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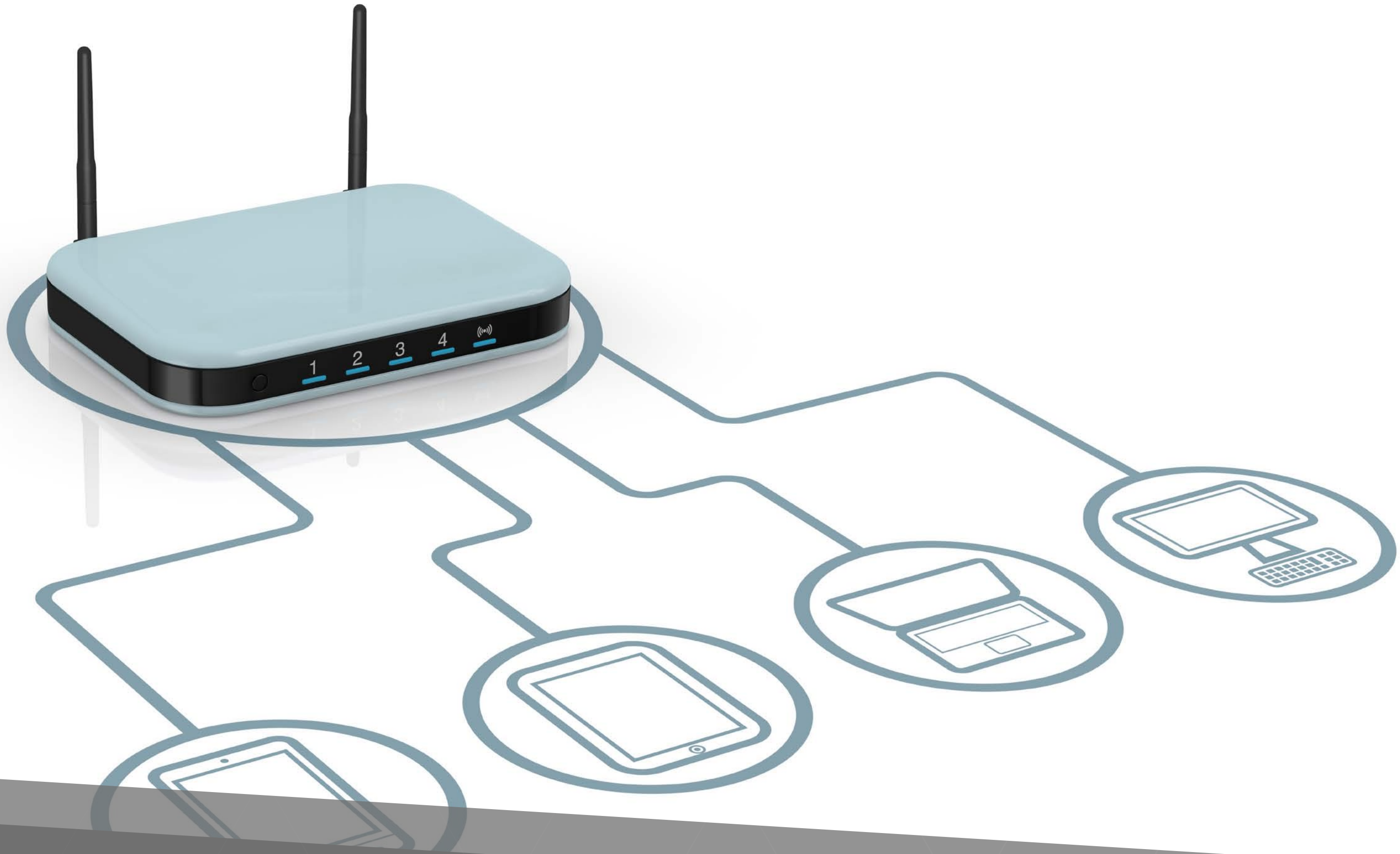
# The Impact of Wi-Fi 6E on Network and Cabling Design

WHITE PAPER




## Introduction

Wi-Fi 6 has become the ubiquitous standard for new wireless installations. It’s benefits over Wi-Fi 5 are numerous:

- Improved device data rates
- Improved outdoor range and performance
- Improved performance in dense environments
- Increased battery life for end devices, and
- Reduced latency over prior Wi-Fi standards

The latest version of Wi-Fi – Wi-Fi 6E – extends the enhancements of Wi-Fi 6 into the 6GHz spectrum and introduces possibilities for exciting new network design options.

The goal of this document is to discuss new technical components of Wi-Fi 6E, the impacts and changes they can have on network design, and how Wi-Fi 6E can impact network cabling.

## Technical Improvements with Wi-Fi 6E

The biggest change with Wi-Fi 6E is the addition of the 6GHz spectrum. The 6Ghz spectrum offers several technical improvements, including bandwidth and the number of available channels, and it allows enterprise networks to be deployed with wider channel bandwidths of 80 or 160MHz.

The amount of bandwidth available at 6GHz is significantly more than the amount that has been available at the 2.4 and 5GHz spectrums used for Wi-Fi 6. The comparison of the amount of bandwidth in Wi-Fi 6 and Wi-Fi 6E is shown in Figure 1.

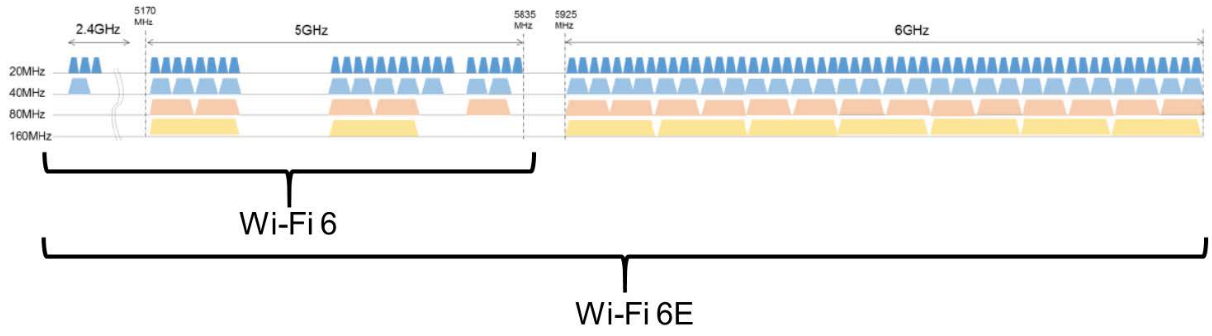



Figure 1: Wi-Fi 6 and 6E bandwidth and channel comparison. Wi-Fi 6E has significantly more bandwidth than Wi-Fi 6.

A comparison of the number of channels in the 5 GHz band and the 6 GHz band is shown in Table 1 (for both the USA and EU, which have different allocated spectrums). There are considerably more channels available with Wi-Fi 6E than with the prior Wi-Fi 6 standard.

**Table 1: Number of channels in the 5 GHz band and the 6 GHz band (both USA and EU). The addition of the 6 GHz band with Wi-Fi 6E significantly increases the number of available channels over the existing Wi-Fi 6 5 GHz band.**

| Channels | 5 GHz Band | 6 GHz Band (US) | 6 GHz Band (EU) |
|---|---|---|---|
| **20 MHz** | 25 | 59 | 24 |
| **40 MHz** | 12 | 29 | 12 |
| **80 MHz** | 6 | 14 | 6 |
| **160 MHz** | 2 | 7 | 3 |

Figure 2 gives an example of maximum throughput for different number of spatial streams for different numbers of clients when using 160 MHz channels with the highest modulation rate and 25 percent overhead. The throughput remains high, even when the active client count numbers are high.

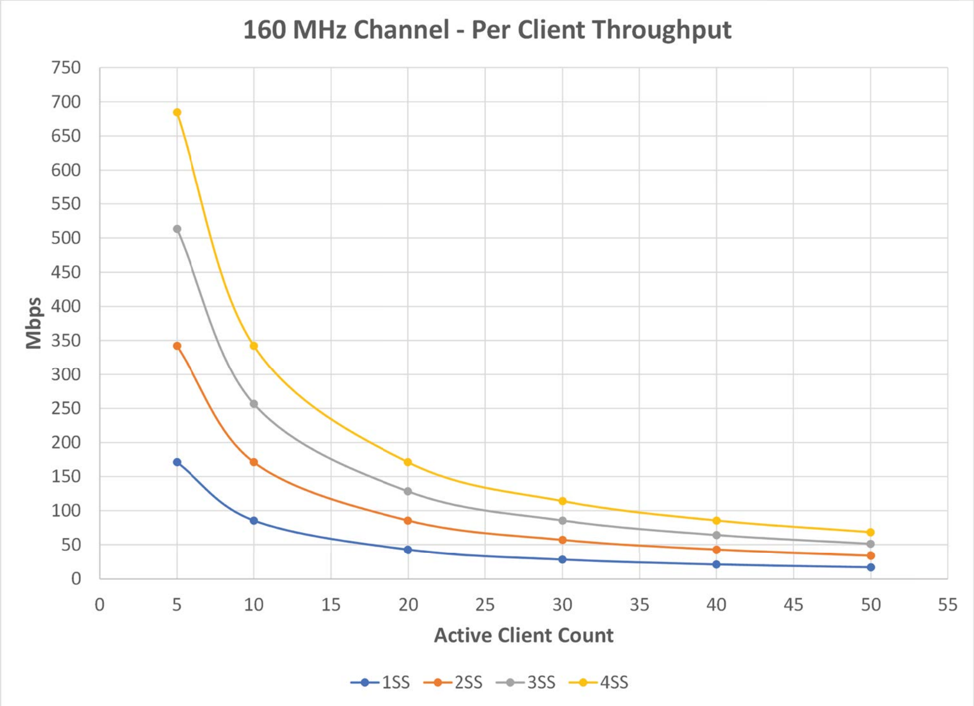



Figure 2: Throughput for different number of spatial streams for increasing numbers of active client counts. While the maximum throughputs are significantly higher with Wi-Fi 6E, they are still far below wired connections.

## Network Changes with Wi-Fi 6E

A major advantage of this new 6 GHz bandwidth is that it is new – backward compatibility is not necessary in the 6GHz band as there are no legacy clients operating in this spectrum. The enhancements and efficiencies introduced by IEEE 802.11ax will always be utilized. This means there is less background noise, which will allow these access points to achieve higher data rates.

### Wired Connections Still Needed with Wi-Fi 6E

However, while the throughputs have increased, they are still far below basic wired connections. Most wired connections today operate at a minimum of 1 Gbps. As shown in Figure 2, with typical numbers of active clients, the throughput with Wi-Fi 6E is well below 100 Mbps. This throughput would still be far too low for applications like uncompressed video or video gaming, which can be a bandwidth hog for universities, with high concentrations of students in on-campus housing.

Additionally, another benefit of wired connections is the delivery of power to the connected device via Power over Ethernet. Therefore, items like security cameras, IP phones, and other devices would require a wired power source even if they are transmitting data over the wireless network. Hence, a wired connection will still be more efficient for many devices rather than trying to go wireless. In addition, for devices that do not need to be mobile such as desktops, docking stations, and other fixed locations for network access, a wired connection is very advantageous. Keeping the wireless environment as open as possible for those clients that require a Wi-Fi connection is a key strategy for network designers to ensure the best possible Wi-Fi experience.

Because of this, Wi-Fi 6E is not expected to significantly change the number of wired connections.

### Layering or Partitioning Spectrum

With the addition of the 6 GHz bandwidth, Wi-Fi 6E will make it much easier to co-locate multiple access points to partition the spectrum as needed. This can mean securely giving different types of users access to different networks, each with robust throughputs for their intended use. Figure 3 gives concepts of how this could be done.

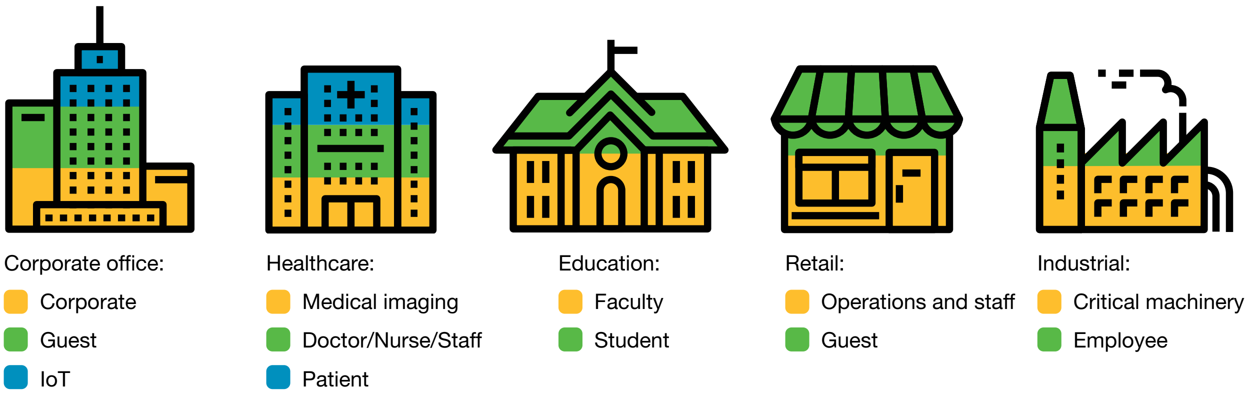



Figure 3: Concepts to partition the spectrum with Wi-Fi 6E. This spectrum portioning could be done with separate access points.

## New Power and Data Requirements for Wi-Fi 6E

Wi-Fi 6E has been designed to enable higher power transmission in wider channels. This attempts to maintain a signal-to-noise ratio regardless of channel bandwidth. In addition, Wi-Fi 6E access points will now be operating with three radios to support the 2.4, 5, and 6 GHz bands. Because of this, Wi-Fi 6E access points will require higher power levels of Power over Ethernet (PoE). Additionally, due to the 6 GHz bandwidth, these access points will require higher throughput connections to the LAN. These higher PoE and throughput requirements make a multi-gigabit (speeds of at least 2.5 and 5GBASE-T) connection a necessity today.

Therefore, an IEEE 802.bt Type 4 switch (also known as PoE++ or 4PPoE) that is capable of multi-gigabit transmission is recommended. Future access points may require speeds of up to 10GBASE-T. Category 6A cables are recommended as they provide the optimal support for both Power over Ethernet and data rates of 2.5, 5, and 10GBASE-T.

## Cabling Recommendations for Wi-Fi 6E

Prior Panduit Wi-Fi technical documents and presentations recommended running up to 4 Category 6A cables per access point. Wi-Fi 6E and the improved ability to partition the spectrum provides an excellent example of how the 4 cables can be used.

An example is shown in Figure 3. On Day 1, a Wi-Fi 5 or 6 access point is used. On Day 2, the initial access points are replaced with Wi-Fi 6E access points and additional Wi-Fi 6E access points are added to allow for spectrum partitioning. On Day 3, all Wi-Fi 6E access points are replaced with Wi-Fi 7 access points.

**Day 1:**
Wi-Fi 5 or 6

4 Cables Installed per Access Point
1 Cable Used per Access Point
**25% of cables used**

**Day 2:**
Wi-Fi 6E (Spectrum Partitioning)

2 Unused cables moved to new Access Point
2 Cables Installed per Access Point
1 Cable Used per Access Point
**50% of cables used**

**Day 3:**
Wi-Fi 7 (Upgraded Access Point)

2 Cables Installed per Access Point
2 Cables Used per Access Point
**100% of cables used**

Figure 3: Example of four cables per access point being used to support spectrum partitioning (Day 2) and to support port aggregation for upgrade access point performance (Day 3), all using the same cabling infrastructure installed on Day 1.

The purpose for running the four cables on day 1 is that it is much more cost effective to run cables when constructing a building rather than when the building is occupied. A cable run is approximately 10 times as expensive to run in an occupied building versus one where the walls are not yet in place.

Therefore, the recommendation for Wi-Fi 6E cabling is as follows:

- Run up to 4 Category 6A cables per access point if future spectrum portioning is possible
- Run at least 2 Category 6A cables per access point if confident there is no future density or spectrum partitioning needed

## Conclusion

Wi-Fi 6E offers significant improvements over Wi-Fi 6 due to the expanded use of the 6GHz spectrum. This additional bandwidth can change the way a network is deployed with spectrum partitioning. With respect to cabling, it confirms the need to run multiple Category 6A cables to an access point.

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