May 2022

HOT TOPIC ALERT

5G/Emerging Technology

Introduction

Slow and unreliable internet connections have long been a source of frustration for consumers. Many became even more acutely aware of the limits of their existing services while working away from their regular places of business during the COVID-19 pandemic. Frozen Zoom screens, large files that seemed to take forever to download, or websites that could not be reached at all due to system overload were all-too-common experiences that triggered irritation around the world.

At the same time, many likely came across references to the somewhat mysterious sounding “5G” and its many promises, with a vague understanding of what it actually is. Yet according to the GSM Association (GSMA), a mobile industry organization, by the end of 2025, more than two in five people across the globe will live within reach of a 5G network.

What is 5G?

5G refers to the “fifth-generation” of mobile networks. Like more recent versions, such as the currently prevalent 4G, 5G is a cellular network that consists of individual cell sites that transmit data among each other using radio waves. The underlying infrastructure 5G relies on is similar to that used by 4G, and involves a combination of towers, sensors, and fiber-optic cables. But 5G entails new elements, as well.

High, mid, low bands

The term “5G” is actually a short-hand term for rather diverse types of networks. Specifically, 5G networks can be split into three main “levels;” namely, low-band, mid-band, and high-band (also referred to as “millimeter-wave” 5G). These levels rely on different parts of the electromagnetic spectrum: low-band 5G uses frequencies below 1 GHz, mid-band uses frequencies between 1 and 6 GHz, and high-band 5G uses frequencies at or above 24 GHz. The distinction between the three is an important one. Higher frequencies involve signals with shorter wavelengths. These signals can carry data at much higher speeds than those with longer wavelengths. The catch is that these higher frequency signals can travel only short distances. In addition, various obstacles, such as a building or even a tree, can block the shortest signals. This means that the three levels of 5G involve varying trade-offs between speed and range. In essence, the faster and better the service, the shorter its range.

Most of the talk surrounding 5G is based on the potential future uses of high-band 5G. Given its ability to access short-range radio signals, it truly holds revolutionary potential. The benefits of 5G are most pronounced with high-band 5G. As a result, these types of networks are expected to spur a wide range of sophisticated applications, ranging from remote surgery to greater automation in industrial settings and other emerging technologies.

However, high-band 5G cannot simply use the existing infrastructure of towers and antennas. Instead, its roll-out will require a dense network of small cell stations to provide seamless connections. Some of these stations are the size of a pizza box, while others are more like the size of a freezer. The stations can be put on various structures, including streetlights, utility poles and buildings. Installing those stations is, however, difficult and expensive. Some providers are strongly committed to pursuing this course. For now, this type of infrastructure is currently only available in select locations in certain cities or, with some carriers, only at very specific sites, such as on college campuses.

Mid-band 5G has a much broader geographic reach than high-band 5G. It is also significantly faster than 4G, and so too represents a large leap forward. The major U.S.-based carriers involved in developing 5G networks – T-Mobile (which merged with Sprint in 2020), AT&T, and Verizon – have carved out various niches within the three 5G ranges. All are currently especially active in pushing mid-band 5G, and access to mid-band 5G services is expected to rise noticeably throughout the U.S. by the end of 2022.

Meanwhile, low-band 5G has been around since 2019 and is built mostly on existing 4G infrastructure. Low-band 5G is faster than 4G, but not hugely so.

Benefits of 5G

5G is fast – really fast. Exact speeds achieved depend on whether the user is using high-band, mid-band or low-band 5G. Speeds also vary based on the context, such as where the user is located and what specific device and network is being used. Some estimates indicate that low-band 5G is about 20% faster than 4G, and that high-band 5G may one day be more than 500 times faster than current connections.

The 3rd Generation Partnership Project (3GPP), a global telecommunications-standard development organization, produces relevant specifications for what constitutes 5G. According to the 3GPP definition, a network officially qualifies as 5G if it supports speeds of at least 20 gigabits (or 2.5 gigabytes) per second for downloads, and 10 Gbps (or 1.25 gigabytes) per second for uploads. This is between 10 to 100 times faster than 4G. This kind of speed doesn’t just mean very short times for downloading data. Such speed will also help unlock the potential of a wide range of applications, especially those that rely on real-time data processing.

In addition, 5G entails much lower “latency.” Latency refers to the time that elapses between giving a device an order to do something, and the action taking place. In essence, it is the amount of delay involved in getting the system to do something. 5G promises more immediate responsiveness. Specifically, depending on the context, the technical specifications set by the 3GPP aim for latency of 1 to 4 milliseconds for 5G (a millisecond is 1/1000 of a second). This is drastically less latency than for 4G, which involves latency of

around 50 to 200 milliseconds. It is also faster than the time (about 10 milliseconds) it takes for a person's brain to process an image seen by their eyes.

Moreover, 5G allows significantly more devices to be connected to the network. Officially, according to the 3GPP, a 5G network must be able to connect 1 million or more devices for every square kilometer (less than half of a square mile). This means that 5G can support many more devices than there are people, even in the densest of cities. Allowing more connectivity is necessary because 5G will connect mobile phones or other devices that people are able to carry and also allow the connection of other personal devices and elements that rely on connectivity that are permanent fixtures in neighborhoods. The range of technology in people's lives continues to expand...from wearable tech like smartwatches and sensors for medical devices to other emerging technology taking up more permanent residence in homes in the form of "smart" appliances, lights, and even the cars in driveways.

A significant aspect of 5G is that, instead of relying on hardware to perform certain network functions, such as routing signals, it relies on software and the "The "cloud" refers to software and databases that use servers located in globally dispersed data centers. Users access these via the internet rather than having their own physical servers or having copies of the software applications on their own physical devices. As a result, "network slicing," or creating "subnets" that tailor connectivity to specific needs becomes possible. Technically, there will be a number of different virtual networks that exist in parallel and rely on the same physical infrastructure. The advantage to subnets is that these network "slices" can have varying properties, providing enough connectivity to meet specific users' needs without providing connectivity levels for which they have no use. This is both more efficient and can, for example, improve responsiveness in emergencies by prioritizing certain uses so network overloads do not slow down responses.

Moreover, 5G networks can be portable or mobile. They can be installed and configured in specific locations and provide the speed and latency required for specific purposes and limited durations at a chosen site. They can also be installed in modes of transportation such as vehicles. This means the benefits of a 5G connection are not limited to a person's home or office.

Use Cases

The potential uses of 5G are arguably limitless. It will take time to see which uses truly come to life and stay for the long term. As analysts note, with every new generation of technology, it typically takes a decade to see whether predicted uses predominate, or whether innovation takes completely unexpected turns. In that sense, building up 5G networks requires a certain leap of faith. As noted so famously in film, "if you build it, they will come".

Use cases help make these seemingly endless possibilities more tangible. The International Telecommunication Union (ITU), the United Nations' agency for information and communication technologies, has grouped potential uses of 5G into three different categories, which partly overlap. These are: enhanced mobile broadband (eMBB), also referred to as extreme mobile broadband; ultra-reliable low latency communications (URLLC); and massive machine type communications (mMTC), also known as massive machine communication or massive Machine to Machine communication.

eMBB refers to a broad range of every-day uses of mobile connectivity that are data- and bandwidth-driven, requiring high data rates. eMBB includes uses for entertainment, communication, and navigation purposes. The higher capacity delivered by 5G will result in an overall quicker and more seamless internet experience. Connectivity will both be more consistent and available to consumers in a broader range of settings, including at public venues and while traveling. This will spur upgrades of existing applications and result in completely new ones. An example would be more interactive and immersive user experiences at "hot spots" such as at sports events, with new applications making it possible for stadium spectators to view instant, high-definition replays on their mobile phones.

Other examples include fully immersive augmented or virtual reality experiences, such as meetings with 360º video or real-time translation services for participants who speak different languages. The most practical use case will be more seamlessly connected offices. This will make it easier to rely on "smart" devices to facilitate cumbersome organizational tasks, such as coordinating meeting room occupancies or desk rotations.

URLLC use cases involve uses that absolutely require low latency as well as strong reliability and security. Examples of such "mission critical" applications include autonomous vehicles, industrial robots, and remote surgery. Uses in the mMTC category involve communication between a massive – i.e., billions – number of devices in a small area with little or no human intervention. These devices may send only small amounts of data, and may send it only intermittently.

mMTC devices are expected to be an important feature of the next-generation network of hugely diverse kinds of physical devices that collect information known as the "internet of things." When connected to the internet, these devices can exchange and analyze data and, in some cases, control each other. Examples of this type of device include wearable heart rate monitors and remote-controlled home lighting systems. This type of device may also include systems with broader significance, such as smart energy grids that detect, and alert authorities to, unexpected spikes in demand that may exceed available capacities. Devices may also include sensors that monitor forest temperatures to provide automated alerts to relevant authorities in case of a fire.

Myths about 5G

Myths about the "driver of the fourth industrial revolution" abound. Some minimize 5G's potential impact, claiming it brings nothing more than speed, and that it's not even as fast as it is claimed to be.

5G is more than just speed, however. The new functionalities are a big part of what makes it so revolutionary. It will change how consumers digest media, access products and services, experience their homes, workplaces and even broader physical communities.

Access to mid-band and high-band 5G remains limited. The underlying infrastructure needs represent one major hurdle. As noted, there are different "levels" of 5G. Consumers' experience with the new technology will vary dramatically depending on whether they have access to low-band, mid-band, or high-band 5G. For example, they may have a device labeled 5G, but they may be using this on a 4G network. The underlying infrastructure needs represent a major hurdle. Frequency allocation is another stumbling block. Service providers can only make the full benefits of 5G available to their customers if the providers can access certain ranges of the frequency spectrum. The government has so far allocated only limited access to the mid-band spectrum, despite strong demand. With access expected to increase in the coming years, rumors about the technology's limits are likely to dissipate.

5G has also sparked concerns about national security risks, especially in the form of spying or sabotage via international vendors of related technology. Such worries are understandable given the notoriously strong links between industry and government in China, for example, as well as discoveries a few years ago that big players, such as Huawei and ZTE, illegally exported U.S. technology to countries under sanctions. The U.S. government clearly shares these concerns, and several Executive Orders and pieces of legislation have drastically limited their presence on the U.S. market. These include barring the U.S. government and its contractors from acquiring or using equipment from certain companies, and the inclusion of multiple companies on the Commerce Department's so-called Entity List, which limits those companies' ability to do business with U.S. companies.

Effect on Real Estate Profession

5G technology will underpin various innovations that will bring new experiences to the world of real estate. These include home tours that blend real-life and virtual aspects as well as increasingly smart buildings.

Meanwhile, real estate professionals and consumers alike will benefit from better-connected offices, remote and otherwise.

Next-level marketing

As 5G technology and related devices evolve, opportunities for more effective marketing abound. For example, augmented reality tours would give potential buyers completely new ways to evaluate a property's potential. Augmented reality mixes virtual and real environments, with digital information added to images of reality viewed through a device. This could be as simple as basic information such as the price to replace a floor displayed as clients tour a home. Or it could help buyers virtually visualize possible renovations, such as an added fireplace or pool.

For now, such augmented reality experiences are often fairly limited in scope. They are generally available via smartphones or tablets, which users have to hold in their hands. Examples would be apps that let shoppers visualize a store's furniture in their homes. The truly transformative experiences that free up users' hands are currently only possible via bulky headsets, limiting their appeal. But progress with new lightweight and cost-efficient head-mounted options, such as smart glasses, could take such tours to a whole new level. Adding sound and texture would fundamentally change the experience as well.

Interconnected, mobile offices

Especially since the COVID-19 pandemic, employees have been spending less time at company offices. Some will be reluctant to return, whether they are dreading long commutes or simply feeling like they are more productive working from home or for those experiencing higher risks based on their health. 5G technology will make it easier for them to choose from where they want to work as stronger connections will be more widely available, allowing for more flexibility.

Real estate professionals have always a transient profession, able to work from the road at any given time. For them and for others who frequently travel while on the job, accessing closing documents or other resources to help clients with property transactions can be burdensome. 5G will pave the way for a more seamless experience by spurring both a shift to cloud-based services and quicker and smoother access to those services.

The new technology will also improve experiences within individual offices from facilitating smoother online collaboration and onboarding of remote staff to fostering AI that frees employees from repetitive tasks.

Effect on real estate values

As 5G rolls out, some of its infrastructure needs are prompting pushback. Homeowners sometimes resist the installation of cell sites near their property, worried that these will undermine property values.

The evidence, however, suggests that the opposite may be the case. A 2021 report (published by Verizon) underscores the importance of a strong internet connection. In fact, 90% of potential buyers indicated that good cellular service and internet infrastructure are important considerations in their searches; in fact, cellular service and internet infrastructure may be more important than a home being move-in ready, having a backyard, or being close to good schools. The report also shows that the pandemic only strengthened the appeal of good connectivity.

Meanwhile, another study, based on over 11.5 million real estate transactions in California between 2010 and 2020, shows that the presence of wireless sites and cell towers have no significant impact on property values. This is especially true of the small cells most relevant to the 5G network. In fact, wireless infrastructure can increase value, especially for younger buyers, who tend to be more comfortable with or even eager to be on the forefront of technological innovation.

Ever smarter homes

5G does not just mean better internet connections and new infrastructure. It will also change the very nature of homes themselves. So-called smart homes use various devices and other technological resources to make domestic chores quicker and easier, or even just more entertaining. Examples include smart refrigerators that keep track of food expiration dates, remote-controlled ovens, as well as voice-activated light or interactive security systems. Homeowners can also treat themselves to augmented reality cooking lessons from a celebrity chef in their own kitchen.

For now, the devices required to make use of such "smart" services operate in a fragmented way, using different network protocols (such as Wi-Fi and Bluetooth). This means glitches are inevitable. Manual input is still required more often than users would like, too. Sophisticated 5G networks will allow the devices to both interact with each other more effectively and provide an overall smoother experience. As a result, existing device uses will become more appealing and entirely new uses will also become possible. Eventually, this will make smart homes both more interesting and affordable for a broader range of consumers.

Impact on Other Types of Business

Given the vast potential of 5G-related innovations, the new technology will have effects beyond the real estate industry. Estimates vary given the topic's breadth, but analysts predict that, by 2030, 5G and the "fourth industrial revolution "will contribute to a rise in global GDP of $1.3 trillion.

The transportation industry will also be affected. Automated cars have often made headlines, and the trucking industry may be disrupted, too. Before consumers ever buy an automated car, they may be hailing rides in vehicles steered by a remote driver. Some may still think of remote-controlled cars as a toy for the young and young-at-heart, but adult-sized versions are becoming a reality and could revolutionize ridesharing. Online retail services will also be taken to completely new levels. Shopping online could become significantly more personalized and three-dimensional. For example, shoppers may be able to first test an outfit on their own 3-D avatars before trying it on in real life

It remains to be seen what this means for commercial real estate and for people working in retail stores. More engaging online experiences may dampen consumers' enthusiasm for in-person shopping, with potentially far-reaching consequences. Yet some note that stores may also find ways to capitalize on the technology by using virtual reality to enhance in-person shopping experiences or in pop-up stores.

With lightning-speed connections, consumers may also never again have to use compressed files which are lower quality. Streaming entertainment services, especially live streaming is likely to rise in popularity. Using high-resolution audio files will greatly improve the quality of broadcasting, offering more complex and richly detailed sound. Video live streaming will also become a noticeably more pleasant experience. This is especially true for mobile devices, where standard-definition resolution, rather than high resolution, remains the norm, and unexpected simultaneous spikes in demand can still undermine the viewing experience.

Government Regulation

Federal

As noted, service providers can only make the full benefits of 5G available to customers if they can access certain ranges of the frequency spectrum. Problems can arise when different users try to use the same frequency band for varying purposes at the same time, so bands are regulated. This regulation includes managing spectrum allocations. Spectrum allocations, both new and old, play a vital role in the new technology's development.

In the U.S., the Federal Communications Commission (FCC) regulates, and auctions off, specific radio spectra. Specifically, it is responsible for non-federal uses, meaning uses by state and local governments, as well as private commercial and personal uses. Meanwhile, the National Telecommunications and Information Administration (NTIA) is responsible for managing the federal government's use of spectrum. 5G and related technologies implicate multiple different agencies, which can cause issues. For example, the Federal Aviation Administration (FAA) late in 2021 raised safety concerns about mobile network carriers using 5G services via a new frequency known as the C-Band. Specifically, the FAA is concerned about such uses interfering with radio altimeters, which are devices relevant for various safety functions on airplanes. The FCC, however, had looked into this very issue and concluded that the concerns were unfounded. After working with wireless companies such as Verizon and AT&T, the FAA in late January of this year agreed to narrow the areas near airports it previously deemed risky for 5G/C-Band use.

Meanwhile, in February, the FCC and the NTIA announced a new initiative to improve U.S. government coordination on spectrum management. Among other things, they pledged to hold regular joint planning meetings and foster proactive exchanges with industry and other federal agencies and reduce disputes. Interagency disagreements can lead to confusion about both the current rules and the direction rules might take in the future. This confusion could leave in a lurch those businesses that are on the forefront of 5G-based innovation, possibly dampening their enthusiasm for such efforts.

State and local

As noted, using the full potential of 5G requires developing a small cell infrastructure consisting of many individual pieces that collect and transmit signals within a short range. Some of these pieces will be placed on existing infrastructure. Such activity needs to be regulated, and many states have already enacted mobile 5G and small cell-related legislation, or are in the process of doing so. For example, the Illinois Small Wireless Facilities Deployment Act, enacted in 2021, sets out the manner in which local authorities may regulate the collocation of small wireless facilities. Similar legislation, that attempts to achieve a balance between local authority and making small cell deployment more efficient, was enacted in 2021 in Pennsylvania.

The potential for a regulatory quagmire is real. Though local realities are surely relevant and will differ quite drastically, the National Conference of State Legislatures (NCSL) has taken steps to reduce the potential hurdles faced by wireless companies due to varying rules. Specifically, NCSL has promoted streamlining state and local (as well as federal) regulation by ensuring that this regulation builds on the same baseline principles. These principles include clarity on processes to acquire permits to access public rights of way, caps on costs and fees, and streamlined timelines for reviewing cell-siting applications.

Consumer Protection

Consumers are already exposed to various risks by using software and devices connected to the internet. Their mobile phones, tablets, and computers already contain considerable amounts of private data. Widespread 5G technology will lead to a growing number of devices collecting more, and more at times, delicate information. For example, a robotic vacuum cleaner may be welcome support, but it also collects information about your home's layout, and that information could be helpful information for burglars. Meanwhile, your phone's health apps may be encouraging you to make healthier choices and provide valuable tracking information to communicate with your physicians, but they are also collecting the kind of information that can lead to predatory marketing or possibly higher insurance premiums.

Ultimately, 5G is all about making it faster and easier to transmit data, and to access such data from a wider range of devices. This means that there will be both new and exacerbated already existing privacy and security risks. Some will be unintentional, but others may be malicious. Reports about hacked baby monitors going rogue and even interacting with children without their parents' knowledge serve as a chilling example. A recent consumer survey confirms that many Americans are concerned about the security of their smart-home technology.

Moreover, since 5G is a software-based, "virtualized" network, it relies on the internet protocol (IP), which is a set of protocols, or rules, that make it possible to send data across networks. Since hackers are familiar with these existing protocols, the potential for attacks is significant. The implications can be even more severe in the context of smart cities that rely on 5G to manage various vital infrastructures, including energy supplies. In Florida, for example, hackers accessed a water plant's supervisory control system and altered the amount of sodium hydroxide in the water.

As a result, the need to strengthen data privacy and information security loom large. Consumer confidence, both on a small and large scale, is crucial if 5G's potential is truly to be realized. Inevitably, measures to strengthen cybersecurity will have to accompany the new technology's increased rollout. The basic techniques of using end-to-end encryption of communications, encrypting data, and insisting on the most secure authentication methods available will play important roles in that effort.

REALTOR® Association Involvement

NAR® has been at the forefront of examining how the expansion of 5G will enable a broad range of innovation that will ultimately affect the real estate industry in various ways. In addition to engaging in discussions with myriad parties, it has proactively been building relations with the biggest stakeholders, including the carriers involved. The ultimate goal is to make sure that NAR's members and the real estate industry as a whole have a seat at the table in this ever-evolving discussion.

The association generally strives to keep its members at the very cutting edge of the many new ideas and technologies entering the real estate space – particularly via its Emerging Technology team, which has been part of NAR's Strategic Business, Innovation & Technology group since 2019.

The fascinating and far-reaching implications of 5G will be discussed at the Urban Roundtable entitled "*Is the City of Tomorrow around the Corner? Learn how digital technologies and sustainable practices are changing the way we plan cities,*" scheduled for May 5, 2022. The discussion will feature Billy Grayson of the Urban Land Institute, a nonprofit education and research organization that focuses on land use, real estate and urban development; Greg Herb, Broker and President of PA-based Herb Real Estate; and Evan Regan-Levine of the JBG SMITH's Investments Group.

State and local associations
State and local associations are also keeping the topic on their radars. For example, on April 19, 2022 the Chicago Association of REALTORS® is scheduled to host a broader discussion on Big Tech, Blockchain & Global Real Estate. The discussion will include a look at 5G-related developments. The event will also feature Liz Sturrock of the Miami Association of REALTORS® as a speaker.

Conclusion

5G has already sparked considerable interest. With providers stepping up their game and actively extending coverage across the United States, the next generation of mobile network technology will both continue to generate headlines and result in more tangible developments during the next few years. As the technology emerges, policymakers, consumers, and the many professionals ultimately affected will need to find ways to both harness 5G's vast potential and rein in its potential pitfalls.

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