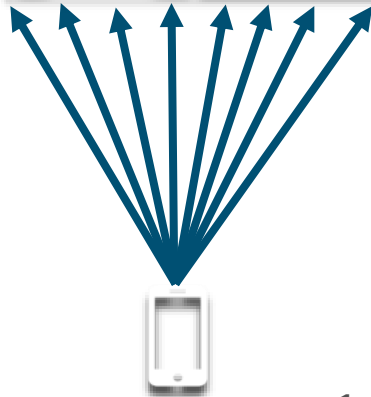
802.11ax 1024 QAM



256 points per quadrant
each point represents 10 bits

25% better data transfer rate - Just like having more pixels on your TV!

Higher Capacity: # of Spatial Streams



8 x 8 : 8

8 Transmitters 8 Receivers 8 Spatial Streams

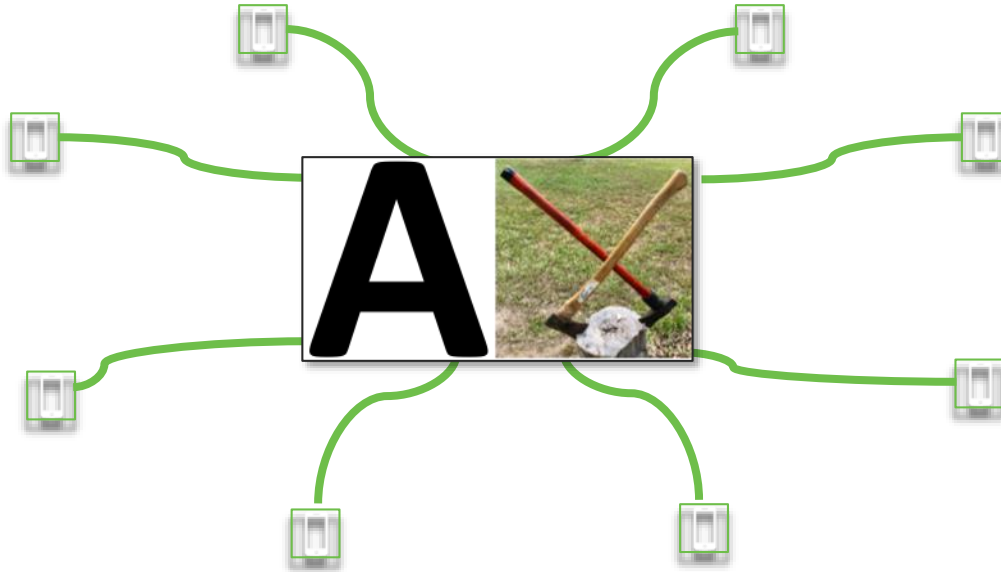
Higher Throughput

1. When clients are closer
2. Spatial multiplexing is used

Longer Range

1. When clients are at farther
2. MRC and TXBF used

Higher Capacity: MU-MIMO



Improves Experience for: Large File Transfer, Video Streaming and Web Services

Typical support up to 4 users over 8 SS.

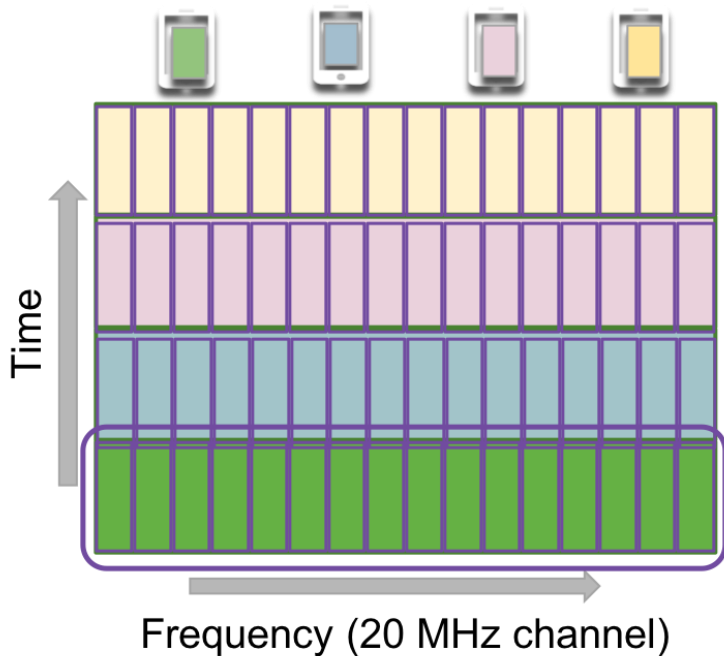
Higher Efficiency: MU-OFDMA



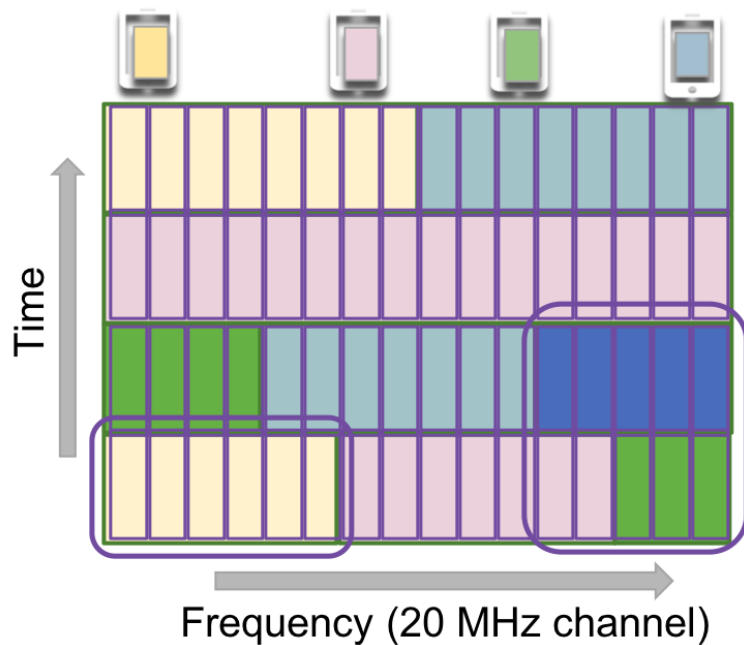
Improves experience for Cloud-based services, Notifications, Wi-Fi Management Frames, Web Browsing and Gaming

Higher Efficiency: MU-OFDMA

OFDM



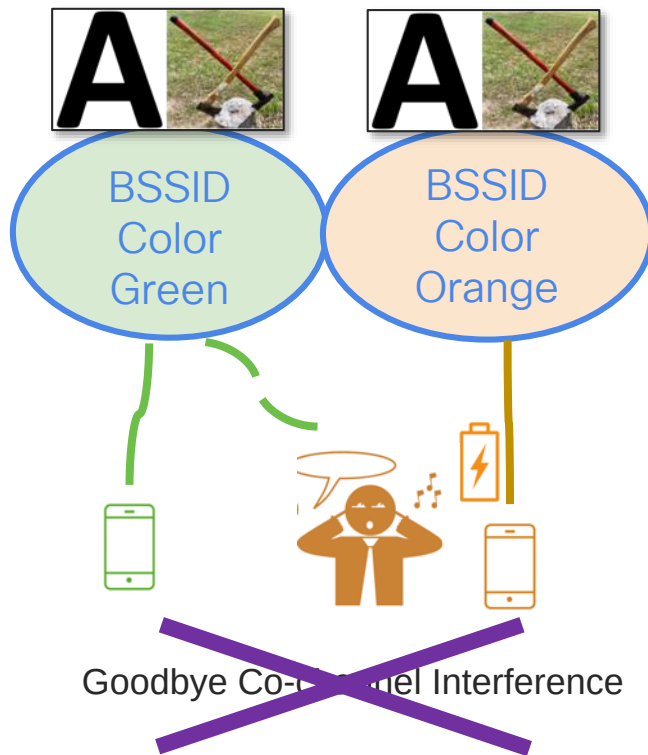
OFDMA



In a mixed environment, AP still needs to negotiate TXOP like it is done with legacy standards
Typical support for up to 8 users in a single TXOP.

Higher Efficiency: BSS Colouring

- Each AP can have own BSS Colour on as Channel
- Signals with the same BSS color use a low RSSI threshold
- Signals with a different BSS color use a higher RSSI



Is this similar to RX-SOP?

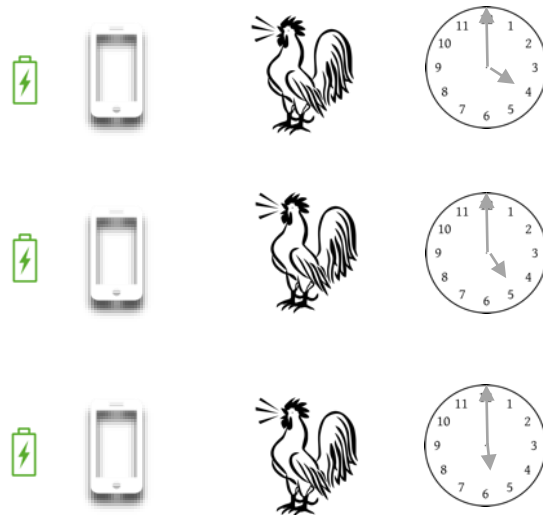
Does it work with legacy standards?

Better Power Management: TWT

Is it time to wake up yet ?



Before 802.11ax, clients wake up at regular and frequent intervals based on Listen Interval (a function of Beacon interval), thereby wasting considerable battery life



With 802.11ax, APs can stagger a wake-up call per clients avoiding air-time contention

What is new?

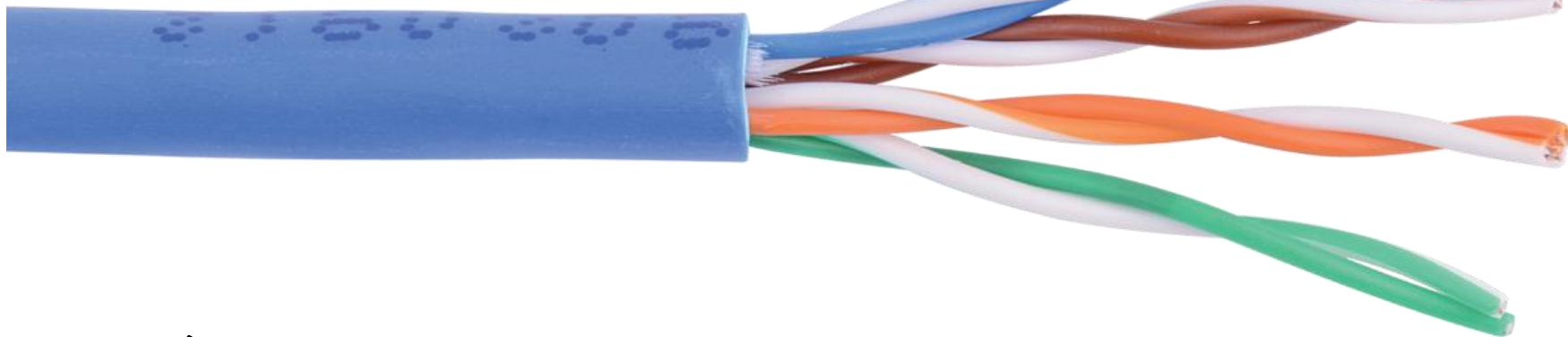
Capabilities	11ac (Wi-Fi 5)	11ax (Wi-Fi 6)
Standard Description	Very High Throughput	High Efficiency
Operates in spectrum	5G only	2.4 and 5G
MU-MIMO	DL Only	DL/UL
Channel Width	20, 40, 80, 80+80, 160 MHz	20, 40, 80, 80+80, 160 MHz
Guard Interval	800/400 ns	800/1600/3200 ns
OFDMA	NA	DL/UL (MU-OFDMA)
Frequency Modulation	256 QAM	1024 QAM with MCS 10, 11
Power Save	STBC, U-APSD	STBC, U-APSD, Target Wait Time (TWT)
Spectral Efficiency	NA	BSS Coloring

mGig – Woah?

to backhaul all this Lovely Wireless

- Also called NBase-T
- 2.5, 5 and 10Gig to the AP
- Over existing cabling
- Supports UPOE (60W)

Cable Type	1G	2.5G	5G	10G
Cat5e	Yes	Yes	Yes	NO
Cat6	Yes	Yes	Yes	55m
Cat6a	Yes	Yes	Yes	Yes



MR Product Line Overview

Meraki MR Wireless Access Point Models

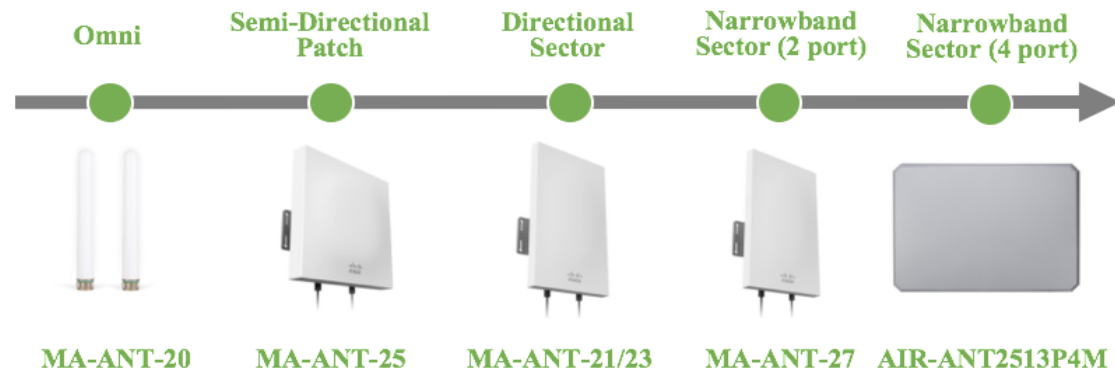
	Hospitality	Entry Level	General Purpose	High Performance	Future Proof
Indoor	 <p>MR30H </p> <p>2 Stream, 4-Radio 802.11ac Wave 2 4-port switch 1 PoE-out port</p>	 <p>MR20</p> <p>2 Stream, 2-Radio 802.11ac Wave 2</p>	 <p>MR33 </p> <p>2 Stream, 4-Radio 802.11ac Wave 2</p>	 <p>MR42 </p>  <p>MR42E </p> <p>3 Stream, 4-Radio 802.11ac Wave 2</p>	 <p>MR52 </p>  <p>MR53 </p> <p>MR53E </p> <p>4 Stream, 4-Radio 802.11ac Wave 2 -Multigigabit</p>
Outdoor		 <p>MR70</p> <p>2 Stream, 2-Radio 802.11ac Wave 2</p>		 <p>MR74 </p> <p>2 Stream, 4-Radio 802.11ac Wave 2</p>	 <p>MR84 </p> <p>4 Stream, 4-Radio 802.11ac Wave 2 -Multigigabit</p>

Antenna Portfolio

Indoor



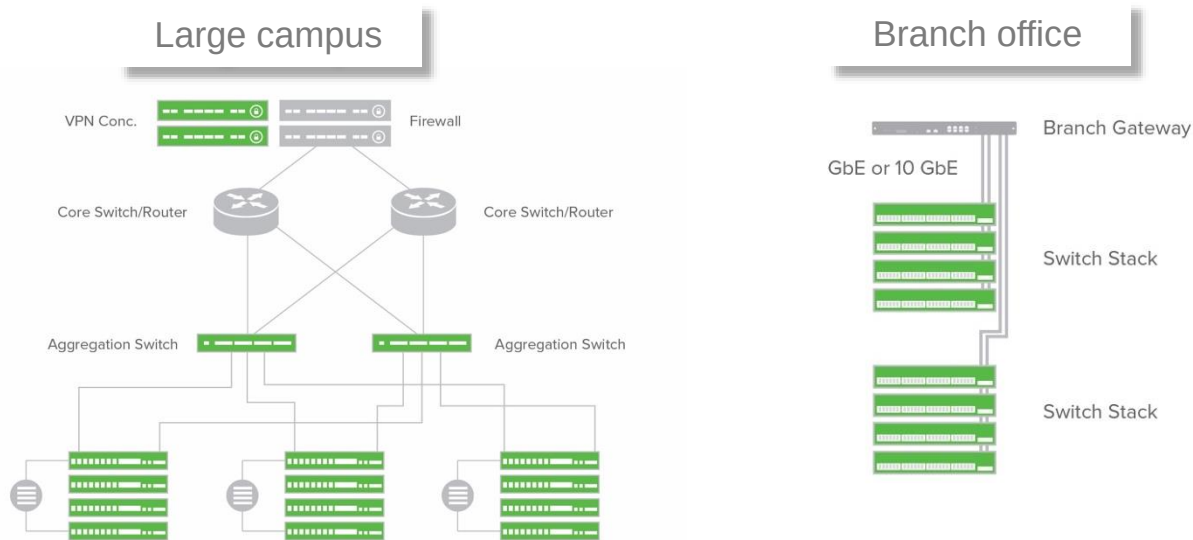
Outdoor



MS Product Line Overview

Cloud-managed from access to aggregation layers

- Gigabit or multi-gigabit access switches with stacking, Layer 3 dynamic routing, PoE/PoE+
- 10G, 40G, 100G aggregation switches for campus deployments
- Stacking and cross-link aggregation support



Meraki Layer 2 Access Switching

Compact

MS120-8



PoE+
options

1G SFP
Uplinks

Slim Form
Factor

Branch

MS120



PoE+
options

1G SFP
Uplinks

Branch &
Campus

MS210



PoE+
options

1G SFP
Uplinks

80G
Stacking

L2+
Static
Routing

RPS
Optional

Branch &
Campus

MS225



PoE+
options

10G SFP+
Uplinks

80G
Stacking

L2+
Static
Routing

RPS
Optional

Compatible Stacking

Meraki Layer 3 Access Switching

Branch & Campus

MS250




PoE+ options


10G SFP+ Uplinks


80G Stacking


Layer 3 Routing


Modular Power

Campus

MS350




PoE+ options


10G SFP+ Uplinks


160G Stacking

Compatible Stacking


Highly Scalable L3 Routing


Modular Power


Modular Fans

Campus

MS350-24X




PoE+/UPoE


10G SFP+ Uplinks


160G Stacking

Compatible Stacking


Highly Scalable L3 Routing


Multigigabit


Modular Power


Modular Fans

High Bandwidth Campus

MS355




PoE+/UPoE


10G/40G Uplinks


400 G Stacking


Highly Scalable L3 Routing


Multigigabit


Modular Power

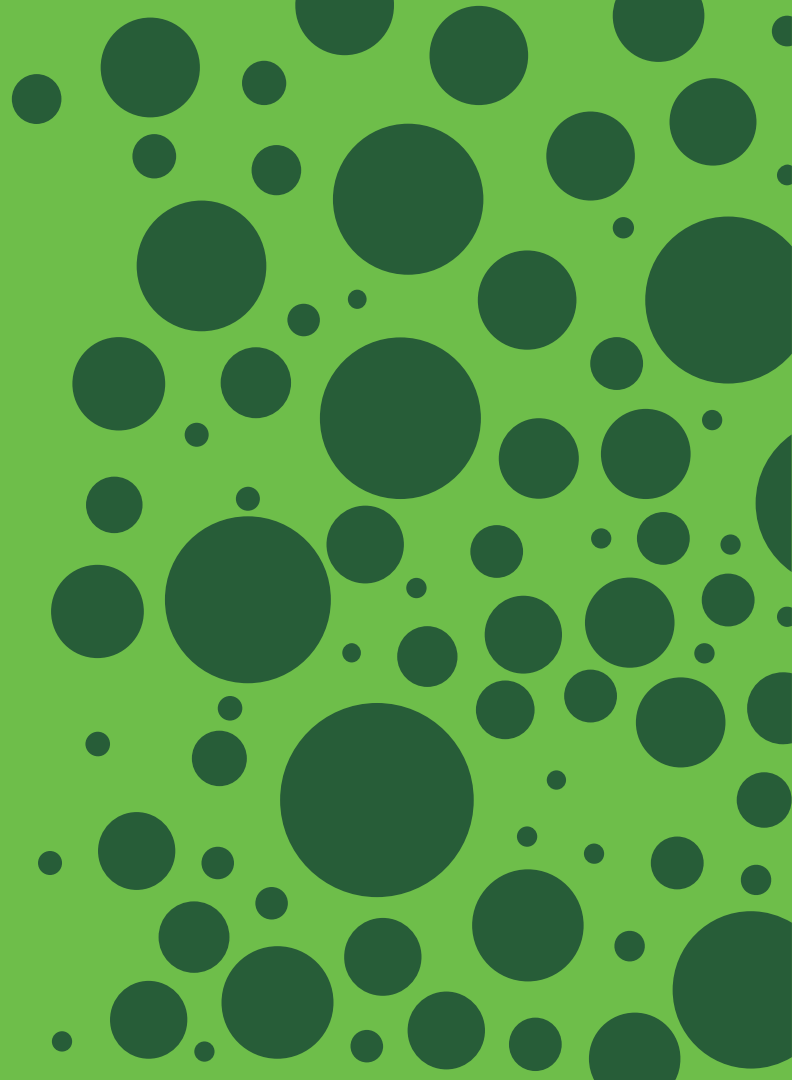

Modular Fans

Meraki Aggregation Portfolio

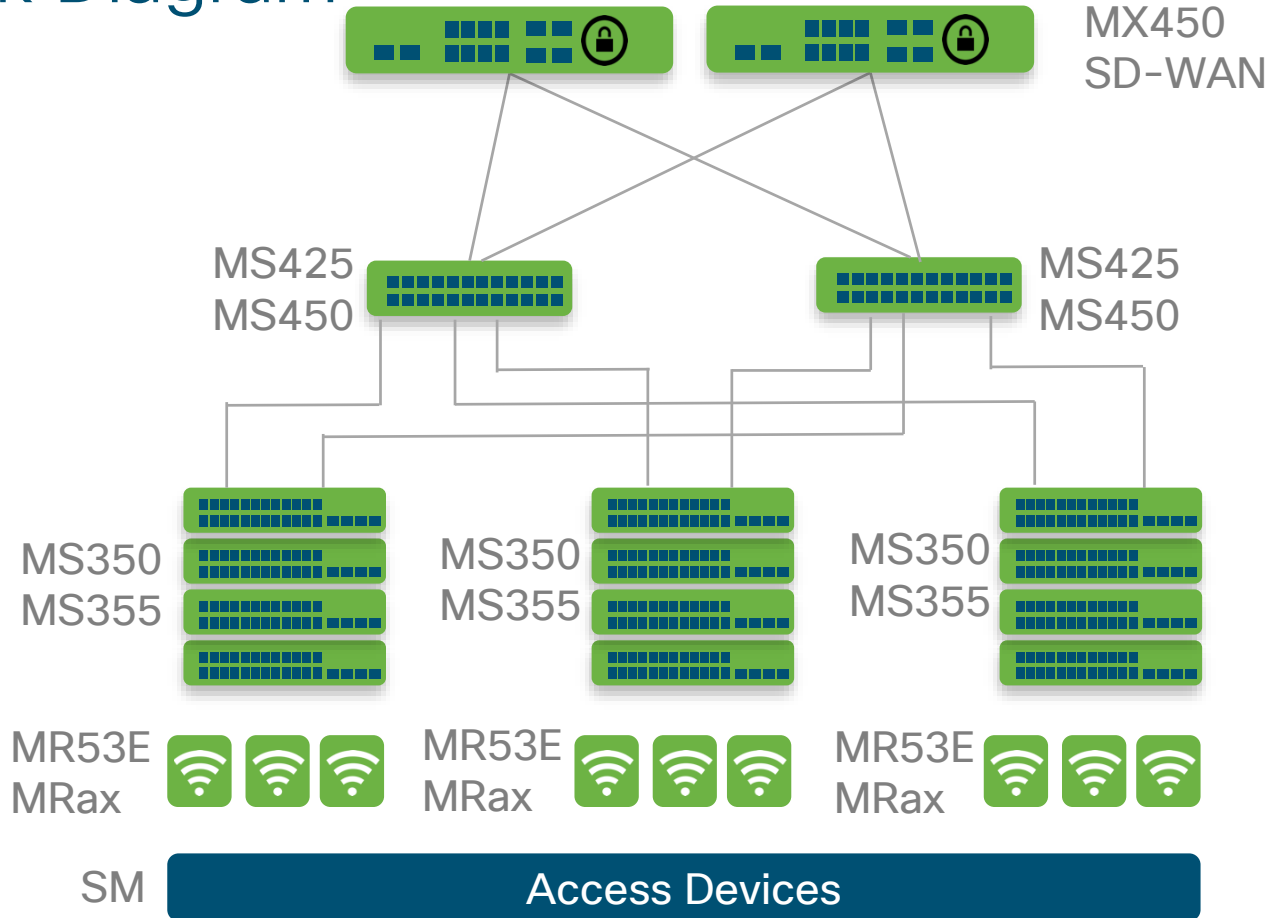
Small & Medium Campus	MS410		 1G SFP links	 10G SFP+ Uplinks	 160G Stacking	 Highly Scalable L3 Routing	 Modular Power	 Modular Fans	
Medium & Large Campus	MS425		 10G SFP+ links	 40G QSFP+ Uplinks	 160G Flexible Stacking	 Highly Scalable L3 Routing	 Deeper Buffer	 Modular Power	 Modular Fans
High Capacity Campus	MS450		 40G QSFP+ links	 100G QSFP28 Uplinks	 400G Stacking	 Highly Scalable L3 Routing	 Deeper Buffer	 Modular Power	 Modular Fans

*Help me make it
simple*

Bring it all together



Network Diagram



All the mGig you will need with the MS355

MS355-24X



MS355-48X



MS355-24X2



MS355-48X2



Gig mGig 10G 40G

- MS355-24X
 - 8 x mGig
 - 16 x 1G
 - 4 x 10G, 2 x 40G
- MS355-48X
 - 16 x mGig
 - 32 x 1G
 - 4 x 10G, 2 x 40G
- MS355-24X2
 - 24 x mGig
 - 4 x 10G, 2 x 40G
- MS355-48X2
 - 24 x mGig
 - 24 x 1G
 - 4 x 10G, 2 x 40G

Terabit Switching with the MS450

MS450 Capabilities:

- Connect up to 12 MS355s
- Higher bandwidth uplink connects to core/data center switch
- Stack up to 8 units for high-availability deployments
- Ample switching capacity for the entire network



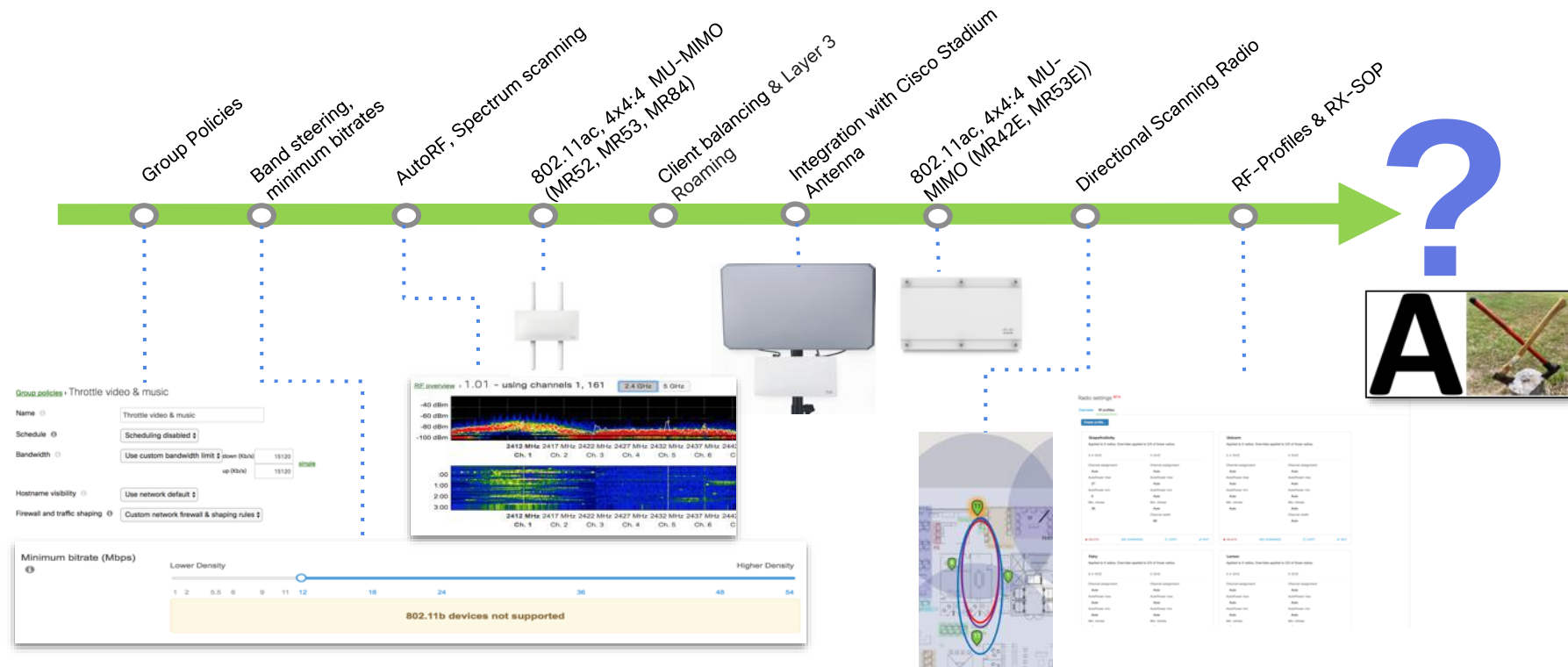
Terabit Switching with the MS450

MS450 Features:

- 12 x 40G QSFP+ ports
- 2 x 100G QSFP28 uplinks
- 400G of physical stacking bandwidth
- 1.36 Tbps of switching capacity



Meraki's High Density Journey



Making this work

Considerations and Recommendations

Wireless

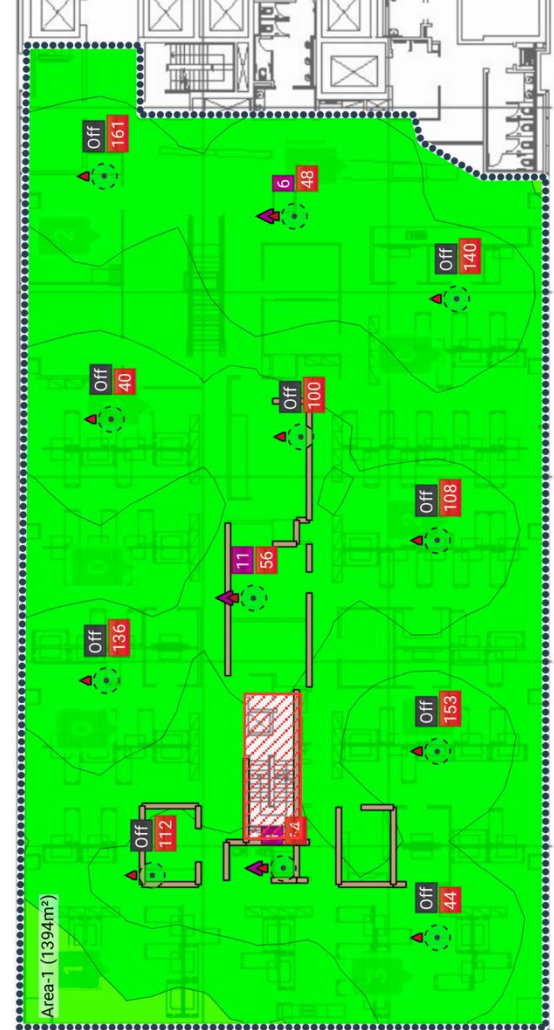
- Clients
- RF Survey
- RF Tuning
- RF, RF, RF and RF
- SSID's
- L3 Roaming
- QoS

Switching

- Higher order link contention
- QoS
- Redundant Config – STP, LACP

RF, RF, RF and RF

- Clients
 - a ,b ,g ,n
 - TX Power
 - RX Sensitivity
 - Antenna
- Survey
- Tuning
 - RF Profiles
 - RX-SOP



RF profiles and RX-SOP

Customise RF characteristics by deployment

Radio settings BETA

[Overview](#) [RF profiles](#)

New Profile

Basic Indoor Profile DEFAULT INDOOR

Applied to 0 APs.

2.4 GHZ		5 GHZ	
Channel assignment	Auto	Channel assignment	Auto
AutoPower max	30	AutoPower max	30
AutoPower min	30	AutoPower min	30
Min. bitrate	11	Min. bitrate	11
		Channel width	40

[CHANGE DEFAULT PROFILE](#) [COPY](#) [EDIT](#)

Basic Outdoor Profile DEFAULT OUTDOOR

Applied to 0 APs.

2.4 GHZ		5 GHZ	
Channel assignment	Auto	Channel assignment	Auto
AutoPower max	30	AutoPower max	30
AutoPower min	30	AutoPower min	30
Min. bitrate	11	Min. bitrate	12
		Channel width	40

[CHANGE DEFAULT PROFILE](#) [COPY](#) [EDIT](#)

Home

Applied to 3 APs. No overrides on those APs.

2.4 GHZ		5 GHZ	
Channel assignment	Auto	Channel assignment	Auto
AutoPower max	30	AutoPower max	30
AutoPower min	30	AutoPower min	30
Min. bitrate	11	Min. bitrate	11
		Channel width	40

[DELETE](#) [COPY](#) [EDIT](#)

RF PROFILES

Edit Home

[General](#) [2.4 GHz](#) [5 GHz](#)

General

Profile name

Band selection

Per AP

Per SSID

☒ Dual band operation (2.4 & 5 GHz enabled)

Best for most applications. Provides more capacity and less interference for client devices and supports legacy clients (802.11b/g, 802.11a).

☐ Enable band steering

☐ 5 GHz band only

SSID will be broadcast only on 5 GHz. Legacy (802.11b/g) devices will not be supported.

☐ 2.4 GHz band only

SSID will be broadcast on 2.4 GHz only. Not recommended as 802.11a devices will not be supported.

Minimum bitrate configuration

☐ Per band

Set the minimum bitrates for the 2.4 & 5 GHz radios separately below.

☒ Per SSID

The radios in this profile will follow the minimum bitrate set on the [Access Control page](#).

Cisco *live!*

#CLMEL

© 2019 Cisco and/or its affiliates. All rights reserved. Cisco Public

RF Profile with more Flexibility!!

Radio settings **BETA**

[New Profile](#)

Basic Outdoor Profile

DEFAULT OUTDOOR

2.4 GHZ		5 GHZ	
Channel assignment	Auto	Channel assignment	Auto
AutoPower max	30	AutoPower max	30
AutoPower min	5	AutoPower min	8
Min. bitrate	11	Min. bitrate	12
		Channel width	40

[CHANGE DEFAULT PROFILE](#) [COPY](#) [EDIT](#)

Office Floor

DEFAULT INDOOR

2.4 GHZ		5 GHZ	
Channel assignment	Auto	Channel assignment	Auto
AutoPower max	17	AutoPower max	20
AutoPower min	11	AutoPower min	14
Min. bitrate	12	Min. bitrate	12
		Channel width	20

[CHANGE DEFAULT PROFILE](#) [COPY](#) [EDIT](#)

Basic Indoor Profile

2.4 GHZ		5 GHZ	
Channel assignment	Auto	Channel assignment	Auto
AutoPower max	30	AutoPower max	30
AutoPower min	5	AutoPower min	8
Min. bitrate	11	Min. bitrate	12
		Channel width	40

[DELETE](#) [COPY](#) [EDIT](#)

RX-SOP

Channel width

Channel assignment method
 AutoChannel will assign radios to channels.
 [Change channels used by AutoChannel!](#)

Radio transmit power range (dBm)
 Transmit shorter distance
 

Min. received power (RX-SOP)

 **PROCEED WITH CAUTION! MISUSE OF THIS OPTION CAN CAUSE SEVERE PERFORMANCE ISSUES WITH YOUR WIRELESS IMPLEMENTATION.**
You should only use this option if you have a clear understanding of the nuances of RX-SOP and have conducted a site survey.

PROCEED WITH CAUTION! MISUSE OF THIS OPTION CAN CAUSE SEVERE PERFORMANCE ISSUES WITH YOUR WIRELESS IMPLEMENTATION.

You should only use this option if you have a clear understanding of the nuances of RX-SOP and have conducted a site survey

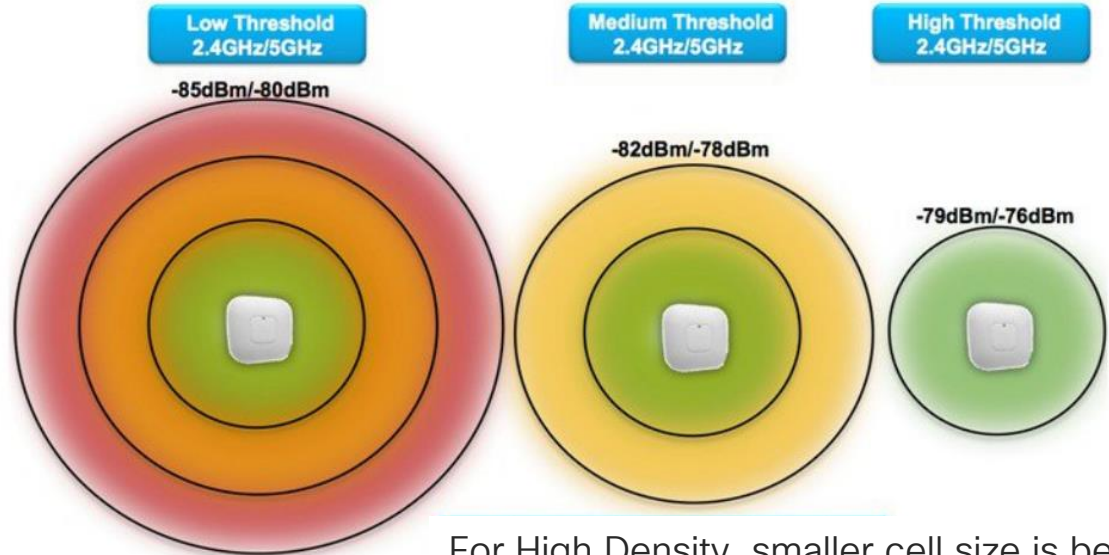
RX-SOP

Min. received power (RX-SOP)

Disabled **Enabled**

Listen for clients farther away Ignore weaker clients

-95 -94 -93 -92 -91 -90 -89 -88 -87 -86 -85 -84 -83 -82 -81 -80 -79 -78 -77 -76 -75 -74 -73 -72 -71 -70 -69 -68 -67 -66 -65 dBm



For High Density, smaller cell size is better!

Useful Links

High Density Deployment Guide:

[https://documentation.meraki.com/Architectures_and_Best_Practices/Cisco_Meraki_Best_Practice_Design/Best_Practice_Design - MR Wireless/High Density Wi-Fi Deployments](https://documentation.meraki.com/Architectures_and_Best_Practices/Cisco_Meraki_Best_Practice_Design/Best_Practice_Design_-_MR_Wireless/High_Density_Wi-Fi_Deployments)

RF Profiles Documentation:

https://documentation.meraki.com/MR/Radio_Settings/RF_Profiles

RX-SOP Documentation:

[https://documentation.meraki.com/MR/Radio_Settings/Receive_Start_of_Packet_\(RX-SOP\)](https://documentation.meraki.com/MR/Radio_Settings/Receive_Start_of_Packet_(RX-SOP))

Multi-SSID Deployment Considerations

- Keep it to 3
- Use Band Steering
- Disable slow bitrates
- Only enable SSID on AP if needed
- Use Tags to advertise SSIDs
- Minimise Channel overlap

Wi-Fi SSID Overhead Calculator

VARIABLES:

Beacon Data Rate (Mbps)	802.11b 1 Mbps
Beacon Frame Size (Bytes)	380
Beacon Interval (ms)	102.4

ASSUMPTIONS:

802.11b Long Preamble used for 1 Mbps; S
802.11g short slot time is assumed, with no
WMM is enabled and beacons are transmitt

Amount of Overhead:

0-10% Low

10-20% Medium

20-50% High

Number of APs on Channel*	Number of SSIDs						
	1	2	3	4	5	6	7
1	3.22%	6.45%	9.67%	12.90%	16.12%	19.35%	22.57%
2	6.45%	12.90%	19.35%	25.80%	32.25%	38.70%	45.14%
3	9.67%	19.35%	29.02%	38.70%	48.37%	58.04%	67.72%
4	12.90%	25.80%	38.70%	51.59%	64.49%	77.39%	90.29%
5	16.12%	32.25%	48.37%	64.49%	80.62%	96.74%	100.00%
6	19.35%	38.70%	58.04%	77.39%	96.74%	100.00%	100.00%
7	22.57%	45.14%	67.72%	90.29%	100.00%	100.00%	100.00%
8	25.80%	51.59%	77.39%	100.00%	100.00%	100.00%	100.00%
9	29.02%	58.04%	87.06%	100.00%	100.00%	100.00%	100.00%
10	32.25%	64.49%	96.74%	100.00%	100.00%	100.00%	100.00%

REF: <http://www.revolutionwifi.net/revolutionwifi/p/ssid-overhead-calculator.html>

Best Practice: https://documentation.meraki.com/MR/WiFi_Basics_and_Best_Practices/Multi-SSID_Deployment_Considerations

L3 Roaming

RUN R26

Firmware

L3 Roaming

RUN R26

Firmware

Insert Advert for R26 Here!!

Groundbreaking Innovation – R26



TCP FastACK

Up to 38% increase



L3 Fast Secure Roaming

About 40ms

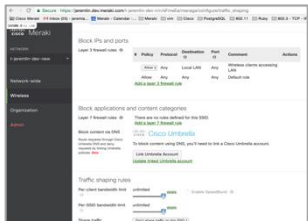


Wi-Fi Location Enhancements

26% improvement in accuracy

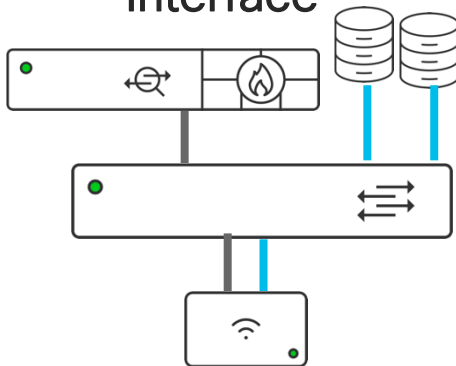
Let's talk firmware MR26.1

Umbrella Integration



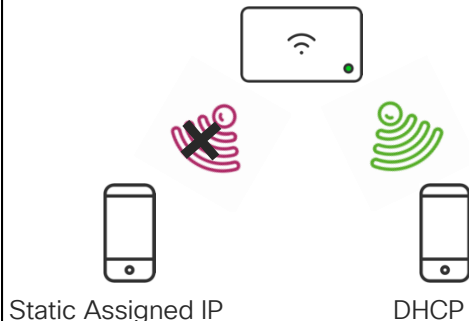
Import Umbrella policies into Meraki dashboard and apply on per-SSID basis or group policies

Alternate Management Interface



MR/MS can be placed on the public network, with a secondary virtual interface available to send certain traffic types on an internal VLAN

Mandatory DHCP



Clients with static IP
addresses are
disconnected

L3 Roaming

RUN R26
End of Advert
Firmware

Quality of Service

- Switching
- Wireless

QoS and Tag Preservation

- MS switches with no Quality of Service defined will treat traffic as **FIFO**; in order to guarantee service, packets can be placed in 6 different classes, and each of them will have a proportional bandwidth assigned to it (**WFQ**)

CoS	Weight
0 (default class)	1
1	2
2	4
3	8
4	16
5	32

	VLAN	Protocol	Source port	Destination port	DSCP	Edit DSCP to CoS map
1	<input type="text" value="100"/>	<input type="text" value="Any"/>			<input type="text" value="Trust incoming DSCP"/>	
2	<input type="text" value="200"/>	<input type="text" value="TCP"/>	<input type="text" value="Any"/>	<input type="text" value="6000"/>	<input type="text" value="Set DSCP to..."/>	<input type="text" value="26 → class 2 (AF31)"/>
Add a QoS rule for this network						

- MS allows you to set a single QoS policy for the entire switched network to provide tag preservation across the network.

DSCP value	CoS value	Title	
<input type="text" value="0"/>	<input type="text" value="0"/>	<input type="text" value="default"/>	<input type="text" value="X"/>
<input type="text" value="10"/>	<input type="text" value="0"/>	<input type="text" value="AF11"/>	<input type="text" value="X"/>
<input type="text" value="18"/>	<input type="text" value="1"/>	<input type="text" value="AF21"/>	<input type="text" value="X"/>
<input type="text" value="26"/>	<input type="text" value="2"/>	<input type="text" value="AF31"/>	<input type="text" value="X"/>
<input type="text" value="34"/>	<input type="text" value="3"/>	<input type="text" value="AF41"/>	<input type="text" value="X"/>
<input type="text" value="46"/>	<input type="text" value="3"/>	<input type="text" value="EF voice"/>	<input type="text" value="X"/>
Add another DSCP to CoS mapping			
<input type="button" value="Save changes"/>			<input type="button" value="Close"/>

MR QoS settings

- Will honor all the received DSCP values, and will match them to the **4 WMM** classes (each client with its own queuing) – see next page
- Default rules for all new networks

Default Rules Enable default traffic shaping rules ▾	
Traffic Type	DSCP tag
SIP (Voice)	46 (EF - Expedited Forwarding, Voice)
All Advertising, All Software Updates, All Online Backups	10 (AF11 - High Throughput, Latency Insensitive, Low Drop)
WebEx, Skype	34 (AF41 - Multimedia Conferencing, Low Drop)
All Video & Music	18 (AF21 - Low Latency Data, Low Drop)

- Manually set DSCP via Traffic Shaping Rule

Rule #2 ⊕ ×

Definition
This rule will be enforced on traffic matching any of these expressions.

Microsoft Dynamics 365 ×

Add +

Per-client bandwidth limit

Choose a limit... ▾

5 Mbps details

PCP / DSCP tagging ⓘ

Do not set PCP tag ▾ / 12 (AF12 - High Throughput, Latency Insensitive, Medium Drop) ▾

- Use **FastLane** to push the trust boundary to the client and guarantee upstream QoS

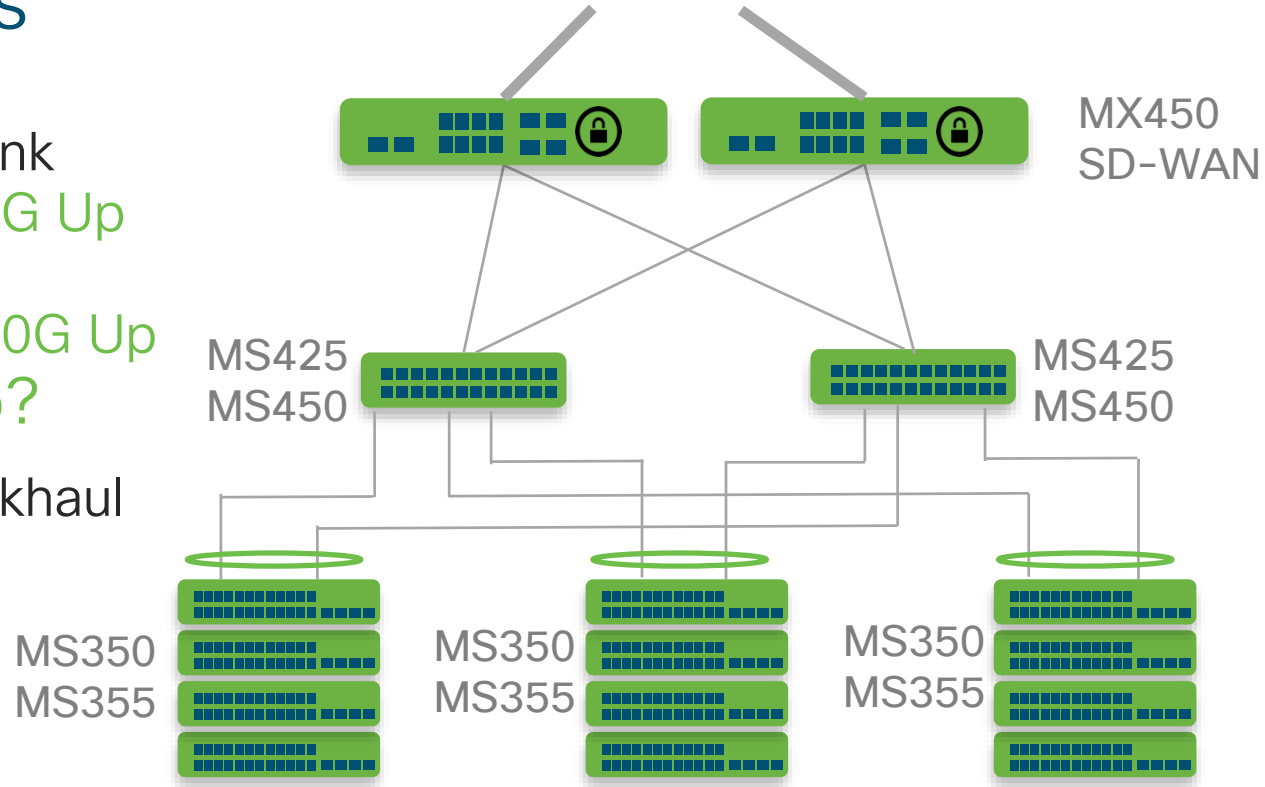
DSCP to WMM Mapping

RFC 4594-Based Model	802.3 DSCP	802.3 DSCP [Decimal]	IEEE 802.11 Model [802.11e WMM-AC]
Voice + DSCP-Admit	EF + 44	46	Voice AC (AC_VO)
Broadcast Video	CS5	24	Video AC (AC_VI)
Multimedia Conferencing	AF4 <i>n</i>	34, 36, 38	Video AC (AC_VI)
Realtime Interactive	CS4	32	Video AC (AC_VI)
Multimedia Streaming	AF3 <i>n</i>	26, 28, 30	Video AC (AC_VI)
Signaling	CS3	40	Video AC (AC_VI)
Transactional Data	AF2 <i>n</i>	18, 20, 22	Best Effort AC (AC_BE)
OAM	CS2	16	Best Effort AC (AC_BE)
Bulk Data	AF1 <i>n</i>	10, 12, 14	Background AC (AC_BK)
Scavenger	CS1	8	Background AC (AC_BK)
Best Effort	DF	0	Best Effort AC (AC_BE)

Ref: https://documentation.meraki.com/MR/WiFi_Basics_and_Best_Practices/Wireless_QoS_and_Fast_Lane

Link Bandwidths

- Ratio Access to Uplink
48:1 1G down : 1G Up
384:1
19.2:1 1G down : 20G Up
What's your ratio?
- Don't forget the backhaul



Redundancy

- Link Aggregation
- Spanning-Tree
- Power
- Stacking

Link Aggregation

- Supported on ports with similar characteristics
Speed and media type
- Up 8 ports in a physical stack
- When configured, becomes LACP Active
- If connecting to Catalyst switch, configure Catalyst for Active or Passive.
- It is recommended to first configure port bonding and then connect physically all cables.

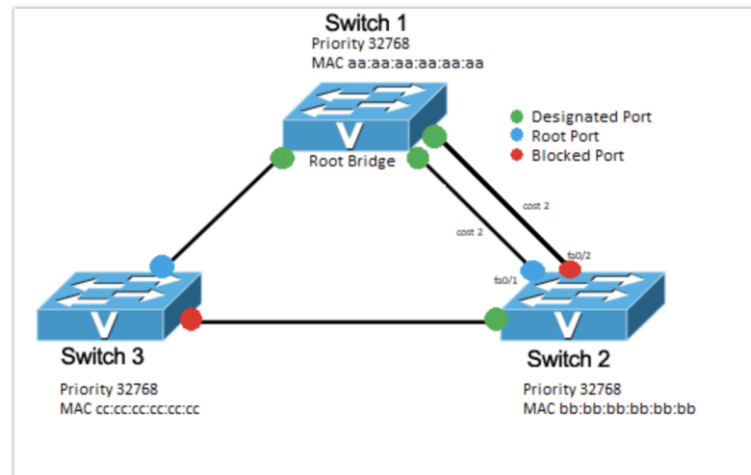
Configuration

Description	Access port on VLAN 1
Tags	none
PoE	Enabled
Aggregation group	3, 4 Using port(s) 3, 4, aggregate speed 2 Gbps
Access policy	Open
Link negotiation	Auto negotiate (1 Gbps)
RSTP	Forwarding
Port schedule	Unscheduled
Isolation	Disabled
Trusted	Disabled
UDLD	Alert only
Port mirroring	Not mirroring traffic

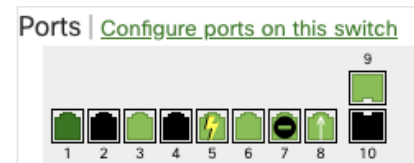
Edit	Aggregate	Split	Mirror	Unmirror	Tag	Search...
☐	Basement MS350-24X	1		MAX4	enabled	Auto negotiate
☐	Basement MS350-24X	2			enabled	Auto negotiate
☒	Basement MS350-24X	3, 4		1812+ NAS	enabled	Auto negotiate
Deimos						

Rapid Spanning Tree (RSTP)

- MS supports RSTP (IEEE 802.1w) only
- Transitions to forwarding state faster than STP
- Only 3 states
 - Discarding
 - Learning
 - Forwarding



- Compatible with RPVST/MST on Catalyst
- Access ports have PortFast enabled by default.
- STP info included in switch port view for fast troubleshooting.



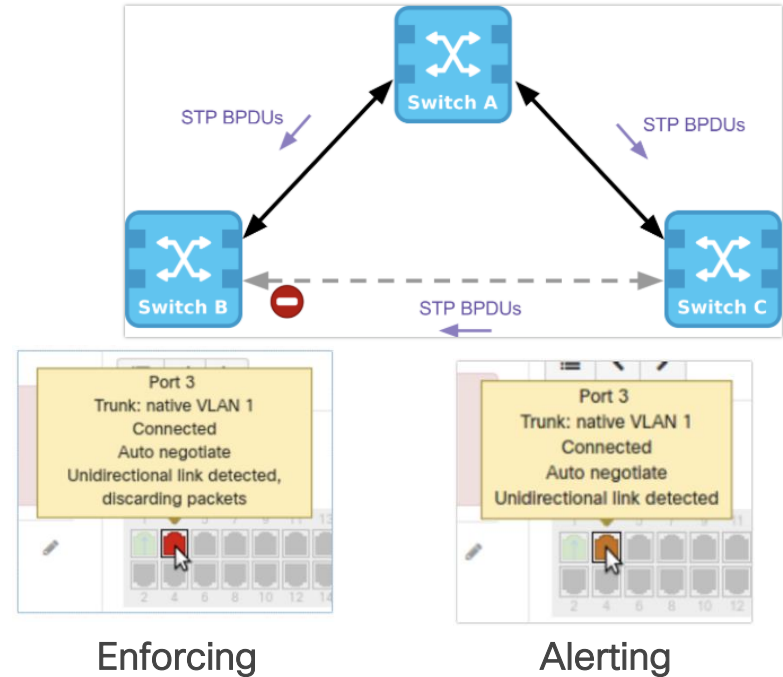
STP Enhancements

- Root Guard: Blocks port if lower priority BPDUs received
- BPDU Guard: Blocks port if any BPDUs received
- Loop Guard: Blocks non-designated port if no BPDUs received
- STP Anomaly Detection
- Unidirectional Link Detection (UDLD): Protects against unidirectional links

Enabled:	<input type="text" value="enabled"/>
RSTP:	<input type="text" value="enabled"/>
STP guard:	<div><div>✓ disabled</div><div>Root guard</div><div>BPDU guard</div><div>Loop guard</div></div>
PoE:	<input type="text"/>
Link: ⓘ	<input type="text"/>
Port schedule:	<input type="text" value="Unscheduled"/>

Unidirectional Link Detection (UDLD)

- Supported on MS switches running 10.10+
- Prevents loops
- UDLD independent of stacking
- Both ends need to support UDLD
- Configuration modes:
 - Alert Only
 - Enforce



- Supported Models:
MS120, MS210, MS225, MS250, MS35x, MS4xx series

L2 Native VLAN Mismatch

- Alerts based on Mismatched Native VLAN config and allowed VLAN list

Detection logic

- Check last received CDP packet to confirm if neighbor is a Meraki Switch.
 - If yes then compare switch port configs for each switch
 - If both are trunk, compare native VLAN and allowed VLAN config. Raise warning on mismatch
 - If both are access, compare VLAN ID config. Raise warning on mismatch
 - If one is trunk and other is access, raise warning

Does not utilize “Native VLAN” tlv in CDP packet. No support for detection with non-Meraki switches.

Status

Connectivity

Usage

59.5 MB (28.6 MB sent, 31.0 MB received)

Traffic

171 bps (171 bps sent, - received)

[MS350-48FP raw](#)

CDP/LLDP

✓ Meraki MS350-48FP - zOOB Management - switch

● [Warning: VLAN Mismatch](#)

PoE usage

Connected port's configuration:

Trunk Port on Native VLAN 4094

Allowed VLANs: all

Current cl

There have

This port's configuration:

Access Port on VLAN 1

(Updated 2018-08-23T23:54:56Z)

this port for the selected tir

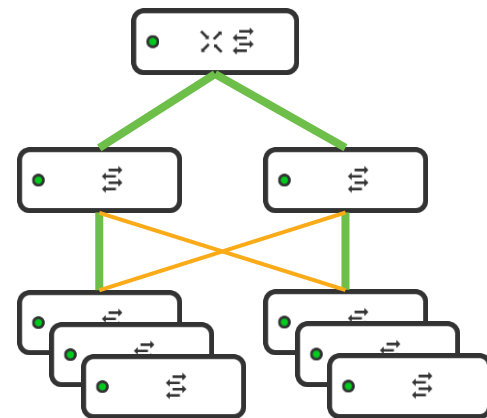
L2 Switch integration – MS + Catalyst

- MS Switches do not support VTP however DO forward VTP frames (transparent mode)
- MS switches do not have the concept of a VLAN database and will pass any dot1q tags received
- Always prune unused vlans from trunks

Type:	trunk
Native VLAN:	1
Allowed VLANs: ⓘ	1,100-102
Trusted: ⓘ	disabled
Storm Control: ⓘ	enabled
UDLD: ⓘ	Alert only

RSTP + MS + Catalyst

- MS Switches do not run Rapid Per VLAN Spanning Tree however RPVST is backward compatible
- RPVST sends RSTP BPDUs out of VLAN 1 (untagged)
 - Allow VLAN 1 on the trunk to make sure the BPDUs are visible on downstream Meraki MS
- Set bridge priorities for STP on the switch environment
 - Please respect STP topology



Guidance

Core - 4096

Distribution - 8192

Access - 61440

STP configuration

Spanning tree protocol ⓘ Enable RSTP ▾

STP bridge priority

STP bridge priority will determine which switch is the STP root in the network. The switch with the lowest priority will become the root (MAC address is the tie-breaker).

Switches/Stacks	Bridge priority
CORE 1 x	4096 ▾ X
Default	32768

[Set the bridge priority for another switch or stack](#)

NOTE: If you are deploying MS as a root bridge, the catalyst switch needs to operate in MST mode

Powering Options

Internal Power Supply

- MS120

Internal + External RPS

- MS210
- MS225

Removable Power Supply , Redundant Option

- MS250

Removable Power Supply , Redundant/Combined Option

- MS350
- MS355

Power supply settings

Default power supply settings
This setting will only apply to switches with multiple power supplies.

☐ Redundant power
Redundant power uses a secondary power supply as a backup source of power in case of failure of the first power supply.

☒ Combined power
Uses secondary power supply as an additive power supply to support PoE for more ports at once. This setting will only apply to [switches that support combined power](#).

If either power supply fails, PoE ports may lose power. Higher number ports will lose power first.

Higher number ports will lose power first

Power supply settings exceptions
Specify custom lists of switches that will not follow the default network power supply settings.

Always use redundant power
Huey x Horse

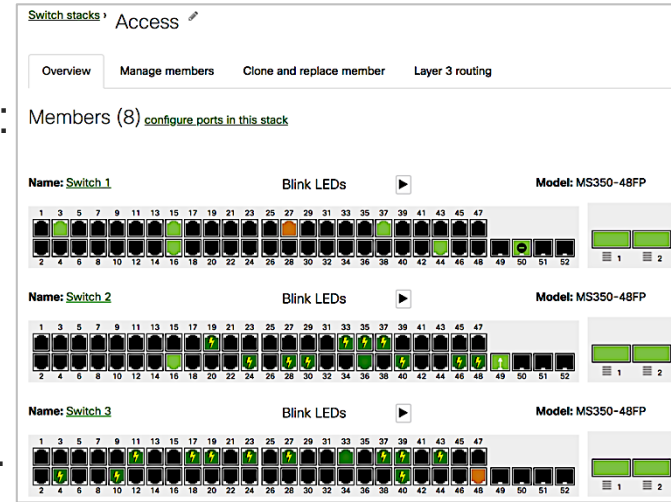
Always use combined power
Scrooge x

Switch	Combined Power Budget
MS350-24P	720W
MS350-48LP	740W
MS350-48FP	1440W
MS350-24X	1440W
MS355-24X	1440W
MS355-24X2	1440W
MS355-48X	1480W
MS355-48X2	1480W

MS Stacking

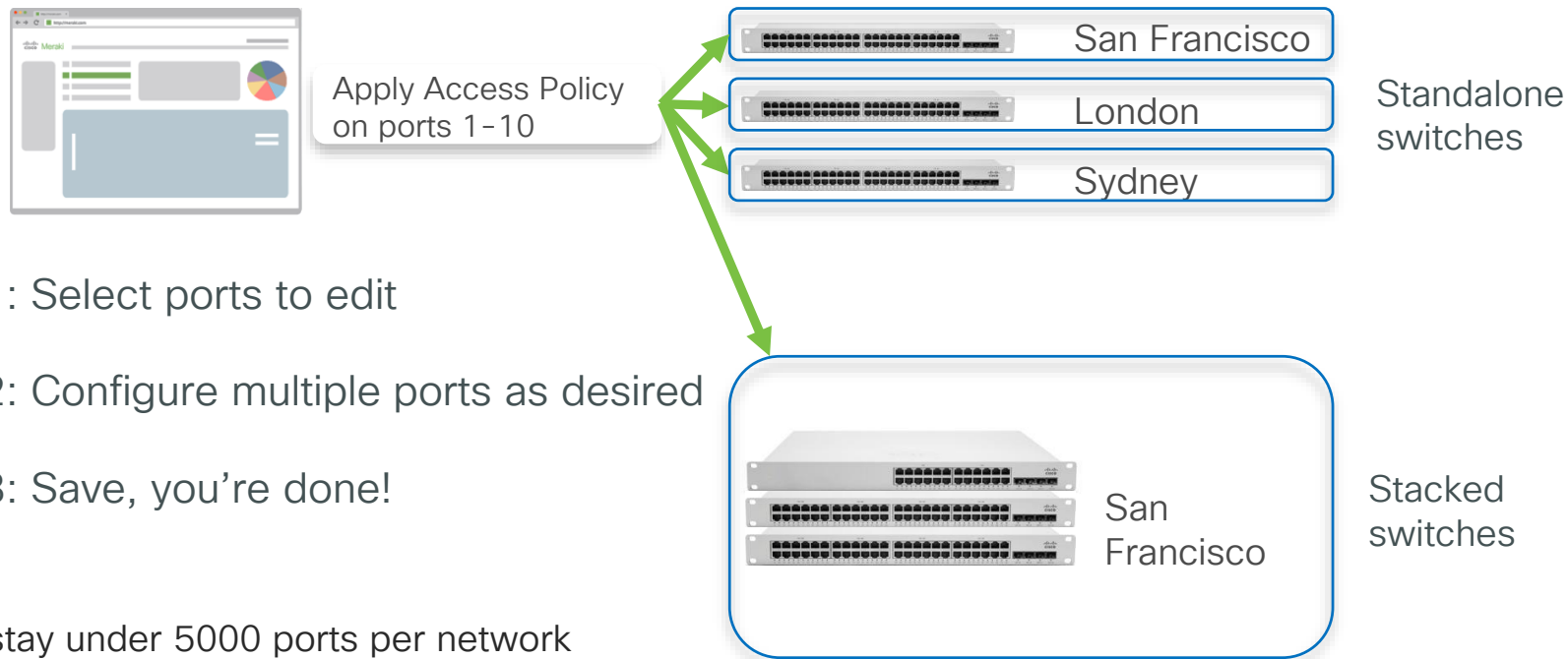
Meraki MS supports different stacking technologies:

- Virtual Stacking: Logical aggregation of switch ports, regardless of their physical location. Supported on all switch models. Simplifies management.
- Physical Stacking: Supported on selected models. Uses dedicated stacking ports to form a physical stack. Improved resiliency and uplink rationalisation.
- Flexible Stacking: Supported on **MS425 only**. Front ports can be converted to stacking ports and then used to connect with other stack members.



Virtual Stacking

- Benefits of virtual stacking apply equally to standalone or physically stacked switches



Step 1: Select ports to edit

Step 2: Configure multiple ports as desired

Step 3: Save, you're done!

** Try to stay under 5000 ports per network

MS Switching Firmware

RUN 10.x
Firmware

MS 10 Switch Firmware, Increased Resilience

Enhanced Storm Control

- Limits the effects of Layer 2 broadcast storms by providing user-configured bandwidth limits for Broadcast and Multicast traffic

Unidirectional Link Detection (UDLD)

- Prevents harmful Layer 2 loops by detecting and blocking unidirectional links

Loop Guard

- Prevents Layer 2 loops by detecting & blocking any port where Spanning Tree control packets are expected, but not received

Dynamic ARP Inspection

- Discards any invalid ARP clients not administered through the DHCP

MS 10 Firmware, New Features

Multi-Host Authentication

- Enhances the 802.1x/MAC authentication by allowing a single host to authenticate access to a port shared by multiple clients

Multi-Authentication

- Enhances 802.1x/MAC authentication by allowing more than one host to authenticate individual access to a shared port

ECMP

- Load balance traffic across your OSPF network to gain greater efficiency

IPv6 ACLs

- Adds IPv6 addresses to ACLs

STP/LAN anomaly detection

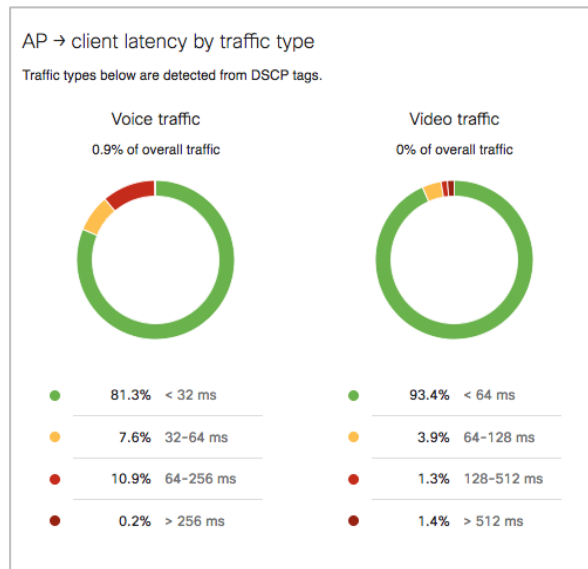
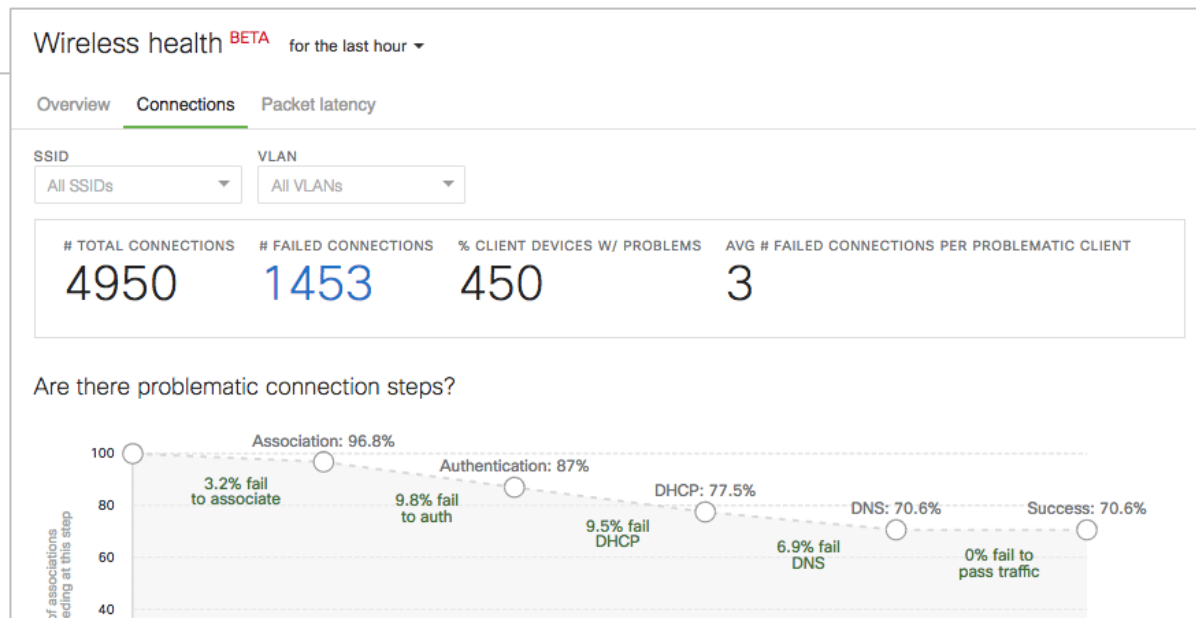
- Dashboard now notifies users of poor network connections and elements of poor network design (use of hub) with additional port notifications

Others

- Wireless Health
- Summary Reports
- Event Logs
- Topology
- Map and Floor Plans
- Network Tools
- Packet Capture

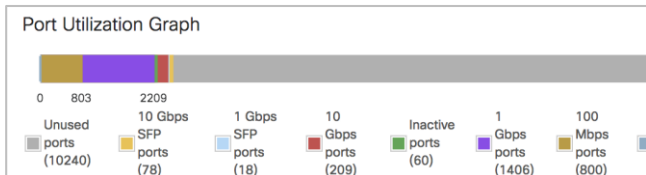
Wireless Health

- Meraki Wireless Health: A powerful heuristics engine that rapidly identifies anomalies – association, authentication, IP addressing, and DNS availability
- Quickly identify worst-performing access points and client devices

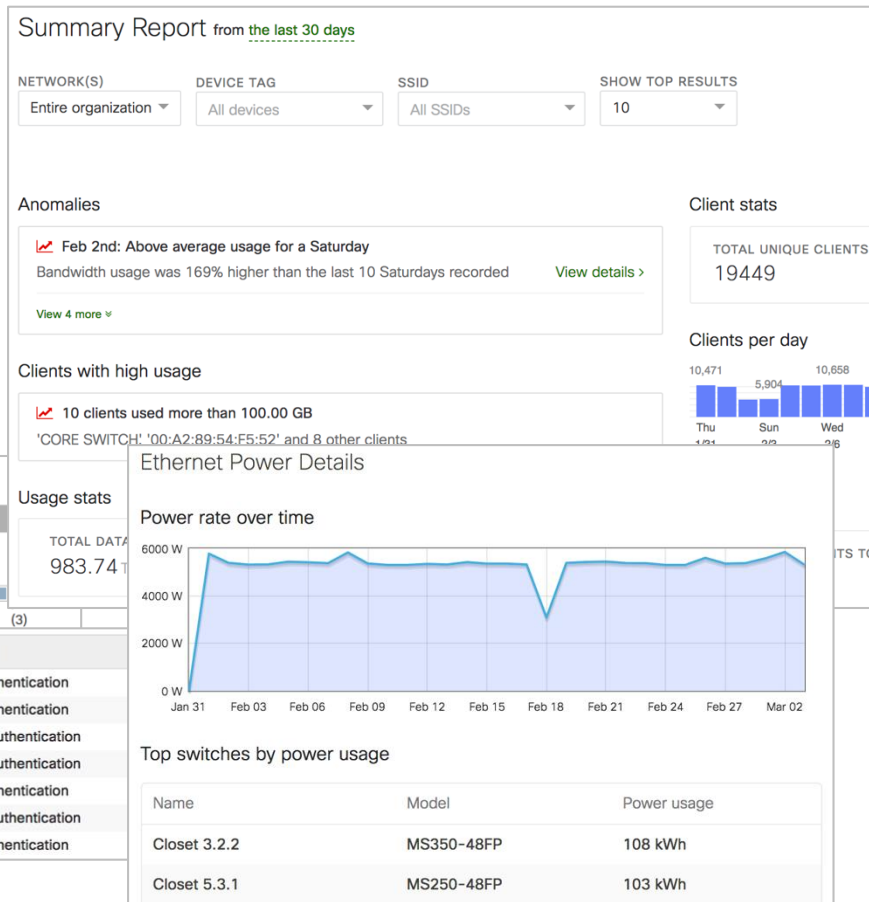


Integrated event logs, alerts, and anomaly detection

- Use detailed network reporting to make informed decisions about infrastructure expansion, staffing, and site planning
- Integrate raw, real-time data with business intelligence systems
- Perform in-depth analysis using built-in API to export comprehensive event logs



Time (PST) ▼	Switch	Client	Event type
Mar 2 17:49:44	Closet 4.1.4	ac:87:a3:26:42:41	RADIUS authentication
Mar 2 17:49:44	Closet 4.1.4	88:15:44:a8:09:c3	RADIUS authentication
Mar 2 17:49:44	Closet 4.1.4	ac:87:a3:26:42:41	802.1X deauthentication
Mar 2 17:49:43	Closet 4.1.4	88:15:44:a8:09:c3	802.1X deauthentication
Mar 2 17:49:33	Closet 4.1.8	00:18:0a:4e:09:48	RADIUS authentication
Mar 2 17:49:33	Closet 4.1.8	00:18:0a:4e:09:48	802.1X deauthentication
Mar 2 17:49:29	Closet 2.1.7	0c:8d:db:69:02:dc	RADIUS authentication



Remote troubleshooting and packet capture

● Switch 1

MS350-48FP e0:55:3d:c8:be:c4



ADDRESS
Level 21, 321 Kent St, Sydney NSW
2000, Australia

LAN IP
10.239.145.41 (via DHCP)

VLAN
1451

PUBLIC IP
122.202.8.149

GATEWAY
10.239.145.1

DNS
8.8.8.8
8.8.4.4

LAN IPV6
Not configured

Summary Ports Power L3 routing Event log Location Tools

Ping

icmp.canireachthe.net

Ping

or

Ping switch

Blink LEDs

Run

Throughput

Run

MTR

icmp.canireachthe.net

Num cycles: 1

Run

Cable test

Warning: This test may disrupt traffic on this port.

ports (ie. 1-5,7,11,20-2)

Run cable test

Cycle port

Warning: PoE powered devices will be temporarily powered down.

ports (ie. 1-5,7,11,20-2)

Cycle ports

MAC forwarding table

Run

Wake client

This tool will send a Wake-on-LAN message to attempt to wake a client. The target client enabled.

MAC: eg. 00:11:22:33:44:55

VLAN: eg. 123

Send

Packet capture for switches ▾

Switch: Switch 1 ▾

Ports: 15

Output: View output below ▾

Duration (secs): 60

Verbosity: Extra high ▾

Ignore: ☐ broadcast packets ☐ multicast packets

Filter expression:

[clear output](#) or [Start capture](#)

--- Start Of Stream ---

reading from file /tmp/click_pcap_dump, link-type EN10MB (Ethernet)

01:26:13.205558 IP (tos 0x0, ttl 128, id 28087, offset 0, flags [none], proto UDP (17),
10.239.144.39.52604 > 255.255.255.255.40006: [udp sum ok] UDP, length 16

01:26:13.398009 IP (tos 0x0, ttl 128, id 25810, offset 0, flags [none], proto UDP (17),
10.239.144.149.55633 > 255.255.255.255.40006: [udp sum ok] UDP, length 16

01:26:13.516373 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.100.100.1 t

01:26:13.595724 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.100.100.16

01:26:13.772486 STP 802.1w, Rapid STP, Flags [Learn, Forward], bridge-id 0000.e0:0

message-age 1.00s, max-age 20.00s, hello-time 2.00s, forwarding-delay 15.00

root-id 0000.00:18:0a:b5:b6:e9, root-pathcost 20000, port-role Designated

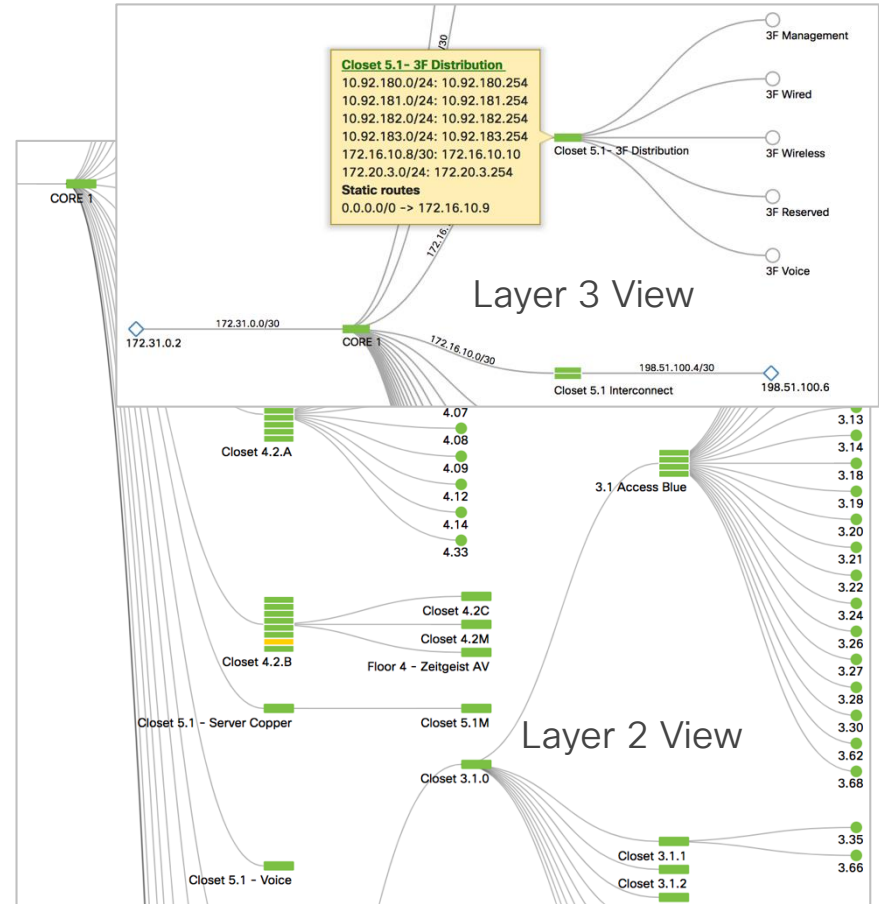
01:26:13.800180 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.100.100.1 t

01:26:13.801563 ARP, Ethernet (len 6), IPv4 (len 4), Request who-has 10.100.100.47

01:26:13.897487 IP (tos 0x0, ttl 128, id 31384, offset 0, flags [none], proto UDP (17),
10.239.144.40.49462 > 255.255.255.255.40006: [udp sum ok] UDP, length 16

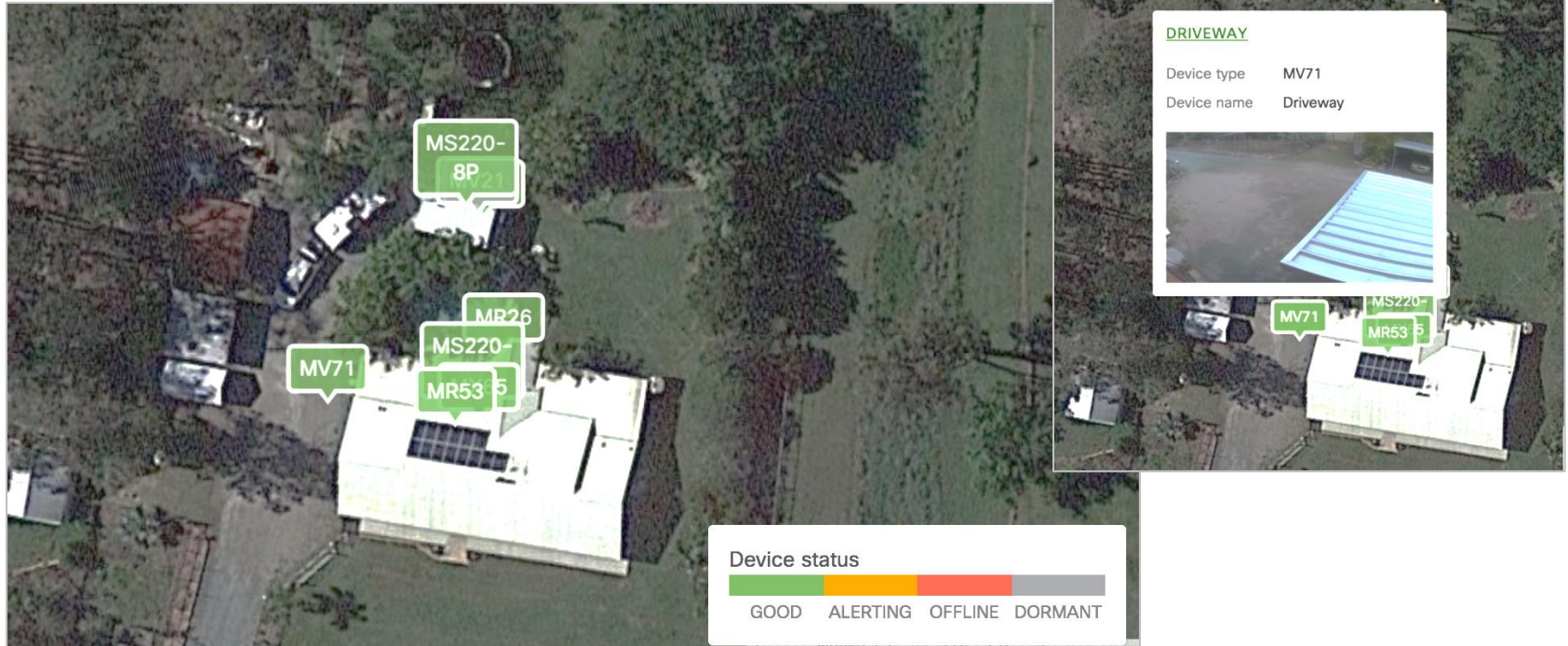
Network Topology – Visibility into your entire network

- View the physical or logical connections of your network with Layer 2 and Layer 3 topology views.
- Discover disabled devices with our intuitive, color-coded network visualization.
- Easily trace the network path from the client device up to the gateway
- Locate non-Meraki devices CDP/LLDP



Maps and Floor Plans

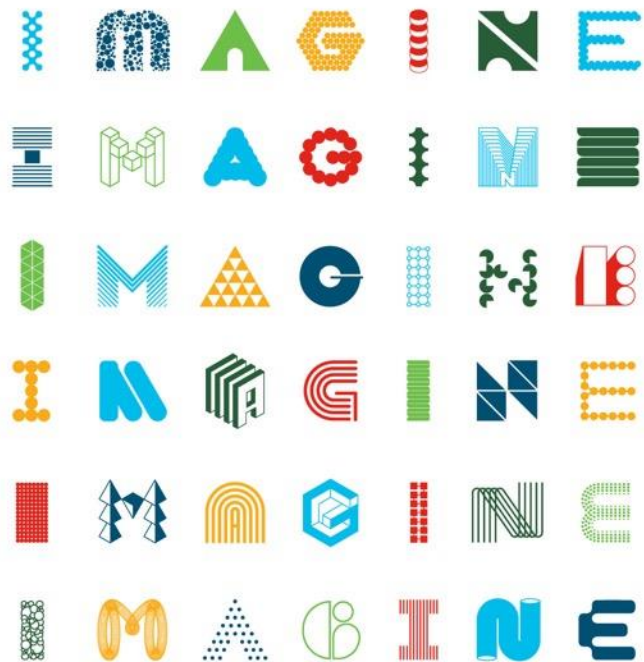
- Now include all devices and thumbnails for MV



Lets take a look

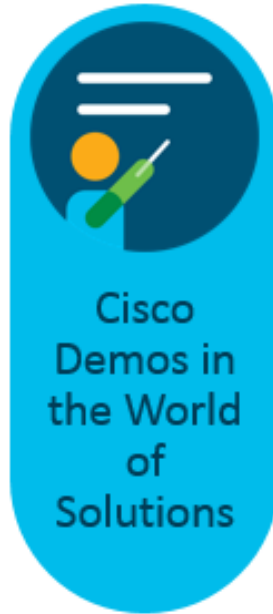
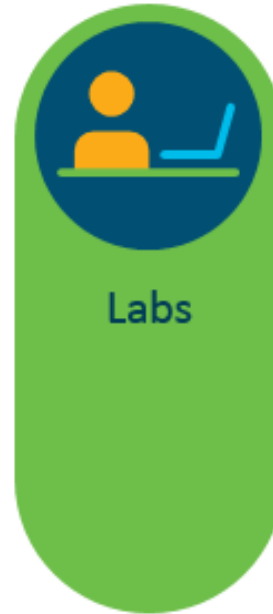
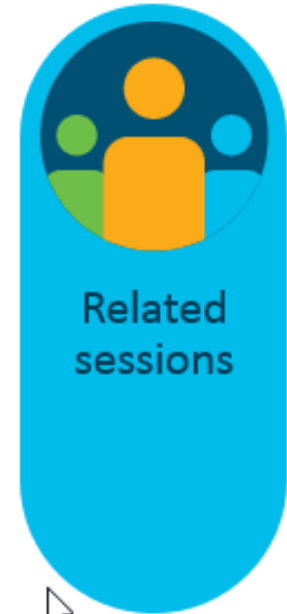


Q & A



INTUITIVE

Continue your education



Other Great Sessions

Session Code	Session Title	Time
BRKEWN-2017	Understanding RF Design for 802.11ax (Wi-Fi 6) Wireless Networks	Thursday 4:30PM
BRKEWN-2439	Wireless Networking: 14 Ways to Fail	Wednesday 4:30PM
BRKEWN-2730	Automation and Troubleshooting Meraki Deployments Using API's	Friday 8:00AM
BRKCRS-1731	Meraki Powered SD-WAN	Wednesday 4:30AM
BRKCRS-2959	Building a hybrid campus network with Catalyst, ISE, and Meraki	Thursday 2:30PM
BRKEWN-2734	Assuring End-user Experience on Cisco Meraki Networks	Thursday 12:50PM
BRKSEC-2069	Meraki Integrations with the Cisco Security Architecture	Thursday 4:30PM
WISP	Walk in Self Paced Labs	Lots
ILTCLD-1001	Meraki - Cloud Managed Networking (LAB)	Friday 9:45AM
DEVNET	Various Sessions, Webhooks, Meraki Beats, Workshops	Lots
	I'm at Meet the Expert	Friday 8:30-10:30AM

Complete Your Online Session Evaluation

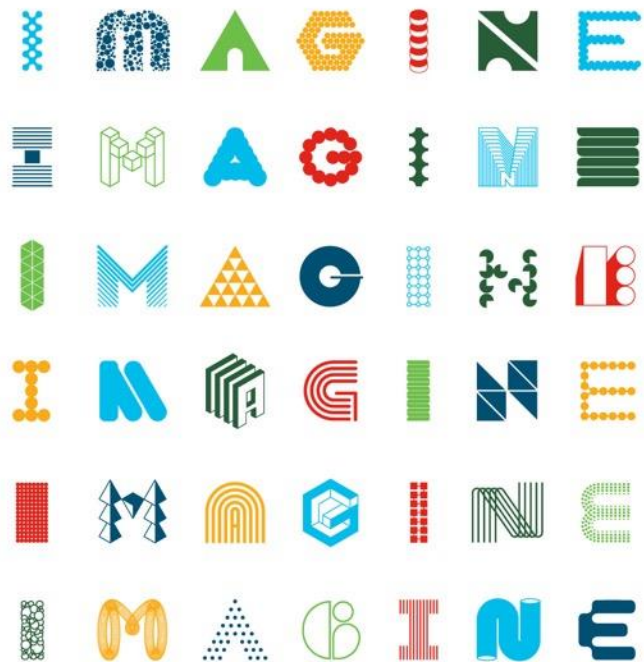
- Give us your feedback and receive a complimentary **Cisco Live 2019 Power Bank** after completing the overall event evaluation and 5 session evaluations.
- All evaluations can be completed via the Cisco Live Melbourne Mobile App.
- Don't forget: Cisco Live sessions will be available for viewing on demand after the event at:

<https://ciscolive.cisco.com/on-demand-library/>





Thank you



INTUITIVE



INTUITIVE