(US)NUA
US Networking User Association

Wi-Fi 7

Unicorn Farts, Black Magic, and all the Gigabits

Tonight's Agenda

1. Who Even Are You?!
2. Brief Wi-Fi Primer
3. What is Wi-Fi 7
4. Considerations for Wi-Fi 7
5. But Wait! There's Wi-Fi 8!

Who Even Are You?

Allyn Crowe
Principal Engineer
Joined Nexum in 2017

Other Experience:

- Public University
- Small Biomedical Company
- Networked Digital Signage

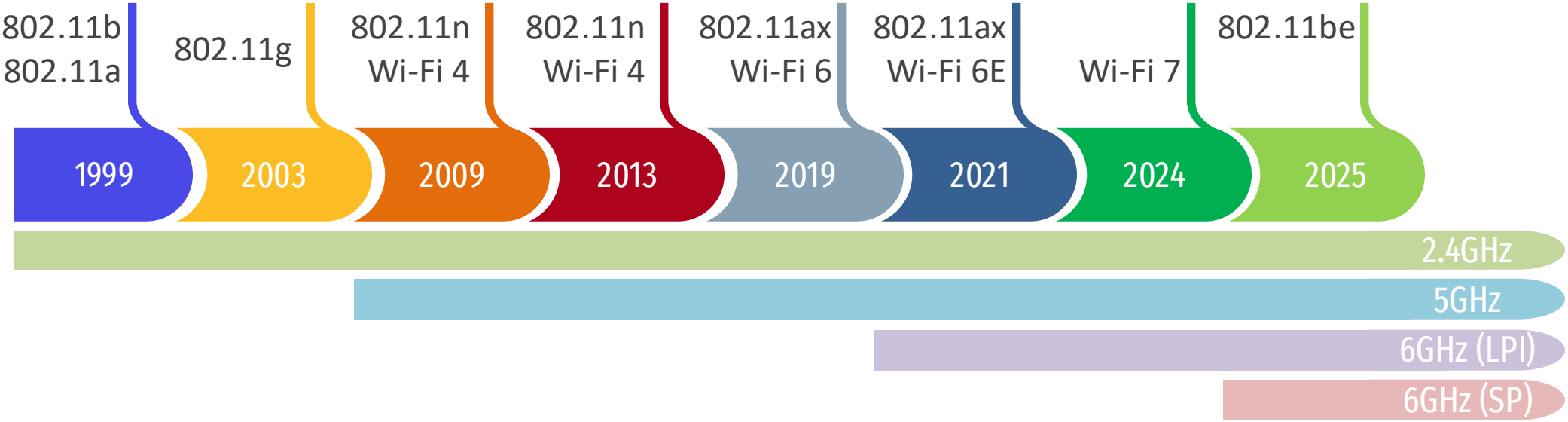
Hobbies:

- 3D Printing
- AV Work
- Whisk[e]y

https://www.linkedin.com/in/allyn-crowe/
https://www.netsecplumber.com

Brief Wi-Fi Primer

IEEE vs Wi-Fi Alliance



Wi-Fi is Half Duplex

Wi-Fi

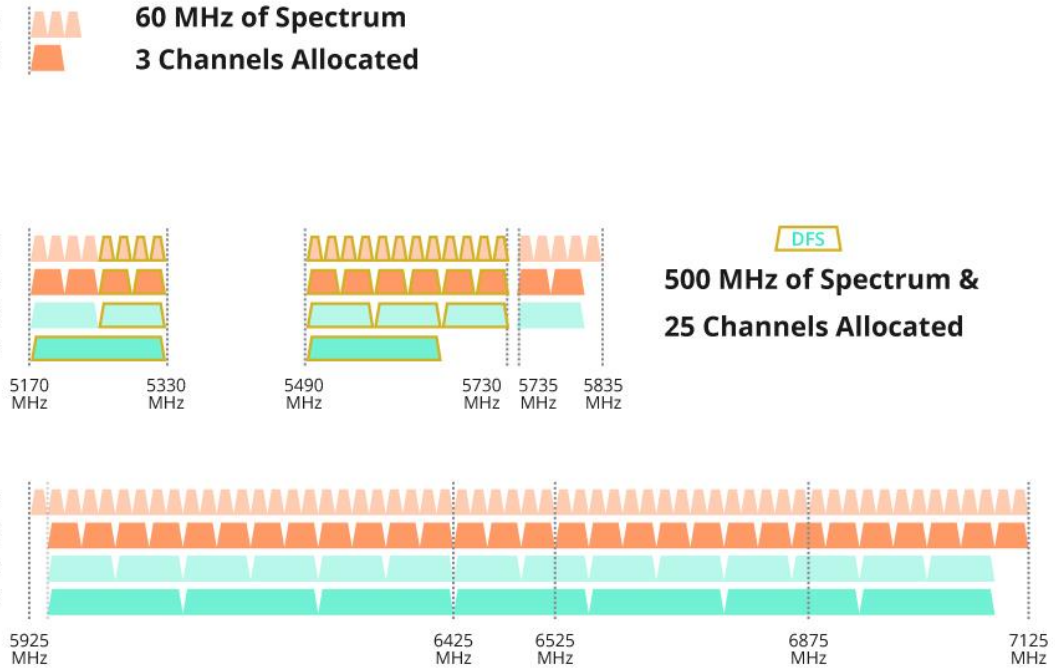
- CSMA/CA (Collision Avoidance)
- Half Duplex
- Actual throughput about half of advertised data rate due to “overhead”
- Throughput decreases as number of clients increases
- Think walkie talkies

Ethernet

- CSMA/CD (Collision Detection)
- Full Duplex
- Line rate
- Throughput based on transmissions*
- Think [wired] telephone

Wi-Fi Channels

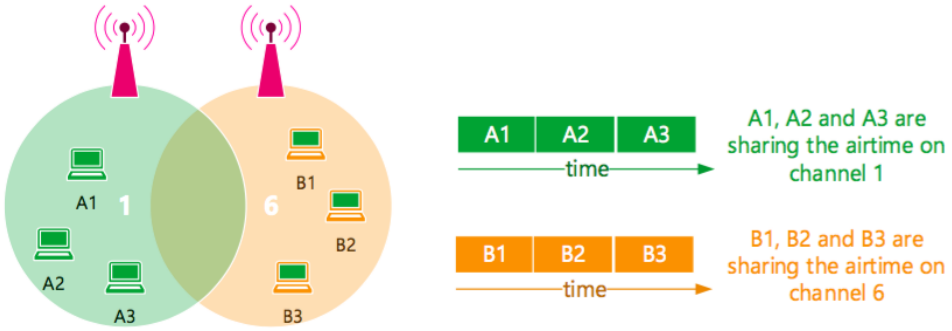
Band	Channels	BW
2.4 GHz	3	20 MHz
	1	40 MHz
5 GHz	25	20 MHz
	12	40 MHz
	6	80 MHz
	2	160 MHz
6 GHz	60	20 MHz
	29	40 MHz
	14	80 MHz
	7	160 MHz



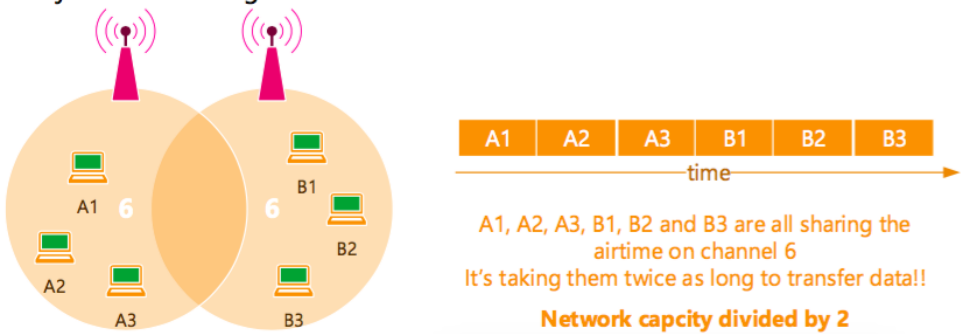
Source: https://www.fs.com/blog/wifi-6-vs-wifi-6e-vs-wifi-7-how-to-choose-36.html

Channel Contention

2 adjacents APs using 2 different channels – Ideal situation



2 adjacents APs using the same channe – Co-Channel Contention



Source: https://semfionetworks.com/blog/co-channel-contention-ccc-explained-with-simple-drawings/

6GHz Power Modes

- Low Power Indoor (LPI)
  - Indoor Only
  - Transmit power limitations based on channel width
  - No connectorized APs
- Standard Power (SP)
  - Fixed Indoor/Outdoor use
  - Requires Automatic Frequency Coordination
  - Channel Restrictions
- Very Low Power (VLP)
  - Mobile indoor/outdoor
  - On person/in vehicle

What is Wi-Fi 7?

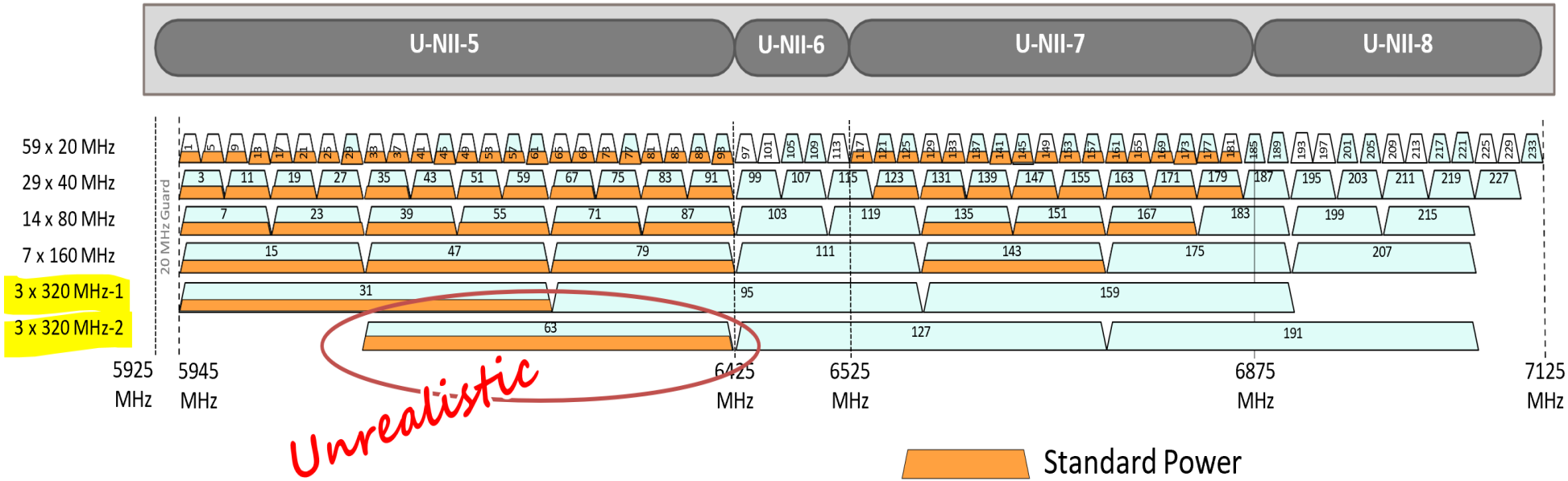
- Wi-Fi Alliance
  - Wi-Fi 7
- IEEE
  - 802.11be
  - Extremely High Throughput (EHT)
- Supporting:
  - Real-time applications
  - Gaming
  - Virtual reality / augmented reality
  - Cloud computing

Wi-Fi 7 Enhancements

- Theoretical Speed up to 46Gbps
  - 320MHz wide channels
  - 16 Spectral Streams
  - 4096 (4K) Quadrature Amplitude Modulation (QAM)
- Multi-Link Operation (MLO)
- Multi-Resource Unit (MRU)
- Preamble Puncturing
- Triggered Uplink Access
- QOS and QOE
- Reduced Latency
- Restricted Target Wake Time (rTWT)

Theoretical vs Reality

320MHz Channels



Source: Philip Wightman's Wi-Fi 7 Overview on (US)NUA member site
https://www.usnua.com/hubfs/Presentation%20PDFs/USNUA%20Presentation%20-%20WiFi%207%20Overview.pptx?hsLang=en/

Theoretical vs Reality

46Gbps

46Gbps –> 2.882Gbps per spatial stream (SS) at 16SS

Reality:

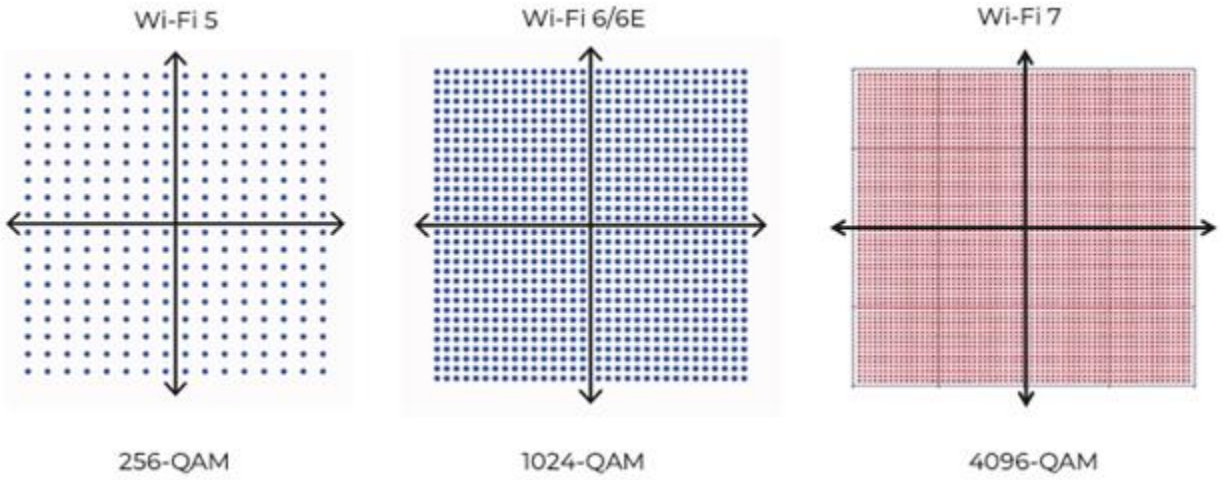
- Throughput caps around half of data rate
- 4SS clients are rare
- 1 or 2SS clients are the norm

Config	Connection Speed
320MHz, 4SS	11Gbps
320MHz, 2SS	5.7Gbps
160MHz, 2SS	2.5Gbps
80 MHz, 2SS	1.4Gbps
40 MHz, 2 SS	0.7Gbps

Theoretical vs Reality

4K QAM

4K QAM

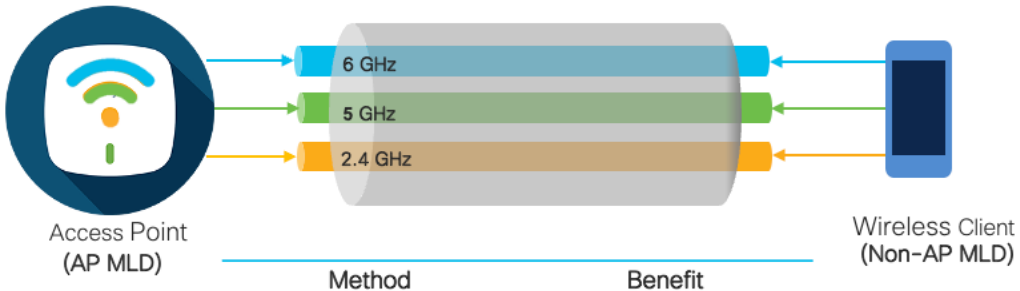


signal-to-noise ratio (SNR):	29 dB or higher	35 dB	40 dB

Source: https://www.extremenetworks.com/resources/blogs/is-wi-fi-7-meant-for-the-consumer-or-enterprise-market/

Theoretical vs Reality
MLO

- Wi-Fi 7 – Multilink (MLO)



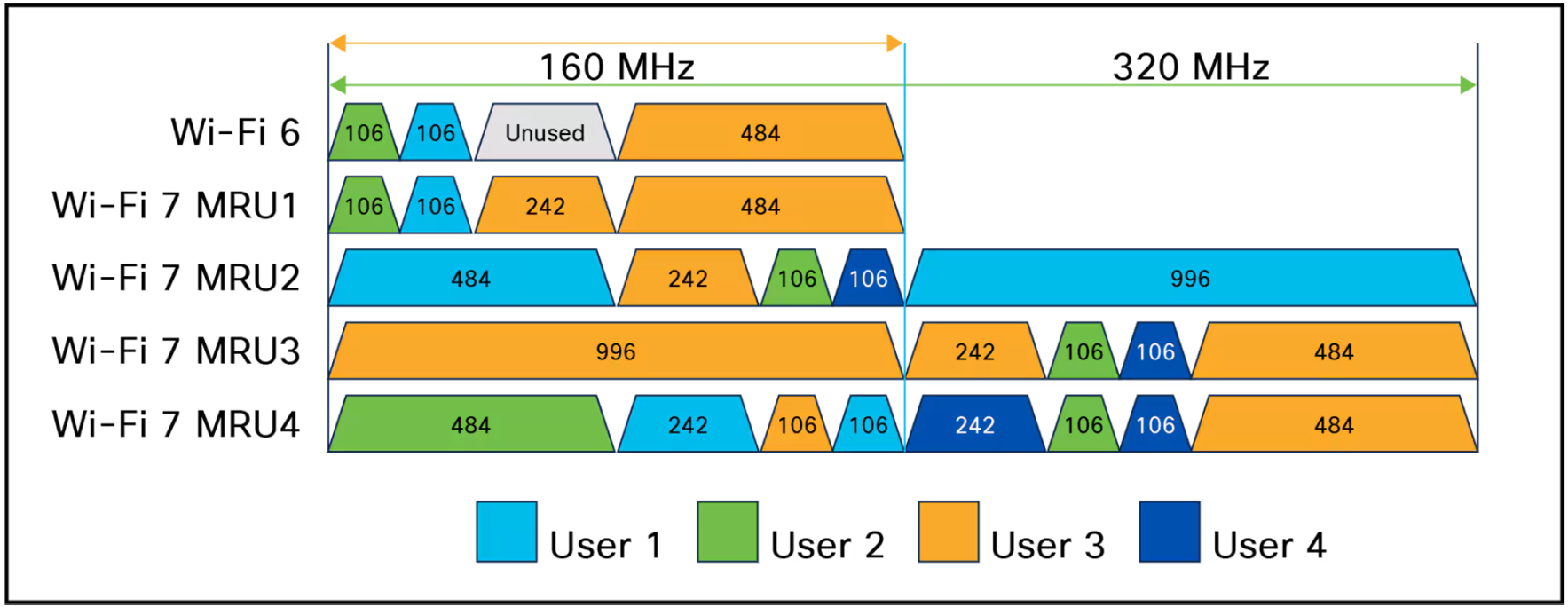
Method	Benefit
Aggregation	Throughput
Steering	Lower Latency
Redundancy	Reliability

MLD: Multi Link Device

Source: https://documentation.meraki.com/Wireless/Design_and_Configure/Architecture_and_Best_Practices/Wi-Fi_7_%28802.11be%29_Technical_Guide

Theoretical vs Reality

MRU

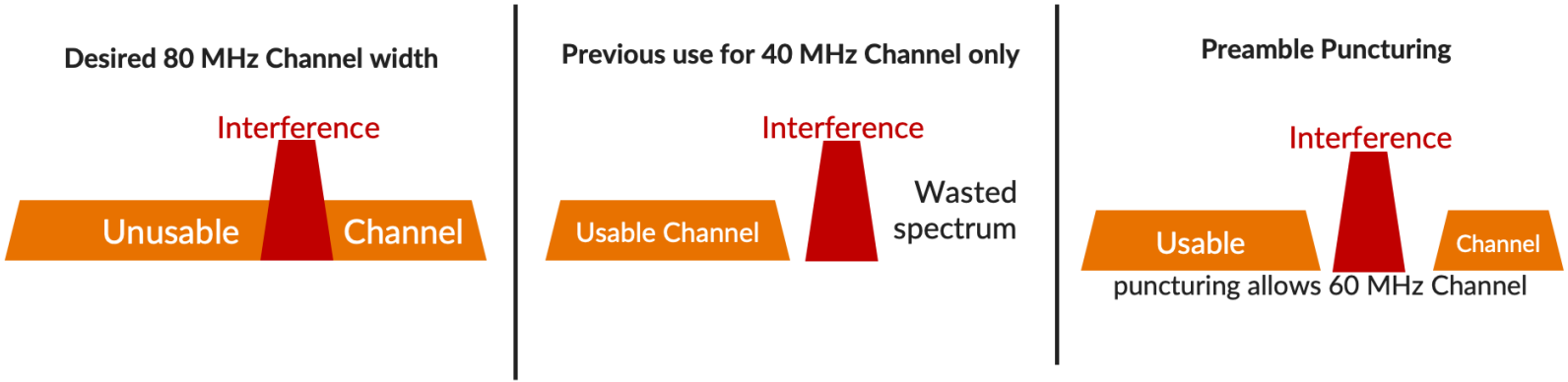


https://www.cisco.com/c/en/us/products/collateral/networking/wireless/wifi7-future-of-wireless-dg.html

Theoretical vs Reality

Puncturing

Preamble Puncturing



Source: https://www.netsecplumber.com/content-categories/wireless-networking-posts/juniper-mist-enters-the-wi-fi-7-fray-with-new-access-points

Wi-Fi 7 Considerations

- WPA3 for 6GHz
- Protected Management Frames (PMF/MFP)
- MLO is working, with caveats
- Puncturing is working, with caveats
- What are you connecting the AP to?
    - AP power requirements
    - APs can exceed 1Gbps uplink
- Design
    - Channel Width – 80 is the new 40
    - 5GHz design is ok, but look for -63 or -64 dBm for voice
    - SP vs LPI

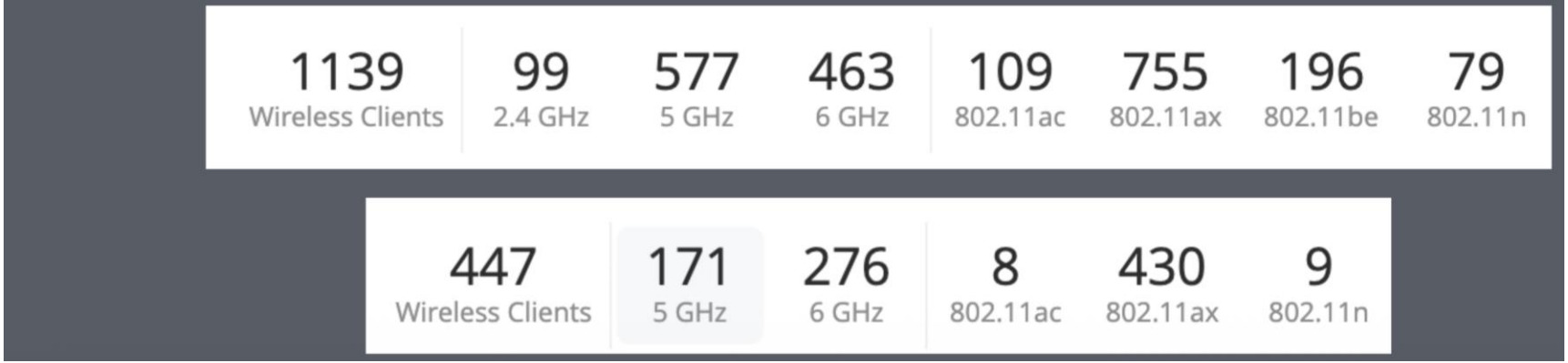
Does this even matter?

About 60% of 6 GHz capable APs have 6 GHz enabled (up from 30% a year ago).

6 GHz client adoption is 20-70% depending on the environment. Most BYOD deployments are in the 30-40% range. Deployments with company-owned devices can trend higher typically.

Wi-Fi 7 – 5-10% client adoption.

As an example, here's an environment with ~41% clients on 6 GHz and 17% as Wi-Fi 7. Or even 62% 6 GHz clients



Source: HPE MFD14 Presentation: https://techfieldday.com/appearance/hpe-presents-at-mobility-field-day-14/ (video coming soon or look on their YouTube)

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BUT WAIT,
Wi-Fi 8
BUT WAIT
THERE'S MORE!

Wi-Fi 8

- 802.11bn
- Ultra High Reliability
- Multi-AP coordination
- Seamless Roaming
- Edge of cell coverage improvements
- Better power efficiency
- Expected 2028

Questions?

Wi-Fi Specific Resources

Wireless LAN Professionals (WLPC): https://wlanprofessionals.com/

Heavy Wireless by Packet Pushers:

https://packetpushers.net/podcast/heavy-wireless/

Clear To Send: https://www.cleartosend.net/

Art of Network Engineering (AONE): https://artofnetworkengineering.com/

Mobility Field Day (MFD): https://techfieldday.com/mfd/

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Thank You!

Connect with me

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- Ohio Renaissance Festival
- Whisk[e]y

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