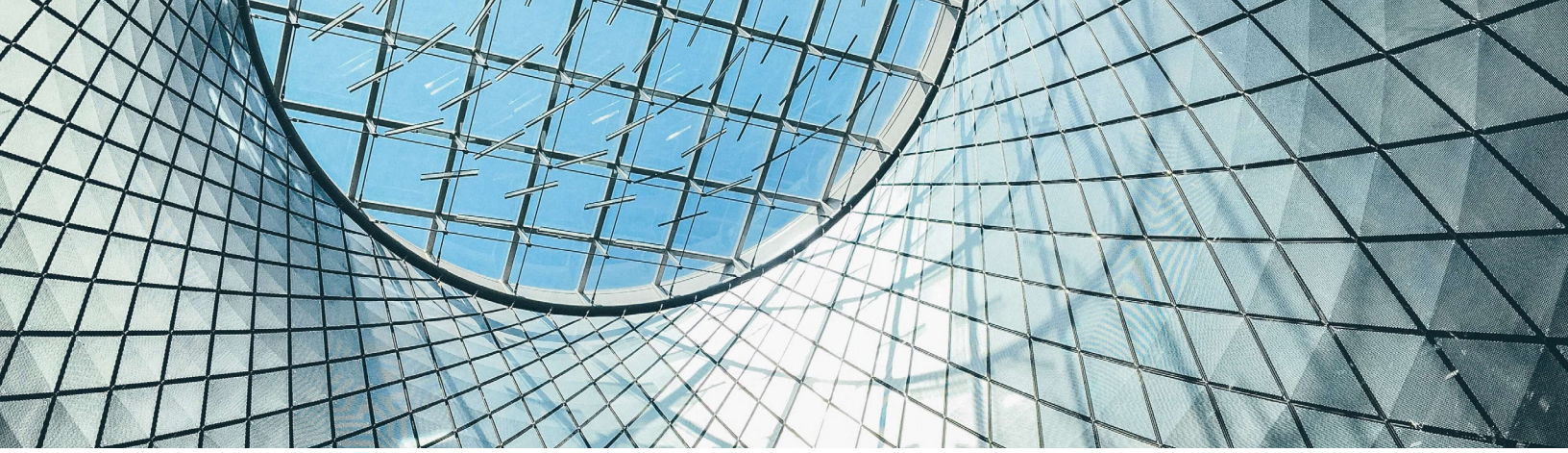

Market Insight Report Reprint

5G primer: What makes it different from the previous 'Gs?'

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While most have heard the term 5G and know that it brings faster speeds, not everyone is clear on what it is exactly, and how it's different from previous mobile generation transitions. Here we demystify 5G by providing a brief overview of the technology, how it differs from previous generations, and what to expect from future developments.

451 Research

S&P Global
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Introduction

5G is arriving in many places around the world with real networks and 5G-capable smartphones. According to the S&P Global 5G Tracker, 5G networks have been deployed by over 150 operators in 67 different markets around the globe. Due to factors such as the feature capabilities following 3GPP standards releases, the initial focus of 5G deployments has largely addressed fixed and mobile broadband services for consumers and businesses.

While most have heard the term 5G and know that it brings faster speeds, not everyone is clear on what it is exactly, and how it's different from previous mobile generation transitions. This report will demystify 5G by providing a brief overview of the technology, how it differs from previous generations, and what to expect from future developments.

THE 451 TAKE

5G, once fully realized, brings a lot the table and will be a driver of digital transformation across a wide range of industries, including within the telecom operators investing in 5G network and spectrum assets. Because 5G is the first network evolution to be 'cloudified,' these networks can be operated in a more agile and efficient manner, quickly creating new services. They will also be able to participate in new value chains, including the emerging market for edge computing services. 5G is moving fast out of the gates but will take time to fully matriculate, especially since the pandemic created a headwind for standards ratification. This fifth generation is appealing to industrial enterprises with wide physical coverage requirements and mission-critical, low-latency applications, but many of these customers will seek private or semi-private setups. 5G is the first mobile generation designed specifically for the needs of enterprise and machine connectivity; previous mobile evolutions were really designed for consumer voice and data services.

5G basics

5G is the fifth generation of wireless cellular technology, which has evolved over the years from 1G to 4G (LTE). While earlier generations were predicated on delivering mostly 'consumer' capabilities, 5G takes mobile connectivity to the next level by enabling previously impossible use cases on mobile networks. These use cases are grouped into three categories: enhanced mobile broadband (eMBB), ultra-reliable low-latency communications (URLLC), and massive machine-type communications (mMTC).

Enhanced mobile broadband will be the first 5G service to launch commercially, and will support high data rates (400Mbps to 1.5Gbps) to enable increased speed across a wide coverage area. URLLC will offer significantly reduced latency for mission-critical communications such as autonomous vehicles, cyber-physical systems including remote surgery, and advanced applications such as AR/VR. Finally, mMTC seeks to improve the flexibility of wireless services by optimizing the use of technologies born in the cloud.

Once fully optimized, 5G will be able to leverage cloud-born technologies such as network function virtualization (NFV), containerization, software-defined networking (SDN), and multi-access edge computing (MEC) to enable operators to rapidly provision new services.

The two major architecture pieces of a mobile network are the radio access locations (RANs), i.e., the radio antennas and base stations that send/receive RF data from surrounding devices and then backhaul the data 'core' to its destination, or provide network services, subscriber management, and network applications like voice and collaboration. The majority of the initial wave of deployments includes 5G radio infrastructure (5GNR), but these were attached to existing LTE cores. This is referred to as non-stand-alone (NSA). By deploying in this way, operators can quickly roll out 5G to achieve first-mover advantage, and increase their marketing profile without implementing a new core network.

The next phase of 5G rollout for many operators will be to deploy the 5G 'stand-alone' core (5GSA). 5GSA introduces a microservices-based, cloud-native core architecture, and once the Release 16 and 17 standards are ratified and commercialized, the technology will become ever more capable of using advanced technologies such as network slicing and MEC to deliver advanced services not possible for existing wireless networks or alternatives. While 4G is still the dominant technology in use today, businesses are beginning to explore the ways they can take advantage of 5G, which is set to become the mainstream wireless technology over the next five years or so.

Not just another 'G'

Although the transitions from 2G to 3G, and 3G to 4G, were largely driven by consumer demand for capable mobile data services, the transition from 4G to 5G is a response to enterprise functionality demands that extend beyond broadband access to the internet. To meet the more stringent requirements of enterprises, 5G promises faster speeds, lower latency and increased scalability when compared to its predecessors. As an illustration, while the peak speed of 4G is roughly 1Gbps, the theoretical peak speed of 5G once fully deployed could be as high as 20Gbps.

Previous generations like 4G used submillimeter wave spectrum (such as 700MHz). 5G will also utilize millimeter wave (>6GHz) to deliver increased – up to 20 times more – bandwidth per channel. However, because of its smaller size, mmW can't travel as far as traditional radio waves, which means that traditional cell towers will have to be redesigned into smaller, more densely populated nodes.

This massive densification will potentially require operators to double the number of RANs around the world in the next 10 years. The need to expand the 5G network infrastructure to users adds costs (siting, energy, infrastructure) and complexity (more distributed topologies), and requires operators to work through local siting and licensing processes to get the new radio locations and infrastructure built out.

What's next for 5G in terms of standards?

As with previous mobile generations, the capabilities of a 5G network are defined by standards. The use of standards has been a key enabler of mobile industry scale. The 3rd Generation Partnership Project (3GPP) develops technical specifications for cellular networks, which includes a sequential series of releases that are defined, debated and refined by 3GPP members. While Release 15 officially introduced the original specifications of 5G, the really innovative elements of 5G for enterprises will come with Release 16 and 17, which will bring the more innovative capabilities and use cases for the technology to light, including mMTC and URLLC.

After a three-month delay, the 3GPP completed the specifications of Release 16 on July 3, 2020. The delays were primarily a result of the group's inability to conduct face-to-face meetings due to COVID-19. While there are many features to Release 16, much of it is focused on expanding the use cases of URLLC, which delivers significantly reduced latency for mission-critical communications such as autonomous vehicles, cyber-physical systems including remote surgery, and advanced applications such as AR/VR. Another key element of the release is the introduction of integrated access and backhaul capabilities, which allow operators to deploy 5G antennas in locations where fiber is scarce or difficult to obtain.

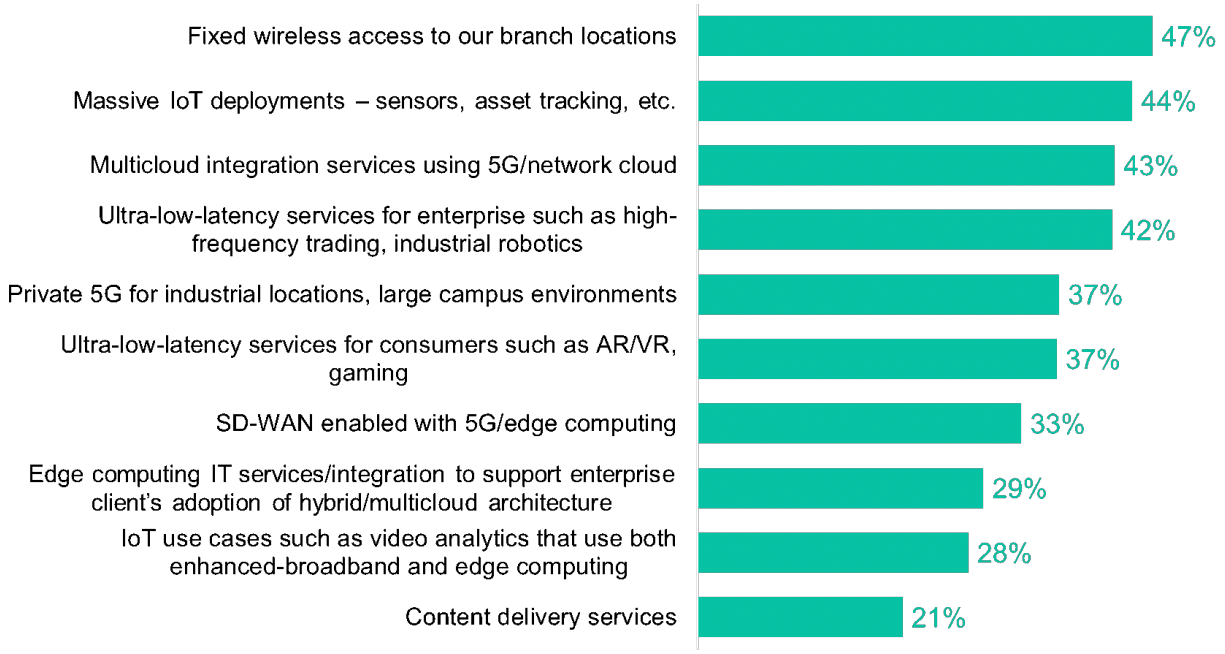
Release 17 also saw delays due to the pandemic. The release was originally expected to be completed in the second half of 2021, but the 3GPP is now expecting completion to occur in 2022 at the earliest, which means wide-scale commercialization likely won't come to fruition until late 2023 or early 2024. Some of the interesting features include the introduction of NR-Light, the addition of more accurate positioning capabilities, support for millimeter wave spectrum above 52.6GHz (up to 71GHz), enhanced RAN functionalities such as power saving, and support for networking slicing as well as self-organized networks.

5G use cases

In the long run, 5G will not only usher in a new era of improved network connectivity, but also new connected experiences for users across a diverse set of industry verticals, including healthcare (remote monitoring, telehealth), transportation (autonomous vehicles and drones), manufacturing (remote control of industrial machinery, autonomous mobile robots, predictive maintenance, industrial AR/VR applications), consumer applications (e-sports, 8K video streaming, cloud gaming, AR/VR, connected cars).

Enterprises are particularly interested in leveraging 5G as a primary or backup connectivity option for their branch offices, and to support IoT and multicloud connectivity requirements. As part of a custom research study with enterprise decision makers that we conducted in 2020, 451 Research inquired about the types of 5G use cases under pursuit (see Figures 1 and 2 for 5G service priorities among consumers and enterprise survey respondents).

Figure 1: Enterprise 5G Use Case Priorities

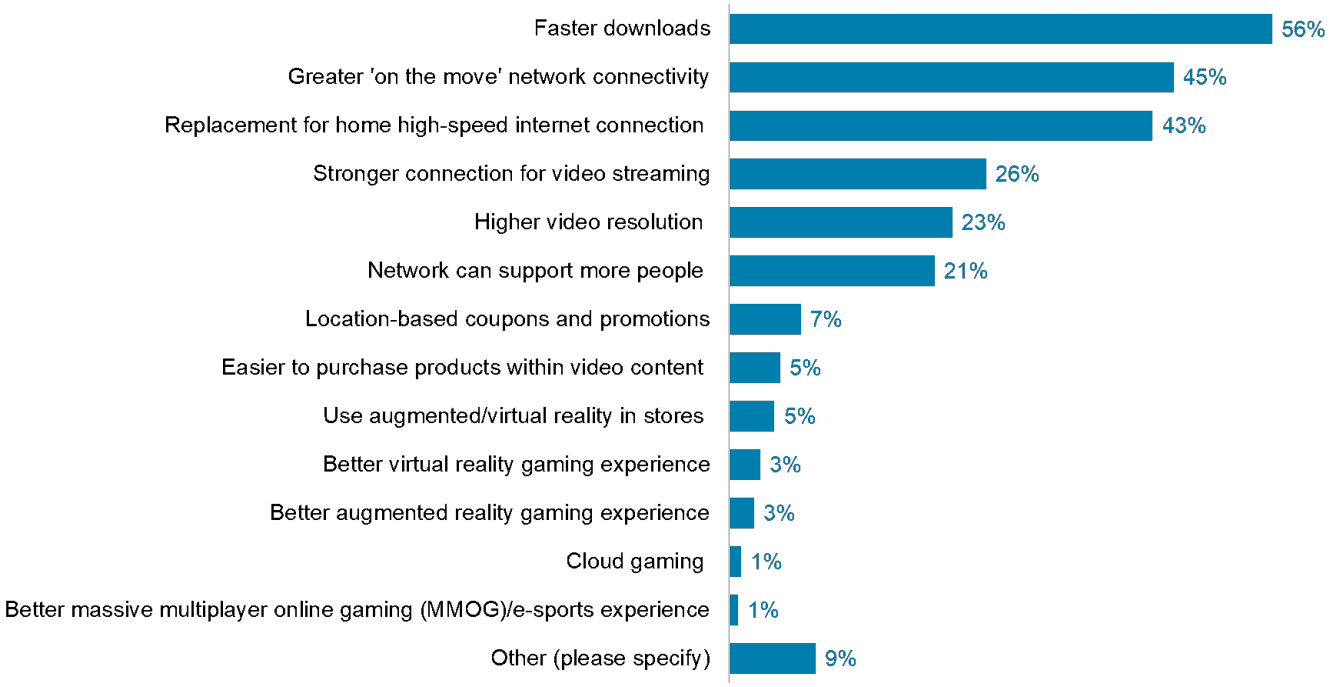


Q. Which of the following use cases do you anticipate pursuing related to 5G services?

Base: All respondents (n=387)

Source: 451 Research/Custom Research Study, Enterprise Buyers, 2020

Figure 2: Consumer 5G Use Case Priorities



Q. Which of the following 5G capabilities would most likely motivate you to get 5G network coverage on your smartphone in the future?
Base: All respondents (n=1,888)
Source: 451 Research's Voice of the Connected User Landscape: Endpoints & IoT, Consumer Smartphone Trends 2020

Private 5G

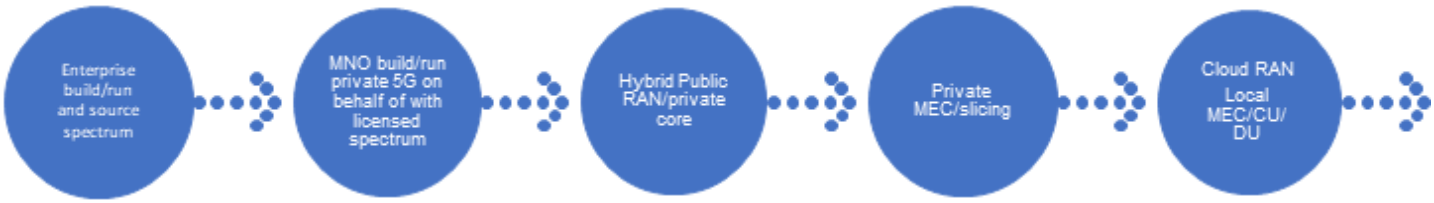
Private 5G brings the bandwidth, device density and latency advantages of 5G with the benefit of allowing enterprises to run communications in a private setup. Private mobile networks are well suited to environments that are spread out over a large area, have a high density of devices, have multimode communications, and require reliable, secure and fast connectivity. While there are a multitude of reasons for deploying a private 5G network, it boils down to advantages in coverage, control, performance and cost.

Despite their appeal, private mobile networks have been challenged by system complexity and spectrum access – which was, and is, severely limited by the cost and availability of licenses, historically dominated by public network operators, government entities and broadcasters. This picture is changing, sparked by innovative shared licensing initiatives such as CBRS in the US, and enterprise use licenses being made available by governments around the globe (e.g., UK, Germany, Japan).

When deciding how to get started, enterprises can take multiple approaches to deploying a private 5G network, as illustrated in Figure 3. While there is no right or wrong approach, 451 Research believes that a winning model will fully optimize both cost and performance while emphasizing a strong security posture.

We expect to see a wide range of deployment architectures and business models. Global telecom operators like Verizon, Vodafone and AT&T are building private network capabilities, but some enterprises will deploy their own equipment, run their own local core networks, and buy or lease their own spectrum, assuming they have the skills on-staff or have partners like global systems integrators or OT companies that can help them build and run these private cellular networks.

Figure 3: Private 5G Deployment Options



Source: 451 Research

What about 6G?

Although it is still early on for 5G, some enterprises and operators are already shifting their attention to the next generation of wireless technology: 6G. This generation will build on the foundation of 5G by taking millimeter-wave spectrum to the next level, leveraging frequency bands in the terahertz (THz) range. Once fully optimized, it has the potential to usher in a new era of connectivity, enabling transformative applications like holographic technology, while providing stronger support for known use cases like environmental monitoring, industrial automation and consumer wearables.

Many organizations have already begun looking into 6G, including the Alliance for Telecommunications Industry Solutions (ATIS), which formed a Next G Alliance consisting of companies like AT&T, Facebook, Qualcomm, T-Mobile and Samsung aimed at accelerating the rollout of 6G in the US. China has launched similar efforts around 6G, with the country's Ministry of Science and Technology setting up two working groups to facilitate R&D efforts while shaping the technical standards around the technology. 6G still has a long way to go, and is unlikely to become a commercial reality before 2030.

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