

Automotive connectivity and efficiency: Seizing the Wi-Fi 7 opportunity

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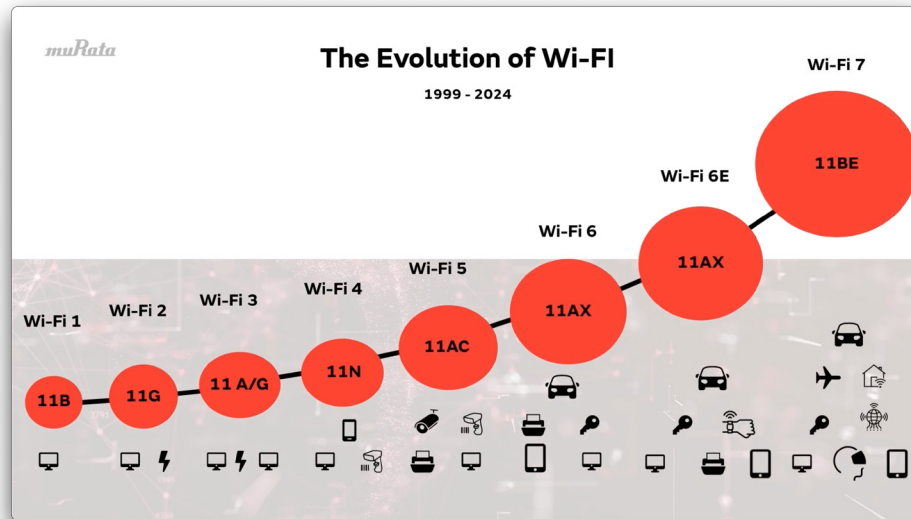


Figure 1: Wi-Fi has come a long way since its first iteration arrived in the late 1990s.
Source: Murata Manufacturing Co. Ltd.

The world has come a long way since the first iteration of wireless network protocols based on the IEEE 802.11 family of standards created what is known as Wi-Fi. In the late 1990s, Wi-Fi was providing 2 megabits per second (Mbps) speeds for basic tasks like email. Over the next quarter-century, Wi-Fi became increasingly capable of handling the simultaneous demands of multiple applications. With a throughput up to 46 gigabits per second (Gbps), Wi-Fi 7 is poised to redefine mobility — delivering not just faster speeds and increased capacity, but technological advancements representing a transformative leap in network performance.

In the automotive world, the dramatic increase in Wi-Fi capabilities over the past several years provides a wide variety of use cases for Wi-Fi 7. Infotainment, originally the primary focus of in-vehicle connectivity, is just the beginning. Over-the-air (OTA) updates, data collection for vehicle diagnostics to enable predictive maintenance, and network connectivity to infrastructure for enhanced safety and efficiency are all supported by the reduced latency, greater stability and increased capacity that Wi-Fi 7 provides.

This translates into a unique opportunity for OEMs and others in the automotive space to stay ahead of the ongoing Wi-Fi evolution, by developing the equipment to best support it and building long-term customer relationships to unlock its highest potential.

Here's a closer look at some of Wi-Fi 7's most important impacts on automotive connectivity and efficiency.

Wi-Fi 7 is uniquely suited to impact automotive connectivity and efficiency, and it is certain to play a pivotal role as vehicles continue their evolution into sophisticated, connected systems.

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Safety: More intelligent cars save more lives

Equipped with high-performance computers that require robust and reliable connections, modern vehicles can be thought of as mobile data centers. As such, they enable the continuing refinement of safety-enhancing technologies like advanced driver-assistance systems (ADAS). Today ADAS is seen largely in the deployment of SAE Level 1 autonomous features like adaptive cruise control, which automatically adjusts vehicle speed to maintain a safe distance from vehicles ahead. ADAS is also evolving into the next stages of automation as OEMs roll out Level 2 features such as highway assist and automated parking. These advancements, along with future innovations aimed at enhancing automation, necessitate larger volumes of data to facilitate rapid decision-making by the vehicle.



Figure 2: SAE Level 2 systems like the Tesla Autopilot, seen here controlling distance from the lead car and centering the vehicle in the lane, need large amounts of data to enable rapid decision-making.

Source: Ian Maddox, CC BY-SA 4.0, via Wikimedia Commons.

With support for up to 16 simultaneous spatial streams (up from 12 in Wi-Fi 6/6E) and a 320 MHz channel width (double that of its predecessor), Wi-Fi 7 is fully equipped to meet the challenge. The standard can meet the high bandwidth demands of ADAS and autonomous driving technologies through real-time data processing and transmission. As vehicle autonomy advances, so too does the need for seamless communication between vehicles and all the outside entities they interact with — sometimes referred to as vehicle-to-everything (V2X) communication. This includes other vehicles (V2V) bicycles (V2B) and pedestrians (V2P). Enhancing vehicle intelligence reduces accidents and improves safety.

User experience: Just like home

As the Wi-Fi Alliance notes in its [fact sheet on Wi-Fi and the connected vehicle](#), today's automotive customers expect their connectivity experience to reflect that of their home or office. This includes the ability to stream music and videos, connect devices to in-car hot spots or cast a smartphone onto the in-dash display. New technologies such as AR/VR will see increase demand as passengers in robotaxis and next-gen automobiles will amplify the consumer necessity for high-speed data.

One of the most headline-worthy technological advancements of Wi-Fi 7 is Multi-Link Operation (MLO), which increases capacity by providing simultaneous data transfer across different frequency bands and channels. While a tri-band router running the Wi-Fi 6E standard can decide whether to use a 2.4 GHz, 5 GHz or 6 GHz band to connect two devices, it can still use only one of these bands on a fixed channel. By contrast, a Wi-Fi 7 router can connect across multiple channels in different bands. In addition to allowing more data to be transferred, MLO can bypass congestion and other interference by switching channels to maintain a stable connection.

For engineers looking to future-proof their device design or network infrastructure, the MLO capability makes Wi-Fi 7 a promising technology. One might imagine a robo-taxi carrying a large group of passengers, each carrying their own competing devices (cellphones, laptops, smartwatches, etc.). Even in dense urban environments, MLO can cut through the clutter to provide an in-vehicle connectivity experience to satisfy the needs of multiple users.

Predictive maintenance: Get a fix

There's an old adage that says "If it ain't broke, don't fix it" — in other words, only expend limited maintenance resources on things that are actually broken. That approach can be thought of as "reactive maintenance," and in the context of the factory floor it carries the unfortunate consequence of disruptions and unplanned downtime. Successful plant managers have learned the value of predictive measures to transcend the limitations of the traditional reactive approach.

Predictive measures can be applied to vehicle maintenance as well. Consumers already may be used to performing preventive maintenance such as oil changes or tire rotations at scheduled mileage intervals, considering the likelihood of failures if such measures are not regularly performed. The predictive approach takes this a step further by performing maintenance tasks only when they are specifically needed. This can be assessed by leveraging wireless devices such as cameras, monitors and sensors to perform real-time data collection on vehicle components. Data can then be sent back to an OEM, which can identify problems and respond with predictive measures. These might take the form of an automated notification that informs the customer when it's time to bring their car in for service. However, a trip to the dealership may

not even be necessary. Considering the growing trend toward software-defined vehicles (SDV), the necessary maintenance may simply involve a software patch. This can be sent as an OTA update via Wi-Fi, saving time and resources for both manufacturers and consumers.

The same dynamic can be applied to install patches that address new cybersecurity threats, update navigation systems with real-time traffic information or even to improve passenger comfort by matching a vehicle's suspension to existing road conditions. In each case, the speed and capacity of Wi-Fi 7 will bolster an OEM's ability to keep updates current. This is a fit for the service model that OEMs are moving toward, in which the customer relationship doesn't end once the vehicle has been purchased, but extends throughout the lifespan of the vehicle. Due to these updates, Wi-Fi 7 has the potential to redefine customer engagement and satisfaction by ensuring that vehicles stay updated with the latest advancements, thereby extending their life cycle and appeal.

Cost savings: Seeing the bigger picture

A successful predictive maintenance strategy and a positive long-term customer-dealer relationship translate to longer vehicle life, which allows customers to realize cost savings. This is true even if the initial hardware expense for Wi-Fi 7 deployment is higher, partly due to its 4K quadrature amplitude modulation (QAM) scheme. Also represented as 4096-QAM, the scheme represents a fourfold leap over its predecessor and requires a strongly improved signal-to-noise ratio (SNR).

For manufacturers, it may be possible to piggyback the development of new devices into existing infotainment systems, saving costs through simplified architecture that takes advantage of the backward compatibility of [Wi-Fi certified](#) products.

It's also valuable to consider the larger picture in which Wi-Fi's advancing technology is unfolding: The near-future vision for connectivity is not about isolated silos, but about whole ecosystems. When cars are pulled into a garage, for instance, they'll communicate with the house to address charging needs and determine load balances. This type of communication will eventually be wireless, it will eliminate the current need to load vehicle electronic control units (ECUs) with copper. This will reduce overall weight and complexity, as well as costs in terms of design, manufacture and field deployment.

Looking ahead

With its high speed, increased capacity, low latency and improved stability, Wi-Fi 7 is uniquely suited to impact automotive connectivity and efficiency, and it is certain to play a pivotal role as vehicles continue their evolution into sophisticated, connected systems. An understanding of its intricacies is critical for manufacturers wishing to maintain a competitive edge, as it will enable them to steer the conversation as they develop compatible products and build long-term customer relationships.

To learn more about Wi-Fi 7 and its impact on the automotive world, turn to resources like [IEEE Spectrum](#) and the Wi-Fi Alliance. Also look to those on the cutting edge of Wi-Fi 7 development, including semiconductor designer [Qualcomm](#) and electronic component innovator [Murata](#).

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