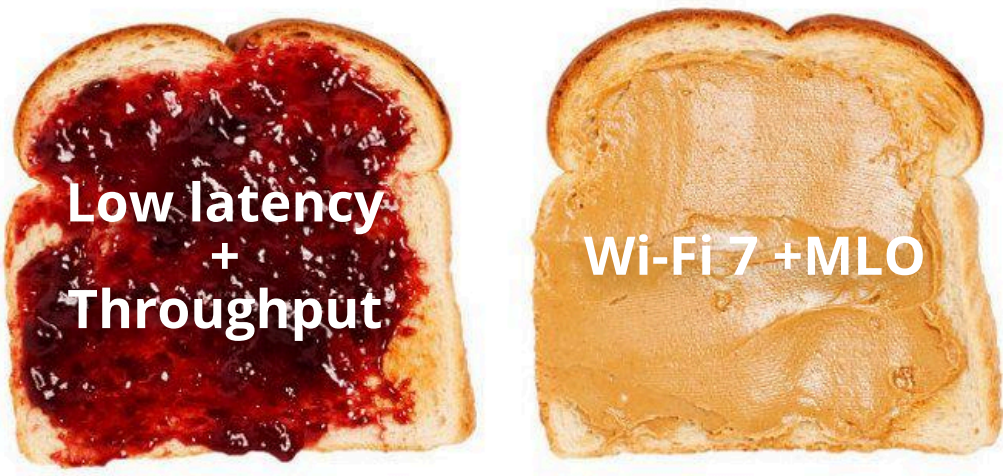


How does Wi-Fi 7 MLO lower latency?

"Measured and Verified: Wi-Fi 7 MLO Latency and Throughput"

EXCENTIS

Table of contents

1 Introduction p.2

2 Wi-Fi MLO ot the rescue! p.2

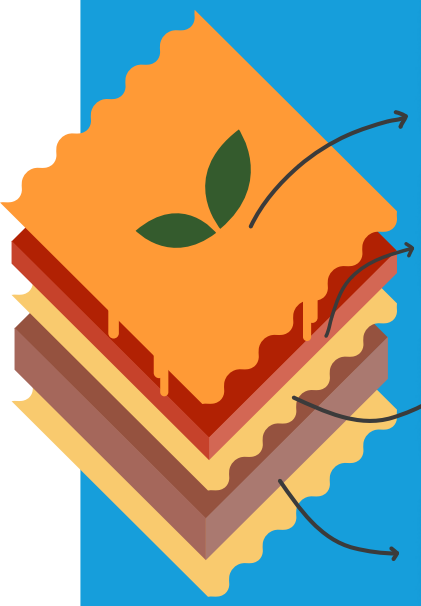
3 Case 1: simple scenario p.3

4 Case 2: two clients at athe same time p.4

5 Conclusion p.6

About EXCENTIS

Our mission is to advance today's networks while paving the way for tomorrow's. This commitment has established us as the go-to knowledge center for All Access Networks. Our proposal is thoughtfully constructed in layers (just like a lasagna) covering testing tools, services and outsourcing.



Outsourcing
Excentis can step in wherever you need us, handling everything from design to engineering, setup, and operations, so you can leverage our expertise and resources as your own.

Services
Providing testing, consultancy, and training for proactive and reactive solutions to address **all access networks** issues.

Testing infrastructure
From lab-controlled precision to real-home Wi-Fi scenarios, we ensure your solutions meet the highest standards before they reach your customers.

Testing tools
Our tools generate traffic for troubleshooting and analysis, pinpoint and resolve issues, ensuring performance, functionality, and stability in labs and real-world scenarios.

Introduction

One of the main things people point to with Wi-Fi 7 is how it delivers lower latency and higher throughput. The feature that really enables this is MLO, or Multi-Link Operation. MLO pairs with high throughput and low latency much like salt and pepper or peanut butter and jelly: **they just go together.**

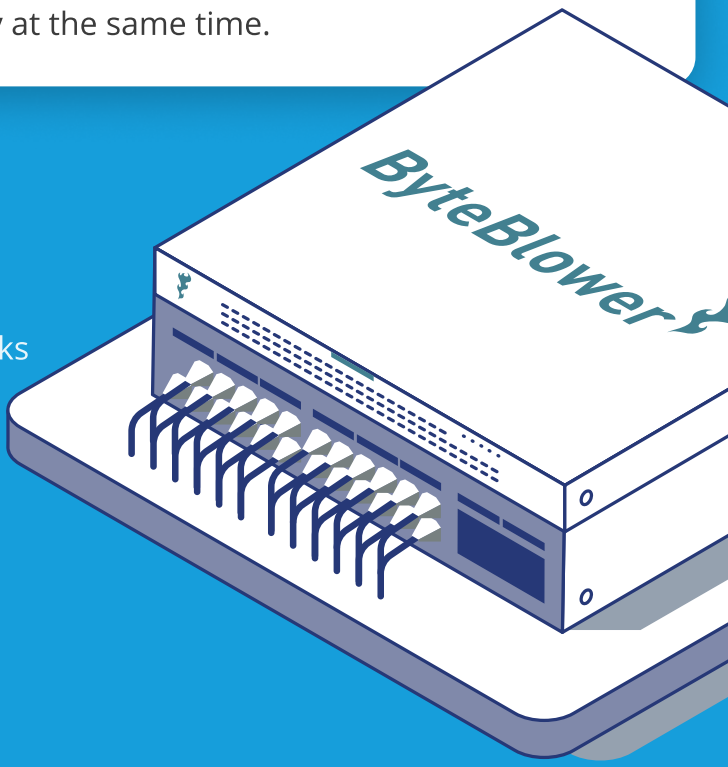
Wi-Fi MLO to the rescue!

One of the key elements of Wi-Fi 7 is MLO: Multi Link Operation. As the name implies the technology enables Wi-Fi 7 devices to use multiple links (e.g. bands) at the same time. It can be compared to channel bonding. In the old days a device was connected to the Access Point (AP) on one link (e.g. on the 2.4 GHz band) and all communication was using this 2.4 GHz channel. Due to changes in the network (e.g. moving closer to the AP) the connection could move to the 5 GHz band. From then on the communication would continue on the 5 GHz band.
With MLO the idea is that the device is connected and can use the two bands at the same time, it doesn't have to switch bands: it can use them effectively at the same time.

ByteBlower

The traffic generator and analyzer for All Access Networks

This test was done with **ByteBlower+Endpoint**, a tool that makes it fast and easy to assess your network's real-world performance, functionality, and stability. Efficient networks reduce maintenance headaches and deliver consistently smooth performance, resulting in happier customers.



Learn more about ByteBlower

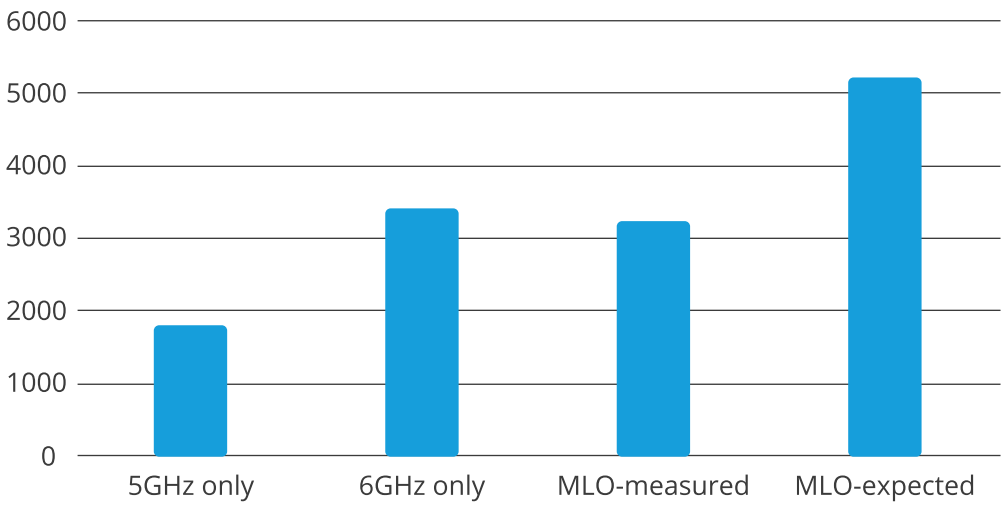
Case 1: simple scenario

To verify the throughput benefits of MLO with Wi-Fi7 we've built a setup in our Wi-Fi testhouse with just a single client. We measure, using ByteBlower, the maximum throughput in 3 cases:

Only using 5 GHz band
Only using 6 GHz band
MLO (connected to both 5 and 6 GHz band)

Since with MLO the device is connected to both bands at the same time the intuitive expected result is that the throughput with MLO is close to the sum of the 5 and 6 GHz band.

The measurement results are shown in the graph below:



The MLO feature didn't lead to higher throughput, it remained roughly the same as using only the 6 GHz band. Why? In practice, "supporting MLO" can mean different things for non-AP (Access Point) devices. In this case, although the client advertises MLO capability, it appears to support only the eMLSR option (enhanced Multi-Link Single Radio). **This means it can transmit or receive data on only one link at a time.** As a result, the maximum achievable throughput is not the combined throughput of the 5 GHz and 6 GHz bands.

Case 2: two clients at the same time

Can MLO provide a benefit when we have two Wi-Fi clients active at the same time?

In this experiment, we focused specifically on latency.

To evaluate the behavior of MLO in Wi-Fi 7, we built a new test setup in our Wi-Fi test house using two access points and two client devices, all supporting Wi-Fi 7. AP2 and Client 2 were placed approximately 7 meters apart, while Client 1 was positioned about 1 meter from AP1. Each access point had a single client associated with it.

For the first scenario (benchmark) we've measured latency with MLO disabled on both APs. Through each device we've measured latency under a load of about 900 Mbps (downlink). The flow on the second link (AP2 to client 2) started 10 seconds after the first one) Our goal was to not saturate the links, as a latency measurements in that case would actually be more like a measurement of the buffersize in the AP.

In scenario 2 we performed exactly the same measurement but with MLO enabled on both APs.

Client 1 (Wi-Fi7) is connected to the Wi-Fi 7 AP at close distance. From an MLO perspective it is connected to both the 5 and 6GHz band.
Client 2 is connected to the 5 and 6 GHz band on AP2 (Wi-Fi 7).

In the first step we sent traffic through Client 1 only, we notice that we achieve a stable throughput of about 900 Mbps.

In step two we also add traffic on the second device, which is also 900 Mbps. By observing the Wi-Fi 7 statistics reported by ByteBlower we noticed that client 1 was actually using the 5 GHz band once the traffic started on the second AP. So MLO did perform a good job!

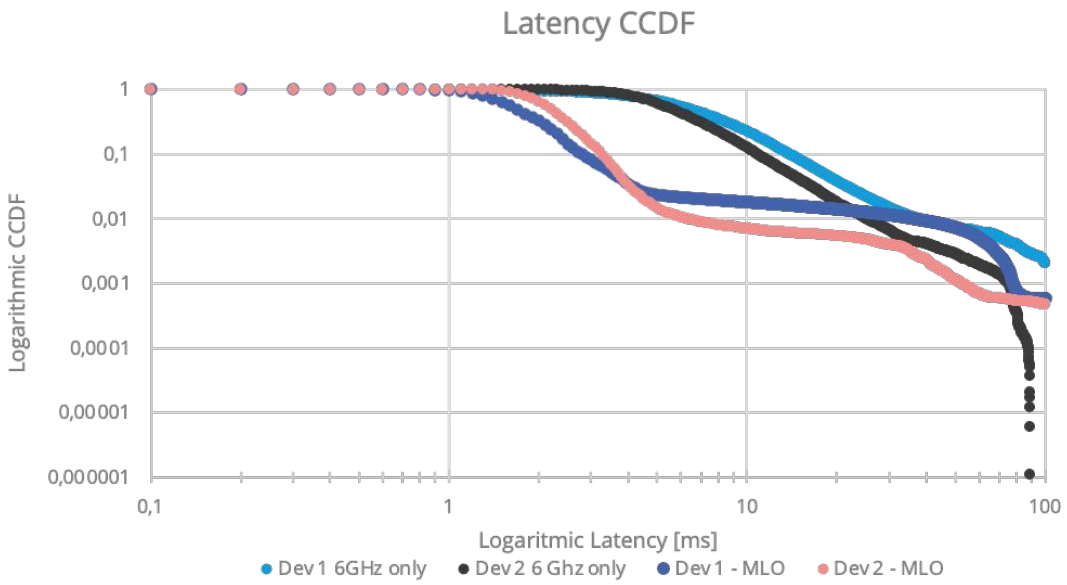
The results for the average latency are shown in the table below:

	Average latency
6GHz-AP1-client 1	8ms
6GHz-AP2-client 2	6,8ms
MLO-AP1-client 1	2,6ms
MLO-AP2-client 2	2,6ms

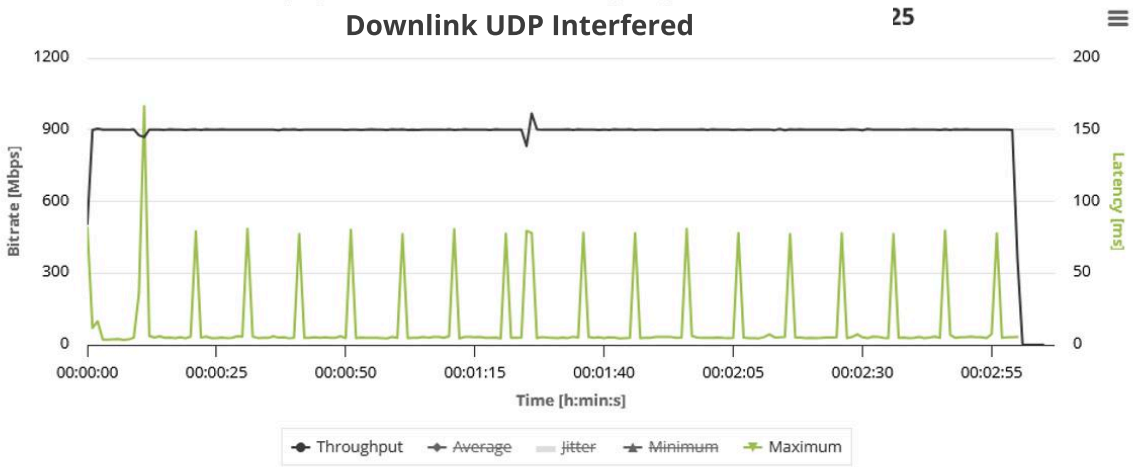
MLO lowered the average latency from about 8 to 2.6 ms for device1 and for device 2 from 6.8 to about 2.6 ms.

If we look at the latency distribution (shown in the graph below), we see that with MLO about 90% percent (0,1 line) of the packets had a latency below 4 ms, while for non-MLO this was slightly above 10ms.

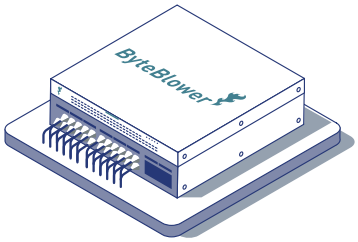
It has to be noted that at 99% percentiles and higher the differences become less and non-MLO even has better performance for device 2.



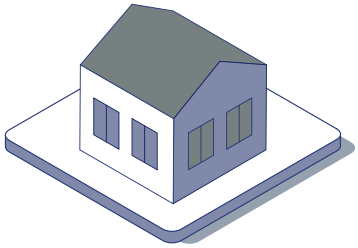
Latency-over-time results from ByteBlower indicate that the flow periodically encounters spikes of significantly higher latency, as illustrated in the graph below.



What can
EXCENTIS
do for you?



+



Test Wi-Fi 7 capabilities in **real world conditions.**

Our analysis shows that **Wi-Fi 7 MLO can significantly reduce latency**, but current implementations still have room for improvement.

The low-latency benefits are not yet delivered consistently, indicating that further optimization is needed to fully unlock MLO's potential.

These insights were only possible thanks to the powerful testing combination of the Excentis Wi-Fi House and the ByteBlower traffic generator and analyzer + Endpoint tool.

The Wi-Fi House is a controlled environment, a building, a real home, using materials such as concrete and wood to simulate everyday challenges.

With ByteBlower Endpoint, we automatically measured how each device performed under realistic conditions, including multi-client traffic and roaming. At Excentis, we're the experts in unlocking the full potential of MLO and Wi-Fi 7.

Ready to elevate your performance? Get in touch with us today and let's make it happen.

Let's talk