Will 5G Replace Wi-Fi?

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Our next 45-50 minutes

- Who we are and how we got here: 5 minutes
- Wi-Fi-background and brief history: 15 minutes
- Cellular (5G) - background and brief history: 15 minutes
- Conclusions: 5 minutes
- Q&A: 10 minutes

Our goal today- share knowledge and gain expertise for the benefit of the ecosystem

Which one is better (faster)?

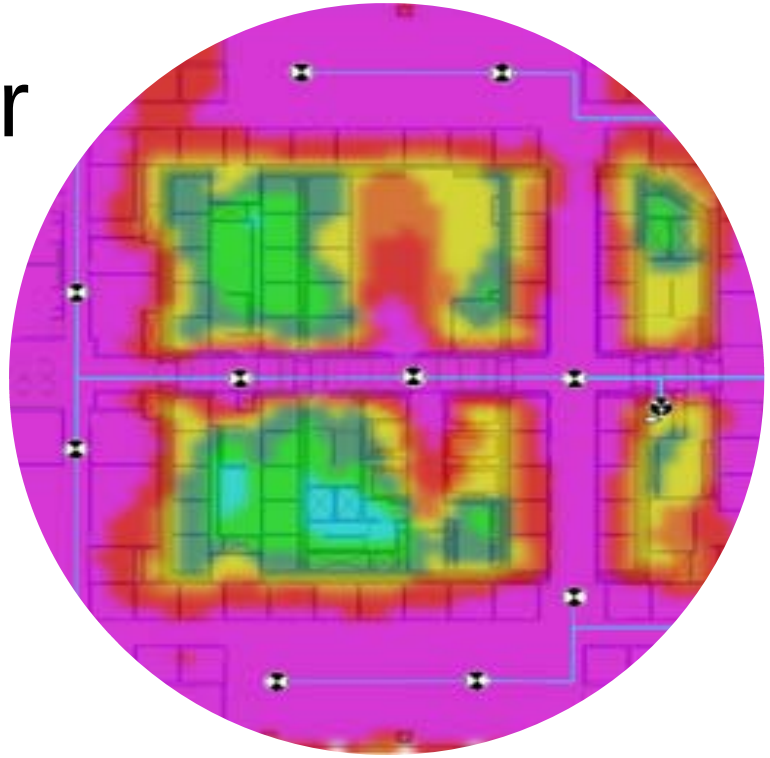
Will 5G replace Wi-Fi?

Gig means
Gigabit
Ethernet
FAST

And This Will
Be Fast Too...

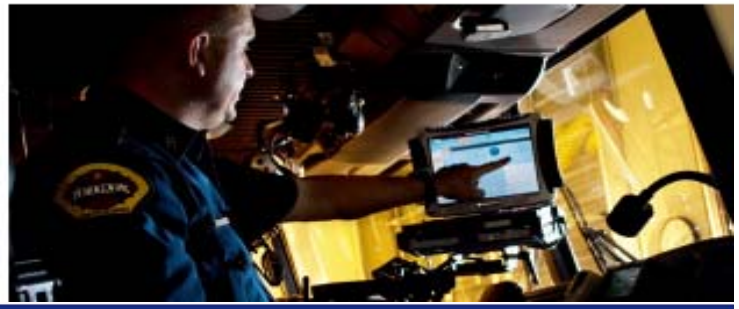
Factors to Consider for Wireless

- Range
- Propagation characteristics
- Throughput speeds
- Who is responsible for installing



Latency

- Latency is 25-30 Msec for 3G
- Latency is 15-20 Msec for 4G
- Goal for 5G is 1 Msec
- Latency for Wi-Fi 6/6E is 20 Msec (currently it is 30 Msec on average)



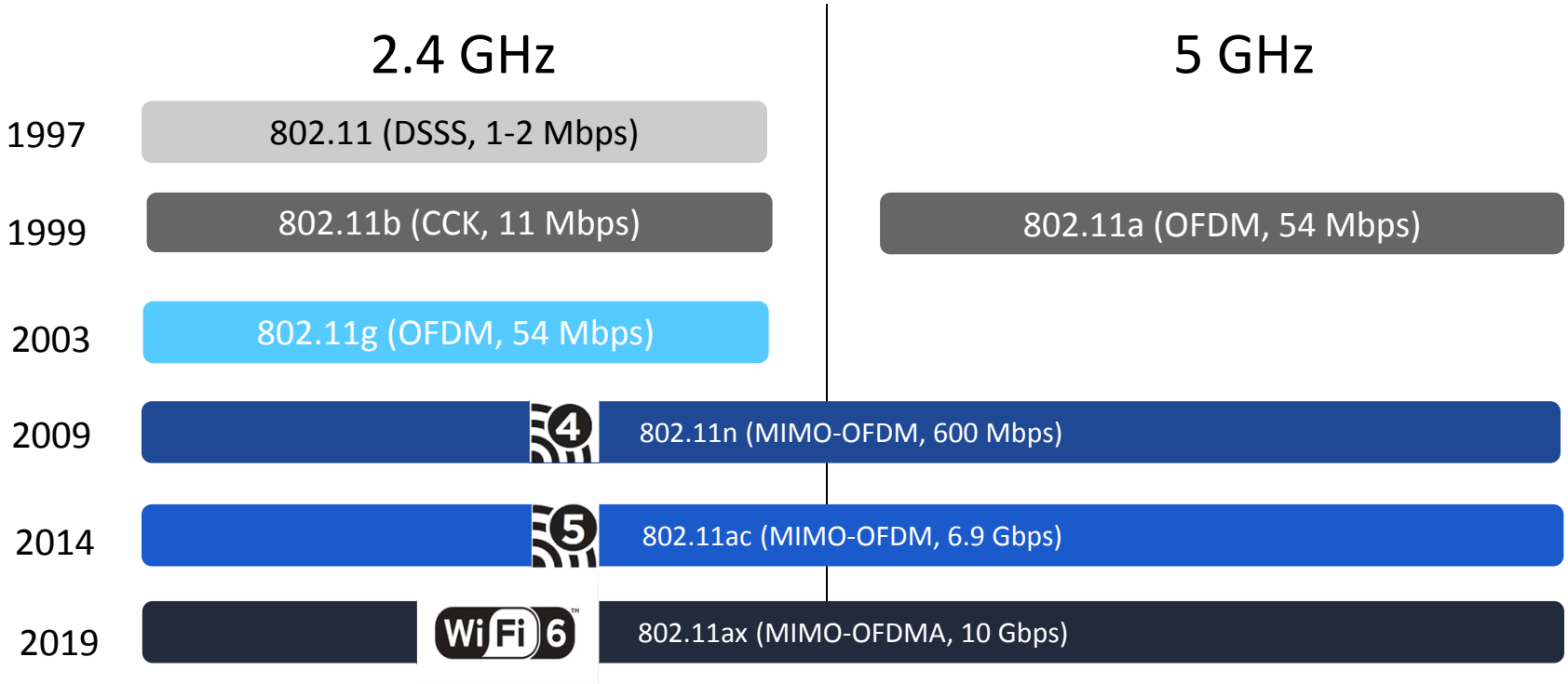
Pros and Cons of Wi-Fi

Pros	Cons
More economical than a cellular network	Network Interference Issues
Requires much less headend space and power than DAS	Network Security Issues
Easy to install & does not require any carrier's approval/coordination	Easy to do a poor installation
Convenience. Not every device is LTE capable, but nearly every device is Wi-Fi capable. Laptops, Tablets, Printers, Smart TV's, too many to list. It is enabling internet of things (IoT)	Still does not provide the mmWave 5G throughput speeds, capacity and latency

Pros and Cons of 5G
(assume driven by DAS indoors)

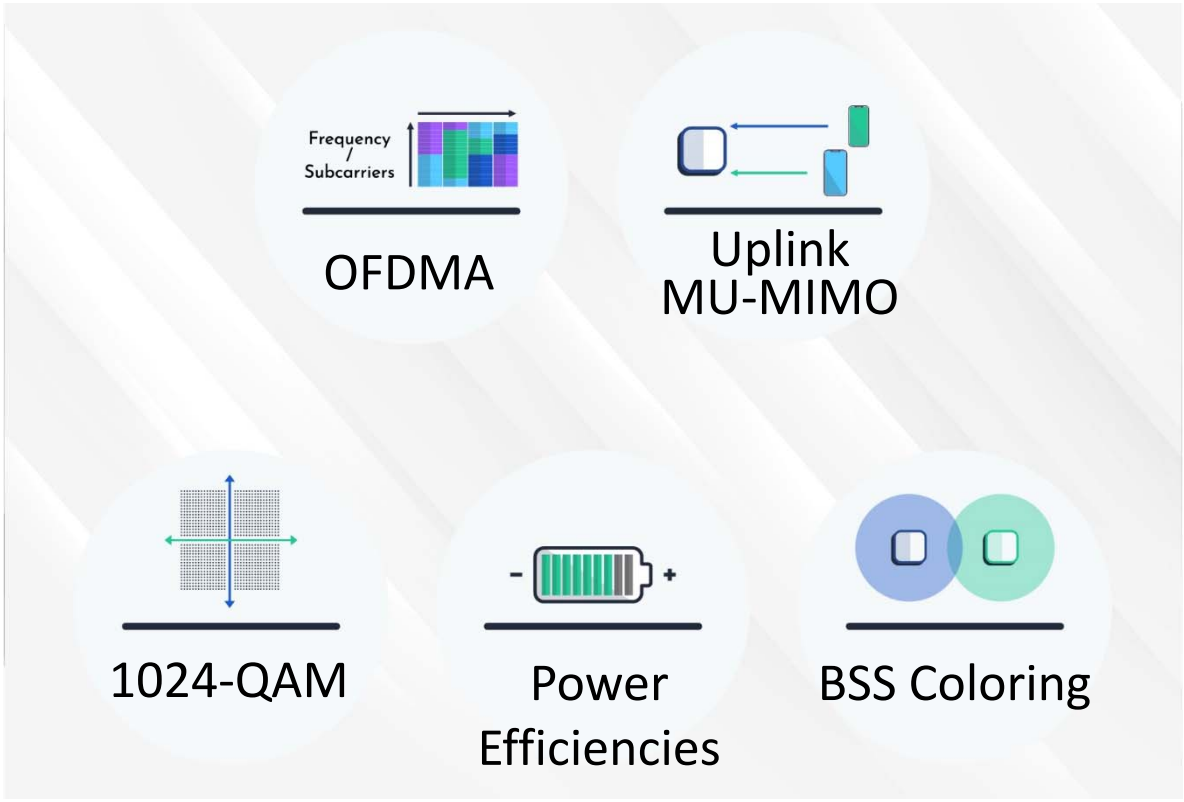
Pros	Cons
Less network interference	More expensive than a Wi-Fi network
Better network security	Requires more headend space and power than Wi-Fi
Faster throughput, more capacity and better latency	More complicated to install. Requires more qualifications and certifications
Better signal quality	Not all devices are capable of connecting to LTE or 5G NR

802.11 – History



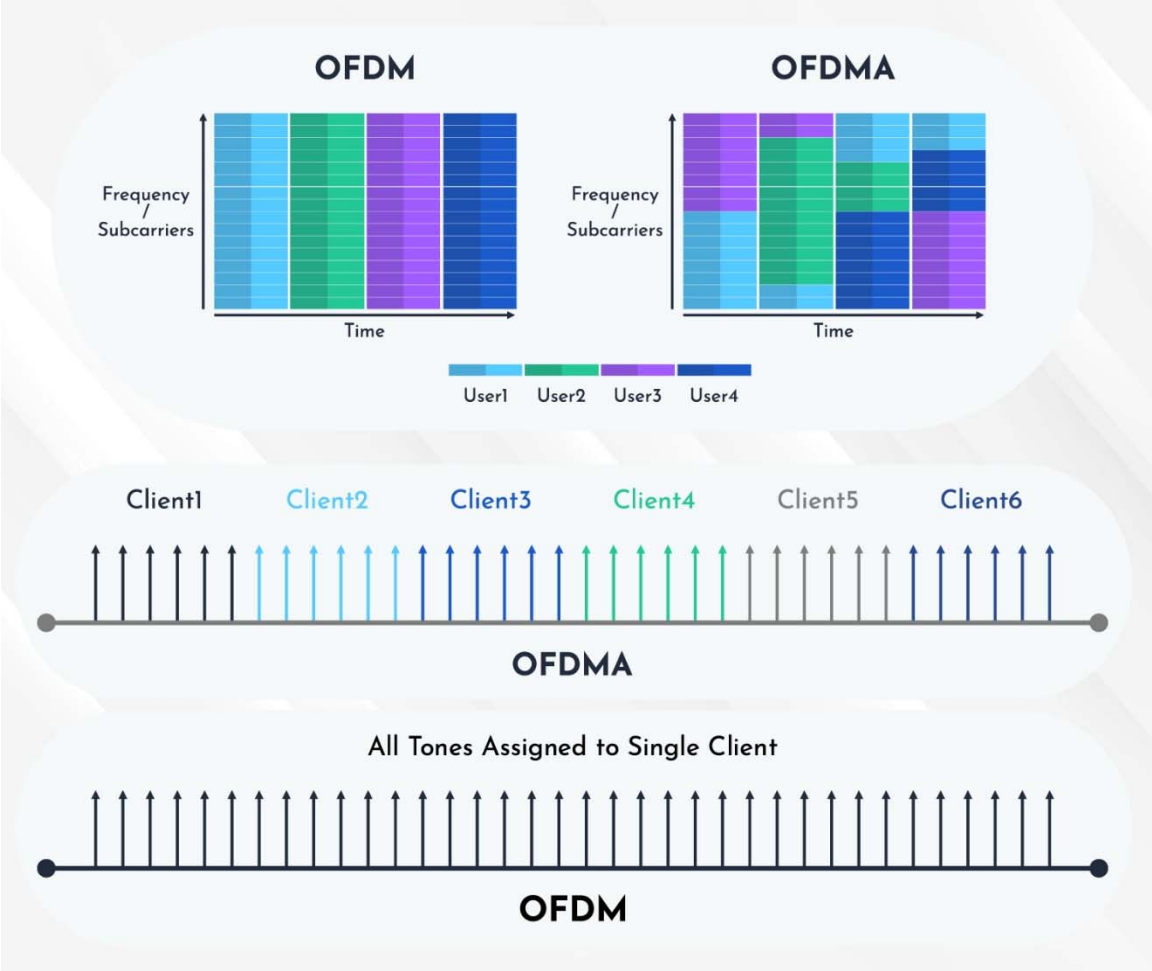
Wi-Fi uses unlicensed spectrum (formerly known as ISM) – it is mostly unregulated, i.e. anyone can set up a transmitter, receiver any where, any time they want.

Key Wi-Fi6 Enhancements



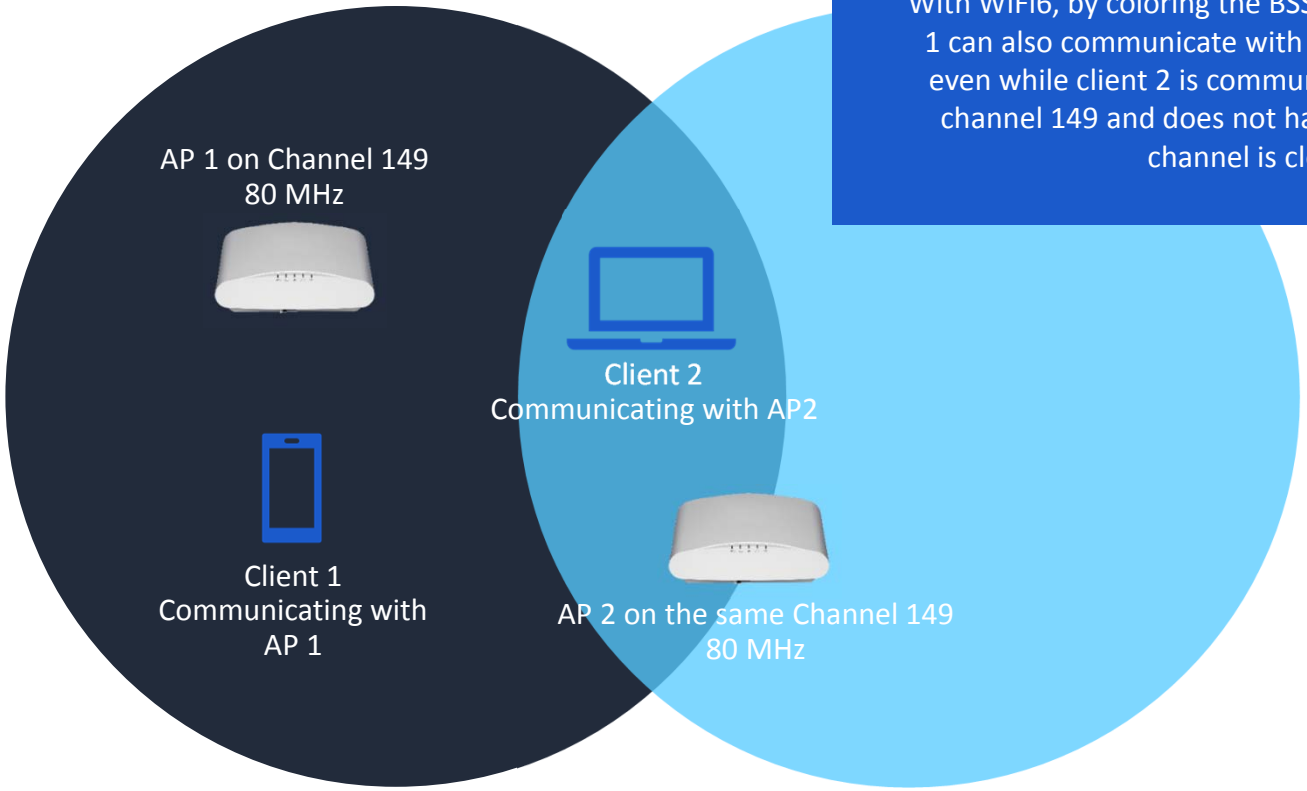
OFDMA Overview

- OFDMA - (Orthogonal Frequency Division Multiple Access) – enables efficient use of Wi-Fi medium across multiple Clients simultaneously
- Instead of allocating the entire Wi-Fi bandwidth to a single client, the radio can serve multiple clients in a single cycle
- Gains in efficiency are analogous to the case where multiple cashiers in a supermarket checkout line can deliver a better customer experience – over a single cashier servicing all customers

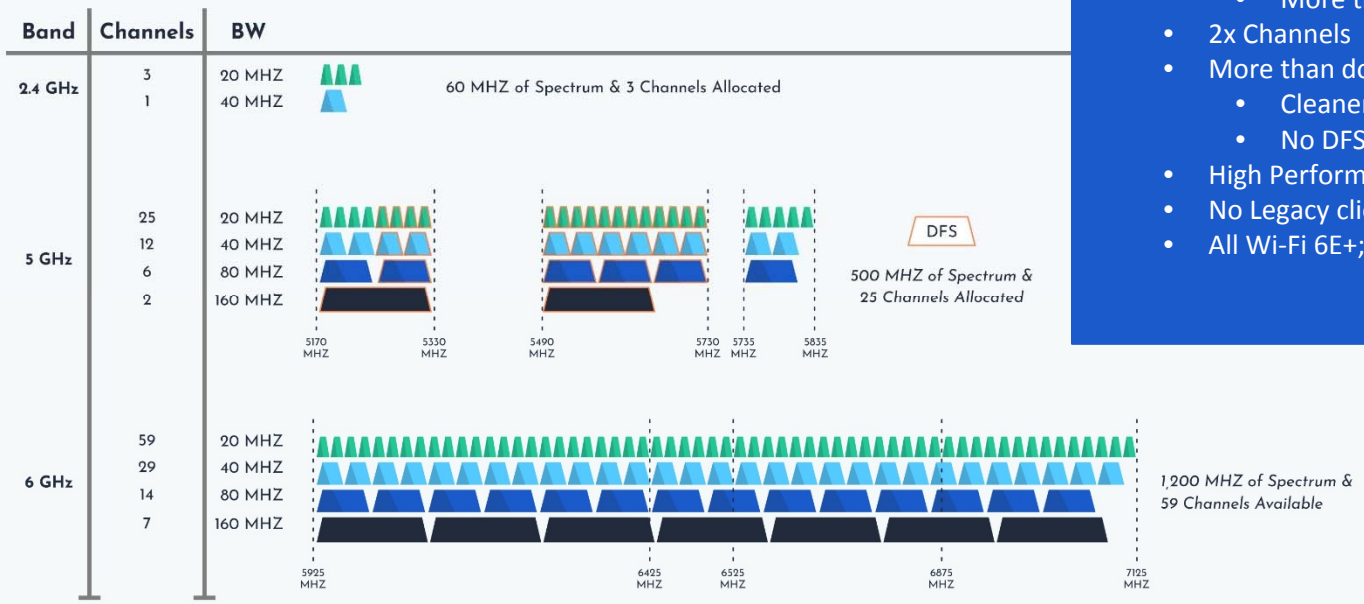


OBSS Coloring

With WiFi6, by coloring the BSS from EACH AP, Client 1 can also communicate with AP 1 on channel 149 even while client 2 is communicating with AP2 on channel 149 and does not have to wait until the channel is clear.



Coming up next: Wi-Fi6E



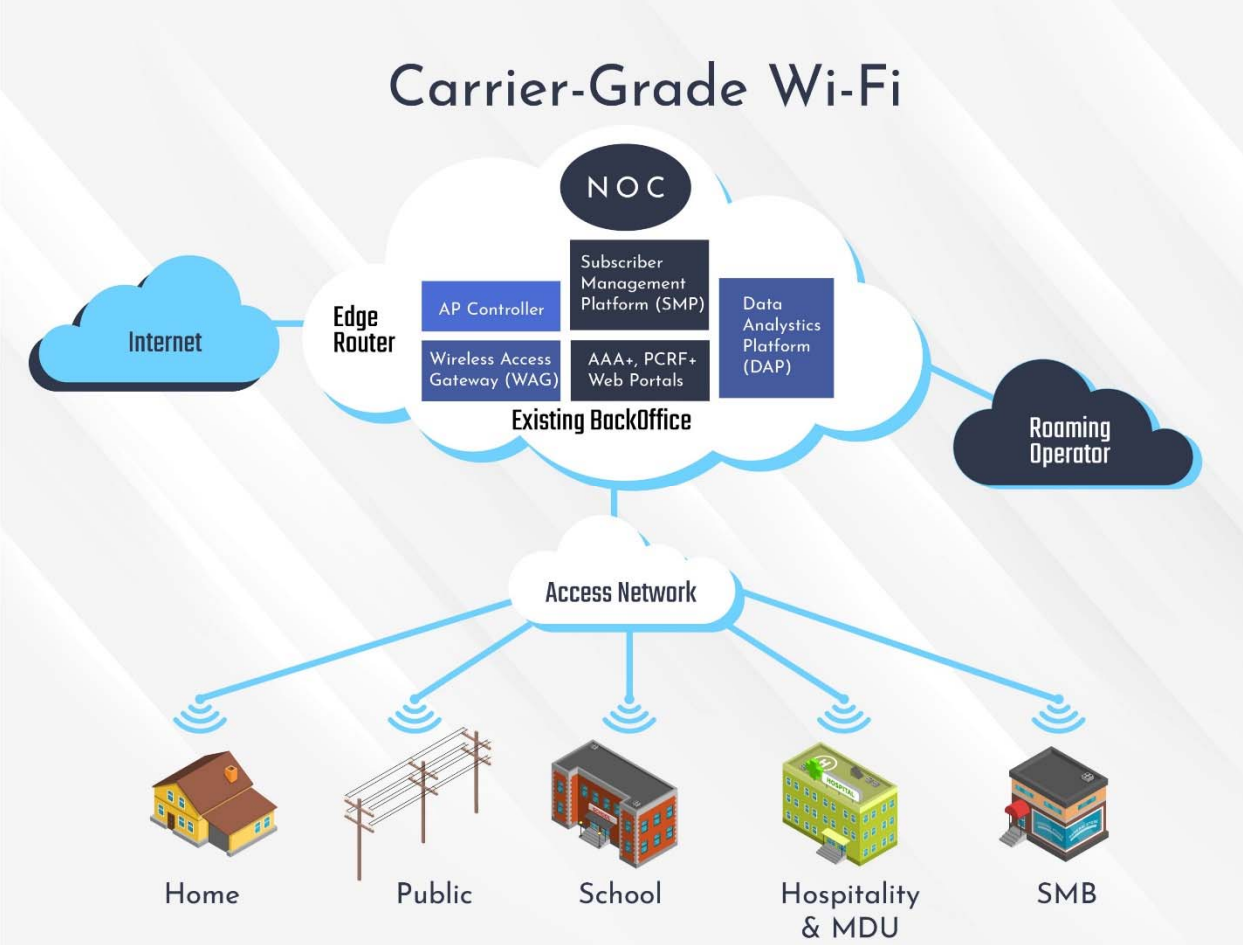
- 2x Bandwidth
  - 1200 MHz of new spectrum
  - More than double 2.4 & 5 GHz combined
- 2x Channels
- More than double 2.4 & 5 GHz combined
  - Cleaner Spectrum
  - No DFS to worry about
- High Performance Clients
- No Legacy clients to hog airtime
- All Wi-Fi 6E+; Gigabit capable

How is Wi-Fi planned and deployed?

Key Performance Indicators (KPIs)

USE CASE	LOW NOISE (<-90 dBm)	HIGH NOISE (> -90 dBm)
	Signal Strength, dBm	SNR, dBm
Low Data Rate (Handheld scanners, POS)	-73	18
High Data Rate (Video Streaming, File sharing)	-70	20
VoWi-Fi	-67	25

What does a typical commercial Wi-Fi network look like?



What does a typical commercial Wi-Fi network look like?

Requires much less space and power than a typical DAS:

- ½ Rack for Controller and Router in HE
- ¼ rack for switching equipment in IDF rooms
- Cabling is mostly CAT6 or CAT6A
- AP density of 1 antenna per 5k SF (excluding arenas and other high-capacity venues)
- Fiber network between Switches and Routers
- Power can be all AC 20 Amp
- Power over ethernet (PoE) for APs

5G

Will 5G replace Wi-Fi?

5GNR (new radios)

Infrastructure Options to Support 5G

Will 5G replace Wi-Fi?

- Usability of current coaxial and fiber DAS architectures
- Cat-5E and Cat-6 not sufficient: Cat-6A is minimum
- Fiber to the “X”
- The fiber backhaul challenge

Advanced Mobile Broadband	2016	2021	Toward 2025
80 percent of sites	90 Mbps	300 Mbps	600 Mbps
20 percent of sites	300 Mbps	1 Gbps	3-5 Gbps
Few percentage of sites	1 Gbps	3-10 Gbps	10-20 Gbps

How is cellular planned and deployed?

Standard Coverage Requirement for LTE

Wireless Service Provider	Technology	Design Criteria (dBM)	% of Area Covered
AT&T	LTE	(RSRP) -95	95%
Verizon	LTE	(RSRP) -95	95%
T-Mobile	LTE	(RSRP) -95	95%

Important Criteria:

- Capacity requirement (Type of environment and estimated number of users)
- Antenna density and target signal strength (floor density, wall materials, existing RF signals)
- Cabling preference (e.g. fiber, category, coax)

General Head End Room Planning

Space for wireless carrier equipment / DAS Equipment

- Typically, we need 750 SF or less per 1 million SF of building space
- Typically utilize an existing MDF, but rooms can be retrofitted to accommodate head end equipment
- We can get creative. Challenges with space has never spotted a project Examples: parking garage or roof shelter or other relatively unleasable/unusable space

Power Requirements for the head end room

- 100 Amps 208 VAC three phase per carrier
- Carriers will be sub-metered

Environmental requirements for the head end

- 1 ton HVAC per wireless carrier

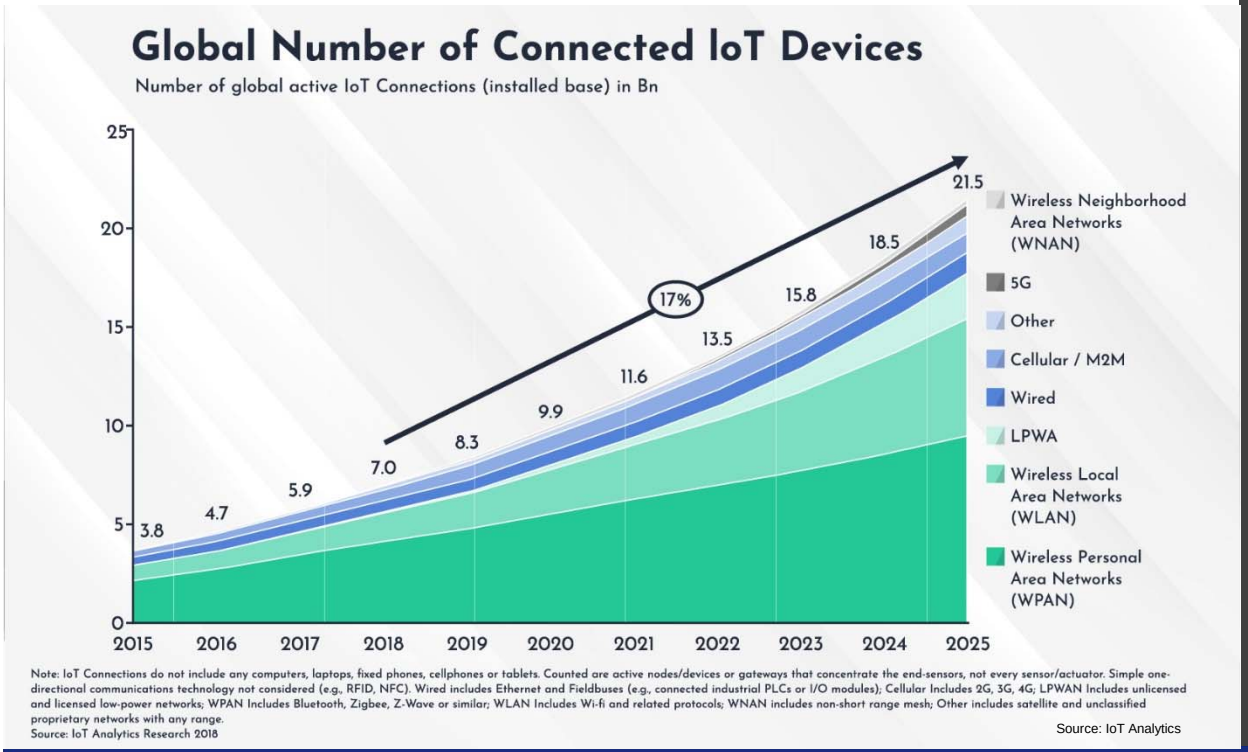
Floor Loading

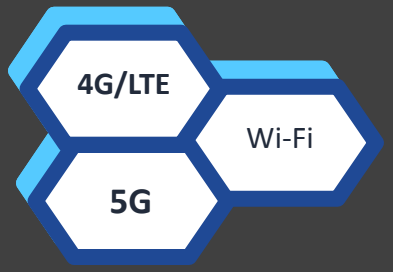
- 125 PSF for BTS equipment

Conclusion

Will 5G replace Wi-Fi?

5G is great – But Wi-Fi isn't going anywhere





- Embedded in nearly every device
- Preponderance of connectivity is indoors
- Wi-Fi is simple, easy, users know it
- High capacity at lowest **cost** per megabit
- Full control and visibility

Capacity is Capacity – We Need Them All

Licensed LTE Solutions

- DAS
- Small Cell
- Macro

5G Solutions

- Small Cell
- DAS

Wi-Fi Solutions

- High Density, Scale & Performance
- WiFi-6 and 802.11ac
- IOT, Location Intelligence & Analytics

CBRS Solutions

- Access Points & Cloud Management
- Analytics

Summary

- Demand for wireless use and connectivity driving technology
- Near-term 5G and related technologies impacting infrastructure to support
- More coverage. More throughput. More fiber! (wireless does not mean cable-less)
- New technologies will open up markets for smaller (under 500,000 SF) building coverage solutions

Thank you

Questions?

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