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ENTERING THE 5G ERA: LESSONS FROM KOREA

DR. EEN-KEE HONG, PROFESSOR, SCHOOL OF ELECTRONICS AND INFORMATION, KYUNGHEE UNIVERSITY

JE MYUNG RYU, SENIOR DIGITAL DEVELOPMENT SPECIALIST, DIGITAL DEVELOPMENT GLOBAL PRACTICE, WORLD BANK

ELYSE JEE HYUN LEE, CONSULTANT, DIGITAL DEVELOPMENT GLOBAL PRACTICE, WORLD BANK

In April 2019, the Republic of Korea launched the world's first smart phone based, business-to-consumer (B2C) 5G commercial services. In two years, the country's 5G subscribers surpassed 13 million, accounting for 20 percent of total mobile subscriptions. Globally, 5G is in the early stage of development both from market and technology perspectives. However, Korea is one of the countries that have demonstrated early successes in bringing a domestic network to scale and building a comprehensive national strategy to maximize the transformative potential of 5G. The country's experience shows that even in countries with mature mobile industry, the government role is still critical as a key enabler for 5G ecosystem development. The government provided strategic clarity and adopted an inclusive process in the implementation of the new generation mobile network. The challenges and the lessons learned from Korea's early experience can offer interesting insights to other countries planning to deploy 5G in the coming years.

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Executive Summary

5G is the fifth generation of cellular networks with superb speed, near-zero latency, and mass connectivity. This next generation of mobile technology is expected to accelerate the digital revolution and shift the economy to the fourth industrial revolution.

Countries around the world, from high-income to low-income groups, are investing in 5G to create opportunities for people, businesses, and society. Of the 27 countries that launched commercial 5G services between February 2020 and February 2021, 11 are low and middle-income countries, including three low-income economies.¹ As of mid-April 2021, 68 countries/territories have launched 5G commercial networks, while 133 countries/territories are investing in 5G in the form of trials, tests, planned and actual deployments.²

In April 2019, The Republic of Korea launched the world's first business-to-consumer(B2C) smartphone-based 5G commercial services. In two years, the number of 5G subscribers surpassed 13 million, accounting for 20 percent of total mobile subscriptions in the country. Mobile network operators (MNOs) are offering specialized 5G business-to-business(B2B) services such as smart factories and smart drones, B2C services such as immersive media and games. The government is also actively supporting use case development by funding 5G projects and trials in 10 strategic industries and 5 core services.

The government has introduced various support measures, including tax credits for 5G investments and encouraging network sharing in suburban rural areas, to facilitate the fast rollout of the 5G network with nationwide network deployment by 2022. MNOs are accelerating investment for the 5G networks

and building partnerships for joint construction and network sharing for efficient network rollout. As of December 2020, 5G coverage by land is 80 percent in Seoul and 30 percent in six metropolitan areas. However, recently, there has been an increase in customer complaints about spotty services as the nationwide deployment is yet to be achieved while customer expectations for quality of service are high.

While 5G is in its early stage of development both from market and technology perspectives, Korea is one of the countries that have demonstrated early successes in bringing a domestic network to scale and building a comprehensive national strategy to maximize the transformative potential of 5G. The country's key 5G milestones to date— including the world's first simultaneous 5G spectrum auction of 3.5 GHz and 28 GHz bands, the world's first B2C smartphone-based commercial launch, and surpassing 13 million subscribers in just two years since the service launch—are largely attributable to the close collaboration between the government and multi-stakeholders.

This case study examines the lessons learned from Korea's 5G journey, with a focus on the government strategy and actions to nurture the ecosystem development. The Korean mobile industry is already equipped with strong research and development (R&D) capabilities, a skilled workforce, and access to finance. However, Korea's 5G case illustrates that the role of government is still critical as a key enabler in 5G deployment even in countries with matured and self-sufficient mobile industry. To secure the country's position as a global 5G leader, the government defined a national vision for 5G, removed regulatory barriers, and facilitated collaboration among multi-stakeholders, including a range of government bodies, telecoms, vendors, researchers, and civil society. The challenges and the lessons learned from Korea's early experience can offer interesting insights to other countries planning to deploy 5G in the coming years.

1 Viavi Solutions 2021.

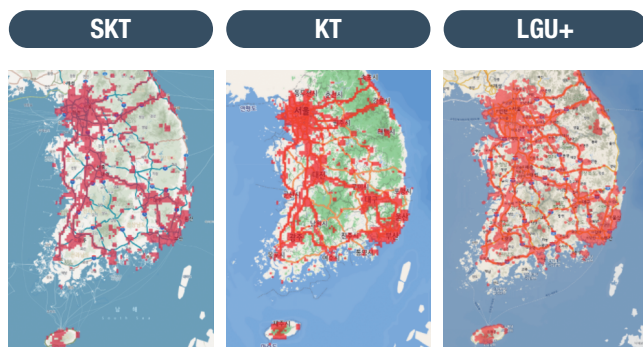
2 GSA 2021.

RECENT 5G DEVELOPMENTS IN KOREA

5G Network Deployment

Since the launch of business-to-consumer (B2C) 5G commercial services in April 2019, all three major Korean mobile network operators (MNOs), SK Telecom, KT, and LGU+, are actively investing in 5G networks to complete the national deployment by 2022. As of December 2020, 5G coverage is 80 percent in Seoul and 30 percent in six metropolitan areas.³

Figure 1. 5G coverage map by carrier as of December 2020

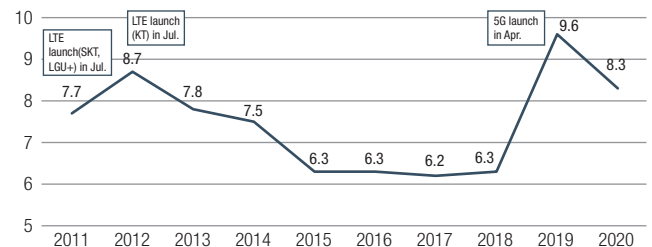


Source: MSIT

In 2019, MNOs invested KRW 9.6 trillion (approximately USD 7.8 billion), up about 50 percent from the previous year, to build 3.5 GHz-band base stations. In 2020, the investment dropped to KRW 8.28 trillion (approximately USD 7.4 billion), 7–8 percent short of the initial target, due to the impact of COVID-19. On average, MNOs have invested KRW 7.5 trillion annually in the last 10 years with a sharp rise in investment in 2012 and 2019, when commercial LTE and 5G services started gaining traction. In the case of LTE,

investment slowed down after the second year of commercialization (see Figure 2).

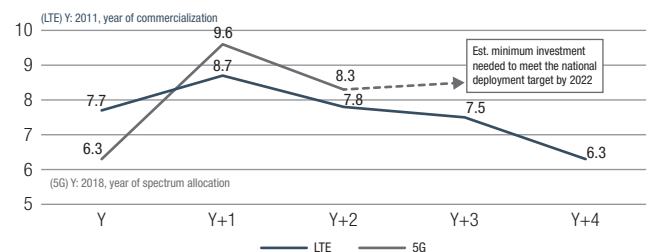
Figure 2. MNO investment from 2011 to 2020, in KRW, trillions



Source: MSIT

The Ministry of Science and ICT (MSIT) projects that, at minimum, KRW 8.3 trillion annual investment is needed until 2023 to adequately meet the national deployment target by 2022 and make up for the investment slowdown caused by COVID-19 (see Figure 3).

Figure 3. 5G Investment by MNOs compared to LTE, in KRW, trillions



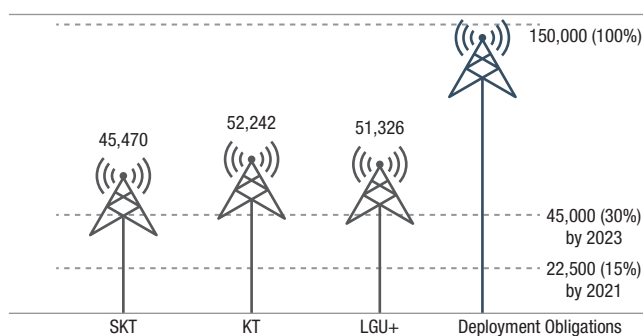
Source: MSIT

To encourage investment and speed up network deployment, the government is offering 3 percent tax credit for 5G investments with an additional 3 percent tax credit for the increase over the average of the previous three years' investment. It also conducts a semiannual service inspection to ensure service quality and coverage. As a result of the rapid subscriber growth, increasing competition, and government encouragement, the three major MNOs are building their 5G networks ahead of the coverage obligation timeline set under the 5G spectrum auction conditions (see Figure 4). By the end of March 2021, all MNOs exceeded the deployment

3 See <https://news.joins.com/article/23958383>.

obligation benchmark set for 2023 with an average of around 50,000 3.5-GHz-band base stations per operator. In total, the three companies built 149,038 base stations, completing 33 percent of the total deployment obligations.⁴ The deployment of 28-GHz base stations has been slow. As of March 2021, 91 28-GHz-band stations have been reported to MSIT.⁵

Figure 4. Base station (3.5-GHz band) deployment by carrier as of March 2021



Source: MSIT

Despite accelerated network deployment, service coverage in buildings and sparsely populated areas has been limited, leading some disgruntled 5G users to launch a class-action suit against the three major MNOs.⁶

Table 1. 5G Rollout outlook by country/region

Country/Region	Available end of 2020	Planned for 2021
China	<ul style="list-style-type: none"> NSA Sub-6 GHz Standalone 	<ul style="list-style-type: none"> Sub-6 FDD Sub-6 carrier aggregation
Europe	<ul style="list-style-type: none"> NSA Sub-6 GHz Sub-6 FDD mmWave 	<ul style="list-style-type: none"> Standalone Sub-6 carrier aggregation
USA	<ul style="list-style-type: none"> NSA Sub-6 GHz mmWave Sub-6 FDD Standalone 	<ul style="list-style-type: none"> Sub-6 carrier aggregation Sub-6+mmwave aggregation
Japan	<ul style="list-style-type: none"> NSA Sub-6 GHz mmWave Sub-6 carrier aggregation 	<ul style="list-style-type: none"> Sub-6 FDD Standalone Sub-6+mmwave aggregation
Korea	<ul style="list-style-type: none"> NSA Sub-6 GHz 	<ul style="list-style-type: none"> mmWave Standalone Sub-6 FDD Sub-6 carrier aggregation Sub-6+mmWave aggregation

Source: Qualcomm 2021

5G Services

5G migration paths can be divided into two major categories: Non-Standalone (NSA) and Standalone (SA), defined by the 3rd Generation Partnership Project (3GPP). With 5G NSA, operators can utilize legacy 4G infrastructure to quickly tap into high-speed 5G services, while 5G SA enables operators to unlock the full potential of 5G by leveraging new features such as Ultra-Reliable Low Latency Communications (URLLC), and network slicing.

Since the launch in April 2019, the three MNOs have been building 5G networks with an NSA mode. The MNOs have completed testing 5G SA networks, but commercial networks are yet to be deployed as of April 2021.

5G use cases can be divided into three broad scenarios: Enhanced Mobile Broadband (eMBB), Ultra-Reliable Low Latency Communications (URLLC), and Massive Machine-Type Communications (mMTC or Massive IoT).

⁴ Base station numbers provided by MSIT.

⁵ Base station numbers provided by MSIT.

⁶ <https://koreajoongangdaily.joins.com/2021/03/22/business/industry/5G-SK-Telecom-KT/20210322174107246.html>

Box 1. Edge computing and network slicing

5G's ultra-low latency is possible, thanks to **Mobile Edge Computing (MEC)**. In conventional cellular networks, communications to and from subscribers are all **processed in a network core data center**. With MEC, some processing **can be done at the edge of the network**, close to the subscriber. Besides providing ultra-low latency, MEC significantly reduces the bandwidth needed for backhaul since it can handle large amounts of data near the source.

Network slicing allows mobile operators to meet a wide range of user service needs. By 'slicing' a network into a set of logical networks on top of a shared infrastructure, operators can provide customized virtual networks with different characteristics to serve different users simultaneously.

Examples of eMBB services include augmented reality (AR)/virtual reality (VR) and multi-point video services based on improved transmission speed. URLLC services include latency-sensitive services such as autonomous vehicles and digital healthcare applications. mMTC applications can power smart cities with a massive amount of real-time data communicated from IoT.

With their strategic approaches in introducing innovative services, the three major MNOs, SK Telecom, KT, and LGU+, have contributed to the country's fast 5G adoption. The operators have attracted 5G subscribers by offering 5G plans bundled with specialized content services and subsidized devices, contributing to the faster-than-expected 5G adoption rate in the country. The MNOs provide a range of 5G B2C and business-to-business(B2B) services that leverage 5G's superior

speed, latency, and connectivity across different usage scenarios (see Box 2).

Table 2. 5G usage cases and scenarios

Usage Scenarios	Description	Use Case Examples
Enhanced Mobile Broadband (eMBB)	Heavy data services	<ul style="list-style-type: none"> Enhanced indoor and outdoor broadband enterprise collaboration AR/VR
Ultra-Reliable Low Latency Communication (URLLC) or Mission-Critical Machine-Type Communication (cMTC)	Latency-Sensitive Services	<ul style="list-style-type: none"> autonomous vehicles smart grids remote patient monitoring and telehealth industrial automaiton
Massive Machine-Type Communications (mMTC or Massive IoT)	Massive-Connectivity Services	<ul style="list-style-type: none"> Internet of Things (IoT) asset tracking smart agriculture smart cities energy monitoring smart home remote monitoring

Source: ITU

The MNOs offer 5G B2B services such as smart factories, autonomous robots, digital healthcare, and immersive media content on the NSA networks operating on the 3.5-GHz band. They are developing new B2B use cases utilizing 5G, MEC, artificial intelligence (AI), big data, and cloud to address diverse industry needs.

The MNOs are also partnering with global industry peers to develop 5G services. In September 2020, LGU+ founded 'Global XR Content Telco Alliance', the world's first international 5G extended reality alliance, to co-develop XR content with global partners.⁷ KT is a founding member of the '5G Future Forum' that develops 5G interoperability specifications to accelerate the delivery of 5G and MEC solutions globally.⁸ SK Telecom launched the 'Global 5G MEC Task Force' with a number of Asian operators to jointly develop MEC technologies and services.⁹

7 <https://www.ajudaily.com/view/20210310162400191>

8 <http://www.businesskorea.co.kr/news/articleView.html?idxno=44762>

9 <https://www.rcrwireless.com/20200113/5g/sk-telecom-launches-global-mec-task-force-asian-operators>

Box 2. Key 5G services

B2C

VR/AR

5G enables AR/VR and multi-point video services with enhanced data speeds and low latency.



VR Social World (SKT)

Users can create their own avatars to watch movies, play games, and socialize with other users in the VR space.

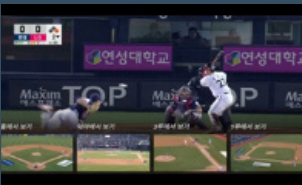


Idol Live (LG U+)

Users can watch their favorite K-pop idols' performances in the VR environment, as if they were sitting in a real theater.

Sports Immersive Media

Baseball is one of the most popular sports in Korea. MNOs introduced 5G specialized services for baseball fans, providing real-time and high-quality game videos.



Multi-Position Videos (LGU+)

Viewers can select from multiple angles to watch (from home, first base, third base, to outfield videos).



Matrix View (KT)

With 40 high-definition cameras, viewers can access 270-degree time slice videos.

Games

5G's ultra-low latency and super-fast speeds provide optimal play environment for online game enthusiasts.



5GX Cloud Game (SKT)

SK Telecom provides a subscription-based 5G cloud game service powered by Microsoft's Xbox Game Pass Ultimate.



GameBox (KT)

KT's subscription-based 5G cloud game service offers 110 games. The service is open to subscribers of other carrier services.

B2B

Smart Factory

SK Telecom's smart factory solutions include 5G-AI Machine Vision for product defect detection, 5G-multifunctional robot that filters out defective products in less than eight seconds, by communicating with a cloud server storing images from 12-MP cameras, AR Smart glasses, and 5G Autonomous Mobile Robot (AMR). SK Telecom offers a subscription-based smart factory service to boost service adoption for SMEs.



Smart Drones

LGU+ provides 5G-powered cloud drone control system that can monitor industrial sites in real time with autonomous flying drone transmitting high-capacity data. Smart drones can be dispatched for various industry use cases including logistics, aerial survey, water survey, bridge safety inspection, and pesticide sprays.



Digital Healthcare

KT and Samsung Medical Center are building a 5G Smart Hospital with a dedicated enterprise network. Currently in the pilot stage, the services in development include digital diagnostic pathology, access to proton therapy information, remote surgery classes, an AI-enabled care for in-patients, and an autonomous robot for the operating room.



5G Subscriptions

On April 3, 2019, Korea launched the world’s first 5G services with 5G smartphones. Even before the large-scale smartphone-based commercial launch, 5G services based on mobile routers (dongles) were introduced for corporate customers in December 2018. In October 2019, six months after the commercial launch, the number of 5G subscribers totaled 3.5 million. 5G subscriptions have been steadily increasing to reach 20 percent of total mobile subscriptions by the end of February 2021.

All three major MNOs, SK Telecom, KT, and LGU+, simultaneously commenced 5G services, while LTE service launch differed by operator for up to four months. Both LTE and 5G surpassed 1 million subscribers in about 2 months since the launch, and it took 14 months for LTE and 19 months for 5G to reach 10 million subscribers.

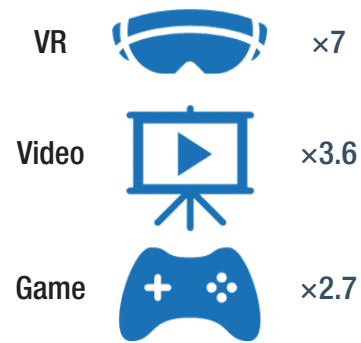
The main impetus for the rapid transition to LTE from 3G was the widespread adoption of smartphones and increased demand for high-value and data-centric services such as video streaming. In 5G’s case, the main early drivers for the transition were consumer expectations for new technologies, demonstrations of differentiated services at the Pyeongchang Winter Olympics, and active marketing by MNOs.

Changes in the Mobile Traffic

According to the SK Telecom subscriber analysis, 5G users tend to watch next-generation media services such as multi-view and 360-degree VR Ecosystem that utilizes 5G’s fast speed and connectivity. As of February 2020, 5G subscribers used VR, online videos, and games 7 times, 3.6 times, and 2.7 times more than LTE subscribers, respectively (see Figure

5).¹⁰

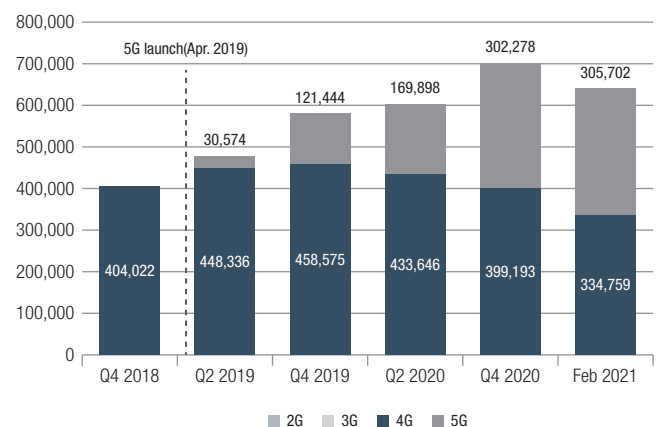
Figure 5. SKT 5G User service increase compared to LTE Users



Source: SK Telecom 2020

On average, 5G subscribers use three times more data per user than LTE subscribers. Although 5G subscriptions comprised 19 percent of the total mobile subscriptions in February 2021, they generated 47 percent of the month’s total mobile communication traffic (see Figures 6 and 7). The average traffic per 5G subscriber is 23.4 GB/month, about three times higher than that of an average LTE subscriber at 8.3 GB/month.

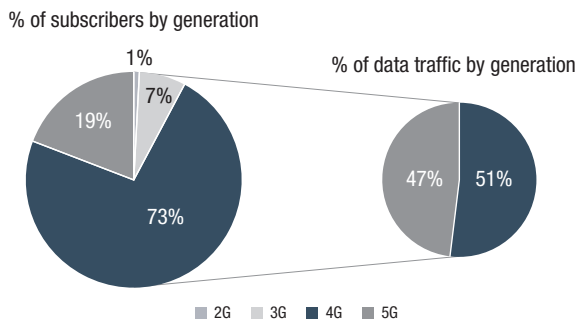
Figure 6. Mobile traffic per generation, in TB



Source: MSIT 2021b

10 https://www.sktelecom.com/advertise/press_detail.do?page.page=1&idx=5195&page.type=all&page.keyword=

Figure 7. Percentage of subscriptions by generation and mobile traffic as of February 2021



Source: MSIT

NATIONAL 5G STRATEGY: FROM THE WORLD'S FIRST TO THE WORLD'S BEST 5G

Policy Developments Leading to 5G

Korea has earned a reputation as a global information and communication technology (ICT) leader with decades of government investments in modern technology. With the aim of accelerating digital transformation, the government began supporting ICT development from as early as the 1990s. Today, the country is the second biggest spender on research and development (R&D) as a percentage of gross domestic product (GDP) in the world.¹¹

The government recognized early that 5G would play a pivotal role in the fourth industrial revolution. In May 2013, the government launched the 5G Forum to initiate formal discussions on the national

5G strategy and readiness, drawing members from public institutions and the private sector. With the establishment of the Presidential Committee on the 4th Industrial Revolution (November 2017), the government declared 5G as one of the three keys to the fourth industrial revolution, Data, Network, and AI (DNA). Since then, the government has significantly expanded its support for DNA, announcing various policies including I-Korea 4.0 Plan (2017); Hyper-Connected Intelligent Network Deployment Strategy (2017); AI R&D Strategy (2018); Data Industry Activation Strategy (2018); System Semiconductor Strategy (2019); 5G+ Strategy (2019); Manufacturing Renaissance Strategy (2019); and the Korean New Deal (2020).

Since the government announced the I-Korea 4.0 Plan in 2017 to promote the fourth industrial revolution centered on enhancing people's lives based on ICT technology, it has clearly presented its vision and roadmap to introduce 5G. Following the launch of the I-Korea 4.0 Plan, the government announced the Hyper-Connected Intelligent Network Deployment Strategy (2017) to prepare for the fourth industrial revolution. The following four policy goals were presented: (a) world's first 5G commercialization and nationwide 5G coverage by 2022, (b) increasing IoT connectivity, (c) implementing smart and reliable network based on software and AI, and (d) deploying nationwide high-speed internet access.

Figure 8. Keys to the fourth industrial revolution



Source: Government of Rep. of Korea 2020

The government's transparent, proactive, and long-term focused spectrum planning was a key enabler in the country's early 5G adoption. Since the early 2010s, the government recognized that making additional spectrum available in a timely manner is

¹¹ <https://www.weforum.org/agenda/2020/11/countries-spending-research-development-gdp/>

a crucial lever to accelerate 5G. It laid out its vision through the Mobile Gwanggaeto Plan (a national spectrum roadmap) 1.0 (2012), 2.0 (2013), and K-ICT spectrum plan (2017).¹² Due to the proactive planning and actions, Korea became the first country to simultaneously allocate the mid band (3.5 GHz) and ultra-high band (28 GHz) for 5G service in June 2018, followed by the world's first smartphone-based 5G commercial service launch in April 2019.

Figure 9. Key milestones leading to 5G launch

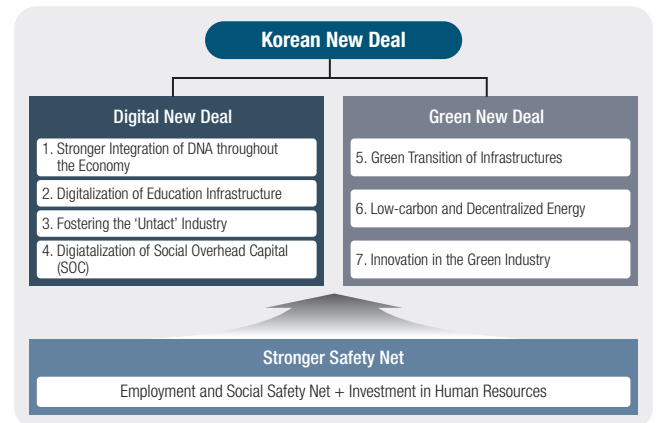


Source: MSIT 2019a

Less than a week after the 5G commercial launch, the government unveiled the 5G+ Strategy. The 5G+ Strategy sets out the government's ambition for Korea as a global leader in 5G technology and the steps it will take to realize this goal. The 5G+ Strategy includes specific policies and measures to support ten strategic 5G-related industries and five core services to transform the economy.

In July 2020, the government announced the Korean New Deal, the national strategy with the vision to create a smart, green, and inclusive country with 5G as a crucial underpinning infrastructure for data and innovation-driven economy. Under the Korean New Deal, the government outlined the Digital New Deal and Green New Deal as two main policies to transform the country from a fast follower into a first mover.

Figure 10. Focus areas of the Korean New Deal

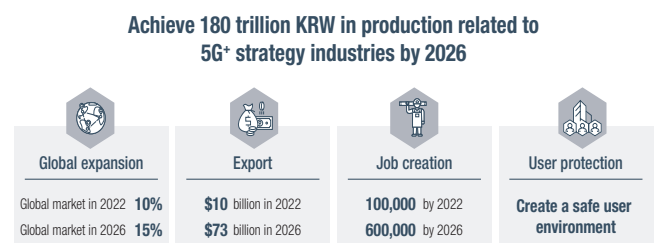


Source: MOEF 2020

Key Policy Direction: Create New 5G based industries and Jobs

The goal of Korea's national 5G strategy is to promote 5G-based new industries and private sector-led market revitalization. As illustrated in Figure 11, the government has defined global business expansion, increased exports, job creation, and creation of a safe user environment as major policy goals. In pursuing these goals, the government has outlined key policy directions as below.

Figure 11. 5G+ Strategy policy goals



Source: MSIT 2019a

¹² The name Gwanggaeto comes from Gwanggaeto the Great, the nineteenth monarch of Goguryeo, a Korean kingdom. Also known as the 'broad expander of territory', his legacy of the great expansion of Korea's territory during his reign gave his people confidence, hope, and strength.

Provide Customized Support for Selected 5G Strategic Industries and Services

The government selected ten strategic industries and five core services to prioritize investment and support. In making the selection, the government considered various factors such as service usability, relevance, global marketability, domestic competitiveness, and the need for policy support. The selection was informed by expert interviews and market analysis by global/local ICT institutions and companies. The government will provide targeted support for each industry based on market maturity and demand. Key government-sponsored 5G use case projects in 5G strategic industries are explained in Box 3.

- Strategic industries and services:
 - Ten strategic industries: network equipment, next-generation smartphones, VR-AR devices, wearable devices, intelligent CCTV, (future) drones, connected robots, 5G V2X, information security, edge computing
 - Five core services: immersive contents, smart factories, autonomous vehicles, digital healthcare, smart cities
- Timeline:
 - 1st stage: Incubate and develop five core 5G services (2018~2021)

- 2nd stage: Promote '5G+ Innovation Project' to drive market adoption of core services (2021~2025)

Create the Conditions for Innovative and Efficient 5G Ecosystem

Both the government and the industry have distinct and important roles in developing an innovative 5G ecosystem. Therefore, the government has defined its role in each phase of the 5G ecosystem to pave the way for private sector-led innovation (See Figure 13). The goal is to create an innovation-friendly regulatory environment for ecosystem development.

Ensure a Safe Deployment of 5G Network and Services

To build the safest user environment in a hyper-connected society, the government placed strong emphasis on 5G security measures. The 5G Cybersecurity Council, with over 50 members from public and private sector, will provide institutional guidance on the cybersecurity policy, technologies, and standards.

Figure 12. Differentiated support for industries based on market maturity and demand

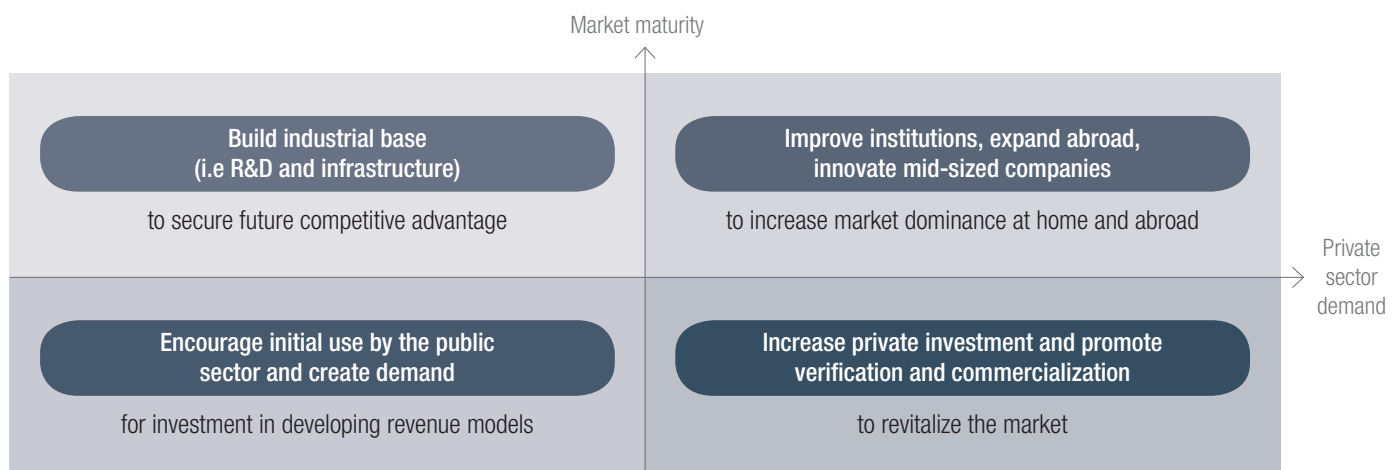
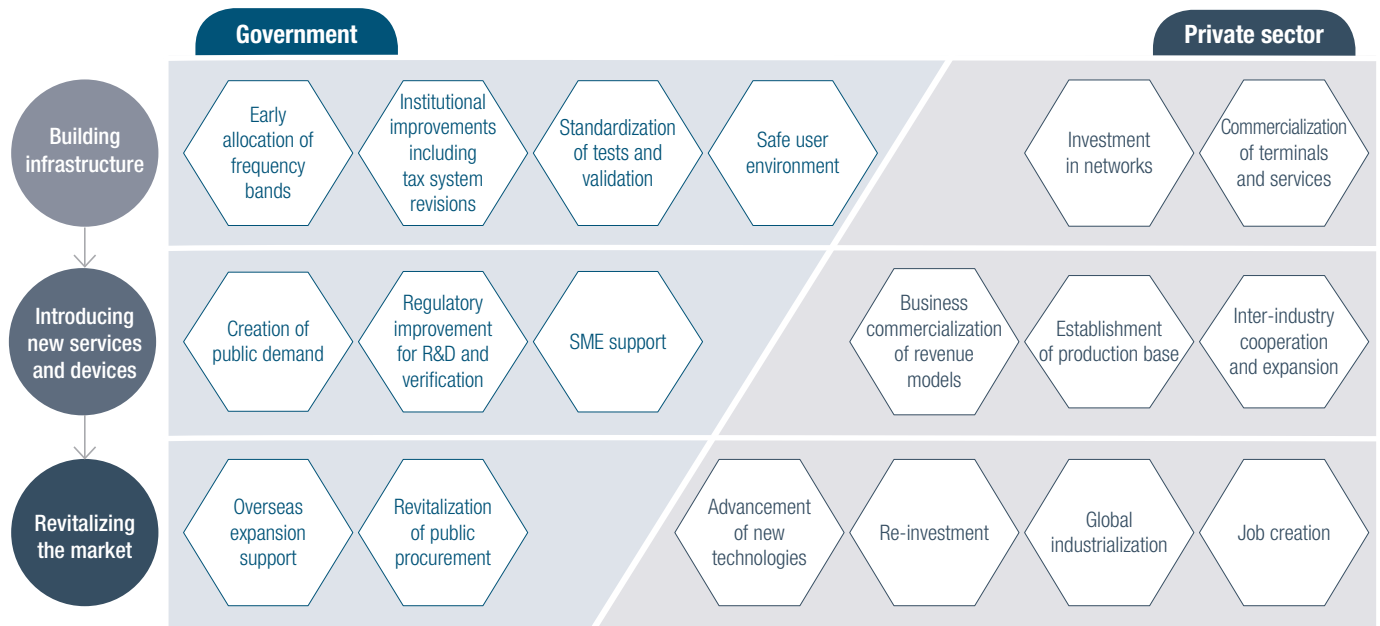


Figure13. Government and industry role by phase in 5G ecosystem development



Source: MSIT 2019

Box 3. Government-sponsored 5G projects

Trial Networks in Government Buildings

The Ministry of the Interior and Safety launched a six-month 5G trial in June 2020 within its Digital Government Bureau. During the trial, the government plans to verify the security and quality of communications afforded by 5G in preparation of government-wide deployment of 5G. The government targets to build dedicated 5G networks in 4 government complexes and 17 municipal governments by 2025.

Immersive Media/AR/VR

MSIT launched the 5G Contents Flagship Project in April 2019 to support the development of 5G immersive media/AR/VR use cases to reach the global market. In October 2019, the ministry showcased 10 selected use cases in the ‘Smart-X based on 5G’ event, as part of the trade show hosted by Korea Trade-Investment Promotion Agency (KOTRA). As of April 2020, the ministry supported 28 use cases, created a seed money investment fund of KRW 30 billion (approximately USD 27 million), and built 5G experience centers in the U.S. (Los Angeles) and Vietnam (Ho Chi Minh City).



AR arthroplasty surgery training by Holoworks



Wide view(12K*2K) 5G VR live sports broadcasting by DIKE



Camel racing AR live broadcasting by Livemolo

Box 3. Government-sponsored 5G projects

Drones

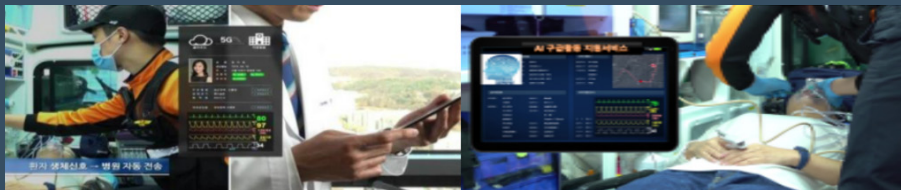
MSIT's DNA + drone technology project (2020~2024, totaling KRW 48 billion [approximately USD 43 million]) is operated by the consortium led by the Korea Electronics and Telecommunications Research Institute (ETRI). The project combines data, 5G, and AI to develop four drone service models:

- Police drones (search and patrol)
- Flood and water quality monitoring drones
- Smart farm drones
- High-rise buildings and infrastructure monitoring drones

The selected consortium consists of three public research institutes including ETRI, three universities including KAIST, and three companies including telecommunications companies (KT, LGU+), drone producers, and AI companies (acrylics, and so on).

Digital Healthcare

In 2019, MSIT launched a three-year, KRW 18 billion (approximately USD 16 million) project to build 5G-enabled medical emergency response system in collaboration with the Ministry of Health and Welfare (MoHW), and the National Fire Agency. The system includes ambulance equipment and emergency data integration and analysis platform that collects and transmits various patient information (voice, video, bio-signals) in real-time through a 5G network.



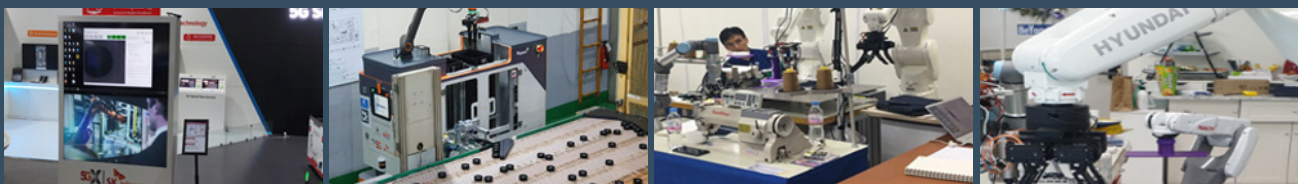
[5G-enabled intelligent emergency medical service]

- ① Patient information collection and analysis (360-degree camera, microphone, 5G network, cloud)
- ② Emergency patient severity classification and smart medical guidance
- ③ Optimal transfer hospital selection support (AI, cloud)
- ④ Automatic rescue report generation
- ⑤ Systematic patient management through emergency medical information network (National Emergency Department Information System, MoHW)

Smart Factory

Since 2019, the government has focused on developing 5G-enabled smart factory solutions to boost the competitiveness of the manufacturing industry. Smart factory solutions such as machine vision, autonomous logistics robots, sewing robots, and gripper robots have been developed and tested in 10 sites. As of the end of 2020, the government supplied 53 factories with smart factory solutions and launched the Korea AI Manufacturing Platform (KAMP) for SMEs.

[5G-enabled intelligent emergency medical service]



Machine vision

Logistics robots

Sewing robots

Gripper robots

Key Government Actions

Creating the best market conditions for rapid and efficient 5G deployment is the government's key goal. The government introduced various actions to achieve its policy goals and create a conducive environment for improving supply (market dynamic) and increasing demand (increasing adoption and usage).

Be an Early Customer to Create a Market for 5G Services and Improve Public Services

The government wants to become a major driver of 5G services by harnessing its purchasing power. The goal is to verify business models and drive market demand by the government's early adoption of 5G services in the public sector.

The 5G+ Strategy introduces a two-stage approach to support the development and dissemination (industrialization) of 5G use cases in the five core services. In the first stage (2019–2021), the government will fund various 5G projects to develop use cases for the public sector. The projects include the '5G+ Smart Social Overhead Capital (SOC) project' to develop 5G-based real-time intelligent monitoring systems for SOCs, public facilities, and nuclear power plants. The government will also support the development of 5G devices such as 5G robots, drones, and intelligent CCTV by funding R&D and pilots. 5G+ Life Projects focus on improving citizens' quality of life in education, health, welfare, and the environment. For example, the projects aim to expand the '5G remote cooperative medical treatment project' to 50 percent of general hospitals by 2023. By developing an AI-based smart city operation system connected to 5G, the government plans to build the foundation for 5G-based smart cities. In the second stage of dissemination and expansion of 5G use cases (2021–2025), the government will build the '5G+ Innovation Center' as a hub for industrialization. The planned budget for the 5G convergence service development is KRW 120 billion until 2022.

Incentivize and Encourage Private Investment

The government provides up to 3 percent tax credit for investments in the 5G network to spur private financing for the 5G rollout. It also provides financial support leveraging development banks and public funds dedicated to 5G-related investment. The government supports 5G pilots and trials in 5G key sectors, including 5G terminals and equipment, 5G V2X platforms, 5G drones, and edge computing, from 13 hubs for 5G testing and verification.

Facilitate 5G Adoption through Regulatory and Policy Reform

For a flexible regulatory environment for 5G convergence services, the government introduces regulatory sandboxes and eases regulation on location data to facilitate location-based services (Location Information Act revised in 2019).

Addressing cyber threats from mass connectivity through a robust security regime is another key priority. The government designates core 5G facilities as critical information and communications infrastructure and develops an ICT convergence protection system, with the revision of the Information and Communications Network Act.

In preparation for the rapid increase of IoT devices, the government replaced the permit system for facilities-based telecommunications business entities with the registration system to remove barriers for new entrants.

Strengthen 5G Ecosystem and Industry Foundation

The government plans to develop core technologies in the next-generation device industry (that is, immersive head-mounted display (HMD), AR classes, wearables, and robots). For example, it will support the development of an open 'cloud robot' platform (2020–2023) that integrates 5G, cloud computing, and AI. Additionally, the government is committed to

increasing R&D investment in advanced technologies (that is, beyond 5G technologies, hologram content core technology development). As securing 5G networks is critical, the government is also focusing on boosting the cybersecurity industry by investing in R&D and supporting the development of security services for 5G convergence services such as smart cities and factories. Establishing a solid foundation for the 5G content market is another key priority. The technology development for realistic cultural experiences in museums, tourist sites, and sports events will be supported. Support for next-generation 5G content production and distribution in key Korean Wave sectors—including broadcasting, music, gaming, and webtoon—will be expanded. Promising technology startups in 5G applied content and service sectors will receive increased R&D support through funding and ‘5G Immersive Contents Lab’ that promotes 5G content startups.

Support Globalization of the Korean 5G Industry

Expanding Korean companies’ access to the global market is a key policy goal of the 5G+ Strategy. The government is promoting the globalization of Korean 5G services by organizing a consortium of large enterprises as well as small and medium enterprises (SMEs) in target markets. The government is also actively engaged in the global 5G standardization process with international 5G standards bodies such as 3GPP and ITU.

Accelerate Digital Transformation through the Digital New Deal

The government has recognized 5G as a crucial underpinning infrastructure for a data and innovation-driven economy. 5G-enabled Digital Deal projects that integrate 5G, data, and AI in industries old and new include the following:

- Immersive content: Produce 195 immersive contents for public entertainment and commercial use in manufacturing, healthcare, construction,

transportation, education, and defense industries by 2025.

- Smart factories: Build 12,000 smart factories to have 30,000 smart factories nationwide by 2025 (17,800 smart factories as of 2020).
- Autonomous vehicles: Operate pilots and develop standards and technology for commercialization.
- ‘Smart Korea Fund’ to support startups: Create a KRW 6 trillion (approximately USD 5.3 billion) fund to invest in startups developing digital solutions for e-commerce and online services, digital infrastructure for remote jobs, remote working solutions to SMEs, and digital healthcare infrastructure.

Additionally, the government plans to build smart government that utilizes 5G and AI with a phased establishment of 5G at all government complexes by 2025. In 2021, the government set aside KRW 11.5 billion (approximately USD 10 million) to pilot 5G-enabled dedicated networks in five agencies.

Table 3. 5G policy targets outlined in the New Korean Deal

	2020	2022	2025
5G penetration	14.3% (as of June 2020)	45%	70%
Nationwide 5G network for smart government	Government work based on wired networks	Deploy 5G wireless network	Dedicated 5G wireless network in all government complexes

Source: MOEF 2020

Encourage Joint Construction and Network Sharing to Expedite National Deployment

The government is encouraging joint construction and network sharing to expedite the national network rollout, optimize investment, and expand 5G access in rural areas.

- **Extension of the joint construction obligations to MNOs to avoid duplicating network and increase investment efficiency**

Previously, joint construction obligations of communications facilities were applied only to the fixed network operators. However, right before the 5G spectrum auction in 2018, the government announced the extension of the joint construction obligations to MNOs on building wireless equipment. Additionally, in anticipation of the increase in base station deployment in small buildings, the government lowered the total floor area threshold for joint construction from 2,000 m² to 1,000 m². According to MSIT, the cost savings from network joint construction is estimated to be KRW 400 billion to 1 trillion (approximately USD 300–900 million) for a 10-year period.¹³

• Launch of the Rural 5G Roaming Task Force Team

In September 2020, MSIT launched the Rural 5G Roaming Task Force Team to review network sharing options in rural and sparsely populated areas.¹⁴ The Task Force Team draws its members from diverse institutions, including the three MNOs (SK Telecom, KT, LGU+), a research institute (ETRI), a standardization agency (Telecommunications Technology Association [TTA]), a trade association (Korea Telecommunications Businesses Association [KTBA]), and a government ministry (MSIT). In April 2021, the MNOs signed a memorandum of understanding (MoU) to share the network in 131 remote locations across the country.¹⁵

Governance

In May 2013, MSIT launched the 5G Forum to initiate formal discussions on the national 5G strategy and readiness, drawing members from public institutions and the private sector. A year after the Forum's launch, MSIT established the 5G Strategy Committee as a public-private partnership vehicle in preparation for the 5G commercial launch. The 5G Strategy

Committee then expanded and evolved into the 5G+ Strategy Committee, the cross-ministerial and multi-stakeholder partnership vehicle, to plan and execute the national 5G strategy. From its inception, the Committee was designed to be inclusive of multi-stakeholder input and participation, inviting members from relevant ministries, industry, academia, and civil society. The Committee is co-chaired by the Minister of MSIT and a private sector expert who is the lead facilitator of discussions.

The Committee is responsible for coordinating cross-ministerial and joint tasks between the public and private sectors. It establishes the action plans and monitors the implementation of tasks through a monthly 5G+ Strategy Review Meeting. Based on the results of the assessments, the Committee revises its strategies to reflect the latest market developments.

For each of the 5G strategic industries, the Committee designates sector representatives from MSIT to lead communication and collaboration among relevant ministries, industries, academia, and research institutes. Additionally, the Committee establishes a direct communications channel for the private sector to raise regulatory issues to be promptly addressed.

The Committee's work is also informed by various issue-specific councils launched by the government, including 5G Service Inspection Task Force responsible for assessing nationwide 5G service quality, 5G Strategic Industry Public-Private Roundtables, 5G Cybersecurity Advisory Council, 5G Policy Council, and 5G Rural Roaming Task Force Team.

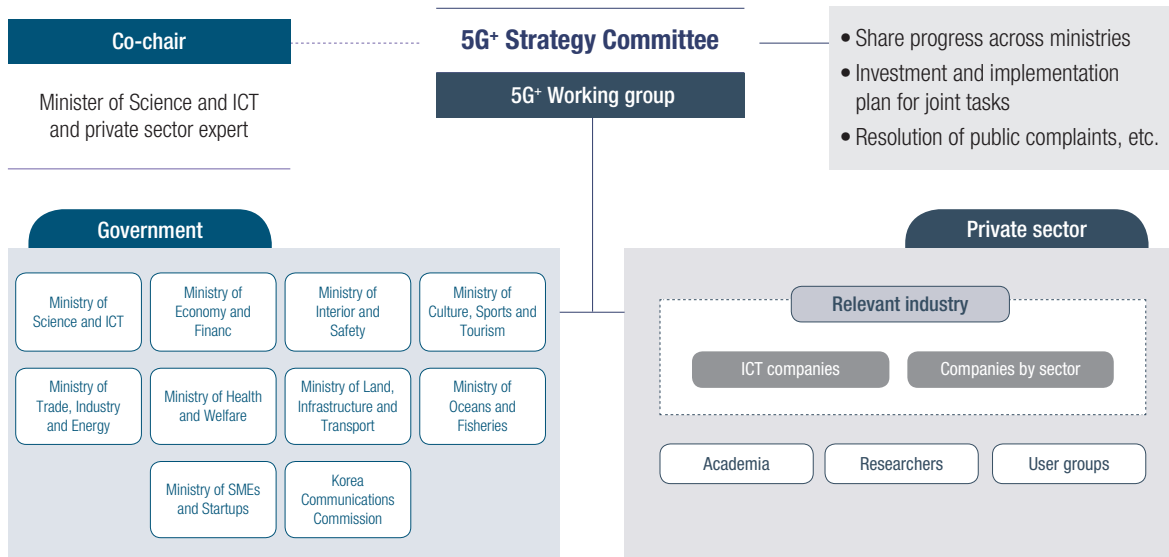
There is a consensus among the members that the Committee has effectively demonstrated a whole-of-government approach at the national level, facilitating cross-ministry governance and regulatory cooperation while promoting healthy competition and cross-industry collaboration.

13 <https://www.msit.go.kr/bbs/view.do?sCode=user&mId=113&mPid=112&pageIndex=12&bbsSeqNo=94&nttSeqNo=1379674&searchOpt=ALL&searchTxt=5g>

14 <https://www.msit.go.kr/bbs/view.do?sCode=user&mId=113&mPid=112&pageIndex=1&bbsSeqNo=94&nttSeqNo=3070221&searchOpt=ALL&searchTxt=5g>

15 <https://en.yna.co.kr/view/AEN20210415002500320?section=search>

Figure 14. 5G+ Strategy Committee



Source: MSIT 2019a

5G SPECTRUM POLICY

Spectrum Planning Leading Up to 5G and Beyond

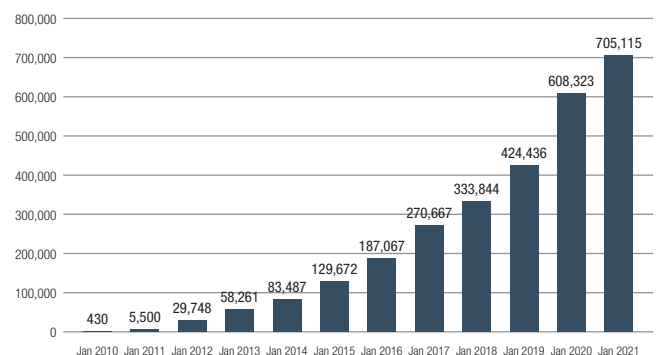
The government’s spectrum policy has direct consequences on the speed, reach, and reliability of 5G services. Therefore, the timely release of the right amount and type of spectrum under the right conditions is critical for a country’s successful transition to 5G.¹⁶ In this regard, the Korean government was proactive in meeting the mobile market’s rapidly increasing demand for spectrum in the last decade.

Korea became one of the first countries in the world to successfully hold a 5G spectrum auction, primarily due to the government’s early planning dating back to the early 2010s.

Following the introduction of smartphones in the market in 2009, Korea witnessed rapid growth in

data traffic/demand from users (see Figure 15). Recognizing the need for long-term, forward-looking policy making to respond to the growing market demand for spectrum, the government established the national spectrum roadmap in the early 2010s to prepare for 5G. The government first addressed the spectrum plan for 5G in Mobile Gwanggaeto Plan 2.0 in December 2013. It subsequently introduced concrete steps to secure the 5G spectrum in the K-ICT Plan announced in January 2017.

Figure 15. Annual mobile traffic, in TB



Source: MSIT

The spectrum planning leading up to the first 5G spectrum auction in June 2018 and the 5G+ Spectrum Plan released in December 2019 are detailed below.

16 GSMA 2018. <https://www.gsma.com/spectrum/wp-content/uploads/2018/12/5G-Spectrum-Positions-1.pdf>

- Mobile Gwanggaeto Plan 1.0 (January 2012): Secure 600 MHz of mobile spectrum by 2020 to accommodate the explosion of mobile traffic due to the introduction of smartphones.
- Mobile Gwanggaeto Plan 2.0 (December 2013): Assign extra 1 GHz bandwidth as a mobile spectrum to prepare for explosive mobile traffic growth.
- K-ICT Spectrum Plan (January 2017): While the Mobile Gwanggaeto Plan focused on the spectrum for the mobile service, the K-ICT plan encompassed the spectrums for industry/safe and smart lifestyle, public use, satellite, and mobile communications, and a total of 40 GHz bandwidth was planned to be secured. In particular, a plan for securing a total of 4,400 MHz bandwidth for 5G was announced.
- 5G+ Spectrum Plan (December 2019): 5G+ spectrum plan is a five-year plan that includes plans for licensed, unlicensed, and local 5G spectrum.

Figure 16. 5G+ Spectrum Plan Timeline

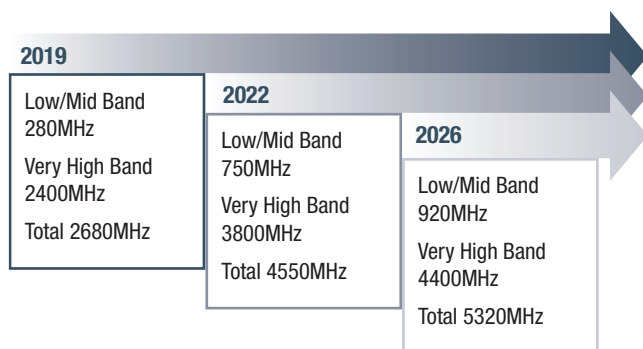
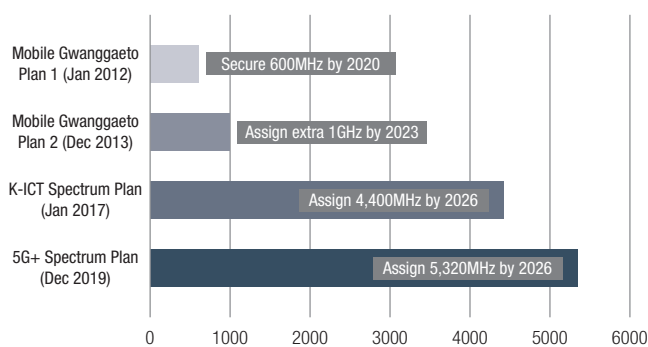


Figure 17. Planned spectrum bandwidth per the spectrum plan



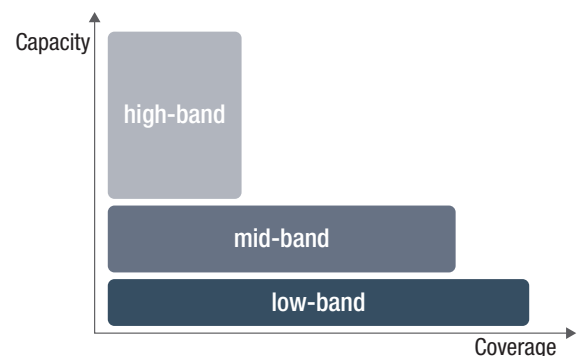
Source: MSIT

5G Spectrum Auction (June 2018)

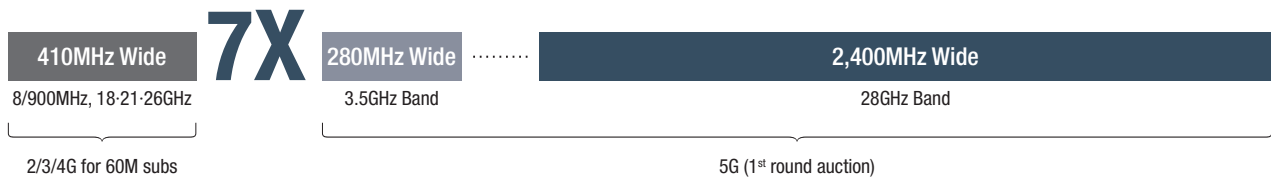
Addressing New Challenges

When the government first began a formal review for 5G spectrum planning in 2017, there was a high degree of uncertainty around the government’s 5G strategy, regulatory approach, along with the unclear prospect of return on investment for the private sector. Unlike the spectrum assignments for the previous generations of mobile networks, there were unique factors and new challenges to consider in assigning the 5G spectrum. First, the spectrum bands at 3.5 GHz and 28 GHz had previously never been allocated for mobile use. In particular, the millimeter wave(mmWave) spectrum bands, which are extremely high-frequency bands between 30 and 300 GHz that enable super-fast speeds up to 1 Gbps per user, have significantly different propagation characteristics from the lower bands in terms of coverage, diffraction, and blockage (see Figure 18). Additionally, the spectrum bandwidth in consideration was much wider, as much as seven times wider than all spectrum in use for 2G/3G/4G networks (see Figure 19). Therefore, the criteria used in the previous auctions for determining technical characteristics and economic value of spectrum was mostly not applicable for the 5G spectrum auction.

Figure 18. Illustrated comparison per 5G bands



Source: Samsung Electronics 2021

Figure 19. Spectrum allocation status from 2G to 5G

Source: MSIT

While the 4G spectrum auction took place after LTE commercialization, the 5G spectrum auction had no precedent with the standardization processes still under way. It was also difficult to predict the impact on competition in the telecommunications market because of the diversity of 5G services and stakeholders. All the uncertainties mentioned above were significant factors in the design of detailed auction rules, such as the calculation of the reserve price and setting of a bandwidth cap per carrier.

The Goals of Spectrum Assignment

The main goal of the 5G spectrum was to promote 5G-based industry and service innovation and induce spillovers from the world's first 5G commercialization. This goal served as a basis for decision-making in designing the terms of the auction, such as spectrum cap, amidst various conflicting views on the auction design.

The pre-5G spectrum policies were reactive. They focused on meeting the demand for additional spectrum triggered by an exponential increase in mobile traffic. On the other hand, the 5G spectrum policy was proactive and forward-looking. The government sought to create new industries, innovative technologies and services while anticipating the change in the market competition that spans beyond the telecommunications sector. The government incorporated this new perspective on spectrum management into the simultaneous assignment of the 3.5 GHz band (for national deployment) and 28 GHz band (for hot spots) with the maximum available continuous spectrum of the 2.68 GHz bandwidth. Another goal of the 5G spectrum auction design was to prevent spectrum

monopolization, create fair competition, and induce the spectrum's effective use by setting the proper bandwidth limit per mobile carrier. Further, the government shortened the 5G spectrum assignment timeline by more than one year compared to the original plan to launch the world's first B2C 5G commercial service (see Figure 20).

Key Factors in 5G Auction Design

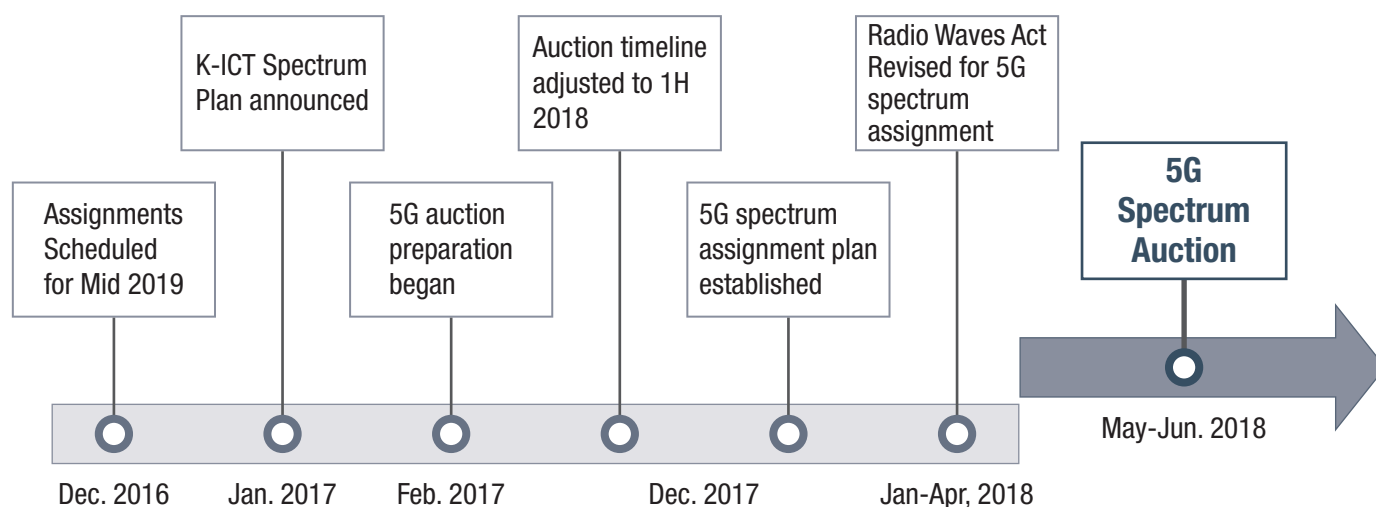
Major considerations in establishing the 5G spectrum policy included the method of assignment (auction versus beauty contest), spectrum cap, reserve price, coverage obligations, and auction rules.

- **Auction versus beauty contest**

Korea has been using the auction method for spectrum allocation since the Radio Waves Act first introduced it in 2010. According to the law, the auction method is to be used whenever demand exceeds the available spectrum. Within the Radio Policy Bureau, however, there was a serious debate as to whether the auction was appropriate for 5G spectrum allocation since the available spectrum exceeded MNO's demand while there was high uncertainty around the economic value of the new spectrum bands. In the end, the Radio Policy Bureau decided to use the auction method, as provided by the Radio Waves Act, after identifying a competitive demand for the mid-band spectrum.

- **Spectrum cap**

Spectrum cap was a more controversial topic than reserve price in Korea's first 5G spectrum auction in 2018. There was a heated demand, especially for the mid-band spectrum at 3.5 GHz, which was

Figure 20. Key milestones for 5G spectrum assignment

Source: MSIT

considered suitable for initial commercial 5G services. MSIT originally planned to allocate 300 MHz in the 3.5-GHz band.

MNOs disagreed on the spectrum cap. Competitors to significant market power (SMP) operator insisted that the bandwidth per operator should be the same to guarantee fair competition. The SMP operator argued a market-based approach is required to optimize spectrum utilization.

Ultimately, MSIT decided to place a strict spectrum cap at 100 MHz bandwidth for 3.5-GHz and 1,000 MHz bandwidth for the 28-GHz band per operator. The ministry announced that the decision was made to promote fair competition, protect consumer interests, and facilitate fast 5G network deployment by the MNOs.

- **Reserve price**

In determining the reserve price for the spectrum auction, MSIT considered several factors such as spectrum pricings in the previous spectrum auctions, competition dynamics of the current mobile market, technical features of the spectrum bands, the scale of bandwidth to be auctioned, and 5G market outlook.

The government tried to balance short-term revenue maximization goals and long-term socioeconomic

benefits from a rapid 5G network deployment. It also paid attention to the potential adverse consumer outcomes from high spectrum prices, especially for 28-GHz mmWave bands with high market potential and uncertainty. Since an excessive spectrum price could hinder the development of 5G applications and devices, the government modified the minimum price criteria and set the reserve price for the 28-GHz band at the lowest level. Instead, the license term was set at five years, half the time set for 3.5 GHz, to reduce investment risks.

- **Network deployment obligation**

MSIT applied different levels of obligations for the 3.5-GHz and 28-GHz bands because of the differences in coverage and capacity of both bands. For the 3.5-GHz band, the MNOs were obliged to deploy 150,000 base stations (including optical repeaters, RF repeaters, and small cells), 15 percent of which to be deployed in 3 years and 30 percent in five years. For the 28-GHz band, MNOs are obligated to build 100,000 cell sites and complete 15 percent of deployment in three years.

Small cell base stations and repeaters were counted for the network deployment obligation to help SMEs gain opportunities for growth in the 5G market.

- **Spectrum auction rule**

In view of assigning continuous wide bandwidth, the auction was executed in two stages: the amount of the spectrum is determined in stage 1 and the exact regions and blocks of spectrum are assigned in stage 2 in the newly introduced clock auction method. The maximum increase was limited to 1 percent in each bidding and the auctions proceeded up to 50 rounds in the first stage.

Auction Results

The 5G spectrum auction that was held in June 2018 ended at round 9.

- 3.5-GHz Band

In the first stage for the total 280 MHz bandwidth auction, 28 blocks were auctioned with 10 MHz per unit block, and the minimum auction price per block was calculated at KRW 94.8 billion (USD 79 million). In the first stage, the reserve price was KRW 2.6544 trillion (=94.8 billion/block X 28 blocks, USD 2.21 billion) in total, and the ending price was KRW 2.7104 trillion (=96.8 billion/block X 28 blocks, USD 2.2 billion).

In the second stage, exact regions and blocks of spectrum were assigned. Factors such as harmonization with existing frequency bands and the scalability to adjacent bands were considered. The MNOs submitted the sealed bid for each frequency block, and the spectrum was distributed according to the combination with the highest sum.

- 28-GHz Band

In the first stage for the total of 2,400 MHz bandwidth auction, 24 blocks were auctioned with 100 MHz per unit block. The minimum price per block was KRW 25.9 billion. The spectrum auction was for the 28-GHz band in the first round. Thus, in the first stage, the total price for the 28-GHz band was KRW 621.6 billion (=25.9 billion/block X 24 blocks)

Spectrum Licensing for 5G Private Networks

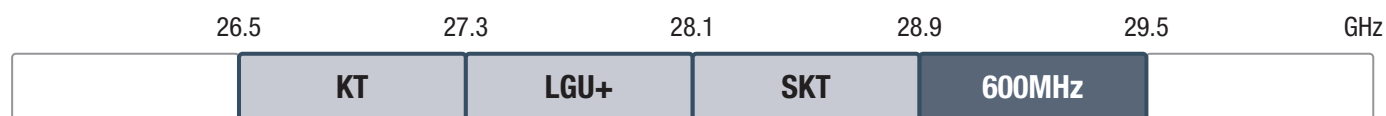
In January 2021, the government announced it would begin assigning 5G spectrum to local and private entities seeking to build their own 5G private networks. The goal is to foster competition, encourage private sector investment and innovation, especially for B2B services and industry verticals. Previously, only MNOs who had been assigned 5G spectrum were eligible to build 5G private networks.

The government will first assign 600 MHz on the 28.9~29.5 GHz band, adjacent to the 28-GHz band currently assigned to the existing MNOs. For the spectrum below the 6-GHz band, the government is considering various options such as spectrum sharing to secure additional spectrum for B2B services.

LESSONS LEARNED

Lesson Learned from Korea's 5G Experience

Globally, 5G is in the early stage of development both from market and technology perspectives. However, Korea is one of the countries that have demonstrated early successes in bringing a domestic network to scale and building a comprehensive national strategy to maximize the transformative potential of 5G. The challenges and the lessons learned from Korea's early experience can offer interesting insights to other countries planning to deploy 5G in the coming years, including developing countries. There are country-specific factors that are contributing to the fast rollout of 5G in Korea, including high population density around urban areas and the advanced telecoms market. For low-income

Figure 21. Spectrum assignment for 5G private networks highlighted in yellow

Source: MSIT 2021d

countries with limited availability of public funds and other competing development needs, some of the lessons from Korea's experience may not be readily applicable or feasible. However, there are some steps that developing countries can take today, regardless of their level of economic development, to establish an enabling ecosystem for 5G to thrive. These may include defining the national 5G vision, developing a long-term spectrum roadmap, and facilitating strategic public-private partnerships.

In Korea's case, the government created an enabling environment for 5G by executing the following:

- **Development of the National 5G vision and strategy to pave the way for private sector-led innovation and ecosystem development**

Korea recognized 5G as one of the keys to the fourth industrial revolution along with AI and data. Deploying 5G was not a goal by itself but rather a part of the broader national vision to transform the economy. As such, the government presented a holistic picture of how 5G fits into the country's overall socioeconomic goals and designed targeted policy measures to achieve those goals, as outlined in the 5G+ Strategy. From infrastructure building to market development, the government clearly defined its role in supporting the private sector in each phase of 5G ecosystem development.

- **Institutional capacity building in spectrum management**

Unlike previous generations of mobile networks, 5G requires the use of much wider spectrum across different low, mid, and high bands. The spectrum management authorities should therefore have strong institutional capacity to forecast demand,

secure spectrum in time, monitor spectrum usage, and prevent harmful interference. In Korea, the Radio Policy Bureau within MSIT's Office of Network Policy is primarily responsible for spectrum policy formulation and regulation implementation. The ministry collaborates with the experts in affiliate research institutes and public institutions across four main functions of spectrum management: spectrum planning, spectrum engineering, spectrum authorization, and spectrum monitoring (see Table 4). For example, through consultations with relevant institutions and experts, MSIT decided to exclude 20 MHz from 3.5 GHz in the 5G auction in 2018, preventing potential interference.

Table 4. Spectrum management functions and institutions

Spectrum Management Function	Relevant MSIT Affiliate and Public Institution
Spectrum planning/policy development	Korea Information Society Development Institute (KISDI)
Spectrum engineering, R&D, standard development	National Radio Research Agency (RRA), ETRI
Spectrum authorization and inspection	Korea Communications Agency (KCA)
Spectrum monitoring	Central Radio Management Service (CRMS)

- **Timely assignment and provision of 5G spectrum**

Korea's early 5G commercialization was possible primarily due to the government's timely assignment of the 5G spectrum. The government clearly defined and communicated national 5G spectrum plans to encourage long-term investments by the private sector. In designing spectrum auctions, the government sought to balance the twin goals of maximizing long-term socioeconomic benefits and retrieving appropriate spectrum fees.

- **Cross-ministerial collaboration, public-private partnerships and multi-stakeholder consensus building under the government leadership**

From the initial public discussions to the major policy decisions, the government ensured multi-stakeholder participation in building and executing the national 5G strategy. The government established the 5G+ Strategy Committee that served as a vehicle for a cross-ministerial and public-private partnership to remove regulatory barriers, design support measures, and set national 5G targets.

The government also facilitated partnerships among MNOs to expedite the national 5G rollout by promoting joint construction of base stations and network sharing in rural and remote areas.

- **Supporting 5G trials and testbeds in the 5G strategic industries.**

Because 5G is a nascent technology, there was a degree of uncertainty around it before and shortly after its arrival. Hence, the government took the role of risk taker and facilitator to encourage the private sector to invest in 5G. After identifying 5G strategic industries and core services, the government funded 5G trials and testbeds in these strategic verticals, such as digital healthcare, smart drones, and smart factories.

- **Periodic assessments of progress and targets**

Since 5G's commercial launch, the government has conducted progress assessments based on market development and multi-stakeholder feedback to ensure that the nation is on course to meet its 5G targets. Alongside the 5G+ Strategy Committee, the government launched various assessment and advisory channels, including 5G Service Inspection Task Force, 5G Strategic Industry Public-Private Roundtables, 5G Cybersecurity Advisory Council, and 5G Policy Council, among others. In addition, as of December 2020, the government has conducted two nationwide service inspections to ensure service quality and coverage. As a result, Korea has consistently ranked top on the independent global 5G performance tests.¹⁷

In conclusion, Korea's rapid rollout of 5G highlights the importance of multi-stakeholder partnerships and forward-looking policy making. The government provided strategic clarity and adopted an inclusive process in the implementation of the new generation mobile network.

¹⁷ <https://rootmetrics.com/en-US/content/south-korean-operators-leading-the-worldwide-5g-race>
<https://www.opensignal.com/2020/12/21/benchmarking-the-global-5g-user-experience-december-update>

Annex 1. Auction Result for 26.5–28.9-GHz Band

	26.5	27.3	28.1	28.9
G.B.	KT		LGU+	
BW	800MHz		800MHz	
1st stage	207.2 Billion KRW (25.9 B/Block*8blocks)		207.2 Billion KRW (25.9 B/Block*8blocks)	
2nd stage	600 Million KRW		-	
Total	207.8 Billion KRW		207.3 Billion KRW	

Annex 2. Auction Results for 3.42–3.7-GHz Band

	3.42	3.50	3.60	3.70
G.B.	LGU+		KT	
BW	80MHz		100MHz	
1st stage	774.4 Billion KRW (96.8 B/Block*8blocks)		968 Billion KRW (96.8 B/Block*10blocks)	
2nd stage	35.1 Billion KRW		-	
Total	809.5 Billion KRW		1218.5 Billion KRW	

Annex 3. Korea's Mobile Traffic by Content Type

	Video	Multimedia	WEB Portal	SNS	Market Download	Etc.
Dec 2018	56.8%	7.9%	16.5%	13.7%	3.6%	1.5%
Dec 2019	57.7%	9.2%	15.8%	11.3%	3.5%	2.4%
Dec 2020	58.4%	8.1%	15.0%	12.6%	3.2%	2.8%

Source: MSIT 2021b

Video: VOD, Streaming, Multimedia: Music streaming, Game, Map, Web Portal: Naver, Daum, Google, and so on.

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