Enterprise Wireless Architectures in 2021

How Significant Wireless Technologies All Play Significant Roles

Wi-Fi 6, 5G, CBRS – These are the topics at the forefront of any wireless discussion today. Experts throughout the networking world are trying to determine whether or not these wireless technologies are competitors or collaborative technologies.

In the field of wireless networking, there is a constant drumbeat about newer, faster, better wireless technologies. These currently include Wi-Fi 6, Wi-Fi 6E, 5G, CBRS (Private-LTE), LoRaWAN, and a plethora of IoT-focused technologies, all backed up with reams of documentation and test results demonstrating their value over their peers. Instead of providing guidance and assistance to navigate the wireless waters, this chatter has created more confusion than clarity. In many cases, the differentiation/advantages of one technology over others are subjective and, at worst demonstratable only via expensive testing equipment and not something the average user experiences. No matter how significant the current discussion around these technologies, the evolutionary process will never end. In fact, a quick search online will result in thousands of links to next-generation Wi-Fi 7 (802.11be), 6G cellular, 7G, and beyond.

What does need to be addressed in detail are the claims that one, and only one, technology will rule the wireless world. The public posturing of 5G and its ability to replace Wi-Fi has been met with a fair amount of scrutiny. The reality is, Wi-Fi and Cellular technologies continue to evolve almost in parallel to each other in the form of Wi-Fi 6 and 5G, both of which share a number of advanced features[1]. But to paint a clearer picture of where and how each technology will fit in the coming months and years, we should begin with a quick look into the technologies in question.

[1]Wi-Fi, Public 5G or Private Network: What's an Enterprise to Do; Catherine Sbeglia, RCR Wireless News

Key Terms to Know:

- **Private LTE or P-LTE (Long Term Evolution)**
  A particular type of 4G and 5G cellular network that delivers the fastest mobile internet experience. Private LTE is a localized version of that cellular network that functions independently of cellular service providers to support an organization's connectivity. A Private LTE network leverages localized micro towers, small cells, edge routers, and other infrastructure on-site—conceptually like Wi-Fi access points— to provide coverage and connectivity. It functions much like a scaled-down version of a public cellular network but with less congestion and more cost-effectiveness—even in areas where public LTE infrastructure doesn't exist. Private LTE can be a licensed, unlicensed, or a shared spectrum solution.
  (Sources: Network World; Cradlepoint)

- **CBRS – Citizen Broadband Radio Service**
  CBRS is the most common example of Private LTE radio interface, which is based on shared spectrum and is typically owned but not often licensed or used. It's not a competitor to 5G, as CBRS is expected to become a Radio Area Network (RAN) for 5G services. It refers to 150 MHz of spectrum in the 3.5 GHz band (3550 MHz to 3700 MHz). While it requires a Spectrum Allocation Service (SAS) to avoid interference, CBRS is essentially an indoor, small cell operation on a shared license spectrum, geared to support voice, text, and data communication.
  (Sources: Extreme Networks; Cradlepoint)

- **5G**
  5G is the fifth-generation technology standard for broadband cellular networks that are meant to provide 50x more speed, 10x less latency, and 1000x more capacity than its 4G LTE predecessor. At the technological level, it's made up of two parts: the Radio Access Network (RAN) and the core network. 5G's key business value is to deliver highly reliable communications to support multiple, simultaneous mission-critical applications.
  As far as 5G is concerned, no other technology offers as much mobility and reach as cellular technology. It's available in homes, businesses, cars, or simply walking down the street. Cellular technology is almost always there, and with additional advancements offered by 5th generation technology, its value will extend beyond basic connectivity.
  (Sources: Intel; RCR Wireless News)

- **Wi-Fi, Wi-Fi 6, Wi-Fi 6E**
  As Wi-Fi continues to evolve, upgrades in the past have always been about speed. The latest Wi-Fi 6 (802.11ax) evolution brings us considerable improvements in efficiency over previous versions, delivering 4x higher capacity and 75% lower latency with triple the speed of Wi-Fi 5. And now, as Wi-Fi 6E is officially on the horizon, so is its ability for Wi-Fi to leverage 1,200 MHz of new frequency space within the 6 GHz band for unlicensed Wi-Fi operation. This means more bandwidth, enhanced performance, and the elimination of slower technology devices, combining to offer an improved and effortless user experience the average user can appreciate.

- **Cloudification**
  The term cloudification refers to the conversion and/or migration of data and application programs to make use of cloud computing. In terms of wireless technologies, the core networks that are the backbone for all Internet connectivity are currently going through a cloudification transformation as the use of data center technologies are extended from the cloud into the network. This is allowing not only support for the growing volumes of data and billions of connected devices but drives the necessity for the cloud to be the key management technology to support Wi-Fi, P-LTE, or more hybrid wireless designs within the enterprise. As digital transformation continues to sweep across every industry and sector, so does the demand for agility, speed, and efficiency.
  (Sources: Extreme Networks; Intel)

Different Job, Different Tool – Finding the Business Use Case

You wouldn't be reading this without already understanding that many types of wireless communications exist. Advancements across the board will change the way networks are built, and IT services are delivered. But no matter how amazing, or powerful, or innovative a solution is deemed to be, its true strength lies in its usage.

That being said, among the wireless technology players, it is commonly accepted that Wi-Fi is a given; it remains the dominant method of connecting PCs, tablets, phones, and most other devices within the enterprise. As Claus Hetting of Wi-Fi NOW stated so well, "it is the Swiss Army knife of wireless communication, able to support almost any type of device, deployment, market, or use case." With a lower cost to deploy, scale and manage, Wi- Fi will continue to be the predominant networking technology for home, business, and enterprise environments, where support for data-hungry devices must all connect to the network. For example, bandwidth-intensive activities like an E-Sports tournament or a lesson plan that involves robotics technology – both situations require significant bandwidth, highly reliable infrastructure, and low latency. Because Wi-Fi uses high frequencies, it's a faster and more reliable option for tasks such as streaming video or uploading data and big files. This is why leading schools like SUNY Canton and McMinn County Schools choose Wi-Fi to power their programs.

Beyond bandwidth, Wi-Fi offers greater analytics and security capabilities than 5G. For most businesses, Wi-Fi is often the customer's first touchpoint with your brand. Whether you're a grocery store or a hospital, one of the most significant advantages of providing connectivity through your own Wi-Fi is the ability to gain real-time network and application insights. For example, a retailer can analyze and use its Wi-Fi data to engage with shoppers related to their location in the store, enable contextual and personalized marketing, and analyze customer and staff behavior to optimize offerings and services.

Additionally, Wi-Fi offers security benefits like WPA3, which is standard with Wi-Fi 6, that bring enhanced capabilities to protect networks and safeguard data. With Wi-Fi, the customer controls and owns all their own data, unlike LTE with data moving throughout another party's network. With Wi-Fi, you manage your data and the analytics your data can provide.

It's also important to note that Wi-Fi is the default wireless technology in almost any enterprise device, most of which will not be converting to cellular or other technologies anytime soon. That's not to say devices cannot or will not eventually support multiple types of technologies. Still, it is extremely unlikely that any new wireless technology could come along in the foreseeable future to displace device dependency on Wi-Fi. From an IT administrator's perspective, ripping and replacing perfect working equipment to move to newer technology, and taking on the cost and burden to do so, isn't plausible. Wi-Fi is engrained in our culture — until there is a viable business use case to justify the undertaking, people will not walk away from Wi-Fi to embrace a new technology. Wi-Fi will remain essential.

Yet, there are certain applications where 5G offers strong advantages over Wi-Fi. As Catherine Sbeglia writes in her editorial report for RCR Wireless News titled Wi-Fi, Public 5G or Private Network: What's an Enterprise to Do, "When used inside of an enterprises facility, 5G cellular technology, which was architected to support high data rates and the low latency necessary for IoT applications, can be an extremely reliable and secure solution to connect critical assets if it is deployed and managed correctly." Private 5G LTE provides benefits ranging from fixed-costs and enhanced data security to improved network performance, making it a viable wide-area LAN option for a variety of deployments. As Cradlepoint demonstrates, at manufacturing sites, 5G can provide the capability to select the spectrum model that is ideal for the scenario, so robotic

devices are guaranteed interference-free connectivity and coverage. Or in warehouses and distribution centers, it's a cost-effective and secure way for organizations to improve operations. Enterprises are using fixed-cost Private LTE to support traffic from hundreds of video cameras to keep footage data on-site, instead of incurring huge data charges with a public cellular pay-per-bit plan. 5G will also play an important role in powering forward-looking experiences, such as remote surgery, drones, and VR. Additionally, self-driving cars and smart cities will depend on the speed, throughput, and coverage density that 5G technology provides.

When looking at 5G, a study by McKinsey and Company found that "the biggest uncertainties for industry professionals lie around the strength of the business cases and the underlying economics, as well as other emerging commercial considerations." The study goes on to find that while "confidence in the technology is high, what's less clear is whether and how soon it can fuel new products and services that customers are willing to pay for." It's been known that the most prevalent potential applications for 5G circle around enhanced mobile broadband and IoT, rather than fixed wireless access or mission-critical applications. While these are not the "revolutionary use cases lauded by 5G proponents, they provide advancements that are still meaningful."

It is no doubt that 5G is a powerful technology, but there seems to be a lack of information on the actual value of 5G. It's a technology waiting to be tapped for innovative new use cases, and as the study suggests, this alone could possibly delay real full-scale deployments. Much like in the early 2000's when 3G was making its rollout debut, it wasn't until the emergence of Blackberry and Apple iPhones years after the launch of 3G were full network capabilities realized.
(Source: McKinsey and Company)

Until those use cases emerge for 5G, it will be difficult to justify the expense(s) that come along with ushering in this new technology beyond more short-term usage. In addition to expenses related to 5G device adoption, costs associated with leveraging new spectrum acquisition, necessary upgrades to the core network, and other spectrum-related costs will slow down the technology's acceleration until a clearer view of use cases is recognized. It will also be vital not to underestimate the challenge of deploying new wireless technology. 5G will require an additional wireless infrastructure to install, manage, secure, etc. – not something any administrator wants to carry out without the economics to support it.

5G's shortcoming is a significant lack of services and devices beyond smartphones, such as laptops and tablets. Additionally, trying to use 5G as a replacement for enterprise Wi-Fi would result in data traffic transiting the carrier network even if the destination is a local server, which is not an optimal solution.

The Complementary Path Forward

Finally, most importantly and most often, there are use cases where Wi-Fi 6 and 5G will work together. Public venues, such as stadiums or malls, are prime examples of where users will leverage a combination of these technologies and will expect zero disruption as they toggle between the two. Fans en-route to a football game might use cellular in their car for GPS directions and then automatically connect to the stadium's Wi-Fi to pull up their e-tickets at the gate. During half-time, they would likely use Wi-Fi to stream video highlights while leveraging cellular for calling. Additionally, these technologies will complement one another when it comes to backhaul and offloading. Carriers will likely start to take advantage of new Wi-Fi 6 access points to handle offload in 5G networks, just as they rely on Wi-Fi to offload 4G and LTE services today. Carriers are facing a similar decision around backhaul. Though fiber is currently the dominant option, many now are considering wireless as a viable alternative.

Wi-Fi, 5G, and CBRS each have individual value propositions and advantages unique to their technology and capabilities that cannot be 100% emulated by alternatives. However, in some cases, another technology can offer a reasonably acceptable level of service, allowing it to support all use cases. In the future, the enterprise might leverage all three technologies to design a single wireless infrastructure.

In terms of when to adopt these technologies, 5G is being deployed in specific markets, but as the headlines attest, it has a long way to go. For enterprises, it's best to wait a few years for the technology to mature and scale. But for Wi-Fi 6, it's available and ready to use now. In fact, we're already seeing major league sports teams like the Houston Dynamo and college campuses such as West Texas A&M deploy Wi-Fi 6 to build excellent, reliable, secure customer experiences.

Progress > Replacement

There is too much focus in our industry on replacement. It likely stems from both vendor competitiveness and the insatiable appetite for innovation that underpins and informs our field. However, the goal post shouldn't be technology replacement, but rather iteration and progress. Statements such as "5G will replace Wi-Fi" or "Say goodbye to the data center" are attractive headlines, but they are neither realistic nor accurate. Not to mention, a rip and replace mentality is immensely costly, and likely infeasible for most organizations. As Neil Anderson states, "Both (Wi-Fi 6 and 5G) have been built with the benefit of hindsight—a history of what worked well, what didn't and how to brace for the next wave of demand from users.

Despite their parallel worlds and user bases, 5G and Wi-Fi 6 have much in common and have experienced similar challenges as they push the envelope of what is possible." We need to have more honest, productive, and nuanced conversations about how old, new, and upcoming technologies will work in tandem and can best be leveraged to meet customers' increasingly high standards. The conversation around Wi-Fi 6 and 5G would be an excellent place to start.

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