WiFi 6

Now With More Cowbell!
Introductions

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● RF Enthusiast
● Geek
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The Short Version
Nerd!!!
6 is bigger than 5, so it is mo’bettah.

~The End
WiFi - History

Back in my day, WiFi networks were deployed for coverage

- Few devices
- AP’s were placed in halls
  - I’m guilty of doing this
- Wifi A,B and G

Now we design for density

- Many devices
- AP’s placed in the classroom
- Wifi N(4),AC(5),AX(6)
## WiFi - Rebranding

<table>
<thead>
<tr>
<th>Generation of network connection</th>
<th>Sample user interface visual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wi-Fi 6</td>
<td>![6]</td>
</tr>
<tr>
<td>Wi-Fi 5</td>
<td>![5]</td>
</tr>
<tr>
<td>Wi-Fi 4</td>
<td>![4]</td>
</tr>
</tbody>
</table>
WiFi - History Continued

Depending on WiFi technology you chose you were band limited.

- **A**
  - 5 Ghz
  - 8 non overlapping channels

- **B & G**
  - 2.4 Ghz
  - 3 non overlapping channels

- **N**
  - Now you could “have your way”™
  - 2.4 and 5 Ghz

- **AC**
  - 5 Ghz only
  - 25+ channels (22-25, 5 Ghz) (3 sad 2.4 Ghz)(Depends on AP)
  - Wider channels
# WiFi - Why Upgrade?

<table>
<thead>
<tr>
<th>Standard</th>
<th>Frequency</th>
<th>Theoretical Speed</th>
<th>Real-World Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>802.11a</td>
<td>5Ghz</td>
<td>6-54 Mbps</td>
<td>3 - 32 Mbps</td>
</tr>
<tr>
<td>802.11b</td>
<td>2.4Ghz</td>
<td>11 Mbps</td>
<td>2-3 Mbps</td>
</tr>
<tr>
<td>802.11g</td>
<td>2.4Ghz</td>
<td>54 Mbps</td>
<td>10 - 29 Mbps</td>
</tr>
<tr>
<td>802.11n</td>
<td>2.4Ghz</td>
<td>300 Mbps</td>
<td>150 Mbps</td>
</tr>
<tr>
<td>802.11n</td>
<td>5Ghz</td>
<td>900 Mbps</td>
<td>450 Mbps</td>
</tr>
<tr>
<td>802.11ac</td>
<td>5Ghz</td>
<td>433 Mbps - 1.7 Gbps</td>
<td>210 Mbps - 1 G</td>
</tr>
</tbody>
</table>
WiFi - Why Upgrade?

Each WiFi revision that has been released has advertised increased Speeds.

“With Great Speed Comes Great Capacity”

Hey, don’t forget to mention that I work on 2.4 Ghz as well.
How fast is 802.11ax?

Let’s say we take the more conservative 4x estimate, and assume a massive 160MHz channel. In that case, the maximum speed of a single 802.11ax stream will be around 3.5Gbps (compared with 866Mbps for a single 802.11ac stream). Multiply that out to a 4×4 MIMO network and you get a total capacity of 14 Gbps. If you had a smartphone or laptop capable of two or three streams, you’d get some blazing connection speeds of 1GB per second or more.

In a more realistic setup with 80MHz channels, we’re probably looking at a single-stream speed of around 1.6Gbps, which is still a reasonable 200MB/sec. If your mobile device supports MIMO, you could be seeing 400 or 600 MB/sec.

And in an even more realistic setup with 40MHz channels, a single 802.11ax stream would net you 800Mbps (100MB/sec), or a total network capacity of 3.2Gbps.
Born (ratified) September 16, 2019

Calling it WiFi AX was cooler!
Wi-Fi CERTIFIED 6™ key features

- **Downlink Multi-User MIMO**
  - Hopefully
- **OFDMA**
  - Yea Baby!
- **Beamforming**
  - Not Beamflex™

- **160 MHz Channel Bandwidth**
  - Meh
  - 40, 80, 160

- **BSS Coloring**
  - Helps the kids play nice

- **8 Spatial Streams**
  - Don’t Cross ’em

- **Target Wake Time**
  - A Nifty WiFi Alarm Clock

- **1024-QAM**
  - Higher Data Rates

**Ooooo Marketing**
OFDMA - Showing Devices the Love.

- Previous WiFi revisions were client-centric. An AP could only send data to one device at a time and would utilize the entire channel width to do it.
- Most network traffic is small in nature or is time sensitive (VOIP)
- With Wifi 6 an AP can send data to multiple devices at a time by breaking up a WiFi channel into smaller sub-channels.
- For example, a traditional 20 MHz channel might be partitioned into as many as 9 smaller channels.
- This allows clients to get more attention.
Infographic - graphic visual representations of information, data, or knowledge intended to present information quickly and clearly.
BSS Coloring - Basic Service Set Coloring - Increasing Efficiency

- With WiFi you need to be careful to make sure you limit channels from overlapping.
- AP’s were not very good coordinating channel resources.
- With WiFi 6 AP’s can identify signals from overlapping networks and make decisions on medium contention and interference management based on this information. Helps devices ignore other devices transmissions.
- Helpful when the density of AP’s are high.
Other Improvements - A lot of little improvements can make a big difference

- **Downlink MU-MIMO**
  - Wasn’t used much in WiFi 5 (AC) hopefully higher adoption in WiFi 6

- **Beamforming**
  - Needed for MU-MIMO
  - Not to be confused with Ruckus BeamFlex™

- **160 Mhz wide channels**
  - With the current number of channels this isn’t very useful

- **8 Spatial Streams**
  - Potential for high data rates
  - Probably won’t see devices take advantage of this

- **Target Wake Times**
  - Devices coordinate with the AP when it will connect next.
  - Great for low power devices

- **1024 QAM**
  - Up to a 25% increase in throughput, but will require a strong clear signal.
Deployment Considerations

- Most WiFi 6 AP’s are going to need more power.
  - PoH or 802.3bt allows for 60 and 90 Watts of power
- Switch upgrade
  - WiFi 6 has the potential to saturate your traditional 1 Gbps network connection
  - Many WiFi 6 AP’s come with a 2.5 GbE port or faster

![Ruckus R750 AP 1 and 2.5 Gbps ports](image1)

![Ruckus 7150-48ZP Switch 16x100/1000 Mbps/2.5 Gbps PoH ports](image2)
Devices - Classic chicken / Egg story

- Devices that support WiFi 6 are out, and new ones are being released at an increasing rate
- Notable phones with support
  - iPhone SE, 11, 11 Pro, and 11 Pro Max Ultra Large
  - Samsung Galaxy S10, S10E, Note 10, S20 Line and Fold
- Computers
  - Dell XPS 13 (2020)
  - HP Spectre x360
  - Lenovo Yoga c940
  - LG Gram 17
  - Not Apple laptops yet
- My guess is most budget Chromebooks will have it for the 2021 buying season.
Access Points

- All the major players in the WiFi market have released some sort of WiFi 6 Access point.
- Most will release a flagship model with more economical versions to follow.
- Many include additional radios such as Bluetooth for IoT devices.
WiFi - Whaatt?? We Get More WiFi Goodness???
I thought you said no more letters?!?!
WiFi 6e - Everything you love about 6, but with an “e”.

- FCC allocated 1.2 Ghz of new Wi-Fi spectrum in the 6 GHz band
  - 2.4 GHz band has 60 MHz allocated
  - 5 GHz band has 500 Mhz allocated

**Wi-Fi 6E brings Wi-Fi® into 6 GHz**

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>More, contiguous spectrum</td>
<td>Gigabit speeds</td>
</tr>
<tr>
<td>Wider channels</td>
<td>Extremely low latency</td>
</tr>
<tr>
<td>Less interference</td>
<td>High capacity</td>
</tr>
</tbody>
</table>
WiFi 6e - Everything you love about 6, but with an “e”.

<table>
<thead>
<tr>
<th>Band</th>
<th>Channels</th>
<th>BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4 GHz</td>
<td>3</td>
<td>20 MHz</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>40 MHz</td>
</tr>
</tbody>
</table>

60 MHz of Spectrum & 3 Channels Allocated

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

500 MHz of Spectrum & 25 Channels Allocated

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

1,200 MHz of Spectrum & 59 Channels Available
WiFi 6e - Everything you love about 6, but with an “e”.
Questions in Chat, or if allowed
Unmute

Press ALT-F4 to issue a complaint!