

5G in Korea

Story, Challenges and Vision of a First Mover

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Introduction

In this article, we will look around the landscape of South Korean telecommunications, in particular focusing on 5G and relevant policies. Considering that South Korea rolled out the first instance of commercial 5G service in the world and showed remarkable growth with regard to the domestic penetration of this technology, I propose that sharing South Korea's experience in 5G implementation may have some implications to relevant policymakers and stakeholders. In relation to this matter, I explain how 5G was implemented and introduce the relevant experience of South Korea in the first two sections. In the following two sections, I introduce the current status of 5G in South Korea and discuss government-wide policies supporting 5G, after which I present perspectives on 5G from different South Korean stakeholders and the challenges they are expected to face. In the last section, I conclude the article with my outlook on the future 5G industry and policy recommendations to be considered.

Timeline: To the Implementation of 5G in South Korea

South Korea rolled out the fifth generation of mobile telecommunication service (hereafter, 5G service) in April of 2019 as the first country to do so in the world [1]. This was just before Verizon's 5G launch in the U.S. This event represents how South Korean regulators and telecom stakeholders were concerned about securing the use of the phrase "world-first launching of 5G." In this section, I will briefly explain South Korea's pre-launch process, centered on relevant policies. The first mid- and long-term government policy that referred to 5G is the "K-ICT Spectrum Plan," [2] which was publicly released in January of

2017. In the plan, the Ministry of Science, ICT, and Future Planning (currently, the Ministry of Science and ICT), the South Korean telecommunication regulator, officially decreed that the ministry will launch a policy research board for 5G spectrum assignment and relevant regulations. The plan noted that in its current state it followed along the same lines as the previous mid- and long-term policy plan, known then as the "Mobile Gwang-gae-to plan." The previous plan borrowed the name from "Gwang-gae-to the Great" referring to a historic expansion of the Korean territory, to manifest its will to expand South Korea's spectrum territory. As before, the plan was expected to be a ten-year plan (2017~2026) and as such was supposed to encompass 5G in its name. The plan mentioned that the ministry will secure spectrum for 5G usage in the mid- and mmWave band, i.e., the 300MHz bandwidth on the 3.5GHz band and the 1000MHz bandwidth on the 28GHz band, respectively. The plan also mentioned that the ministry is preparing spectrum for industrial use, including the IoT, unmanned mobile vehicles, industrial sensors and radar systems, and the next generation of unlicensed spectrum (WiGig).

Three MNOs in South Korea, SK Telecom, KT and LG U+, commonly welcomed the release of the plan and made known their will to participate on the research board headed by the regulator. At the same time, the ministry launched the policy research board and prepared for the assignment of the 5G spectrum. The board included not only stakeholders (MNOs and facility manufacturers such as Samsung and LG-Ericsson, among others) but also specialists from public research institutes (e.g., KISDI, ETRI, TTA) and academic institutes. The board met for more than a year and specified relevant issues, including the spectrum width, minimum auction prices, the auction methodology, and assignment times. In a

discussion among board members, it was decided to release the spectrum earlier than the original plan (4Q 2018 ~ 1Q 2019) and finish the assignment process before the second quarter of 2018. The main concern over such a decision was focused on the world-first launching of commercial 5G, which could be exploited in terms of advantages in standardization and market share in the first phase of 5G facility deployment. Moreover, the MNOs also expected to have a “new flagship” in the commercial market, as their ARPU (average revenue per unit) was slowly decreasing after LTE’s ARPU peaked in the mid-2010s.

South Korea’s first 5G spectrum auction was held on June 15th, 2017. A month earlier, the ministry released the specifications of the auction. Two bands were auctioned: the 280MHz bandwidth on the 3.5GHz band, for ten years, and the 2400MHz bandwidth on the 28GHz band, for five years. The board considered that the 3.5GHz band will be used for commercial services, likely requiring years of stable service, while the 28GHz band could be dedicated to industrial/specialized usage, which may assume some of the risk related to the launch. The combinatorial clock auction (CCA) methodology was adopted for the first time in the South Korean spectrum auction. The CCA calls for the participants to compete for the width of the band in the first phase and for the location in the second phase. The main concern with regard to the auction design was to minimize the fragmentation of the spectrum while ensuring some ‘reasonable’ level of competition during the auction process. All three MNOs in South Korea participated in the auction, and it ended on the second day. SK Telecom and KT both won the 100MHz bandwidth, while LGU+ won the 80MHz bandwidth on the 3.5GHz band. At 28GHz band, each firm succeeded in bidding for the 800MHz bandwidth.

The license term for the 5G spectrum started in December of 2017, six months after the end of the auction. The delay was due to the delayed release of 5G facilities and the field experimentation schedule. The ministry postponed the assignment and granted temporary licenses until the release date of the facilities to ease the burden on operators with

regard to spectrum fees and let them invest more in the 5G network. MNOs also responded to this offer by hurrying their initial deployment of the facilities. They deployed more than half of their entire network obligation during the first year; the regulator obligated each firm to deploy 22,500 and 45,000 stations until the third (2022) and fifth year (2024) of the assignment, and each firm deployed more than 25,000 base stations until the end of 2019.

Challenges and Lessons Learned

To understand how South Korea successfully implemented LTE and 5G services, we need to consider their previous experiences that lead to such results. South Korea is known to have the fastest mobile network in the world [3] according to several surveys. Moreover, related content/O2O (online-to-online) services such as mobile delivery, e-commerce, and mobile messenger services also showed strong growth in South Korea¹. In my consideration, this level of success could not have been born without the challenges that arose during the pre-LTE time. The challenges taught South Korean stakeholders (in the mobile industry) how to avoid the worst route in the mobile market.

One of the examples I want to consider is the WiBro case. In the middle of the 2000s, South Korea attempted to implement a South Korean standard for WiMax technology, called WiBro. At the time, 3G was about to be implemented in South Korea, while market players had low levels of experience with the mobile broadband market. As it happened, ETRI, a South Korean electronics research institute, developed its mobile broadband standard based on its experience with 3G-related standards. WiBro was considered to have better performance than other competing standards, including 3G. Moreover, there was the opinion to encourage Korean-made standards that could be applied

¹ “According to data from Korea’s Ministry of Science and ICT, the annual gross merchandise value (GMV) of local O2O platforms totaled nearly 126 trillion won (USD 113 billion) in 2020, up 29.6 percent from 97 trillion won in the previous year” [4].

globally. The throughput (the highest speed) of the WiBro standard reached nearly 40Mbps; this speed was three times higher than the 3G standard of the time. There was, of course, concern over its success in that the wireless broadband services did not have a key application, also known as “killer app,” and the standard was not compatible with the 3GPP standard, a hindrance to its global distribution at the time. Considering that wireless broadband is widespread now, the perspective on the service itself seemed to be correct. However, the surrounding environment at the time, including the network to support high-speed/large-traffic services and costs for services including devices and equipment, was not suitable. The WiBro service was implemented in 2006, a year later than 3G, and was shut down in 2018, while the 3G service is still ongoing with more than 300,000 subscribers.

In my consideration, the challenges from WiBro services served as a profound lesson to the South Korean market. More specifically, South Korean stakeholders appeared to learn lessons about why the global standard is important, what the so-called “cash-cow” will be in the network services market, and when the right time for a new standard will arrive. In the global market, WiBro was considered to be a regional standard, though some foreign operators such as KDDI of Japan and Sprint of the U.S. also adopted the service. Owing to its narrow adoption, the cost for devices and equipment was stuck at some level, and when it was about to spread, LTE, a hard-charging descendant capable of faster throughput at a lower cost, snatched market share. Most of all, in my consideration, the timing was not proper. The South Korean market adopted 3G service from early 2003, but the service did not reach five million subscribers until 2007², which is (reportedly) far below its cost-benefit line. This meant that South Korean MNOs could only have a limited capacity for additional investment. When we consider that the implementation of broadband service was quite

² South Korea reached five million 3G subscribers in the second half of 2007. It reached 20 million in 2012, ten years after the implementation of the service.

fast in South Korea, operators other than those in South Korea may have much less willingness to make additional investments, especially in regional standard services.

For me, the market strategies of MNOs and the regulation policies of regulators who control LTE and the 5G market are understood as aligned with such experiences. Operators and regulators started to support activities in ITU and 3GPP for global standardization. Stakeholders had more discussions about launching commercial services in the domestic market at an earlier time. To encourage more investment from operators, the regulator obliged the operators to build more than the specified number of base stations. Most of all, stakeholders seem to understand that any policies or market strategies cannot survive if not enacted at the right time and in the right environment.

Current Status of the 5G network and relevant industries in South Korea

5G in South Korea has shown smooth growth since its commercial roll-out. South Korean 5G subscribers numbered 17.46 million as of June of 2021, representing 23.1% of the entire South Korean mobile subscriber market [5]. The number of base stations has reached 162,299 [6], i.e., 11% of all South Korean mobile base stations. The latest qualification of 5G service (Dec. 2020) notes that 5G coverage has reached 478.17 Km² in Seoul (average for each MNO, of 605Km² in the entire area), 1417.97km² in six major cities (average: 4817.44km²), and 3328.16km² in 78 non-major cities [7]. With such numbers, the status of South Korean 5G appears in general to be healthy. Given the increased number of premium service subscribers, MNOs showed increased revenue and operational profits [8]. However, each stakeholder, i.e., regulators, operators, and consumers, is unhappy in some way.

Korean operators seem to consider that 5G is not meeting the expectations relative to its predecessor, LTE. Before the roll-out of 5G, operators faced issues of limited capacity and revenue; the high speeds and increased prices of 5G can resolve the problem of bottle-necked

mobile networks on legacy (3G and LTE) networks. From their past experience of transformation from 3G to LTE, operators may expect that adopting a new generation of technology may resolve such difficulties. In my understanding, the request for the early assignment of the 5G spectrum from operators has such a background. However, their competition over the “world-first 5G” and the subsequent marketing appear to have had a limited effect on the South Korean mobile market.

Compared to LTE service, which showed a 44% penetration rate at the same time point (June 2013), 5G has accomplished only half of this rate (23.1%, June of 2021). Moreover, with the delay of the 28GHz band equipment roll-out, the aforementioned large-scale initial investment in the spectrum is about to sink. To make matters worse, the jury is still out regarding their conflicts with foreign content producers, such as Google and Netflix, over exchange rate fees (or network usage fees).

For regulators, the delayed penetration of 5G service and other applications in industry was far below their expectations. This situation appears to be responsible for the low initial investment of operators from the perspective of regulators. In the first two years of LTE spectrum assignments (with ten-year license durations), operators built approximately 250,000 base stations, about a third of all base stations constructed thus far. The regulator may have a similar expectation about the initial investment and had obligated a similar degree of network obligation for the 5G spectrum. It calculated the same number of base stations (150,000 stations) for the nationwide network and thus imposed similar network obligations during the third (15% of 150,000) and fifth (30% of 150,000) years of the assignment. However, the resulting network in the first two years of 5G was (apparently) a disappointed to the regulators. Operators invested in only 162,299 stations, far fewer than in the LTE case, and the increasing rate of 5G penetration appears to have slowed down earlier than expected.

Consumers also seem to have worse expectations than as they had upon the initial adoption of 5G. In the first six months of its adoption, the initial penetration rate of 5G exceeded that of LTE. 5G subscribers reached five million in November of 2019, while LTE reached the same number in June of 2012, a year and a half after its adoption. However, though claims about the quality of 5G networks are increasing, the increasing rate of 5G penetration appears to be decelerating. 5G subscribers numbered 17.46 million (23.1% penetration rate) in the first two years of adoption, while LTE had 23 million subscribers (44% penetration rate). What is more interesting is that some initial users of 5G who entered into a two-year contract in 2018, were found to have returned to LTE service after their contracts [9].

Industrial 5G markets in South Korea started their activities just recently. All MNOs have founded departments dedicated to industrial 5G enterprises [10]. Operators, manufacturers, and related stakeholders (e.g., investors) organized an alliance, i.e., SMIC (Smart Manufacture Innovation Center, 2018), to provide testbeds for their members and to collaborate in R&D. The South Korean government initiated their own offices for the distribution of smart factories (Korea Smart Manufacturing Office) centered by the Ministry of Commerce, Industry, and Energy and the Ministry of SMEs and Startups to support the SMEs' adoption of smart factories [11]. The goal of the project is to build more than 30,000 smart factories by 2022.

5G-Plus Plan and Digital New deal

South Korea implemented two post-release policies for 5G: the 5G Plus Strategy [12] and the Digital New deal [13]. The first of these mainly focused on the promotion of 5G-relevant industries. The second centered on supporting digital transformation to deal with the economic recession incurred from the Covid-19 pandemic.

The 5G Plus strategy was launched in April of 2019, just after the roll-out of commercial 5G services in South Korea. The strategy focused on the promotion of 5G-relevant industries and specified its goal to reach 180 trillion KRW

(approx. USD 160 billion) of industrial production by 2026. In contrast to previous spectrum plans, the strategy was implemented as an inter-ministry (or government-wide) plan involving not only the Ministry of Science and ICT (MSIT) but also the Ministry of Strategy and Finance (hereafter MSF); the Ministry of Commerce, Industry, and Energy; and other relevant ministries. The strategy involved the selection of ten core industries and five core services and

manifested field-specific goals and strategies for each of them. The field-specific strategies are categorized into five types: (i) public investment, (ii) incentivize private investment, (iii) regulatory revisions, (iv) infrastructure construction, and (v) supporting (foreign) exports.

Table 1. Summary of the 5G Plus Strategy: Categorized Strategies

Strategies	Summary
Public Investment	<ul style="list-style-type: none"> • Initiate pilot projects/field tests for five core services • Initiate a 5G-based real-time monitoring system to social infrastructure (e.g., railroads, airports) • Apply 5G-based telemedicine to more than half of general hospitals
Incentive for Private Investment	<ul style="list-style-type: none"> • Incentivize the early deployment of 5G base stations by offering tax reductions • Support the construction of 5G-based testbeds and experimentation fields • Support the building of 5G-based smart factories with digital transformation in industrial fields
Regulatory Revision	<ul style="list-style-type: none"> • Revise relevant telecommunication acts • Secure more 5G-usage radio spectra in the low- to mid-range bands • Strengthen cyber-security systems
Infrastructure Construction	<ul style="list-style-type: none"> • Support R&D and foreign exports of the next-generation smart devices • Encourage 5G-based technology foundations and in-house start-ups from large enterprises • Launch 5G-based technology education programs for the younger generations
Supporting Export	<ul style="list-style-type: none"> • Support global partnerships for SMEs and large enterprises • Lead global standardization in 3GPP and ITU • Support the global expansion of domestic businesses via ODA and overseas bases

The strategy largely benchmarked the UK's governmental strategy ("A 5G Strategy for the UK," March 2017) [14] in several ways. It focused on governmental support to build testbeds for R&D and to develop applications by encouraging pilot projects in relevant fields. Also, it suggested the elimination of regulatory hurdles and the opening of public facilities for 5G base stations. It also suggested support from the government, especially providing more radio spectra and infrastructure. In contrast to the plan in the UK is that the South Korean strategy specified its implementation plan for each industrial field. In other words, South Korean strategy is more proclamatory in that the country not only presented its plan for promotion but also manifested its willingness to revise relevant regulations.

Among its sub-strategies, it is important to point out the tax deduction for MNOs related to their investments in 5G facilities/equipment as one of the most effective promotions. Specifically, the MSF and MSIT increased tax deductions from the telecom-relevant investments from the previous 1% to up to 3% (metropolitan areas: 2%, rural area: 3%). Although this was a year-long temporary deduction, the windfall to the MNOs was estimated to be approximately 3~50 billion KRW (est. USD 25~45 million), enough to support the promotion of early deployment. Given its effectiveness, the MSIT and MSF recently re-launched a similar tax reduction for 5G-specialized network licensees (as discussed in relation to 5G-specialized networks later). Notably, a recent policy report from WPI Strategy [15], which suggested an industrial plan to adopt 5G-related technology on a large scale to the UK, includes the South Korean 5G Plus strategy and the temporary tax deduction for 5G investment. Following the launch of 5G services, South Korea could not avoid the damage from the Covid-19 pandemic. All three MNOs suffered damage to their revenue from the pandemic in the first quarter of 2020. Given that a large part of their retail revenue relied on retail shops, the damage was unavoidable. MNOs recorded lower retail revenue immediately after the pandemic, and revenue from fiber-line services (e.g., IPTV

contents, subscriber services) could barely offset their losses from mobile markets. As the pandemic becomes endemic, the South Korean government wants to find clues to overcome the disaster from IT-based solutions. As a result of their search, the South Korean government released the "Digital New Deal" project as a part of the "Korean New Deal" project.

The South Korean government stated that the Korean New Deal project stems from a perception of transformation. In public, the president said that the Covid-19 pandemic raised two issues in the South Korean economy, requiring a transformation of its paradigm. The president raised climate change and digitalization as two major issues and suggested the Korean New Deal project to deal with them. This project consists of three major parts: the Digital New Deal, the Green New Deal, and the enforcement of social security. The project may invest 160 trillion KRW (est. USD 140 billion) from public and private funds and generate 1.9 million jobs in the public and private sectors.

The Digital New Deal may respond to digitalization issues. It focused on supporting the digital transformation of D.N.A. (an abbreviation of "Data, Network, and Artificial Intelligence") industries, education, and other relevant social infrastructure elements. For D.N.A. industries, the project set an investment plan to strengthen their ecosystem. The investment may reach 38.5 trillion KRW (est. USD 35 billion), and public sources may cover 32 trillion KRW (est. USD 29 billion). The goal of investment in D.N.A. fields is twofold: first to enhance the productivity of industrial fields and second to create jobs in relevant areas. In education, it focused on the digital transformation of the education infrastructure. This investment may reach 1.3 trillion KRW (est. USD 1.1 billion). A goal of investment in the education field is to construct an on/offline-mixed educational environment. For social infrastructure, the focus is on the digital transformation of core social infrastructure projects, including airports, factory clusters, and harbors, among others.

Table 2. Summary of the Digital New Deal: Categorized Objectives

Field	Summary
D.N.A. (Data, Network, AI) Industries	<ul style="list-style-type: none"> • Build a data dam that can contain and supply a significant amount of public/private data to the field • Support smart factories for SMEs and raise public/private funds for start-ups • Develop a 5G-AI based electronic government system
Education	<ul style="list-style-type: none"> • Build a 100%-connectable Wi-Fi network for every school • Enhance the online school system for universities and vocational schools
Untact Industry	<ul style="list-style-type: none"> • Build a digital-based hospital for smart healthcare and telemedicine • Build a specialized respiratory hospital • Distribute wearable devices for chronic patients for remote healthcare • Develop a remote workplace/convention platform for SMEs
Social Infrastructure	<ul style="list-style-type: none"> • Construct a C-ITS system and a detailed road atlas • Construct a remote water control system for rivers, harbors, dams, and reservoirs • Build a public smart distribution hub for SMEs • Construct a centralized harbor platform based on block-chain technology

Perspectives on 5G in South Korea

When we consider the recent situation of South Korea, it seems that South Korean regulators in the end utilized a two-way strategy: letting MNOs concentrate on commercial markets in the 3.5GHz band and letting SMEs and industrial stakeholders choose between 3.5GHz and 28GHz. The regulator decided to push for more investments in the commercial market while maintaining the entry barriers to the market as they were before. On the other hand, it decided to allow more entries from non-MNOs into the industrial market.

In the commercial market, operators and MNOs seem to have different short-run views. MNOs consider that the increased revenue from the adoption of 5G is not enough to make up for the cost of the increased consumption of high-rated media. Specifically, they require more investment to differentiate their new services from LTE services, though currently they rely on legacy networks. There is a reason for this hesitation. Although they knowing that their current investment, which is predictable, may be realized in a few years, they cannot be sure of how much of it will return. To resolve such a dilemma in the short run, MSIT suggested a cut in legacy spectrum fees conditioned by their investment in

5G, which is quite an exceptional offer. However, MNOs appear to have different ideas about the South Korean B2C market. MNOs consider that the 5G service is difficult to differentiate from LTE in the current consumption structure, which mostly relies on video-media-based data traffic. Such an expectation is reflected in their published investment plan. SK Telecom expects that their 5G subscribers, which now number five million, will increase to 18 million by 2025. Considering that SK Telecom's share in the mobile market is slightly less than 50%, such an expectation corresponds to about half of South Korean subscribers, i.e., around 30 million. In such an environment, MNOs appear to choose to minimize their costs by reducing new investments in 5G networks. As a sign of this minimization, all three MNOs had smaller CAPEX levels compared to those in 2019, showing 8.7 ~ 24% drops [16]. In the LTE case, MNOs maintained their new investments until their fourth year of adoption [17]. In contrast, MNOs are decreasing their CAPEX levels by more than 10% each year, and the absolute scale of the investment remains less than that of LTE.

Facing such a situation, the regulator also appears to be dissatisfied and wants more investment in the network. As it happened, the time for reassignment of the legacy spectrum (2G, 3G, and LTE) was about to arrive. Considering that the operators are exploiting their legacy LTE network for 5G NSA (non-standalone), regulators used a "carrot and stick" approach for the reassignment of the legacy spectrum. That is, regulators set the goal for an additional 5G network capacity and cut spectrum licensee fees according in the resulting 5G network until the end of 2022 [18]. MSIT set 120,000 base stations as the goal for each operator. Starting with the current number of base stations (60,000 for each), spectrum license fees can be cut from 4.2 trillion KRW (est. USD 3.8 billion) to 3.17 trillion KRW (est. USD 2.9 billion) for ten years if they reach the goal. If they fail to reach the goal, the entire price, similar to their original prices from the previous spectrum auction, will be imposed.

Compared to dismal expectations pertaining to the commercial market, MNOs appear to have

better results and expectations in the industrial market. SK Telecom released a more vivid expectation/business plan via its investment relation report. The report presented the company's approach for an entrepreneurial business in three parts: data centers, cloud computing, and industrial IoT [19]. It also predicted growth in their entrepreneurial business revenue from 1.4 trillion KRW (est. USD 1.2 billion) to 4.5 trillion KRW (est. USD 4.1 billion) by 2025. In the data center market, the company predicted growth up to 300% according to considerable growth in capacity demand from 92MW (2021) to 300+MW (2025). In the industrial IoT market, the company expected steep growth centered on industrial solutions and network infrastructure. KT and LGU+ also expressed similar predictions about their B2B business and markets. KT reported the greatest increase in its revenue growth rate (6.2%, YoY) from the AI/DX (digital transformation) category in its recent investment report [20]. The company also reported that it will launch new businesses, including digital bio/healthcare and AI robots for industrial customers soon. In contrast to KT, LGU+ showed the highest revenue growth rate in its entrepreneurial solution category (23.5%, YoY) [21].

However, in contrast to this, regulators appear to consider that there are certain unresolved issues about industrial 5G. As in the past³, SMEs have argued that solutions and private networks provided by MNOs are quite costly compared to their owned network. Therefore, MSIT decided to provide 5G spectrum for private industrial networks, as in Japan and Germany [22]. It decided to provide some mmWave band for private networks and a paired mid-range band for its anchoring usage. By allowing more entries from non-MNOs and attempting to meet industrial demand, MSIT willingly encourages more competition in the growing industrial

³ According to a survey conducted by the Korea Small Business Institute (2020) [25], more than 80% of SMEs considered the costs of investments as their most worrisome factor. Second on this list was the burden of after-sales management, considered by 57% of respondents.

market and finds more reference usage incidences.

South Korea's Challenge and Vision about the Future 5G Market

(1) Long-run challenge for 5G in South Korea

Among several hurdles, the primary and most considerable issue in South Korea's 5G market is the population structure. As most retail services are as well, network services are mainly relying on the population. The South Korean population increased with its (relatively) young generation during the 2000s and 2010s and is expected to reach its highest level in 2027 at 51.93 million [23]. Moreover, there are extremely high concentrations of people in cities and in the capital metro area⁴. These two factors have motivated operators to build efficient mobile networks and increase revenue thus far. However, the recent decrease in birth rates, reaching the lowest in the world in 2020 (0.84) [24], gave operators dismal expectations of future revenue in both commercial and industrial markets.

To deal with this challenge, as is described in section 3, MNOs appear to respond by undercutting future investments in the commercial market by limiting their new network to certain "sweet" spots, including major cities. Regulators attempted to encourage and push operators not to scale back further investments in the commercial market. The regulator seems to consider that the insufficiency in key applications worsens operators' dismal expectations. This situation has resulted in governmental support for R&D in the area of content services, including meta-verses, AR/VR, and other related non-telecom industries through promotional policies. However, except for these sector-wise policies, what is most important is to provide a solution to the market growth issue, which is mainly caused by the population structure. Without resolving this,

dissonance with regard to market perspectives cannot easily be addressed, and the best response from market players may create a self-fulfilling prophecy.

What is better in the industrial market is to remember that the market is newly born and that most stakeholders agree regarding its growth in the long-run future. However, operators, manufacturers, and regulators seem to have different opinions about the way to achieve the goals. For me, operators still want to place barriers in the industrial market, mainly in the form of spectrum licenses thus far. They argue that the current network system, LTE and 5G NSA - a mixed network of 5G and LTE - works in parallel and will be good enough for the next ten years. They also claim that the current South Korean industrial market is yet mature to adopt a 5G-based industrial network⁵. Most of the requirements from SMEs can be processed by LTE-based M2M (machine-to-machine) devices and equipment. They also note that conglomerate clients such as Samsung, SK Hynix, and Hyundai Motors can request to build private base stations of their own, and MEC (mobile edge computing) can retain their securities with the services and spectrum provided by operators. The resulting argument from operators is that regulators need to leave the industrial market alone until its stabilization.

The regulator appears to have a different idea from the operators. What they consider is that the markets, including industrial and commercial markets, need more competition. The South Korean regulator has attempted to bring new competitors into the mobile market. However, most of the applicants were not satisfactory. The industrial market, which can be sliced in a small enough area, can be a new opportunity for non-MNOs to enter the market with the smallest sunk costs such that the regulator can foster potential competitors by separating them from MNOs. As a result, the regulator decides to open the industrial market by adopting a 5G specialized network mainly based on 28GHz with small

⁴ According to South Korean Statistics [26], 91.2% of the population lives in urban areas and 50.2% of the population lives in Seoul and Gyeonggi-do (Seoul metropolitan and suburban area).

⁵ The distribution of high-leveled smart factories for which synergy can be expected with industrial 5G network is difficult to find among SMEs [28].

amounts of the mid-range spectrum (for anchoring usage only).

(2) Digital New Deal 2.0 and South Korean vision

The Digital New deal, which was revised as the Digital New Deal 2.0 recently, mainly focuses on the promotion of B2C and B2B markets by expanding infrastructure and public-based usage levels. Digital New Deal 2.0, released in July of 2021, can be characterized by two features. First, it specified the goals in the first version by including regulatory revisions. For example, it disassembled “building a data dam for public/private usage” in the first version into three sub-parts: revising the Regulation of

Personal Information Security, enacting the General Regulation of Data Processes, building a “Center for Unidentified Information Usage” (preliminary). With these specifications, the project can provide more vivid expectations to industrial stakeholders about how their business environments will change. Second, promotions for ICT-related industries were re-categorized into independent parts. Compared to the first version, which handled the development of the new industries in a subsidiary role relative to other plans, the revision changed the hierarchy, including these parts in the main plans. This condition will impose more responsibility and power on related institutes and governance structures.

Table 3. Summary of Digital New Deal 2.0: Categorized objectives [27]

Field	Summary
Promoting Connected Industries	<ul style="list-style-type: none"> • Support ICT-converged businesses, including meta-verses and AI robots <ul style="list-style-type: none"> ○ Construct an open meta-verse platform and support content for meta-verses ○ Promote field tests for 5G-AI based robots and related services • Foster digital-based technologies, including the cloud, blockchain, and the IoT <ul style="list-style-type: none"> ○ Develop cloud services for public demand ○ Support the SaaS transformation of private software corporations ○ Construct the “Center for Technology Innovation” ○ Construct test beds for AI-based IoT and related services

Implications of the policy can differ according to the level of concern about it. As one financial policy, which may focus on subsidizing digital-related areas during the pandemic, the Digital New Deal is taking the correct approach. 5G-related industries require considerable initial investments and now suffer from insufficient key applications. These industries can exploit such public contributions and subsidies for digital

transformations. Moreover, such public funds can give SMEs opportunities to develop their services at low costs by sharing publicly developed resources.

However, as an aspect of public policies, including regulations over network-related markets, the project cannot easily provide significant implications with regard to South

Korea's vision for the 5G industry, especially for the industrial-usage network. As noted earlier, South Korean market players and regulators still have dissonance in how they will approach the market and what their shared goals will be.

In addition, the South Korean government recently released the "5G-Plus Convergence Service Strategy" (August 20, 2021, [29]), which aims to support the previous 5G-Plus plan and Digital New Deal. Although the previous and current plans share most of the sub-goals, the new plan has a few notable features. First, it announced the organization of a South Korean nationwide partnership akin to "5G-PPP" (private-public partnerships) of the European Union. This implies that South Korean stakeholders have begun to consider that they need a place for conversations with other industries' stakeholders. In other words, industrial stakeholders in different areas have started to consider digital transformation based on the 5G network. Second, the government announced its support for the commercialization of smart factories, a goal that aims to expand the application fields and standardize the certification process. This implies that the previous plan's phase, which mostly focused on R&D and finding testable cases, is about to finish, with stakeholders starting to consider its application in actual fields.

Outlook and Recommendations

The South Korean mobile industry has shown progress that is worthy of attention. The country is considered to have one of the fastest and widespread nationwide mobile networks. Based on the network, the domestic OTT (over-the-top) media market and O2O (online-to-online) service market have also experienced massive growth in recent years. However, the South Korean 5G industry is now facing great challenges in its commercial-based business model due to the population structure of the country. To overcome such challenges, stakeholders – government, public entities, MNOs, and other industry-related entities – are focusing on 5G technology for industrial usage. A series of policies supporting and promoting R&D and the introduction of services/networks have been announced. Although enormous efforts have been made thus

far, few exemplary cases exploit the full potential of the 5G network. Such a limitation mainly comes from the lack of a case that has a fully equipped automated system and is ready for the application of the 5G network. On the bright side is that stakeholders now acknowledge the potential of such businesses and strive greatly to find a proper business model. After having a few years of experience, in my consideration, we may have more cases and statistics that can address the aforementioned issues

Despite the limitations, we can surmise what fields are expected to grow and what types of policies will be required to help with this growth. What I am focusing on are the mmWave band and FWA (fixed wireless access) network. As LTE and current broadband services started to grow from retail consumers, the demand for 28GHz and higher bands that can provide rapid transfers of large amounts of data may start from home. What is (expected to be) different from the previous season is that this may be related to workplaces, i.e., industrial-related demand, though they are positioning this demand at home. As the Covid-19 pandemic situation becomes chronic, at-home work will become a type of standard job culture. On the other hand, many (U.S.) employers still believe that working in a face-to-face mode, not merely via a monitor, will be required to maintain employees' job performance levels [30].

To meet the needs of each side, I consider that a highly immersive environment for remote offices is likely to be adopted, with (possible) support by the FWA network. The FWA network has several strengths, and the best among them is that it does not require the installation of a wired network. This will reduce construction fees and allow high flexibility for home offices. Home offices may exploit the best strength of the 5G FWA network, which was originally designed for the manufacturing field. More large-and-vivid displays or 3D hologram displays that support naked eye viewing may replace the current immersive services via wearable devices. From this new demand at home, the industrial usage of 5G will progress and expand to highly equipped manufacturers.

To support such changes in the future, what I suggest to policy stakeholders is as follows. First, the South Korean government reorganizes its governance over ICT-related policies. Considering that the use of information technology has spread throughout numerous industries, it is natural that many different industries are involved in ICT-related policies. However, as ICT policies become popular, I consider that they will require centered governance that can organize regulations and manage promotion policies. Specifically, for competition issues related to newly generated industries, a governmental consensus that can mediate conflicts between different industries should be installed. For example, South Korean own-driver taxis protested the implicit approval of private car-sharing services (such as Uber and Lyft in the U.S.) and the regulator (the Ministry of Land, Infrastructure, and Transport) could not but prohibit these businesses [31]. Related to such a demand, the South Korean government introduced the Presidential Committee on the Fourth Industrial Revolution, but the commission could not muster more than a discussion organization.

Second, current public policies in South Korea should narrow their focus and change how policies are formed. Currently promoted projects mostly take a top-down approach, which indicates the fields and entities they will support. However, in this way, public entities and their policies cannot catch up with the progress of technology and business. I would suggest instead maintaining an open-public fund that adopts a type of 'bottom-up' approach. The South Korean government has operated certain public-based open funds, akin to 'angel investment matching funds.' What I suggest is that public promotion policies should utilize such a formation as a standard. By taking such an approach, I expect that such a fund can be tracked via a specific approach and ultimately improve the effectiveness of fund investment, with society/government sharing in the payoff of this and other public investments.

References

- [1] Park, J. (2019, April 3) S.Korea first to roll out 5G services, beating U.S. and China. *Reuters*. Retrieved from <https://www.reuters.com/article/southkorea-5g-idUSL3N21K114>
- [2] The Ministry of Science, ICT, and Future Planning (2017). Establishment of the K-ICT Spectrum Plan (*Korean*). Retrieved from <https://www.korea.kr/news/pressReleaseView.do?newsId=156179653>
- [3] Fogg, I. (2021). Benchmarking the 5G Experience - Asia Pacific - June 2021. *OpenSignal*. Retrieved from <https://www.opensignal.com/2021/06/14/benchmarking-the-5g-experience-asia-pacific-june-2021>
- [4] Pulse (2021, April 9). S. Korea's online-to-offline market thrives amid pandemic. *Maeil Business News Korea*. <https://pulsenews.co.kr/view.php?year=2021&no=340610>
- [5] Tomas, J. P. (2021, August 6). South Korea ends June with almost 16.5 million 5G subscribers: report. *RCR Wireless News*. Retrieved from <https://www.rcrwireless.com/20210806/5g/south-korea-ends-june-almost-16-million-5g-subscribers-report>
- [6] Korea Communications Agency (2021, August 1). Statistics for Radio Base Stations (*Korean*). Retrieved from <https://spectrummap.kr/rwdinfolabstats/viewRdwSvcByStats.do?menuNo=300507>
- [7] The Ministry of Science and ICT (2020, August 5). Release of Qualification Results for 5G Networks (*Korean*). Retrieved from <https://www.msit.go.kr/bbs/view.do?sCode=user&mId=113&mPid=112&bbsSeqNo=94&nttSeqNo=3012555>
- [8] Cho, M-H. (2021, February 3). South Korean telcos see profit jump in 2020 thanks to 5G and remote services. *ZdNet Korea*. Retrieved from <https://www.zdnet.com/article/korean-telcos-see-profit-jump-in-2020-thanks-to-5g-and-remote-services/>
- [9] Suzuki, S. (2020, November 7). Poor 5G connectivity disappoints South Korean users. *Nikkei Asia*. Retrieved from <https://asia.nikkei.com/Business/Telecommunication/Poor-5G-connectivity-disappoints-South-Korean-users>
- [10] Yonhap News Agency (2020, July 2). KT chief calls on mobile carriers to focus 5G toward B2B services. *Yonhap News Agency*. <https://en.yna.co.kr/view/AEN20200702004200320>
- [11] Kim, E-J. (2018, December 20). S. Korea launches 5G alliance for 'smart factories.' *Yonhap News Agency*. Retrieved from <https://en.yna.co.kr/view/AEN20181220003500320>
- [12] The Ministry of Science and ICT (2019, April 8). Release of the 5G-Plus Strategy (*Korean*). Retrieved from <https://www.korea.kr/news/pressReleaseView.do?newsId=156325462>
- [13] The Ministry of Science and ICT (2020, July 15) The Digital New Deal Is to Lead Digital Transition in the World After COVID-19, Retrieved from <https://english.msit.go.kr/eng/bbs/view.do?sCode=eng&mId=4&mPid=2&pageIndex=&bbsSeqNo=42&ntSeqNo=443&searchOpt=&searchTxt=>
- [14] Hancock, M. and Neville-Rolfe. L. (2017). Next Generation Mobile Technologies: A 5G strategy for the UK. Department of Digital, Culture, Media & Sports. Retrieved from <https://www.gov.uk/government/publications/next-generation-mobile-technologies-a-5g-strategy-for-the-uk>
- [15] WPI Strategy (2020, July). Powering Up Manufacturing, Levelling Up Britain. *Vodafone UK News Center*. Retrieved from <https://newscentre.vodafone.co.uk/app/uploads/2021/07/5G-Manufacturing-Report-210726-1.pdf>
- [16] Lee, J.J. (2021, February 4), SK Telecom's spending on 5G drops 24% in 2020. *The Elec*. Retrieved from <http://www.thelec.net/news/articleView.html?idxno=2317>
- [17] KT Q2 2014 Capex dips 6.8 percent to 562.7 billion won. (2014, July 30). *Telecomlead.com*. Retrieved from <https://www.telecomlead.com/4g-lte/kt-q2-2014-capex-dips-6-8-percent-562-7-billion-won-52149>
- [18] The Ministry of Science and ICT (2020, November 30). Release of Mobile Spectrum Reassignment Policy (*Korean*), Retrieved from <https://www.korea.kr/news/policyBriefingView.do?newsId=156424204>

- [19] SK Telecom (2021) SK Telecom CEO Seminar Presentation. Retrieved from <https://www.sktelecom.com/img/eng/presen/20210614/SKTCEOSeminar2021EN.pdf>
- [20] KT (2021), KT Earning Release (2Q 2021). Retrieved from https://corp.kt.com/eng/attach/record/2021/KT%20ER%20PT%20Q2%20ENG_f.pdf
- [21] LGU+ (2021), LGU+ Earning Release (2Q 2021), <https://www.uplus.co.kr/cmng/eng/inre/peir/RetrievePelriQuarterList.hpi?mid=10414>
- [22] Chun, Y-H. (2021, June 29) 5G frequency bands to be available to non-telcos. *Yonhap News Agency*. Retrieved from <https://en.yna.co.kr/view/AEN20210629005500320>
- [23] Statistics from Korea Government Official Work Conference (Accessed in 2021, August 1) Retrieved from <https://kosis.kr/visual/populationKorea/PopulationByNumber/PopulationByNumberMain.do>
- [24] Kim, C. (2021, February 24). South Korea's fertility rate falls to lowest in the world. *Reuters*. Retrieved from <https://www.reuters.com/article/us-southkorea-fertility-rate-idUSKBN2AO0UH>
- [25] The Ministry of SMEs and Startups (2019). Survey on the information level of Korean small and medium enterprise (*Korean*), *Korean Technology and Information Promotion Agency for SMEs*, TIPA research Report 19-01, Approval No. 398001
- [26] Statistics from Korea Government Official Work Conference (Accessed in 2021, August 1). Retrieved from https://www.index.go.kr/potal/main/EachDtlPageDetail.do?idx_cd=1200
- [27] The Ministry of Economy and Finance (2021, July 14). Government Announces Korean New Deal 2.0. Retrieved from <https://english.moef.go.kr/pc/selectTbPressCenterDtl.do?boardCd=N0001&seq=5173>
- [28] Kang, J.W. and Park, J.S. (2020). KOSBI SMEs Focus (*Korean*). *Korea Small Business Institute*
- [29] The Ministry of Science and ICT (2021, September 1). To ensure a successful implementation of the Digital New Deal MSIT announces "5G+ Convergence Diffusion Strategy." Retrieved from <https://english.msit.go.kr/eng/bbs/view.do?sCode=eng&mId=4&mPid=2&pageIndex=&bbsSeqNo=42&ntSeqNo=533&searchOpt=ALL&searchTxt=>
- [30] PwC (2021, January 12). PwC's US Remote Work Survey. Retrieved from <https://www.pwc.com/us/en/library/covid-19/us-remote-work-survey.html>
- [31] Chung, J. (2020, March 7). South Korea passes bill limiting Softbank-backed ride-hailing service Tada. *Reuters*. Retrieved from <https://www.reuters.com/article/us-socar-taxi-idUSKBN20T30P>

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