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5G in 2020

Plotting a course from invention to innovation

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Introduction

Many consumers and businesses expect 2020 to be the year of fifth-generation (5G) wireless networks and are eager to experience this transformational technology. However, almost as quickly as 5G is being added to the vernacular of the casual wireless user, we are also witnessing the first signs of disillusionment. Recently published opinions argue that 5G likely will fail to achieve radical differences from the current mobile experience and that 5G lacks a “killer app” to leverage its full potential.[1]

Early hype generated by 5G’s potential, coupled with its limited availability at the end of 2019, are understandable reasons for some skepticism. But how ominous are these signs of cynicism? Are 5G application innovation and associated business model development doomed if users do not experience transformative change as quickly as they expect?

Examining previous wireless generational upgrades, 4G-LTE in particular, reveals a lag of two to three years between network infrastructure deployment and innovative applications and business models. Deloitte’s analysis in this paper suggests that carriers, applications providers, investors, and users should expect a similar gap for 5G. However, this expected gap between deployed infrastructure and application innovation should not be mistaken for a dormant period, as it is typically marked by experimentation, invention, and investment—the success of which can be determined only after the infrastructure becomes prevalent in enterprise networks and is deployed at scale for consumers. Furthermore, governments should note that this period can provide an opportunity to advance national infrastructure policy through the creation of demand signals that speed up 5G deployment and help enable subsequent innovation.

Infrastructure-led innovation

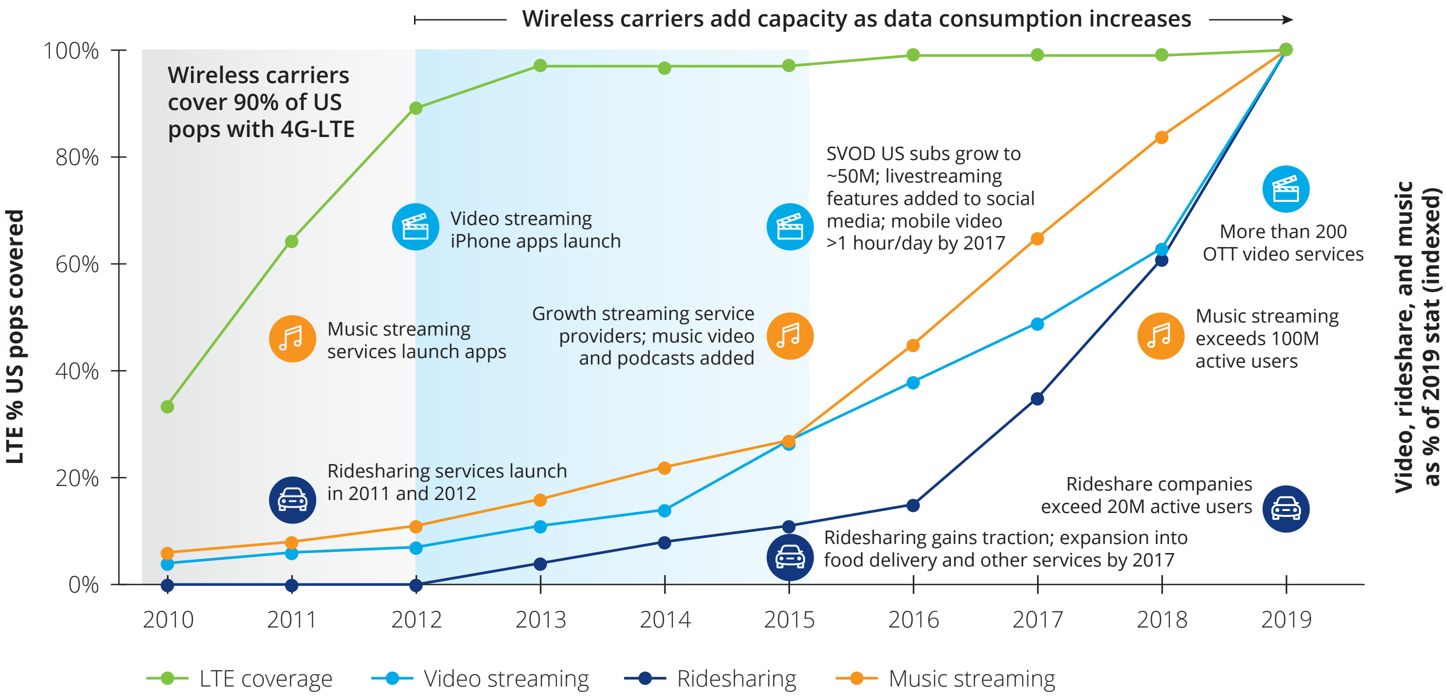
Each generation of wireless technology has had its hallmarks of innovation. 3G ushered in a wave of smartphone advances, which produced a new ecosystem of mobile apps. Meanwhile, growing data usage generated a reinforcing cycle of network upgrades and propelled the United States to a leading position in 4G-LTE deployment. 4G-LTE itself delivered high-speed mobile broadband, fueled the "on-demand" economy, and powered "anytime, anywhere" streaming video, social media, and gaming. 5G's promise of low latency and gigabit speeds is expected to drive similar innovation, with enterprises anticipated to be early adopters and beneficiaries.

Achieving 5G's benefits likely will require a multiyear journey. 4G-LTE launched in 2010 and achieved 90 percent coverage of the US population in 2012.[2] In the years leading up to 4G-LTE deployment, the US government made spectrum readily available to enable rapid deployment. Between 2006 and 2008, the Federal Communications Commission (FCC) auctioned an average of 142 MHz nationwide in the 700 MHz and AWS-1 bands.[3] Between 2010 and 2012, as LTE adoption accelerated and data usage grew, the government auctioned another 65 MHz to help augment capacity. In total, the FCC made more than 200 MHz available to wireless carriers to deploy 4G-LTE.[4] Meanwhile, wireless carriers spent approximately $400 billion on spectrum and infrastructure, including wireless equipment, towers, fiber, and the labor to deploy it.[5]

Carriers' infrastructure and spectrum investments were critical to deliver the high-speed wireless capacity needed to satiate consumers' unquenchable thirst for watching video, uploading user-generated content on social media platforms, and enabling gig-economy services such as ridesharing and meal delivery. However, Deloitte analysis shows that such transformative services and applications did not appear in tandem with the 4G-LTE network (see figure 1). Rather, they were adopted years after 4G-LTE was deployed at scale. Ridesharing gained 16 million users in 2015, which was five years after 4G-LTE launched and three years after 4G-LTE achieved 90 percent US coverage. Video streaming had two adoption inflection points: The first occurred in 2014, when both long- and short-form video gained adoption on mobile devices; the second occurred in 2018, when "cord-cutting" became more prevalent. 4G-LTE deployment likely had the greatest impact on the 2014 inflection, which occurred two years after 4G-LTE coverage reached 90 percent of the US population. Music streaming followed a similar pattern, in which widespread adoption lagged mobile infrastructure deployment by two to three years.

Transformative services and applications were adopted years after 4G-LTE was deployed at scale.

Figure 1. Innovations enabled by 4G-LTE infrastructure took off years later[6,7,8,9]



Note: Indexed value captures the relative user growth rate or usage growth for various use cases during 4G-LTE.

Most of the innovations and business models that depend on nearly ubiquitous 4G-LTE coverage were not envisioned at its launch. These infrastructure-led innovations were born from wireless technology advancements that generated ubiquitous coverage, higher speeds, lower costs per bit, and improved reliability. Infrastructure dependence is so great that many gig-economy companies reference their reliance on high-quality mobile networks in their public Securities and Exchange Commission (SEC) disclosures.

From invention to innovation

When competing based on infrastructure-led innovations, having first-mover advantage is essential. By definition, a national wireless network is accessible to all, making infrastructure an enabler rather than a differentiator. But first-mover advantage unlocks the underlying network effects and helps leapfrog international competitors in a global economy. Therefore, the speed at which innovators use the new infrastructure often determines which business model emerges as the winner. Investment and experimentation that spawn invention during and immediately after infrastructure deployment have proven key to achieving first-mover status.

For example, the most successful ridesharing companies were those that experimented first with 4G-LTE-enabled real-time navigation and location precision capabilities.[10] These companies' innovation offered a unique value proposition—ease of use, flexibility, and predictability for riders and drivers alike—that fueled their growth. While 4G-LTE was not the sole enabler of success—inexpensive capital and an evolving regulatory environment also boosted application innovation—4G-LTE's capabilities were an important contributor.

Social media, streaming video, messaging, and gaming companies also used the period during 4G-LTE deployment for innovation, including through acquisitions. For instance, Facebook acquired Oculus VR in 2014 to experiment with artificial reality,[11] and Twitter acquired Periscope, a live-video streaming company, in 2015.[12]

Despite 5G's relative infancy, we are witnessing intense levels of investment in trials and alliances for 5G-enabled consumer and enterprise use cases—a situation quite similar to the early days of 4G-LTE. Among enterprises, 5G networks have gained attention as a reliable, standards-based solution for stores, hospitals, factories, ports, and other locations to help overcome today's challenges of nonstandard point solutions. Enterprises may benefit from the speed that 5G offers, as well as advantages such as network slicing, latency, and device density. In addition, ecosystems to ideate and experiment on methods to leverage of 5G's cross-sector capabilities are beginning to take shape. For instance, auto manufacturers have partnered with network equipment providers and edge computing players to assess 5G's potential in smart manufacturing.[13]

The power to innovate during the gap between infrastructure deployment and product adoption is not confined to startups, cloud providers, or application companies. Wireless carriers should be especially well-suited to innovate, given their advanced knowledge of 5G capabilities. Moreover, carriers can use this time to orchestrate partnerships with other ecosystem players. Already, wireless carriers and cloud providers have announced alliances as they position for computing and analytical resources on the network edge.[14] As enterprises adopt 5G for both indoor and outdoor use cases, carriers should continue to expand alliances to include IoT device manufacturers, enterprise software companies, and system integrators with cross-industry experience. Additionally, carriers should take advantage of their 5G core's data aggregation capabilities and network performance control to help add value to their emerging cloud and enterprise partnerships.

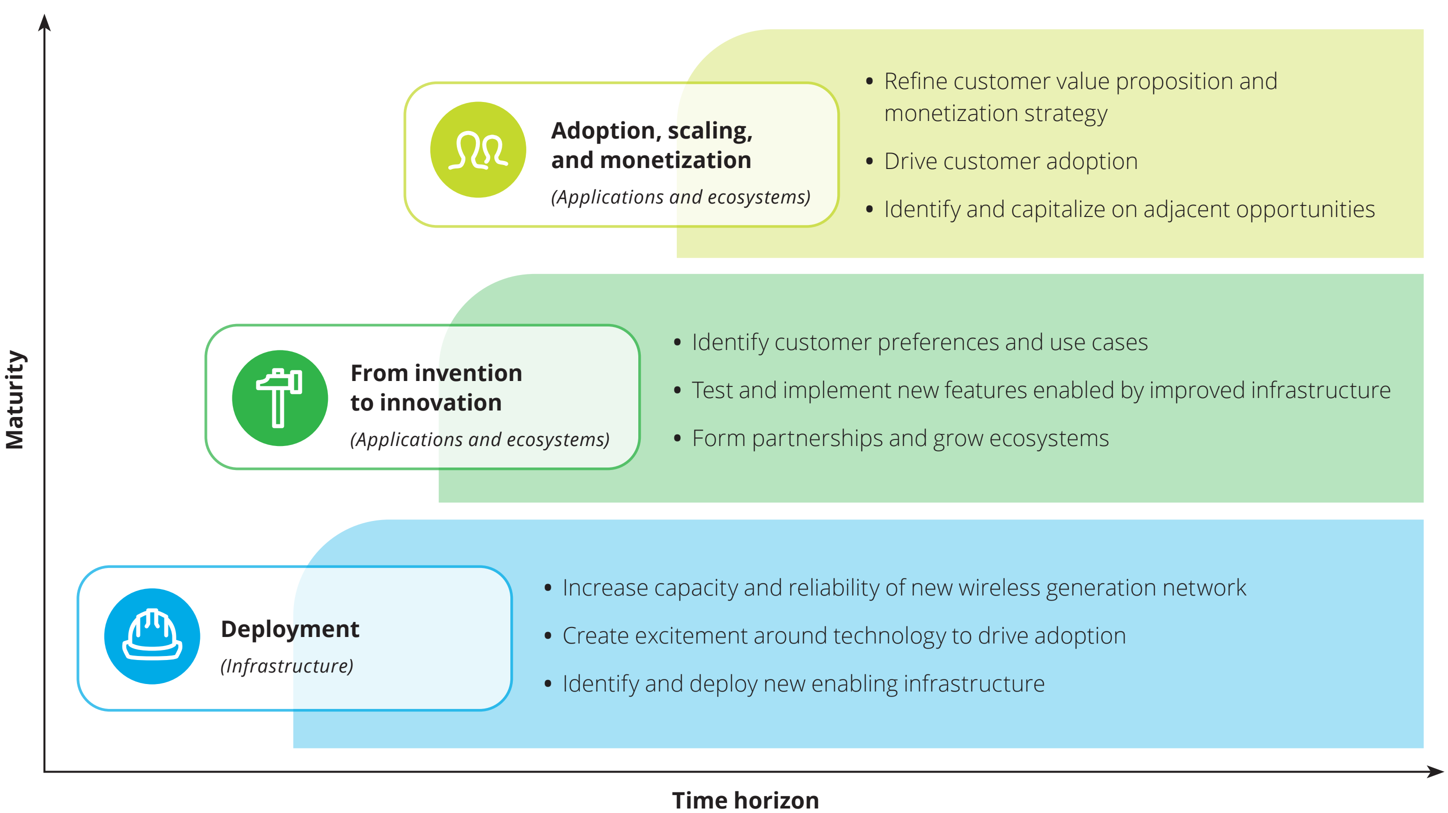
The COVID-19 pandemic has generated a sharp increase in 4G-LTE traffic for wireless carriers around the world.[15] While much of this increase can be attributed to a dramatic ramp-up in remote work and in-home entertainment traffic, there also has been an increase in other forms of traffic driven by innovative service delivery techniques, as previously stringent regulations have been relaxed.[16] Telemedicine, as an example, has been given broad-reaching permission and is able to create new data and case studies that are likely to permanently alter the role of connectivity in medicine. Remote learning, similarly, has seen a significant rise in utilization, with students using video to interact with teachers and classmates.[17] As 5G gains widespread adoption, these services are likely to see additional innovation.

Patient for innovation but impatient for infrastructure deployment

In 2013, a year after 4G-LTE covered approximately 90 percent of the US population, some consumers and businesses still questioned the merits of fourth-generation wireless technology. Despite immediate improvements in wireless speeds, users eager for infrastructure-led applications had to wait two to three years—until after 4G-LTE was deployed at scale. (Figure 2 illustrates the overlap in the first two stages of new wireless generations' infrastructure-led innovations.)

We expect a similar time lag for 5G application innovation.

Figure 2. Infrastructure-led innovation stages of new wireless generations[18]



Sources: Deloitte analysis of previous wireless generations

Still, a potential years-long wait for 5G applications does not appear to dampen consumers' and businesses' enthusiasm for this transformative technology. In a recent Deloitte US consumer survey, 67 percent of respondents said they are likely to upgrade to a 5G-compatible smartphone when 5G service is available in their area.[19] Similarly, 75 percent of the 400+ business executives surveyed in a Deloitte Enterprise Connectivity study noted that they see advanced connectivity solutions such as 5G as being critical to their business initiatives over the next three years.[20]

> Lessons from successful 4G-LTE deployment and innovation suggest that companies, customers, investors, and governments should be patient for innovation but impatient for infrastructure deployment.

Lessons from successful 4G-LTE deployment and innovation suggest that companies, customers, investors, and governments should be patient for innovation but impatient for infrastructure deployment. The latter is a prerequisite for investment and invention, which in turn yields innovation—vital for continued economic growth, job creation, and national security. Given these positive impacts, an important issue for governments and policy makers is how to create incentives that can help accelerate infrastructure deployment.

Creating a policy environment conducive to 5G infrastructure deployment may be more complicated than with previous generations of wireless technology because of the scope of 5G functionality and the variants in 5G architecture. While 4G-LTE architecture is generally similar across geographies and use cases, 5G deployment decisions may vary based on population density and desired capabilities. For example, deploying ultra-reliable low latency (uRLLC) communication for solutions such as remote factory or oil rig inspections using drones requires significantly more edge computing capability and enhanced fiber and backbone infrastructure than deploying 5G enhanced mobile broadband (eMBB) for consumers. Similarly, massive machine-type communications (mMTC) for use cases such as smart grids for utility providers or supply chain solutions for logistics providers may require greater network densification than eMBB use cases. These variations also imply that deploying eMBB requires a different business case and policy incentives than deploying uRLLC and mMTC functionality. While the business case for widespread eMBB coverage can be made based on consumer traffic growth and lower cost per bit, the case for low latency and device density typically relies on IoT devices and edge computing capabilities resident in enterprise networks. Moreover, the use cases and financial benefits of uRLLC and mMTC are less certain in the near term, suggesting that the intervening period between infrastructure deployment and application innovation may be longer than with eMBB (although private networks in enterprise environments may see a shorter gap than the anticipated two to three years for consumer-centric national networks).

Global geographic differences may further complicate policy making that is necessary to speed up US 5G deployment. For example, the business case for eMBB, which relies on a highly dense network of small cells operating at higher frequencies, is likely more attractive in countries such as Japan and South Korea, which have much higher population density and nearly twice the traffic per device on average than in the United States.[21] This gives wireless carriers in Asia market-based momentum for rapid and extensive 5G deployment. Nonetheless, US carriers remain committed to investing in and rapidly deploying 5G.

These geographic differences may require governments to create demand signals that spur 5G infrastructure deployment and support use cases beyond accommodating traditional wireless traffic growth. Similarly, if policy objectives deem it imprudent to rely heavily on legacy supply chains, creating demand signals or events that reward architectural and supply chain diversity may prove helpful.

Opportunities to promote US 5G deployment and adoption

Numerous opportunities exist in the United States to make investments to promote further deployment, adoption, and commercialization of 5G architectures. These can include:

Exploring multivendor solutions, including open RAN architectures that utilize US-centric supply chains, to support government 5G test beds

Funding and supporting 5G R&D that meets government criteria for network and supply chain security. This may include partnering with industry to fund testing of new equipment added to existing carrier networks to help alleviate the typical pressures of experimenting with new vendor solutions

Accelerating availability of airwaves and capacity required for 5G coverage. While a vast amount of US mmWave spectrum has been auctioned, carriers lack much-needed midband spectrum, which has better coverage and propagation characteristics

Fast-tracking the permit process for small-cell and fiber builds that allow carriers and infrastructure companies to more quickly deploy cell sites and bring services to market

Focusing on rural 5G and mobile broadband access to enable application innovation to reach all US geographies

Providing financial incentives to integrate advanced 5G infrastructure and applications into national infrastructure projects such as airport renovations, port automation, and general services administration (GSA) warehouses, among others

Incentivizing small businesses and larger enterprises to encourage innovation and new 5G-enabled business models

The actions described on the previous page equate to being patient for innovation but impatient for infrastructure deployment. Successful innovations can lead to the adoption of new products and services that utilize the added infrastructure. As adoption grows, new ecosystems will similarly expand; it is critical that regulators and policy makers allow funds to flow back to the infrastructure companies to sustain the market's new growth trajectory.

Innovations that germinate from 5G will likely follow a two-to-three-year delay similar to that seen with innovations spawned from previous wireless generations. US carriers are committed to their 5G deployments and already are spending billions on network and spectrum to advance 5G capabilities.[22] Outside the United States, especially in Asia, governments appear to be most proactive in creating demand signals that help fund 5G infrastructure deployment, including providing midband spectrum availability and experimenting with new architectures and whole-of-government solutions. Singapore's Changi airport, for instance, has issued requests for proposals (RFPs) to deploy a 5G network for a better indoor experience and digital terminal solutions.[23] And despite a general economic slowdown due to the COVID-19 pandemic, the Chinese government has received a commitment from its three telecom carriers to complete their planned infrastructure 5G deployments without delay to advance health care and temperature monitoring applications to combat COVID-19.[24] Similarly, South Korean companies have deployed mobile apps using public government data to let users know if a location was visited by anyone infected by the virus.[25]

Impatience for infrastructure should be even more imperative given COVID-19. Accessing health data to help identify those most at risk, optimize treatment center capacity, enable remote testing and diagnosis, and optimize the medical supply chain to replenish essential products from manufacturers could be made simpler and more efficient using 5G. While it is uncertain which 5G use cases envisioned today will actually materialize in the years to come, the one certainty is that 5G can help trigger innovative business models that gain large-scale adoption. In the near term, a more proactive and coordinated stance from the United States to provide demand signals that help existing and new participants gain immediate market traction and scale would likely accelerate deployment—and by doing so, application innovation—in a manner that advances national economic and security objectives.

While it is uncertain which 5G use cases envisioned today will actually materialize in the years to come, the one certainty is that 5G can help trigger innovative business models that gain large-scale adoption.

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