2012

# CONSULTATION ON SPECTRUM REFARMING POLICY IN PERU

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THIS REPORT IS PUBLISHED BY KISDI AS PART OF THE "ICT DEVELOPMENT CONSULTATION PROGRAM: DELIVERING CO-PROSPERITY THROUGH ICT DEVELOPMENT" SPONSORED BY THE KOREA COMMUNICATIONS COMMISSION (KCC) OF THE REPUBLIC OF KOREA.

# FOREWORD

Over the last decade, information and communication technologies (ICT) have demonstrated a positive and significant impact on economic development by increasing the flow of services and information, spurring innovation in the networks and applications that travel through the networks. Today, the world is witnessing the emergence of a new ecosystem of opportunity, a communications and information infrastructure that has the potential to advance the economic and social well-being of all countries and all people.

However, the benefits of ICT are not fully realized in many countries where ICT is often out of reach of the poor and those in rural areas. The challenge of creating digital opportunities in developing countries remains a daunting task that requires orchestrated efforts from stakeholders around the world. Recognizing the need to bridge the digital divide between developed and developing countries and the importance of Korea's role in this regard, Korea has embarked on various ICT Cooperation Projects. Since the early 2000s, Korea Information Society Development Institute (KISDI) has initiated ICT Cooperation Projects by providing ICT Policy Consultation and Telecommunications Advisory Mission for partner countries.

This report is the result of the Consultation on Spectrum Refarming Policy in Peru for the year 2012. Based on the analysis of Peruvian spectrum refarming environment, policy alternatives and recommendations were made in consideration of the global trends and Korea's experience in spectrum refarming management.

On behalf of KISDI, I would like extend my deepest gratitude to the Ministry of Transportation and Communications (MTC) in Peru and experts of KISDI Consulting Group for actively supporting our mission of achieving co-prosperity with partner countries. We look forward to the results of this consultation contributing to the advancement of spectrum management and socio-economic development in Peru.

Dongwook Kim
President
Korea Information Society Development Institute

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## GLOSSARY OF TERMS

| | |
|---|---|
| ANFR | Agence Nationale des Fréquences |
| APT | Asia Pacific Telecommunity |
| ARCEP | Autorité de Régulation des Communications Électroniques et des Postes |
| ARIB | Association of Radio Industries and Businesses |
| ATSC | Advanced Television Systems Committee |
| AWG | APT Wireless Group |
| AWS | Advanced Wireless Service |
| BPSK | Binary Phase Shift Keyed |
| CAGR | Compound Annual Growth Rate |
| CEPT | Conference of European Postal and Telecommunications |
| CFRS | Commission du Fonds de Réaménagement du Spectre |
| CISCO | Commercial and Industrial Security Corporation |
| CPF | Commission de Planification des Fréquences |
| CRMO | Central Radio Management Office |
| CSA | Counseil Supérieur de l'Audiovisuel |
| CTIA | Cellular Telecommunications Industry Association |
| CVS | Commission de Valorisation du Spectre |
| DD | Digital Dividend |
| DGAT | General Directorate of Authorizations in Telecommunications |
| DGCC | General Directorate of Concession in Communications |
| DGCSC | General Directorate of Control and Supervision of Communications |
| DGRAIC | General Directorate of Regulation and International Affairs in Communications |
| ECC | Electronic Communications Committee |
| EDGE | Enhanced Data Rates for GSM Evolution |
| FCC | Federal Communications Commission |
| FDD | Feature-Driven Development |
| GSM | Global System for Mobile Communications |
| ICT | Information and Communication Technologies |
| IDEN | Integrated Digital Enhanced Network |
| IEEE | Institute of Electrical and Electronics Engineers |
| ITU | International Telecommunication Union |
| KCA | Korea Communications Agency |
| KCC | Korea Communications Commission |
| KISDI | Korea Information Society Development Institute |
| MIAC | Ministry of Internal Affairs and Communications |
| MSS | Mobile Satellite Service |
| MTC | Ministry of Transportation and Communications |
| NTIA | National Telecommunications and Information Administration |
| NTT | Nippon Telegraph & Telephone Corporation |
| OMB | Office of Management and Budget |
| OSIPTEL | Organismo Supervisor de Inversión Privada en Telecomunicaciones |
| PCAST | President's Council of Advisors on Science and Technology |
| PCIA | Personal Communications Industry Association |
| PMSE | Programme-Making and Special Events |
| PNAF | National Plan for Allocation of Frequencies |
| PPDR | Public Protection and Disaster Relief |
| QPSK | Quaternary Phase Shift Keying |
| R/P | Recurrence or Persistence |
| STL | Studio to Transmitter Li |
| SUG | Spectrum Use Goal |
| TA | Transition Administrator |
| TDD | Time Division Duplex |
| TVWS | TV White Space |
| UHDTV | Ultra HDTV |
| UMTS | Universal Mobile Telecommunications System |
| UWB | Ultra-Wideband |
| WiMAX | Worldwide Interoperability for Microwave Access |
| WPAN | Wireless Personal Area Networ |
| WRC | World Radiocommunication Conference |

# PART 1. INTRODUCTION

Since the early 2000s, the Korea Information Society Development Institute (KISDI) has provided ICT Policy Consultation to policy-makers from developing countries with best practices and case studies related to the topic of consultation. For the year 2012, ICT Policy Consultation was proposed to Peru with the topic of spectrum refarming. Korea's KISDI and the Ministry of Transportation and Communications (MTC) of Peru agreed on the topic and contents of the consultation program. By March 2012, the KISDI Consulting Group was established headed by Dr. Insoo Kang of KISDI, consisting of experts and professionals from related institutions such as the Korean Communications Agency (KCA) in the field of spectrum refarming. As part of the Consultation on Spectrum Refarming Policy in Peru, a series of meetings, seminars and workshops were held from May to October 2012 through close cooperation between the KISDI Consulting Group and MTC. This report summarizes the results of the consultation and recommendations made by the Consulting Group.

# PART 2. CONSULTATION

## 1.Motivation

Smart mobile devices are prevalent in everyday life. With advancements in mobile technology and service diversity, numbers generated by smart mobile subscriptions and, accordingly, mobile data traffic generated by these devices are forecasted to continue increasing rapidly. Besides quantitative growth, high-capacity mobile broadband service is another rising challenge in handling the mobile data traffic boom.
The explosive increase of mobile date traffic is closely connected with spectrum demand. It grows with the society at large, and particularly in priority there is tremendous excess demand on specific bands that have high socio-economical value. It is time to find a way to use spectrum more efficiently, meeting various spectrum needs and consequently providing the required spectrum at the right time. Spectrum revocation and relocation makes it practical to use the cleared band for new purposes so that it plays a key role as a spectrum management tool in using the scarce resource efficiently, securing spectrum for emerging new services as well as increasing industry competitiveness and public benefit.

## 2.Diagnosis of Efficient Spectrum Use in Peru

The statistics figures on Peruvian mobile subscribers and revenues show the rapid growth of mobile market and services. In this situation, spectrum revocation and relocation is needed to deal with mobile data traffic and the following spectrum demand. Although MTC and OSIPTEL regulate the telecommunications market and manage spectrum use, challenges have been found in Peru's spectrum revocation and relocation system: inefficient use of spectrum resources, insufficient legal framework, and incomplete planning and infrastructure.

## 3.Spectrum Refarming Policies in Selected Countries

Spectrum revocation, relocation and compensation policy in Korea, the US, Japan and France are reviewed as benchmarks: their framework overview, revocation and relocation process, and compensation system. Each representative experience based on its policy is also presented. With the analysis and comparison of selected

countries, key items for implications and recommendations for Peru are drawn as follows: applicable law, organizational structure, compensation coverage and financing system, arbitral service, and any features to facilitate revocation and relocation.

### 4.Implications and Recommendations

Through the above procedure, we ponder implication and finally show our recommendations on the revocation and relocation policy in Peru. We also present actual cases of selected countries, focusing on Korea, to help the Peruvian government understand and apply these recommendations, which include three main issues: improving the legal framework, planning the process, and building up infrastructure.
The very first and most important point for the policy is legal framework, which gives the government the authority to implement spectrum revocation and relocation pursuant to a clear legal basis. After amending legal issues, the next to-do is planning the actual applicable revocation and relocation process. It is necessary to do revocation and relocation planning and set up the practical procedure based on the results of analysis. After improving the framework and setting up a practical process for revocation and relocation, sufficient infrastructure must be built for implementation. Here, we identify three essential key issues: compensation structure, organization in charge of compensation work, and financing system to cover compensation.

### 5.Further Issues

We suggest two issues that may become apparent in the long run. One is the need to determine how to further develop a recommended spectrum revocation and relocation policy in Peru. To maximize policy efficiency in the application of recommendations in the previous chapter, we suggest developing human resources and securing finances. The other issue determining for what purpose Peru can use the newly acquired spectrum band after spectrum revocation and relocation. It is noted that spectrum revocation and relocation is almost the only useful tool for providing spectrum in the short term in response to the amount of spectrum demand considered, especially mobile broadband.

## PART 3. APPENDIX

### 1. Digital Dividend

The digital dividend refers to the spectrum that is released in the process of digital television transition, whereby analog platforms are switched to digital-only platforms. Key foreign countries have been examining how best the digital dividend can be used for broadcasting, public use or mobile communications in order to set policy directions. In this section, the band plans for the digital dividend of three regions (US, Europe, and Asia) are explained, and the utilization trends of digital dividend in key countries including the US, Canada, Mexico and Japan are introduced.

### 2. Technical Aspects of How to Relocate 2.5GHz and 3.5GHz

In this section, we explain technical analysis methods such as radio quality analysis and service classification and compensation on radio facilities based on the Korean system. We then study the feasibility of the WiMAX frequency in 2.5GHz and 3.5GHz bands in which the Peruvian government is interested and furthermore suggest some proper bands to be relocated.

# PART 1.
# INTRODUCTION

# I. PROJECT OVERVIEW

Since the early 2000s, the Korea Information Society Development Institute (KISDI) has provided the ICT Policy Consultation to policy-makers from developing countries with best practices and case studies related to the topic of consultation.

For the year 2012, the ICT Policy Consultation was proposed to Peru with the topic of spectrum refarming. Korea's KISDI and the Ministry of Transportation and Communications (MTC) of Peru agreed on the topic and contents of the consultation program. By March 2012, the KISDI Consulting Group was established headed by Dr. Insoo Kang of KISDI, consisting of experts and professionals from related institutions such as the Korean Communications Agency (KCA) in the field of spectrum refarming.

As part of the Consultation on Spectrum Refarming Policy in Peru, the Consulting Group in May 2012 made its first on-site visit to Peru. The Consulting Group had a kick-off meeting with the task force in Peru to identify the current status of ICT and spectrum management in the country. In the middle of June 2012, Peruvian experts and government officials in the field of spectrum refarming were invited to Korea for the Study Visit. In August 2012, the Consulting Group visited Peru again for a second field study, during which it conducted in-depth interviews with experts in Peru and held a series of meetings for sharing information and expertise in spectrum refarming. In October 2012, the workshop for the final presentation of a draft of the consultation report was held in Lima, Peru. This report summarizes the results of the consultation and the recommendations made by the KISDI Consulting Group for the Peruvian government (MTC).

**TABLE 1. PROGRESS OF THE PROJECT**

| | | |
|---|---|---|
| Project Title | Consultation on Spectrum Refarming Policy in Peru | |
| Agency | KISDI (Korea) and MTC (Peru) | |
| Period | March 2012 ~ December 2012 | |
| Objectives | To Provide Recommendations on the Implementation of Spectrum Refarming Policy in Peru by Reviewing the Current ICT Status of Peru and Sharing Best Practices in Spectrum Refarming | |
| Schedule | Phase 1 (Peru, May) | - First Visit: Specification of Work Scope for Consultation / Preparatory Work (Data Collection, Interviews, etc.) |
| | Phase 2 (Korea, June) | - Study Visit: One week Program of Seminars and Site-Visits (KISDI invited five government officials from Peruvian Task Force) |
| | Phase 3 (Peru, August) | - Second Visit: Presentation of Midterm Report / Additional Data Collection and Interviews |
| | Phase 4 (Peru, October~December) | - Drafting of Final Report and Presentation<br>- Final Report to be Submitted |

## II. OUTCOMES OF EACH PHASE OF THE CONSULTATION

The first visit of the Consulting Group to Peru was paid in May 2012, during which the work scope for the consultation was specified and preparatory work such as data collection, surveys and interviews was conducted. While holding a series of meetings with directorates of the Viceministry of Communications, the Group analyzed the current status of the ICT environment and spectrum management in Peru as well as reviewed specific issues raised by MTC. In addition, the Group visited telecommunications service providers (Telefonica Moviles, Claro (America Movil) and Nextel del Peru) in Peru and analyzed their respective uses of spectrum.

**TABLE 2. SPECIFIC ISSUES RAISED BY MTC DURING THE FIRST VISIT**

| Bandwidth | Issues |
|---|---|
| 700 MHz | Digital Dividend |
| 2.5 GHz | Measures for Spectrum Refarming for Efficient Use of Spectrum |
| 3.5 GHz | Measures for Spectrum Refarming for Efficient Use of Spectrum |

In June 2012, five government officials from Peru were invited to Korea for a one-week program of site-visits and seminars. They visited the government agency and public institutions in charge of spectrum management as well as telecommunications service providers and broadcasting companies in Korea. During a series of seminars, radio spectrum policy in Korea and methodology for the estimation of terrestrial spectrum requirements were discussed. After the Study Visit Program, the Consulting Group gave a presentation of the interim report during a second visit in August 2012. Network operation centers in Lima were visited by the Group, and the MTC raised additional issues related to spectrum refarming in Peru.

**TABLE 3. ADDITIONAL ISSUES RAISED BY MTC DURING THE SECOND VISIT**

| No. | Issues |
|---|---|
| 1 | How to Compensate in a Specific Case of Few Customers and Incipient Network Development |
| 2 | Legal and Institutional Framework for Compensation in Developed Countries Including Korea |
| 3 | How to Measure Efficiency for a Data Transmission Network |

The final workshop on the Consultation on Spectrum Refarming Policy in Peru was held in October 2012. The workshop was intended to give a presentation of the final report on the Consultation and discuss following-up measures. The consulting group analyzed current status of spectrum management in Peru and provided policy recommendations on the issue. Meanwhile, an expert from the Inter-American Development Bank (IDB) participated in the workshop and gave a keynote speech with the topic of the regulatory implications and strategic implications of spectrum management in the LAC region. In addition, a senior policy advisor from Korea who has extensive experience in the field of ICT joined the visit and had a series of meetings with high-level officials from Peru while sharing experience and expertise in the ICT development policies and strategies.

**TABLE 4. KISDI CONSULTING GROUP**

| Organization | Participant | Position | Remark |
|---|---|---|---|
| Korea Information Society Development Institute (KISDI) | Insoo KANG | Senior Research Fellow | Project Manager |
| | Jaehyun YEO | Research Fellow | Telecommunications and Spectrum Research Division |
| | Sangyong KIM | Research Fellow | |
| | Seonghoon YOO | Researcher | Program Officer |
| Korea Communications Agency (KCA) | Bongkyu YI | Director | Spectrum Refarming Department |
| | Songyi SONG | Manager | |
| | Youngmin PARK | Manager | Spectrum Reimbursement Department |
| Korea Internet & Security Agency (KISA) | Ki-Joo LEE | President | Senior Policy Advisor |
| 2UIN (Unified Us Company) | Heedo RHO | CEO | Senior Policy Advisor |
| Inter-American Development Bank (IDB) | Jiyoun SON | Director | Advisor and Facilitator |
| | Antonio GARCIA | Lead Specialist | Advisor and Facilitator |

The KISDI Consulting Group has provided consultation and made proposals on Peruvian spectrum refarming policy for better development while considering Korea's case and the international trend. In this report, major issues on spectrum refarming including the current status of ICT and spectrum management in Peru are discussed in detail. Based on the analysis of those issues, recommendations and policy alternatives are suggested.

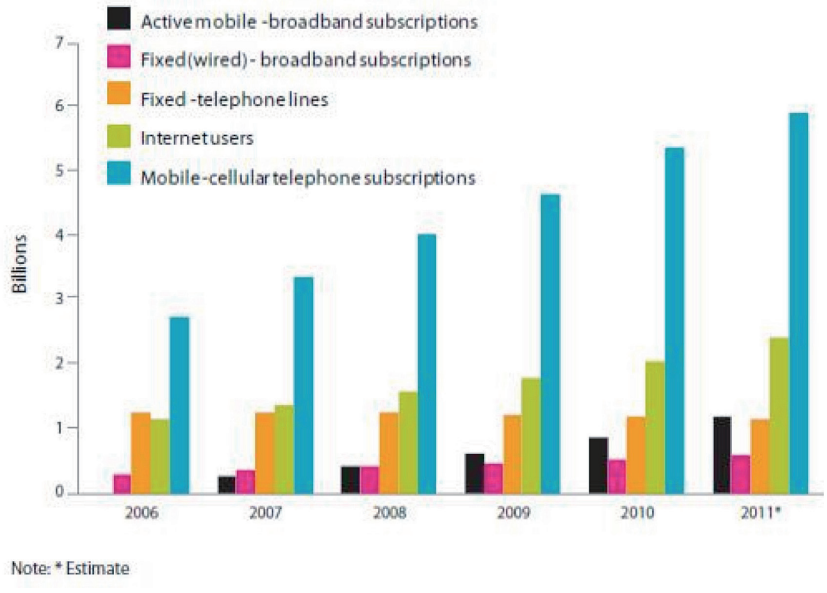
# PART 2.
# CONSULTATION

# 1. Mobile Data Traffic Big Bang

## 1) Mobile Device, Anytime, Anywhere

Smart mobile devices have flooded the world. According to ITU[1] , total mobile-cellular subscriptions reached almost 6 billion by the end of 2011, with a global penetration of 86% and 79% in the developing world. Its growth is one of the noteworthy factors. More than 80% of the 660 million new mobile-cellular subscriptions in 2011 was driven by developing countries. Notably, there were 105 countries with more mobile-cellular subscriptions than inhabitants by the end of 2011. See Figure 1.

**FIGURE 1. WORLDWIDE MOBILE SUBSCRIBERS**

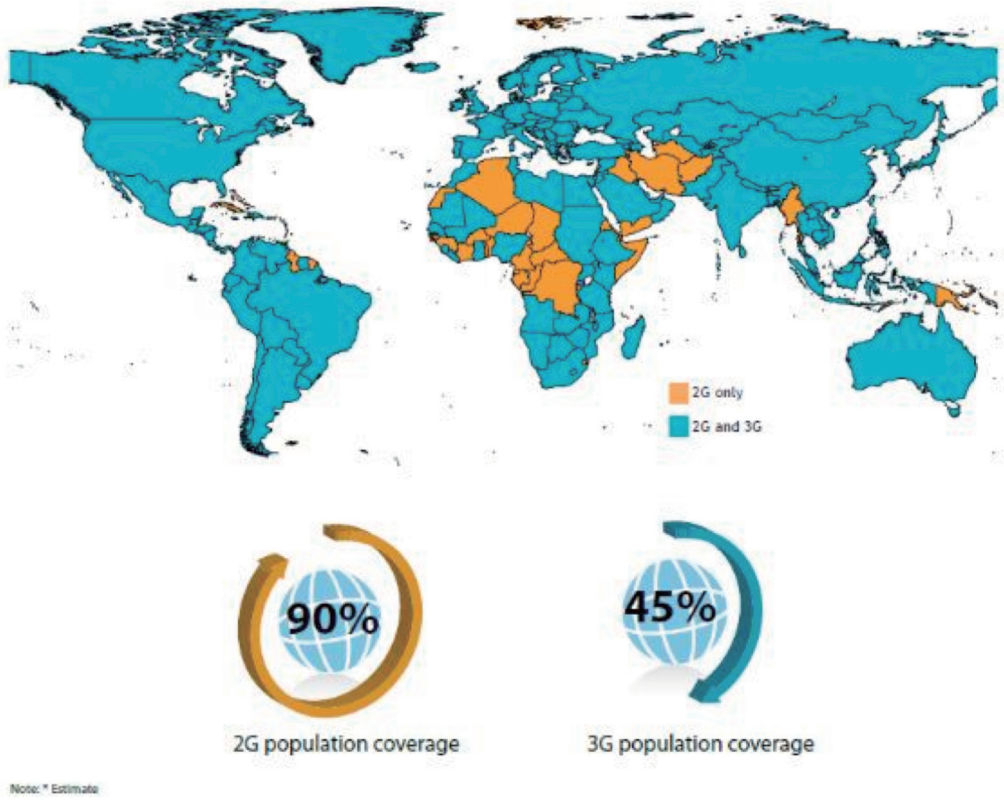



As you can see, mobile broadband was another rising issue in handling mobile traffic. There were already active 1.2 billion subscriptions worldwide in mid-2011, reaching a 40% annual subscription growth in 2011. Korea and Singapore had more mobile-broadband subscriptions than inhabitants. Overall, these have grown 45% annually over the last four years and today there are twice as many mobile-broadband as fixed broadband subscriptions.

Figure 2 below shows the countries that offer 2G and 3G services commercially as of mid-2011. One hundred and fifty nine countries have launched 3G service commercially, and their coverage has reached 45%.

[1] Hereafter, all the data on number of subscriptions and coverage are from ITU World *Telecommunication/ICT Indicators Database 2012 (16th Edition) and The world in 2011 ICT facts and figures, June 2012.*

**FIGURE 2. WORLDWIDE MOBILE COVERAGE**




There is quantitative growth in the number of mobile device subscribers, and the number and capacity of used services per device and/or subscriber are increasing rapidly. Our smartphone and table PC can perform lots of functions such as computer, media and communication as a single device.

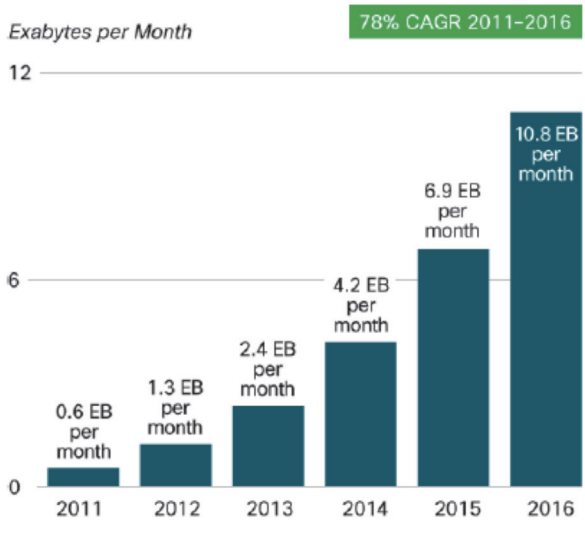
Above all, development and advancements in mobile technology result in the evolution to 4G and spread of mobile access systems such as Wi-Fi. It is said that the technical environment has been set to cover high-capacity services, which make it possible to introduce various smart mobile devices to the market and for users to adopt them actively in their everyday life. It is common for us to use smart devices for viewing real-time HDTV, streaming LTE 3D video clips, or playing high-resolution video games that generate a significant amount of mobile data traffic.

**FIGURE 3. EXPANSION OF HIGH-CAPACITY MOBILE CONTENTS SERVICES**


## 2) Upsurge in Mobile Data Traffic

According to the worldwide mobile data traffic forecast by CISCO in Figure 4[2], global mobile data traffic per month was 0.6 EB[3] in 2011. It is expected to be 10.8 EB per month in 2016, an 18-fold increase, reaching a compound annual growth rate (CAGR) of 78% from 2011 to 2016.

**FIGURE 4. WORLDWIDE MOBILE TRAFFIC GROWTH FORECAST OVERALL**



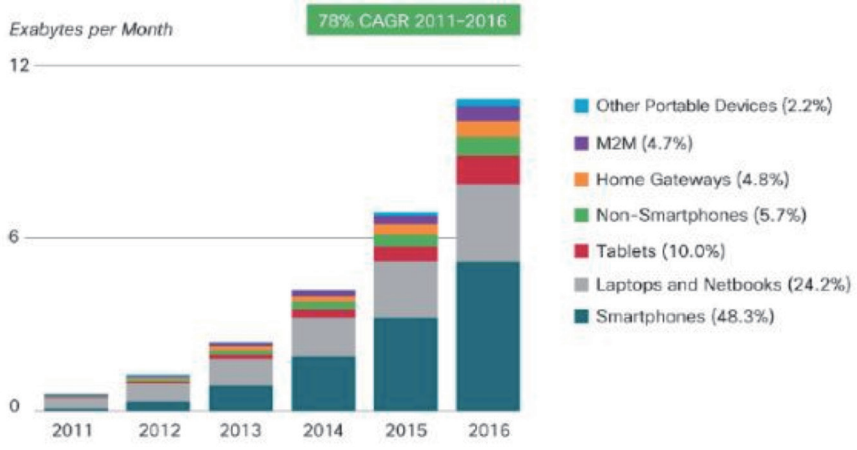

Displaying mobile data traffic forecast in detail by device type and service type, Figures 5 and 6 show the reason why traffic is expected to exhibit high growth until 2016. Mobile data traffic is said to arise from the increasing use of smartphone devices and mobile video services in the next few years

In device diversification, smartphones will get the top spot, comprising almost half of all traffic in 2016, despite laptops and netbooks were the major sources generating mobile data traffic in 2001. However, laptops and

[2] All the data about traffic here are from *Cisco Visual Networking Index : Global Mobile Data Traffic Forecast Update, 2011-2016*, February 14 2012.
[3] EB means Exabyte. 1 EB = 1024 PB (Petabyte) = 1018 bytes = 1,000,000,000,000,000,000 bytes

netbooks will still take second place, and emerging devices such as tablets and machine-to-machine (M2M) should not be overlooked in light of their greater and more significant portion.

**FIGURE 5. WORLDWIDE MOBILE TRAFFIC GROWTH FORECAST BY DEVICE**



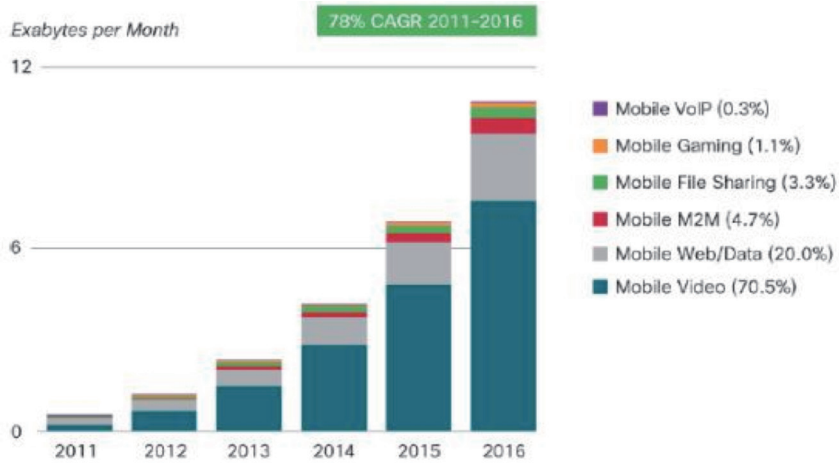

For mobile connected devices in particular, Cisco predicted that the number of mobile connected devices including M2M modules will exceed that of people on earth by the end of 2012. They once said that the number will be 10 billion in 2016, or 1.4 mobile devices per capita. The number of mobile connected tablets already tripled to 34 millions in 2011, and each tablet generated 3.4 times more traffic than the average smartphone. Table 4 shows the growth in average mobile data traffic by device type.

**TABLE 5. GROWTH IN AVERAGE TRAFFIC BY DEVICE TYPE**

| Device Type | Mobile Data Traffic (MB per month) | | | Growth in Traffic 2011-2016 CAGR (MB per month) | Growth in Users 2011-2016 CAGR |
|---|---|---|---|---|---|
| | 2010 | 2011 | 2016 | | |
| Smartphone | 55 | 150 | 2,576 | 119% | 24% |
| Portable gaming console | 244 | 317 | 1,056 | 76% | 56% |
| Tablet | 405 | 517 | 4,223 | 129% | 50% |
| Laptop and Netbook | 1,460 | 2,131 | 6,942 | 48% | 17& |
| M2M Module | 35 | 71 | 266 | 86% | 42% |

When it comes to service content types, mobile video service is forecasted to generate 70% of all the traffic by 2016— that is, 7.6 EB out of 10.8 EB. There is no doubt that mobile video content generates much more data traffic than other mobile content types such as text, voice and images.

**FIGURE 6. WORLDWIDE MOBILE TRAFFIC GROWTH FORECAST BY SERVICE TYPE**



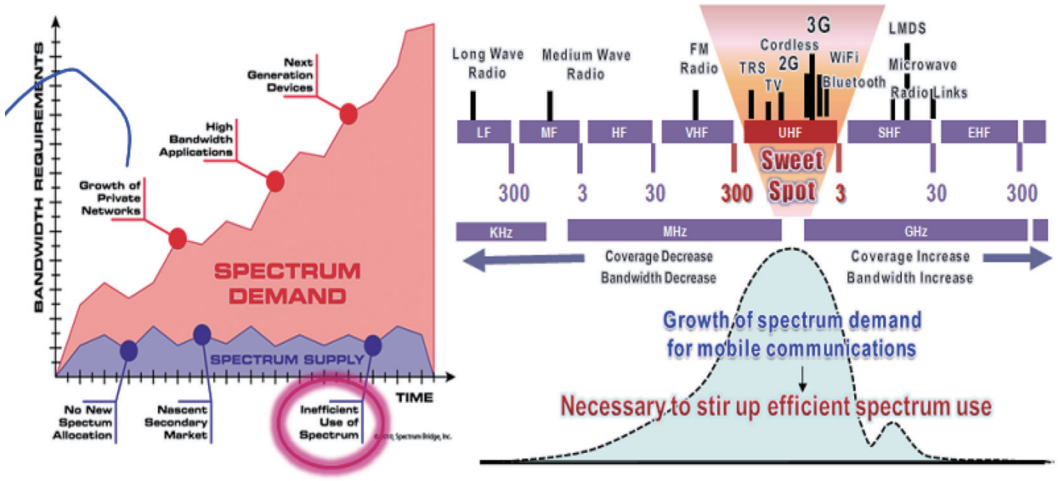

Such a recent mobile data traffic boom, in return, moves telecommunication operators to construct next-generation networks and provide advanced services more quickly. Finally, the mobile communications ecosystem has become contents-and-application-centric: high-definition video, games and N-Screen services, mobile cloud services, and ultra high-capacity services with ultra broadband technology.

## 2. Consultation Issue: How to Efficiently Use Scarce Resource and Secure Additional Spectrum

### 1) Spectrum Challenge

The explosive increase of mobile date traffic is closely connected with spectrum demand. Spectrum demand rapidly grows with the society at large, while spectrum resource is scarce and has high economical value due to technological limitations for using the spectrum. The usable spectrum band is expanding now, but the band between 300MHz and 3GHz or below 5GHz is more valuable and usable for mobile communication than any other bands. Therefore, there will be a tremendous excess demand of spectrum, particularly with priority for specific bands that have high socio-economical value and/or spectrum for mobile broadband. As well as mobile broadband, license-exempt (unlicensed) spectrum, including TVWS, UWB, Wi-Fi, WPAN and flexible access bands, is required more and more as various low-power devices are in use and to be used.

**FIGURE 7. FAST-GROWING SPECTRUM DEMAND**




In conclusion, it is the exact time to have to find a way to use spectrum more efficiently, meeting various spectrum needs and consequently providing required spectrum at the right time.

## 2) Spectrum Refarming: Revocation and Relocation

ITU-R says that spectrum refarming (redeployment) is defined as a combination of administrative, financial and technical measures aimed at removing users or equipment of the existing frequency assignments either completely or partially from a particular frequency band. The frequency band may then be allocated to the same or different service(s). These measures may be implemented in short, medium or long time-scales[4].

Europe also says that spectrum refarming (redeployment) is a combination of present and future administrative, financial and technical measures within the limits of frequency regulation in order to make a specified frequency band available for a different kind of usage or technology. The measures may be implemented in the short, medium or long term[5].

Between the two representative definitions worldwide, the common thing is that it entails administrative (license termination, cancellation or change), financial (a license fee or spectrum usage fee) and technical measures (e.g. spectrum sharing).

There are two general ways to perform spectrum refarming: one is spectrum revocation and relocation, and the other is spectrum sharing. We address the former, spectrum revocation and relocation. In the recent trends of growing spectrum use and mobile data traffic, spectrum revocation and relocation policy has been highlighted in light of effect on the efficient use of scare resource. This is because spectrum revocation and relocation makes existing user(s) move to another/other band(s), allowing use of the cleared band for newer purposes so that it

[4] ITU, RECOMMENDATION ITU-R SM.1603

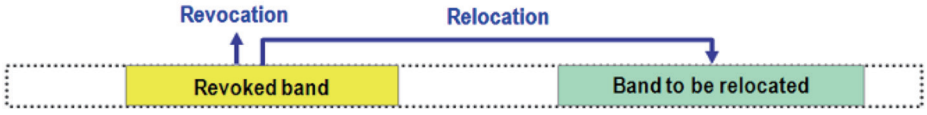
[5] Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), *ECC Report 16refarming and secondary trading in a changing radiocommunications world, September 2002*

can play a key role in using spectrum more efficiently. In conclusion, spectrum revocation and relocation is a necessary tool for efficient use of resources and securing new spectrum.

As previously determined, spectrum revocation and relocation is said to be the combination of administrative and financial measures among spectrum refarming methods. In that regard, it is said to be the most optimal spectrum refarming strategy for securing spectrum in the short term, or within three years.

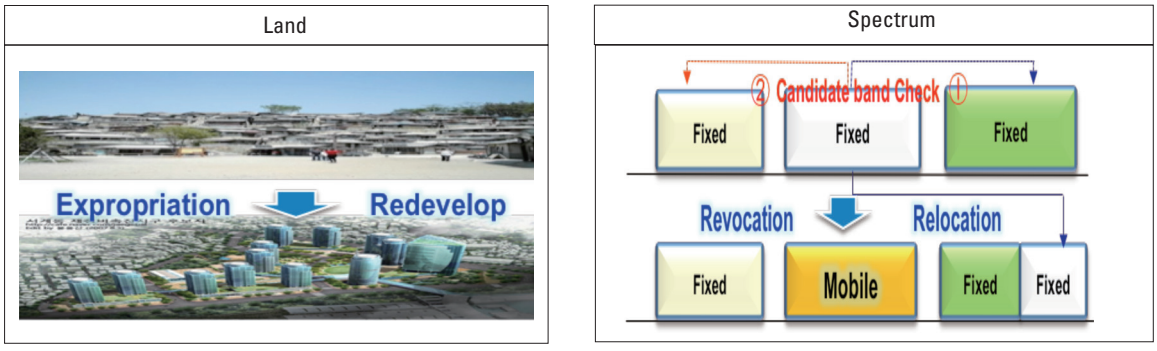
The definition of "spectrum revocation" is a withdrawal of all or some of an allocation of frequencies, a designation of frequencies, or an approval for use of frequencies. "Spectrum relocation" means an allocation of frequencies, a designation of frequencies, or an approval for use of frequencies after the revocation and replacement.

**FIGURE 8. THE MEANING OF SPECTRUM REVOCATION AND RELOCATION**




In order to easily understand spectrum revocation and relocation, please refer to Figure 9, which compares spectrum and land. In land cases, if the government wants to change an old part of the city into a new and more advanced one, it will expropriate and redevelop the old city part. So in new city part, brand new apartments and buildings are going to be built. The spectrum case is very similar to that of land. In order to accommodate more advanced mobile services into a band, the government checks several candidate bands and determines a target band for the service. Then government removes users from that band (spectrum revocation) and move the users to any other band (spectrum relocation). After spectrum revocation and relocation, the service can be launched into the redeveloped band.

**FIGURE 9. COMPARISON OF RESOURCES**




A typical spectrum revocation and relocation process is like a figure 10. At first, the government monitors spectrum efficiency based on a spectrum inventory report produced on a regularly basis, which is followed by planning, implementation, and compensation payment.

**FIGURE 10. SPECTRUM REVOCATION AND RELOCATION PROCESS**


In conclusion, spectrum revocation and relocation policy contributes to the timely provision of spectrum for the service using international harmonization bands like 3G or 4G. It is necessary to use the scarce resource efficiently and secure additional spectrum for emerging services, and finally boost industry competitiveness and public benefit.

## 1. Mobile Market and Statistics

Population slightly increased to 29,967,254 and mobile lines increased steadily to 32,461,415 annually in 2011.

**TABLE 6. THE NUMBER OF MOBILE LINES IN PERU**

| Year | Com. Móviles del Perú (Bellsouth)* | Telefónica Móviles | Nextel | America Móvil | Total | Population | Density |
|---|---|---|---|---|---|---|---|
| 1993 | 15,000 | 21,000 | - | 36,000 | - | 22,600,000 | 0.16% |
| 1994 | 22,000 | 30,000 | - | 52,000 | - | 23,650,810 | 0.22% |
| 1995 | 32,000 | 43,397 | - | 75,397 | - | 24,021,545 | 0.31% |
| 1996 | 71,000 | 130,895 | - | 201,895 | - | 24,446,899 | 0.83% |
| 1997 | 116,000 | 319,706 | - | 435,706 | - | 24,876,068 | 1.75% |
| 1998 | 230796 | 504995 | 503 | 736294 | - | 25,313,572 | 2.91% |
| 1999 | 314,107 | 712,117 | 19,486 | 1,045,710 | - | 25,729,647 | 4.06% |
| 2000 | 373,091 | 898,173 | 68,403 | 1,339,667 | - | 26,140,779 | 5.12% |
| 2001 | 430,282 | 1,087,152 | 110,248 | 1,793,284 | 165,602 | 26,547,145 | 6.76% |
| 2002 | 550,162 | 1,239,056 | 129,780 | 2,306,943 | 387,945 | 26,947,798 | 8.56% |
| 2003 | 650,617 | 1,506,637 | 146,971 | 2,930,343 | 626,118 | 27,346,612 | 10.72% |
| 2004 | 680,493 | 2,124,776 | 184,895 | 4,092,558 | 1,102,394 | 27,745,952 | 14.75% |
| 2005 | | 3,383,835 | 249,475 | 5,583,356 | 1,950,046 | 27,219,264 | 20.51% |
| 2006 | | 5,058,497 | 345,029 | 8,772,154 | 3,368,628 | 27,675,226 | 31.70% |
| 2007 | | 9,436,371 | 472,688 | 15,417,247 | 5,508,188 | 27,715,565 | 55.63% |
| 2008 | | 13,114,150 | 659,879 | 20,951,834 | 7,177,805 | 28,740,948 | 72.90% |
| 2009 | | 15,600,558 | 833,287 | 24,700,361 | 8,266,516 | 29,296,794 | 84.31% |
| 2010 | | 18,447,249 | 1,123,394 | 29,115,149 | 9,544,506 | 29,630,293 | 98.26% |
| 2011 | | 19,872,705 | 1,429,412 | 32,461,415 | 11,159,298 | 29,967,254 | 108.32% |

* Merged with Telefónica Móviles in 2004

The Peruvian mobile operator indicates higher shares for Telefónica Móviles (61%), America Móvil (34%) and Nextel (5%). Sales per mobile operator were recorded, with Telefónica Móviles at US$12.5 hundred million, America Móvil at US$12 hundred million and Nextel at US$3.2 hundred million in 2011.

**FIGURE 11. MOBILE MARKET SHARE**

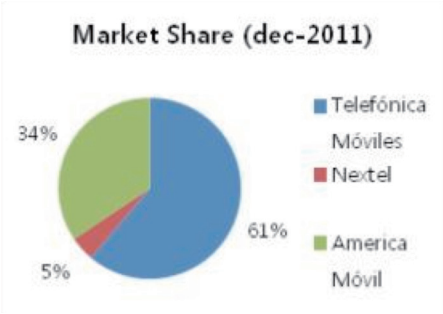



**TABLE 7. MOBILE MARKET REVENUE**

| REVENUE ($ Millions) | 2009 | 2010 | 2011 |
|---|---|---|---|
| Nextel | 239.46 | 279.44 | 318.49 |
| América Móvil | 779.70 | 996.49 | 1,185.17 |
| Telefónica Móviles | 963.66 | 1,114.05 | 1,255.61 |

Operators and technology mobile lines are as follows, and Telefónica Móviles has the most shares, in both 2010 and 2011.

**TABLE 8. THE NUMBER OF MOBILE LINES PER OPERATOR AND TECHNOLOGY**

| YEAR | 2010 | | | | 2011 | | | |
|---|---|---|---|---|---|---|---|---|
| TECHNOLOGY | AMÉRICA MÓVIL | TELEFÓNICA MÓVILES | NEXTEL | TOTAL | AMÉRICA MÓVIL | TELEFÓNICA MÓVILES | NEXTEL | TOTAL |
| CDMA | | 870.320 | | 870,326 | | 530,509 | | 530.509 |
| GSM | 9,544,506 | 17,576,923 | | 27,121,429 | 11,159,298 | 19,342,196 | | 30,501,494 |
| iDEN | | | 1,089,758 | 1,089,758 | | | 1,369,944 | 1,369,944 |
| WCDMA | | | 33,636 | 33,636 | | | 59,468 | 59,468 |
| TOTAL | 9,544,506 | 18,447,249 | 1,123,394 | 29,115,149 | 11,159,298 | 19,872,705 | 1,429,412 | 32,461,415 |

Each operator was assigned 850MHz and 1900 bands for mobile communication services, with bandwidth of 25 or 35 and so on. Technical aspects include GSM, IDEN, EDGE and UMTS, and the number of villages for each technical aspect varies by the operators.

**TABLE 9. THE BANDWIDTH ASSIGNED/MOBILE COVERAGE PER OPERATOR AND TECHNOLOGY-**

| | Bandwidth assigned (MHz) | | Number of villages covered by technology (III-2011) | | | |
|---|---|---|---|---|---|---|
| Carrier | 850MHz | 1900 | GSM | IDEN | EDGE | UMTS |
| Telefónica Móviles S.A. | 25 | 25 | 19,538 | | 196 | 196 |
| América Móvil Perú S.A.C. | 25 | 35 | 28,610 | | 16,952 | 3,664 |
| Nextel del Perú S.A. | * | 35 | | 1,858 | | 1,288 |

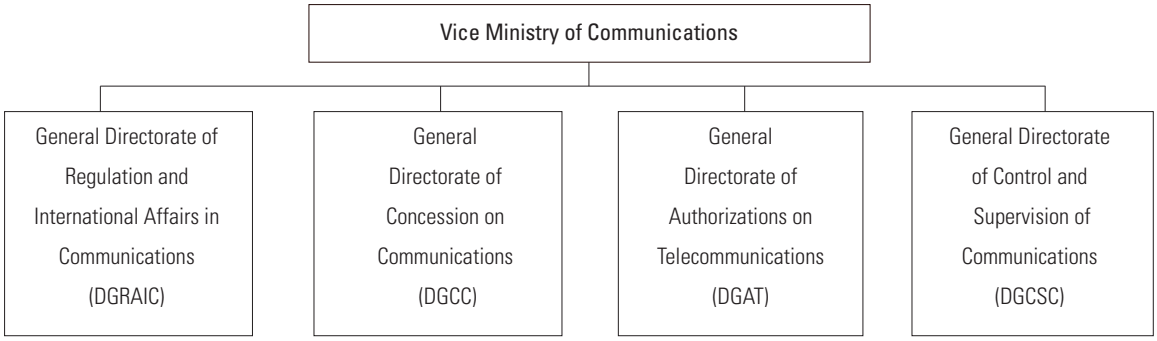
* Nextel del Perú has different spectrum assignments nationwide, depending on the area. For example, in the city of Lima and Callao, it has assigned 22.375 in bands 806-821 and 821-824, paired with 851-866 and 866-869.

## 2. Regulatory Environment

### 1) Organizational Structure

MTC manages radioelectric spectrum for the provision of telecommunications services. The General Directorate of Concession in Communications (DGCC) is in charge of licensing for public services, while the General Directorate of Authorizations in Telecommunications (DGAT) is in charge of procedures for private services and broadcasting.

**FIGURE 12. ORGANIZATIONAL STRUCTURE OF COMMUNICATION PART WITHIN MTC**




There is also OSIPTEL, the supervising agency in the public telecommunications service market dealing with issues related to tariffs, quality of service, interconnections, and unfair competition between operators, among others. OSIPTEL, however, has no power to regulate spectrum issues.

**TABLE 10. COMPARISON BETWEEN SPECTRUM MANAGEMENT FUNCTIONS OF MTC AND OSIPTEL**

| | |
|---|---|
| MTC | - Establishes general policy in telecommunications<br>- Market Access: License granting<br>- Manages and controls spectrum<br>- Represents State in negotiations and agreements<br>- In charge of Technical Secretariat of FITEL, proposing general policy and its programs and projects<br>- Manages spectrum for telecommunications services and broadcasting |
| OSIPTEL | - Regulates the market and supervises fair and loyal competition<br>- Tariffs<br>- Interconnection<br>- Quality of Service<br>- Rulemaking for user protection, orientation, complaint (2° stage), Supervises fulfillment of Concession Contracts<br>- Resolves concerns between operators |

### 2) Legal System

In general, telecommunications services are regulated by the Telecommunications Law (approved by Supreme Decree No. 013-93-TCC) and its bylaw (approved by Supreme Decree No. 020-2007-MTC and modifications). The Single Concession Law (Law No. 28737) and its bylaw (Supreme Decree No. 041-2006-MTC) foster convergence services and streamline procedures for new competitors in the telecommunications market. Under this new regime, operators willing to offer several public services need to follow only one concession pro-

cedure, instead of getting a concession per service as before.

It is important to point out that spectrum assignment is a different procedure than concession because this is granted by Ministerial Resolution while spectrum is assigned by Directorial Resolution. The National Plan for Allocation of Frequencies (PNAF) has been approved by Ministerial Resolution No. 187-2005-MTC/03. Use of the radioelectric spectrum is made according to the National Plan for Allocation of Frequencies. The PNAF is the standardized technical document that includes allocation of frequencies tables and classification of uses for the radioelectric spectrum as the general technical standards for the use of the radioelectric spectrum.

It is forbidden to use radioelectric stations for a purpose different from what was authorized, except in the following cases: support of the national or civil defense systems and during exception states; when it is necessary to protect human life, support the maintenance of public order, guarantee security of natural resources as well as public and private goods; and informing the Ministry.

### 3) Spectrum Use

The assignment is the administrative act through which the State gives a person the right of use over a determined portion of the radioelectric spectrum within a determined geographical area for the provision of telecommunication services according to those established in the PNAF.

The assignment of the radioelectric spectrum in the bands identified for wireless fixed access systems and allocated on a primary basis for the provision of telecommunications public services will be performed through auction in the provinces of Lima and Callao. The assignment of the radioelectric spectrum in allocated bands for the provision of more than one public telecommunications service provides the operator with the right to provide those services. A previous requirement for this situation is that the operator of the spectrum's assignment holds the concession that allows providing telecommunication public services corresponding to the allocation of the assigned frequency band.

According to the Telecommunications Bylaw, there are two ways to assign spectrum: one is on a first come, first served basis, and the other is through bidding. The former is done when there are no restrictions. DGCC assigns spectrum for public services according to frequency arrangements approved. Interested parties file a project, including its expansion plan and spectrum use goals. Meanwhile, bidding is necessary when there is restriction of frequency availability, it is mentioned in the National Frequency Allocation Plan, and there is restriction of concessionaires due to technical reasons.

The Ministry can instruct the Private Investment Promotion Agency- PROINVERSION, to carry out bidding processes. Below are the frequency bands bidding processes carried out by PROINVERSION, including license charges:

**TABLE 11. SPECTRUM BANDS ASSIGNED BY BIDDING**

| Band | Licensee | Bandwidth (coverage) | Service | Bid (year) |
|---|---|---|---|---|
| 1900MHz | América Móvil Perú | 15+15MHz (nationwide) | Mobile | US$180 million (2000) |
| 1900MHz | América Móvil Perú | 15+15MHz (nationwide) | Mobile | US$ 21.1 million (2005) |
| 1900MHz | Telefónica Móviles | 12.5+12.5MHz (nationwide) | Mobile | Changed by the same amount of spectrum returned in 850 MHz (2005) |
| 1900MHz | Nextel del Perú | 17.5+17.5MHz (nationwide) | Mobile | US$27 million (2007) |
| 1900MHz | Viettel Group | 12.5+12.5MHz (nationwide) | Mobile | US$1.3 million + broadband Internet for 4,023 schools for 10 years (2011) |
| 10.5GHz | Global Crossing Perú | 6 channels 7+7MHz (Lima&Callao) | Local Carrier, Internet | US$220.8 thousand (2011) |
| 850MHz | América Móvil Perú | 12.5+12.5MHz (nationwide) | Mobile | US$22.2 million (2007) |
| 800MHz | Nextel del Perú | 3+3MHz (Lima&Callao) | Mobile | US$4.7 million (2009) |
| 900MHz | Telefónica Móviles | 5+5MHz( Lima and Callao)<br>8+8MHz (Rest of the country) | Public telecommun ications service | Beauty contest<br>Deploy 700,000 fixed lines in 4 years. Monthly fee S/. 30<br>Installation cost S/. 170<br>Migrate Studio to Transmitter Links for Frequency Modulation stations (estimation US$360,000.00) (2007) |
| 450MHz | Telefónica Móviles | 5+5MHz (Lima&Callao) | Fixed telephony, Internet | Beauty contest<br>Deploy 501,000 fixed lines in 4 years. Monthly fee S/. 30<br>Installation cost S/. 30<br>Migrate Studio to Transmitter Links for Medium Wave and Short Wave stations (estimation US$162,500) (2008) |
| 2.5GHz | Yota del Perú | 24MHz (Lima, Callao, Trujillo and Lambayeque)<br>22MHz (Rest of the country) | Local Carrier, Internet | US$3.9 million (2009) |
| 900MHz | In progress | 16+16MHz (Lima&Callao)<br>13+13MHz (Rest of the country) | Mobile | |

Spectrum assignment includes the corresponding Spectrum Use Goals, which is a mechanism to ensure the efficient use of the spectrum, although not a useful practice. There is no license charge for spectrum assignment, but a fee must be paid annually for spectrum use, according to provisions established in the Telecommunications Bylaw, depending on the service.

The Spectrum Use Goals Rule was approved by Ministerial Resolution No. 087-2002-MTC/15.03. This rule establishes the following principles for efficient use of spectrum: efficiency, investment promotion, fostering competition, equal opportunities and fairness, transparency, and comprehensive analysis. Spectrum Use Goals should take into account the following:

- Be consistent with Minimal Expansion Plan.
- In case of fulfillment, use goals for the following years should fulfill indicators established for the last year in technical exhibit.
- If Spectrum Goal is not fulfilled, spectrum must be revoked to State and concession shall be cancelled.

The forms for spectrum use goals were approved by Administrative Resolution No. 023-2002-MTC/15.03. UECT, which were established for the following services: i) Satellite national/international long distance carrier, ii) Local carrier, iii) Trunking, iv) Paging, v) Mobile telephony and PCS, vi) Fixed telephony, vii) Mobile satellite, viii) Direct broadcast satellite, ix) Environmental music, and x) Links between radioelectric stations. In 2004, by Directorial Resolution No. 201-2004-MTC/17, the trunking service form was modified, and later in 2006, by Directorial Resolution No. 2377-2006-MTC/17, local carrier and fixed telephony services forms were modified.

Licenses are granted for providing services, regardless of technologies deployed. Peruvian Government policy is technological neutrality, so technology is not regulated, and operators can choose the technology that they consider more efficient for providing a service.

Regarding tradability (secondary market), licenses can be transferred with authorization from the Ministry. In the case of spectrum assignments, there are caps in some frequency bands (mobile services, 3.4-3.6) that must not be overcome.

## 3. Experiences in Spectrum Refarming

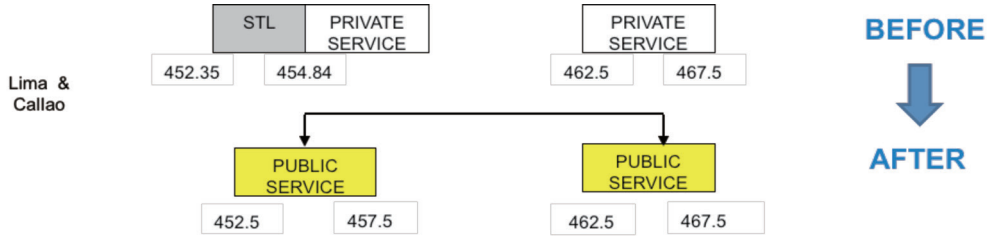
In order to foster competition in the public telecommunications services market, the Ministry has relocated frequency bands for public services, precluding other services such as broadcasting or private applications. In these cases, some provisions were established in order to protect the rights of spectrum holders or users.

For example, in the case of 450 band and 900 band bidding, it was established as part of the rules in the bidding process that bidders would have to assume migration costs for Studio to Transmitter Links for Sound Broadcasting Services operating in these bands, to other frequency bands.

The 450 band was originally used for Studio to Transmitter Links for Sound Broadcasting (Medium Wave and Short Wave) and private services. In 2007, it was allocated for public telecommunications services.

The bidder would have to assume relocation costs for STL operating in this band to other frequency bands. In 2008, band 450(5+5) was assigned to Telefonica Móviles S.A. by Beauty Contest in Lima and Callao under the following conditions: To deploy 501,000 fixed lines in four years, Monthly fee S/. 30 (aprox US$10), Installation cost S/. 30 (approx. US$10), Assume STL relocation costs estimated: US$162,500. See Figure 13.

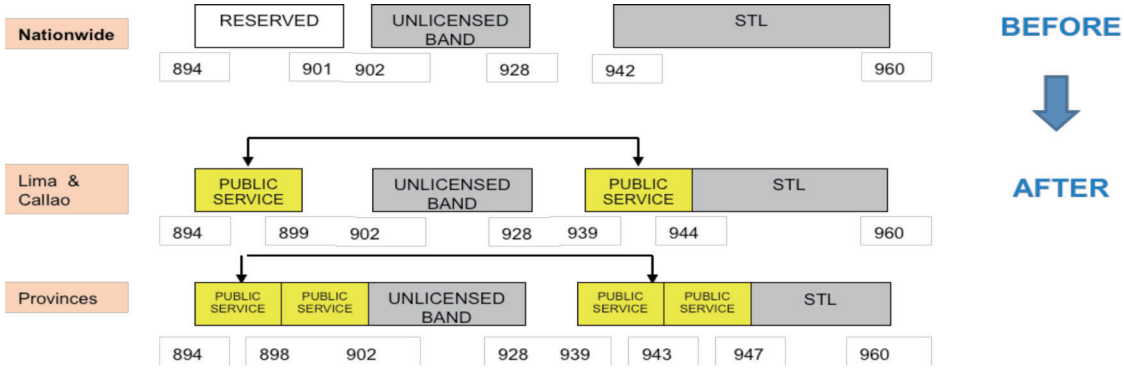
**FIGURE 13. 450MHz RELOCATION CASE IN PERU**




On the other hand, in the case of 900 band bidding (in process), rules have established that the bidder will have to assume migration costs for unlicensed devices operating in the 902-928 band. It is important to mention that there is a proposal for allowing the use of the 915-928 band for unlicensed devices, which is pending to be published for comments. Such a rule, once approved, will minimize migration costs for the bidder. Part of it was originally used for Studio to Transmitters Links for Sound Broadcasting (Frequency Modulation). In 2006, part of it was allocated for public telecommunications services.

The bidder would have to assume relocation costs for STL operating in this band to other frequency bands. In 2007, band 900 (5+5in Lima and Callao and 8+8 in the provinces), as assigned to Telefonica Móviles S.A. by Beauty Contest, under the following conditions: To deploy 700,000 fixed lines in four years, Monthly fee S/. 30 (approx. US$10), Installation cost S/. 170 (approx. US$57), Assume STL relocation costs estimated: US$360,000. See Figure 14.

**FIGURE 14. 900 RELOCATION CASE IN PERU**




In all cases, migration cost issues are negotiated between parties. The Ministry provides bidders with information regarding spectrum holders and is in charge of modifying the licenses for migration to different frequencies.

## 4. Problems and Challenges

Peru expects to make effective use of spectrum resources through the government's spectrum revocation and relocation program, applying a strong will to policy making. However, scrutiny of the current situation is required to make effective policy and develop an effective plan. Therefore, to promote the acceleration of policy development in spectrum revocation and relocation, it is necessary to clearly state the problem.

A careful consideration of Peru's spectrum management policy reveals three problems that they encounter. First of all, spectrum resource is used inefficiently in Peru so that there is a need for spectrum revocation and relocation. Second, there is no basis in law to revoke and relocate spectrum. Lastly, infrastructure to promote spectrum revocation and relocation is incomplete. In this section, we will describe the above-mentioned problems in detail and identify considerations in establishing policy for spectrum revocation and relocation in Peru.

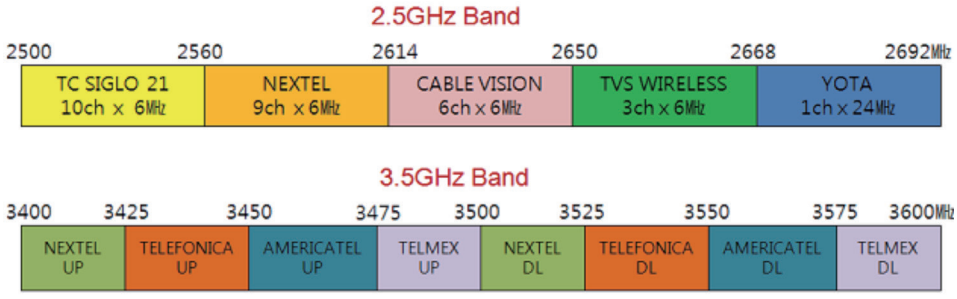
### 1) Inefficient Use of Spectrum Resource

Peru recognizes that spectrum is assigned inefficiently and that it is necessary to revoke and relocate spectrum. For this reason, it has been thinking of ways to process this. However, wireless operators in Peru doubt that spectrum resources should be distributed by the government due to the fact that they are a national resource. Most of them have argued that they are efficient users. They also claim that, considering that many restrictions for spectrum use exist, they use spectrum resources efficiently.

Their logic entails the following. To use spectrum resources, an operator may need a steel tower for installation antenna. However, this is regulated by the local government. Therefore, given the limitations set for steel towers, operators use spectrum as efficiently as they can. Extra facilities are required to improve spectrum effectiveness, but this is limited to spectrum for mobile. Considering the overall status of spectrum assignment, this is not logically sound.

The government of Peru is pondering revocation and relocation of 400 bandwidth of 2.5 and 3.5 band. The 2.5 and 3.5 band is used for mobile communication, and TC Siglo 21, Nextel, Cable Vision, TVS Wireless, and Yota use this frequency for fixed wireless internet service in the 2.5 band. In the 2.5 band, the 24 bandwidth was assigned by auction to YOTA, while the rest of the bandwidth was allocated to other operators on a first come, first served basis.

**FIGURE 15. CURRENT ASSIGNMENT OF 2.5GHZ AND 3.5GHZ BAND IN PERU**



In the case of the 2.5 band, the first TC Siglo 21 was assigned the 2500-2614 band on a first come, first served basis without compensation, but they sold the free frequency 2560-2614 band to Nextel, for which service isn't provided after assignment. Generally, if the frequency of the country property is unused or has low usage, the government should revoke frequency and assign it to new users. However, measures were not revoked for TC Siglo 21, but rather a case has occurred that TC Siglo 21 transferred the assigned frequency after being paid by Nextel. Of course, Peru has a law that allows the transfer of frequency. However, it is obvious that the frequency is not the target of the transfer because the relevant frequency is assigned without payment on a first come, first served basis.

In this case, not only the seller but also the buyer of the spectrum that is not subject to transfer is said to forget the fact that spectrum resource is considered public national property when trading spectrum for the purpose of profit of a corporation. This is the exact example of regarding spectrum as private goods.

Also, the same band operators use more frequency than needed. Nextel purchased the 54 bandwidth frequency of the 2.5 band from TC Siglo 21, but it does not provide services using the band. They only retain the frequency. Spectrum hoarding seems to be the overall trend for Peru carriers. Also, frequency users of the 3.5 band only retain it, and utilization of the frequency is low. Total service subscribers amount to 2,000, but the 200 frequency use width indicates low frequency utilization efficiency. Because the Internet market is inactive, it is difficult for operators to extend their services. However, they haven't the willingness to revitalize services by using the assigned frequency. They have hidden intentions to use it for mobile communications in the event of future changes in use or to profit through transfer.

The Peruvian government assigning the frequency on a first come, first served basis when the frequency exceeds demand is not required as in many countries, but they introduced the auction early. Initially, the bidding price of frequency was much higher than the current level, but the price of frequency has recently been lowered. Low frequency price may indicate inactivity of the telecommunications market, or the value of frequency may be underestimated. The value of frequency has shrunk because frequency was released excessively in the market.

In the case of 3.5, the frequency is assigned with a width of 200 to four carriers, but the amount obtained at auction remained at only US$35 million. Frequency was assigned, but the Internet business of operators did not succeed. The price of frequency may be underestimated due to the uncertainty of the market, but the excessive supply of frequency can be a factor.

One incentive for operators to retain frequency at a low price is delaying business for other operators or their competition, since the assignment period for frequency lasts 20 years.

Operators have the authority to retain frequency for 20 years because they bought it rightfully, and they can require continuous frequency refarming for the persistence of the business after 20 years. Therefore, the government can't easily revoke or relocate relevant frequency. If the Peruvian government assigned only a sufficient amount of frequency needed by operators and retained the free frequency, a more flexible frequency policy would have been possible.

The Peruvian government has frequency revocation experience for the 450 and 900 bands as the auction conditions the cost of STL equipment replacement targeting broadcasters. However, the new bidder paid the transfer cost without legal proceedings concerning revocation and relocation. This is only possible if the revocation cost

don't exceed the amount obtained at auction, and it is different from the case of the government conducting a legal revocation and relocation process as a tool to improve frequency use efficiency in response to unused or low use for assigned frequency.

If conducted through legal proceedings when frequency is used inefficiently, proper frequency revocation and relocation is possible with the government's commitment to exercise its privilege.

The Peruvian government has some experience in frequency revocation, but this seems weak as a basis for revocation and relocation policy for the increase of the frequency utilization efficiency.

### 2) Insufficient Legal Framework

As mentioned earlier, spectrum revocation and relocation with legal basis in Peru is not practiced, even though it exists. Spectrum assigned according to Ministerial Resolution no. 087-2002-MTC/15.03 can be revoked, and licenses can be canceled.

The government of Peru suggests the Spectrum Use Goal of "Minimal service expansion plan" to operators, but this goal does not seem to accommodate the service extension guidelines set by the government. This means that specific standards for Spectrum Use Goals or technical requirements have yet to be set in Peru. Operators submit plans for update coverage levels according to the Spectrum Use Goal, but the standard of measurement is unclear. The Peruvian government decides on whether it is efficient use or not based on information supplied, but there are no ways to verity it.

Consequently, it is not easy to succeed in securing the grounds for spectrum revocation and relocation by regulating operators. To revoke and relocate spectrum efficiently, the government of Peru should provide reasonable legal evidence to judge efficient utilization as well as criteria for when revocation and relocation is possible.

Also, it is necessary to suggest details for an implementation standard in taking steps toward an enforcement ordinance. Therefore, the government of Peru should establish a legal framework for the effective use of spectrum and revocation and relocation to prevent wasting spectrum resource through arbitrary interpretation of the law.

### 3) Incomplete Planning for Spectrum Refarming and Infrastructure

To implement spectrum revocation and relocation, laying the groundwork for it should be continued in parallel with building infrastructure. Although there is basis for revoking spectrum in Peru, it is incomplete and difficult to verify Spectrum Use Goals submitted by operators because their criteria are vague. Moreover, the Peruvian government lacks the techniques or equipment for monitoring that process.

Determining spectrum use is required prior to beginning spectrum revocation and relocation. In addition, the Peruvian government should issue specific standards for spectrum revocation and relocation, and provide information about substandards through verification.

The government should decide on whether it would be able to revoke and relocate based on standards and communicate that decision to service providers to gain their complete understanding on the matter.

In order to revoke and relocate spectrum efficiently, Peru should find out actual spectrum requirements for the frequency band that is currently available through analysis, but the government has thus far not conducted the study. Analyzing spectrum requirements is not only for assigning appropriate spectrum bandwidth through the application of various variables but also for understanding the appropriate spectrum for the current service. Assigning spectrum as needed and relocating the remainder for other purposes after estimating spectrum requirements could improve spectrum utilization efficiency.

In addition to analyzing spectrum requirements, there are other important considerations for spectrum revocation and relocation. Preferably, in order to provide current services continuously, conducting analysis on the characteristics of the spectrum band is required because there should be no significant difference between spectrum that is scheduled to be relocated and the frequency currently being used. Along with this, cost analysis must be performed as well as the preparation for action on potential legal issues. It seems that these types of analyses don't exist in Peru.

Moreover, Peru does not have a compensation scheme for generated loss during spectrum revocation and relocation. In the case of the 450 and 900 band, the government insisted on compensation as a condition for allocation, but it was not a compensation system that adhered to any compensation plans. Even if mutual negotiations among operators hold many advantages, there are risks of delays in negotiations due to the specific agenda of operators or problems in spectrum demand and supply brought about by excessive compensation.

For these reasons, government support and mediation is required. The government's decision on reasonable compensation can prevent excessive compensation, especially since this will promote efficient spectrum use and ensure the timely supply of spectrum resources. In Peru, establishing a compensation system can improve the effectiveness of regulations of spectrum supply and demand.

Moving forward, it is expected that many frequency revocation and relocation cases will be made to improve frequency utilization efficiency in Peru. In response to this, a professionally dedicated agency for frequency revocation and relocation will be required. As time passes, operators will continue to accumulate knowledge based on their frequency revocation and relocation experience, raising legal issues or delaying negotiations in order to avoid revocation and relocation, or in order to receive more compensation.

However, it is not easy to respond to issues raised by operators because most relevant government work has not been as consistent as that of agencies or enterprises. Also, professional knowledge of related fields along with analysis of the technological, economical, legal aspects of frequency revocation and relocation are needed in order to respond to these issues. Therefore, the government should accumulate professional knowledge through agencies responsible for frequency revocation and relocation, and there is a need for this to be accompanied by infrastructure that can carry this process out systematically. It needs to build a systematic infrastructure for spectrum revocation and relocation.

Finally, promoting policies for frequency revocation and relocation will need funding, and confirmation of financial resources is important for compensation of or operation of dedicated agencies. Currently, policies are being promoted and funded through General Accounting in the Peruvian government. While it appears to be all right to operate the agency and compensation using the general account, it may be difficult to quickly proceed with revocation and relocation because of the fact that it must go through budget approval for the central government, allowing for the period of revocation and relocation to drag on unnecessarily.

Taking this into consideration, secure finance arrangements are required for timely supply of the frequency in accordance with rapid revocation and relocation. Current diagnostic results for frequency revocation and relocation in Peru show that the government is aware of a lack of powerful means to pursue the process.

Because no proper requirements were submitted in the assignment of frequency, its value is low, especially because some operators have practiced spectrum hoarding in order to obtain it cheaply. This situation is detrimental to frequency revocation and relocation.

Also, the institutional strategy to effectively conduct the frequency revocation and relocation is weak without the infrastructure to run it professionally. Thus, in order for the Peruvian government to secure the implementation of frequency revocation and relocation, a standard for efficient frequency usage must be established, along with its legal aspects and the construction of professional infrastructure.

On the first visit to Peru, we discussed and identified current issues and problems in the spectrum revocation and relocation policy of the country. On the second visit, we analyzed Korean cases and some in selected countries for reference and to determine implications. From those procedures, we now present the project team's recommendations on the revocation and relocation policy of Peru.

We address three main issues as follows: improving legal framework, planning the process, and building infrastructure.

## 1. Korea

### 1) Framework Overview

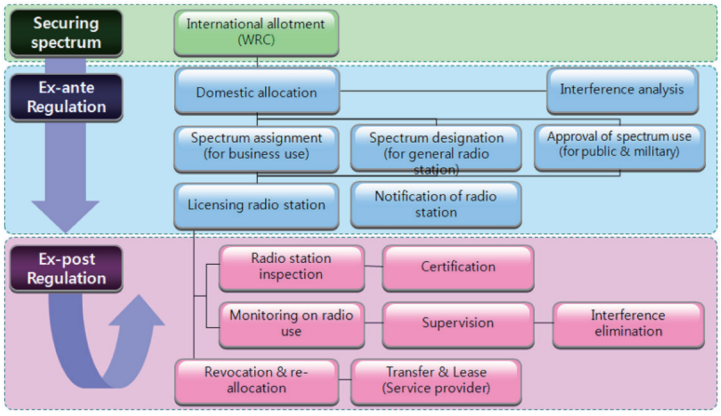
Revocation and relocation was introduced in 2000 with the amendment of the Radio Waves Act. Detailed regulations on compensation were established in the 2005 revision, which set up current regulations about how to formulate processes and calculate compensation as well as file objections. In particular, by stipulating the concept of frequency revocation and relocation, revocation and relocation of licensed bands became possible and allowed for compensation. This lay the groundwork for support to investigate and confirm spectrum utilization.

Along with this, the requirement of revocation and relocation in case allocation changes and the relocation of inactive bands were stipulated clearly to promote efficient spectrum use. Refarming is implemented based on the Radio Waves Act, Article. 6, on improving spectrum utilization efficiency. Refarming is required in each case of the following, based on Article. 6.2, Spectrum Revocation and Relocation: allocation change such as from FM broadcasting relay to mobile communication; inactive use, for example, with a very low level of subscribers or radio stations; band arrangement such as from analog to digital technology.

The scope of compensation was prescribed as 'ordinary generated loss' in the Radio Waves Act, Article 7. Calculation of compensation is based on the remaining value of current facilities and the expenses on newly acquired facilities.

KCC is responsible for and manages the whole process of revocation and relocation, while KCA supports R/P planning and is in charge of site check and actual compensation work.

**FIGURE 16. THE WHOLE SPECTRUM MANAGEMENT SYSTEM IN KOREA**



## 2) Revocation and Relocation Process

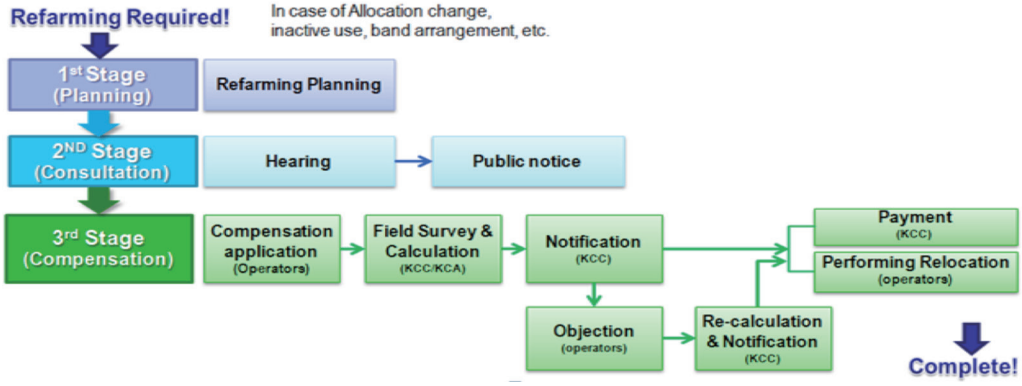
Revocation and relocation go through three stages: planning, consultation and compensation.

The first step is planning, a preparatory stage to find potential bands through investigation of international spectrum usage status and the internal spectrum use map. KCC sets up policy for bandwidth and time for revocation and relocation according to the relocation required in case of allocation change, inactive use, band arrangement, etc.

The second step is consultation, which consists of receiving advice from experts and interested parties and following the Public Notice for revocation and relocation. At this stage, KCC makes a final decision considering the various opinions of stakeholders and announces it.

Last is the implementation of actual compensation and perfume relocation procedures. KCC set the actual amount for compensation, announced it, and gave compensation while operators carried out relocation requirements on their facilities and/or network. If there appear to be any objections against compensation during this stage, recalculation and notification would be performed after reviewing them.

**FIGURE 17. GENERAL REVOCATION AND RELOCATION PROCESS IN KOREA**




## 3) Compensation

When implementing spectrum revocation or relocation, KCC shall compensate for the general loss based on Article 7 (Compensation for Losses, etc.). Compensation is calculated by the formula at Enforcement Ordinance Schedule 1.

**TABLE 12. LEGAL PROVISIONS FOR COMPENSATION IN KOREA**

| Article 7 (Compensation for Losses, etc.) |
|---|
| (1) In implementing spectrum revocation or relocation under Article 6-2, KCC shall compensate for any loss incurred in the ordinary course of business by the relevant installer and a person who has obtained approval of frequency use under Article19 (5).<br>(2) KCC may collect the amount of compensation under paragraph (1), where losses are compensated for under the main sentence of paragraph (1), from the person who has newly obtained allocation or designation of frequencies and approval for use of frequencies for the relevant frequencies. |

Internal compensation in Korea is based on the remaining value of current facilities and expenses on newly acquired facilities. In particular, it estimates compensation considering economically durable years, reflecting the effort of management of current users to facilities subject to compensation.

**TABLE 13. COMPENSATION FORMULA IN KOREA**

| Case | Facilities subject to compensation | Compensation coverage |
|---|---|---|
| Revocation | Current Facilities | Remaining Value + Removal Cost + Extra Expenses |
| Relocation | Current Facilities<br>+ New Facilities | Remaining Value + Removal Cost + Extra Expenses<br>+ Transfer Cost<br>+ Financial Cost for the acquisition |

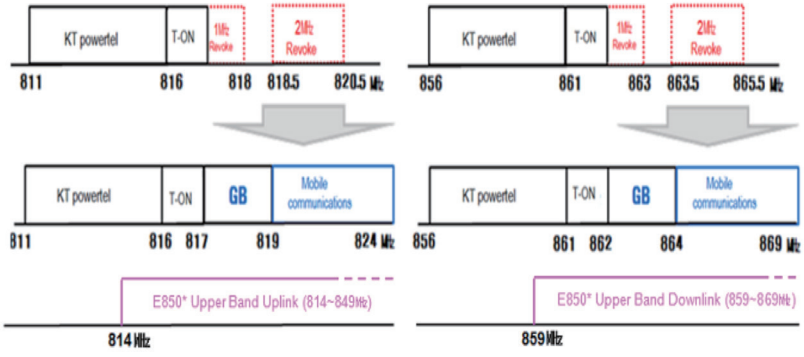
Compensation is covered by the Communications Development Fund, which is based on spectrum charge assignment and contribution. However, the compensation budget can differ from actual compensation because appropriation of compensation is budgeted before claim for reimbursement, since it operates as the ordinary budget. Meanwhile, it could be given to current users preferentially, after which it is collected from new users (or operators) who were allocated a relevant band.

## 4) Representative Experience

Revocation and relocation of spectrum in Korea is mainly for securing and supplying extra frequency for mobile.

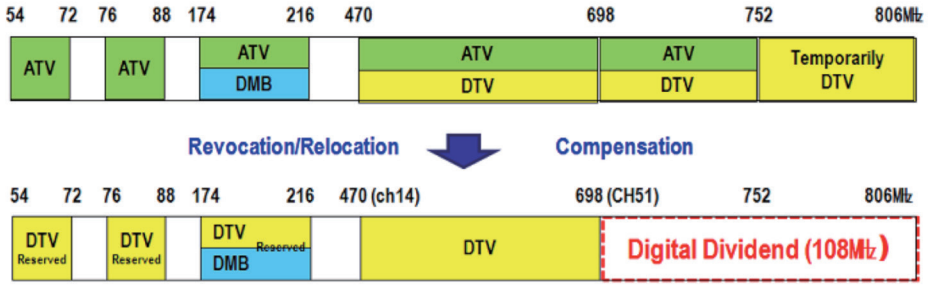
The first case is TRS Revocation. Reassignment of TRS spectrum in the 800MHz band due to its expiration (→ Re-farming – KT Powertel: 14MHz bandwidth). TRS subscribers and its revenue have fallen. The validation process for revocation has begun through legal and technical analysis. Legal Analysis on the possibility of revocation and technical analysis on radio interference and estimation of reasonable spectrum demand were conducted based on the number & type of subscribers, and their usage pattern. Finally the revocation of 2MHz pair (4MHz) from KT Powertel, 1MHz pair (2MHz) from T-on Telecom happened. Auction for mobile service was held in a timely manner. E850 band is a new global LTE band which comprised 2 sub-bands; upper-band (B26: 814-849MHz, 859-894 MHz) and lower band (B27: 806-824 MHz, 851-869 MHz), and 3GPP approved upper band (B26) specifications in March 2012.

**FIGURE 18. REPRESENTATIVE REVOCATION AND RELOCATION EXPERIENCE IN KOREA: TRS**



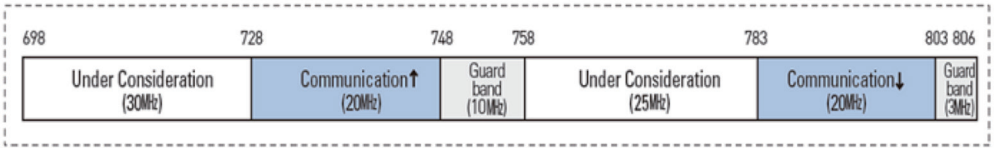
Second case is DTV Transition. DTV Channel relocation for DTV Transition takes place in December 2012. Compensation for existing users (e.g. broadcasters) will be given. Additional spectrum for mobile service is going to be secured. Radio stations necessary to change anything is subject to compensation.

**FIGURE 19. REPRESENTATIVE REVOCATION AND RELOCATION EXPERIENCE IN KOREA: DTV (1)**




885 DTV radio stations are necessary to change their channel among 1,243 stations being operated in 470~806MHz band (56 channels). 7 radio stations for mobile and radio broadcasting relay and insular communications being operated in DTV band. 40MHz bandwidth for mobile broadband among digital dividend will be secured by auction. Final allocation plan including 1.8GHz and 2.1GHz will be announced by December 2012.

**FIGURE 20. REPRESENTATIVE REVOCATION AND RELOCATION EXPERIENCE IN KOREA: DTV (2)**




## 2. US

### 1) Framework Overview

Laws on frequency revocation and relocation in the United States are specified in the regulations of US Federal Law (US Code 47[6]). However, details for the procedure of revocation and relocation are the responsibility of the administrative agency according to any matter that arises when it has been received and processed. Frequency management in the US is characterized by taking separate and dual management systems for commercial and federal frequencies in order to improve the efficiency of management according to the larger territory. Thus, revocation and relocation in the case of commercial frequency is granted to the Federal Communications Commission (FCC) and, relating to the relocation of the federal frequency, is responsible for the National Telecommunications and Information Administration (NTIA) of the Department of Commerce.

The US promotes transition to commercial frequency for the federal government through enactment of the Commercial Spectrum Enhancement Act of 2003. According to this law, in the transition to commercial fre-

[6] Communication Act 1934, 1996.

quency from public frequency, the NTIA, a government agency, estimates cost; the FCC prepares for the corresponding cost through an auction for new operators; and the relocation fund management agency, Office of Management and Budget (OMB), gives compensation to existing users and government agencies[7].

## 2) Revocation and Relocation Process

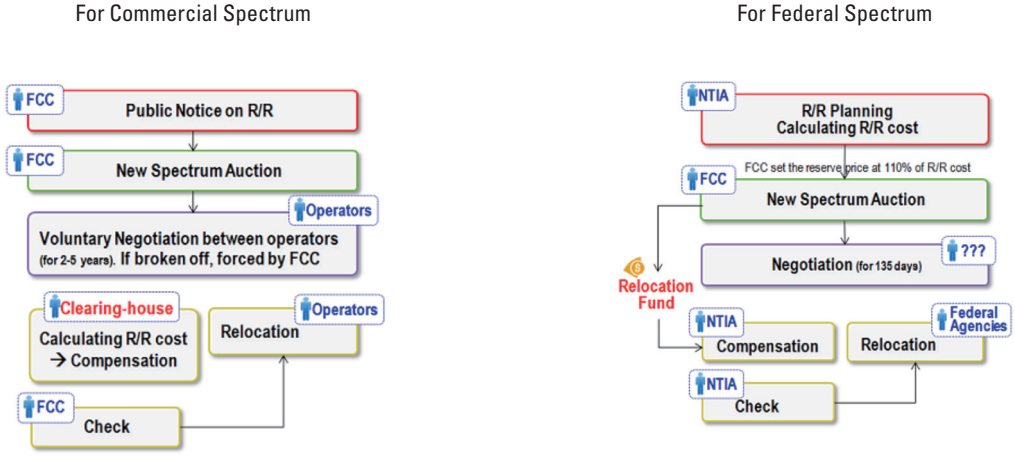
In the US, frequency of usage is managed by the agency, as mentioned earlier, so revocation and relocation procedures are also distinguished depending on frequency of usage. First, in the case of revocation and relocation of commercial frequency, the FCC makes decisions on relocation considering frequency usage, international frequency allocation, etc., which it announces. Usually, frequency revocation and relocation proceeds through a negotiation process between operators (2-5 years), and if the negotiation process breaks down, it will be forcibly relocated by the FCC. This forced relocation is made, new operators guarantee payment of minimum relocation costs, and the FCC may order prohibition of use of the appropriate frequency to existing users. In particular, FCC selects an arbitration agency to ensure the smooth revocation and relocation of frequency, and performs compensation in accordance with transfers for the existing user.

**TABLE 14. REVOCATION AND RELOCATION SYSTEM IN THE US**

| | Who to decide? | How to compensate? | What's the issue? |
|---|---|---|---|
| Commercial Spectrum | FCC | Setting up the compensation criteria **by FCC**<br>→ Arbitrating **by Clearing-house** | Preference for volunteer negotiation |
| Federal Spectrum | NTIA | Calculating compensation **by NTIA**<br>→ checking out **also by NTIA** | Consideration on safety & security |

Meanwhile, in the case of federal frequency, NTIA directly oversees revocation and relocation tasks unlike commercial relocation, considering security characteristics because it is used in defense, aerospace and government agencies. For the transition of federal frequencies for commercial purposes, NTIA estimates relocation costs and FCC conducts an auction after determining the lowest bid (110%) considering these costs. OMB pays relocation costs with a Spectrum Relocation Fund raised by auction to appropriate public agencies, and NTIA finally confirms the execution of the relocation of public agencies.

**FIGURE 21. GENERAL REVOCATION AND RELOCATION PROCESS IN THE US**




[7] Study concerning the frequency revocation and relocation plan, the Ministry of Information and Communication, 2004, 28 side.

## 3) Compensation

Coverage of compensation according to frequency revocation and relocation in the US is in principle compensation of 'all costs' according to the system installed on a 'comparable level' of that for existing users. 'Comparable level' means equivalent of Throughput, Reliability and Operating Cost[8]. 'All costs' includes all incurred for equipment transition, software purchases, facilities transition, task manual change, training costs, and changes in relevant regulations.

**TABLE 15. COMPENSATION COVERAGE IN THE US**

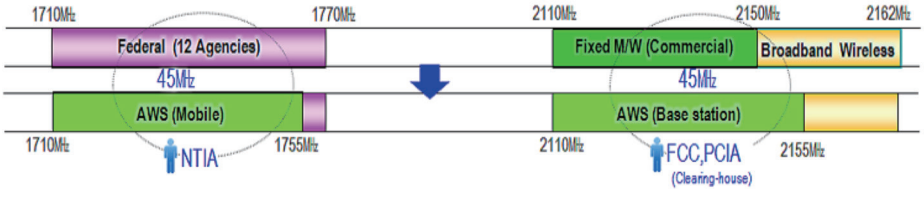
| Division | Details |
|---|---|
| Hard Cost | Costs that are directly related to the system are being replaced due to relocation, such as the cost of the equipment and engineering |
| Transaction Cost | Relocation related to external consulting costs, facility transfer costs, material costs, which do not correspond with the cost |

For example, in the case of the compensation for the Advanced Wireless Service (AWS) frequency revocation and relocation, NTIA calculated through defining the cost to build the system 'Comparable Capability' like a unfit for wireless equipment. As the federal agencies are not available to compensate the public frequency of 1.7 ㎓, the relevant federal agencies secured relocation funds by action of relevant frequency and validated the costs after the fact. If the commercial frequency compensation of 2.1 ㎓ was made as a way to share the cost with the related operators, on the other hand, the Clearinghouse went through a preparatory step with a cost-sharing basis of commercial microwave stations. In the case of 800㎒ band relocation, it was to be approved by the TA in accordance with the terms that the replaced equipment should be within 'comparable level' as the previously used equipment.

## 4) Representative Experiences

The first case is relocation from federal 1.7GHz and commercial 2.1GHz band to AWS. Spectrum revocation and relocation cases in the US, which include the first AWS, were assigned to a new holding AWS spectrum that could provide mobile communication services over 3G through relocation of commercial and public frequency. In this case, the public frequency of the 1.7㎓ band, the federal frequency revocation and relocation procedure was applied based on relocation target, cost estimation and duration estimates by NTIA. FCC presented guidelines concerning the 2.5㎓ band move to existing facilities and compensation of comparable level, and the CTIA and PCIA selected by an arbitration agency (Clearinghouse) for the revocation and relocation process has progressed. The AWS spectrum is assigned by auction for $13.9 billion, and the reserve price was set as 110% over the relocation cost.

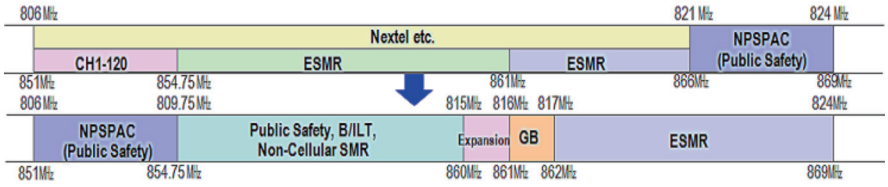
**FIGURE 22. REPRESENTATIVE REVOCATION AND RELOCATION CASE IN THE US: FEDERAL 1.7GHZ, COMMERCIAL 2.1GHZ →AWS**




[8] Throughput is the amount of information that can be delivered within a given period of time. Reliability indicates the time to accurately convey the information in the system. Operating Cost means the operating and maintenance costs (FCC, 9th Report & Order, April 2006, ET Docket No. 00-258).

The second case is the relocation from the federal 800MHz band to public and commercial use. Sprint Nextel returned its 4.5MHz bandwidth from the 800MHz band and relocated it to 1.9GHz so that the 800MHz band would be used for Public Safety (PPDR) and commercial purposes. Sprint Nextel bore the revocation and relocation cost with the difference of $2.8 billion between $4.86 billion for the newly acquired 1.9GHz band and $2.06 billion for the relinquished 800MHz band. The arbitration agency designated was not an existing arbitration agency but a TA (Transition Administrator), and they assigned superintendency regarding the 800㎒ band relocation.

**FIGURE 23. REPRESENTATIVE REVOCATION AND RELOCATION CASE IN THE US: FEDERAL 800MHZ → PUBLIC AND COMMERCIAL**




* *ESMR : Enhanced Specialized Mobile Radio*

Recently, spectrum swap, which involves the exchange of region and frequency band between individual operators has been made[9]. The FCC should undergo screening in the public interest for the transfer frequency for frequency swap.

## 3. France

### 1) Framework Overview

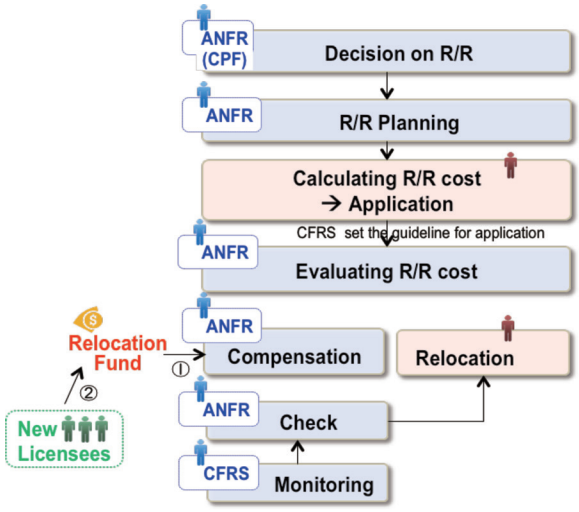
France managed regulations on communication and spectrum as it provided the Communications Act (loi sur la réglementation des télécommunications) and created the ARCEP (Autorité de Régulation des Communications Électroniques et des Postes). Spectrum revocation and relocation, by the Communications Act, Article 33, Section 42, was implemented, and compensation is determined by CPF (La commission de planification des fréquences). Also, radio frequency is managed by CSA (Counseil Supérieur de l'Audiovisuel).

### 2) Revocation and Relocation Process

France has recognized frequency as a scarce resource, and the national agency ANFR manages frequency for efficient use. ANFR manages it under the principle that frequency resource management should be performed in a manner consistent with public interests because of its increasing demand in commercial applications.

[9] AT&T made a frequency swap of Colorado, Oklahoma and Florida with Sprint-Nextel in August 2009, Verizon Wireless demanded a FCC frequency swap between licensee of 1900㎒ frequency

**FIGURE 24. GENERAL REVOCATION AND RELOCATION PROCESS IN FRANCE**




* ANFR: Agence Nationale des Fréquences (National Frequency Agency)
CFRS: Commission du fonds de réaménagement du spectre (Refarming Fund)
CPF: Commission de planification des fréquences (Frequency Planning )
CVS: Commission de valorisation du spectre (Valuation)

Looking at the frequency revocation and relocation transition procedure, relocation is first promoted by comparing the utility toward relocation costs and the expected profit through relocation[10], and CPF determines frequency revocation and relocation. If the decision is made, new operators submit relocation documents by the CFRS guidelines, and CFRS determines relocation cost evaluation, ANFR formulates the relocation execution plan, and CVS presents relocation cost estimation methods and principles. When the transition is in progress, the CFRS oversees the relocation execution of ANFR and manages implementation of the convention of the new operators and existing operators as it manages relocation agreement planning and the allocated funds.

France cooperates with stakeholders for cost estimation and frequency assignment concerning relocation. They are tightly structured among ANFR and a variety of professional committees.

### 3) Compensation

France enacted laws regarding spectrum revocation and relocation as well as compensation in 1997. Meanwhile, estimation of compensation is regulated to compensate for losses incurred typically with considering the introduction cost for new equipment and the remaining value of existing facilities.

There are two types of classification in a broad sense: estimated value in books and introduction cost for new equipment. Estimated value in books is calculated as cost savings according to introduction cost for new equipment, the remaining value of existing facilities and cost to reuse existing facilities. Meanwhile, estimating the remaining economic value within the range of difference between the benefits of new and existing users entails that estimating the frequency relocation costs is accomplished by 'estimating the value of their networks'. 'The

[10] By comparing the utility of the new users and existing users to determine frequency revocation and relocation, if the utility of new users is greater, revocation and relocation is optimum as social and economic, and if it is not optimum, the optimal policy judgment is required.

relative relocation method' to estimate relocation costs estimates the difference of incurred costs by present value of future costs that occur in the absence of frequency relocation and the frequency relocation[11].

**TABLE 16. COMPENSATION FORMULA IN FRANCE**

compensation costs = introduction cost for new equipment + remaining value - cost savings

* introduction cost for new equipment: new equipment cost incurred by the relocation
* remaining value: book value of disposal equipment (acquisition cost + accumulated amount of depreciation)
* cost savings: cost saving amount of renewal of existing facilities

France managed the relocation fund[12] to implement quick and smooth revocation and relocation pursuant to France's 'Code of Posts and Electronic Communications' article L41-2[13] . Through funds, compensation costs in principle cover all the expenses of the new user of the relocation band, and part of the fund can be pre-paid through government funding. Specially the parties have to take into account the problems that may occur and operate the funds transparently.

### 4) Representative Experiences

In fact, France has a case that accomplished spectrum revocation and relocation for the public (Defense) to introduce mobile communication services such as IMT-2000.

**TABLE 17. REPRESENTATIVE REVOCATION AND RELOCATION CASES IN FRANCE**

| | Incumbent User | Existing Service | New Service | Relocatin Cost |
|---|---|---|---|---|
| 1.9-2.3 GHz | France Telecom, MoD | Fixed | IMT-2000 | 38 Million Euro |
| 1,800 MHz | MoD | Fixed | GSM | 7 Million Euro |
| 2.4-2.69 GHz | MoD | Fixed | SRD, Bluetooth, IMT | 8 Million Euro |
| A-TV band | Broadcasters | Broadcasting | D-TV | 60 Million Euro |

## 4. Japan

### 1) Framework Overview

The Ministry of Internal Affairs and Communications (MIAC) in Japan has enacted regulations regarding spectrum revocation and relocation for the purpose of efficient utilitzation[14]. Accordingly, the MIAC investig

[11] For example, when a cable is replaced with an optical fiber, compensation considers the increase in transmission capability due to the new facility and supports part of optical fiber costs in comparing the capacity of transferred facilities.

[12] The frequency relocation fund took 3 million euros as initial funding from the Ministry of Finance in 1997. The fund can be operated flexibly, transferring spectrum charge assignment (saving 84.55 million euros until 2004) to the fund.

[13] L41-2 : Those assigned the necessary frequency shall shoulder the full cost of relocation. Some of those costs can be pre-paid through the frequency relocation fund managed by the Frequency Management Agency.

[14] Radio Regulation Law, Article 26-2 (Monitoring of the use of radio spectrum), Article 71 (change in spectrum), Article 71-2 (Measures for switching specific frequency and measures for ending specific frequency), Article 99-11 (Radio Inspection Council of Advisory). Prepared based on frequency revocation and relocation.

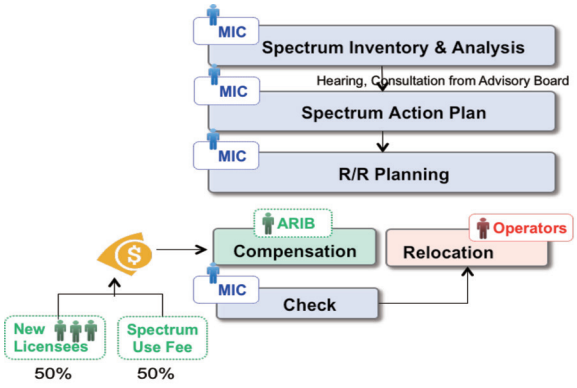
ates the spectrum utilization rate and evaluates for effective utilization of spectrum. Considering the economic effect on the distribution and alternation of spectrum revocation and relocation, if radio wave requires management or when the public interest requires it, it needs to be enforced.

## 2) Revocation and Relocation Process

MIAC is conducting a usage survey that is progressively divided into three bands of spectrum and pushing forward by making the results public as well as implementing spectrum distribution and alternation or spectrum revocation and relocation by stages. Throughout consultation on Radio Monitoring, they have ensured objectivity and professionalism. To facilitate spectrum revocation and relocation smoothly, they assigned ARIB (Association of Radio Industries and Businesses) as an alternative institution by specifying the frequency changes and exit measures regarding calculation of compensation and payment of radio industries, and are able to conduct business.

The whole band is divided into three sections (~770㎒, 770㎒~ 3.4㎓, 3.4㎓~), one of which spectrum inventory in carried out for in rotation every year.

**FIGURE 25. GENERAL REVOCATION AND RELOCATION PROCESS IN JAPAN**




## 3) Compensation

Japan has managed the benefits system for monetary compensation for the unrecovered part of invested capital, such as an existing radio station installation that users could not use due to the spectrum revocation and relocation. The benefits system states compensation for a range of losses estimates amount resulted from the order of frequency change. It is necessary to consider the remaining value of existing facilities, new facility, and financial cost including removal cost for the spectrum revocation and relocation.

**TABLE 18. COMPENSATION FORMULA IN JAPAN**

| Compensation = remaining value + financial cost |
|---|
| The remaining value of existing facilities and part of newly occurring losses |

The compensation fund for spectrum revocation and relocation in Japan comes from new users covering the fees. Thus, through spectrum revocation and relocation, users who use particular bands can benefit. However, as there is shortage in spectrum with increased usage, existing users also have to pay.

Consideration to compensate for the loss of the new users is 50 percent of the total burden of the loan within five years, but can be paid in installments along with, in principle, the interest rate. Propagation loss is 50% of the amount of compensation fee to cover. Japan has managed spectrum revocation & relocation using special accounting[15].

MIC designated ARIB as an exclusive agency for compensation and commissioned actual work. ARIB manages and facilitates compensation (calculation, payment, etc.). Regarding 3.9G, MIC also designated KyowaExeo Corp. (株式会社協和エクシオ) for compensation for personal licensee 3.9G (2012.2.3).

## 4) Representative Experiences

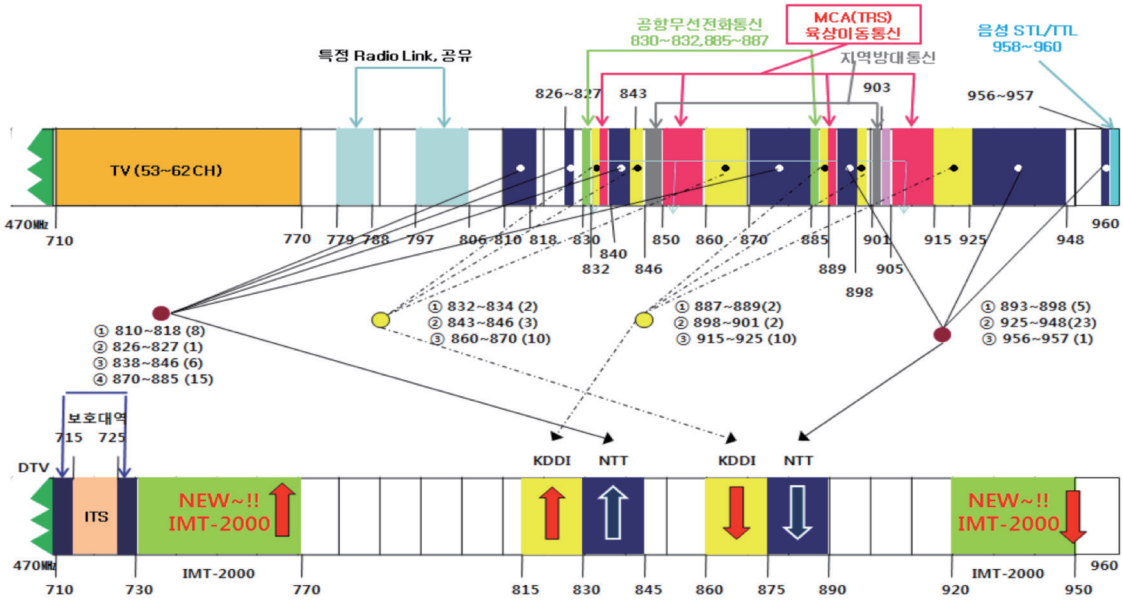
Japan has revoked and relocated public spectrum for mobile communication and wireless LAN applications, as there is an increase in mobile traffic with the push forward to secure mobile communication frequency.

**TABLE 19. REPRESENTATIVE REVOCATION AND RELOCATION CASES IN JAPAN**

| Usage | Band | Time | Purpose | Details |
|---|---|---|---|---|
| Mobile | 1.7 ㎓, 2.0 ㎓<br>1.5 ㎓<br>800 ㎒ | Nov 2005<br>May 2007<br>May 2010 | Public → Mobile(3G)<br>Mobile(2G) → Mobile(3G)<br>Local PPDR, Airport Cordless Phone → Mobile(3G) | Refarming from frequency to secure relocation of radio station for public to 3G usage<br>Refarming from existing 2G usage to 3G usage<br>Refarming of frequency from wireless to 3G usage to secure relocation for local prevention of disasters |
| WLAN | 4.9~5.0 ㎓<br>5.25~5.35 ㎓<br>5.47~5.725 ㎓ | Sep 2002<br>May 2005<br>Jan 2007 | Fixed M/W → WLAN<br>Weather Radar → WLAN<br>Experimental → WLAN | Reallocate frequency to secure implementation of fixed micro circuit<br>Reallocate frequency secured by narrowband of meteorological radar and common technology<br>Reallocate frequency secured by technology of radar and wireless LAN to prevent interference |

[15] The amount of expenses is applied to measures for ending specific frequency designated by the Ministry of Internal Affairs and Communications and up for compensation through special accounting work.

FIGURE 26. REPRESENTATIVE REVOCATION AND RELOCATION CASE IN JAPAN: 800MHZ




## 5. Comparison and Implications

Through spectrum revocation and relocation case in major countries, following implications are derived and summarized in Table 20.

First, based on the law in most countries, administrative institutions conduct revocation and relocation for the efficient use of frequency recovery.

Second, these institutions gather specialists' opinions about usage evaluation and compensation, including cost estimates to expand spectrum revocation and relocation. In the case of the US, especially for relocation to occur, swaps between providers through relocation are done quickly, but they must be approved by FCC.

Third, compensation varied for each country, where some equated compensation with the remaining value of existing facilities. The range of compensation reflects the general characteristics of the compensation system of each country as a result.

Fourth, there are cases where a separate fund for special accounting practices for expeditious revocation and relocation was set aside in the compensation fund. New users took on this burden in most countries.

Fifth, some countries designated an arbitral authority or organization for the calculation and verification of compensation for revocation and relocation. For example, France is conducting revocation and relocation and compensation systematically with the Fund Committee, Spectrum Value Committee, etc.

**TABLE 20. COMPARISON AMONG SELECTED COUNTRIES**

| | Korea | U.S. | France | Japan |
|---|---|---|---|---|
| Regulations | Radio Waves Act | C.F.R 47 Telecommunications Law | Telecommunications Regulation Act | Radio Waves Act |
| Organization | KCC (Commission) | FCC (Commission) NTIA (Administration) | ANFR (Agency) | MIC (Ministry) |
| Facilitating Relocation | Gathering professional opinions E.g.) Advisory board | Expanding revocation and relocation scope E.g.) Swap between operators | Managing various committees E.g.) Relocation Fund Committee | Consultation with council E.g.) Analysis on Spectrum Inventory |
| Compensation Coverage | Compensation for Salvage Value of existing facilities and financial cost (considering economically durable years) | Full compensation with Equivalent Level | Compensation based on Salvage Value of existing facilities | Compensation for Salvage Value of existing facilities and financial cost |
| Compensation Finances | Advanced payment with fund (General Accounts) and charged to new licensees after that | New licensees (auction price) | Advanced payment with fund (Special Accounts) and charged to new licensees after that | Spectrum use fee and new licensee (50% assigned to each) |
| Arbitral Service | KCA (affiliated organization) | Clearinghouse for commercial (private company) | ARCEP (agency) | ARIB (association) |

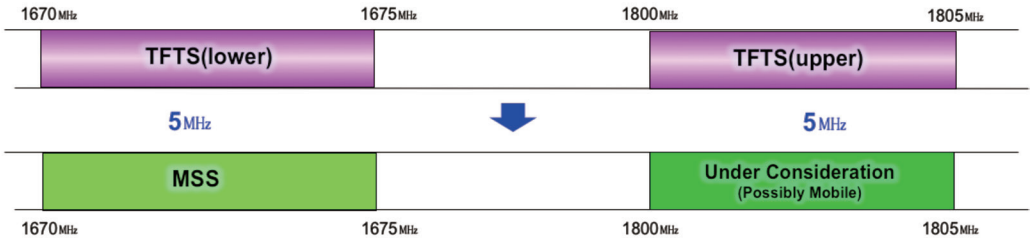
※ *For your information, here are additional cases in Germany and the UK.*

- Germany

Terrestrial Flight Telecommunications System (TFTS) Band 1670~1675㎒, 800~1805㎒. The band1670~1675㎒ (lower) and 1800~1805㎒ (upper) had been used for TFTS since 1992. At WRC-03, 1668-1675㎒ was allocated to Mobile Satellite Service (MSS) from April 1, 2007[16] . ECC has decided to designate 1670-1675㎒ to the MSS in Europe, and 1800~1805㎒ is under consideration for its harmonized use[17].

[16] ERC/DEC/(92)01
[17] ECC/DEC/(02)07, ECC/DEC/(04)09

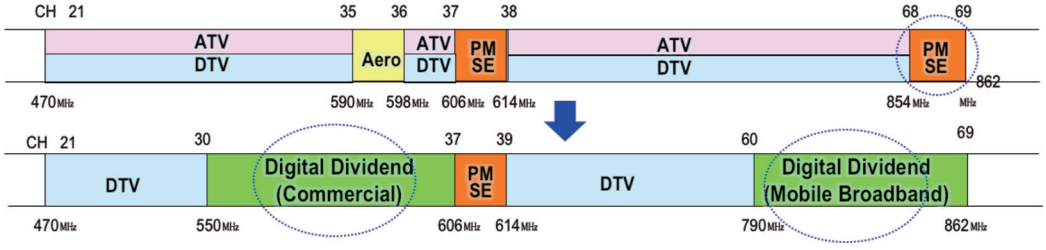
**FIGURE 27. REVOCATION AND RELOCATION CASE IN GERMANY**




- UK

Ofcom manages revocation and relocation planning and implementation in general. Ofcom designates an independent entity responsible for actual compensation work. For the revocation and relocation case of the 800 ㎒ band, Ofcom rearranged 800㎒ to use it for next-generation mobile broadband, which resulted in clearing channel 69 of PMSE users. Equiniti Limited has been appointed to administer a funding scheme that provides funding to eligible PMSE users affected by the clearing of channel 69 to give them replacement spectrum during the changeover period.

**FIGURE 28. REVOCATION AND RELOCATION CASE IN THE UK**



On the first visit to Peru, we discussed and identified current issues and problems in the country's spectrum revocation and relocation policy. On the second visit, we analyzed Korean cases and those of some selected countries for reference and to determine implications. From this procedure, we finally present the project team's recommendations on revocation and relocation policy in Peru.

These recommendations consist of three main issues: improving legal framework, planning the process, and building infrastructure.

## 1. Improving Legal Framework

The very first and most important point for the policy is legal framework, which gives government the authority to implement spectrum revocation and relocation pursuant to a clear legal basis. We figure out three findings and accordingly give recommendations for each.

**TABLE 21. FINDINGS AND RECOMMENDATIONS FOR IMPROVING LEGAL FRAMEWORK**

| Findings | Recommendations |
|---|---|
| 1.1 Spectrum should be managed to be used efficiently as a national public resource. | 1.1 Clarify the efficient use of spectrum legally. |
| 1.2 Spectrum revocation and relocation is carried out pursuant to the legal procedures. | 1.2 Establish the applicable provisions on spectrum revocation and relocation and actual procedures. |
| 1.3 The losses of existing users should be minimized. | 1.3 Establish the applicable provisions on compensation and its procedures. |

Finding 1.1 states that spectrum should be managed to be efficiently used as a national public resource. For that point, I recommend 1.1 to Clarify the efficient use of spectrum legally. Second finding is that spectrum revocation and relocation should be carried out pursuant to the legal procedures. So as a recommendation 1.2 is to establish the applicable provisions on spectrum revocation and relocation and actual procedures. Finding 1.3 is that the losses of existing users should be minimized. So I recommend 1.3 to establish the applicable provisions on compensation and its procedures.

For the application of study findings and recommendations to the Peruvian case, we use Korean policy as a benchmark. As spectrum revocation and relocation proceed, legal provision should be sequentially set up as in the flow chart shown in Table 21. The articles for spectrum revocation and relocation flow from improving the efficiency of spectrum via revocation and relocation of frequency to compensation procedures. The provisions of each stage are stated in the Radio Waves Act, with details are prescribed in the *Presidential Decree of Radio Waves Act and the Regulation of Korea Communications Commission on Enforcing Radio Waves Act* in order.

It should be noted that the three steps of making the act are closely related and sequentially implemented, so legal framework should also be connected in the same way.

**TABLE 22. KOREAN LEGAL SYSTEM ON SPECTRUM REVOCATION AND RELOCATION**

| | Improving the efficiency of spectrum use | → | Revocation and Relocation of Frequencies | → | Compensation Procedure |
|---|---|---|---|---|---|
| ACT | **Article 6** Improving the efficiency of spectrum use | | **Article 6-2** Revocation or relocation of frequencies | | **Article 7** Compensation, etc.<br>**Article 7-2** Objections, etc. |
| Decree | **Article 4** Survey on current spectrum use | | **Article 5** Notice of revocation or relocation of frequencies, etc.<br>**Article 6** Criteria to evaluate spectrum use<br>**Article 7** Requirements of band arrangement | | **Article 8** Calculation method and application procedure for compensation<br>**Article 9** Compensation payment |

## 2. Planning the Process

After amending legal issues, the next to-do is planning the applicable actual revocation and relocation process. We note that, unless there is a systematic revocation and relocation analysis framework, it would be problematic to come to an agreement between the government, operators and any interested parties by undergoing trial and error. It is necessary to perform revocation and relocation planning and set up the practical procedure based on its analysis outcome.

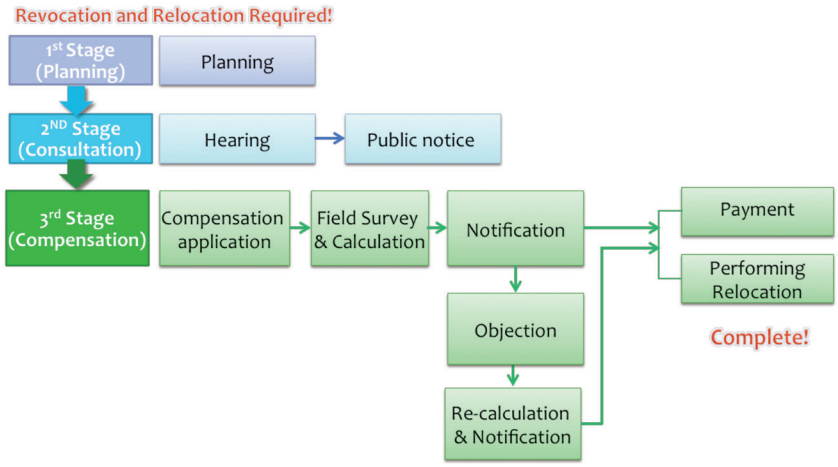
**TABLE 23. FINDINGS AND RECOMMENDATIONS FOR PLANNING THE PROCESS**

| Findings | Recommendations |
|---|---|
| 2.1 Authorities conducted systematic and comprehensive analysis on legal, technical and economic issues to minimize any possible trouble between interested parties as well as ensure spectrum efficiency. | 2.1 Authorities conducted systematic and comprehensive analysis on legal, technical and economic issues to minimize any possible trouble between interested parties as well as ensure spectrum efficiency |
| 2.2 Timetable for implementing revocation and relocation as well as providing additional spectrum has been set in the light of analysis outcomes. | 2.2 Timetable for implementing revocation and relocation as well as providing additional spectrum has been set in the light of analysis outcomes. |

Countries conducted systematic and comprehensive analysis on legal, technical and economic issues to minimize any possible trouble between interested parties as well as ensure spectrum efficiency. Thus, it is recommended to make the process systematic and analyze feasibility of revocation and relocation, and validity on legal, technical, and economic aspects.

It was found that a suitable timetable for implementing revocation and relocation as well as providing additional spectrum was set based on analysis outcomes. Thus, it is recommended to plan the revocation and relocation, and set its timetable for short, mid and long terms.

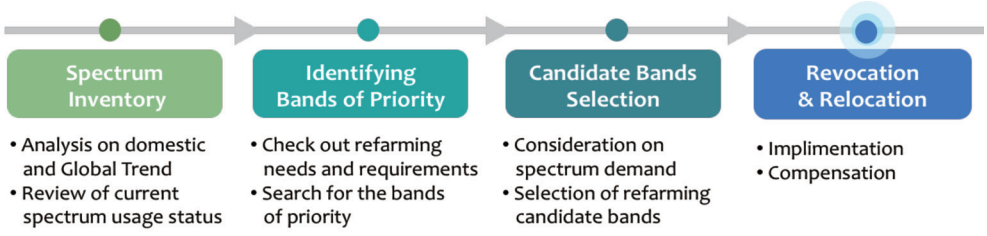
**FIGURE 29. KOREAN CASE: GENERAL SPECTRUM REVOCATION AND RELOCATION PROCESS**




For the Peruvian government's application, a three-staged process shown in the chart above could be a good example for reference. The chart is the general process of revocation and relocation in Korea. For us, the process involves three stages of planning, consultation and compensation in cooperation with various organizations. The Peruvian government may make a process chart with reference to cases in other countries that were explained in the previous chapter.

What follows are more detailed recommendations for the planning stage, which is considered to be the most important and elaborate. Two things must be done: identifying appropriate candidate bands on which revocation and relocation to be applied; and setting up the process for analyzing its validity and feasibility.

**FIGURE 30. KOREAN CASE: HOW TO IDENTIFY CANDIDATE BANDS FOR REVOCATION AND RELOCATION**




In identifying candidate bands for revocation and relocation, there should be comprehensive consideration of various issues such as global harmonization, technical development, and spectrum regulatory and telecommunication market circumstances in Peru (see Figure 29). Revocation and relocation is said to be able to secure additional spectrum relatively more quickly than any other refarming tools because the policy aims to obtain clear bands by transferring existing occupants from their original band to another one. However, once revocation and relocation has been applied on a band, it is almost impossible to use the band for another purpose for a long time. This is why the government should think about the different aspects of spectrum-related issues in the first planning stage, i.e. candidate bands selection.

Once the revocation and relocation band has been chosen, it is necessary to analyze the validity of revocation and relocation based on reviewing its legal and technical issues. In particular, technical analysis on reasonable spectrum demand, transferability and interference is said to be a starting point of revocation and relocation

However, the fact that revocation and relocation has been proven valid according to legal and technical analysis outcomes does not always mean that it is recommended to carry out revocation and relocation immediately. This is because it needs to conduct additional feasibility analysis on economic issues considering revocation and relocation cost, cost-benefit ratio and global trends. For the revocation and relocation feasibility of public (military) spectrum, the nature of public interest should also be considered.

**FIGURE 31. KOREAN CASE: HOW TO ANALYZE THE VALIDITY AND FEASIBILITY OF REVOCATION AND RELOCATION**

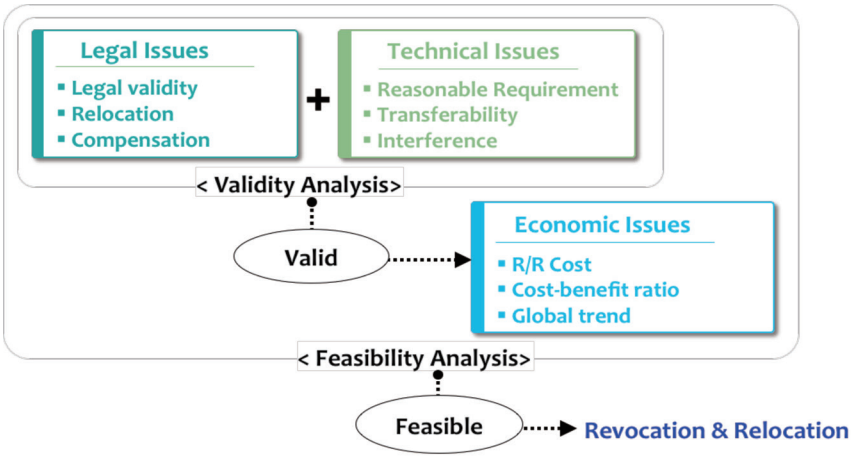



Figure 31 summarizes and displays information on feasibility analysis. As explained previously, we have a systematic and comprehensive analysis framework that includes legal, technical, and economic issues to enhance the efficiency of spectrum use and minimize any possible conflict interested between parties.

The 800㎒TRS band reassignment due to its expiration in 2011 was the first case in Korea on which an all-encompassing – legal, technical, and economical - analysis framework was applied. For legal analysis, KCC assured that revocation of unused spectrum was at the discretion of the government when it came to spectrum reassignment following expiration of the license term. KCC also technically analyzed a reasonable spectrum requirement considering the current and future number of subscribers, and accordingly drew the conclusion that the TRS spectrum could be partially revoked. For economic analysis, verification on costs such as that for transferring some base stations, changing repeaters and so on was conducted.

## 3. Building Infrastructure

After improving the legal framework and setting up a practical process for revocation and relocation, the last thing is to build sufficient infrastructure to act. Here, we identify three essential issues: compensation structure, organization in charge of compensation work, and financing system to cover compensation.

**TABLE 24. FINDINGS AND RECOMMENDATIONS FOR BUILDING INFRASTRUCTURE**

| Recommendations | Findings |
|---|---|
| 3.1 Establish an organized practical compensation procedure and follow it in terms of coverage, calculation, negotiation and evaluation. | 3.1 Revocation/relocation and compensation work follows the detailed procedure set up by authorities. |
| 3.2 Create a new agency or commission the work to a suitable part of the established organization. | 3.2 A separate agency is established for the work mentioned in 3.1. |
| 3.3 Create a Relocation Fund and allocate license fee from new users to the Fund. | 3.3 Financing is needed to cover compensation and operating expenses incurred by the agency in 3.2. |

Findings on our study of selected countries' revocation and relocation policy show that revocation, relocation and subsequent compensation work follows the detailed procedure set by the authority in each country. We then recommend the establishment of an organized practical compensation procedure, and follow it in terms of coverage, calculation, negotiation, and evaluation.

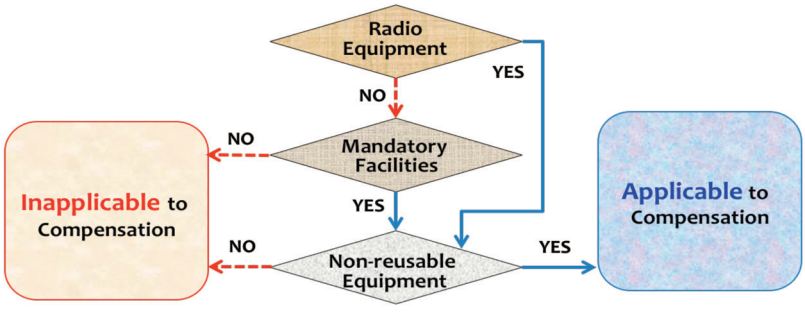
We found that for effective and efficient application, a separate agency was established for the compensation work mentioned in 3.1 (Table 24), or the work was commissioned to a suitable part of the existing organization. For the Peruvian case, the government needs to create a new agency to deal with revocation, relocation and compensation work or to commission it to the proper division/department within MTC as a recommendation (3.2).

Lastly, 3.3 is a matter of financing, which is an important issue to practically implement any policies. The same is true of spectrum revocation and relocation policy. According to our study, there were similar kinds of financing system among countries to cover compensation and operating expenses incurred by the agency in 3.2. In that regard, we recommend to create a Relocation Fund and to allocate partial auction price to the Fund.

To help you apply our recommendations above, it would be useful to show current Korean and selected countries' systems for each issue.

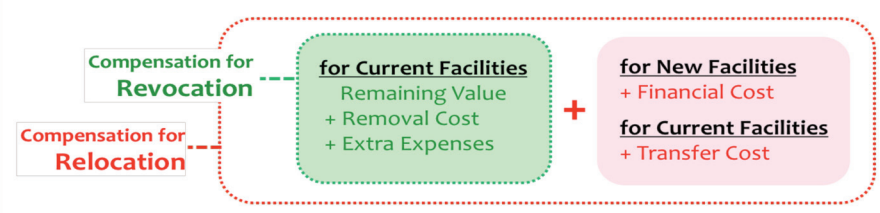
First, we can talk about the compensation structure related to recommendation 3.1, including items of compensation application and calculation. KCC shall compensate for the general loss at law. Figure 32 is about how to choose which equipment is subject to compensation in light of the type, mandatories, reusability of it. You are advised to prepare this kind of judgment flow chart to identify a facility that is applicable for compensation by your law or not. After that, for example, you can decide on the coverage of compensation for the salvage value of existing facilities versus full compensation on an equivalent level.

**FIGURE 32. KOREAN CASE: HOW TO SELECT FACILITIES TO WHICH COMPENSATION APPLIES**



Another item to think about is how much to compensate. The formula shown in Figure 33 is how to calculate compensation in Korea, which is stated in the Schedule 1 Calculation Criteria of Compensation in the Presidential Decree of Radio Waves Act. Schedule 1 consists of four articles of ▸calculation formula, ▸definitions, ▸calculation and payment process and method, ▸others.

**FIGURE 33. KOREAN CASE: COMPENSATION COVERAGE FOR ITS CALCULATION**




As shown in recommendation 3.2, the second issue is to decide on who will be in charge of and implement compensation work. Spectrum revocation, relocation and subsequent compensation work should be planned and carried out comprehensively in a systematic manner, considering all the related issues: identifying candidate bands, analyzing validity and feasibility, and the compensation procedure of calculation, notice, and payment.

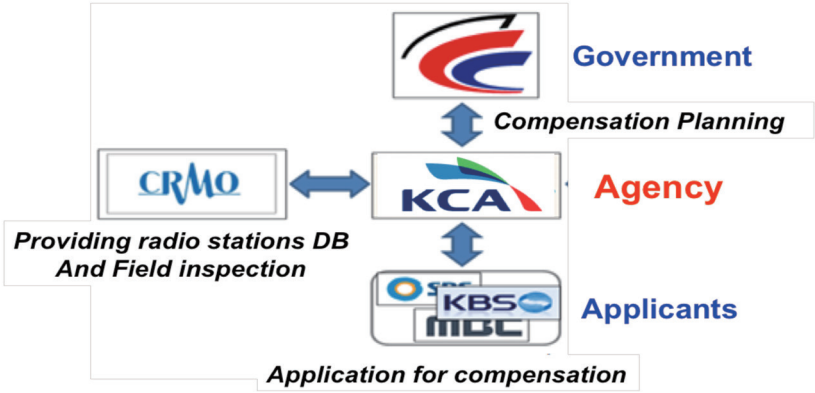
There are two typical ways of doing it as explained in the selected countries' compensation systems discussed: One is to use a separate arbitrating organization, i.e. Clearinghouse for the US; the other is to newly establish an affiliated and/or specialized agency under the government's supervision and then commission the work to the agency or an established one, as in the Korean case.

The former is a way to help users negotiate and calculate compensation neutrally through a third party. While it is desirable to proceed with compensation and not be directly handled by the government but under independent negotiations among users, even in case of Clearinghouse, a close relationship with the government takes precedence in order for compensation to work. This is because enhancing spectrum usage rights followed by relocation is highly related to spectrum policy and administrative procedures of the government such as transferring radio stations and reviewing the possibility of spectrum designation.

Also, consideration for national defence, public safety and security should be added to revocation and relocation of the bands being used for public (military) purpose. For the public (military) spectrum, for example, the US does not let Clearinghouse do compensation work, and instead allows the NTIA to do it itself.

The latter is found in the Korea system. Article 78 Delegation and Entrustment of Authority of the Radio Waves Act prescribes as follows. (1) KCC may delegate part of its authority under this Act to the heads of institutions affiliates with KCC, as prescribed by Presidential Decree. (2) KCC may commission part of his/her duties under Article 7 ,7-2, (…) to KCA. Here, Article 7 is the provision on Compensation for Losses, etc. and 7-2 is about Objection to compensation payment calculated for the applicants, that is, radio stations installers applicable to the compensation, etc. Based on this article, KCC has commissioned compensation work to KCA.

**FIGURE 34. KOREAN CASE: ORGANIZATIONAL COOPERATION SYSTEM FOR COMPENSATION WORK**

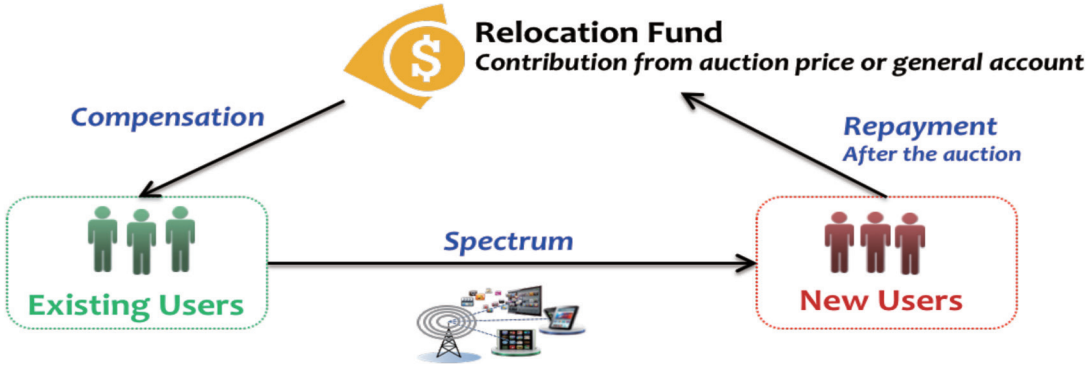



While in charge of the work, KCA cooperates with all the relevant and interested parties in the compensation process (see Figure 34 above). KCA supports the government, i.e. KCC, in compensation planning and policy making. The Central Radio Management Office (CRMO) provides radio stations DB to which KCA refers when scanning to select compensation facilities and calculating compensation. It is needless to say that applicants for compensation payment such as broadcasting companies are also one of the key partners when carrying out actual compensation work.

Nevertheless, there may exist a situation where the two scenarios above seem not to be appropriate and/or neither readily apply. It is then possible just to make one proper division/department within the government, e.g. MTC for Peru, responsible for the work until all matters are sufficiently ready. In that case, however, it needs to be aware that it is not enough to guarantee independency and specialty of compensation work due to limited human resources and organizational structure.

The last issue shown in recommendation 3.3 is a financing system to cover compensation. Based on our study on selected countries' systems, we suggest that it is desirable to run a Spectrum Relocation Fund described in Figure 35. The government compensates existing users who release spectrum with the Fund, and new users accordingly pay the price in return for the acquired spectrum bandwidth. Not only Korea but also the US, France and other countries operate this kind of financing system.

**FIGURE 35. KOREAN CASE: FINANCING SYSTEM FOR COMPENSATION**



In general, the Fund is taken from the amount paid following spectrum auction (or corresponding method to auction) that is received into a special account or general account. In the case that the Fund comes from the general account, compensation should be estimated and reflected in the next fiscal year in advance, i.e. in the previous year. Applications from existing users, their evaluation and payment proceed in the pertinent year. So if the estimated amount of compensation is less than the actual, the government should make up a revised supplementary budget, and vice versa, return the excess of the assigned budget against overestimation, which results in a major obstacle to efficiently operate the budget. In that respect, it needs to take close and careful consideration of the way funds are raised for the special account and general account. The financing systems of the countries explained in the previous chapter may be a good example at this point.

France runs a separate Spectrum Relocation Fund that was partially raised from government contribution at the initial stage and since then has been covered by payments from new users for the acquired spectrum bandwidth. Japan also covers 50% of compensation with a spectrum usage fee, and compensation is allowed to be paid in advance.

These kinds of financing systems can be a great way to facilitate revocation, relocation and compensation in that they are more flexible in managing compensation, e.g. dealing with the cost for existing users to purchase new facilities to transfer into another band without any delay. It is certain that spectrum bands currently used for public (military) purpose comprise the major spectrum revocation and relocation projects required for the coming years. Thus, it is time to think about how to flexibly manage compensation finances for smooth relocation.

Here, we would like to suggest two further issues that may occur in the long run: development of spectrum revocation and relocation policy in Peru, and determining for what purpose Peru can use the cleared and secured band according to spectrum revocation and relocation.

## 1.How to Further Develop Recommended Policy

For the first issue of developing spectrum revocation and relocation policy, the government needs to think about how to maximize policy efficiency in the application of recommendations in the previous chapter. For that, we suggest to train professionals, establish an R&D center, and strengthen technical analysis in light of the technical evolution roadmap.

Also, securing finances is an important matter to progress and advance policy as well as to implement it smoothly. The government needs to invest in technical advances and activate the mobile market in Peru.

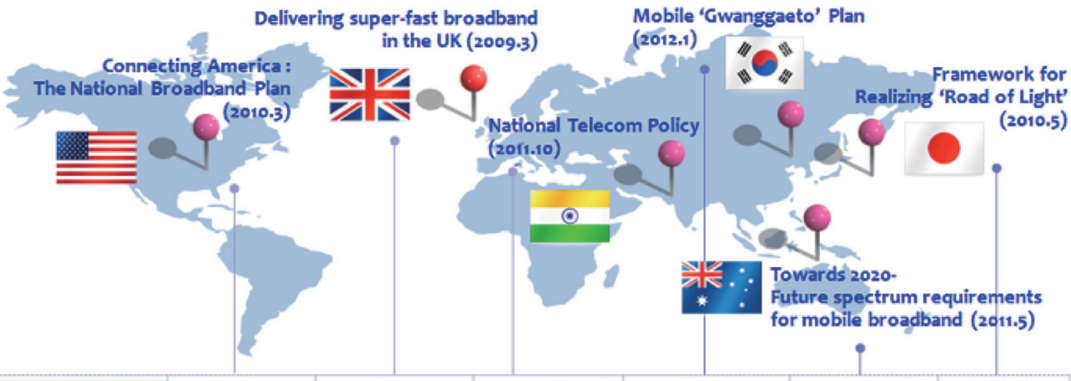
## 2.Toward Mobile Broadband

The second issue is about the use of the newly acquired spectrum band after spectrum revocation and relocation. The band to which revocation and relocation applied is mainly aimed at providing additional spectrum for next-generation mobile communications. The band under 3GHz has excellent propagation quality, but it is supposedly impractical to secure broadband over the 10MHz bandwidth, which means that revocation and relocation is almost the only useful way of providing spectrum in the short term in response to consideration of the amount of spectrum demand, especially for mobile broadband.

For mobile broadband, global harmonization is a critical factor to cut down network deployment cost and service price by benefiting from economy of scale for terminal equipment, devices or systems as well as providing global service, and consequently it is important to secure global common bands.

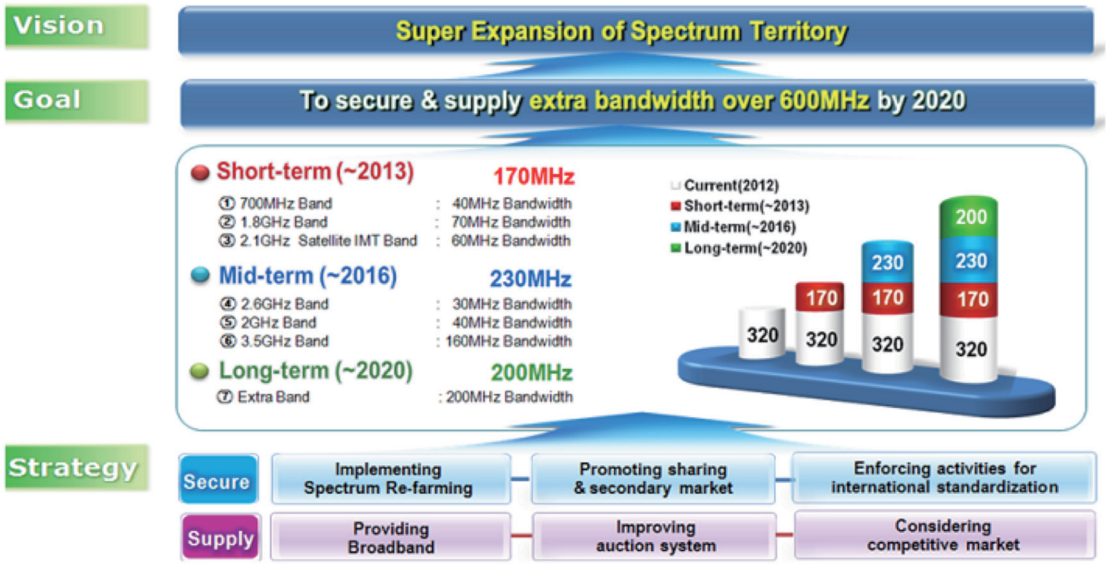
In recent years, ICT-leading countries including Korea, the US, the UK, Japan, Australia and India have published their National Mobile Broadband Plan and progressed in securing additional spectrum for mobile broadband based on the Plan. See Figure 36 for the mobile broadband plan and Figure 37 for the Korean example called the “Mobile Gwanggaeto Plan”.

**FIGURE 36. MOBILE BROADBAND PLANS IN SELECTED COUNTRIES**




| | | | | | | |
|---|---|---|---|---|---|---|
| Current Bandwidth | 545MHz | 350MHz | 200MHz | 320MHz | 380MHz | 370MHz |
| Additional Bandwidth | 500MHz | 750MHz | 500MHz | 600MHz | 696MHz | 340MHz |
| Timetable | 300MHz by 2015<br>500MHz by 2020 | 255MHz by 2012<br>750MHz by 2020 | 300MHz by 2017<br>500MHz by 2020 | 170MHz by 2013<br>230MHz by 2016<br>200MHz by 2020 | 396MHz by 2014<br>696MHz by 2020 | 340MHz by 2015 |

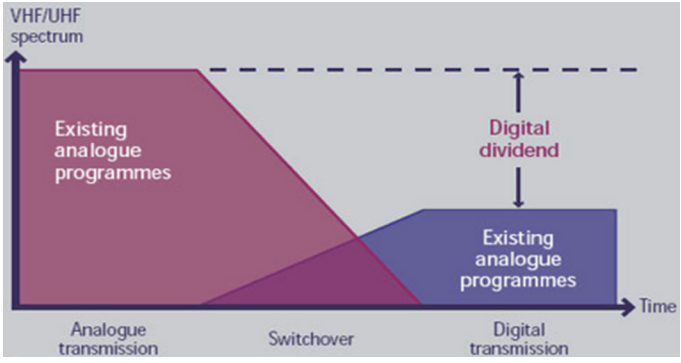
**FIGURE 37. MOBILE BROADBAND PLAN OF KOREA, "MOBILE GWANGGAETO PLAN"**



# PART 3.
# APPENDIX

## 1. Outline

The digital dividend refers to the spectrum that is released in the process of digital television transition whereby analog platforms are switched to digital-only platforms. The digital dividend spectrum is located below 1GHz and can carry signals longer than high frequency spectrums. Also, like the 800㎒ band used for 2G, the radio waves in the spectrum can easily penetrate or diffract over obstacles. Due to these physical attributes, it is a very valuable limited resource that requires fewer base stations to cover the same geographical area and thereby allows facility investment to be substantially reduced.




*Source: International Telecommunication Union (ITU)*

Mobile carriers and broadcasters have divergent views on the utilization of the digital dividend spectrum. While mobile carriers are arguing that the spectrum should be used for mobile communication in order to handle the exploding mobile traffic and provide faster services in the future, broadcasters are saying that the spectrum should be used for broadcasting services in order to allocate additional channels after the digital conversion and provide high-quality services such as UHDTV (Ultra HDTV). As this example shows, the digital dividend is a very popular spectrum that various businesses want to use.

Key foreign countries have been examining how best the digital dividend can be used for broadcasting, public use or mobile communications in order to set policy directions. As a result, most countries have formulated plans to use the digital dividend for broadband mobile service because mobile traffic is exploding due to the incredible popularity of smart devices (smartphones, smart pads, etc.) and a broadband frequency bandwidth of around 100㎒, which can hardly be secured in a low-frequency spectrum, can be secured.

Also, at the 2007 World Radiocommunication Conference, the ITU decided that the 790-862㎒ band would be allocated to Region 1 (Europe and Africa) and the 698-806㎒ band would be allocated to Region 2 (Americas) and Region 3 (Asia-Pacific) for use by IMT.

At the subsequent WRC-12, the proposal of some countries in the Middle East and Africa – Region 1 countries that urgently needed to meet the demand for wireless broadband communication – to allocate the 694-790㎒ band for mobile communication was accepted, and it was decided that the band would be allocated and designated for mobile communication and that the allocation would be effective right after the WRC-15. Accordingly, the digital dividend spectrum was designated as a common mobile communication spectrum of the world.

## 2. Band Plans for Digital Dividend

Currently, many countries around the world have completed or are going through the process in which public analog television broadcasting is converted to digital television broadcasting. As mentioned above, they announced that the frequencies released after the conversion would be used for mobile communication or allocated such frequencies through auction.

The US started utilization of the digital dividend spectrum (hereinafter referred to as DD) earlier than other countries: in 1997, it allocated some of the DD spectrum to the use of Public Protection and Disaster Relief (PPDR), and the rest was allocated for commercial communication services including mobile communication.

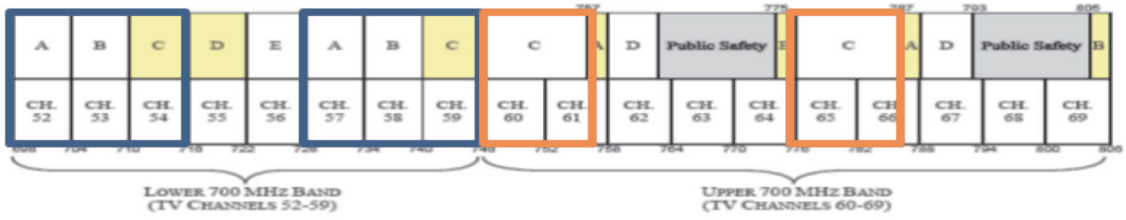
On the other hand, in Europe, in order to secure economies of scale for use by mobile communication, a common band plan has been suggested for the DD spectrum, and Asian countries are also considering to use the released spectrum in accordance with the band plan presented by the Asia Pacific Telecommunity (APT).

While key countries in South America were expected to follow the band plan of the US, which is geographically close to them, they will reportedly decide on how to use the spectrum in consideration of the band plan proposed by the APT.

### 1) US

The US has decided to use the frequency band 698-806㎒ (a bandwidth of 108㎒) released after the digital TV conversion for PPDR and commercial communications and put the frequencies up for auction in accordance with the band plan as shown below.

**FIGURE 39. THE DD BAND PLAN IN THE US**




*Source: FCC*

According to the US band plan, the DD spectrum is divided into lower 700㎒ and upper 700㎒ and used for FDD-based service. The frequency blocks D and E in the lower 700㎒ are allocated as unpaired frequencies and can be used as a supplementary spectrum for downlink of TDD-based service or 4G service. While the frequency block D in the upper 700㎒ has been allocated for commercial communication that supports PPDR, it didn't sell by auction and thus has been reallocated for PPDR.

The lower 700㎒ band consists of a bandwidth of 36㎒ (2x18㎒) and the upper 700㎒ band consists of a 22㎒ bandwidth (2x11㎒). Since only 30㎒ (2x15㎒) of the former and 20㎒ (2x10㎒) of the later can be used for mobile broadband, they might not be suitable for broadband frequency-based mobile communication service.

## 2) Europe (CEPT Recommendation)

In order to utilize the DD spectrum for mobile communications including LTE as soon as possible, the CEPT of Europe decided on its channel allocation plans in October 2009 and announced in May 2010 that members of the European Union shall follow the plans. The 470-790㎒ band will be used for digital TV, and the common DD spectrum in Europe is a bandwidth of 72㎒, which is the 790-862㎒ band. Below is the European DD band plan.

**FIGURE 40. THE DD BAND PLAN IN EUROPE**

| 790-791 | 791-796 | 796-801 | 801-806 | 806-811 | 811-816 | 816-821 | 821-832 | 832-837 | 837-842 | 842-847 | 847-852 | 852-857 | 857-862 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Guard band | Downlink | | | | | | Duplex gap | Uplink | | | | | |
| 1 MHz | 30 MHz (6 blocks of 5 MHz) | | | | | | 11 MHz | 30 MHz (6 blocks of 5 MHz) | | | | | |

*Source: CEPT*

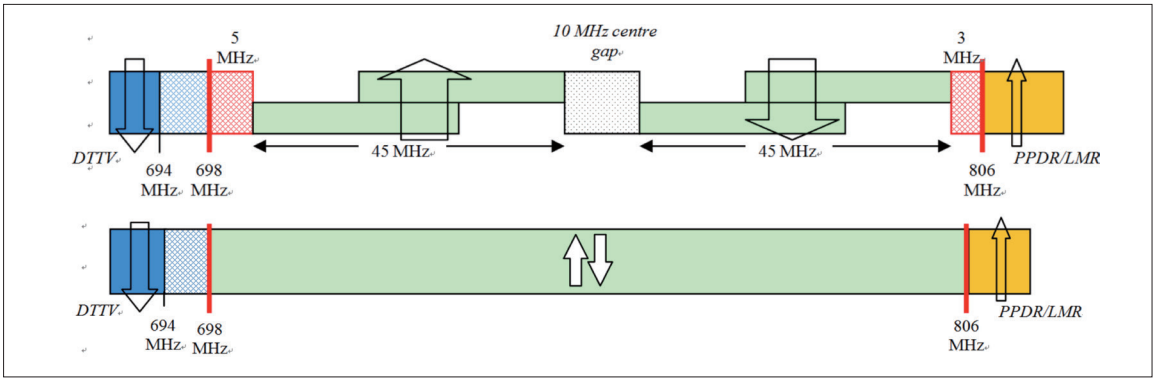
Under the CEPT plan, members of the EU that do not prefer FDD-based channel types or cannot allocate channels through FDD can apply TDD; however, it is expected that almost all countries will adopt the FDD-based 60㎒ (2x30㎒) band plan.

## 3) Asia (APT Recommendation)

After the DD spectrum was allocated for use by IMT after the WRC-07, common ways to allocate frequencies in the Asia-Pacific region were discussed through the APT Wireless Group (AWG). An agreement was reached on the common frequency allocation plan of the DD band plan of the Asia-Pacific Region at the AWG in September 2010, and the plan was submitted to the ITU-R in October 2010 and incorporated into the ITU-R IMT frequency allocation recommendations.

The common frequency allocation plan proposed by the APT is two-fold: FDD and TDD are the options. The FDD-based method uses 90㎒ (2x45㎒) for uplink and downlink and consists of a 10㎒ center gap and a 8㎒ guard band (698-704㎒ and 803-806㎒). While the TDD-based method basically uses a 108㎒ bandwidth, a bandwidth of 8㎒ is allocated as an internal guard band, so a 100㎒ bandwidth can be used for TDD.

**FIGURE 41. THE DD BAND PLAN IN THE ASIA-PACIFIC REGION**



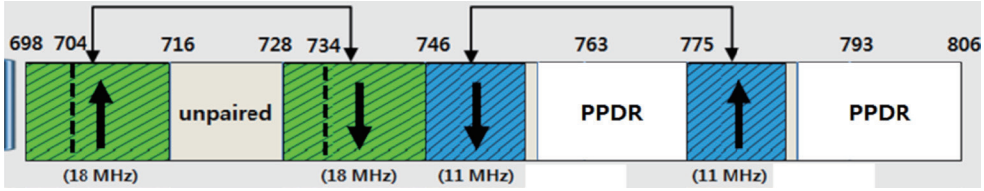

*Source: APT report 14*

## 3. Utilization Trends of Digital Dividend in Each Country

### 1) US

In 1997, the US announced plans to use the DD spectrum for public safety and mobile communication and allocated a 24㎒ bandwidth for PPDR. The rest, a 84㎒ bandwidth, was put up for auction for both communication and broadcasting service providers, and mobile carriers such as AT&T and Verizon secured most of it. The D block - a 10㎒ (2x5㎒) bandwidth - that didn't sell in the 2004 auction was re-auctioned for commercial communication on the condition that the block would be technically compatible with the PPDR frequency next to it, but it didn't sell once again, and it was decided that the block would be used for PPDR.

**FIGURE 42. THE DD UTILIZATION PLAN IN THE US**



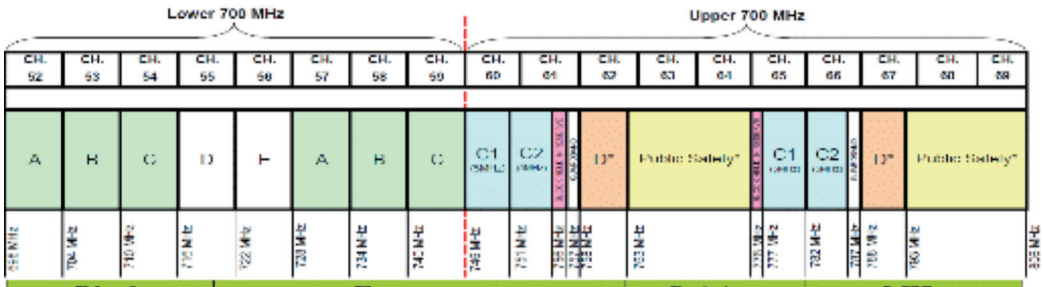

The US implemented digital conversion earlier than other countries to dominate the digital broadcasting market in advance and has been leading the way in the provision of 4G service in the DD spectrum. However, the exploding mobile traffic has led to increasing demand for broadband bandwidth frequencies and broadband frequency-based mobile service. Since the band plan was formulated without considering the increasing demand for frequencies, it has become difficult to effectively respond to this need.

### 2) Canada

Canada launched an ATSC-based digital TV service in June 2002 and completed digital conversion in September 2011. Like the US, a bandwidth of 294㎒ among the frequency band 54-698㎒ was allocated for digital TV, and the frequency band 698-806㎒, a bandwidth of 108㎒, was secured as the DD spectrum.

After receiving consulting services on the utilization of the DD spectrum, three solutions have been presented: ① selective application of the US band plan, ② partial modification to the US band plan to present option A and option B, ③ selective application of the band plan of the APT. Due to its proximity to the US, Canada has decided to selectively apply the US band plan in the utilization of the DD spectrum mainly because of compatibility with the PPDR spectrum of the US. In this regard, Canada has announced that it will hold an auction in early 2013 in accordance with the band plan as shown below.

**FIGURE 43. THE DD FREQUENCY UTILIZATION PLAN IN CANADA**




| Block | Frequency | Pairing | MHz |
|---|---|---|---|
| A | 698 – 704 MHz/ 728 – 734 MHz | paired | 6+6 MHz |
| B | 704 – 710 MHz/ 734 – 740 MHz | paired | 6+6 MHz |
| C | 710 – 716 MHz/ 740 – 746 MHz | paired | 6+6 MHz |
| D | 716 – 722 MHz | unpaired | 6 MHz |
| E | 722 – 728 MHz | unpaired | 6 MHz |
| C1 | 777 – 782 MHz/ 746 – 751 MHz | paired | 5+5 MHz |
| C2 | 782 – 787 MHz/ 751 – 756 MHz | paired | 5+5 MHz |

*Source: Policy and Technical Framework, Industry Canada*

## 3) Mexico

Mexico launched an ATSC-based digital TV service in 2004 and will complete its digital conversion in October 2016. It has announced plans to auction off the frequencies released after the conversion for mobile communication. Its digital TV spectrum and DD spectrum are the same as those of the US: a bandwidth of 294㎒ among the frequency band 54-698㎒ and a bandwidth of 108㎒ from 698 to 806㎒, respectively.

While Mexico was expected to adopt the US DD band plan because its spectral composition is the same as that of the US and it shares borders with the US, it announced in September 2012 that it would adopt the band plan of the APT. The decision was based on the judgment that in the utilization of the DD spectrum, the band plan of the APT provides more advantages when it comes to the efficient use of frequencies as well as the utilization of high-quality equipment and networks at lower costs through economies of scale.

The DD spectrum of Mexico has a 10㎒ center gap and is based on FDD that uses a bandwidth of 45㎒ for both uplink and downlink, in accordance with the recommendation of the APT.

## 4) Japan

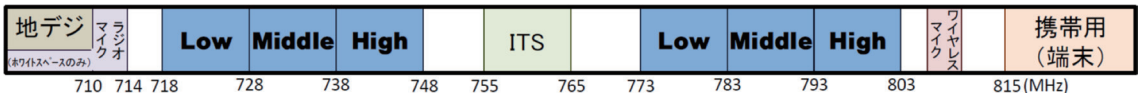
While a bandwidth of 130㎒ - 90-108㎒, 170-222㎒ and 710-770㎒ - has been released after the digital TV conversion in Japan, the DD spectrum has been widened to use the 698-806㎒ band plan of the APT.

Japan was the first country in the Asia-Pacific region that announced plans to use the DD spectrum for ITS and mobile communication. While it planned to pair the DD spectrum with the 900㎒ band to use it for mobile communication, it decided to selectively apply the band plan of the APT because there were concerns that no other country had adopted such a plan.

In June 2012, the Ministry of Internal Affairs and Communications implemented frequency allocation of the frequencies from 718 to 748㎒ and from 773 to 803㎒ to enable the use of 3.9G mobile communication

equipment. While an allocation-after-evaluation system was basically applied, absolute evaluation criteria were applied when there was no competition, and both absolute and comparative evaluation criteria were applied when there was competition.

**FIGURE 44. THE FREQUENCY ALLOCATION SPECTRUM IN JAPAN**




Source: Ministry of Internal Affairs and Communications

NTT DoCoMo, KDDI and e-Access selected their first, second and third preferences, and after the evaluation of the Ministry of Internal Affairs and Communications, NTT DoCoMo ranked first, with e-Access and KDDI ranking second. Accordingly, NTT DoCoMo has received the Middle band, while e-Access and KDDI have received the High band and the Low band, respectively, which were the second preference bands. It is expected that LTE service will be provided in these bands after 2015 when frequency refarming is completed.

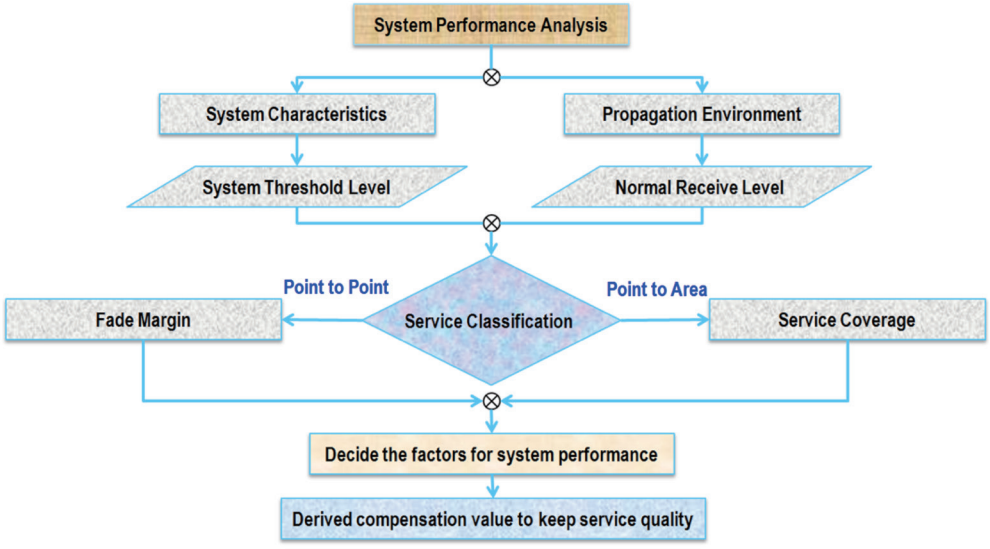
## 1. Overview

According to the Korea radio act and official announcements, KCA compensates for non-reusable units of existing facilities continuously after frequency revocation and relocation. When the used frequency is changed to higher or lower than before, propagation losses between transmitter and receiver are different in every case. This means that the signal transmission quality depending on carrier frequency should keep the transmitter and receiver link fade margin as a requirement for current frequency users.

Therefore, compensation on technical aspects can be divided into radio propagation characteristic quality compensation and existing facilities compensation. Radio quality compensation means calculating the value of loss when comparing old and new bands and then compensating for the gap of the values by system replacement to new, higher-performance equipment. For existing facilities compensation, the system has to separate reusable and non-reusable units depending on specific characteristics of the equipment. If you compensate for the loss in terms of radio quality and existing equipment, the former frequency user should receive sufficient funds from new user because the former can get similar frequency characteristics such as fade margin and service area as well as new facilities for new frequency bands at no extra cost if they don't upgrade to bands with higher performance.

In this chapter, some of the criteria and methods are described as having legal basis in Korean law. Thus, Peru's interesting relocation issue regarding fixed WiMAX service will be dealt with a detailed analysis of factors and suggestions for some proper relocation frequencies.

**FIGURE 45. ANALYSIS FRAMEWORK**



## 2. Technical Analysis Method

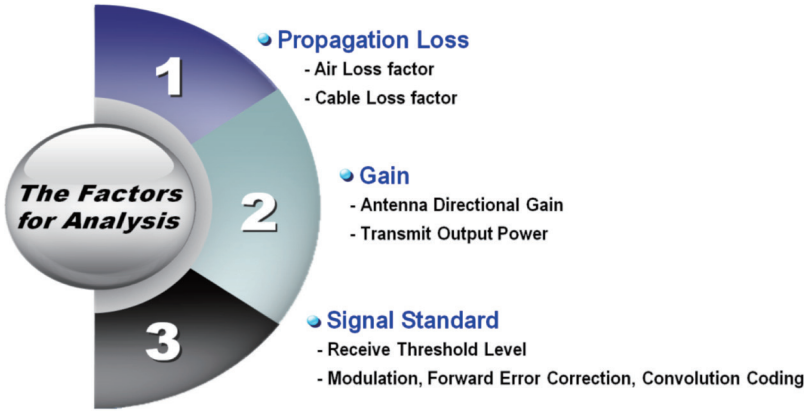
### 1) Radio quality analysis

#### a. Introduction

The typical factors for radio quality comparisons are free space loss, waveguide loss, and those show the biggest difference gap in air loss calculation. Also, diffraction loss and fading effects such as Doppler effect are additional study factors according to normal receivers in fixed or mobile stations. From the chosen factors, a theoretical loss value can be compared for old and new frequency bands, and the value might be proved by actual measurement in the field, after which a correction can be made on the value from the research model.

#### b. Propagation Loss and Gain

**FIGURE 46. ANALYSIS FACTORS**




Loss and gain are basic key factors for comparing radio environment quality during frequency relocation in technical analysis. Propagation loss consists of air loss factor, which includes free space path loss, steam absorption, rain attenuation, diffraction losses. Cable loss factor must be influenced by cable type. The cable loss factor should be changed linearly depending on frequency, total length, and thickness of main feeder from antenna to system equipment for the transmitter and receiver. This is easy to compare because the cable manufacturer normally supplies a detailed loss value in specific datasheets.

System gain consists of antenna gain and the output power of transmitters. The diameter of the antenna for the higher frequency band has to be smaller than the lower frequency band because of wavelength, so this means that the directional antenna gain of the higher frequency band is higher than the lower frequency band with the same diameter condition. However, output power of the higher frequency transmitter might decrease compared with lower frequency output power, so antenna gain is the best way to achieve system gain compensation normally. Adding a kind of additional amplifier is not a good idea because it may worsen the noise figure characteristic.

$$P_r(dB) = P_t + G_t + G_r - L_{free} - L_t - L_r - L_{oas} - L_{diff}$$

Pr means power on the receiver side. It can be derived from a simple formula mathematically. Pt is transmit power, Gt is transmit antenna gain, Lgas is loss due to oxygen or steam in the air.

Table 25 is an example of an STL system regarding air loss factors, free space path loss, absorption, rain effect and diffraction loss. According to the sample values, the most important factor of air loss is free space path loss. Additionally, the relative value can be compared simply by using a logarithmic scale. There is no need to do complex calculation normally to compare both bands instantly.

**TABLE 25. SAMPLE PROPAGATION LOSS AND GAIN COMPARISON BETWEEN 950MHZ AND 1700MHZ BAND**

| Frequency | 951.875MHz | 1707.0MHz |
|---|---|---|
| Transmit Power[dBm] | (+) 38.5 (7W) | (+) 37.0 (5W) |
| Tx Antenna Gain[dBi], 2.4m | (+) 23.9 | (+) 30.7 |
| Tx Feeder Loss[dB], 100m | (-) 4.0 | (-) 5.6 |
| Link Distance[km] | 65.3 | |
| Free Space Loss[dB] | (-) 128.3 | (-) 133.4 |
| Atmospheric Absorption[dB] | (-) 0.3 | (-) 0.4 |
| Diffraction Loss[dB] | 0 | 0 |
| Rain Attenuation[dB] | (-) 0.02 | (-) 0.05 |
| Rx Antenna Gain[dBi], 2.4m | (+) 23.9 | (+) 30.7 |
| Rx Feeder Loss[dB], 100m | (-) 4.0 | (-) 5.6 |
| Receive Power | - 50.4 dBm | - 46.6 dBm |
| Receive Threshold Level[dBm] | - 70 dBm | |
| Fade Margin[dB] | 19.6 | 23.4(3.8dB better) |

The reason why the diffraction loss is 0 is because STL should be always kept in the line of sight so that it doesn't need to be compared for the LOS link.

### c. Signal Standard

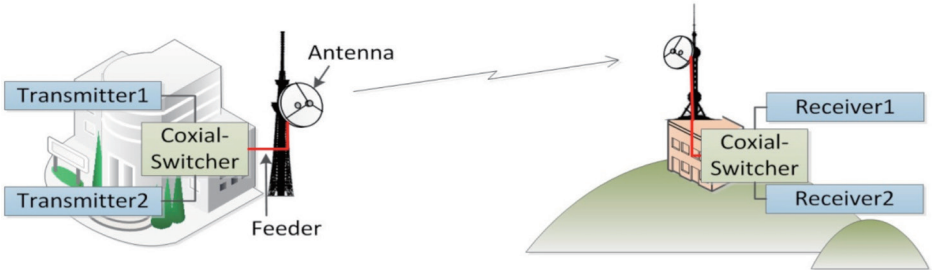
Signal standard is an additional factor for every relocation case that has needed system replacements. It is also always one of the main considerations because it will make a bigger fade margin or extend the service area. The signal standard includes digital signal process and modulation such as QPSK and BPSK and error correction type and so on that are affected to receive threshold level. For instance, the receive threshold level of the DTV standard is much lower than the analog TV standard normally. According to a research paper, the ATSC standard system has more than 25dB sensitivity level margin compared with the NTSC standard system. This is not a big difference from other broadcasting standard cases.

## 2) Service Classification

According to the service link type between transmitter and receiver, the main comparison factor might be decided between two kinds of service quality models: point to point under line of sight conditions, and point to area under non-line of sight conditions.

### a. Point to Point

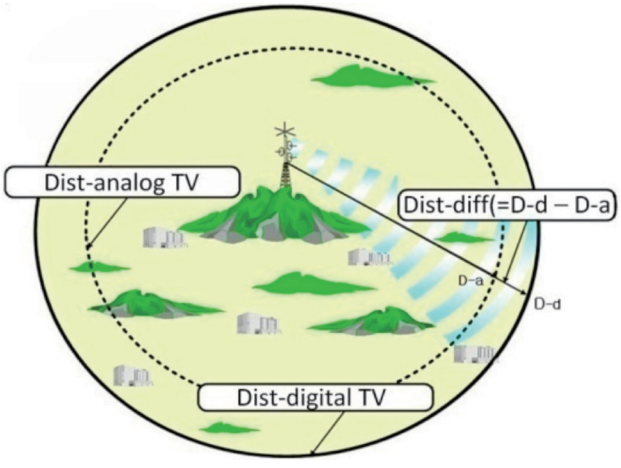
**FIGURE47. POINT TO POINT**




One typical type of point to point service is STL. This is used for broadcasting signal transmission, voice or internet communication signal transmission, etc. In this case, fade margin is a key comparison value that consists of propagation loss and gain. The formula can be defined simply. In the Korean case, the fade margin was defined as the difference between the receiving power and receiver's sensitivity level. The threshold power computed by mathematical formula has been proved by many research papers and ITU-R recommendations.

### b. Point to Area

**FIGURE 48. POINT TO AREA**



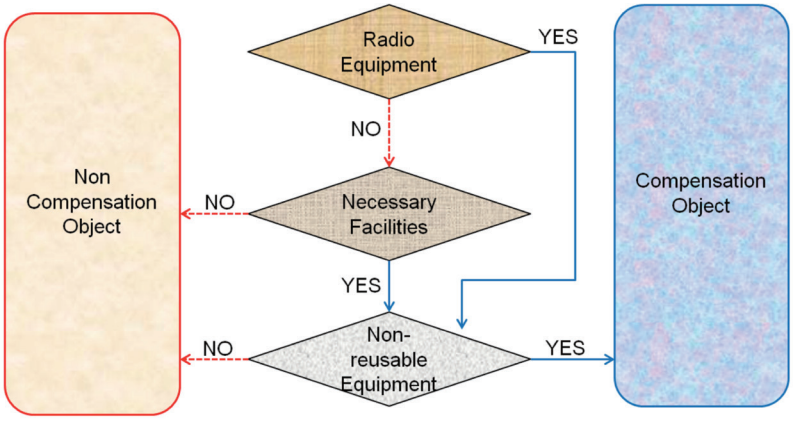

The typical types for point to area service include DTV and analog TV broadcasting as well as fixed broadband Internet service and mobile telecommunication. TV broadcasting and fixed Internet service are not very different from the telecommunication service case, but a moving propagation model would make connections worse between transmitter and receiver, such as air loss and received signal power, so it has to make considerations for the mobile case always. In Korea's case, the reference model of TV delta field emission power was based on the ITU-R 1546 recommendation and Okumura Hata research paper model. The research paper model should change service locations depending on the specifics of each case.

## 3. Radio Facilities Compensation

### 1) Introduction

The Korea radio act and related announcements stipulate a detailed process and criteria for which kinds of products can become compensation products. There are three important characteristics to be determined: whether the product is radio equipment or not, whether the product is a necessary facility or not, whether the product is reusable or not. For frequency relocation, most of the necessary facilities can be used continuously after frequency change, such as antenna tower, power source equipment, signal source equipment, control units, main feeder, air condition controller and so on. In case of revocation, the new consumer has to compensate for most of the existing facilities sometimes, but this does not apply for all of the facilities because a tower uses many applications normally, so antenna tower is not just for a withdrawn system.

**FIGURE 49. DECISION ON COMPENSATION FLOW CHART**



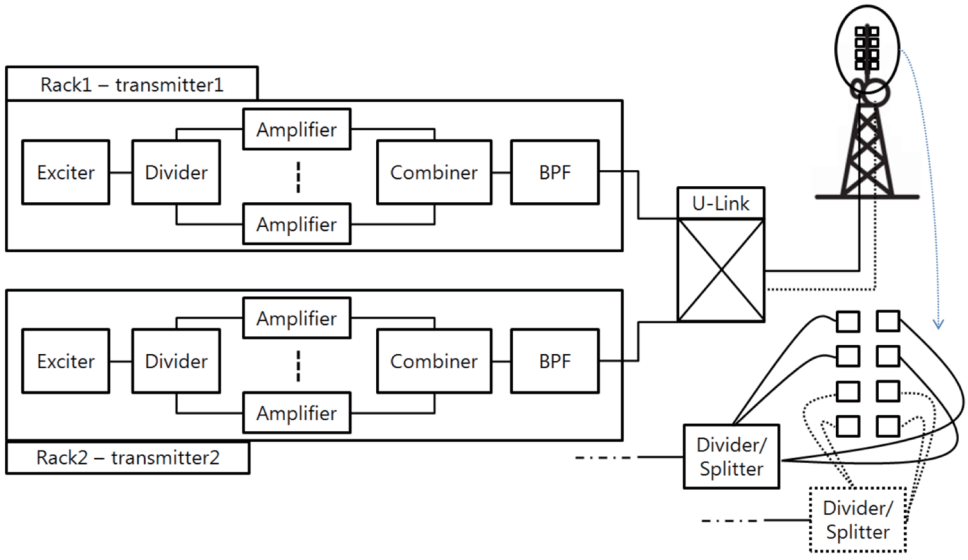

### 2) Acceptance Criteria of Compensation Equipment

Frequency revocation and relocation are related to radio equipment most closely because signal source must be carried by radio frequency carrier. This means that all frequency users have some sort of radio station composed of RF facilities.

Radio equipment for relocated frequency has various RF characteristics and functions depending on application such as broadcasting, microwave link and telecommunication. To decide on a range of RF facilities, first of all, the system has to be analyzed in detail, from signal source to RF output via antenna.

The block diagram is a sample configuration for a DTV transmitter. Most of the blocks are RF-dependent units, but it is also tunable in the few hundred megahertz range. This means that replacement units are not fixed before the final decision on a frequency relocation plan by government.

FIGURE 50. CONFIGURATIONS OF DTV TRANSMITTER




## 4. WiMAX Frequency Relocation Feasibility Study in 2.5GHz and 3.5GHz Band

### 1) Preparatory Steps and Goal

#### a. Current Frequency Usage and Existing Systems for WiMAX Service in Peru

- The table of frequency allocation in Peru
- IEEE 802.16 (mobile WiMAX) standard
- Frequency efficiency comparison based on subscribers
- Candidate relocation band and study cases

#### b. Proposal of Frequency Relocation Band for Efficient Use

- Decision step for compensation units of current system
- Radio quality comparison of interested bands
- Analysis of frequency-dependent units of WiMAX system
- Possibility analysis equipment specification
- Derive the proper relocation band and replace system requirements

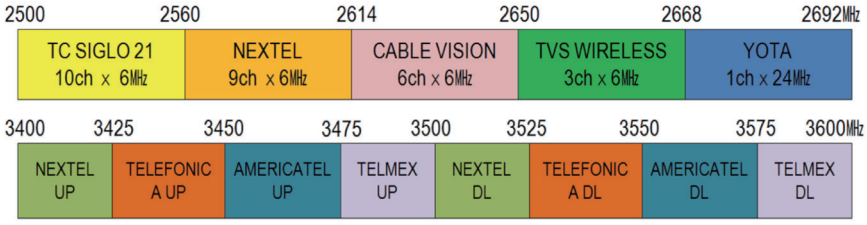
### 2) Frequency Allocation and WiMAX Standard

#### a. Frequency Allocation and Operators in Peru

MTC allows fixed broadband service in this band, but current WiMAX network providers have installed the IEEE 802.16e standard system because it was updated by a study group from IEEE, thus they are capable of providing mobile services with their own systems. When a study to find the proper frequency bands in the

other frequency ranges for the relocation is taken place, fixed and mobile services are described in Peruvian frequency attribution which are candidate services resulted from the relocation.

**FIGURE 51. FREQUENCY ALLOCATION AND OPERATORS IN PERU**




| Frequency | Atribucion | Attribution |
|---|---|---|
| 2500-2690 | FIJO<br>MOVIL salvo móovil aeronáautico<br>Fijo por satéelite<br>Radiodifusióon por satéelite | FIXED<br>MOBILE except aeronautical mobile<br>Fixed satellite<br>Satellite broadcasting |
| 3400-3700 | FIJO<br>FIJO POR SATELITE (espacio-Tierra)<br>Aficionados<br>Móovil<br>Radiolocalizacióon | FIXED<br>FIXED-SATELLITE (space-to-Earth)<br>Amateur<br>MOBILE<br>Radiolocation |

## b. IEEE 802.16 Standard and WiMAX Profiles

The IEEE 802.16 study group has published its projects and their status. In the IEEE standard, operators can choose any licensed frequency below 11GHz and even higher, so there are no limitations on frequency selection by MTC and operator (Table 26). WiMAX means 'Worldwide Interoperability for Microwave Access', a name given by the WiMAX forum industry alliance, but its original specification is from IEEE study group.

**TABLE 26. IEEE 802.16 STANDARDS**

| Standard | Description | Status |
|---|---|---|
| 802.16.2-2004 | Recommended practice for coexistence<br>(Maintenance and rollup of 802.16.2-2001 and P802.16.2a) | Current |
| 802.16k-2007 | Bridging of 802.16<br>(an amendment to IEEE 802.1D) | Current |
| 802.16-2009 | Air Interface for Fixed and Mobile Broadband Wireless Access System<br>(rollup of 802.16-2004, 802.16-2004/Cor 1, 802.16e, 802.16f, 802.16g and P802.16i) | Current |
| 802.16j-2009 | Multihop relay | Current |
| 802.16m-2011 | Advanced Air Interface with data rates of 100 Mbit/s mobile and 1 Gbit/s fixed.<br>Also known as Mobile WiMAX Release 2 or WirelessMAN-Advanced.<br>Aiming at fulfilling the ITU-R IMT-Advanced requirements on 4G systems | Current |
| P802.16n | Higher Reliability Networks | In Progress |
| P802.16p | Enhancements to Support Machine-to-Machine Applications | In Progress |

Regarding certification from the WiMAX forum, some band classes and certified profiles are made up to 3.8GHz because this guarantees interoperability among WiMAX devices.

**TABLE 27. CERTIFICATION FROM WIMAX FORUM**

| Band Class | Frequency Band(㎓) | Channel Bandwidth(㎒) | Identifier | | | |
|---|---|---|---|---|---|---|
| | | | Duplex Mode | Old 1 | Old 2 | New |
| 1 | 2.3-2.4 | 8.75 | TDD | 1A | MP01 | M2300T-01 |
| | | 5 & 10 | TDD | 1B | MP02 | M2300T-02 |
| 2 | 2.305-2.320, 2.345-2.360 | 3.5 | TDD | 2A | | M2300T-03 |
| | | 5 | TDD | 2B | MP03 | M2300T-04 |
| | | 10 | TDD | 2C | MP04 | M2300T-05 |
| | | 5 & 10 | TDD | | | M2300T-06 |
| | 2.345-2.360, 2.305-2.320 | 2×3.5 | FDD | 2D | | M2300T-07 |
| | | 2×5 | FDD | 2E | | M2300T-08 |
| | | 2×10 | FDD | 2F | | M2300T-09 |
| | | TBD | FDD | | | M2300T-10 |
| 3 | 2.496-2.690 | 5 & 10 | TDD | 3A | MP05 | M2500T-01 |
| | 2.496-2.572, 2.614-2.690 | 2×5 or 2×10 | FDD | 3B | | M2500T-02 |
| 4 | 3.3-3.4 | 5 | TDD | 4A | MP06 | M3300T-01 |
| | | 7 | TDD | 4B | MP07 | M3300T-02 |
| | | 10 | TDD | 4C | | M3300T-03 |
| 5 | 3.4-3.8 | 5 | TDD | 5A | MP08 | M3500T-01 |
| | 3.6-3.8 | 5 | TDD | 5AH | | M3700T-01 |
| | 3.4-3.6 | 5 | TDD | 5AL | MP09 | M3500T-02 |
| | 3.4-3.8 | 7 | TDD | 5B | | M3700T-02 |
| | 3.6-3.8 | 7 | TDD | 5BH | | M3700T-03 |
| | 3.4-3.6 | 7 | TDD | 5BL | MP10 | M3500T-03 |
| | 3.4-3.8 | 10 | TDD | 5C | MP11 | M3500T-04 |
| | 3.6-3.8 | 10 | TDD | 5CH | | M3700T-04 |
| | 3.4-3.6 | 10 | TDD | 5CL | MP12 | M3500T-05 |

## c. Global WiMAX Deployment

In frequency attribution in Peru, you can find frequency bands that include the words "Fixed and Mobile" below 6GHz. These are candidate relocation bands for WiMAX service. However, the global deployment status is also very important because of network construction cost and maintenance cost. The interesting bands overlap some frequency ranges. Finally, it was determined to be from 3.7GHz to 3.8GHz or from 5.85GHz to 6GHz.

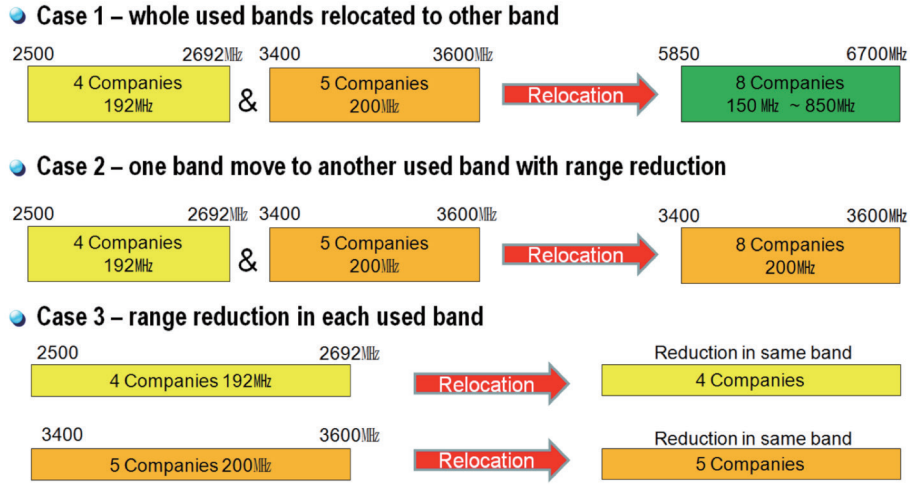
**TABLE 28. CANDIDATE RELOCATION BANDS FOR WIMAX SERVICE**

| Frequency | Continent | Country | Network Operator |
|---|---|---|---|
| 2.3 GHz | American | U.S | AT&T, Horizon Wi-Com |
| | Asia | Australia | Unwired |
| | | Malaysia | P1, Amax, REDtone, YTL com. |
| 2.5 GHz | American | U.S | Clearwire, Open Range Communications, Commnet, TDS Metrocom, Xanadoo, Digital Bridge Communications, Nextwave, Craig Wireless, Quad Cities Online, Solo Direct Connect |
| | | Mexico | Ultravision, MVS |
| | Europe | Russia | Yota, Comstar-UTS, Synterra, Summa Telecom, Novaya Telefonnaya, Companiya |
| | Asia | India | BSNL |
| 3.4~3.6 GHz | American | U.S | IDP Spectrum, Azulstar, Towerstream, Next Phase, Scared Wind Communications, Wex-Tex Telecom, Arialink, Zing |
| | | Mexico | Axtel |
| | Europe | Germany | DBD, Televersa Online, NeckarCom, VSENET |
| | | Spain | Iberbanda, Euskaltel, Clearwire |
| | | Russia | Icon Private Equity, Tattelecom, Enforta, Start Telecom/Peterstar, Centre Telecom, MetroMax |
| | Asia | Australia | Allegro, Internode(Agile), Unwired |
| | | Malaysia | Airzed, STARKOM |
| 5.2~5.8 GHz | Europe | Germany | MVOX |
| | | Russia | Enforta, Trivon |
| | Asia | Australia | BigAir, Clever Communications |

### d. Consideration for Relocation Scenario Cases

Below, three cases are the studies for relocation. The first case involves whole used bands relocated to another band. The second involves one band moved to another used band with range reduction. If you do not want to reduce the allocated total bandwidth, then you can use the 3.6-3.8GHz band. The third case involves simple reducing current allocation frequency in the same band by at least half. The 200MHz spectrum space may then be placed in those bands.

**FIGURE 52. STUDY CASES FOR RELOCATION**




## 3) Comparison of Frequency Quality and Performance among Candidate Bands

### a. Propagation Environment Comparison for Interested Bands

Table 29 shows comparison values for the loss factors for each frequency based on the analysis factors. The basic frequency is set to 3.5GHz. The upper frequency is assumed to be the line of sight signal transmitting, while the lower one is assumed to be due to mobile conditions including diffraction loss in suburban area. The most important comparison value of this table is related loss, which shows a 5dB gap from both tables between 2.5/ 3.5 and 3.5/5.5. This is the minimum compensation value for WiMAX frequency relocation.

The gap of loss between proposed bands should normally be covered by gain factors such as transmit antenna gain or additional amplifier.

WiMAX system operators in Peru used directional antennae, so it is expected that transmit antenna replacement might be enough to keep current radio quality.

**TABLE 29. COMPARISON VALUES OF THE LOSS FACTORS**

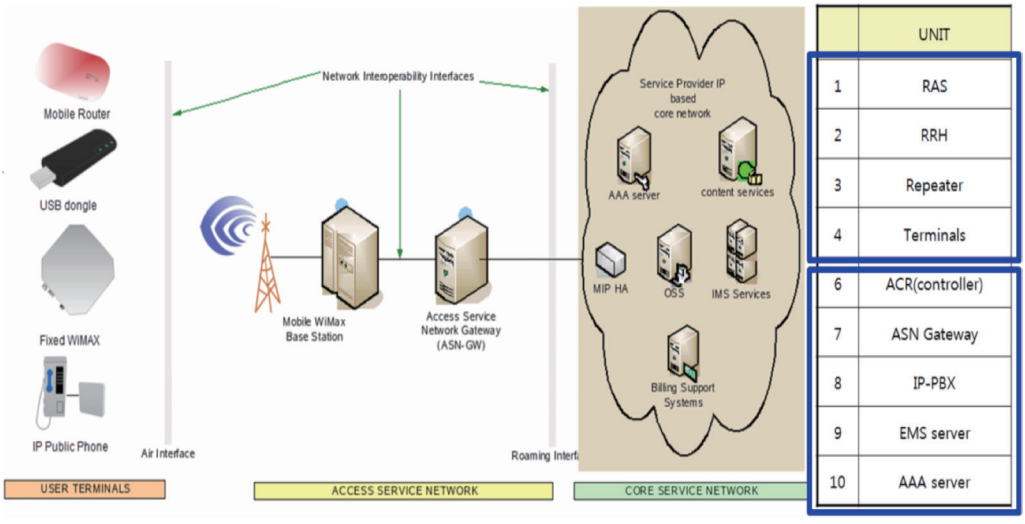
| Frequency | 2.3GHz | 2.5GHz | 3.5GHz | 5.5GHz |
|---|---|---|---|---|
| BTS(RAS) Cable Loss[dB], 50m | -5.75 | -6.05 | -7.25 | -9.5 |
| Atmospheric Absorption[dB] | -0.14 | -0.14 | -0.16 | -0.18 |
| Free Space Loss[dB] | -93.3 | -94 | -96.9 | -100.87 |
| Total Loss | -99.19 | -100.19 | -104.31 | -110.55 |
| Relative Loss(3.5GHz referenced) | 5.12 | 4.12 | 0 | -6.24 |

| Frequency | 2.3GHz | 2.5GHz | 3.5GHz | 5.5GHz |
|---|---|---|---|---|
| BTS(RAS) Cable Loss[dB], 50m | -5.75 | -6.05 | -7.25 | -9.5 |
| Atmospheric Absorption[dB] | -0.14 | -0.14 | -0.16 | -0.18 |
| Lee Simulation Model (Mobile device service on US Suburban) | -133.3 | -134.3 | -138.1 | -143.2 |
| Total Loss | -139.19 | -140.49 | -145.51 | -152.88 |
| Relative Loss(3.5GHz referenced) | 6.32 | 5.02 | 0 | -7.37 |

### b. Frequency-dependent Units of the WiMAX System

To decide on compensation unit, here is a simple diagram of WiMAX service operation to separate the necessary facilities and RF-dependent facilities. Nos. 1 to 4 are RF-dependent facilities, while nos. 5 to 10 are not RF-dependent units but they are necessary for WiMAX service. Each product should be checked for whether they are reusable or not when changing frequency. If these are applied to three studies, protocol units from numbers 5 to 10 are reusable in all of the proposed cases.

**FIGURE 53. WIMAX SERVICE OPERATION SIMPLE DIAGRAM**



## 4) Result of the Feasibility Study

### a. Deployed WiMAX System Characteristics

The inspected data is based on datasheets from Alvarion, which is the most famous WiMAX base station and mobile station manufacturer. This is inspected because the variable frequency range of existing systems must be determined in making decisions on whether they are reusable or not. The important points in this table are frequency range, bandwidth and center frequency resolution. From the data, it can be inferred that the Alvarion product can be used flexibly in the specific range.

However, if allocated frequency moves very far from the current band, then it should be replaced totally. They also provide a 5.8GHz range product so that all of our studies make sense in the product supply aspect.

**TABLE 30. DEPLOYED WIMAX SYSTEM CHARACTERISTICS**

| Alvarion | Radio & modem | | | | | | Transmit Power | |
|---|---|---|---|---|---|---|---|---|
| | Model | Frequency | Bandwidth | Standard | Mode | CF resolution | Max Tx power | Antenna gain |
| BS | Extrem 3650 | 3.65-3.7㎓ | 5, 10, 2 x 10㎒ | IEEE 802.16-2005 | TDD | 125㎑ | 17-30dBm | 13dBi |
| | Extrem 5000 | 4.9-5.35,<br>5.47-5.95㎓ | 5, 10, 2 x 10㎒ | IEEE 802.16-2005 | TDD | 2.5㎒. | 0-21dBm | 14.5dBi |
| | Extrem 3600 | 3.6-3.8㎓ | 5, 10, 2 x 10㎒ | IEEE 802.16-2005 | TDD | 125㎑ | 17-30dBm | 13dBi |
| | Micro Indoor | 2.496-2..69㎓ | 5, 10㎒ | SOFDMA | | 10㎒ | 36dBm<br>38dBm | |
| | | 3..4-3.6㎓ | 5, 10㎒ | SOFDMA | | 14㎒ | 34dBm | |
| CPE | Extrem 3650 | 3.65-3.7㎓ | 5, 10㎒ | IEEE 802.16-2005 | TDD | 125㎑ | 22dBm @ 10㎒<br>19dBm @ 5㎒ | 15dBi |
| | Extrem 5000 | 4.9-5.35㎓ | 5, 10㎒ | IEEE 802.16-2005 | TDD | 2.5㎒. | QAM64:18dBm<br>QAM16:21dBm<br>QPSK:21dBm | 16dBi |
| | Extrem 3600 | 3.6-3.8㎓ | 5, 10㎒ | IEEE 802.16-2005 | TDD | 125㎑ | 22dBm @ 10㎒<br>19dBm @ 5㎒ | 15dBi |
| | VSU 2500<br>VSU 3500<br>VSU 3600 | 2.496-2.690㎓<br>3.4-3.6㎓<br>3.6-3.8㎓ | 5, 10㎒<br>5, 10㎒<br>5,, 10㎒ | IEEE 802.16-2005<br>IEEE 802.16-2005<br>IEEE 802.16-2005 | TDD<br>TDD<br>TDD | | QAM64: 24 dBm<br>QAM16: 27 dBm<br>QPSK: 27 dBm | |
| | VSU 5000 | 4.9-5.9㎓ | 5, 10㎒ | IEEE 802.16-2005 | TDD | | QAM64: 18 dBm<br>QAM16: 20 dBm<br>QPSK: 21 dBm | |
| | USB 250 | 2.496-2.69,<br>3.4-3.6㎓ | 5 @ 3.5㎓, 10㎒ | IEEE 802.16e | TDD | 250㎑ | 45dB | |

### b. Check Mandatory Replacement Units and Reusable Units

Finally, compensation units are summarized as in the table below, considered non-reusable due to the fact that frequency relocation depends on the cases. “Yes” means that all facilities need replacement. Partial means for changing some of the components, such as band pass filter and antenna. By no means can it be used continually after relocation. For reference, the cost of new RAS installation amounts to almost US$100,000, and the cost of filter changing is almost US$3,000. So, you can imagine which one is the best for compensation cost reduction.

**TABLE 31. COMPENSATION UNITS**

| | Equipment | RF Dependent | Compensation Unit (Non reusable) | | |
|---|---|---|---|---|---|
| | | | Case 1 | Case 2 | Case 3 |
| 1 | RAS | Yes | Yes | Yes/Partial | Partial |
| 2 | RRH | Yes | Yes | Yes/Partial | Partial |
| 3 | Repeater | Yes | Yes | Yes/Partial | Partial |
| 4 | Terminals | Yes | Yes | Yes/No | No |
| 6 | ACR(controller) | No | No | No | No |
| 7 | ASN Gateway | No | No | No | No |
| 8 | IP-PBX | No | No | No | No |
| 9 | EMS server | No | No | No | No |
| 10 | AAA server | No | No | No | No |

### c. Which Case is the Best Relocation Plan for Peru

Most cost efficiency cases involve range reduction in each used band. In some of the auction cases in Peru, the winning prices were not much higher than the facilities replacement cost. Thus, case 1 or case 2 is not possible because outgoing costs may be higher than incoming money. However, according to the relocation purpose, you can choose among any of the proposed cases.

1. According to your experience, how would the compensation be applicable in case there are a few customers and incipient network deployment, in the following scenarios?
   a. Reduction of spectrum for a first come, first served basis assignment.
   b. Revocation of spectrum for a first come, first served basis assignment.
   c. Relocation of spectrum, when it was assigned by auction.
   d. Revocation of spectrum, when it was assigned by auction.
   e. Reduction of spectrum, when it was assigned by auction.

There is no difference between spectrum revocation and relocation for the spectrum pricing (auction) case and those for the first come, first served case in Korea. Therefore, the same calculation of compensation is applied.

In case of spectrum revocation for spectrum pricing (auction), the government should reimburse the spectrum price in the remaining period before expiration of spectrum use to incumbents of the spectrum use.

The Korean Radio Waves Act shows that the exclusive spectrum usage right is given to a spectrum user who has spectrum by spectrum pricing, and there is a trend to revise it and gear toward protecting the spectrum usage right of spectrum pricing rather than that of first come, first served.

The condition of 'There are a few customers' has no effect on compensation. However, will it be a good condition for spectrum revocation and relocation?

The condition as incipient network deployment means that there are a few wireless stations for compensation but equipment in all the stations are like new. Thus, compensation is affected by the numbers of stations and usage periods.

2. For the above scenarios, if compensation is an option:
   a. Should it be included in the cost of towers, power supplies, management centers?
   b. Should it be included in the cost of CPEs or devices?

The answer has to be explained only in terms of frequency revocation and relocation because compensated products are not different according to the above questions such as in first come, first served or auction.

Frequency relocation always includes revocation first because it is necessary for new service approval from the government based on the Korea radio act. Used frequency range reduction in the compensation aspect is not revocation, but it has to apply the relocation criteria because most of the products for service in revoked bands will be used continuously in reduced bands in the same way as relocation cases. To apply this condition, the current frequency user requests a kind of approval for frequency change and equipment replacement from the government. If the current user does not want to service anymore because of frequency relocation, then only the radio station in that case has to be compensated in terms of revocation condition.

Frequency revocation means that the government does not have to approve the existing service of the network provider and request for approval of frequency change. All the products in revoked condition have to be considered for compensation or none according to radio facilities criteria.

**The answer to question a. above**

In the case of relocation, most of the necessary facilities can be used continuously after frequency change, such as antenna tower, power source equipment, signal source equipment, control units, main feeder, and air condition controller. The items in question can't be included in compensated equipment.

In the case of revocation, the government has to compensate for most of the existing facilities sometimes, but this does not mean all of the facilities because a tower is used for many applications normally. Thus, the antenna tower is not just for a withdrawn system and management center (room) as well as for old systems, and the current user can sell their space in the building after revocation. However, control units in the management center should be compensated because those undergo forced removal by the new user.

The compensation cost for the above cases should be evaluated for residual value according to the cost calculation criteria.

**The answer to question b. above**

In the case of relocation, decision factors that include whether they are radio equipment or not, whether they are necessary facilities or not, and whether they are reusable or not are important to make a decision on the acceptance criteria of compensation equipment. CPE is necessary radio equipment for WiMAX service, so compensation must be made for it. However, you do not need compensation sometimes if it can be used continuously in relocated bands. Most of important criteria include whether the equipment is reusable or not for WiMAX CPE. For more detailed information, you can find specific ideas in the 'WiMAX frequency relocation feasibility study in 2.5GHz, 3.5GHz band' chapter in the appendix.

In the case of revocation, compensation has to be made for the CPE or user terminal because it is radio equipment, a necessary unit and non-reusable. For more detailed information, you can find acceptance criteria in the 'radio facilities compensation' chapter in the appendix.

The compensation cost for the above cases should be evaluated for residual value according to the cost calculation criteria.

3. Please provide detailed costs considered in the Korean cases for compensation.

KCC shall compensate for the general loss based on Article 7 Compensation for Losses, etc. Compensation is calculated by the formula in Enforcement Ordinance Schedule 1 as follows:

**1. Formula for compensation calculation**

a. In the case of spectrum revocation, calculation follows this formula:

Compensation = Remaining value of current facilities + Removal cost+ Extra expenses

b. In the case of spectrum revocation, calculation follows this formula:

Compensation = Remaining value of current facilities + Financial cost for the acquisition of new facilities + Removal cost + Transfer cost + Extra expenses

**2. Definition and criteria according to the calculation formula of 1, etc.**

a. "Current facility" means the facilities that are needed to directly operate radio stations such as radio equipment. In this case, the radio station is that installed by authorization or registration of equipment or approval for spectrum use no later than the date of public notice on spectrum revocation or relocation.

b. "Remaining value of current facility" means the remaining value of the existing facility to be torn down according to spectrum revocation and relocation. It is evaluated based on the method and criteria of 'the Public notice of values and appraisal of real estate Act'.

c. "Removal cost" means the expenses to spend on teardown of the existing facility according to spectrum revocation and relocation, except for the case that the facility is removed for the purpose of selling a component of the facility.

d. "Financial cost for the acquisition of new facilities" means the financial cost based on the following formula:

(i) substitutional facility

Financial cost = (Acquisition value of new facility – remaining value of current facility)

$$\times \left(1 - \frac{1}{(1 + \text{interest rate})^{\text{remaining durable years}}}\right)$$

(ii) additional facility

Financial cost = (Acquisition value of new facilities)

$$\times \left(1 - \frac{1}{(1 + \text{interest rate})^{\text{remaining durable years}}}\right)$$

e. "Transfer cost" means the expenses to spend on the construction work for facility change such as transfer of installation place or replacement of the component of radio equipment according to spectrum relocation. Transfer cost, however, cannot exceed half of the acquisition value of the new facility that is replaced or added to the existing one.

f. “Extra expenses” means concomitantly generated expenses such as fees for authorization and inspection of the radio station and/or charge for compensation assessment according to spectrum revocation or relocation.

4. How do you measure efficiency in spectrum use for a data transmission network ?
Which are the methods used?

Currently the most common way, spectrum efficiency is denoted by transmittable bit per unit Hz (bits/) in general. It is not easy, however, to conclusively talk about spectrum efficiency because the characteristic and specification of spectrum varies with differences in purposes and bands in use.

In the US, the President's Council of Advisors on Science and Technology (PCAST) has recently published a study that includes the methodology of measuring spectrum efficiency. It would be worthy to give this further review.

5. How can you determine the minimum spectrum required for providing a broadband wireless service?

It is necessary to make many assumptions and predictions in order to assess spectrum requirements. For example, a forecast on service demand through a survey of latent users and its data traffic to be generated should be done. Generally speaking, assessment of spectrum requirement is the way to calculate it while preparing for the worst based on such a traffic forecast. That is why assessment of the minimum spectrum requirement is based on the low level of traffic forecast and assumption made on the situation, which are likely not to be attuned to unexpected traffic upsurge for this reason.

6. Please provide the wording for legal framework for compensation in countries included in your presentation (Korea, France, Germany, US and Japan).

*Note: Except for the US, the provisions below are translated into english for your information. Please consider them unofficial and refer to the original text in their own languages*

## ■ KOREA

### Radio Waves Act

*Article 7 Compensation for Losses, etc.*

(1) In implementing the withdrawal of frequencies or refarming of frequencies under Article 6-2, the Korea Communications Commission shall compensate for any loss incurred in the ordinary course of business by the relevant installer and a person who has obtained approval of frequency use under Article 19 (5) (hereinafter referred to as "installer, etc.:): Provided that the same shall not apply to the following cases:

1. Upon following the request of the installer, etc.;
2. Where the International Telecommunication Union has altered the distribution of frequency, following the alteration of international distribution of frequency that is to be commonly adopted by all nations;
3. Where using a frequency that is set for subordinate business (referring to the business regarding which main business is to be protected in operating the relevant frequency, and which is not to be protected from the main business; hereinafter the same shall apply).

(2) The Korea Communications Commission may collect the amount of compensation under paragraph (1), where losses are compensated for under the main sentence of paragraph (1), from the person who has newly obtained the allocation of frequencies, designation of frequencies, and approval for use of frequencies (hereinafter referred to as "new user") for the relevant frequencies.

(3) When the Korea Communications Commission intends to determine the amount of loss compensation under paragraph (1), it shall seek opinions from the relevant installer, etc.

(4) Notwithstanding the main sentence of paragraph (1), the Korea Communications Commission may have a new user directly compensate for the loss incurred to an installer, etc.

(5) Where the frequencies allocated under Article 11 (1) fall under any subparagraph of Article 6-2 (1) and the Korea Communications Commission has withdrawn such frequencies, it shall refund, as prescribed by Presidential Decree, the price paid for allocation of frequencies for the remainder of the utilization period under Article 15 (1): Provided that the same shall not apply to any alteration of distribution of frequencies at the request of a person who has obtained allocation of frequencies.

(6) Compensations under the main sentence of paragraph (1) and collectible amounts pursuant to paragraph (2) shall be paid out of and added to the Broadcasting Communications Development Fund under Article 324 of the Framework Act on Broadcasting Communications Development (hereinafter

referred to as the "Broadcasting Communications Development Fund"), and the refund of prices for allocation of frequencies under the main sentence of paragraph (5) shall be paid out of the Broadcasting Communications Development Fund and the Information and Communications Promotion Fund under Article 41 of the Information and Communications Technology Industry Promotion Act (hereinafter referred to as the "Information and Communications Promotion Fund'). <Amended by Act No.10393, Jul.23, 2010>

(7) Necessary matters concerning the computation criteria and payment procedures of compensations under the main sentence of paragraph (1) and paragraph (4), the collection of collectible amounts under paragraph (2), and the refund of prices for allocation of frequencies and distribution under paragraph (5) shall be prescribed by Presidential Decree. <Amended by Act No.10393, Jul.23, 2010>

## ■ US

US Code Title 47 Telegraphs, Telephones and Radiotelegraphs

CHAPTER 8 National Telecommunications and Information Administration

*§ 926. Authority to recover reassigned frequencies*

(a) Authority of President
Subsequent to the withdrawal of assignment to Federal Government stations pursuant to section 924 of this title, the President may reclaim reassigned frequencies for reassignment to Federal Government stations in accordance with this section.

(b) Procedure for reclaiming frequencies
(1) Unallocated frequencies
If the frequencies to be reclaimed have not been allocated or assigned by the Commission pursuant to the 1934 Act [47 U.S.C. 151 et seq.], the President shall follow the procedures for substitution of fre quencies established by section 924(b) of this title.
(2) Allocated frequencies
If the frequencies to be reclaimed have been allocated or assigned by the Commission, the President shall follow the procedures for substitution of frequencies established by section 924(b) of this title, except that the statement required by section 924(b)(1)(B) of this title shall include—-
(A) a timetable to accommodate an orderly transition for licensees to obtain new frequencies and equipment necessary for its utilization; and
(B) an estimate of the cost of displacing spectrum users licensed by the Commission.

(c) Costs of reclaiming frequencies
The Federal Government shall bear all costs of reclaiming frequencies pursuant to this section, including the cost of equipment that is rendered unusable, the cost of relocating operations to a different frequency,

any other costs that can be directly attributed to the reclaiming of the frequency pursuant to this section, and they are authorized to be appropriated such sums as may be necessary to carry out the purposes of this section.

(d) Effective date of reclaimed frequencies
The Commission shall not withdraw licenses for any reclaimed frequencies until the end of the fiscal year following the fiscal year in which a statement under section 924(b)(1)(B) of this title pertaining to such frequencies is received by the Commission.

(e) Effect on other law
Nothing in this section shall be construed to limit or otherwise affect the authority of the President under section 706 of the 1934 Act (47 U.S.C. 606).

**C.F.R TITLE 47 – Telecommunication**

*§ 300.1 Manual of Regulations and Procedures for Federal Radio Frequency Management*

ANNEX O Relocation of Federal Government Radio Systems In Accordance With the Commercial Spectrum Enhancement Act

O.5.1 Relocation Costs
Relocation costs as defined in Section 113(g) of the NTIA Organization Act (47 U.S.C. 923(g)) means the costs incurred by a federal entity to achieve comparable capability of systems, regardless of whether that capability is achieved by relocating to a new frequency assignment or by utilizing an alternative technology. These costs include:
a. the costs of any modification or replacement of equipment, software, facilities, operating manuals, training costs, or regulations that are attributable to relocation;
b. the costs of all engineering, equipment, software, site acquisition and construction costs, as well as any legitimate and prudent transaction expense, including outside consultants, and reasonable additional costs incurred by the federal entity that can be attributed to relocation, including increased recurring costs associated with the replacement facilities;
c. the costs of engineering studies, economic analyses or other expenses reasonably incurred in calculating the estimated relocation costs that are provided to the FCC pursuant to this Act;
d. the one-time costs of any modification of equipment reasonably necessary to accommodate commercial use of such frequencies prior to the termination of the federal entity's primary allocation or protected status, when the eligible frequencies as defined in this Act are made available for private sector uses by competitive bidding and a federal entity retains primary allocation or protected status in those frequencies for a period of time after the completion of the competitive bidding process; and
e. the costs associated with the accelerated replacement of systems and equipment if such acceleration is necessary to ensure the timely relocation of systems to a new frequency assignment.

Radio Law

*Article 71 Changes of Frequencies, etc.*

(1) When deemed necessary for the purpose of regulating radio waves or securing public interest, the Minister may order to change designation for frequency or antenna power of radio stations (except registered stations), or frequency or antenna power of registered stations, or the location of radio equipment of artificial satellite stations, only within the scope of not disturbing the fulfillment of the purposes of said radio stations.

(2) The Government shall compensate said licensee, etc. for the loss resulting from ordering the change, in accordance with the provisions of the preceding paragraph, in the designation for frequency or antenna power, or frequency or antenna power of registered stations, or the location of radio equipment of artificial satellite stations.

(3) The loss to be compensated under the preceding paragraph shall be the loss that normally results from the measures taken in accordance with the same paragraph.

(4) Any person who is dissatisfied with the amount of compensation in paragraph (2) may bring in an action in an ordinary court to demand the increase of the compensation amount within three months from the day of obtaining notification of the compensation amount.

(5) The Government shall be a defendant for a suit filed under the preceding paragraph.

(6) When taking measures related to the order, the licensee who received an order to change the location of radio equipment of the artificial satellite station shall notify without delay the Minister of it.

*Article 71-2 Specific Frequency Change Support Service and Specific Frequency Termination Support Service*

(1) The Minister may, where the Minister changes the Frequency Assignment Plan or the Plan for the Available Frequencies Allocated to Broadcasting (hereinafter referred to as "Frequency Assignment Plan, etc.") that fall under the following items, when the Minister deems it necessary for ensuring adequate use of radio waves, toward licensee or other establishers of radio equipment who will conduct construction work for changing radio equipment concerning change of frequency or antenna power stipulated in item iii), compensate said construction costs and other forms of necessary support (hereinafter referred to as "specific frequency change support service") within the extent of the available budget.

i) The Minister provides time limits for frequency use not exceeding 10 years, counting from the day of public notice of change of the Frequency Assignment Plan, etc. as conditions concerning the use of specific classification of radio stations (referring to "classification of radio stations" stipulated in the applicable MIC ordinance in line with technical requirements stipulated in Chapter III concerning modes of radio communications, purposes of radio stations and radio facilities. The same shall apply hereinafter.) and allocates

assignable frequencies (hereinafter referred to as "frequencies to be assigned to a new classification" in this article) in said classification of radio stations (hereinafter referred to as "old classification of assignment" in this article) to a classification of radio stations other than the old classification of assignment.

ii) In the case where there are classifications of radio stations having the same radio communications mode and the same purpose (hereinafter referred to as "classification of the same purpose" in this item) as the old classification of assignment in classifications of radio stations, in which frequencies to be assigned to a new classification can be assigned, other than old classifications of assignment (referred to as "new classification of assignment" in the following item), the ratio of frequencies, that can be assigned to a classification of the same purpose, in the frequencies to be assigned to a new classification is equal to or less than three fourths.
iii) Toward applications for radio station licenses (hereinafter referred to as "specified newly established radio station") in a new classification of assignment concerning the Minister's public notice of radio stations accompanying the Minister's public notice of change of the Frequency Assignment Plan, etc., frequencies to be assigned to a new classification shall be approved for assignment within five years, counting from the day of public notice of said change of said Frequency Assignment Plan, etc. In this case, frequencies or antenna power of established radio stations shall be changed beforehand (limited to the extent that the change d oes not hinder the purpose of established stations; in the case of the change of frequencies, limited to the extent that the change is within the range of frequencies to be assigned to a new classification), in order for those radio stations in an old classification of assignment, which actually assigned frequencies to be assigned to a new classification upon the public notice of said change of said Frequency Assignment Plan, etc. (hereinafter referred to as "established radio station"), not to hinder specified newly established radio stations from operating thereof such as interference.

(2) The Minister may, in order to facilitate establishment of radio stations notified by the minister (hereinafter referred to as "specified notified stations"), where the Minister changes the Frequency Assignment Plan based on the evaluation results of Article 26-2 paragraph (3), and where the Minister specifies periods for using part or all of frequencies (hereinafter referred to as an "previous assignable period") that are assignable to radio station classifications other than radio station classifications pertaining to specified notified stations within a period not exceeding five years (10 years where it is deemed especially necessary in consideration of financial impacts on licensees caused by said change of the Frequency Assignment Plan; hereinafter in this paragraph referred to as a "standard period"), calculating from the day of public notice on said change of the Frequency Assignment Plan (except for the cases fall under cases stipulated in other part than those listed in each item of the preceding paragraph), compensate licensees, who are to apply for change in designation of frequencies until the day of expiration of a previous assignable period due to setting forth of said previous assignable period or to abolish radio stations, for ordinary costs arising from the setting forth of said previous assignable period shorter than the standard period and other necessary support (hereinafter referred to as "specific frequency termination support service") within the extent of available budget.

## ■ FRANCE

Postal and Electronic Communications (Code des postes et des communications électroniques)

*Article L41-2*

Without prejudice to the second subparagraph of Article IV of 30-1 of Law No. 86-1067 of 30 September 1986 on freedom of communication, the holders of the authorizations referred to in Article L. 41-1 bear the full cost of the necessary changes to the provision of frequencies assigned to them. The financing of a portion of this expense can be provided by the funds managed by redevelopment of the spectrum from the National Frequency Agency. The amount and manner of distribution of contributions referred to in the preceding paragraph shall be determined by the ANFR under the conditions specified by a decree in Conseil d'Etat.

Decree No. 2012-821 of 25 June 2012 relating to the distribution among publishers audiovisual communication services terrestrially, the cost of redevelopment of frequencies for diffusion of new services (Décret n° 2012-821 du 25 juin 2012 relatif à la répartition, entre éditeurs de services de communication audiovisuelle par voie hertzienne terrestre, du coût des réaménagements des fréquences nécessaires à la diffusion de nouveaux services)

Subject: Determination procedures for the allocation of the cost of redevelopment frequencies needed to launch new audiovisual communication services.

*Article 1*
When the refarming of frequencies intended to allow the diffusion of new audiovisual communication services, the service providers mentioned in the second paragraph of Article IV of 30-1 of the law of 30 September 1986 referred to above bear the cost of this redevelopment under conditions determined by this decree.

*Article 2*
The costs referred to in Article 1 include: The expenditure incurred by the technical operations related to transmission facilities of audiovisual communication services terrestrially; Expenditure on information that the frequency shifts needed to editors services delivered; Operating expenses incurred by the Agency as a result of the frequency of redevelopment, particularly those related to the collection of complaints from viewers and the advice they are given.

7. Regarding the fund Used for Compensation in Korea:
   a. What is the specific legal framework?
   b. Who had supported the fund and what is the amount of money they gave?
   c. What are the other uses for the fund?

a. According to the Framework Act on Broadcasting Communications Development Article 24 (Establishment of Broadcasting Communications Development Fund, the Fund) the Korea Communications Commission shall establish the Fund.

b. According to the same Act Article 25 (Formation of Fund), the Fund shall be formed with the government's contribution and loans, spectrum price, contributions by broadcasting business entities etc. The amount of money for the fund is not certain.

c. According to the same Act Article 26 (Use of Fund), the Fund shall be used for the following projects and activities:

1. Project for research and development in broadcast communications
2. Project for the development, establishment and dissemination of standards for broadcast communications
3. Project for training human resources for broadcast communications
4. Project for boosting broadcast communications services and development of the foundation for broadcast communications services
5. Supporting broadcast communications operated for public interests and public services
6. Supporting the production and distribution of content for broadcast communications
7. Compensation for losses by spectrum revocation and relocation pursuant to Article 7(5) of the Radio Waves Act
8. Others related to broadcast communications

※ The Act can be read via http://elaw.klri.kr.kr