Spectrum Reassignment Policy in South Korea and Its Implications

김 희 천 (Heechun Kim)*

**ABSTRACT**

This paper introduces the details of the recent South Korean spectrum reassignment policy in 2020 and opens the discussion on its implication of the policy. In October 2021, the Ministry of Science and ICT (MSIT), a South Korean telecommunication regulation body, presented a spectrum reassignment plan (MSIT (2020)). The plan included 410MHz width of mobile spectrum used for the 2G, 3G, and LTE services in South Korea. It was the largest reassignment plan in terms of the width and the total price of the entire spectrum. As well as its scale, the decisions on reassignment policy showed noticeable features in several aspects. First, the Authority partially allowed operators to have flexibility in the usage term for spectrum, which could be seen as being diverted from the Authority’s previous course of policies. Second, the Authority associated the final reassignment price for LTE licenses with the operators’ future deployment of 5G base stations.

**Key words:** Spectrum Reassignment (주파수 재할당), Spectrum Policy (주파수 정책), Spectrum Pricing (주파수 할당대가)

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I. Introduction and Policy Backgrounds

In October 2021, the Ministry of Science and ICT (MSIT), South Korean telecommunication regulation authority, presented a spectrum reassignment plan (MSIT (2020)). The plan included 410MHz width of mobile spectrum used for the 2G, 3G, and LTE services in South Korea. It was the largest reassignment plan for South Korea in terms of the width and the total price of the entire spectrum. Moreover, the policy showed noticeable features in several aspects. First, the Authority partially allowed major network operators to have flexibility in the usage term for spectrum, which is major difference from the Authority’s previous course of policies. Second, the Authority associated the final reassignment price for LTE licenses with the operators’ future deployment of 5G base stations. Such policy experiment, which leverages usage of spectrum with relevant forthcoming service, can suggest that South Korean spectrum regulation can take more market-oriented approach.

In this article, I introduce policy background of South Korea including the brief review of relevant regulation and reassignment process. In the second chapter, I discuss the factors concerned in the process of policymaking. The third chapter presents resulted policy decisions in the usage of terms, reassignment prices, and relevant obligation. In the last chapter, I discuss the implication of the reassignment policy and conclude the article.

1. Regulatory Background

In South Korea, the Radio Wave Act governs and regulates the overall process for reassignment and competence of the regulation body (henceforth, the Authority). First, the Act pronounces that the Authority can reassign the radio spectrum (license) to the current assignee upon the end of the current usage terms (Paragraph 1). The

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1) (1) The Minister of Science and ICT may reassign the radio frequencies the use period of which expires to the relevant frequency user at the time of expiration of their use period: Provided, That the same shall not apply to any of the following cases: 1. Where the frequency user does not want such reassignment; 2. Where it is necessary to use the radio
Act only describes the negative cases rather than depicts the conditions or requirements for the reassignment. For such a regulation, there are interpretations that the decision of reassignment is generally accepted as a permissive order and the Authority has general discretion for setting conditions or obligations of reassignment (Cho (2009), Song (2010), Lee (2011)). After setting the general discretion of the Authority, following paragraphs set the restrictive suggestion for the Authority. The Act suggests hearing the opinions from the interested stakeholders (Paragraph 2(2)) and obliges to notify its decision of cancelling reassignment or imposing additional conditions upon reassignment a year before the end of the usage term.

According to the Act, MSIT presented its reassignment plan in November 2020 since 330MHz of 690MHz width was expected to finish its usage term until December 2021. Of all spectra assigned, 280MHz width was assigned for 5G service from December 2018 with a 10-year usage term. Of the rest (410MHz width), which was assigned for the 2G, 3G, and LTE usage, the 310MHz width faced reassignment. In other words, 75% portion of spectrum dedicated to the legacy services were about to finish its usage term. Among them, 30MHz width of the spectrum was used for 2G service. SK Telecom was using 5x2MHz block in the 800MHz band (824-829/869-874MHz, FDD) and LG Uplus was using 10x2MHz block in 1.8GHz (1770-1780/1860-1870MHz, FDD) respectively. Both blocks were once reassigned in June 2011 for a 10-year duration of usage term so that they frequencies at issue for the purposes of national defense, public safety and the rescue of people in trouble; 3. Where the International Telecommunication Union has allocated the radio frequencies at issue for other services or usages; (K-Law, 2021)

Radio Waves Act – Article 16 (Reassignment) (2) Where the Minister of Science and ICT intends to make a reassignment under paragraph (1), he/she may have any interested parties submit their opinions. (ibid.)

10MHz width block in 800MHz band used by KT is excluded from reassignment because of defaulting assignment obligation from KT.

SK Telecom’s 800MHz block was originally assigned to Korea Mobile Telecom Service in May 1984 for Car-Phone usage. As the KMT merged with SK Telecom in 1994, it is used as the PCS usage and become 2G usage. In 2000, the Ministry of Information and Communication, the former body of the current MSIT, decided to adopt revised regulations on spectrum assignment. Before 2000, the regulatory body distributed the business license to the mobile operators and attached the spectrum license (or usage right). Upon the revision of

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faced the end of the nearest due in June 2021. Two 2x5MHz blocks in the 2.1GHz band (20MHz width) were used for the 3G spectrum. Each block was assigned to SK Telecom (1955-1960/2145-2150MHz, FDD) and KT (1975-1980/2165-2170MHz, FDD) respectively. The Authority initially assigned the 3G blocks in December 2001 and reassigned in December 2016 with a 5-year of usage term. Assignees faced the end of the (previous) reassignment term in December 2021. The rest was used for LTE service and faced the end of the usage term between June and December 2021. They are two blocks in the 800MHz band, a one block in the 900MHz band, two blocks in the 1.8GHz band, three blocks in the 2.1GHz, and a one block in the 2.6GHz band. Among the entire spectrum used for LTE, three blocks had the due beyond the upcoming reassignment decision: 20MHz width block in the 1.8GHz band (KT, 1755-1765/1850-1860, FDD) and 60MHz width in the 2.6GHz band (SK Telecom, 2500-2520/2620-2640MHz, FDD; 2540-2550/2660-2670MHz, FDD). The Authority auctioned them in July 2016 with a 10.5-year of usage term so that their usage terms were supposed to finish in December 2026.

**<Table 1> Summary of Reassigned Spectrum**

<table>
<thead>
<tr>
<th>Service</th>
<th>Band</th>
<th>SK Telecom</th>
<th>KT</th>
<th>LG Uplus</th>
<th>Total</th>
<th>End of Usage Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>2G</td>
<td>800MHz</td>
<td>10MHz</td>
<td></td>
<td></td>
<td>30MHz</td>
<td>Jun. 2021</td>
</tr>
<tr>
<td></td>
<td>1.8GHz</td>
<td></td>
<td></td>
<td></td>
<td>20MHz</td>
<td>Jun. 2021</td>
</tr>
<tr>
<td>3G</td>
<td>2.1GHz</td>
<td>10MHz</td>
<td>10 MHz</td>
<td>20MHz</td>
<td>20MHz</td>
<td>Dec. 2021</td>
</tr>
<tr>
<td>LTE</td>
<td>800MHz</td>
<td>20MHz*</td>
<td></td>
<td>20MHz*</td>
<td>280MHz</td>
<td>Jun. 2021 (SKT, LGU)</td>
</tr>
<tr>
<td></td>
<td>900MHz</td>
<td></td>
<td></td>
<td></td>
<td>20MHz</td>
<td>Jun. 2021</td>
</tr>
<tr>
<td></td>
<td>1.8GHz</td>
<td>35MHz</td>
<td>35MHz*</td>
<td></td>
<td>280MHz</td>
<td>Dec. 2021</td>
</tr>
<tr>
<td></td>
<td>2.1GHz</td>
<td>30MHz</td>
<td>30MHz</td>
<td>40MHz</td>
<td></td>
<td>Dec. 2021</td>
</tr>
<tr>
<td></td>
<td>2.6GHz</td>
<td></td>
<td></td>
<td></td>
<td>40MHz</td>
<td>Sep. 2021</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>95MHz</td>
<td>95MHz</td>
<td>120MHz</td>
<td>310MHz</td>
<td></td>
</tr>
</tbody>
</table>

*Used for nationwide coverage

the Act, the Authority began to regulate spectrum assignment and reassignment by the Act, and previous business licenses were turned into an assigned spectrum (licenses). Followed by such a transition, and reassigned in 2010 and 2011 respectively.
The initial price (including auction prices) for the entire spectrum was amounted to about KRW 4.3 trillion (est. USD 3.6 billion) for the whole usage term. Considering that the net profit from three operators in 2020 reached about KRW 2 trillion (est. USD 1.6 billion), the stakeholders could not ignore the expected spectrum price.

2. Brief Summary of Reassignment Process

In general, there are six steps for spectrum reassignment in South Korea. Upon the arrival of the expiration date for the previous assignment, the Authority first decides whether to reassign or not the candidate spectrum. The decision generally follows discretion from the Authority. After the reassignment decision is made, the Authority must notify any changes in condition or obligation at least a year before the expiration of the usage term. The Act merely defines the notification to the user of the spectrum and does not require any specifications likewise a public rehearsal or notification process. However, according to the relevant administration law, the Authority would consider the notification method available to the current assignees. On the other hand, it takes a different path if it is an initial assignment when the spectrum is assigned to new applicants. In case of the initial assignment, it requires public notification of relevant information at least a month before the assignment process. Public notification openly announces all relevant information about the assignment process including (reservation) price, network obligations, and other requirements for the applicants. However, the Authority adopted an additional review process for the current reassignment even though it is not required. In the current reassignment process, the Authority not only asked operators to submit their opinions and suggestions but also established a consultation board to invite relevant stakeholders and experts. The board was operated for about six months (March 2020 ∼ August 2020) and appointed experts from relevant institutes including national policy research institutes and academic institutes.
In addition, the Authority held a public rehearsal before it notifies the final decision to the operators. In November 2020, MSIT publicly presented a provisional policy plan for reassignment and a methodology adopted for calculating the reassignment price of the spectrum to the operators and stakeholders. In the previous cases of reassignment decisions, the relevant authorities\(^5\) publicly announced the decision result in a document rather than holding any open discussion or policy rehearsal, since it is not required or regulated by the Act. Considering that there was a petition for the release of information from the operators that raised public concerns about the conflict between the Authority and operators (Song, 2020), it is natural to think that the Authority was pushed to respond to the public pressure. After the presentation, the Authority announced the details of policy information in the end of November 2011, and operators submitted applications for reassignment. Upon the applications and due dates, the Authority held two sessions of evaluation for reassignment in March 2021 and September 2021 each and finished the reassignment process. SK Telecom and KT applied for reassignment of all spectra blocks they held. LG Uplus also applied for all spectrum blocks, but the 2G spectrum(1.8GHz) was reassigned upon the condition that the spectrum will be reclaimed once they finish the service even before the fifth year.

\(^5\) Korea Communication Council (KCC) and the Ministry of ICT and Future Planning (MSIP) were in charge of the reassignment policy in 2011 and 2016 respectively.
II. Factors for Consideration

1. Review of Legacy Services’ Usages

Among the all factors, the Authority placed the highest priority on the sustainability of the legacy services - 2G, 3G, and LTE services - in its decision making. In other words, the Authority’s main questions were about whether subscribers of the services would be affected from the reassignment policy and how much it could be. To answer the questions, the Authority and relevant experts reviewed the “lifecycle” of legacy services and made forecasts for the recent futures. Firstly, the Authority reviewed the trend of subscribers for each generation of mobile services. Because the scale of the mobile market is largely affected from the subscribers, reviewing the trend of the subscribers for each generation may provide some clues to understand the mobile service’s lifecycle.

In the perspective of subscribers, the 2G service spent 12 years from its adoption to reach the highest peak. Operators provided the service for about 18 years until their shut-down decision of the service. The 2G subscribers gradually increased from its initial adoption in 1994 to its highest peak (est. 40.2 million subscribers) in 2006. After the adoption of the 3G service in 2006, the 2G service showed a steady decrease in subscribers and recorded 1 million subscribers at the end of 2019. KT finished the 2G services in 2012 and other operators (SK Telecom and LG Uplus) were expected to terminate the service soon6) The 3G service experienced a relatively short period of “rise and fall.” It also showed gradual growth in subscriber from its adoption in 2006, but it enjoyed its heydays only for 5 years. Its highest number of subscribers were less than its predecessor. The 3G service handed over the newest generation title to the LTE in 2011. The subscriptions of the 3G were only about 35.4 million in 2011 at its highest peak and it showed a rapid decrease

6) KT had about 160-thousand subscribers when they were approved to shutdown the 2G service. SK Telecom finished 2G service in July 2021, and LG Uplus is also approved to finish 2G service in June 2023. 2G service recorded 1.02 million subscribers (1.5% share over all subscribers).
with the adoption of LTE service. MSIT’s official record reported that 7.51 million subscribers were using the 3G service at the end of 2019. LTE, the challenging successor to the 3G, was launched in March 2011 and showed a very rapid increase in subscriptions from its beginning. It spent only two years to catch up with the subscribers of the 3G, while the 3G took four years to catch up with its predecessor. Moreover, the LTE beat the highest peak of the 3G before the end of the third year of its adoption (December 2014, recorded 35.97 million subscribers). It also recorded the highest-ever subscribers in South Korea as the single mobile service in 2019 (56.34 million, 83.4%).

After reviewing trends of the legacy services’ subscribers with relevant stakeholders and experts, the Authority concluded that the 5G and LTE services can coexist for the next five years even though the LTE is likely to be affected from the 5G. The Authority found that the growth rate of the 5G subscribers is likely to follow that of the LTE rather than the 3G after they observe the 5G’s initial growth rate and investment from operators. And it is forecasted that the number of the 5G subscribers will catch up with the LTE before 2024. The Authority and stakeholders agreed that demand for the LTE spectrum may decrease accordingly, and they should reconsider an additional reassignment of the LTE spectrum after that. For the other legacy services, the Authority and stakeholders also agreed that the sustainability of the services is important. For the 2G, it was expected that its
subscribers can decrease below 200 thousand by 2023 and the service can face a termination in the recent future. For the 3G, the Authority and stakeholders shared their opinion in that the service will follow a gradual decrease for a few years. However, they also shared the voice that the 3G subscribers are less likely to decrease below one million within two or three years. They also agreed that the current spectrum allocation to the 3G (2x5MHz for SKT and KT, respectively) is the least amount for continuing the service until it shuts down.

*Figure 3* Expectation for 5G and LTE growth and decrease in subscribers

![Figure 3](image)

Source: MSIT (2020), Interpreted by author

2. Opinions from Operators and Other Stakeholders

As a part of the reassignment process, the Authority asked opinions from stakeholders including mobile operators who may use the reassigned spectrum. Operators officially submitted statements and comments about their demand for each band/block of spectrum, terms of usage, reassignment obligation, and spectrum prices. They focused on the terms of usage and spectrum prices.

For the usage terms, operators commonly commented that demand for the spectrum could be changed according to the factors such as the penetration rate of the 5G service, and they asked a policy device that can allow some flexibility in the usage terms to respond to such an uncertainty. Specifically, operators asked for setting different terms of usage for each spectrum band/block by their own decision.7)

7) According to the Radio Waves Act of South Korea, operators are not allowed to return their
They wanted to set relatively long usage terms (at least 5 years each) for the band(blocks) on which they built nationwide LTE network. It implies that the operators shared similar expectations with the Authority for the next five years and wanted to secure such spectrum bands for stable service provision of the LTE. For the other spectrum bands that used for subsidiary purpose, operators submitted different opinions. For the LTE-use 2.1GHz band, operators commonly asked relatively short terms of usage compared to the nationwide network bands. Operators commented that they expect less frequent use of the band within a few years as the 5G replaces the additional demand in mobile traffic from the LTE. For the 3G-use 2.1GHz band, operators asked five years of usage terms for reassignment. They showed their expectation that more than a million of the 3G subscribers will stay on the service for the next five years. For the 2G spectrum band, relevant operators asked for extending the usage term upon the termination decision from the Authority. At the time (Nov. 2020), LG Uplus did not receive the termination approval from the Authority so that they proposed for flexible usage terms conditioned upon the end of service (6 months ∼ 5 years). SK Telecom, who already acquired the termination of service until March 2021, asked for a very brief terms of usage (less than 6 months).

<Table 2> Requests from South Korean Operators about the Reassignment Bands

<table>
<thead>
<tr>
<th>Bands</th>
<th>SK Telecom</th>
<th>KT</th>
<th>LG Uplus</th>
</tr>
</thead>
<tbody>
<tr>
<td>800MHz</td>
<td>5 years (LTE)* / 6 months (2G)</td>
<td>NA</td>
<td>3 ∼ 5 years*</td>
</tr>
<tr>
<td>900MHz</td>
<td>NA</td>
<td>7 ∼ 10 years</td>
<td>NA</td>
</tr>
<tr>
<td>1.8GHz</td>
<td>3 ∼ 5 years</td>
<td>7 ∼ 10 years*</td>
<td>6 months ∼ 5 years (2G)</td>
</tr>
<tr>
<td>2.1GHz</td>
<td>5 years(3G) / 2 ∼ 3 years(LTE)</td>
<td>5 years</td>
<td>3 ∼ 5 years</td>
</tr>
<tr>
<td>2.6GHz</td>
<td>NA</td>
<td></td>
<td>3 ∼ 5 years</td>
</tr>
</tbody>
</table>

spectrum licenses during their terms of usage, unless the Authority retrieves licenses to punish licensees for their erroneous usage. Even though the license is being retrieved, the remained spectrum fees for the rest of usage terms should be paid as well. To complement such a limitation in the Act, operators asked to add such an optional clause to the reassigned license.
For the price of reassignment, operators and relevant experts suggested different opinions. Operators commonly commented that the Authority should impose the price proportioned to the total revenue (3%) of mobile service that corresponds to the reservation price of the new auction. They claimed that the Enforcement Decree of the Radio Waves Act regulates the standard for the calculation of the (re)assignment price (Article 14) and imposes approximately 3% of the total mobile service revenue.\(^8\) They also argued that the Authority should calculate the price according to Appendix Table 3 of the Decree that amounts to KRW 1.5 trillion (est. USD 1.3 billion, total) for five years. Besides, relevant experts suggested different opinion from operators. Professor Song, S-K. (Hong-Ik University, Law) claimed that the Authority should consider the previous auction’s final price of each spectrum rather than the proportioned revenue. He asked to quote the provisory clause of Article 14 that defines the case in which the Authority can apply a different standard for calculating the price of the assignment.\(^9\)

His interpretation of the clause suggested that the reassignment price also can be calculated based on the price from the previous auction if there is a spectrum used for the same or similar usage. He pointed out that operators already used the reassignment spectrum for the same purpose (mobile services), and such a fact justifies applying the clause. Moreover, his claim was supported by the previous case (2016) in which the Authority adopted the recent auction price for calculating the reassignment price. According to his claim, the estimation of the total price (which is based on the previous auction prices) was amounted to KRW 3.9 trillion (est. 8) Table 3 of Enforcement Decree of the Radio Waves Act regulates the calculation method for reservation price as the following: The sum of 1.4% of the averaged past five years’ total revenue in mobile service and 1.6% of the averaged revenue from the next five years. 9) Enforcement Decree of the Radio Waves Act, Article 14 (Standards for Computation and Procedures for Imposition of Price for Assignment of Radio Frequencies) (1) The standards for computing the price for the assignment of radio frequencies under the latter part of Article 11 (3) of the Act are as specified in attached Table 3: Provided, that where any other radio frequency whose use is the same as or similar to the radio frequency subject to assignment has ever been assigned through an auction, the price for radio frequency assignment may be computed taking account of the following matters: 1. The price for the allocation of radio frequencies of the same or a similar use;
USD 3.6 billion) for five years.

III. Resulted Policy Decision

1. Terms of Usages

The Authority allowed the operators to choose the reassignment terms from five to seven years by considering the opinions of stakeholders, sustainability of services, and refarming plan of the spectrum bands. The Authority restricted the usage terms for the 2.6GHz band for at most five years. For other bands, except for the 2G service (LG Uplus, 1.8GHz) band, it allowed the operators to choose the terms of usage from five to seven years. For the 2G band (1.8GHz, LG Uplus), upon the condition the spectrum will be reclaimed if the service is shut down, the Authority provisionally set six month of usage term (until December 2021).

What made the above decision is the following: In setting the term of usage for the 2.6GHz band, the Authority restricted the terms of usage according to its refarming plan that is purposed to provide the whole 2.6GHz band for 5G usage. MSIT’s mid-term spectrum plan called ‘5G-Plus Spectrum Plan’ (released in December 2019) presented building a spectrum portfolio consisting of three band ranges: Below-3GHz band, 3∼6GHz band, and above 25GHz band. As part of the plan, the Authority chose the 2.6GHz band as the first band to be provided for 5G usage in the below-3GHz band range and built a plan to re-farm the neighbored blocks into the form of whole single broadband.\(^\text{10}\)\) The plan for the band includes not only the block facing the current reassignment (held by LG Uplus) but also 60MHz-width blocks held by SK Telecom, which will expires the usage term in December 2026. The Authority also planned to match the expiration date for all spectrum blocks in the band to reserve the whole 160MHz-width spectrum for the next 5G usage until the end of 2026.\(^\text{11}\)\)

\(^{10}\)\) In the same plan, MSIT mentioned that it will extend the mid-range band for 5G centered by 3.42-3.7GHz and the ultra-high band for 5G centered by 24-28GHz which is auctioned in May 2018 respectively.
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For the other bands including 800/900MHz, 1.8GHz, and 2.1GHz, the Authority set the usage of terms from five to seven years by accepting the opinions of operators who commonly wanted 5-around years of usage term. Also, the Authority allowed operators to choose their own terms of usage for each band in consideration of their differences in demand. Moreover, the Authority partially accepted the request of operators and allowed an early return of spectrum licenses even during the terms of usage. Operators commonly claimed that there is a huge uncertainty in forecasting the LTE traffic load even for a close future. They also argued that such uncertainty could cause loss from fixed operating costs including spectrum prices and relevant fees, and discourage their incentive for investment in the 5G network. However, rather than fully allowing them to return the unwanted spectrum blocks, the Authority made certain restrictions and stated that the treatment is an exceptional one. First, the Authority restricted operators to choosing only one block to return between the 2.1GHz and the 2.6GHz band. Given that operators hope to lessen the cost burden from the unnecessary provision of the spectrum, it is natural to expect that the subsidiary band is more likely to be idled. Second, the Authority restricted operators to return the spectrum after the first third year of usage terms upon the evaluation from MSIT. The Authority added a comment that the evaluation will examine whether returning of such spectrum blocks could cause a profound impact on LTE subscribers’ welfare or not. When the application for return is accepted, the spectrum price for the remaining terms will be exempted. For example, suppose that some operator had received reassignment in the 2.1GHz band for five years of usage term and asked return of the spectrum after it spent the first three years of the term.

11) In the same plane, MSIT also mentioned that the other bands such as the 1.8GHz and/or the 2.1GHz band also can be considered as candidates for re-farming in preparing the demand for the 5G-FDD spectrum in the future.
period. Upon MSIT’s evaluation and approval for the return, the operator can return the spectrum, and the remaining price for two years will be exempted. The Authority stated that the treatment was to implicitly encourage more investment in an upcoming network as a part of the user-friendly policy. However, there could be criticism of the treatment that could harm the consistency of the policy history. Considering the reason why the current regulation does not allow the ad-hoc return of spectrum license so far, the treatment, even if it is said exceptional one, can cause counter-productive results. The relevant regulations in South Korea, mostly governed by the Telecommunication Business Act and the Radio Waves Act, are built on the assumption that the Authority sets the requirements for operators and strictly examines the qualifications of whom can efficiently provide and manage public services. According to it, the Authority guarantees the terms of usage for spectrum to operators and obliges them to provide public services of a certain condition. If the Authority allows operators to return the spectrum for any time during their usage terms, it will discourage operators’ incentive for the initial commitment.

Moreover, stakeholders also commented that there could be harms in efficiency not only from lowered incentive for long-run investment but also efficiency of spectrum usage because the returned spectrum will remain unused until the Authority find a new licensee or re-farm the neighbored band. However, for the current reassignment, given that initial investments for the legacy services were done in their previous usage terms – mostly longer than 10 years, stakeholders’ comments on low initial investment were considered as resolved. For the terms remaining unused, some other stakeholders commented that there are other spectrum band still remaining unused more than two years. They also advocated that two years of unused term is quite bearable in considering that terms of usage are generally more than five years and sometimes reach to ten years.

2. Reassignment Prices

MSIT designed reassignment price by taking a two-step approach; First, it calculated
the ‘base price,’ that is standardized from the previous auction prices for each spectrum. For the spectrum that does not have auction reference or does have exceptionally high price, the Authority applied standardization of prices according to K-means clustering. And then, it applied the ‘discount factor’ to the base price depending on the deployment scale of the 5G base stations from operators. The Authority explained that it considered the situation in which the LTE base stations are widely exploited to complement the 5G services. In such a case, the contributions from the LTE network could discourage operators building the new 5G stations. To elicit how much the LTE stations can contribute to the 5G services, the Authority took the scenario-based analysis and estimated changes in the revenue from mobile services. Moreover, the Authority also estimated the expected changes in operators’ costs for network building (CAPEX) by their additional deployment of the 5G base stations with respect to the previous trend in subscribers, base stations, and network investment. The Authority intended to reflect such estimations and take the ex-post (or follow-up) adjustment by the form of discount factor.

1) Discussion on the base price

As the first step of pricing process, the Authority took benchmark method by taking references from the previous auctioned prices. The Authority found that the benchmark method is the most desirable way to find proper ‘base prices’ for the reassignment. In the hearing, MSIT representative commented that the method has a legislative basis in the Act (Article 14 of the Enforcement Decree of Radio Waves Act) and they already have enough reference cases for each spectrum. The previous
price for each spectrum assignment was recalculated into the yearly-based prices and summed by the reassignment terms. The resulted total price for all spectrum blocks amounted to KRW 4.2 trillion for a five-year term.

Before taking the benchmark method, the Authority and relevant group of experts examined several different approaches from other countries including Japan (MIC (2020)), the UK, Germany, and etc. They classified the methodologies into three categories: the market-based approach, the income-based approach, and the cost-based approach. The market-based approach exploits information from past market transactions or purchasing records of similar objectives to find an optimal price for a certain objective. Provisionary Clause of the Article 14 (of the Radio Waves Acts), which allows taking references from the past auction or assigned prices for a spectrum of the same or the similar usage, could be considered as a sort of market-based approach. The income-based approach analyzes the income, revenue, or other cash flows from business using the objective. The Appendix Table 4 of Article 14, which calculates 3% of revenue from the mobile service as the reference for the assignment price, could be considered as a sort of income-based approach. The cost-based approach equates to an optimal price of the objective as the cost taken to replace the function of the objective (or opportunity cost of the objective). For example, when it calculates the price of a certain spectrum by the cost-based approach, it could consider additional costs for building the base stations to maintain the same amount of capacity in the network without using the specific spectrum.

Operators also suggested an alternative methodology to justify their own suggestions for the reassignment price. In detail, they equated total willingness to pay to an expected revenue subtracted from operating expenses, investment returns, and averaged profit rates of other industries. They claimed that the total reassignment price should not exceed the total willingness to pay. After reviewing the alternative, the Authority pointed out some reasons why they could not accept the suggestion. First, the Authority pointed out that operators’ calculations on operating expenses and investment returns are arbitrary in that they missed technical details. For example, they did not show any specific list of items included in expenditure. In other words, given that the calculation purely depends on the
information created from themselves, which is different from the audited/inspected accounting, it lacks objectivity. Second, the Authority concerned about the double-margin issue in operators’ methodology. Operators claimed that not only their investment returns, which represent their usual expected profits from the capital investment, but also an averaged profit rate of other industries should be guaranteed. Relevant experts interpreted such factors as the same element, a margin or the profit from business. The Authority and relevant experts found a loss of plausibility in that their claim missed theoretical and empirical background.

Even after a justification for the benchmark method, it still bears some limitations. First, the experts pointed out that the method is hard to reflect differences and similarities among the spectrum. For example, a price for KT’s 1.8GHz spectrum (15MHz width) auctioned in 2013 was KRW 900 billion (est. USD 840 million) for a 10-year usage terms. On the while, a price of the KT’s neighbored block (KRW 450 billion) or SKT’s block in 1.8GHz (KRW 387 billion) is much cheaper than the KT’s block. If they are compared in per-year/MHz unit, the unit price for the KT’s 2013 block (KRW 7.5 billion) is much expensive than other blocks in the same band (SKT’s 2013 block: KRW 3.75 billion, KT’s 2011 block: 19.365 billion). Second, there are cases that do not have reference prices from the previous auctions. For example, spectrum in 800MHz band and 900MHz band were all assigned by nomination (or beauty-contest) so that they don’t have any previous auction references. In either case, there was a difference in the price among spectrum blocks in the similar band or usage so that operators raised the question about fairness of pricing.

To resolve such limitations, the Authority applied a standardization to the prices by clustering spectrum blocks according to features shared among the spectrum blocks in similar usage. In detail, the Authority exploited K-means clustering to find groups of similar usage. To find proper variables that feature similarities in usage, it examined all the available factors that may affect valuation, such as revenues, subscribers, time of the first assignment, and technical generations. Regression analysis identified the width of the spectrum band and the number of base stations as the fittest factors and resulted in five subgroups from clustering.
<Figure 6> Result of Regression Analysis

Source: MSIT (2020), Interpreted by author

<Figure 7> Result of K-means Clustering Analysis

Source: MSIT (2020), Interpreted by author
2) Discussion on the discount factor

The Authority applied the ‘discount factor’ to the base prices to find the final prices of the spectrum. The size of the discount factor may change according to how much the 5G service replaces the predecessors. The Authority considered two channels of depreciation in the value of the LTE spectrum. First, it pointed out that a decrease in the LTE service contribution to the overall mobile business may lead to the operators’ less willingness to pay for the LTE spectrum. The Authority assumed that it could observe such changes in contribution from the changes in revenue and subscriber share. Second, the Authority considered that increasing investment in the new technology could diminish operators’ willingness to pay for the legacy spectrum. The Authority found that most increments in investment (in new generation) are directly related to the number of the new 5G base stations, which is also directly observable.

Having the possible two channels, the Authority tried to design a mechanism for the discount factor that relates the value of the LTE spectrum. By combining estimations based on the trends in mobile services and a scenario-based survey conducted by the relevant experts, the Authority found that there could be five reachable routes they can arrive around 2023. In other words, the Authority may impose different reassignment price after they observe the amount the 5G base station in 2023.

The design intended to minimize the gap between an ex-ante expectation and an ex-post realization in the valuation of the spectrum. In the South Korean policy perspective, imposing overestimated prices was pointed out as a discouraging factor for operators’ investment in the new technology. On the other hand, imposing underestimated prices could be problematic in that it failed to collect the profit from public assets.12) It is fair to interpret that the existing calculation method from the Appendix Table of Article 14, which distributes 1.4% from the past revenue and 1.6% from the future revenue, was also an attempt to minimize such a gap.

12) There were some critiques about assigning a new spectrum for a relatively low price to the new entrant because it harms value of the public assets (Kim, H-A, (2015, September 1)).
However, the method still bears limitations in that it only relies on the revenue when estimating the value of the spectrum, thus it is hard to reflect changes in the factors affecting the value of the spectrum such as the cost of network deployment, a generation of the mobile services.

<table>
<thead>
<tr>
<th>Requirement for the 5G Base Stations Deployments (per operator)</th>
<th>Reassignment Prices (Total, Discounted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 30,000 Stations</td>
<td>KRW 4.4 trillion (est.)</td>
</tr>
<tr>
<td>Above 30,000 ~ Below 60,000 Stations</td>
<td>KRW 4.1 trillion (est.)</td>
</tr>
<tr>
<td>Above 60,000 ~ Below 90,000 Stations</td>
<td>KRW 3.9 trillion (est.)</td>
</tr>
<tr>
<td>Above 90,000 ~ Below 120,000 Stations</td>
<td>KRW 3.7 trillion (est.)</td>
</tr>
<tr>
<td>Above 120,000 ~ Below 150,000 Stations</td>
<td>KRW 3.4 trillion (est.)</td>
</tr>
<tr>
<td>Above 150,000 Stations</td>
<td>KRW 3.2 trillion (est.)</td>
</tr>
</tbody>
</table>

Source: MSIT (2020), Interpreted by author

In such a viewpoint, a new mechanism, though it is not stipulated in the relevant regulation, attempted to reflect the relevant factors and directly incentivize operators’ investment in upcoming services. Stating from the base price (the KRW 4.37 trillion) that assumes no adoption of the 5G service, the price for the current deployment (2Q 2020, 60,000 base stations (est.) for each operator) amounted to KRW 3.9 trillion. When they satisfy the highest criterion, the 150,000 or more base stations, the reassignment price will be discounted up to KRW 0.72 trillion, which corresponds to 27% of current price. In detail, the mechanism may work in a following process. First, according to the deployment milestones and discount rate, the Authority may set the reassignment price for each of spectrum. The discount rate

13) According to the survey on experts and estimation for the market perspective, the Authority found that having more than 150,000 base stations, which amounts to the same number of base stations for the LTE’s nationwide network, will be enough for the stand-alone 5G network. Moreover, the survey also resulted that whether the 5G subscribers can exceed the LTE subscribers around 2023 is mostly depends on having enough coverage for nationwide service. The Authority recalculated the possible replacement from the LTE to the 5G by combining two results and estimated the changes in value of the LTE services.
will be applied to each spectrum with identical proportion. And then operators may commit the milestone they would arrive and deploy the 5G base stations according to their own strategy. At the end of 2023, the Authority will examine the number of base stations built upon the examination and recalculate prices it will add or return to the operators.

IV. Discussions and Conclusion

1. Policy Implication and Discussion

The current reassignment policy has implications in that it showed the Authority’s perspective on the legacy services and relevant spectrum licenses. Because the generation of service is now transiting to the 5G but more than 90% of subscribers are still using the legacy services, keeping the quality for the majority of subscribers and supporting operators to invest more in the new network are both crucial matters to the Authority. In this environment, the current policy reflects the Authority’s view on the longevity of the legacy services, sustainability of their current policy framework, and structural changes in the mobile service market.

For the longevity of the legacy services, the Authority seems to expect that the services may continue (at least) for the next five years. When we consider that the South Korean mobile service market still bears the feature of a bureaucratic economy characterized by controlled allocation of nationwide mobile spectrum, the will of the Authority to continue the service is likely to be self-fulfilled. However, regulation still stands on the implicit assumption that justifies the control from the Authority,14) any transfer or return of spectrum usage right still requires approval.

14) The current telecommunication regulation in South Korea detaches usage right for the spectrum from the business rights for the mobile service, while they were attached together before the revision of relevant regulations before the year 2000. South Korean regulation also changed the entry into the mobile market from the approval system to the declaration (application) system in 2019. However, the declaration of mobile service business requires the mobile usage spectrum, which is assigned by the Authority, so the applicant’s holding
from the Authority. In such a manner, it is still widely accepted that the operators still rely on the legal and industrial framework controlled by the Authority and may continue to provide the legacy services if the Authority insists on it. As the closest example, before the approval of the 2G service termination, the Authority set a guideline for the protection of legacy subscribers. The guideline adjured the operators to help subscribers switch from the 2G to other services, provide enough incentive for volunteered switching, and lower the 2G subscribers below the certain number.

Although the market still stands on the bureaucratic grounds, it is also noticeable that the Authority tried to change the current legal framework according to the change in the market environment. In the current reassignment policy, the Authority partly accepted a request from operators that intended to save the reassignment price and other relevant costs for legacy services. And it also responds to the market environment that requires vast investment in the development of the new network. As mentioned above, the reassignment policy allowed a limited range of flexibility in the usage terms to lessen the burden from spectrum prices and management of the old network, which could be a direct and an indirect cost for operators. And the policy also encouraged their effort to build a new network for the 5G service by rewarding them with a discount on the reassignment price upon the new deployments. However, such policies could be read as a ‘non-classical measure’ compared to the classical (or pro-active) approach (Massaro and Kim, (2021)). For such a reason, it could be vulnerable to the criticism in that the current treatment should undermines the consistency in terms of long-run spectrum policy. In such a perspective, it is arguable that losing consistency may weaken the Authority’s control over the market and depreciate commitment power, which should be led to an inefficiency in the usage of spectrum resources (Powell, 2004). Respond to such a claim, I consider that the current government-centric framework is facing the expiration of its life span for several reasons. First, the South Korean economy requires a change of the “winning formula” as it is about to arrive at the end of the rapid-growth period. South Korea enjoyed gradual growth for the past 30-more years and a highly populated market structure in the metropolitan area with (relatively) homogenous characteristics (Lee et al. (2011)). Such an environment helped operators save the cost of network
deployment and monetize their investment by using the centralized and concentrated network (Sridhar et al., (2013); Larson, (2017)) However, as the market growth slows down and the market structure becomes decentralized, their past business strategy is not that effective anymore, so that the policy paradigm needs to be changed. In such a manner, I would add an advocative interpretation for the policy in that it provides opportunity to observe how the market will respond to it.

In addition to the above, the year 2026, in which usage term of current reassignment is mostly expected to end, also carries interesting connotation for the next reassignment. In 2026, almost all the spectrum licenses for the current reassignment and remaining blocks (1.8GHz block for SKT and KT, 2.6GHz for SKT, which were not included for the current reassignment) are expected to expire. At the time of the expiration, 1.8GHz band and 2.6GHz band can be extended to at most 220MHz width (1805∼2025MHz) and 170MHz width (2500∼2670MHz) respectively. It means that each operator can hold more than 100MHz width in the below-3GHz band, which could be crucial for securing their network coverage. Moreover, the time may ripe for the next long-run spectrum strategy that prepares 5G and the next generation. Along with results from the current reassignment policy, which includes partial experimentation on the usage of terms and incentivized price scheme, observations from legacy and 5G service may provide enough evidences for shaping a new spectrum and telecommunication policy for the upcoming generations; whether they will keep the current government-centric long-run strategy or another alternative such as decentralized demand-based scheme, and etc.

2. Conclusion

The current article is purposed to explain the process and results accompanied by the

15) South Korean population was increasing with (relatively) younger generation during 2000s and 2010s, which is expected to reach the highest in 2027 at 51.93 million (KOSIS, 2021). Moreover, there was an extremely high concentration of populations in the cities and capital suburban areas. Relevant statistics (KOSIS, 2021) also reported that 91.2% of the population live in the city area and 50.2% of the population live in Seoul and Gyunngi-do(suburban province) area.
South Korean spectrum reassignment policy released in November 2021. Although there were a lot of news and articles that describes the 5G adoption and relevant policies in South Korea, there were rare reviews that captures overall landscape of South Korean policy and related legal/politic backgrounds. In such a perspective, I think this article can provide a unique basis for academic discussion and suggestion for the South Korean telecommunication and spectrum policy.

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