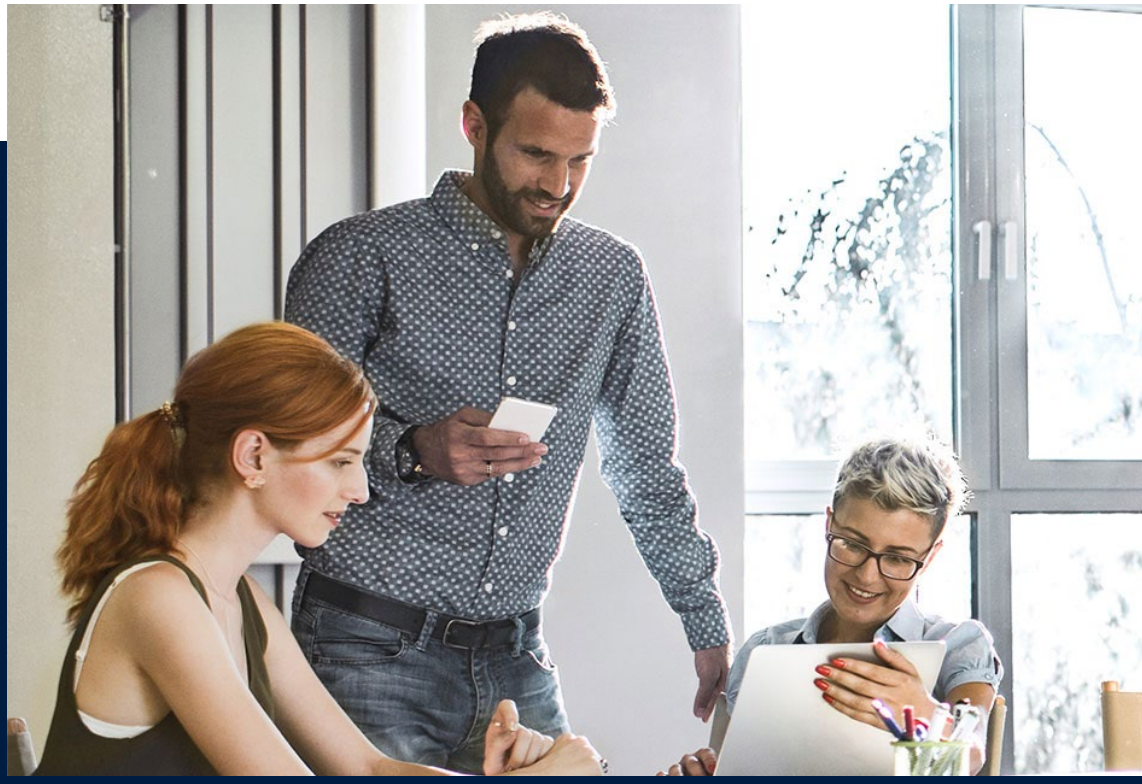
LANCOM SYSTEMS

White Paper

2×2 Wi-Fi 6 vs. 3×3 Wi-Fi 5



What advantages does a wireless LAN infrastructure based on 2×2 MIMO Wi-Fi 6 access points offer compared to an installation with 3×3 MIMO access points with Wi-Fi 5?

Wi-Fi 6 access points with two streams are technologically superior to Wi-Fi 5 devices operating three streams. This white paper illustrates the advantages of the Wi-Fi 6 standard over Wi-Fi 5.

The Wi-Fi 5 standard operates solely in the 5-GHz band

Wi-Fi 5 access points are equipped with two radio modules so that they can supply Wi-Fi to end devices in both the 5-GHz and 2.4-GHz frequency bands. However, the Wi-Fi 5 standard does not support the 2.4-GHz frequency band. Many cheaper or older end devices only support the 2.4-GHz frequency band, so in locations where a Wi-Fi 5 infrastructure is installed, these clients are forced to work with the older Wi-Fi 4 standard. In contrast, Wi-Fi 6 operates in both the 5-GHz and 2.4-GHz frequency bands.

How much bandwidth is available to users?

When it comes to the effective Wi-Fi bandwidth available to individual end devices, a key factor is the number of antennas built into the clients and thus the number of streams that can be used. This is a look at the market statistics on modern client devices:

→ Approx. 65% of all Wi-Fi users today use 1×1 MIMO clients (single-stream support).
→ Around 30% of customers use 2×2 MIMO-enabled clients (two-stream support).
→ Only about 5% of all Wi-Fi users have devices capable of 3×3 MIMO (three-stream support).

The majority of end devices available today (smartphones, cheaper tablets) are single-stream clients. Standard laptops and tablets in the upper price range are typically dual-stream devices. It is only high-end laptops, usually costing more than 2,500 EUR, that have 3-stream capability at all. Most networks rarely have to serve a 3-stream user. Consequently, only a very small number of clients are actually able to use the full bandwidth of a 3-stream Wi-Fi 5 access point.

Less congestion in the radio field

Due to the channel bundling defined in the standard, a 3×3 stream Wi-Fi 5 access point can only serve one 3×3 client, one 2×2 client, or two 1×1 clients at the same time. Wi-Fi 6 operates far more efficiently: Introduced with this standard, the channel management method orthogonal frequency division multiple access (OFDMA) supports sub-carriers with a bandwidth of 2 MHz, which are used to partition a 20, 40 or even 80-MHz Wi-Fi channel. This allows Wi-Fi channels to be utilized far more effectively. It is bit like operating a carpool: Large numbers of cars with a single occupant (Wi-Fi 5) will cause heavy traffic, while fewer, multi-occupant cars (Wi-Fi 6) can travel faster.

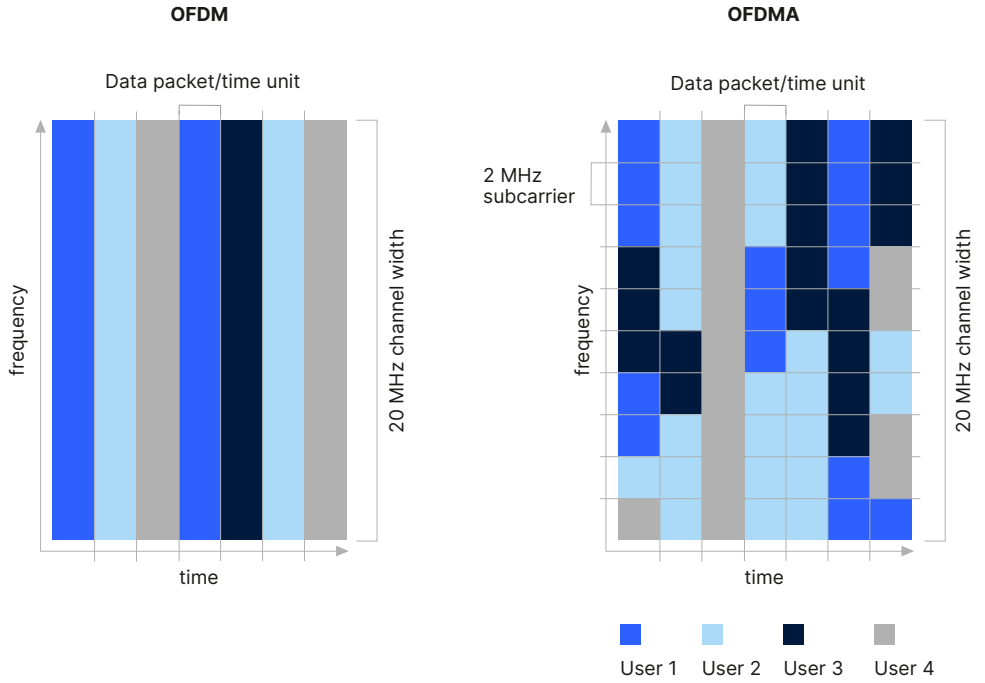


Figure 1: OFDM (Wi-Fi 5) compared with OFDMA (Wi-Fi 6) technology

More bandwidth per stream

Compared to Wi-Fi 5, Wi-Fi 6 offers significantly higher throughput per stream. An example: With an 80-MHz channel width, Wi-Fi 6 has a speed advantage of 168 Mbps.

A 3-stream Wi-Fi 5 access point has a total gross throughput of 1.3 Gbps (433 Mbps x 3 streams), but a 2×2 MIMO Wi-Fi 6 device with 1.2 Gbps (600 Mbps x 2 streams) reaches almost the same speed.

Channel width in MHz	**20**	**40**	**80**	**160**
Mbps with QAM-256 (Wi-Fi 5)	87	200	433	867
Mbps with QAM-1024 (Wi-Fi 6)	143	266	601	1,201

Table 1: Achievable gross data rate (download speed) cf. Wi-Fi 5 to Wi-Fi 6 per stream

Think about long-term investment protection, too

Considering the increasing number of Wi-Fi 6 clients arriving in the coming years, we can expect Wi-Fi 5 access points to be technologically obsolete within the next two years at the latest. What with Wi-Fi 7 already being planned, future end devices may no longer even support the former standard. We haven't even mentioned the long list of important Wi-Fi 6 features that a Wi-Fi 5 access point does not support. These include features like MU-MIMO, which Wi-Fi 6 supports in both the downlink and uplink directions. This is especially useful in environments with large numbers of Wi-Fi users and bandwidth-hungry real-time applications, as it also improves latency and throughput. As well as the OFDMA mentioned above, modulation has increased from QAM-256 to QAM-1024, battery life on the client side is extended with target wake time (TWT), and there is basic service set coloring (BSS coloring) with spatial re-use. For a detailed description of the individual technologies that arrived with Wi-Fi 6 and the resulting

advantages for Wi-Fi users, see the LANCOM technology website on Wi-Fi 6. You can also view an explainer video, or download a detailed white paper for an in-depth review of the individual items.

Pricing

Despite the wider range of features they offer, 2×2 MIMO Wi-Fi 6 access points are usually cheaper than 3×3 MIMO Wi-Fi 5 devices. This speaks strongly in favor of the newer, more advanced technology.

Summary

3×3 MIMO Wi-Fi 5 access points only offer a slightly higher total throughput in Wi-Fi environments where large numbers of expensive 3-stream end devices are operated. In any other environment, Wi-Fi 6 with 2×2 MIMO is faster. This is evident from the table above, along with the fact that 2×2 and 1×1 clients have a lower data throughput with Wi-Fi 5 than with Wi-Fi 6. Another point in favor of Wi-Fi 6 is that users of the 2.4-GHz band—i.e. the majority of users—do not benefit from the Wi-Fi 5 standard at all. The individual technologies available since the introduction of the Wi-Fi 6 standard underline once again the advantages of going with the newer standard.

Especially if you intend to operate the equipment for several years, plans for a new wireless LAN infrastructure should be based on the latest standard Wi-Fi 6 or Wi-Fi 6E.

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