NEXT-GEN NETWORKS

Industrial automation benefits from Wi-Fi 6 and, soon, Industrial 5G

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Next-Gen networks in industrial automation

Today's industrial automation solutions are experiencing a rapid increase in the number of sensors and hand-held devices needed to support the traditional priorities of safety, productivity, monitoring, and control. These sensors and devices are delivering increasing amounts of critical data simultaneously, with a requirement for higher throughput than in the past. The wireless data networks that support industrial automation must manage those diverse, high-speed data sources with greater energy efficiency and tighter cybersecurity than previously available.

With the emergence of the Industrial Internet of Things (IIoT), industrial automation will adopt new, advanced applications, currently moving from concept to design, that present fresh challenges for the wireless networks that support it. In turn, the technical standards that enable those wireless networks are evolving to meet the new requirements. As an old aphorism has it, "Necessity is the mother of invention."

The most fundamental, widely applicable development in next-generation wireless network technologies that support industrial automation is the Wi-Fi 6 standard (IEEE 802.11ax) for wireless local area networks (WLAN) serving the factory floor or industrial campus. This is an evolution from the previous Wi-Fi 5 standard. For more expansive wireless wide area networks (WWAN), the reliance is on mobile telecommunication cellular network technologies such as 2G, 3G and 4G. On the relatively near-term horizon, however, a new WWAN standard known as 5G will be available. If properly designed, integrated, and implemented, these two new technical standards for wireless networks (WiFi 6 and Industrial 5G) will offer significant gains in the industrial goals of safety, productivity, energy efficiency, and cybersecurity, while accommodating future applications still on the drawing board.

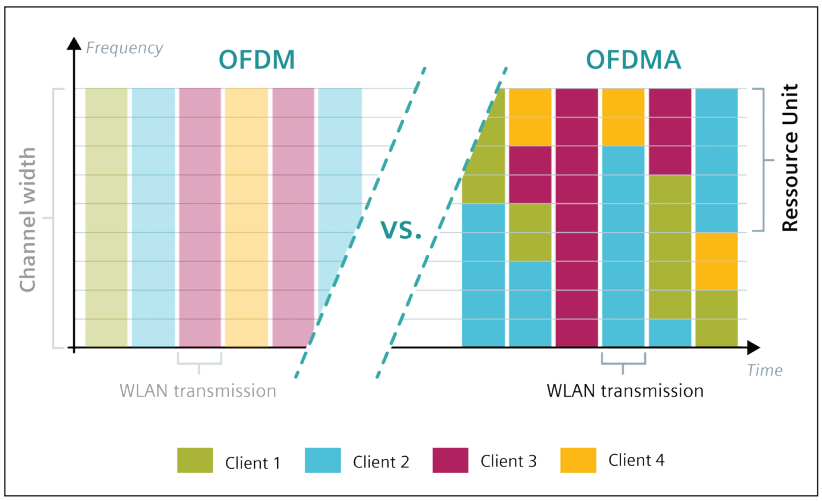
In many cases, the strategies for efficiently and profitably implementing Wi-Fi 6 and, relatively soon, 5G in industrial environments, will require enterprises to collaborate with partners that offer relevant domain expertise. Respected mainstays of the industrial automation industry and the wireless networks that support it are developing purpose-built hardware and software to enhance the value proposition offered by next-gen wireless networks, including future viability.

Wi-Fi 6 is here, now

Wi-Fi 6 is not just a new iteration of an old standard, but an update that offers performance gains in several key existing and new functional areas.

Wi-Fi 6 is the first WLAN standard to achieve the fundamental goal of simultaneously treating every automation sensor, node or portable device and their inputs-outputs as peers of equal importance. To achieve this advancement, Wi-Fi 6 is based on OFDMA (orthogonal frequency-division multiple access), an enhancement of the existing ODFM data transmission technology used in Wi-Fi 5. OFDMA divides the communication channel into up to nine sub-channels that can be distributed among different participants. This allows service to more users in less time, more efficient transmission of

smaller data packets, and improved Quality of Service (QoS) management of high-priority, deterministic traffic.



In the 21st century, the drive for energy efficiency remains paramount for wireless networks because it provides significant operating, financial, and environmental benefits. Wi-Fi 6 employs a new feature known as Target Wake Time (TWT), which reduces network energy consumption by determining when field devices such as sensors need to be polled or accessed. This allows the remote devices to "sleep" when not communicating data, and thus consume less energy. This feature extends the low-power battery life of sensors in an industrial automation scheme, reducing maintenance needs and downtime, while boosting productivity.

Modern day industrial automation operates, by definition, in a networked environment and therefore is vulnerable 24/7 to cyber threats originating from sources such as social engineering, denial of service, ransomware and even disgruntled insiders. Wi-Fi 6 offers Wi-Fi Protected Access 3 (WPA3), the latest iteration of the wireless security protocol developed by the Wi-Fi Alliance. WPA3 is more secure and comprehensive than its predecessor, WPA2, with stronger authentication and cryptographic measures than previously available. Key elements of the new protocol include Management Frame Protection (MFP) and Simultaneous Authentication of Equals (SAE) that work to prevent illegitimate deauthorization of clients, protect against brute-force attacks, and make unwanted decrypting of sessions more difficult.

In summary, Wi-Fi 6 supports dense industrial automation environments that rely on a vast number of sensors and handheld devices that simultaneously require high throughput speeds, high bandwidth and capacity, energy efficiency, and cybersecurity – as well as future viability. This new WLAN standard will benefit various industry verticals that rely on automation, such as food and beverage and automotive manufacturing, oil and gas production, and critical infrastructure such as water/wastewater treatment, and power utilities.

Industrial 5G on the horizon

Media hype currently aimed at 5G rollouts for the consumer market tends to obscure a critical point. That is, consumer 5G and Industrial 5G are two different animals. It is the latter, Industrial 5G, that offers a unique value proposition for industrial automation.

Industrial 5G will gradually roll out over the next year or two. In a word, Industrial 5G is still nascent. This timeframe gives enterprises time to assess their future automation needs, determine the wireless network technologies that best fit their requirements, and develop a network migration roadmap that integrates Wi-Fi 6 and Industrial 5G networks. Many if not most enterprises will accomplish these tasks by collaborating with a trusted advisor who has a heritage in industrial automation and the wireless networks that support it.

So, what are the critical distinctions between the standards driving consumer 5G and the standards that enable Industrial 5G?

Consumer 5G services being rolled out by major telecom players are currently based on Release 15

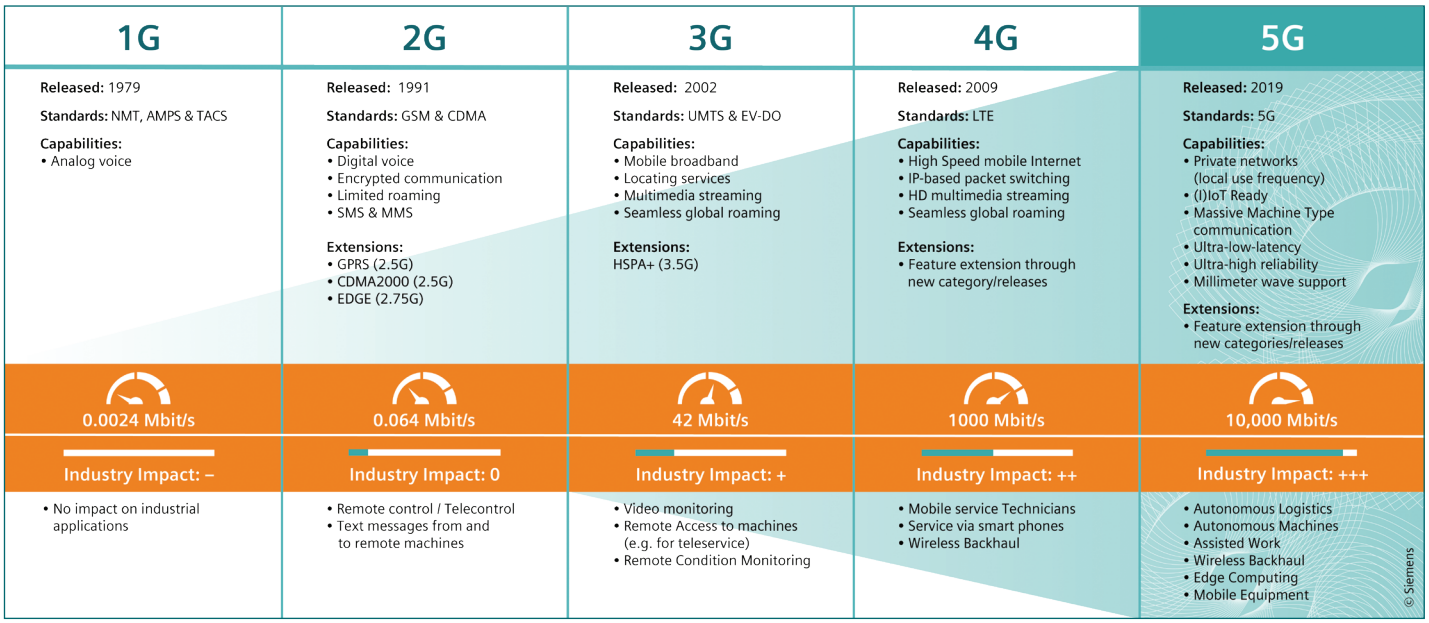
(R15) of the wireless standard generated by the 3GPP (3rd Generation Partnership Project), a consortium of mobile telecom standards organizations. In contrast, advanced functionalities that meet industrial-grade requirements – including lower latency and higher reliability – are features of Release 16 (R16) and Release 17 (R17) of the 5G cellular standard. The adoption of R16 and R17 in support of industrial automation applications will create Industrial 5G.

When Industrial 5G is rolled out, users will benefit from fundamental advancements in data speeds, latency, and network capacity. Faster data speeds – 10x to 20x faster than 4G – will be based on an approach known as enhanced Mobile Broadband (eMBB). The highest reliability of network traffic with the lowest guaranteed latencies below 10 milliseconds (ms) will be achieved through a technology known as Ultra-Reliable Low-Latency Communication (URRLC). Up to 1 million sensors and devices can be connected per square kilometer based on the use of Massive Machine-Type Communication (mMTC). These advanced features all add up to improved application performance and higher reliability on the factory floor or industrial campus.

Industrial 5G-enabled networks will be built out gradually over years to come. Over time, various suppliers of the industrial automation ecosystem will develop applications capable of taking advantage of Industrial 5G's attractive performance enhancements. But it is important for C-suite executives and technical managers to begin planning now to benefit from Industrial 5G in the future. Adoption will require addressing certain complexities. For example, the aforementioned advancements in speed, latency and capacity cannot be realized simultaneously. Applications requiring the very highest data speeds will not attain the lowest possible latency. Conversely, applications requiring the lowest latency will not attain the highest data speeds or allow the highest number of simultaneous users. That means that industrial automation enterprises must carefully define the requirements of their various applications to create a viable strategy for implementing Wi-Fi 6 and Industrial 5G.

Wireless spectrum provides options

The key to the success of a wireless network is spectrum access. This is where CBRS – Citizens Broadband Radio Service – may come into play.



The evolution of 5G

CBRS offers a new cellular deployment model that enables the use of both licensed and unlicensed frequencies. It combines attributes of Wi-Fi (in-building coverage) and cellular (outdoor coverage with higher data speeds, network capacity and signal range). CBRS also offers improved cybersecurity relative to both Wi-Fi and cellular traffic because it enables an exclusive, (non-shared) private network.

CBRS makes available 150-megahertz (MHz) of spectrum in the 3.5 gigahertz (GHz) band, a frequency range that boosts coverage and capacity. Combined with unlicensed spectrum in the 2.4 and 5 GHz bands currently in use, as well as the 6 GHz band becoming available for use in the United States, CBRS can provide ample opportunities to deploy wireless networks tailored to specific industrial requirements. A trusted advisor on industrial automation and the wireless networks that support it should also be able to provide expert guidance on industrial application requirements and spectrum use.

Siemens leadership in wireless networking

Since first releasing a Wi-Fi device in 2004, Siemens has earned its globally recognized reputation for excellence in designing and implementing industrial automation schemes and the wireless networks that support them.

Siemens' long-term goal for Wi-Fi 6 deployment in support of industrial automation has focused on how to leverage increased data throughput per device, greater network capacity, and improved network efficiency to deliver client value. Our clients benefit from faster, more granular, more secure monitoring and control schemes, especially as devices and sensors proliferate under the IIoT.

To accomplish this goal and realize these benefits for its clients, Siemens has developed a complementary suite of functionalities enabled by Siemens' iFeatures. Only with highly reliable, purpose-built hardware and software developed especially for applications in the often-harsh industrial environment, can clients exploit the full potential of Wi-Fi 6. Siemens' iFeatures, applied in tandem with Wi-Fi 6, can future-proof a client's investment in next-gen wireless networks in support of industrial automation.

Additional device-specific improvements like Digital I/O in combination with Sleep Mode, for example, improve the efficiency of battery-powered applications like automated guided vehicles (AGVs) and mobile end devices. In this approach, a higher-performing Industrial WLAN enables new applications, such as augmented reality for assisted work, as well as robotics, remote-controlled equipment, autonomous intralogistics, and more. ("Intralogistics" refers to managing, monitoring, and optimizing materials and data within a single facility.)

Siemens: a trusted advisor for Industrial 5G

The smart factories of the future will require additional new applications such as mobile robots in production, autonomous vehicles in transportation and logistics, and augmented reality applications for service and maintenance technicians. The unprecedented reliability, extremely low latencies, and comprehensive IIoT connectivity being engineered into Industrial 5G and Industrial WLAN based on Wi-Fi 6 are expected to accommodate these and other pioneering industrial applications. Specifically, Siemens expects that Industrial 5G will enable a bright future for factory automation, process automation, human-machine interfaces, logistics and warehousing and maintenance.

Through its membership in 3GPP, Siemens has been actively involved in the development, implementation and future deployments of the R16 and R17 releases of Industrial 5G as we independently develop long-term, sustainable, wireless network solutions for industrial automation applications.

In Siemens' private, standalone Industrial 5G test network at the Nuremberg Test Center in Germany, we are developing communication solutions and applications in an actual industrial environment. Siemens' goal is to develop a holistic Industrial 5G ecosystem for automation environments applicable to the entire portfolio of industry verticals. In fact, Siemens has already developed two SCALANCE Industrial 5G routers (model MUM856-1 & MUM853-1) that will operate today on 4G networks and tomorrow on 5G networks as they are built out.

As a founding member of the 5G Alliance for Connected Industries and Automation (5GACIA), Siemens is collaborating with other organizations in the information and communication technology (ICT) field to steer the future of the automation and manufacturing industries.

Integrating Wi-Fi 6 and 5G

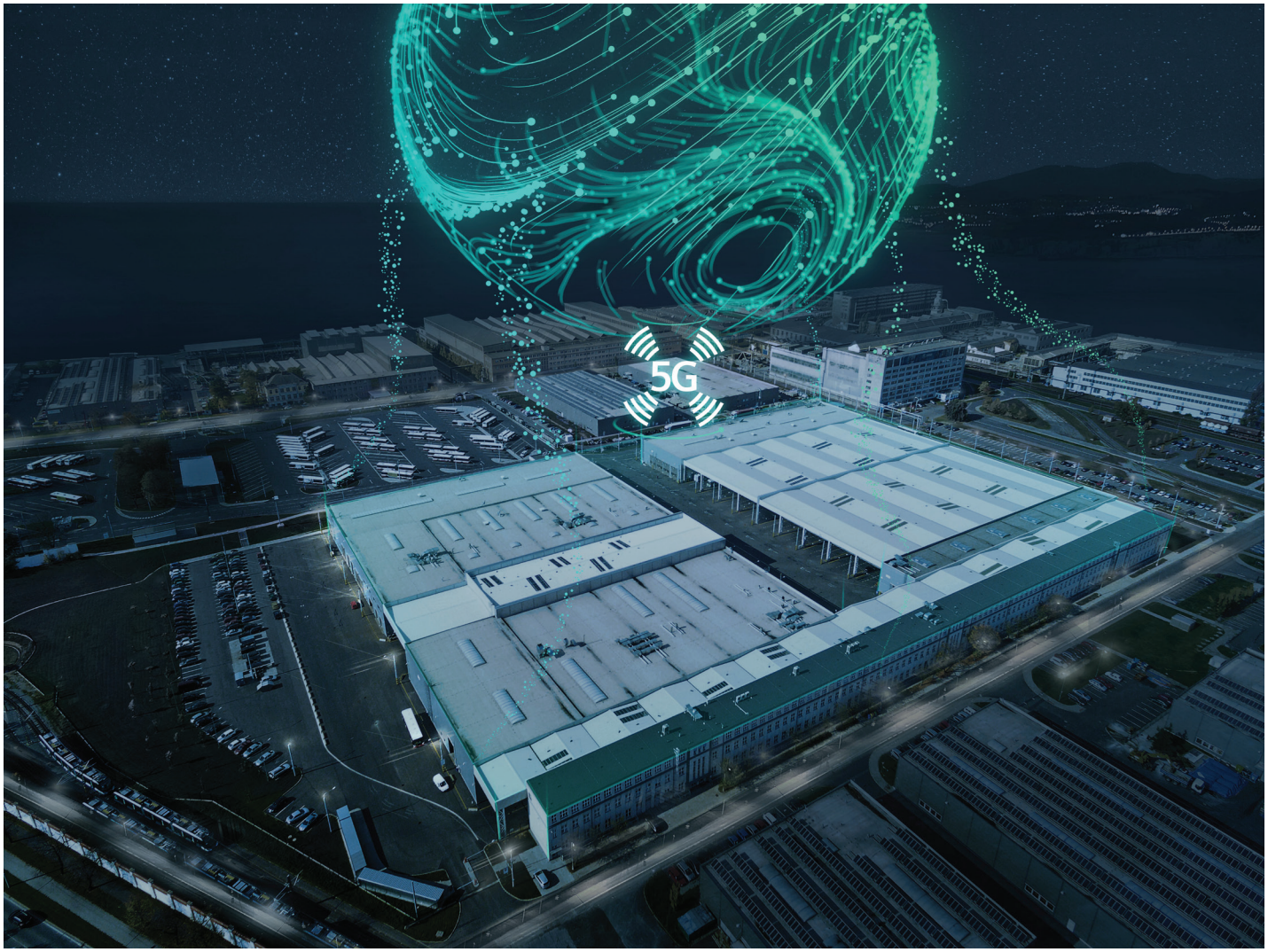
Wi-Fi 6 and Industrial 5G share some common goals – faster data speeds, increased bandwidth, and low latency – and it is tempting to view them as competing options. However, these two technologies also possess distinct differences that will enable a complementary mix-and-match approach benefitting industrial automation.

The most obvious difference is that Industrial 5G is a cellular technology, typically operated by private carriers on licensed spectrum, while Wi-Fi 6 is a WLAN technology that operates solely on unlicensed spectrum. (Industrial 5G will also operate on unlicensed spectrum, enabling private 5G networks.) The two technologies also differ in how they approach user authentication and network security. Most importantly, their use cases differ and therefore, this makes them potentially compatible, depending on the client's requirements.

How might they work together? Wi-Fi 6 will extend the traditional Wi-Fi advantage of providing localized, wireless connectivity and it is primarily an access technology that requires backhaul. Industrial 5G is more applicable to wide area connectivity or to a fixed wireless access point and it excels at data backhaul. An Industrial 5G umbrella network could support backhaul and cloud access to an industrial campus which runs numerous Wi-Fi 6 access points. Individuals using mobile handheld devices could move seamlessly between Wi-Fi 6 networks tied together by Industrial 5G.

Thus, mixing and matching Industrial 5G and Wi-Fi 6 will depend on how best to meet a client's requirements in a rational, flexible manner. The potential capital investment (Capex) and operations and maintenance (O&M) costs will be critical factors to consider.

We can illustrate these points with three use cases. Consider a brownfield automotive or food and beverage manufacturing campus in which each separate facility provides Wi-Fi 6 for wireless connectivity for autonomous production and processes and mobile workers within four walls. A public or private Industrial 5G network covers the entire campus, tying together the separate Wi-Fi 6 networks and backhauling all resulting data to a single monitoring and control facility. In the case of a power grid, with geographically dispersed substations, Wi-Fi 6 would provide a WLAN within each substation, while Industrial 5G would tie them together for inter-substation communication as well as data backhaul. In an intelligent transportation system, autonomous vehicles or trains might employ Wi-Fi 6 onboard, while Industrial 5G handles inter-vehicle communication and data backhaul for every node.



Let's talk

Anticipating your future requirements – given ongoing changes in automation technology and the marketplace itself – can be challenging. While Wi-Fi 6 is available today, Industrial 5G continues to evolve. Collaborating with a trusted advisor can bring your evolving requirements into sharper focus.

Siemens Professional Services can help clients understand how these emerging standards and network technologies, along with Siemens' complementary offerings, can support a client's applications, productivity and competitiveness. A trusted advisor can significantly enhance the operational performance of Wi-Fi 6 and Industrial 5G implementations for the industrial automation environment.

Get in touch and let's talk about how we can help you navigate the future.
Email us at siemensci.us@siemens.com and reference "Industrial 5G" or "Wi-Fi 6" in the subject line.

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