ZYXEL
NETWORKS

Understanding the benefits of **WiFi 7**

WiFi 7 (IEEE 802.11be)
White Paper

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Why do we need WiFi 7?

There is always a need for higher connection speeds and bandwidth. But logically, there must also be a point at which we have reached or gone beyond the level of performance that most of us really need. We do not yet seem to be anywhere close to reaching that point with wireless connectivity.

For some users – at least for now – it may indeed be the case that the current technology (WiFi 6 and WiFi 6E) delivers enough. For other organisations, there is a definitive and identifiable need for the higher performance that WiFi 7 (IEEE standard 802.11be) promises to deliver.

In this document, we look at the benefits that WiFi 7 delivers and how we expect adoption to develop.

How WiFi became an essential part of our lives

Wireless connectivity is essential for us all today. Wherever we go, we expect to be able to connect to WiFi and enjoy a smooth and seamless experience on our smartphones, tablets and laptops. WiFi provides us with access to the services and information that have become vital to our everyday working and personal lives. It's the way we connect to business applications and services, to online banking and shopping websites and even public services. Whatever we are doing and wherever we are, we choose to connect via WiFi if we can.

Usually, WiFi is fast and reliable and the degree to which we have become dependent on it is patently evident in the way we respond when we can't access a wireless network.

As our online activity has developed, so has the sophistication and richness of the services we use. There is real competition for our online attention. All of us habitually use video conferencing and streaming services on a daily basis and we consume most of our visual and audible entertainment though the Internet. Consequently, bandwidth requirements have continued to explode.

This pressure is felt not only at the gateway to the network, through which all incoming and outgoing traffic must pass, but also right across and out to the edge of the infrastructure. With WiFi being the preferred method of connection for almost every single edge device, wireless connections must increasingly be capable of supporting multiple connections, all-consuming large amounts of bandwidth simultaneously.

This heightened need for bandwidth and speed has compelled the WiFi industry to find ways to deliver ever-higher levels of performance. And once we get used to that higher performance, there is no going back. We easily forget what it used to be like. The response we used to get from wireless technology just a few years ago is not something we would be prepared to tolerate today.

Prior to the arrival of WiFi 6 in 2019, the maximum theoretical data rate achievable (with WiFi 5 802.11ac) was 3.5Gbps. Today, with WiFi 6 and 6E, it's almost three times more at 9.6Gbps. While that would probably be absolutely fine in an ordinary home setting, in places where WiFi is being used by scores or even hundreds of users simultaneously, the frequencies can soon become congested and lead to a degradation in performance.

Why WiFi 7 matters

We now see WiFi 7 emerging and providing us with potential speeds of up to 46Gbps; WiFi 7 is five times faster than WiFi 6 or WiFi 6E – theoretically. In a real-world situation, you probably wouldn't need much more than 30Gbps throughput with WiFi 7. Even so, it is significantly faster than WiFi 6 or 6E.

WiFi 7 is also giving us much better support for fast and stable connections for many users in ultra-dense environments.

This astonishing level of performance and capability provides much more than most ordinary households or small businesses, cafes, bars, shops or restaurants really need at the moment. That will change over time and as more client devices come onto the market that support WiFi 7, upgrading will become more compelling.

While that will take some time, there are a number of scenarios in which it will make sense to upgrade to WiFi 7 as quickly as possible. In environments where there are extremely high densities of users – in sports arenas and concert halls, airports and train stations, and in large schools and university campuses, for example, WiFi 7 will provide really significant benefits as it can provide much faster and more consistent high-speed connections for many more users.

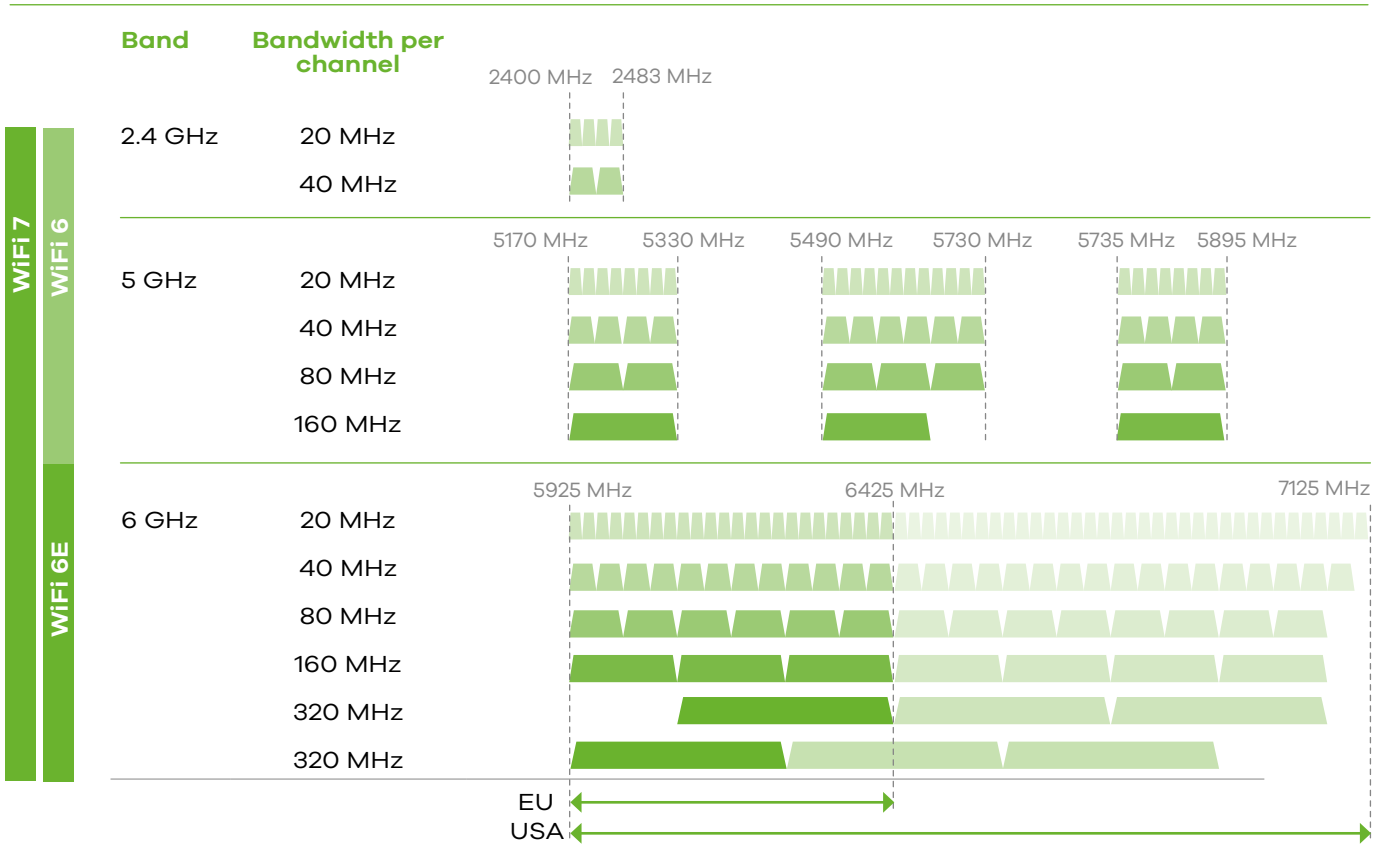
> WiFi 7 can provide speeds of up to 46Gbps – five times faster than WiFi 6 or WiFi 6E

What makes WiFi 7 different?

When it was released in 2021, WiFi 6E (802.11ax) was the first wireless standard to make use of the 6GHz frequency band. Until that point only the 2.4GHz and 5GHz frequencies had been available. With the additional band it became possible to support wider channels of up to 160MHz, providing higher throughput, allowing more devices to connect to the wireless network simultaneously and reducing the potential for interference and latency.

With WiFi 7, the technology takes a significant step forward, making better use of the 6GHz frequency band and doubling the maximum channel width to 320MHz. This means WiFi 7 can deliver significantly faster data rates to many more devices.

Just to be clear, WiFi 7 will still be capable of using the 2.4GHz and 5GHz frequencies – and that's important. But with the extra spectrums available in the 6GHz band, it has a lot more room to manoeuvre and provide optimised connections.



Ultra-high capacity QAM

QAM (quadrature amplitude modulation) is a technique that enables more data to be sent over a single channel, expanding bandwidth.

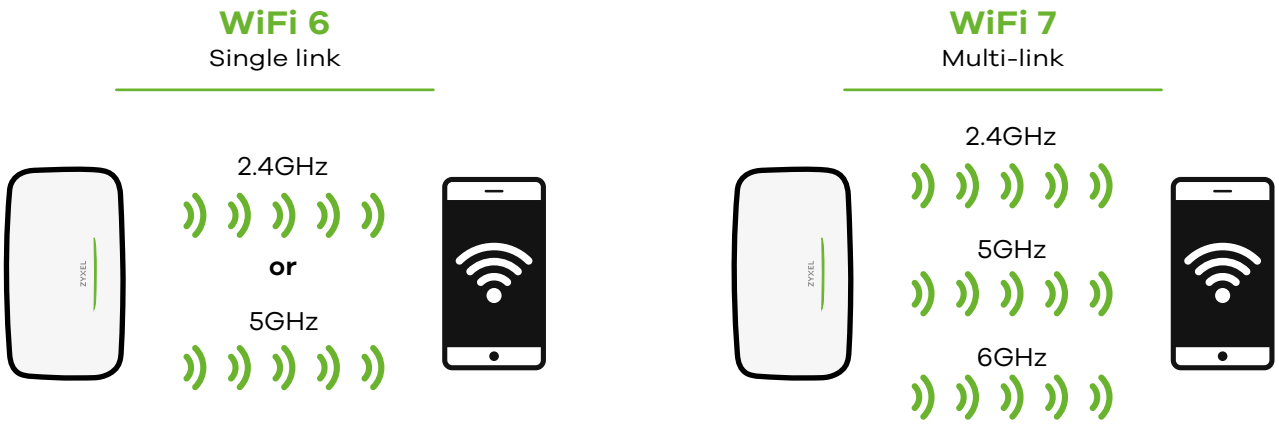
WiFi 6 and 6E supported 1024 QAM, which was a vast improvement on the 256 QAM of WiFi 5.

WiFi 7 supports 4096 QAM (also known as 4K QAM), which translates into a much higher data transfer rate that will significantly speed up the transmission of rich content, files and high-definition video.

Multi-link operation (MLO)

This is the most innovative breakthrough delivered with WiFi 7 and it delivers several benefits, including a substantial increase in throughput and potential for improvements in roaming experience and the stability of WiFi connectivity. In short it should allow the user experience to be significantly enhanced.

With MLO, wireless connections can make use of different frequency bands and channels at the same time, making it possible to take advantage of the different capabilities of each, such as higher speed and bandwidth available on the 6GHz band, or the longer connection range of the 2.4GHz frequency. MLO also allows a single client device to connect to multiple APs at the same time, which helps to ensure stability when users are moving around a location.



16 x 16 MU-MIMO

With WiFi 7 there are more spatial streams available, which means more devices can be accommodated.

On WiFi 7 access points, it's possible to have as many as 16 antennas – double the number usable for WiFi 6 / 6E. This means more devices can be supported at consistently high speeds.

Where will WiFi 7 make a difference?

WiFi 7 is faster and more efficient than previous versions of the 802.11 standard. It is capable of delivering streamlined, simultaneous connectivity for more users and less potential for interference and delay. As we have mentioned earlier, the real benefit comes in terms of how WiFi 7 provides more stable and consistently fast speeds for more users in areas where there is a high density of connections.

It is the combination of the higher frequency modulation available on the 6GHz band, double the number of available channels and the capability – with MLO – for individual connections to make use of all three bands (2.4Ghz 5GHz and 6GHz) that makes this possible.

Even though there may not be that many mobile devices on the market that support WiFi 7 just yet, some are expected before the end of 2023 and many more will start to appear in 2024. Organisations that do need to support these higher density environments will be well-advised to purchase WiFi 7 routers and access points in advance of widespread availability of WiFi 7 client devices to future-proof their connectivity.

The other main scenario we see is where the speed and stability of WiFi 7 can be used to displace hard-wired connections. There are several examples of where this could happen – for video production, streaming and broadcasting, to connect medical and industrial monitoring devices, for high-performance computing and even to connect parts of the network infrastructure.

In most smaller businesses and homes, WiFi 7 is not going to make too much of a difference just yet. As there are fewer users there will be less competition for space on the available frequencies and less potential for the interference that causes latency and results in poor responsiveness for WiFi users.

In most SMB scenarios – for now at least – WiF6 and WiFi 6E will be fast enough. The exception may be in situations where intensive streaming of high-definition video content is taking place on a regular basis. For these use cases, the enhanced performance delivered by 4K QAM may merit early investment in WiFi 7, even for a relatively small business.

As the technology matures and as more laptops, tablets, smartphones and other devices with built-in support for WiFi 7 come onto the market, the case for all organisations to embrace it will become more compelling.

5x faster speeds

WiFi 7 presents astounding maximum speeds of up to 46Gbps – five times faster than the 9.6Gbps offered by WiFi 6/6E

2x bandwidth channels

WiFi 7 adds support for new, extra-wide 320MHz channels, doubling the bandwidth capacity to accommodate more devices simultaneously

Where will WiFi 7 be adopted?

As we have already said, WiFi 7 will have the most impact in high-density environments where there are many users connecting and wanting stable and reliable, high-speed wireless connectivity.

We also expect to see adoption in industries where the faster performance and reliability of WiFi 7 mean that a wireless connection can now be used where previously only a cabled Ethernet connection was deemed to be good enough.

High density use cases

- **Education**
  Larger schools, colleges and universities may need to support very large numbers of users who need stable and reliable connections, especially during term times.

- **Transport**
  Travel hubs such as airports and train stations have some of the highest user densities, most of whom will roam right across the coverage area, and a constant turnover of users joining and leaving.

- **Conference centres and hotels**
  These use cases often see the highest levels of demand being placed on the WiFi network, as business users make use of online resources and continue to work on the move between their daily schedule commitments.

- **Arenas and shopping malls**
  With thousands of users gathering in one location for events or to shop, there is a constant need to support very large numbers of fast and dependable connections.

Ethernet replacement use cases

- **Healthcare**
  Vital medical devices such as patient monitors and life-support systems need connections that are fast and reliable with real-time communication and minimal latency.

- **Video and audio production, streaming and broadcasting**
  In professional production and broadcast environments, high-quality and uninterrupted transmission is essential to provide the stable and consistent connection with no risk of interference or drop-outs.

- **Manufacturing and industrial automation**
  Fast and robust connectivity is needed to support the monitoring and management of manufacturing and process control systems.

- **Data centres and IT infrastructure**
  There is an absolute requirement for high throughput and bandwidth, combined with assured reliability and low latency.

- **High-performance computing (HPC)**
  High-speed data transfer and low latency between nodes is essential for efficient parallel processing.

20% data rate increase

WiFi 7 packs in more data from 10 bits to 12 bits per symbol to give an additional 20% boost in higher peak data rates

100% lower latency

WiFi 7 latency performance is significantly improved, thanks to the new capabilities like Multi-link operation (MLO)

Getting the pace of adoption right

Despite there being a clear need to manage higher densities of users and connections in some places and the potential for WiFi 7 to replace hard-wired Ethernet network connections for some scenarios, it is worth thinking about the pace at which WiFi 7 should be adopted. There are two or three considerations here that may impact the timing of customer investments.

First of all, while the details of the commercial standard are available, it is not yet finally ratified by the WiFi Alliance and IEEE. This is expected in 2024. While WiFi 7 is here, it's still in the early stages of its development. There are still some challenges to be addressed with respect to the way some of the key technologies are deployed. This is especially true for MLO, which is extremely flexible and also quite complex. It may take a little time for a uniform approach to WiFi 7 to be settled upon.

In addition, devices that can connect to WiFi 7 and take advantage of its benefits will only start to emerge at the end of 2023 and during 2024.

Until support for WiFi 7 is more widespread, any routers and access points deployed will simply be supporting connections using previous standards.

The challenges are the same whenever a new networking technology is introduced and Zyxel's approach is always consistent. We want to deliver the best and most reliable operation and performance to our customers and will release products only when we can be sure that they will deliver the expected performance improvements, benefits and the return on investment that Zyxel customers expect. At the same time, we also want them to have access to those advantages as soon as possible.

We want to ensure that we can deliver the best possible products and results to our customers – and ensure their investment is protected. WiFi 7 is a complex technology and partners and customers should embrace and integrate it at their own pace and when the time is right for them.

Zyxel and WiFi 7

We will be introducing our first WiFi 7 products towards the end of 2023. The initial range will be limited to a handful of models and will provide the core advantages of faster performance and extended support for high-density environments that we know many of our customers will be eager to adopt as soon as possible.

Further features and enhancements will be added as we develop our WiFi 7 range. The way this is done is important. Many approaches can be taken with respect to the application of deployment of the new WiFi 7 features and exactly how these technologies are used in wireless access points will be crucial.

Zyxel boasts over 30 years of networking expertise, offering continuous and long-term support to customers in over 150 global markets. This long-term support is particularly crucial for WiFi 7, given that the technology is still in its early stages of development.

With our WiFi 7 solutions, we are working with Qualcomm, one of the most highly regarded chipset makers in the market. We have a long-standing partnership. They share our dedication and commitment to delivering the highest quality and a solid return on investment for customers.

Why choose Zyxel for WiFi 7?

Zyxel will provide enterprise-grade WiFi 7 solutions that will deliver assured levels of performance and quality. We are working with an industry-leading and trusted chipset maker, and our customers can be certain of having future-proof solutions and getting an excellent return on their WiFi 7 investments.

We always develop our products based on customer feedback and this will continue with WiFi 7, enabling Zyxel to deliver the features and benefits that will really make a difference to them.

Finally, as we continue to develop our cloud-based approach, we will provide the capability for partners or network administrators to configure, monitor, secure and control their WiFi 7 device through our Nebula cloud platform, which we are constantly working to enhance and improve.

For all these reasons, Zyxel is the ideal partner for all your WiFi 7 needs. If you have any questions or would like to discuss WiFi 7 in more depth, please get in contact with your local Zyxel office.

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