Assignment of Exclusive Spectrum Licenses in Japan: Use of an Auction for the Licensee Selection Process

by

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Abstract

The demand for spectrum resources has increased in the past decade due to the flourishing wireless industry worldwide. This change requires Japan's Ministry of Internal Affairs and Communications (MIC) to establish a transparent, fair and efficient spectrum allocation process that will enable it to select an optimal set of licensees to realize efficient spectrum use. This thesis proposes an auction system that assigns exclusive spectrum licenses to firms competing in the Japanese wireless industry.

MIC currently uses a comparative examination system, which unfortunately lacks certain features the Ministry is required to address. An auction system is an alternative, already employed by many countries to allocate spectrum resources optimally, to secure a transparent and fair decision-making process, and to raise revenue for national coffers.

The Diet's approval of legislation authorizing MIC to use auctions is one obstacle because it requires much time and effort to persuade political parties, incumbents, and newcomers of the value of the auction system over the current system. Another challenge to the effectiveness of the auction system is its design, which must be built-to-order based on the goals of each government and specific market conditions.

This research covers four areas: (1) The development and transition of the Japanese mobile industry; (2) Analysis of stakeholders' attitudes toward the introduction of the auction system; (3) A proposed strategy for developing an auction design based on an analysis of English, Germany and Clock Auction Design; (4) The design of an auction system for Japan's specific cases.

Thesis Supervisor: William Lehr
Title: Research Associate, Communications Futures Program

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Finally, I am profoundly grateful to my family, departed father, my mother and my two sisters. Following my father's death, I could not have come here without the understanding and the support of my family. Good memories of them have continued to encourage me since I arrived here.

Hironori Matsunaga

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Chapter 1

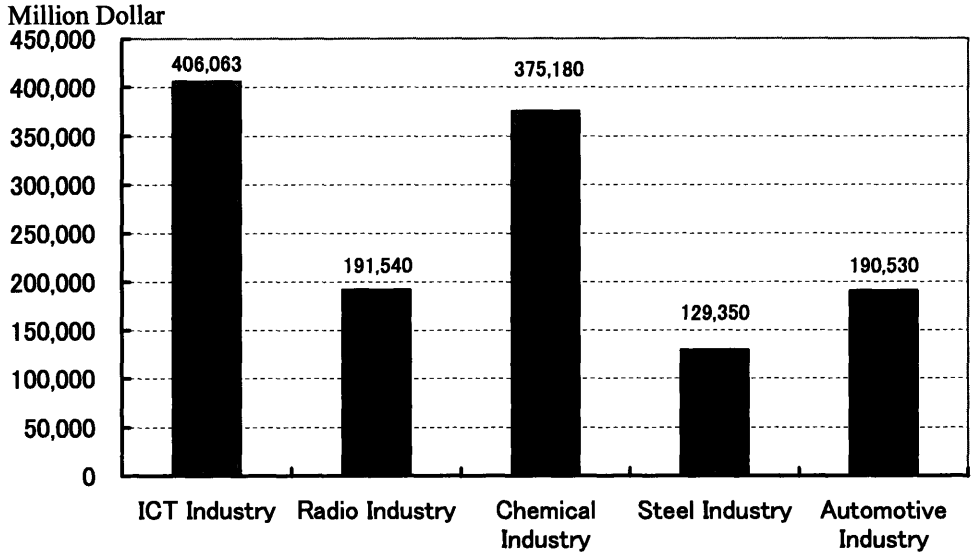
Introduction

1.1 Introduction

Our daily life depends on information and communications technology (ICT). Fixed phones, mobile phones, personal computers with WiFi, etc. allow us to talk or exchange texts, photos, and video with others. In particular, mobile phone has changed our lifestyle by providing means to communicate outside the home or office, even when we are on the move. The Japanese ICT industry is now a huge industry, comparable to other main industries as shown in Figure 1-1. The Radio industry accounts for 47% of the ICT industry and has the same size as the automotive industry in Japan. The Radio industry includes businesses which rely on radio spectrum resources directly or indirectly, such as the radio communications and broadcasting (excluding cable TV) business, the contents-developing businesses, and the manufacture of radio communications and broadcasting equipment. With regards to the wireless communication business, mobile phone services account for 50% of the radio industry, as shown in Table 1-1. The Mobile phone has become the main communications tool in Japan; the number of mobile phone subscribers exceeded that of fixed phones in 2000. The Mobile phone industry plays the main role in the ICT and radio industries at the present time, and will certainly do so in the near future as well.

The radio spectrum is a requisite resource for all radio industries such as the mobile phone industry. It is a scarce national resource, and a regulator allocates it to various purposes in each country. Because of the growth of the radio industry, spectrum resources are coming to be stretched to the limit. A regulator, therefore, needs to manage the resource

carefully. Effective resource allocation is the key to developing industries and to maximizing the value of the spectrum resource.



Note: Based on the exchange rate of 1 USD = 100 JPY.
Source: ARIB, 2005 [73], p.15, Figure 4-1-2.

Figure 1—1: Market Sizes of Radio Industry and Main Industries in 2003

Table 1—1: The Transition of the Breakdown of Radio Industry

(million dollar)

	1999	2000	2001	2002	2003
Radio Industry	152,195	173,468	184,604	181,796	191,540
Radio Communications and Broadcasting	101,661	116,267	127,116	128,636	131,358
Contents Developing	22,547	25,571	24,896	23,806	23,363
Manufacture of Radio Equipment	27,987	31,630	32,592	29,354	36,819
Mobile Communications	68,378	80,771	91,613	93,674	95,790
Proportion of Mobile Communications in Radio Industry (%)	45	47	50	52	50

Note: Based on the exchange rate of 1 USD = 100 JPY.
Source: Modified from [73] P.19-20.

1.2 Problem Statement

The Ministry of Internal Affairs and Communications (MIC) holds jurisdiction over the spectrum resource in Japan. It allocates spectrum resources for various purposes according to international coordination and assigns spectrum licenses to each spectrum user. The spectrum management is based on command and control. MIC employs comparative examination to assign licenses when more companies apply for the limited number of spectrum licenses than are available. The comparative examination involves problems. Lack of transparency and fairness are considered the prime issues for the spectrum licensing process in the current Japanese situation. In October 2004, SoftbankBB, a group company of the largest Asymmetric Digital Subscriber Line (ADSL) provider in Japan, brought suits against MIC requesting the suspension of the 800MHz band assignment plan and the development of a new spectrum assignment plan for the band. The CEO of SoftbankBB charged that "MIC's spectrum license assignments are decided by a few officials in a closed room. The process lacks transparency and fairness." This event dropped a bomb. But, MIC had actually been holding the Study Group on Policies for Effective Radio Spectrum Use since January 2002, and had discussed the issues of transparency and fairness relating to the current method, before the event occurred.

Auction is a potential alternative for the comparative examination in the license assignment process. The US and many European countries have already employed it and use it for selecting various licensees for various purposes such as the third generation (3G) mobile phone and Broadband Fixed Wireless Access services. MIC considered the possibility of auction, but it deferred the auction option. The final report on the Basic Concepts on Review of the Spectrum User Fee System, which was compiled by the Study

Group on Policies for Effective Radio Spectrum Use in October 2004, stated that auction carried a risk of boosting the licensing price and bringing about the decline of the ICT industry, taking as an example the European auction for 3G mobile spectrum licenses and the later weakened ICT industry. Instead, the report proposed comparative examination utilizing market mechanisms (even though, as the report itself mentioned, that process would not overcome the problems of lacking transparency and fairness). In addition, the process contains the basic problems of command and control such as information asymmetry and imperfect ability to process information etc. Furthermore, such a complex examination process risks confusing both MIC and applicants at the time of its actual use. The report also stated that auction would be the mid- and long-term study topic for spectrum policy.

This thesis discusses the circumstances likely to surround auction employment if it is assumed for the licensing case for the 4G mobile service, which is expected to be introduced around 2010. Though regulators grant mobile service licenses a few years before mobile phone carriers start service, this case assumes the licensing occurs in 2010 because the introduction timing has not yet been clearly decided.

The main focuses are the political environment for auction employment in Japan and auction design. MIC needs the Diet to pass a bill to authorize the auction method for the purpose of introducing it into the current spectrum management system provided by the Radio Law. Consequently, the stances of stakeholders will directly affect the introduction of auctioning. The Federal Communications Commission (FCC) in the US needed 8 years from when it first asked Congress for authority to use auctions in 1985, till it finally succeeded in getting the legislation in 1993. Auction design is also an issue. The difficulty of designing auctions makes MIC hesitate to positively consider its employment.

If auction design can guarantee it will not boost bidding prices and will assign spectrum licenses to the optimal applicants, MIC and stakeholders will also change their minds. The main auction goals for the Japanese government are assumed based on the discussion in the final report of MIC's study group to be to secure transparency and fairness, and to realize effective spectrum allocation based on an overall economic perspective, rather than to yield as much revenue to the government as possible. Considering these goals, this thesis discusses the design strategy based on the analysis of past auction in US and Europe.

1.3 Structure of the Thesis

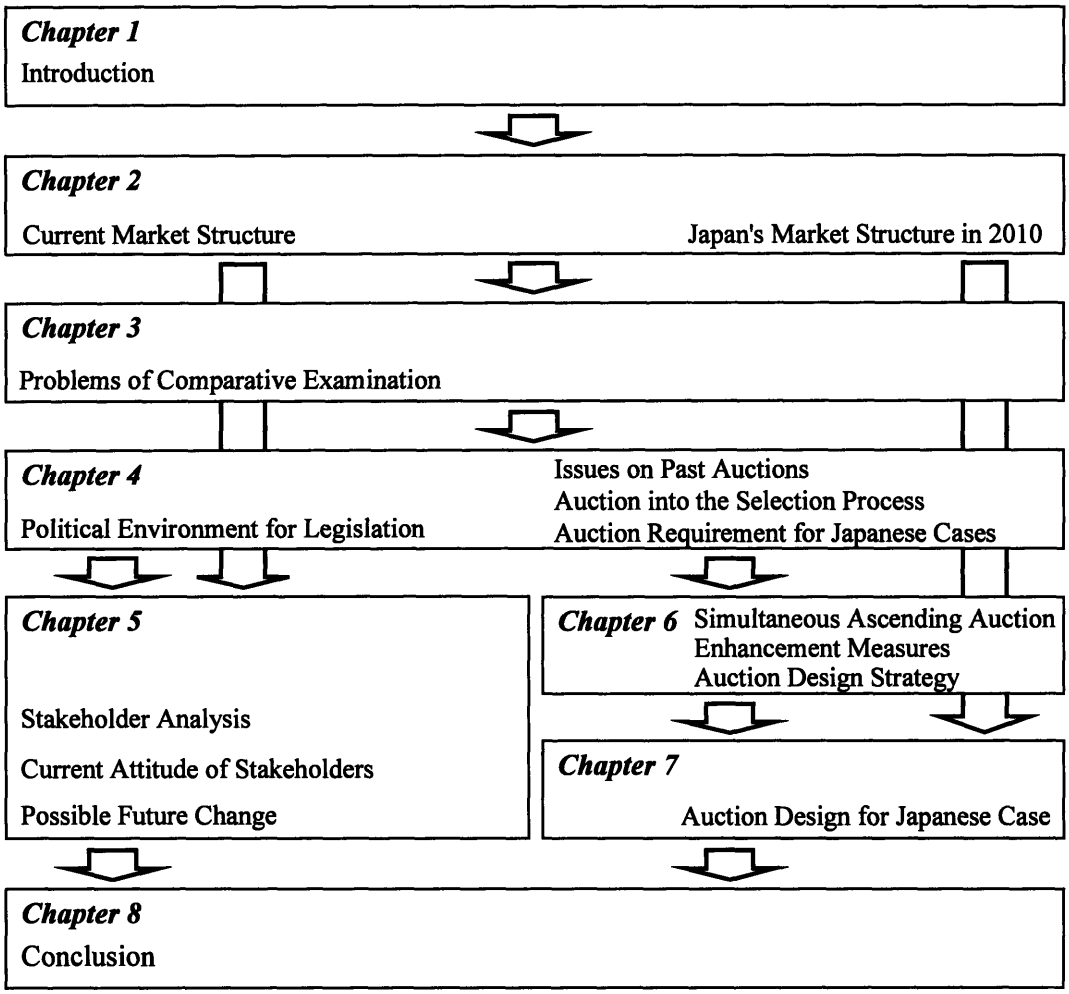
The thesis is divided into eight chapters. The introductory chapter describes the background of the record and states research objectives. The other chapters are described below and in Figure 1-2.

- ***Chapter 2: Japan's Mobile Industry***

  Chapter 2 explains Japan's mobile phone industry. The history of the Japanese mobile phone industry and current situation provide the basis for understanding the discussion that follows. The impact of the mobile number portability system and assumptions about the Japan's market structures in 2010 come next. These are followed by a presentation of mobile technology's upcoming trends.

- ***Chapter 3: Spectrum Resources***

  Chapter 3 first describes the characteristics of spectrum resources and spectrum license management models, then focuses on comparative examination method, on which the Japanese government relies, and on inherent problems of the system.



Source: Author, 2006.

Figure 1—2: Structure of the Thesis

- ***Chapter 4: The Auction as an Alternative to the Comparative Examination***

Chapter 4 describes the purpose of the auction and topics relevant to the introduction of auctions, including the political circumstances that control auction legislation, problems with past spectrum auctions, the comparative examination method utilizing market mechanisms proposed by the final report of the MIC's study group, and an alternative method: employment of the auction in the licensee selection process by

MIC. All of these topics contributes to the understanding of whether MIC would introduce the auction system or not.

- ***Chapter 5: Stakeholder Analysis: Adding Auctions to the Radio Law***

  Chapter 5 examines political circumstances surrounding the introduction of the auction, based on the stakeholder analysis, which investigates questions and answers in the Japanese Diet and statements submitted for public comment in reports compiled by the MIC's study group. An understanding of the current stakeholders' attitudes about the introduction of auctions helps to explain the future possibility of auctions form a political point of view.

- ***Chapter 6: Auction Design***

  Chapter 6 discusses a strategy to develop auction design based on the analyses of past auctions implemented by regulators throughout the world. The first part discusses the "simultaneous ascending auction", which is the primary type of the spectrum license auction. The next part of the chapter discusses enhancement measures of the simultaneous ascending auction. Based on these discussions, the final part presents a strategy that demonstrates the crucial decision-making issues regarding the auction design process. The strategy helps MIC develop auction design, considering Japanese market structures.

- ***Chapter 7: Designing Japanese Auction***

  Based on the strategy developed in Chapter 6, Chapter 7 discusses auction designs that are expected to work best in each of two assumed Japanese mobile market structures in 2010. The first case assumes the same market structure as today: one strong incumbent, two weaker incumbents, and two weak newcomers. The second case

assumes a more balanced competition after significant change influenced by mobile number portability and by the entrance of two newcomers. In this second case, there are the three incumbents have comparable strengths. In the same case, there are two weak newcomers, one strong newcomer, and one weak newcomer.

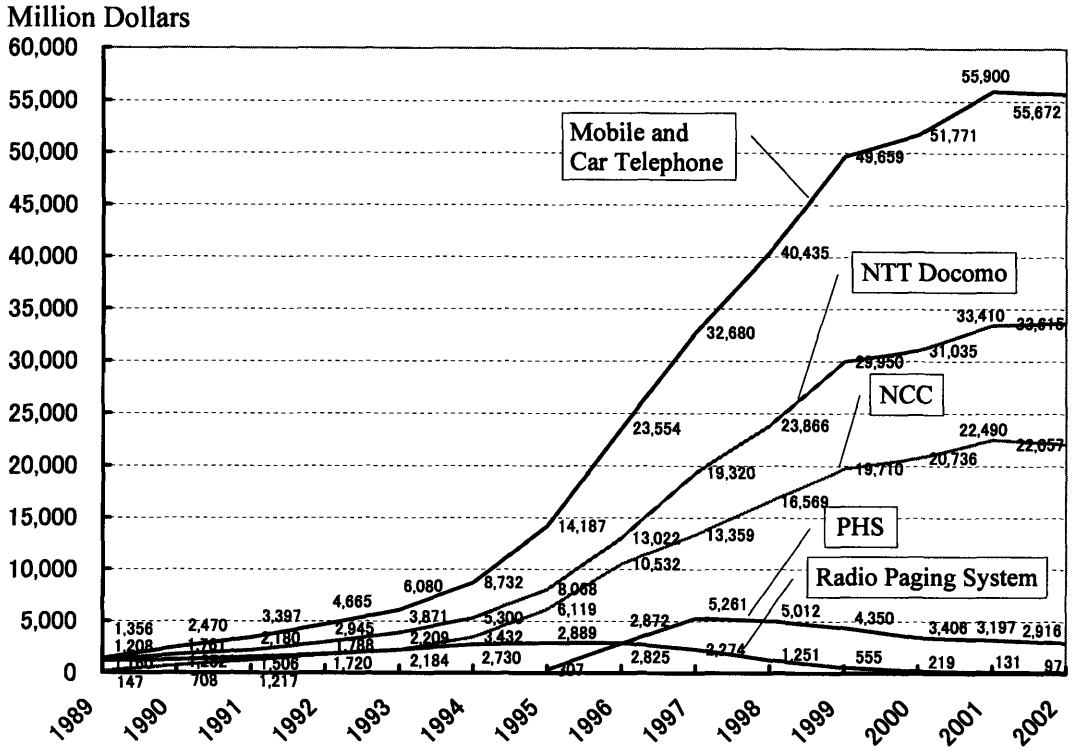
- ***Chapter 8: Conclusion***

  Chapter 8 summarizes the discussion presented in the thesis, and recommends that MIC reconsider the use of the auction method and begins immediately.

Chapter 2

Japan's Mobile Industry

The Japanese mobile industry has grown and developed dramatically since the mid-1990s. Figure 2-1 shows the increase in sales of mobile communications services (not total consolidated sales) since 1989. The total sales of mobile phones and car telephones



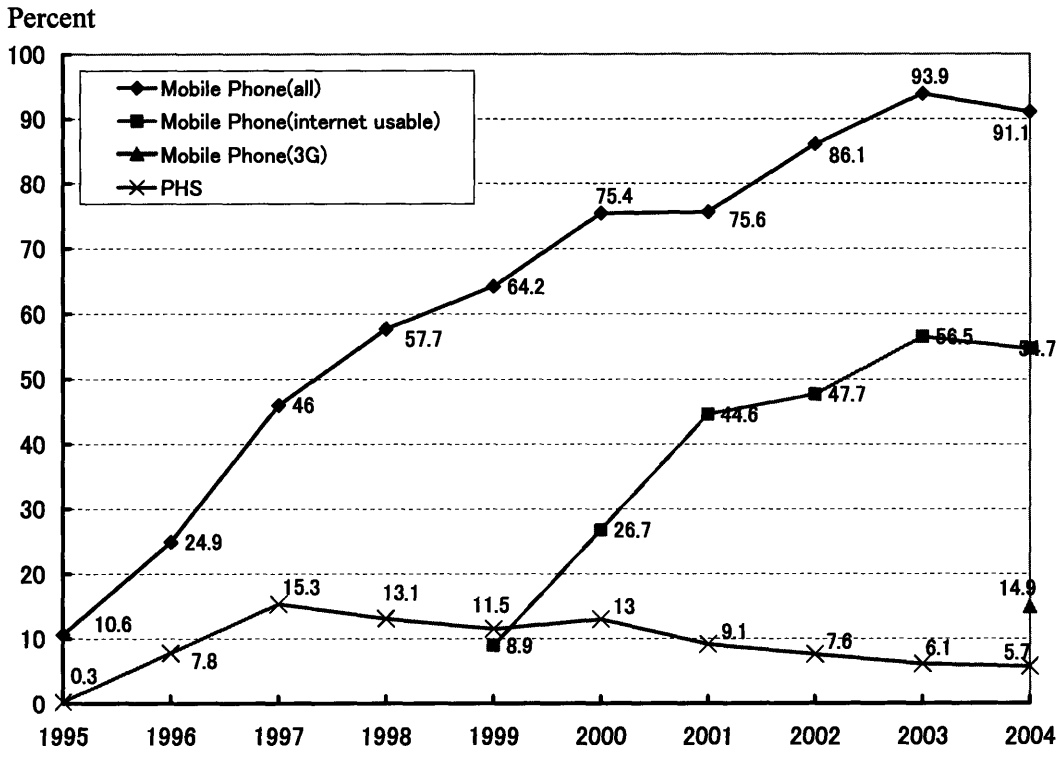
Note: The data in this graph are based on the data and categories from the MIC's Information and Communications database [66]. The sales figures are based only on service sales, not total consolidated sales. Mobile and Car Telephone figures are the sum of NTT Docomo and NCC sales. NCC represents all new carriers including Digital Phone, Tu-Ka, J-Phone, au, etc. (but not NTT Docomo); based on the exchange rate of 1 USD = 100 JPY.
Source: Author, 2006.

Figure 2—1: Transition of Sales of Mobile Communications Service in Japan

exceeded $55 million in 2001. However, saturation rate of mobile phone holders has been increased, recent sales growth are slow.

Japanese ownership ratio of mobile phones and Personal Handyphone System (PHS) per household has changed dramatically over the past decade as shown in Figure 2-2. The ratio of mobile phone dramatically increased, especially between 1995 and 1997.

With regard to Internet mobile usage, the rate reached around 50% in a few years following the introduction of Internet connection services such as the i-mode in 1999. The



Note: Chart is based on data from MIC's Communications Trend Reports [72]. The Mobile Phones category includes 3G mobile phones, Internet usable mobile phones and simple mobile phones but does not include PHS.
Source: Author, 2006.

Figure 2—2: Ownership Transition Ratio: Mobile Phones & PHS per Household in Japan

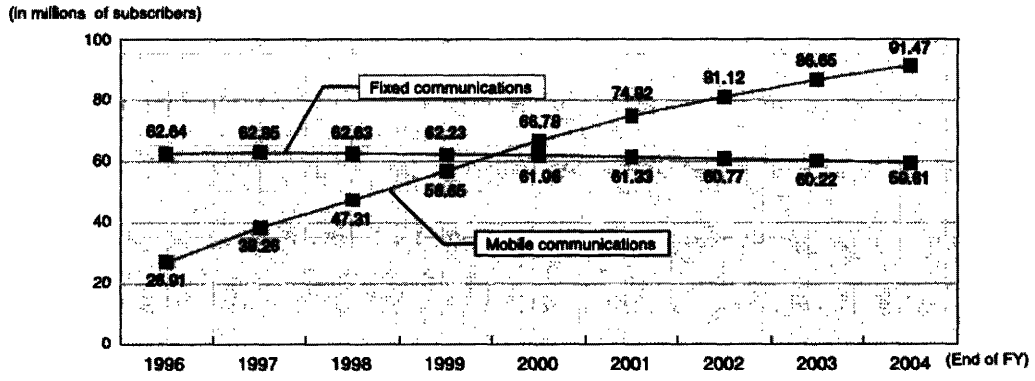
average number of handheld mobile phones in Japan in 2004 was 2.5 phones for all Japanese households, or 2.7 phones for households that said they used mobile phones [72]. Mobile phones have gained widespread use in business and non-business affairs in Japan.

2.1 History of Japan's Mobile Phone Service

Japanese wireless phone service essentially began in 1979 when Nippon Telegraph and Telephone Public Corporation started car telephone in 23 wards of Tokyo. This public corporation was privatized in 1985 and the name was changed to its buyer, Nippon Telegraph and Telephone Corporation (NTT), which essentially held a monopoly on the service until 1988. NTT initiated Japan's first mobile phone service in 1987. Nippon Idou Tsushin Corporation (IDO) and DDI Cellular Group entered the mobile phone market in 1988. IDO covered the Kanto and Tokai areas of Japan including cities such as Tokyo and Nagoya, and DDI Cellular Group covered the rest of Japan. Thus, two companies, NTT and IDO or NTT and DDI Cellular Group, provided mobile phone services throughout Japan. NTT established NTT Mobile Communications Network Inc. in 1992, then the new company pursued the mobile phone business of the NTT group. This duopoly structure continued until 1994 when digital phones and the Tu-Ka groups entered the market. In 1995, the NTT Personal Group and DDI Pocket Group began the service of PHS, which had a different function from 1G, 2G, and 3G mobile phone. The mobile phone market became more competitive with the entry of PHS service and many more newcomers of mobile phone service in 1994.

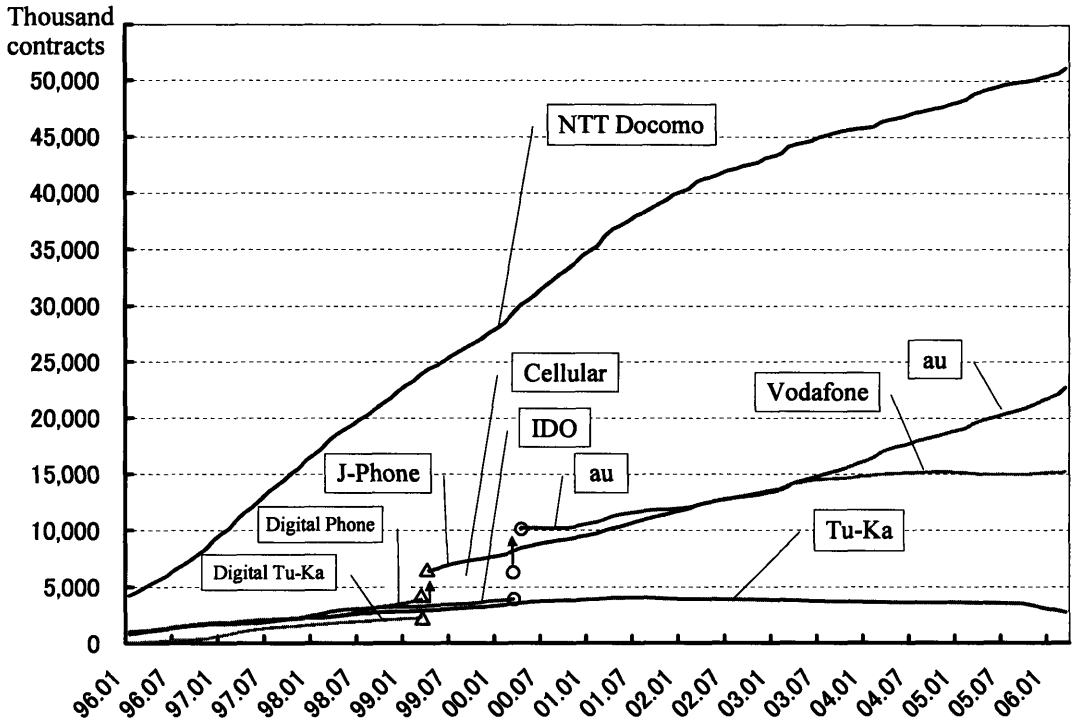
Based on the merger of Digital Phone and Digital Tu-Ka groups in 1999, J-Phone was established at which year NTT Mobile Communications Network Inc. started the i-mode

service. The i-mode service allows users to send or receive e-mail and to use internet webpage, etc. The company changed its name to NTT Docomo in 2000. As shown in the Figure 2-3, also in 2000 the number of subscribers to mobile communications exceeded that of fixed communication users in Japan. In addition, Kokusai Denshin Denwa (KDD), Daini Denden Inc. (DDI), and IDO merged, at which time a new communications firm, KDDI Corporation (KDDI) was established. The DDI Cellular Group changed its name to au after a reorganization in 2000, and then au merged with KDDI in 2001. NTT Docomo started 3G service named FOMA in 2001. KDDI (au) and J-phone initiated 3G service in 2002. KDDI employed the CDMA2000, and J-Phone employed W-CDMA. J-Phone changed the name to Vodafone in 2003; Tu-Ka group merged with KDDI in 2005. The current oligopoly structure has been shaped in the recent years.



Source: MIC, 2005 [67], p. 44, Figure 2-2-1.

Figure 2—3: Changes in the Number of Subscribers to Fixed Communications and Mobile Communications: 1996-2004



Note: The merging of companies is described as being implemented in April of 1999 and 2000 as a matter of convenience based on the database of TCA [65]; Tu-Ka merged with Au in October 2005 but its service has been provided under the same brand name by KDDI, which provides Au mobile service.
Source: Author, 2006.

Figure 2—4: The Transition of Mobile Subscribers in Japan

Table 2—1: The Transition of Mobile Subscribers in Japan

(1000 Contracts)

	96.01	97.01	98.01	99.01	00.01	01.01	02.01	03.01	04.01	05.01	06.01	
NTT Docomo	4,223	9,686	16,674	22,889	28,057	34,863	40,114	43,301	45,807	48,099	50,496	NTT Group
IDO	1,029	1,705	2,497	3,237	3,788							Currently under KDDI
CELLULAR	1,722	3,248	4,133	5,088	6,142							
au						10,606	11,968	13,583	16,209	18,923	21,792	
Tu-Ka	802	1,787	2,252	2,818	3,344	3,865	3,913	3,828	3,652	3,601	3,011	
Digital Phone	863	1,861	2,281	3,585								Currently under Softbank
Digital TU-KA	31	649	1,639	2,168								
J-Phone					7,771	9,578	11,759	13,456				
Vodafone									14,838	15,152	15,134	
Mobile total	8,670	18,936	29,476	39,785	49,103	58,913	67,755	74,168	80,506	85,775	90,433	
PHS Total		5,166	6,924	5,857	5,672	5,839	5,675	5,533	5,183	4,505	4,618	
Radio Paging	10,609	10,312	7,895	4,265	2,300	1,514	1,182	995	829	668	520	

Source: Author, 2006 based on [65].

In 2005, the MIC granted new 3G mobile phone licenses to three newcomers, BBmobile, eMobile, and IPMobile for the spectrum which came to be additionally allocated to 3G mobile phone service. These three firms all plan to initiate 3G service beginning within 2006 or to do so in 2007. However, BBmobile merged with Vodafone in 2006, and then acquired a strong infrastructure and added 15.21millions of subscribers, which Vodafone owned. Thus, the newcomers have been reduced to two companies: eMobile and IPMobile. One Segment Digital TV Broadcasting began for mobile phone and other mobile information devices in 2006 and is considered as the step toward the convergence of telephone and broadcasting services. Figure 2-4 and Table 2-1 show the transition of mobile subscribers and the merger of carriers in Japan beginning in 1996. NTT Docomo has maintained the largest market share. KDDI has been providing mobile phone service under the brand name of au and Tu-Ka after 2005, such that KDDI's total subscribers number about half of that of NTT Docomo. Vodafone has maintained the same level of subscriber number for about two years, however, it has not developed momentum compared to the other two companies.

Table 2-2 also shows the mobile phone carriers in March 2006 after the MIC licensed newcomers in 2005. The newcomers, eMobile and IPMobile, have not started up their services yet. The size of each of the companies differs significantly. BBmobile merged with Vodafone, and consequently, it has become the third largest mobile communications firm in Japan. Newcomers have to take market shares from incumbents in order to survive because mobile phone has already diffused to society and new subscribers will be not many. However, the smaller business capacity of mobile service may work against the industry where economy of scale and economy of scope have a larger influence. Newcomers can

take advantage of the impact of the new telecommunications policy as MIC plans to introduce the mobile number Portability System in November 2006, whereby users can take their mobile phone numbers with them when they subscribe to a new company.

Table 2－2: Mobile Phone Carriers after the Licensing of Newcomers in 2005

Name	Category	Subscriber (million)	Sales at 2005.3 (bUSD)	Remarks
NTT Docomo	Incumbent	51.14 (at 2006.3)	42.1	-
au + Tu-Ka (KDDI)	Incumbent	22.70+2.74=25.44 (at 2006.3)	20.2	-
Vodafone	Incumbent	15.21 (at 2006.3)	12.7	Merged with BBmobile in 2006.3
BBmobile (Softbank)	Newcomer (Plan to start from 2007.4)	6.69 (Plan at 2011.3)	7.59 (SoftBank ADSL)	Licensed 2005.11
eMobile (eAccess)	Newcomer (Plan to start from 2007.3)	5.05 (Plan at 2011.3)	0.50 (eAccess ADSL)	Licensed 2005.11
ipmobile	Newcomer (Plan to start from 2006.10)	11.6 (Plan at 2011.3)	-	Licensed 2005.11

Note: At the exchange rate of $1 USD = 115 JPY.
Source: Author, 2006.

2.2 Introduction of Mobile Number Portability System in Japan

The MIC will introduce the mobile number portability system on November 1st, 2006 [68] after which mobile carriers must provide number portability service, which allows mobile users to keep their current mobile phone number when they change providers. This in turn can reduce users' resistance to change carriers. However, the users' mobile e-mail addresses will need to be changed with the new carrire, and this inconvenience may negatively affect users' motivation to change carriers. However, the general understanding is that mobile users will be able to change carriers much more easily when they can keep

their phone numbers and can base their selection of carriers on a comparison of prices and services.

Thus, the MIC (and most carriers and economists) expect that market competition will increase, especially price competition because most users choose carriers based on price [69]. The introduction of this number portability system will squeeze incumbents' business by enhancing competition; newcomers such as eAccess and IPMobile embrace the number portability system as an opportunity to expand their market share (mainly from incumbents).

Table 2—3: The Introduction of Number Portability in Other Nations

Country	Date of introduction	Cumulative use rate	Time for Process	Cost
UK	1999.1	5% (2.51million)	Ave. 9 days	Max 30GBP
Netherlands	1999.1	5% (0.6million)	3 business days	9.08 Euro
Switzerland	2000.3	-	-	Free
Spain	2000.12	1.6% (0.53million)	5 days	Free
Denmark	2001.7	11% (0.33million)	Approx.30 days	Free
Sweden	2001.9	5% (0.4million)	5 business days	Free
Norway	2001.11	14.8% (0.59million)	6.5 days	85 Norway krona
Italia	2002.5	1.6% (0.87million)	30 days (Target.5-10 days)	Free
Belgium	2002.10	2.2% (0.17million)	2 days	Max 15 Euro
Germany	2002.11	0.47% (0.27million)	Ave. 6 days	22.5-24.95 Euro
Ireland	2002.11	2.2% (0.066million)	2 - couple of hours	Free
France	2003.6	0.1% (0.045million)	30 days	15 Euro
EU average	2002.4 (EU directive)	2% (6million)	9 days	14 Euro
US	2003.11	-	less than 2.5 hours	Max 1.75 USD/Month
Singapore	1997.4	-	-	Free (from 2003.8)
Hong Kong	1999.3	86.3% (5.78million)	1-2 days	40HKD (From 2002.3)
Australia	2001.9	8.6% (1.08million)	couple of hours	8Australian dollar (Only once)
Korea	2004.1	0.9% (0.3million)	0.5-1 hour	1,100 Won

Note: Data as of April 2004.
Source: Modified from [70].

Table 2-3 shows the changes in cumulative use rate, necessary time for processing and costs in other countries after they introduced the mobile number portability system. The

cumulative rate of users who utilized the number portability system ranged so widely that it is difficult to predict how Japanese users will behave after the number portability system is introduced. The key is the convenience of the portability process. The MIC expects that the basic process time for registering the number portability system will be within a couple of hours, and the fee for using the number portability system will depend on each carrier [68]. The Japanese process will be user friendly because necessary time will be short and cost is considered to be reasonable. Based on a survey carried out by Survey Research Center Co., LTD. in 2005, 15% of Japanese users would like to change their current mobile phone carrier, 43% of users report they have no idea whether they will change their current mobile phone carrier or not after the introduction of mobile number portability. In addition, 48.7% of those who want to change mobile phone carriers report that they would choose au, 17.8% would choose NTT Docomo, 10.9% would choose Vodafone, and 22.5% reported no preference [69]. Thus, the impact of number portability seems to be huge.

2.3 Japan's Market Situation in 2010

In the future, Japan's incumbent mobile carriers will need to survive in a more competitive market from today's (2006) market. Company share of the mobile phone market in March 2006 is the following: NTT Docomo, 55%; KDDI (au + Tu-Ka), 27.7%; and Vodafone (merged with BBmobile in March, 2006), 16.6%. However, the entrance of newcomers and the introduction of the mobile number portability system could change the current market share balance. Because the mobile number portability system could facilitate transfers of mobile users between carriers and newcomers will try to take market share from incumbents. This paper assumes two market cases in 2010 for an auction design.

➢ ***Case 1— Same as Current Conditions: One very strong incumbent, two mid-sized incumbents, and two weak newcomers***

This case assumes that the market situation will not change much from the current situation. The current mobile user does not use the mobile number portability system a lot because of inconvenience of the system such as necessity to change e-mail address, additional cost and time, and because of mobile carriers' effort to keep their subscribers by reducing price etc. Newcomers such as eMobile and IPMobile will likely try to take market shares form incumbents, but they will fail to attract users and get just enough subscribers to continue their business. And then, there will be still large difference of business capability basically because of the differences of subscriber number.

Table 2—4: Market Structure in 2010 – Case1 –

Name	Category	Subscriber (million)	Sales at 2005.3 (bUSD)	Remarks
NTT Docomo	Incumbent	65.26	53.7	-
au + Tu-Ka (KDDI)	Incumbent	37.38	29.7	-
BBmobile (Softbank)	Incumbent	24.49	20.5	Merged with Vodafone in 2006.3
eMobile (eAccess)	Newcomer	5	4	Licensed 2005.11
ipmobile	Newcomer	11	8	Licensed 2005.11

Note: BBmobile merged with incumbent, therefore it is categorized to incumbent; incumbents' subscriber number and sales are calculated based on the assumed annual growth rate as follows, 5% of NTT Docomo, 8% of KDDI, and 10% of BBmobile (previous Vodafone). Subscriber numbers of newcomers' are based on their business plans for 2011. Sales are calculated assuming the sales of 0.8bUSD per 1 million subscribers.
Source: Author, 2006.

➢ ***Case 2 — More Flat Market Structure: Three incumbents, and two weak newcomers. Furthermore, one strong and one weak newcomer considering entering the market***

This case assumes the market situation will change dramatically in four years because of the efforts of smaller incumbents and newcomers to take advantage of the mobile number portability system. Assuming that 15% of current mobile users will have transferred to BBmobile (previous Vodafone), and 5% to KDDI, 2.5% to the two newcomers — all from NTT Docomo users by 2010, and the market structure will be flatter than the current situation. There will be three incumbents, those power balance are more balanced than case 1, and two small-sized and still weak newcomers comparing to the incimbents. In addition, the market structure change will increase the attractiveness of the mobile phone market for new entries and one strong foreign company and one small-sized Japanese company would consider entering the market.

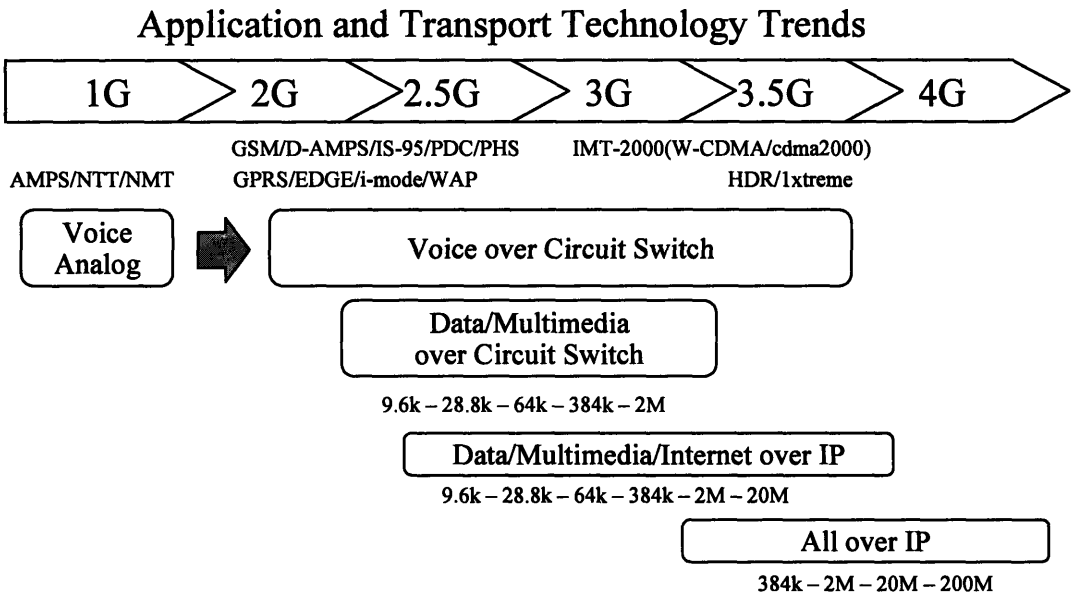
Table 2－5: Market Structure in 2010 – Case2 –

Name	Category	Subscriber (million)	Sales at 2005.3 (bUSD)	Remarks
NTT Docomo	Incumbent	48.95	40.3	-
au + Tu-Ka (KDDI)	Incumbent	40.64	35.1	-
BBmobile (Softbank)	Incumbent	34.27	28.7	Merged with Vodafone in 2006.3
eMobile (eAccess)	Newcomer	6.6	5.3	Licensed 2005.11
ipmobile	Newcomer	12.6	10.1	Licensed 2005.11

Note: Assuming that 15% of mobile users will have transferred to BBmobile (previous Vodafone), and 5% to KDDI, 2.5% to each of the two newcomers all from NTT Docomo users at the time of 2010 based on the figures of case 1.
Source: Author, 2006.

2.4 The Expansion of Mobile Phones in the Near Future

The mobile phone is representative of mobile communications devices, and is the most personal communications tool in widespread use today. Many people, for example more then 90% of house holds, carry a mobile phone with them, and talk or use data or Internet services over the mobile phone, the functions of which have developed generation by generation.



1G: Basic mobile telephony service

2G: Mobile telephony service for mass users with improved ciphering and efficient radio spectrum utilization

2.5G: Mobile Internet service

3G: Enhanced 2.5G services plus global roaming and emerging new applications

Source: Etoh, Minoru., 2005 [71], p. 4, Figure 1.1.

Figure 2—5: Generation of Mobile Networks

Figure 2-5 shows various generations and applications of mobile phones and networks. In addition, each generation offers new services and functions as described below. Also, current Japanese mobile phones provide the following services in addition to basic telephony service: e-mail, web browsing, location-dependent services such as GPS, Java applications, videoclip downloads, multimedia mail such as pictures and video [71].

Currently, the 3G mobile phone is mainstream in Japan. However, Japanese mobile carriers have started development projects to upgrade the mobile phone network. NTT Docomo presented the "super 3G" concept; KDDI presented an "ultra 3G" concept both of which are processes that will enable Fixed Mobile Convergence (FMC). Carriers will introduce the IPv6-based packet network into the backbone network, and then provide the same level of communication service wherever users are by enabling various network access methods. One mobile device works as a mobile phone outside the home and office or hotspots, as a wireless LAN in a hotspot, and as a device to connect optical fiber in the home or office, for example. The convenience of the mobile device will increase as will the role of the mobile devices in the workplace and home in general. Consequently, the mobile phone will play an increasingly important role as the information infrastructure for society.

Japanese carriers plan to use the same spectrum bands as the current 3G mobile phone uses. However, the 4G will use a different spectrum band to be decided by the World Radio Conference (WRC) in 2007. It is expected that the 4G will become the main service in the future and carriers' fates will depend on whether they can obtain a 4G mobile phone spectrum license or not [69].

Chapter 3

Spectrum Resources

3.1 Characteristics of Spectrum Resources

The radio spectrum is a range of radio frequencies and part of the electromagnetic spectrum Article 2 of the Japanese Radio Law defines the radio wave as the electromagnetic wave that has a frequency lower than 3000GHz [35]. Radio technology enables radio devices to send information to other devices without physical connection and from remote areas.

Many people and organizations, both private and public, use radio spectrums for personal, business, and public purposes, such as radio programming, TV broadcasting, mobile phone service, a community wireless system, and defense systems, etc. Recent technologies and business model developments have increased the demand for radio wave spectrum resources.

Different radio frequencies have different characteristics described in terms of propagation, bandwidth, and interference [59]. *Propagation* refers to the area reachable by the radio wave. Lower-frequency radio waves tend to propagate over long distances and penetrate certain materials; higher-frequency radio waves tend to propagate over shorter distances and more linearly. High-powered signals propagate further than lower-powered signals.

Bandwidth means the range of frequencies, measured in Hertz, which is used to transmit or receive radio waves. With a wider bandwidth, more information can be transmitted in a certain time period.

The third characteristic is *interference*. This refers to the fact that radio devices cannot distinguish wanted radio wave signals from unnecessary or random radio wave signals. Unnecessary signals may be created artificially or naturally. Interference reduces the quality of radio wave use or even makes it useless. For example, interference reduces the quality of voice communication and data rates, and eliminates communications connections. Interference is somewhat dependent on technology. More sophisticated equipment can improve receiver performance.

The characteristics of the radio frequency spectrum, from the view point of resources, are shown in Table 3-1.

Table 3—1: Characteristics of the radio frequency spectrum

Characteristics	Concept
Finiteness	The supply of spectrum band does not change. If more users utilize a specific spectrum band, that band reaches finiteness because regulators limit the use of a specific spectrum band.
Externality	Spectrums affect each other mutually if they are used in a close spectrum band in the same area, depending on the strength of emission power. If the same spectrum is used in the same area, it causes interference.
Regionality	The same spectrum can have a range of quality based on where it is used. It is easier to understand from an international viewpoint.
Non-homogeneous	Each frequency has specific characteristics that make it suitable for certain uses
Non-depletable	Spectrum use may be limited at any time by regulators, but using the spectrum at a specific time does not prevent use of a spectrum later.
Non-storable	Spectrum band cannot be stockpiled, although it is non-depletable. Spectrum not used at a specific time is lost forever

Source: Author, 2006 based on [57][59].

3.2 Spectrum Resource Allocation

3.2.1 Regulation of Spectrum Use

Governments have played a major role in managing spectrum resources for many years in order to maintain a healthy spectrum use environment. The U.S. Federal Radio Commission was established in 1927 by the U.S. Congress for the purpose of managing the radio spectrum. The Commission's authority was transferred to the Federal Communications Commission, which was newly created in 1934. Since that time, the FCC has played a key role in promoting effective use of spectrum resource to benefit the nation.

Three reasons explain the purpose of the government commitment.

First, the government has the responsibility for stewardship of this public asset—spectrum resources. Thus, it is natural that the government managed the resource from the outset.

Second, the spectrum is a scarce resource that suffers from interference in areas of congested use. Government must allocate the spectrum so as to promote secure, safe, and efficient use. Interference caused by unmanaged spectrum use generates negative spillover, so the government's role is to manage these public goods.

Third, manufacturers produce radio equipment to sell to those who use it privately or publicly. As well, individuals and organizations use spectrum resources for various purposes such as commercial service. Spectrum resource management is a regulatory measurement of the service and industry structure.

Governments manage this resource for other purposes, such as safety, emergency service, defense, generating government revenues, etc. [60]. The government exerts its enforcement capability in order to manage this resource for the benefit of the nation. Cave

describes the objectives for governmental spectrum management as the realization of economic efficiency, technical efficiency, and public policy [61]. These three aspects function as a lens to evaluate the efficacy of the government's management of spectrum resources. Table 3-2 illustrates the objectives and policy directions of UK spectrum policy, as an example.

Table 3−2: Objectives and Policy Directions for UK Spectrum Management

Objectives	Policy directions
Economic Efficiency	- Market allocation of spectrum to users and uses that derive higher value from the resource. - Provide responsiveness and flexibility to changes in markets and technologies; accommodate new services as these become technically and commercially feasible. - Minimize transactions costs, entry barriers, and other constraints on a competitive efficient market.
Technical Efficiency	- Intensive use of scarce spectrum consistent with adherence to technical interference limits. - Promote the development and introduction of new spectrum-saving technologies, where cost is justified by the value of spectrum saved.
Public Policy	- Consistent with government policy toward broadcasting, competition in the telecom market, and consumer choice. - Safeguard interests of spectrum use for efficient functioning of defense, emergency, and other public services. - Changes to UK spectrum use should remain consistent with the UK's international and European obligations.

Source: Modified from Cave, 2002 [61], p.6.

3.2.2 Models of Spectrum Resource Management

There are three typical models for government control of spectrum management: (1) *Command and control model*, (2) *Exclusive use model*, and (3) *Commons model* [62][64]. These models can be applied within one country, but the choice of model depends on the

attributes of objective spectrum bands and purpose. Table 3-3 shows the features of these models and examples of applications to current wireless industries.

Table 3—3: Spectrum Management Models

Model	Mode	Feaures	Purpose of Use and issues
Command and Control	Licenced *exclusive inflexible*	-Technology, provider, services specified by regulator - Un-tradable license	Mobile phone (in Japan) Broadcasting spectrum -Legacy of using "interference" threat to oppose competition (FM radio UHF broadcasting) -Slow to deploy new technology (digital TV conversion)
Exclusive Use (Market)	Licensed *Property right exclusive (semi)-flexible*	-Flexible, transferable licenses to operate in area/band* -Licensee chooses technology, services* -Secondary markets: licensee can trade rights to third parties	Mobile phone (in US) - Question on the benefits of mandating a single standard - Further growth constrained by lack of access to available spectrum
Commons (Market)	Unlicensed	-Underlay: USB, Part 15 devices** -Overlay: interleaving, white space** -Dedicated: ISM 2.4 and 5GHz Bands	WiFi access - Power limits on equipment - No exclusive right to interference protection - Congestion emerging as problem

Note: * If regulator does not put conditions for spectrum use, ** Secondary use.
Source: Modified from Lehr, 2006 [60], pp.5-6.

The *command and control model* is the most traditional, having been in use from the beginning of the 20th century when the federal government began assigning exclusive rights to use individual bandwidth blocks as its method for limiting overcrowding and interference. This model is used even now in the U.S. for most spectrums within the FCC's jurisdiction. Governments allocate and assign frequencies to limited categories of spectrum users for particular government-defined uses. The government puts conditions on the license, such as service restrictions, power limits, technology restrictions, etc. There are strict limits on the license transfer from the original license holder to a third-party individual or company. In

addition, a regulator employs a comparative examination process to select licensees if there are many applicants.

The *exclusive use model* allows the licensee to have exclusive and transferable rights to the use of a specified spectrum within a fixed geographic area. These flexible-use rights, which are mainly comprised of technical rules, also protect spectrum users against interference. In this model, exclusive rights act as property rights. However, the model does not create full property rights in spectrum. The regulator proactively uses a market mechanism, such as auction and the secondary market, which enables licensees to share or transfer their rights through sale or lease. This model facilitates efficient spectrum use and increases investment and innovation—two advantages over the command and control model.

The third is the *Commons model.* Unlicensed users share frequencies based on usage rights that are ruled by technical standards or etiquettes. However, there is no limit on the number of users and no rights to protect from interference. The user needs to follow technical standards or etiquettes that set power limits and other criteria for the purpose of mitigating potential interference, to use the allocated spectrum for unlicensed use. Many countries including Japan use some version of this model, for undedicated unlicensed spectrum band such as Industrial Scientific Medical (ISM) bands of 2.4 and 5GHz.

The Japanese government employs the command and control model to manage most parts of the spectrum for broadcasters, mobile phone service, etc. The government defines many conditions for licenses, and examines license applicants to select those who will yield the most benefit to the nation. However, criticism of the command and control model intensifies every year.

Given that the focus of this thesis is on the selection process for licensees, the remainder of the discussion will concentrate on comparative examination in the command and control model.

Table 3—4: Characteristics of Spectrum Management Instruments

	Individual Licensing	Initial Assignment	Secondary Trading	User Price
Command and Control	Yes	Administrative	No	None (except administrative change)
Administrative Incentive Pricing	Yes	Administrative	No	Yes, ("opportunity cost")
Primary Auctions	Yes	Auction	Not necessarily	Not normally
Secondary Trading	Yes	Auction or administrative	Yes	Not necessarily
Unlicensed Spectrum	No	None	None	None

Source: Cave, 2004 [52], p.5, Table 1.

3.3 Comparative Examination: The Selection Process

3.3.1 Process and Criteria for Examination

When numerous individuals or organizations apply for the limited number of available licenses, regulators assign the spectrum licenses to the most qualified applicants based on the results of a comparative examination that is part of the command and control model. The method and criteria for evaluation differ from country to country, and depend on the eventual purpose of the spectrum use. Generally, a committee within the regulatory body decides on a number of criteria that are weighted by their importance. The regulator evaluates the offer made by each applicant using the established criteria, then selects the plan that has the best

mix of those criteria—usually the highest weighting. The criteria may include many kinds of terms, and regulators set the criteria in advance.

The following is an example of Swedish criteria for spectrum licenses for mobile services [55].

- ***General criteria***
  - Financial resource
  - Reliability and investment in research
- ***Specific criteria***
  - The speed of network rollout
  - The requirement for geographic and /or population coverage
  - Pricing plan for the service
  - Quality of the service
  - Technology and competitiveness

The Swedish government utilized comparative examination for 3G mobile service from May 2000 to June 2001 [56]. The government selected four licensees from among ten applicants. The process set two steps in the evaluation process. The regulators examined the following three criteria in the first step.

(1) Financial capacity: The applicant should demonstrate that it has sufficient capital at its disposal to establish the promised network.

(2) Technical feasibility: The applicant should demonstrate the network's reliability, availability, voice quality, and other quality parameters. The applicant should

also demonstrate that it has access to appropriate expertise and necessary experience to construct a mobile telecommunications network.

(3) Commercial feasibility: The applicant should present documented business and marketing plans with investment plans and financial projections that show the costs, revenues, and resources required to provide the proposed services.

If an applicant passed this portion of the examination, the regulator further evaluated them based on the following criteria: (1) coverage in relation to surface area and population, and (2) the rollout speed for the networks. The evaluation results of each applicant were compared to the others by the regulator, and then the four licensees were decided.

In the case of 3G mobile licensing in Japan in 2000, the MIC carried out comparative examination based on five criteria:

(1) Adequacy of planned business for the demand;

(2) Properness of the radio station deployment plan and certainty of the plan;

(3) Adequacy of the spectrum use;

(4) Necessity of opening radio station; and

(5) Contribution to the development of healthy telecommunications industry.

However, only three companies applied for the three licenses, so in the end comparative examination was not needed.

3.3.2 Problems With Comparative Examination

Criticism of the command and control model has grown in proportion to the increasing demand for spectrum resources. Noam found that when the command and control model with comparative examination is utilized, the following problems arise:

> Competitors were excluded. Foreigners were barred. New technologies were excluded or delayed. Politics intervened in a hamfisted manner. Spectrum bands were utilized unevenly and inflexibly. Governments hogged vast stretches. Scarce licenses became highly valued, and fortunes were made in the reselling of licences from the well-connected to the merely efficient. Some licenses were loaded with requirements for off-budget public services. Licenses were temporary in theory – discouraging investments – but permanent in practice – diluting the attached requirements. . . . The old administrative paradigm was in crisis. [53]

First-order, negative effects include the method of comparative examination, excluding competitors, and barriers against foreigners. Meanwhile, exclusion or delayed technologies are examples of second-order negative effects. Selection failure is not the only cause of problems; inflexibility and untradable licenses also degrade efficient spectrum use. Still, the regulator's inability to select the best licensees certainly contributes to such problems.

The comparative examination is one reason for the problems mentioned above, because regulators do not select the best licensees. Several factors help explain why poor licensee selections occur. The command and control model and comparative examination were established years ago when different technologies and applicants prevailed. Thus, with today's cutting-edge technologies and applicants seeking to utilize them, it is natural that the older model and selection method will not work well. Radio technologies have made quantum leaps in development, and applicants have diverse meanings for purpose of use, size of organization, attribution, etc. These factors have become prominent today, and cause the comparative examination method to become unusable.

- ***Information asymmetries***

Information asymmetries exist between regulators and applicants such as telecommunications operators. Applicants do not provide all the needed information to regulators—intentionally or not. Even though regulators are able to evaluate the applicants, imperfect and distorted information can make optimal selection impossible.

If there are no information asymmetries, the regulator can determine the most capable applicants and assign them a license at the exact price they are willing to pay, so that all the rent is given to taxpayers [55]. Thus, information asymmetry is one cause of the failure to select the best applicants.

- ***Imperfect information process ability***

The regulators themselves can be part of the problem. Even though they may acquire the right information on applicants, huge amounts of information may exceed a regulator's ability to process the information adequately in a limited timeframe [57]. In particular, regulators are becoming less able to accumulate and process sufficient information for successful examination [3][61] because new technologies have developed so rapidly and the volume of applicants for the examination process has increased dramatically. Furthermore, regulators are not necessarily the best ones to make decisions on commercial matters, even with the support of consultants. They must use their best judgment when selecting the criteria with which to assess proposals [54]. Regulators lack the ability to make a correct assignment of licences that will optimize spectrum resource use.

- ***Lacking Transparency and Unfairness***

The comparative examination process has become non-transparent. Cramton states: "It is difficult to see why one proposal won out over another" [3]. As long as regulatory officials or members of the committee examine applicants, it is difficult for the process to be as transparent as most market mechanisms are.

Regulators have difficulty establishing reasonable, objective, and clear criteria, such as a business plan or implementation ability, to evaluate each applicant's offer. Although the regulator's committee selects examination criteria, their decisions are often subjective, and there are opportunities for favoritism and corruption. In addition, people may have different opinions about the optimal mix of parameters. Thus, the composition of the examiner group affects the results of evaluation, and one group of examiners may allocate licences to applicants differently from another group of examiners [55][57]. Eventually, such a subjective process leads to unfair examination.

Governments are easy targets for such claims. For instance, the competition authorities in Brussels received complaints that the sale of spectrum licenses discriminated against non-French companies [54].

- ***Expensive, time-consuming***

Comparative examination is expensive and time-consuming for the FCC [9]. Even with streamlined hearings, the FCC required two years on average to grant thirty cellular licenses. In addition, applicants spent a lot of money to influence the regulator's decision [3]. Applicants do not need to bid in comparative examination, but they need to pay secondary costs such as waiting time and groundwork costs.

3.3.3 The Current Spectrum Management System in Japan

The Japanese government also utilizes the command and control model. And as other regulators (such as the U.S. government have found), the Japanese government has encountered problems with the model. Compared to the U.S. and European countries such as the UK and Germany, the Japanese government continues to advocate the use of command and control. It does not employ auction (the exclusive use model) because of questions raised about selections based on monetary value and other problems occurred in the past spectrum auction in U.S. and European countries. The following problems are also adverse effects of the command and control model with comparative examination:

(1) The regulator accepts acquired rights of spectrum use, and then allows inefficient spectrum use;

(2) Curtails newcomers in reality;

(3) Degrades the functioning of industrial activity among incumbents;

(4) Eventually curtails the birth of venture companies that want to use spectrum;

(5) Diminishes the motivation to develop spectrum-use new technologies and new services [58].

The Japanese government should consider countermeasures to overcome these problems. If the current political, industrial, and administrative environment does not allow full employment of the exclusive use model even for mobile phone licensing, the government should consider using the model at least partially in the current system.

Chapter 4

The Auction as an Alternative to the Comparative Examination

Telecommunications regulators have mainly used the administrative examination to assign spectrum licenses to applicants who want to use spectrum exclusively such as mobile phone companies. In addition, the first-come first-served and lottery methods have also occasionally been used [10]. However, the auction system has come to the forefront in many countries to assign the licenses because those governments believed the auction to realize more transparent, fair, efficient, and revenue raising process. In particular, the auction system became popular at the timing of assigning spectrum licenses for 3G mobile service following the pioneering application in some countries such as US, New Zealand.

Table 4－1: The 3G Mobile Service Licensing Method

Year	Auction	Comparative Examination
2000	Germany, Italy, Netherlands, New Zealand, Switzerland, UK	Norway, Portugal, South Korea, Spain, Sweden, Japan
2001	Australia, Austria, Belgium, Denmark, Greece, Israel	France
2002	Latovia, Slovenia, Taiwan	Ireland, Luxembourg, Malaysia, Slovakia

Source: Author, 2006 based on UMTS Forum HP.
Note: The US has not allocated the 3G license for 2G Hz band.

Table 4-1 shows the major countries that allocated the 3G licenses using auctions or comparative examination method. Many European countries employ the auction system for allocating mobile wireless licenses, while many Asian countries use the comparative examination system. Telecommunications Regulators in many countries apply the auction system not only for 3G mobile spectrum licenses but also for other kinds of licenses such as TV, Public Fixed Wireless Access, etc. Auctions are now well established as one choice among several for managing spectrum license assignment.

4.1 The Birth of Auctions for Spectrum License Assignments

The spectrum auction concept is not new. The US Congress held hearings on the auction system in 1958 for radio spectrum allocation method. R.H. Coase, a Nobel laureate economist, proposed the idea in 1959 [19]. The theoretical research on auctions began in the 1960s. However, this early research did not directly apply to the practical auction design [1]. New Zealand was the first country to conduct auctions — for the UHF television spectrum — in 1989, and it legislated the use of the auction in the same year. It employed the second price sealed bid auction [2]. The UK followed suit with legislation in 1990. In the US, the FCC started using auctions in 1994 for enhanced paging services employing the recently developed simultaneous ascending auction. The FCC first asked Congress for authority to use auction in 1985 but it was not until 1993, after many twists and turns, that the Congress granted limited auction authority in the Omnibus Budget Reconciliation Act (OBRA). After examining various auction designs, the FCC developed the simultaneous ascending auction design, which has become to the dominant design.

4.2 Purposes of Auctions

Telecommunications regulators have distinct purposes for transferring to the auction system from other systems such as the comparative hearing or lottery systems. Generally, the spectrum auction provides the following benefits if its design and rules operate well, as regulators and economists have anticipated.

- ***Optimum allocation of spectrum resources***

  In the auction system, bidders generally receive a license by making the highest monetary bid among a pool of bidders. Bidders evaluate the monetary value of spectrum resources based on the NPV of their business plan, for which a spectrum license is necessary to realize. Therefore the bidder who has the most efficient and profitable business plan often makes the highest bid for the resource [7]. The winners, the highest bidders, are expected to realize the most efficient spectrum use by developing the most efficient and profitable business and yielding huge revenue. As a result, licenses are allocated to the optimal set of licensees through auction.

- ***Equitable and transparent decision***

  The auction system assigns licenses based on the bidder's transparent competition following the auction design and rules provided by telecommunication regulators. The auction system is a fair and transparent decision-making process because "all parties can see who won the auction and why" [3]. The auction design and rules may have some features favored by incumbents or newcomers. However the design and rule is supposed to be fair and reasonable for all bidders as long as a government establishes those through a coordination process with stakeholders. The bidders have decision power on the license assignment because bidding prices made by bidders decide the winners or

licensees without governmental intervention. Auctions can relax governmental favoritism of "national champions" over newcomers and foreign firms and reduce the degree of protectionism, which is unlikely to benefit consumers or taxpayers [7].

- ***Raise revenue for national coffer***

  The revenue of auctions benefits national coffers. The bidding competition imposes a burden on bidders' financial capacity, and it leads to auction revenues, which can be used to offset distortive taxation [3]. For example, a UK auction yielded 34 billion USD, about 2.5% of the GNP, or enough money to build 400 new hospitals [7]. In the US, the attractiveness of developing a new revenue stream facilitated the introduction of the auction system [21]. Governments which employ comparative examination have their distinct philosophy that they can promote more effective utilization of the spectrum resource than employing auction, but they miss the measure to raise the substantial amount of revenue by auction.

The aims of auctions need to be examined case by case. For instance, UK spectrum regulators expected that auctions would help them to efficiently assign spectrums, promote competition, and realize full economic value of the spectrum license [7]. Most governments consider the optimal allocation of spectrums to maximize social benefit as a prime goal. With regard to other benefits, auctions help reduce time and cost of the license allocation process in the US. The Nigerian government hopes to overcome collusion between bidders and telecom regulator by auctions, because the comparative examination process supported collusion.

On the other hand, auctions can manage the utility of spectrum resources for a nation. As well as comparative examination, regulators provide constraints such as specific service

and technological standards on the use of auctioned spectrum in accordance with international spectrum planning coordination considering the contribution for national benefit.

4.3 Political Environment for Legislation of Auctions

Spectrum regulators need to first get state or federal governing bodies (e.g., the US Congress) to authorize the auction process in order to implement an auction-based spectrum policy. Usually a government representative drafts a bill, most often at the request of a regulatory board, and, based on the recommendations of policy makers, the legislator and his/her supporters persuades the legislative body to pass it. The support of policy makers and legislative bodies differ country by country and over time. If a legislative body opposes the process, auctions can not go into practice even though a proposal may be practical and beneficial to the nation as a whole. Thus, to realize a spectrum auction, coordination of policy makers and legislators is critical as well as adeptly promoting its essential benefits, and designing the auction system well.

To better analyze the Japanese case, the legislative process for auction legislation in the US can provide good insight. It took almost eight years for the FCC to succeed in legislating auctions in 1993 as the FCC first proposed auctions to Congress in 1985. The major participants in the auction debates before 1993 included current licensees such as broadcasters and initial cellular operators, licensee hopefuls, the FCC, Congress, the administration, and a group of economists. They are considered stakeholders; the Table 4-2 shows main stakeholders and their position and background. Except for the administration and economists, the others initially felt that the disadvantages would eventually outweigh the benefits of auctions.

Table 4—2: The Main Stakeholders Related to Auction Introduction Process in the US

Category	Position and Background
Current licensees (e.g. Broadcasters, Private radio operators, Satellite operators, Cellular operators)	Position: oppose (1) Easier to receive license and get more rents under the alternatives such as comparative examination, lottery. (2) Auctions could possibly increase competition because regulators would likely try to provide more spectrum to more users to receive revenue *Licensees who do not expect future license would:* - Gain little benefit from auctions, thus be worse off - Face the possibility of fee increases or additional compensation because of Congress's interest in increasing spectrum *Licensees who expect future license:* - would receive a more balanced tradeoff than for those who do not expect future license
Expected future licensees (e.g. PCS hopefuls)	Position: Different position each by each Positions depend on each future licensee' view on its likelihood of receiving a license without competitive bidding - PCS hopefuls did not oppose because lottery and comparative examination would not be advantage
FCC	Position: Strong auction advocate since 1985 (Chairman Flower era) (1) Fowler, had a stronger pro-market ideology than previous chairman (2) Fowler was the first chairman to have experience with lottery (3) Inside FCC group aggressively advocated auctions
Congress	Position: Oppose (1) Believed auction will aid monopolies. Sensitive to arguments that small and minority businesses were disadvantaged by auctions (2) Believed selling precious and limited national property to the highest bidder is inappropriate (3) Did not want to antagonize broadcasters because they seek favorable coverage by broadcasters. Broadcasters were the primary means to communicate with voters.

Source: Author, 2006, based on [21].

In particular, in the US case, broadcasters had been influential and the main counterforce to the auction legislation because they held licenses but believed the introduction of an auction would set a precedent for charging a spectrum usage fee to them and would reveal the spectrum value based on the auction bids [21]. Furthermore,

broadcasters took advantage of their mutually beneficial relationship with policy makers by compensating them with traditional forms and in-kind donations, and their relationship with the FCC by giving them some authority on broadcast contents [33].

Table 4—3: Five Political Factors Lessening Opposition to FCC License Auctions in 1993 Budget

Factor	Opposition Mitigated (OM) Support Encouraged (SE)	When Factor Obtained
Limiting auctions to non-broadcast licenses	OM: public and private beneficiaries of public trusteeship	Any time
Preferences for "Designated Entities"	OM: congressional leadership SE: administration	Any time
1992 Cable Act changed broadcaster-cable rent-seeking margins	OM: Broadcasters indebted to, and dependent on, Congress/FCC for favorable regulation	October 5, 1992
Auction monies used for deficit reduction	OM: none SE: taxpayers, general public	Any time
White House highly deferential to congressional leadership	OM: congressional leadership	Spring 1993

Source: Hazlett, 1998 [33], p.564, Table 6.

However, the policy environment changed between 1985 and 1993, which ushered in the auction legislation. Kwerel explains three major factors that supported the policy change: the increase of demand for the government to find new revenue sources, the change the Democratic' stance on the spectrum policy to support auctions, and the defect of the lottery and the necessity of the displacing new method [21]. Meanwhile Hazlett describes the reasons as shown in Table 4-3.

Broadcasters succeeded in blocking all auction legislation until 1993, and also succeeded in prohibiting auctions for broadcasting licenses in the Omnibus Budget

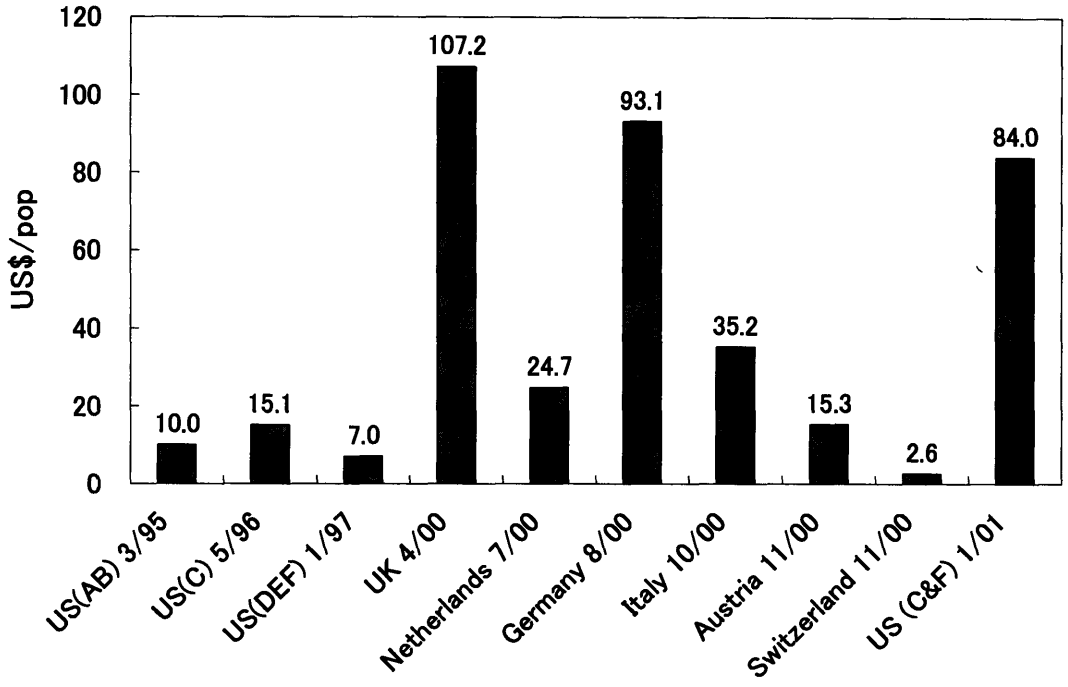
Reconciliation Act of 1993. However, Congress expanded the FCC's authority to include commercial broadcasting licenses in 1997, still even at the time, broadcasters were able to obtain digital television licenses for free [33].

Determining spectrum allocations involves complex political, engineering, and economic factors [3]. Some stakeholders enjoy comparative examination, the others expect to enjoy more from auction, and the all stakeholders insist their conflicting opinions to maximize their own interests. Therefore, it takes time to effect a major regime shift. In responding to Hazlett's question as to why it took 67 years until the auction was introduced from the first proposal, Coase comments, "About the only answer I can give is: because that was the time it took" [34].

4.4 Diversity of result That Flow from Auctions

The prices of spectrums differ depending on the auction timing, the market features and auction design. Figure 4-1 shows the variation of the price for the 25MHz spectrum bandwidth per population for mobile service use [3]. The spectrum use for the US is 2G and 3G for other European countries. Even though the auction was for the same service in the nearby region at almost the same time, the big difference of price can be seen in the case of Netherlands and Germany. The auction design and market structure are the main factors that impact the auction results.

Different auction designs generate different results under similar market conditions. McMillan notes that "some kinds of auctions work better than others: this was why so much effort went into designing the spectrum auction" [19]. He explains that the result of an auction



Source: Cramton, 2002 [3], p.627, Figure 1.

Figure 4—1: Mobile Wireless Price Comparison (2x10 MHz + 5 MHz)

type depends on the design of the auction. The combination of basic design forms, details and rules directly impact the behavior of bidders and the results. The auctions in Austria and Switzerland are a good example to see this point as discussed by Grimm et al. [5]. The regulators in both countries implemented an auction system in the fall of 2000 for a market with three incumbents after the cool-off of market enthusiasm on Universal Mobile Telecommunications System (UMTS) technology and the legal settlement of the main battles in the pan-European field. Both auction designs followed the simultaneous ascending

auction format, but each government set the number of providing license based on the different ways; Switzerland employed the fixed number following UK and Austria employed the flexible number following Germany. The results showed a huge difference as described in Figure 4-1. The other auction designs such as the first-price or the second-price sealed bid auction may result in greater differences in price and in attribution of winners if applied to similar market conditions.

On the other hand, Klemperer says that the "auction design is not one size fits all. The ascending design that worked very well for the UK worked very badly in the Netherlands, Italy, and Switzerland because of entry problems and this was predictable (and predicted in advance)" [4]. With regard to UK and Netherlands cases, regulators employed almost the same design, but yielded quite different results. An analysis shows that the difference of the incumbent number between the 2G mobile service was the main factor for the different levels of competition intensity in auction; the UK had 4 incumbents; Netherlands had 5 [30]. Thus, the same auction design can generate diverse results in different industry structures and under various market conditions; for example, the number of incumbents and potential newcomers and a different set of industry expectations will generate far different results.

In the process of developing an auction plan, telecommunications regulators need to understand two aspects: auction design and market structure. Regulators should well under stand the features of different auction design. And the auction design should take into account the structure of the target market, i.e. the number of incumbents and of potential newcomers, in order to perform as expected.

Binmore et al. comment that, in auction design, industry organizations issues are more

influential or dominant on the auction result than the informational issues, in particular, for the problems of attracting entrants and dealing with alliances and mergers. Notably, better designs require high quality market research to overcome such issues [7]. However, though the auction design and market are the two sides of the coin, economists consider the industry and market conditions as creating the greatest impact on the auction results than the auction design [3][7][11]. In addition, theory has its limits though it is useful to understand what and where the limits are [19]. In the process of designing and implementing an auction, auction practitioners need to understand these points.

4.5 Issues That Influenced Past Auctions

The spectrum auction has been carried out in many countries including New Zealand, US since 1989. Some auctions were successful and others faced serious problems. In the following section, I examine the main problems that have impacted auctions. Telecommunications regulators need to overcome these problems to achieve successful auctions. These issues mainly focus on the simultaneous ascending auction because historically most auctions have used this design.

4.5.1 Boosting the License Price

Auctions in some cases have boosted the bidding price. The European 3G auctions raised 39 billion Euros in England and 50.8 billion Euros in Germany [4][5]. The motivated bidders from both incumbents and newcomers competed for the spectrum licenses for the 3G mobile service in the key huge markets in Europe. Auction bidders considered the licenses as the necessary ticket for the expected and profitable mobile service after 2G mobile service. The fail to get the license meant the fail to enjoy the beneficial chance for all, and the loss of

mobile business for incumbents. On the other hand, the FCC's re-auction for license C and F block broadband Personal Communication Services (PCS) raised $16.9 billion in 2001 [6]. These bids enriched national coffers; however, the winning companies had to pay a heavy burden in the high prices they paid. This high price impacted the service strategy of winning companies, and caused delays in use or the disuse of the spectrum.

The case of NextWave Communications after the PCS auction in 1996 is notable. It bid approximately $4.74 billion for a PCS license in the US [31], but then got into financial trouble for building its network. Though the company petitioned the FCC to restructure is payments, the FCC rejected even deferment of payments on the basis of protecting the auction process integrity. NextWave went bankrupt and defaulted on its payment obligation but its spectrum rights went unused. Some winners of the European 3G auction also were delayed or failed to use their spectrum. Though high expectations based on the rapid growth of 3G markets prompted key European carriers to pay huge license fees, in the end, those carriers could not secure financing to develop their network on schedule [9].

Economists assert that the bidding payment is a sunk cost in that it does not affect the later user price. However, the high bidding price can prompt a company to change its business strategy if financial conditions deteriorate. McMillan notes that if a company needs to pay higher interest rates on a large amount of the debt, the firm's increased debt from its high bid price shrinks the company's financial base, tightens its spending power, and then causes the shrinkage of the company's investment size for infrastructure development, service development, and R&D [10]. Considering the actual consequences of this type of auction, boosting license prices carries a risk of creating inefficient spectrum use.

With regard to service price, some argue that the high price of an auction can be

transferred to the service price for consumers, and then a nation of customers essentially pays of the auction fee. Kwerel demonstrates this logic using the US mobile market as an example. Once the bid is paid, the payment can not be taken back from government, and does not change regardless of the amount of payment to the government. Therefore, the payment of the bid price has the character of historical cost, and may not impact the price and availability of the wireless service. His analysis of the US mobile phone market supports the conclusion that even a firm pays its high bid for a spectrum license, the burden of high bid does not raise the price of wireless service [8]. Binmore et al. explains the relationship between the house and the land prices, because it is similar to that of the wireless service fee and spectrum price. Because the price of a house is determined by the housing market at the time of the new house sales, it does not change regardless of whether the housing developer acquired the land free, for example by inheritance, or by paying the full market value of the land [7]. Based on this argument, the auction is considered not to affect the service price.

4.5.2 Winner's Curse: Licensee Dissatisfaction

In all types of auctions, bidders decide their bidding price based on their evaluation of its worth to them. When a bidder overlooks or ignores the other bidders' evaluations of objects/services/contracts in the process of developing a bidding price, the bidder may pay more than the actual market worth to win, and later on may realize he/she over-bid. This is called Winner's Cure, and occurs often in auctions [17].

Klemperer notes that bidders, who are inexperience in business and auction, poor and naive, suffer the effects of Winner's Curse more than strong and experienced bidders. Because each bidder decides on a bidding price based on its evaluation, experience and

strategy, the stronger bidder usually wins through extremely informed and cautious bidding and generally pays a relatively low price for the goods, services or contract. Less experienced bidders must be careful not to over-estimate the value [11].

In the case of a simultaneous ascending auction, the bidder can know the other bidders' evaluation, thus the Winner's Curse problem can be controlled as long as one bids under one's maximum self-evaluation [10]. If the bidder ignores his/her rational evaluation of the object/service/contract by being excessively influenced by other bidders' strong bidding attitude or high bids, the bidder can become a victim of Winner's Curse. It is not clear whether the winners in England's or Germany's 3G mobile license auction over-estimated the value or not, but the bidding prices were considered too high enough to worse the firms' financial condition.

While winning high bids (resulting in Winner's Cures) can temporarily increase the national revenue as a result, it can diminish a company's financial reserves and ability to expand, and can negatively affect an firm's bottom line, which in turn can affect employees, investors and the over all industry. Therefore, governments should design auctions to prevent Winner's Curse for the healthy development of the industry.

4.5.3 Small Number of Participants

When a relatively small number of the bidders enter an auction, this poses a risk to government of causing inefficient auction and could result in small revenues because of weak or very little competition. The combined factors of an auction's design and market structure affects the number of participates entering an auction. Few weak bidders are willing to join auctions if they think they will lose against stronger bidders.

In addition, the telecommunications industry loses diversity and dynamism if auctions

fail to attract newcomers and if only incumbents win. Technology innovations and business plan developments are active and rapid in the telecommunication fields. Both incumbents and also newcomers generate dynamism through those activities. Auctions should allow both newcomers and incumbents to carry out their business and to develop the industry with innovations.

Designing the attractive auction to facilitate participation is an important challenge for telecommunications regulators and economists who consult governmental spectrum auction. Generally, a simultaneous ascending auction does not attract many entries because the process can lead strong bidders to discourage less powerful competitors from entering and to depress bidding [11]. Especially, if the number of licenses equals the number of incumbents, newcomers or weaker bidders often hesitate to participate. On the other hand, a sealed bid auction pulls in more entrants because its results are less certain than with a simultaneous ascending auction because of the limited information sharing during the auction [11]. The setting method of the spectrum license number for the auction license changes the ratio of the number of incumbents to available licenses, and impacts the chances of weak bidders winning. Thus it affects the weak bidders' motivation to participate. The 3G auction in Switzerland and Netherlands are prime examples of this problem. Wolfstetter suggests that the variable license number design is more attractive than the fixed number design because the flexibility of spectrum license, which ranges between the number of incumbents and the number of incumbents plus two in Germany for example, gives newcomers the hope to receive a license [12].

4.5.4 Collusive Bidding and Demand Reduction

Collusive bidding distorts each bidder's straight and honest commitment to an auction based on its evaluation. Therefore, it could deter efficient and optimal resource assignments, which is realized by giving resources to those who place the highest value on the object or service up for bid.

The simultaneous ascending auction can be considered as a negotiation process between the bidders because bidders signal how to arrange the licenses among them using bids for communication tools [13]. Bidders can use the early state of auction to reach an agreement as to who should get what object in order to stop raising prices, sometimes using punishing rivals [11]. This design is vulnerable to collusion between bidders if its operation rules and system allow signaling, which is the mean to exchange the idea and intention among bidders.

Preventing collusive bidding is a main issue for the government and auction designer. Economists have proposed methods to control collusive bidding using example of past auction experiences, such as in US and Germany. When values of multiple objects for an auction are close, the government can induce competitive bidding by means of information policy and reserve pricing. Cramton states that concealing bidder identities, setting high reserve prices, offering preferences for small business and non-incumbents, and offering larger licenses are useful to reduce the effectiveness of bid signaling and prevent collusion [13].

Demand reduction is a typical result of collusive bidding, which occurs more easily with weak competition. This is a common strategy of bidders, which reduces the auction revenue. When a bidder has a large demand in an auction, it sometimes decides to reduce its demand and lead the auction to finish keeping the bidding price relatively low, rather than

boosting the price to scare off competitors [14]. The German GSM spectrum auction is a representative example of the demand reduction as shown in Table 4-4. Mannesmann reduced the demand from 10 to 5 frequencies during the second round after sending a message during the first round expecting T-Mobile to understand the signal expressing Mannesmann's intention and reduce the demand also to 5 frequencies during the second round. At the time, two other weak bidders had already given up because of the high bid prices.

Demand reduction is a kind of collusion, however, if a government does not desire high revenue from auction with a purpose to reduce the burden for telecom companies, and as long as the newcomers are not excluded by unfair methods such as threats and excessively high jump bidding, demand reduction is not necessarily a problem because it is the result of informal negotiations between bidders through a transparent process.

Table 4—4: Demand Reduction in the German GSM Spectrum in 1999

Round	Frequency #									
	1	2	3	4	5	6	7	8	9	10
1	36.36	36.36	36.36	36.36	36.36	40.00	40.00	40.00	40.00	56.00
	M	M	M	M	M	M	M	M	M	M
2	40.01	40.01	40.01	40.01	40.01	40.00	40.00	40.00	40.00	56.00
	T	T	T	T	T	M	M	M	M	M
3	40.01	40.01	40.01	40.01	40.01	40.00	40.00	40.00	40.00	56.00
	T	T	T	T	T	M	M	M	M	M

Note: Frequencies 1-9 were endowed with a bandwidth of 2x1 MHz, frequencies 10 with 2x1.4 MHz; M and T means Mannesmann and T-Mobile respectively.
Source: Grimm et al., 2003 [15], p.1558, Table 1.

4.6 Application of the Auction to the Current Japanese Licensee Selection Process

4.6.1 Spectrum Use Fee System in Japan

The Japanese spectrum management regulation is defined by Radio Law, which was established in 1950, and amended in 2005. Table 4-5 shows the structure of the law. The law describes the process of obtaining a spectrum license assignment: (1) applicants for a radio station license shall submit an application to the MIC (as outlined in chapter 2 section 1 article 6 of the Radio Law); (2) the Minister of MIC shall examine whether the application satisfies all the required items in Article 7 in Chapter 2, section 1 [35][36]. The MIC allocates all spectrum resources.

Japan's Radio Law does not define the comparative examination, but does define the Essential Standards for Establishing Radio Stations Other Than Broadcast Stations (Radio Regulatory Commission Rules No.12 of September 11, 1950). In article 9, it describes the criteria that applicants must meet: (1) applicants who secure the most equity and efficient spectrum use and contribute to advance the common welfare get the priority in case spectrum resources are in short supply, and (2) examinations of application take the total plan of the radio station's establishment into consideration [37]. Therefore, if more applicants apply for licenses than are available, MIC compares the all business plans, and then fixes an order of priority on applicants. As described under comparative examination issues in Chapter 3, the process lacks transparency, evenness, and has no clear means to select optimal users to realize the efficient use of spectrum.

The Current Japanese spectrum management system stands on the foundation of the spectrum use fee system. The MIC collects the fee on the pretext of common service

expenses. The Table 4-6 and Figure 4-2 shows income from spectrum use fee and use of collected fee [39].

Table 4－5: Japanese Radio Law Structure

Chapter and Section	Contents
Chapter I.	General Provisions
Chapter II.	Licenses, etc. for Radio Stations
Section 1.	Licenses for Radio Stations
Section 2.	Registration for Radio Stations
Chapter III.	Radio Equipment
Chapter III-2.	Technical Regulations Conformity Certification, etc., of Specified Radio Equipment
Section 1.	Technical Regulations Conformity Certification of Specified Radio Equipment and Construction Type Certification
Section 2.	Self-Confirmation of Technical Regulations Conformity of Special Specified Radio Equipment
Chapter IV.	Radio Operators
Chapter V.	Operations
Section 1.	General
Section 2.	Operation of Coast Stations, etc.
Section 3.	Operation of Aeronautical Stations, etc.
Chapter VI.	Supervision
Chapter VII.	Protests and Lawsuits
Chapter VII-2.	The Radio Regulatory Council
Chapter VIII.	Miscellaneous Provisions
Chapter IX.	Penal Provisions

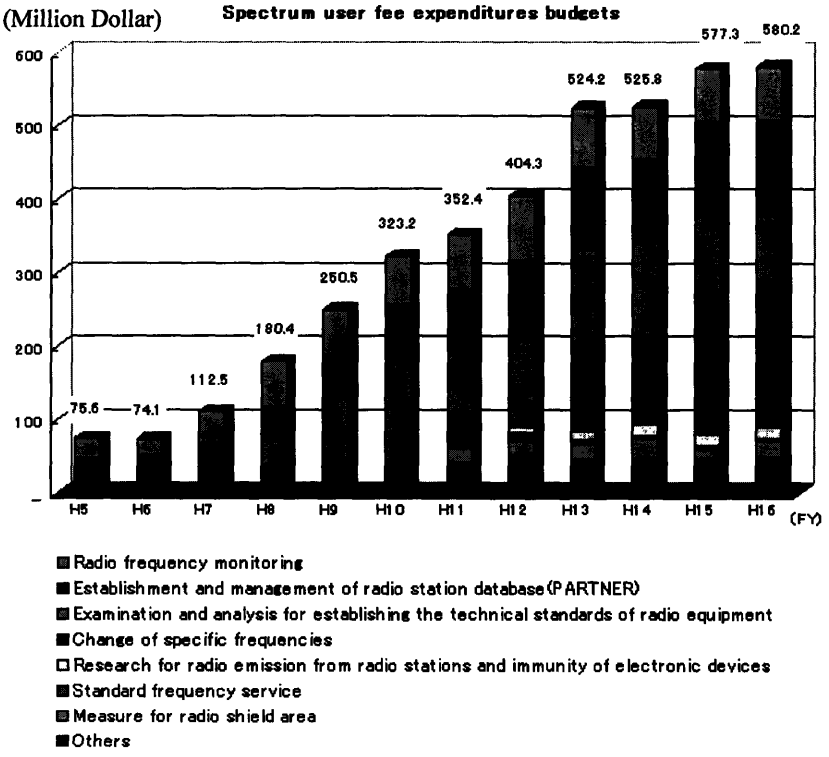
Source: MIC, [36].

Table 4—6: Spectrum Use Fee Budget

(Million Dollar)

FY		1993	94	95	96	97	98	99	00	01	02	03	04
Revenue budget		75.6	74.1	112.5	180.4	250.5	323.2	352.4	404.3	451.1	503.6	535.8	552.4
Expense budget		75.6	74.1	112.5	180.4	250.5	323.2	352.4	404.3	524.2	525.8	577.3	580.2
Break down	Radio frequency monitoring	27.9	22.6	45.6	62.8	60.8	65.0	72.9	86.9	80.9	70.6	72.2	72.3
	Establishment and management of radio station database (PARTNER)	19.7	23.1	35.9	46.1	60.5	81.6	70.9	109.8	112.1	113.6	126.5	130.0
	Examination and analysis for establishing the technical standards of radio equipment	-	-	-	33.9	87.5	133.5	125.3	117.8	123.1	124.4	102.8	84.5
	Change of specific frequencies	-	-	-	-	-	-	-	-	123.3	124.4	195.0	202.2
	Research for radio emission from radio station s and immunity of electronic devices	-	-	-	-	-	-	3.1	6.3	12.0	15.2	15.2	15.2
	Standard frequency service	-	-	-	-	-	-	19.0	12.3	5.3	5.3	5.3	5.4
	Measure for radio shield area	-	-	-	-	-	-	18.8	19.2	20.5	25.6	12.9	19.9
	Others	28.0	28.5	30.9	37.5	41.6	43.0	42.4	52.0	47.1	48.8	47.4	50.7

Note: At the exchange rate of 1 USD = 100 JPY.
Source: MIC, [39].



Note: At the exchange rate of US$1 = 100 JPY
Source: MIC, [39].

Figure 4—2: Spectrum Use Fee Budget

➢ ***Purpose of Usage of Spectrum Use Fee Budget Stipulated by Japan's Radio Law [39]***

(1) Monitoring and adjustment of radio waves, search for illegally installed radio stations: Maintenance and operation of radio monitoring facilities

(2) Establishment and management of the integrated radio stations database: Maintenance and Operation of the Productive and Reliable Telecommunications Network for Radio Stations

(3) Research and development for expansion of radio spectrum resource: Relax the present situation of tight spectrum use under 6GHz to meet new spectrum demand. Examination and analysis of the results thereof, for establishing the technical standards of radio equipment using technologies that contribute to efficient utilization of radio: Development of technical examination services concerning frequency crowding

(4) Specific frequency change support service

(5) Specific frequency termination support services

(6)Countermeasures to reduce the dead zone of mobile phone service: Supporting program to diffuse radio system

(7) Others: Support of radio shielding countermeasure services, maintenance and operation of standard radio facilities, studies to secure radio safety, etc.

The spectrum use fee system is based in the Japanese spectrum resource management administration, and it does not seem practical to demolish the current system and establish a completely new system. The licensing process is closely tied to the spectrum use fee system; therefore, the introduction of the auction system needs to take the system into account.

4.6.2 Proposal on the Licensees Selection Process by MIC's Study Group

The MIC has been holding the Study Group on Policies for Effective Radio Spectrum Use since January 2002 (Chair: TAGAYA Kazuteru, Vice-President for Education and Professor at the Faculty of Law and Economics, Chiba University) in order to consider new promotion measures for a scheme of effective radio spectrum use. The study group compiled the final report on the basic concepts on review of the Spectrum User Fee System on October 1, 2004 [40]. In the final report, the study group describes the limits of the European-US style auction and proposes a "comparative examination utilizing market mechanism" based on the proposal in the study group's initial report complied in December 2002.

- ***The Limits of the European US Auction*** **[41]**

  The European US auction brought about the following problems once the license fee or bidding price took a jump as seen in the 3G auction in European countries such as England and Germany. The problems assumedly impeded the effective use of this spectrum resource.

  (1) Service-start delays, reduction in the population-frequency cover ratio, difficulty consumers face when starting up the service.

  (2) The decline of the IT industry, which is the national growth strategy industry in Japan.

  (3) The potential negative effects on prompt future spectrum reallocation because of the progress of fixed interest made by a long license period (such as 20 years in the case of collecting expensive license fees).

On the other hand, auction is applicable only in cases of limited licenses, thus its applicable scope is also limited. Therefore, it is difficult to employ the auction system as the basic system for all kinds of radio stations considering various uses and services.

- ***Comparative examination utilizing market mechanism [41] [42]***

The study group on Policies for Effective Radio Spectrum proposed a comparative examination utilizing a market mechanism. The method is expected to take advantage of the auction system market mechanism for the licensing process by overcoming the various risks inherent in the auction system.

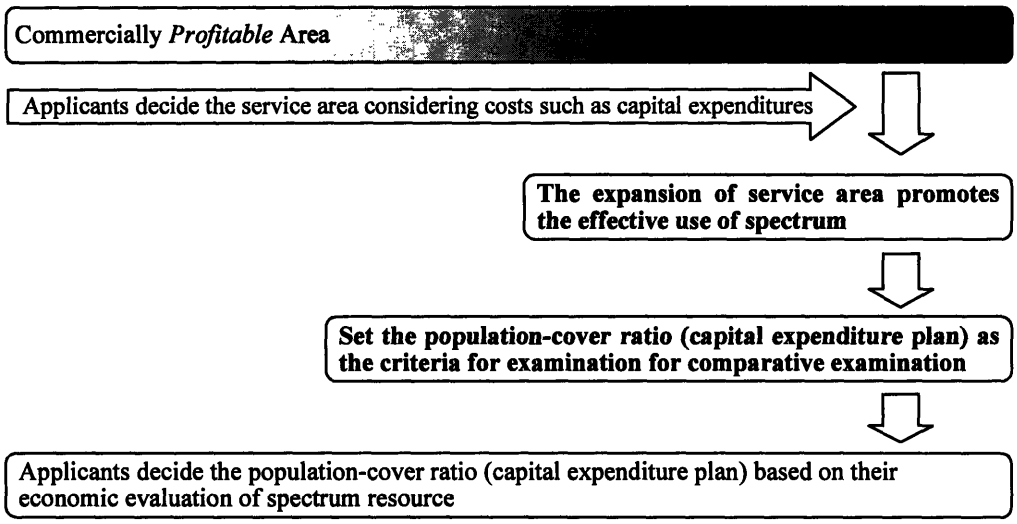
(1) The proposal takes the measurements rather than bidding price (money) to evaluate the applicants' economic evaluation of the spectrum resources.

(a) The highness of population cover ratio (Figure 4-3)

The MIC requires applicants to submit a progress plans for increasing the population-cover ratio for future services, and considers the plan an evaluation item. Applicants evaluate the economic value of the spectrum, and then submit the plan considering the costs such as additional capital investments to improve the population-cover ratio within the acceptable range for their business plan.

(b) Voluntary fee for spectrum reallocation costs (Figure 4-4)

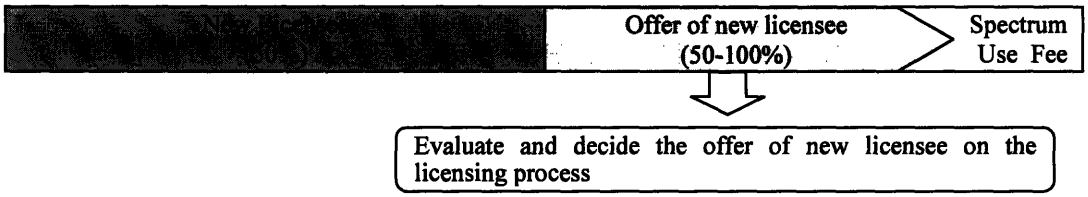
The MIC requires applicants to submit a voluntary fee for spectrum reallocation costs, and considers this an evaluation item if a spectrum for new licenses has been created by reallocating previous spectrum users via financial compensation from a national coffer.



Source: MIC, 2002 [42], p.64.

Figure 4—3: The Relationship between the Economic Value of the Spectrum and the Population-cover Ratio

The case of the exclusive use of spectrum (mobile phones, e



Source: MIC, 2002 [42], p. 65.

Figure 4—4: Contribution Amount by New Licensee

(2) The selection process should consider the appropriateness of business plans and technological abilities in order to select the optimal spectrum user in addition to the each applicant's economic evaluation of spectrum. Therefore, the comparative examination, which comprehensively includes the aforementioned criteria, is appropriate. The MIC should set the criteria based on score on the item mentioned above and the other items, and should announce those criteria in advance for the purpose of securing transparency, equity and a swift licensing process.

(3) Based on the viewpoints of (i) and (ii), when the market mechanism should be introduced into licensing process considering the purpose of spectrum use, the MIC should introduce a comparative examination utilizing a market mechanism, rather than an auction.

4.6.3 Introduction of Auction into the Licensee Selection Process

The MIC expects the comparative examination utilizing a market mechanism to apply the advantageous features of auctions; however it seems too difficult to get the expected results because of the following reasons.

(1)Difficult to secure equitability and transparency as long as the MIC implements a comparative examination based on its business plan and technological ability.

(2)The MIC can not necessarily choose the optimal set of licensees.

(3)The applicants' submissions of progress plans for the population-cover ratio and the contribution amounts for the spectrum reallocation plan can be considered as the first-price sealed-bid multidimensional auction.

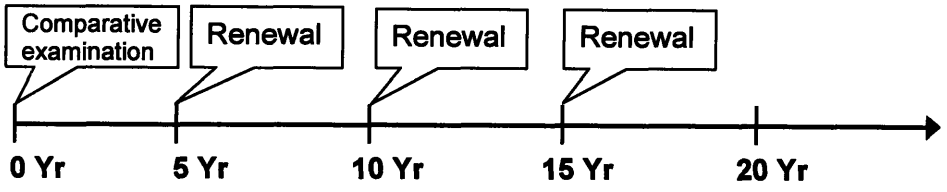
(4)The complex selection process dampens applicants' enthusiasm for entrance,

especially for weaker newcomers, because of the difficulty of developing application strategy, forecasting the results, and following reduced expectation caused by complexity.

The proposed method may have disadvantageous features such as the comparative examination requirement and unclear and uncertain features of the multidimensional auction. It is difficult establish the relative importance of all of the criteria. Therefore, firstly, the MIC should not choose the hybrid selection method of auction and comparative examination in order to avoid suffering from the unclear combinational negative effects of comparative examination and multidimensional auction. Second, the MIC should introduce the auction into the licensee selection process taking the style which fits to the current spectrum use fee system. Figure 4-5 shows the role of auction as a substitute for the comparative examination in the spectrum management system. The suggestion system, which uses an auction, should be positioned between the command and control regime and market regime.

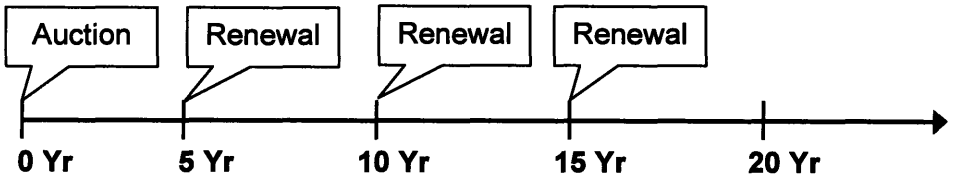
The discussion on the collected money is complicated. The MIC collects the present spectrum using fees for the purpose of covering administration costs. The auction revenue may yield additional revenue. There are various arguments on defining the use of the auction revenue from a legal perspective. This thesis passes over the argument and focuses on the discussion of the license assigning process. In addition, the thesis also passes over the discussion on the character of license such as the issue on property right or not.

(1) Current Japanese System: Command and Control (CC) Regime



- License Period: 5 years
- Licensees need to renewal licenses every five years
- The MIC can implement spectrum reallocation when necessary

(2) Suggestion System: Eclectic Regime between the CC and Market Regimes



- License Period: 5 years
- Licensees need to renewal licenses every five years
- The MIC can implement spectrum reallocation when necessary
- Auction to establish transparent, fair, and optimal allocation

(3) Major Auction System: Market Mechanism Regime

- License Period: 20 years (for example)
- Long license period gives makes it like private property
- Difficult to implement spectrum reallocation

Source: Author, 2006.

Figure 4—5: Comparison between Suggestion System and Other Systems

4.7 Auction Requirements for the Current Japanese System

Generally, the success of an auction is evaluated based on monetary measures such as gross revenues, revenue per capita, or revenue per MHz per capita [16]. Cramton measures success in terms of revenue, the similarity of market price (bidding price) for similar items, and the formation of efficient license aggregation [3]. The higher the revenue, the better the auction is in general from government's perspective. This concept is correct from the viewpoint of "selling goods." However, it does not necessary correspond to the Japanese government's requirements for an auction.

Based on the MIC's critique of the Europe-US auction system, in its study group's final report, the MIC focused on the risk of boosting bidding prices and its negative effect on industry and efficient spectrum use. This indicates that the MIC does not require the huge revenue derived from a high bidding price. On the other hand, it wants to achieve the general purposes of the ideal spectrum policy: transparency, speed, certainty of selection and objectivity [32]. The Japanese auction assumes the following goals in the order of preference.

(1) Equitable and Transparent Assignment Process

(2) Optimal Assignment of Spectrum Resource

(3) Attractive to Newcomers

(4) Efficient Assignment Process

(5) Weed out Participants with Speculative Purpose

(6) Secure Enough Government Revenue for Spectrum Administration

4.8 Auction Facilitate Industry Amalgamation

The introduction of licensing auctions can prompt the mobile companies in Japan to consider the adequate shape of industry structure in the next generation, which may not cause too strong competition. Both potential entrants and incumbents can incur additional costs if regulators carry out license auctions that have more bidders than available licenses. Incumbents ultimately risk paying additional costs for the license through greater competition in the auction based on their strong expectations not to lose the game. On the other hand, newcomers risk failing to get into the industry regardless of investing for preparation of the auction and the new service. These risks promote cooperative realignment before the implementation of an auction. For example, companies merged before entering the European 3G auction to enhance their financial capacities to win the auction and develop their business ability after the auction.

Telecommunication companies have merged to enjoy an economy of scale when necessary to survive. In the US for example, Sprint Corporation and Nextel Communications merged in August 2005 [43] and AT&T Inc. and BellSouth Corporation merged in March 2006 [44]. The new AT&T was enhanced from the merger, and it sped up innovation, competition and convergence. The telecommunications industry has a tendency to form monopolies through competition.

It is considered that auctions facilitate amalgamation of telecommunications companies, which may occur through competition after service introduction, based on motivation of the private sector, rather than the government. Auctions may promote more effective use of industry resources than the comparative examination system, which cuts off the resources of unlicensed companies based on a government entity's assessment.

Table 4—7: Relationship between Auction Issues and Japanese Spectrum Policy Goals

Japanese Policy Goals	**Boosting the License Price**	**Winner's Curse: License Dissatisfaction**	**Small Number of Participation**	**Collusive Bidding and Demand Reduction**
Equitable and Transparent Assignment Process	-	-	Un equitable auction design effects the participation of newcomers	Auction design, which allows collusion, lacks equitability
Optimal Assignment of Spectrum Resource (Effective use of spectrum resource)	Impact the service introduction because of heavy burden	License values do not fit to actual winner's evaluation	Risk to miss potential beneficial licensees and fail to realize optimal set of licensees	Collusion and demand reduction distort the optimal assignment
Attractive to Newcomers	New comer hesitate to participate	Newcomers tend to suffer from Winner's Curse	Fail to attract newcomers can cause the small number of participation	Collusion among incumbents drives away newcomers
Efficient Assignment Process	Take long time to reach the end of auction	-	-	Necessary time come to be shorten though auction result would be distorted
Weed Out Participants with Speculative Purpose	Risk to be speculative	Speculative bidding contribute to cause Winner's Curse	Speculative bidder may be excluded	-
Secure Enough Government Revenue for Spectrum Administration	Beneficial in short term view, but may not in long term view	-	Weak or no competition yields small revenue	Reduce auction revenue

Source: Author, 2006.

Chapter 5

Stakeholder Analysis: Adding Auction to the Radio Law

Having a spectrum is the prime requirement for firms to carry out business that requires wireless devices and networks. Governments in most nations worldwide allocate spectrum resources for exclusive use based on a license system; in Japan, this license system is defined by the Radio Law. If the Japanese government needs to amend the license system, it also needs to coordinate and to reflect the stakeholders' intentions whose interests deeply relate to the license system. In other words, if the government cannot succeed in coordinating the stakeholders, it cannot amend the law. This chapter analyzes the attitude of stakeholders relating to the issue of spectrum auctions and how they should be worded in the current Radio Law. The analysis first discusses the questions and answers made in the national diet by policy makers, academics, industry representatives, government officials. Next, this chapter focuses on the opinions submitted for public comment presented in two reports by the Study Group on Policies for Effective Radio Spectrum Use in 2002 and 2004. The stakeholders are categorized as the Diet, Government (MIC), Incumbent Firms, Newcomer Firms, and others.

5.1 Categorization of Stakeholders' Position

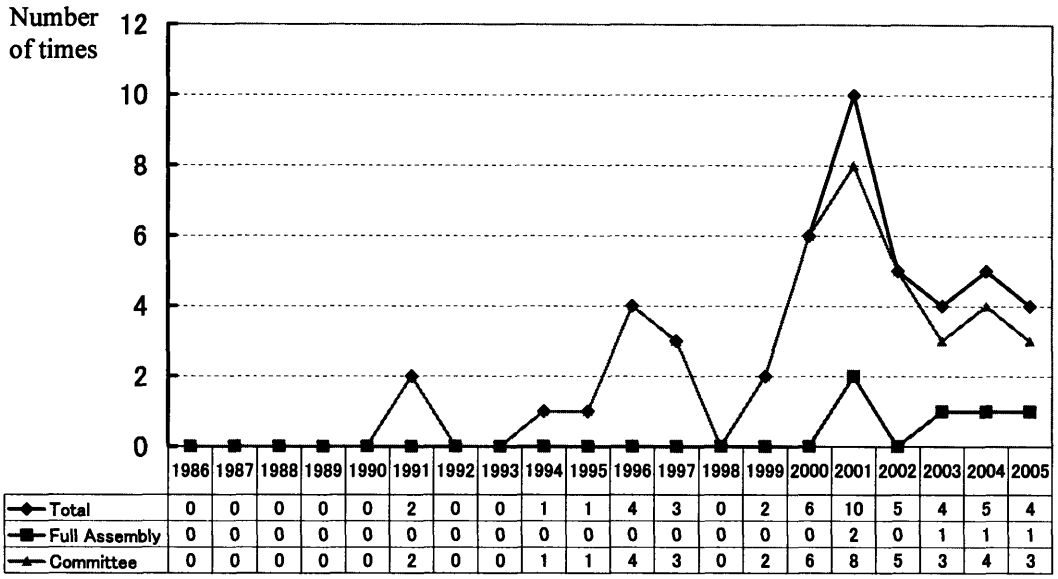
The stakeholders' position is based on the categorization of their statements in the Diet and on opinions submitted for public comment in two reports compiled by MIC's study group. The analysis classifies those statements and opinions based on three categories: (1) Support,

Opposition or Undecided for auction introduction; (2) Strong or Weak stances; and (3) Center or leaning to one or another of the two stances. The criterion (1) is self-evident. With regards to criteria (2), the basis for selecting a strong or weak placement depends on whether the stakeholders directly use the word "auction" to express their priority idea. If stakeholders say, "It is prudent that MIC does not introduce the *auction,*" this is categorized as strong opposition; if a stakeholder says "I prefer to employ the method that prevents fee increases, not the *auction,*" this is categorized as Weak Opposition because even if a stakeholder uses the word "*auction,*" the priority idea is to employ the method that prevents fee increases (not the auction). The criterion (3) expresses whether stakeholders have a secondary idea or not. If a stakeholder says, "Government should avoid the immediate introduction of the auction, and study the auction system carefully," this is categorized as on the Opposition-Supportive side rather than the Opposition-Central side because the stakeholder mentions that the government should continue studying the auction system rather than shelving the idea.

5.2 The Diet

The Japanese Diet has been considering issue of spectrum auctions since 1991. Based on a set of questions and answers on the issue found in the Diet's archives, which are available in its official minute's database, the Diet discussed the issue 5 times in full session and 42 times in committee meetings between 1991 and 2005. Spectrum auction did not become a topic of congressional concern before 1991. Figure 5-1 shows the transition since 1986 after the FCC in the US submitted the auction bill to the US Congress in 1985. Based on the archive of statements in the Diet, the spectrum auction issue was discussed for the first

time in the Diet in 1991 when the government discussed a bill to legislate the introduction of spectrum use fees in 1992.



	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total	0	0	0	0	0	2	0	0	1	1	4	3	0	2	6	10	5	4	5	4
Full Assembly	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	1	1
Committee	0	0	0	0	0	2	0	0	1	1	4	3	0	2	6	8	5	3	4	3

Source: Author, 2006.

Figure 5—1: Number of Full Assembly and Committee to Take Up the issue of Auction

Table 5-1 shows the key statements made in the Japanese Diet. After 1994, some congressional representatives asked the government to explain its opinions on spectrum auction when the government submitted bills to amend the Radio Law or the Broadcast Law. Because the Radio Law defines the spectrum use fee system, it attracts the attentions of congressional representatives on the monetary issues and then spectrum auction which yield a lot of revenues for national coffer. Broadcast law does not directly relate to auction. But the government requests very low spectrum use fee to broadcasters, then, the auction issue appeared from the view points of that how much beneficiaries of spectrum resource should

pay for the right to use it and how government should decide price and collect fees. Still, these representatives just mentioned their interests in spectrum auction and asked the government about its plans or vision on spectrum auctions in this arena. The government mentioned problems related to auctions such as bidding price boost and identified an auction issue as the major themes for a policy study to be carried out by the government. There was no discussion of auctions in 1998. The Diet began to examine the concept of spectrum auctions more aggressively after 2000 when European countries began carrying out 3G auctions. Following this, Japan's full congressional assembly, where the important issues are discussed and voted on, began discussing the auction issue. Furthermore, the critique of Japan's current licensing system, the spectrum use fee system and comparative examination method for the licensees selection, began to appear. In particular, the Democratic Party of Japan submitted bills that proposed introducing the auction system for two consecutive years, in 2003 and 2004. Though the Diet killed the bill, this action deepened the discussion.

Table 5－1: Brief of Key Questions and Answers in the congress

Date	Questions, requests, or proposals	Answers
1991.4.18	Explain the cost to use spectrum in foreign countries. (Hiroshi Nakai, opposition party)	The system and cost vary country by country. Some countries use just spectrum fees system and receive up to US$ 100K and $10 million, and some countries employ the auction. (Tetsuo Morimoto, government delegate)
1991.4.24	Explain the situation in the US on how broadcasters' oppose to the introduction of spectrum usage fee (Bun Takebe, opposition party)	Spectrum usage fee and auction are discussed. There are proponents of auction in government and congress in the US. (Tetsuo, Morimoto, government delegate)
1996.5.22	Explain the fees that mobile phone companies would pay to use spectrum in Japan compared to the US case. (Mitsuzou Kishimoto, administration party)	The Japanese government received from mobile companies totally 3490 million JPY in 1994 and 6920 million JPY in 1995. In case of US, the government started auction from 1994. Companies pay totally around 1.8 trillion JPY for two auctions. Monetary cost is huge in the US to carry out mobile phone business. (Mitsuo Igarashi, government delegate)
1996.6.4	Explain the opinion of administration reform committee on the spectrum auction introduction as the process of telecommunication industry deregulation. (Reiko Nishikawa, administration party)	Government began to discuss the spectrum allocation method such as auction, etc. from this April. Auction system has the following problems and has not received stable reputation. - Heavy burden to the companies - Wealthy companies occupy spectrum - Incumbents lose the chance of reward of licenses - Law suits occurred in the US (Mitsuo Igarashi, government delegate)

Date	Questions, requests, or proposals	Answers
1997.4.16	(Opinion delivery session) I would present my opinion on the social capital improvement relating to telecommunications. - Government should introduce auction. - Except for Japan and France, many advanced countries employ auction. Even semiadvanced countries such as Greece, Mexico and India etc. has already began experiments on auction for the preparation of introduction. - Because Broadcasters and Newspapers enjoy the position of spectrum incumbents that they may difficult to take up the news of auction. (Hajime Oniki, Professor of Osaka Gakuin University)	
2001.3.1	Explain the idea on the auction. Some counties employs auction and collect huge revenue for national coffer. (Atsushi Ooshima, opposition party)	Government is examining the merit and demerit carefully. Auction is under consideration. Government understand the features are as the following (Merit) - transparent process (Demerit) - Heavy burden to companies - Wealthy companies occupy spectrum - Weak newcomers may be excluded from market - Nonpayment of auction bid and re-auction may be occur and spectrum use come to be unstable - High bid price may be transferred to the service price and user pay the spectrum cost eventually - Reduction of telecommunication companies' evaluation (Kenji Kosaka, Vice Minister of MIC)

Date	Questions, requests, or proposals	Answers
2001.4.10	Explain the reason that government did not employ auction at the timing of licensing the spectrum license for 3G mobile service (Kaneshige Wakamatsu, administration party)	The past study group concluded not to introduce auction. Furthermore, telecom companies, manufacturers, and industry groups submitted the adverse opinion for the auction introduction. In addition, the auction for the 3G service in the Europe brought about the serious problems as the following *(the explained problems are the same as in the answer in 2001.3)* However, government may be possible to employ auction by establishing rule which limits the target of use or setting the highest price, etc. Nevertheless, government continues the careful study on the optimal spectrum reallocation method. (Kenji Kosaka, Vice Minister of MIC)
	It is natural that industry oppose to the introduction of auction because auction may increase the cost for them. However the spectrum is national property but not industries' property. The current policy focuses on industry protection or incumbent protection, but not contribution to the benefit of nation. (Kaneshige Wakamatsu, administration party)	Government continues study on the optimal spectrum management method. (Kenji Kosaka, Vice Minister of MIC)
2001.4.12 2001.6.7	Supplementary resolution was added to the bill of the Radio Law amendment. It include - Government should continue to study the fair and transparent spectrum allocation method such as auction.	
2002.3.20	Explain the opinion on the auction from the view point of NHK (Japan Broadcasting Corporation) (Koichi Takemasa, opposition party)	Spectrum policy should reflect the situation of each country. The adequacy of auction should be considered based on the comprehensive view point for industry promotion and effective use of spectrum. (Katsuji Ebisawa, President of NHK)

Date	Questions, requests, or proposals	Answers
2003.5.6	(Explanation of the bill to amend the radio law submitted by opposite party: The Democratic Party of Japan) Auction should be introduced in order to manage the new demand of spectrum and satisfy the followings. - Government should decide the economic value of spectrum based on the market mechanism - Secure the transparent and fair licensing process (Koichi Takemasa, opposition party)	
2003.5.8	Explain the purpose of use the collected money by auction * question to the Koichi Takemasa, who submitted the bill (Testuji Nakamura, opposition party)	The revenue, which is generated by the sales of national property to specific user, should be used for the nation. Therefore, national coffer should take the revenue; still provide the necessary amount of budget for spectrum administration by giving priority. (Koichi Takemasa, opposition party)
	Please explain the idea on the proposed auction system * question to Minister of MIC as opinion of government (Satoshi Shima, opposition party)	It is true that auction is one method to allocate spectrum. However, it has the following problems. - Too much negative effects were recognized in Europe - Difficult to get the understanding of nation on the idea to "buy" the right to use national property for such a long time like 20 years Still, need to study the auction (Toranosuke Katayama, Minister of MIC)
	Japanese Communist Party opposes to the introduction of auction (Naoaki Haruna, opposition party)	
2004.4.1	(Explanation of the bill to amend the radio law submitted by opposite party: The Democratic Party of Japan) Auction should be introduced in order to manage the new demand of spectrum and satisfy the followings. - Government should decide the economic value of spectrum based on the market mechanism - Secure the transparent and fair licensing process (Koichi Takemasa, opposition party) * The Democratic Party of Japan submit the bill of auction introduction again following the 2003	

Date	Questions, requests, or proposals	Answers
2004.4.6	I opposite the introduction of auction which is proposed by the Democratic Party of Japan. Explain the idea of government on the auction introduction. (Hiroshi Imai, administration party)	Government consider auction is not adequate for the spectrum allocation based on the following result - Most of the companies within 11 companies, which won the auction in UK or Germany, have not started the 3G service yet - Two company within the 6 German auction winning companies leave the business - Deteriorate the business condition of telecommunication companies and of electrical communication device manufacturers - Brings about negative effect on the national growth strategy industry - Strong risk to boosts the license fee and to bring about negative effect on the development of broad band environment. - Strong risk to facilitate the establish right of the spectrum use and to disturb the reallocation of spectrum (Kanichiro Aritomi, government delegate)
2004.4.13	Explain the reason to employ the comparative examination to select licensees (Manabu Terada, opposition party)	The purpose of employing the comparative examination is to select the best licensees, which nations may accept, by the following. - examination on the business plan - examination on the technological ability but not by auction which select only based on the amount of bidding money. (Kanichiro Aritomi, government delegate)
	Explain the possibility to employ both comparative examination and auction (Manabu Terada, opposition party)	Auction has many problems as the followings *(the explained problems are the same as in previous answers)* After the study on the auction system, it concluded auction is not adequate. (Masahiro Tabata, Vice Minister of MIC)
	Explain the problem form government view on the proposal of auction submitted by the Democratic Party of Japan (Manabu Terada, opposition party)	It is problem to select licensees only based on the monetary capacity (Kanichiro Aritomi, government delegate)

Date	Questions, requests, or proposals	Answers
	Government has been explaining auction is not adequate by mentioning the case of UK and Germany. However, the result of the two cases can not necessary rationale auction itself is wrong. Explain the idea of government on this point. (Kaname Tajima, opposition party)	It is problem that no brake woks to stop excess competition in the auction because it bases on the monetary value. UK and Germany case explain this point simply (Kanichiro Aritomi, government delegate)
	Vodafone in the UK seemed to control it bidding. It is true that wrong business judgment raised the bidding price in the past, but those experiences must brings about the practical discretion. Thus the auction is considered to work adequately. Explain the idea of government on this point. (Kaname Tajima, opposition party)	Government examines not only UK and Germany cases but also other country cases, and then made conclusion not to employ auction. There is room to study on the economic value of spectrum. However, it is not adequate to employ auction at this point. (Kanichiro Aritomi, government delegate)
2005.2.7	The Democratic Party of Japan advocates the introduction of auction. Please explain the idea how much government can receive by auctioning 30MHz from 800HHz band. (Satoshi Shima, opposition party)	It is difficult to say the amount of income with confidence. (Taro Asou, Minister of MIC)
	Considering the revenue in UK, Japan may receive the amount of order of one trillion JPY by the auction. One division in MIC decides how to allocate the value of one trillion JPY. This is huge charge. (to Minister of Finance) One trillion from auction revenue may help to reconstruct government finance. (Satoshi Shima, opposition party)	It is subtle to implement auction and to sell the spectrum at high price for the purpose of government finance reconstruction. Government continues studying the issue, especially being careful on how to secure fairness. (Taro Asou, Minister of MIC)
2005.7.28	Explain the reason why auction has not been employed eventually, though the Democratic Party of Japan has been advocated the introduction of auction (Daizou Kusuda, opposition party)	Government decided not to introduce auction based on the final report of the "Study Group on Policies for Effective Radio Spectrum Use.", which provides two proposals as the following - It is adequate to introduce the pricing method for spectrum use fee reflecting the economic value of spectrum. - It is necessary to put a brake on the use and the price of spectrum use (Taro Asou, Minister of MIC)

Date	Questions, requests, or proposals	Answers
2005.10.18	Explain whether government studied spectrum auction as alternative or not, and the reason why it was not employed. (Seiji Hagiwara, administration party)	Government holds the "Study Group on Policies for Effective Radio Spectrum Use" from 2003.1 to discuss the spectrum management system, and carried out public comments three times during the study period as wall. The study group indicated the problems as the followings - Bidding price easily boosts and high price puts heavy burden to companies, and then declines total ICT industry - Government may need to set long license period. This reduces the flexibility to carry out the effective spectrum use. (Kazuhiro Suda, government delegate)

Note: The minutes are from the database of the Japanese Congress found by searching with the key words "radio" and "auction" from 1945.1.1 to 2006.4.4 for all committees and the full assembly.
Source: Author, 2006.

Table 5－2: Positions of players in the Diet

Name	Category	Position
The Liberal Democratic Party	Diet (1), (Administration party)	Strong Opposition, Center
Komeito	Diet (2), (Administration party)	Strong Opposition, Center
The Democratic Party of Japan	Diet (3), (Opposition party)	Strong Support, Center
The Japanese communist party	Diet (4), (Opposition party)	Strong Opposition, Center
NHK	Incumbent	Weak Neutral, Center
Prof. Oniki	Academia	Strong Support, Center

Source: Author, 2006.

5.3 Japanese Government: Ministry of Internal Affairs and Communications

Contrary to the FCC's strong advocacy for spectrum auctions in the US, the MIC, Japan's telecommunications regulator, has opposed the introduction of auction mainly due to an auction's risk to cause extremely high bidding prices, which put heavy burden to mobile companies and then brought about negative effects to all Information and Communications Technology (ICT) industry as seen in the Europe after the 3G spectrum license auctions. The MIC's statements in 1991 during congressional hearings demonstrated its neutral attitude toward the auctioning of licenses at that time. However, later, in 1996, the MIC changed to became skeptical over the idea of spectrum license auctions voicing an almost opposite view of its 1991 stance, noting the negative points of auction process taking place in the US at the time. Still, the MIC said it would continue studying the auction as an alternative to its current comparative examination used for giving out licenses. After 2000 when auctions in UK and England raised a huge amount of funds, the MIC came out clearly against auctions, citing in particular, the difficulty it would have in stopping upward spirals of the bidding price, which the MIC believed would negatively impact the healthy development of the ICT industry. The MIC also stated that it would be difficult to get nation's support of a system in which firms would have to buy the right to use national property such as spectrum resource, for extended periods of time such as 20 years. Prior to 1993 the US Congress expressed a similar concern that selling precious and limited national property such as spectrum resource to the highest bidder would be inappropriate [21].

Table 5-3 shows the advantages and disadvantages of the auction process, which the MIC used to compare the views of governments that employ auctions. The MIC and other governments hold different views on the issue. The MIC disliked extracting large sums of

money from telecommunications companies, for example, though other governments are pleased to receive large funds for their national coffers. Strong protection for industries should come first, and allocating an effective spectrum use system and raising revenue should come second in the MIC's view.

Table 5—3: Auctions Advantages and Disadvantages from the MIC's viewpoint and the viewpoint of auction employing regulators

Evaluation	MIC of Japan	Auction employing regulators
Advantage	-Transparent -Fairness	(1)Revenue for national coffer -Transparent -Fairness
Neutral		(2)Weak newcomers can secure license by the government special treatment (3)High bid price is sunk cost, and then is not transferred to the service price (4)Reduction of telecommunication companies' evaluation (5)Wealthy companies occupy spectrum
Disadvantage (Problem)	(1) Heavy burden to companies (2) Weak newcomers may be excluded from market (3) High bid price may be transferred to the service price and users eventually pay the spectrum cost (4) Reduction of telecommunication companies' credit evaluation (5)Wealthy companies occupy spectrum -Non-payment of auction bid and re-auction may occur causing spectrum use to become unstable	-Non-payment of auction bid and re-auction may occur and spectrum use becomes unstable

Interpretations of the issues are different on the same issues

Source: Author, 2006.

Even in 2005, the MIC cited the negative effects that auctions could have on the national economy and in particular on the communications industry, which could be stifled by extremely high bidding prices from auctions. In addition, the MIC stated that spectrum auctions may (and in other nations, did) exclude newcomers though other countries managed

this problem by offering special treatment to newcomers such as credits or reserved licenses.

Based on the findings in the final reports complied by the "Study Group on Policies for Effective Radio Spectrum Use" in 2004, and the results of public comments, the MIC decided not to adopt auctions when amending the Radio Law. However, the MIC said it would consider the auction system as a long-term policy study topic.

5.4 Incumbents

The group of strong incumbents in an auction for would include mobile phone companies, and TV and radio broadcasters. Based on the opinions from incumbents — firms that currently hold licenses submitted during the public comment period on the reports of the Study Group on Policy for Effective Radio Spectrum Use in 2002 and 2004 shown in Table 5-4 and Table 5-5, this group basically opposes license auctions. Though only couple of incumbent companies in the industries submitted an opinion, the opinions from the some appear to be rational. Incumbents have risk averse attitude on the increase of cost to use spectrum resource. Incumbent mobile phone companies weakly opposed the auction based on their remarks made at the public hearings and their main fear was that they would have to pay much money to receive licenses via the auction process, however they also were interested in the market mechanisms, which could allocate spectrums in a fair and transparent manner. Mobile companies preferred comparative examinations using market mechanisms basically because the auction process does not guarantee a low- or fixed-cost license fee, but they also may have some trepidation over the comparative examination because it is based on government officials' arbitrary judgment even though the MIC appeals to judge taking advantage the market mechanism with transparent scoring process.

Table 5—4: Public comment relating to spectrum auction on the first report of the Study Group on Policy for Effective Radio Spectrum Use in Dec. 2002

Opinion	Name	Category	Position
Advocated for the comparative examination utilizing market mechanisms (rather than an auction) as long as it would not pose a heavy burden on the new licensees at the time of spectrum reallocation.	KDDI	Incumbent	Weak Opposition Undecided side
Understand that the comparative examination utilizing market mechanisms is a more advanced concept than auction and other established methods	Tu-Ka	Incumbent	Weak Opposition Center
The proposed comparative examination utilizing market mechanisms is as beneficial as the original method because the method reflects opinions and conditions of the Japanese market and in light of the unsuccessful spectrum auctions' results in Europe and US.	CIAJ	Industry Association of Manufacturers	Weak Opposition Center
It is adequate to introduce the Comparative examination utilizing market mechanism for a while because there are adverse opinions against auction introduction and opinions to keep the possibility of future auction introduction. Government should study the auction system from the view of medium and long term period	Nippon Keidanren	Association of All industries	Weak Neutral Support side

Source: The Study Group on Policies for Effective Radio Spectrum Use, 2002 [42], App.35.

With regards to the broadcasters, they may oppose the auction if the MIC decides to legislate a spectrum auction based on the TV Tokyo's opinion. Even with the current spectrum usage fee system, broadcasters pay extremely small fees compared to mobile phone companies. Broadcasters may hate to risk an increase in their cost for spectrum use if auction would be introduced. The Japanese incumbents' stance is very close to that of the US incumbents before 1993 as described by Kwerel [21].

Table 5—5: Public Comments on Spectrum Auction for the Final Report of Study Group on Policy for Effective Radio Spectrum Use — Aug. 2006

Opinion	Name	Category	Position
It is prudent that MIC does not introduce auction	Prof. Yasuda Takayama TV Tokyo	Academia Newcomer Incumbent	Strong Opposition Center
Government should avoid immediate introduction of auction and study auction system carefully	Softbank	Newcomer	Strong Opposition Support side
Agree to employ the method that prevents fee increases, not the auction	eAccess	Newcomer	Weak Opposition Center
Agree to employ the use fees in the future instead of an auction. However, government should study the auction system to possibly overcome the problems of Europe and US type auctions	Personal	Personal	Weak Opposition Support side
Government should carefully collect short-term revenue because it can reduce R&D investment and create a risk of losing long-term economic benefits for wireless industry. Advocated keeping the total usage fees low.	Motorola	Manufacturer	Weak Opposition Center
Usage fee should reflect the market mechanism as much as possible. It is necessary to set open, transparent and adequate prices when government sets incentive price instead of auction	DTI, UK Government	Foreign Government	Weak Neutral Center
Oppose the study group's conclusion describing auction is not prudent. An inappropriate auction design could cause negative results. However, many countries use it successfully and it seems to allocate scarce resource adequately and fairly and creates incentives for effective spectrum use.	US Government	Foreign Government	Strong Support Center

Source: The Study Group on Policies for Effective Radio Spectrum Use, 2004 [50], P.6.

5.5 Newcomers

The newcomers in this Japanese case are emerging IT and information companies that provide mainly ADSL services and IP phone service, e-commerce service etc. They are considering entering the mobile industry or starting wireless information services. Softbank

and eAccess were granted small 3G licenses earmarked for newcomers in 2005 to enter the mobile phone industry.

They opposed the spectrum auction based on the results of auctions in Europe and the US that boosted prices, as noted again and again by MIC. Developing the wireless network put heavier burdens on newcomers than incumbents causing them to be more sensitive to the license fee. However, Softbank, the strongest newcomer, said the government should study the proposed auction system carefully to find ways to overcome the problems that surfaced in European and US spectrum licenses. The stance of newcomers appeared subtle. Auctions can bring about more chances for newcomers to enter market than the comparative examination, which is believed to be influence by the government's favoritism of incumbents. Thus, once the countermeasures to avoid the price boost in auctions have been established, newcomers may change their view and support the auction system.

5.6 The others

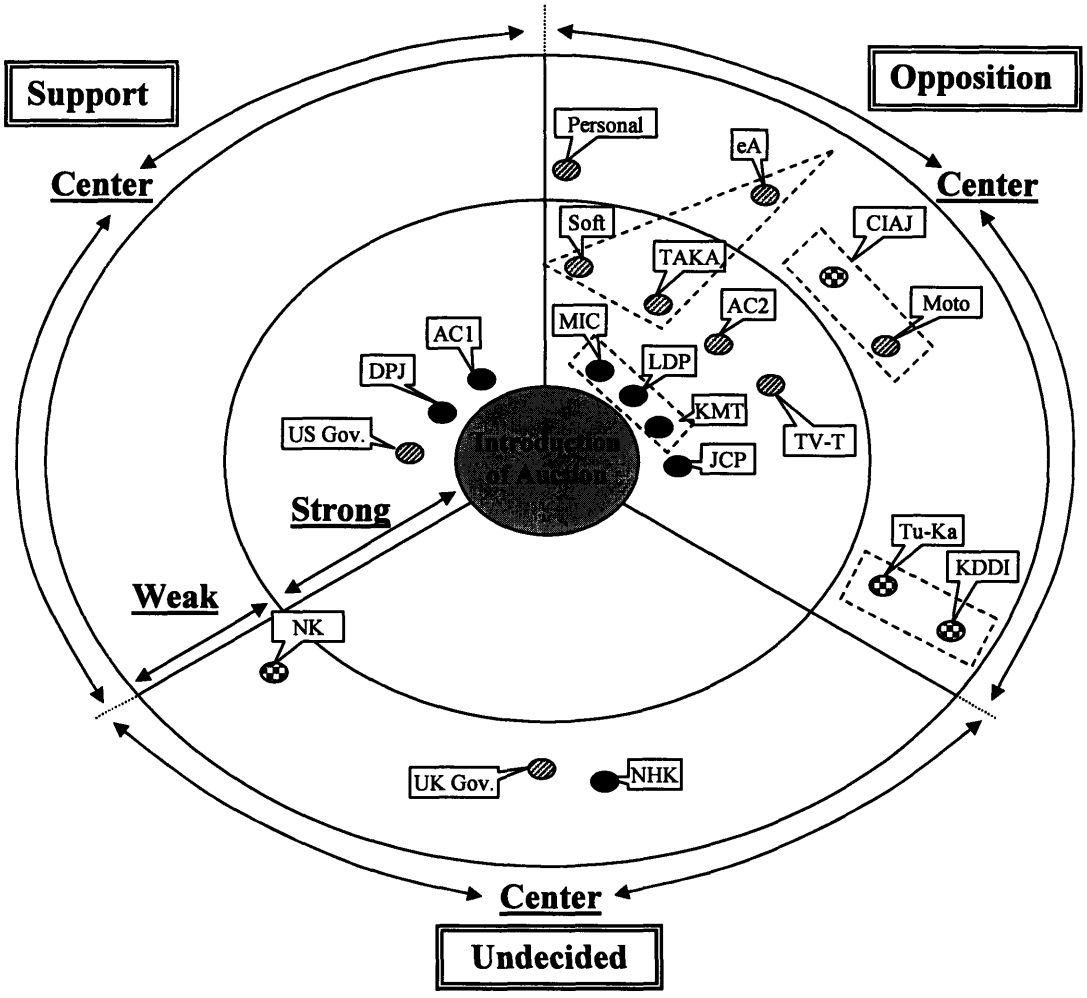
In addition to the stakeholders discussed above, academia, economic organizations, industry associations, electronics device venders, and foreign governments can also be considered as stakeholders. The opinions of academia are diverse based on their specialties and interests. Economists, in general, advocate auctions. Nippon Keidanren, an economic organization, and CIAJ, an industry association submitted restrained or middle-of-the-road opinions because they needed to better assess their members' views on the topic and come up with a solid opinion. Motorola's opinion could represent the views of manufacturers. They felt they would not suffer from the boost of license price caused by an auction, but the experiences of manufacturers in the Europe made them nervous about auctions. Foreign

governments such as the US and UK government commented as well. The US government sees the auction as a telecommunications industry deregulation process in Japan and seems to support the auction introduction. However, MIC refers their opinions, but may do not count as the influential opinion to change the MIC' stance toward the auction advocacy.

5.7 Overall view on the Auction Process

Figure 5-2 describes stakeholders' positions. All influential groups such as Japan's administration parties, the MIC, incumbents and newcomers have different views on the auction. The opposition party has a strong desire for the auction; however it is too weak to realize this goal without supporters and allies. The current power and opinion distribution has been shaped by the MIC's continuous and consistent effort to address the problems of auction using examples from the US and Europe.

The anti-auction tone dominates the current policy discussions in Japan, which seems to be more severe than the discussions were in the US soon after 1985. However, the possibility of adopting the auction is not a dead issue. Figure 5-3 shows the potential change of policy environment from the three lenses: Political, Cultural and Strategic. The political lens focuses on where the decision power is located; the cultural lens focuses on the social identities of the people and organizations; the strategic lens focuses on the social system deliberately constructed to achieve overarching strategic goals [51]. With regard to the political lens, the Liberal Democratic Party (LDP), Komeito (KMT), and MIC hold the political power to decide on a spectrum policy. They oppose to the introduction of the spectrum auction.



LDP : The Liberal Democratic Party
KMT : Komeito
DPJ : The Democratic Party of Japan
JCP : The Japanese Communist Party
AC1 : Prof. Oniki
NK : Nippon Keidanren

AC2 : Prof. Yasuda
TAKA: Takayama
TV-T : TV Tokyo
Soft : Softbank
eA : eAccess:
Moto : Motorola

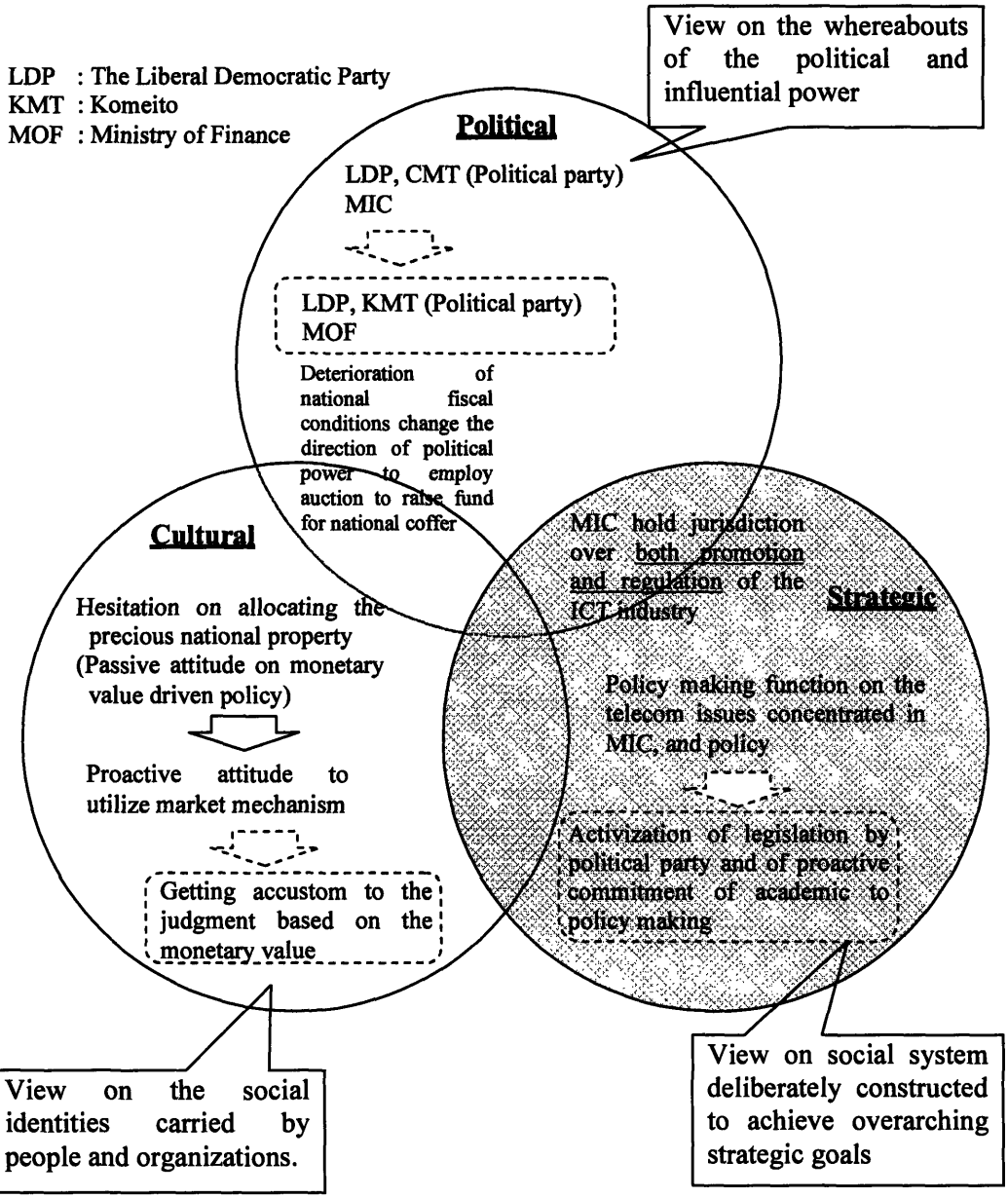
● : Statements in the Diet from the middle of 1990s

⊛ : Public comments on the initial report of the "Study Group on Policy for Effective Radio Spectrum Use" — December 2002

◍ : Public comments on the final report of the "Study Group on Policy for Effective Radio Spectrum Use" — August 2006

Source: Author, 2006.

Figure 5—2: Stakeholders Who Support the Auction over the Current System



Source: Author, 2006.

Figure 5—3: The Political Circumstance Change that allows shift to Auction Friendly Policy Mind based on Three Perspectives

However, political parties are interested in that auction as the source of governmental budget funding as shown in Satoshi Shima' statement in 2005.2.7 of Table 5-1. Thus, the deterioration of a national coffer could possibly change the direction of political power to support the auction. The revenue from spectrum auction such as the order of 100 billions or trillions JPY (around billions or 10 billions USD) must be attractive for administration parties in the situation of lack of financial resources. In this situation, the Ministry of Finance (MOF) rather than MIC may come to play a bigger role based on its jurisdiction over the national budget.

The cultural lens mentioned the change on how society evaluate the value of and consider the way to use the national property such as spectrum resource. MIC is hesitant to allocate spectrum use, a precious national resource, through an auction, as shown in the statements in 2003.5.8 and 2005.2.7, for instance. The Japanese government has been selling national properties such as national land, government-owned buildings, etc., to raise funds to improve national coffers and it is trying to downsize national assets and improve financial condition using the sales revenue. This policy may change the cultural perspective on the policy and reduce the barrier to the implementation of the spectrum auction.

Finally, the more participation of groups outside MIC to develop bills can also reduce the barrier for introducing the auction. Currently, the MIC controls both the promotion and regulation of the ICT industry and it plays the main role for establishing or amending laws relevant to the telecommunications industry. Furthermore, it will be difficult to make major changes to current legislation such as implementing an auction process for licenses if such changes do not support MIC interests. Meanwhile, the participation of political parties and academics in the policy framing process can impact the current legislation structure. The

attempts of the Democratic Party of Japan in 2003 and 2004 are good example in that they deepened the argument and broke with the MIC's policy directions.

It is very difficult to introduce the spectrum auction system in Japan because most of the powerful stakeholders oppose the auction. Furthermore, introducing the auction system faces cultural and strategic hurdles. However, if the political environment changes as described above, the spectrum auction system could become a real possibility.

Chapter 6

Auction Design

Various kinds of auctions have been used worldwide. For example, Sotheby's and Christie's famous art auction houses use the ascending auction also called the English auction. "In the ascending auction, the price is successively raised until only one bidder remains, and that bidder winds the object at the final price" [17]. The descending auction, also called the Dutch auction, has been used in the Netherlands flower market and in fish auctions worldwide [20]. "In the descending auction, the auctioneer starts at a very high price, and then lowers the price continuously. The first bidder who calls out that she will accept the current price wins the object at that price" [17]. Many auctions may have come into being based on practical goals and past experience without a sound theoretical background. On the other hand, simultaneous ascending auction, which is currently used for spectrum auction, was designed based on economic theories, which arose in the 1960s and became influential during 1990s [1]. The first auction of New Zealand employed the second price auction, which William Vickrey theoretically explained in 1961 and for which he won the Nobel Prize in 1996. The FCC invented the simultaneous ascending auction, which came to in use from 1994, with the cooperation of theoretical and experimental economists [21].

An auction design can be generally categorized based on a combination of some basic design forms such as ascending or descending, sealed or open bid, sequential or simultaneous. In addition, practical auctions require more detail design such as the number of licenses and information-sharing method, and implementation rules such as withdrawal rule and payments of reserve prices case by case.

Table 6−1: Properties of Standard Auctions for One Lot

	Open English Auction	Sealed First Price	Sealed Second Price	Dutch Auction
Market Clearing price?	Yes	Only approximately	Yes	Only approximately
Identifies strongest bidder?	Yes	Not reliably	Yes	Not reliably
Revenue obtained?	May be weak with few bidders	Good in some situations	May be weak with few bidders	Good in some situations
Opportunity for cartels	At risk	Lower risk	Lower risk	At risk
Winner's Curse	Offers some protection	At risk	At risk	At risk
Comments	Well understood	Well understood, suitable for complex tenders	Not well understood, some political risk	Not well understood

Source: NERA et al., 1996 [22], Auctions p.6, Table 4.1.

Table 6−2: Properties of Standard Auctions for Several Lots

	Sequential English Auction (or similar)	Discriminatory Auction (Simultaneous Sealed First Price)	One Price Auction	Simultaneous Open Auction (FCC Style)
Market Clearing price?	Only approximately	Only approximately	Yes	Yes
Identifies strongest bidder?	Not reliably	Not reliably	Yes	Yes
Revenue obtained?	Good in some situations	Good in some situations	May be weak with few bidders	May be weak with few bidders, but good in some situations
Identical lots at same price?	No	No	Yes	Yes
Winner's Curse	Offers some protection	At risk	At risk	Offers some protection
Comments	Well understood	Well understood, suitable for complex tenders	Not well understood, some political risk, for identical lots only	Novel, but easy to copes with related but non-identical lots

Source: NERA et al., 1996 [22], Auctions, p.7, Table 4.2.

This chapter focuses on basic considerations that are necessary in developing the framework for an auction design for Japan, reflecting the current situation of the Japanese spectrum management system as described in Chapter 4.

The first section reviews simultaneous ascending auction. Although there are various kinds of auction as listed in Table 6-1 and Table 6-2, I focus on this type *b*ecause most of all regulators have employed this. Main three types of simultaneous ascending auction are considered US and UK Types, German type and Clock Auction. The description of three types highlights those types' features, which guide the direction of Japanese auction.

The next section discusses the main enhancement measures for the simultaneous ascending auction to overcome the problems described in Chapter 4. Those encompass: prequalification, license number, information sharing, payment method, reserve price and withdrawal. Those measures allow regulators to realize a desired auction that reflects the market condition.

Finally, the last section develops a strategy for Japanese auction design, based on the preceding discussion of three types of simultaneous ascending auction and enhancement measures.

6.1 The Mainstream Design: Simultaneous Ascending Auction

The simultaneous ascending auction is at present the major spectrum auction type used worldwide. The FCC first developed this auction type in 1994 based on the proposal of Paul Milgrom, Robert Wilson, and Preston McAfee. The simultaneous ascending auction has been employed for dozens of spectrum auctions all over the world with slight variations and has raised more than $200 billion in revenue. Furthermore, it has been refined over

time, and has been extended to the sale of divisible goods in the electricity, gas, and environmental markets [13]. Therefore, I focus on simultaneous ascending auction for spectrum auction's design.

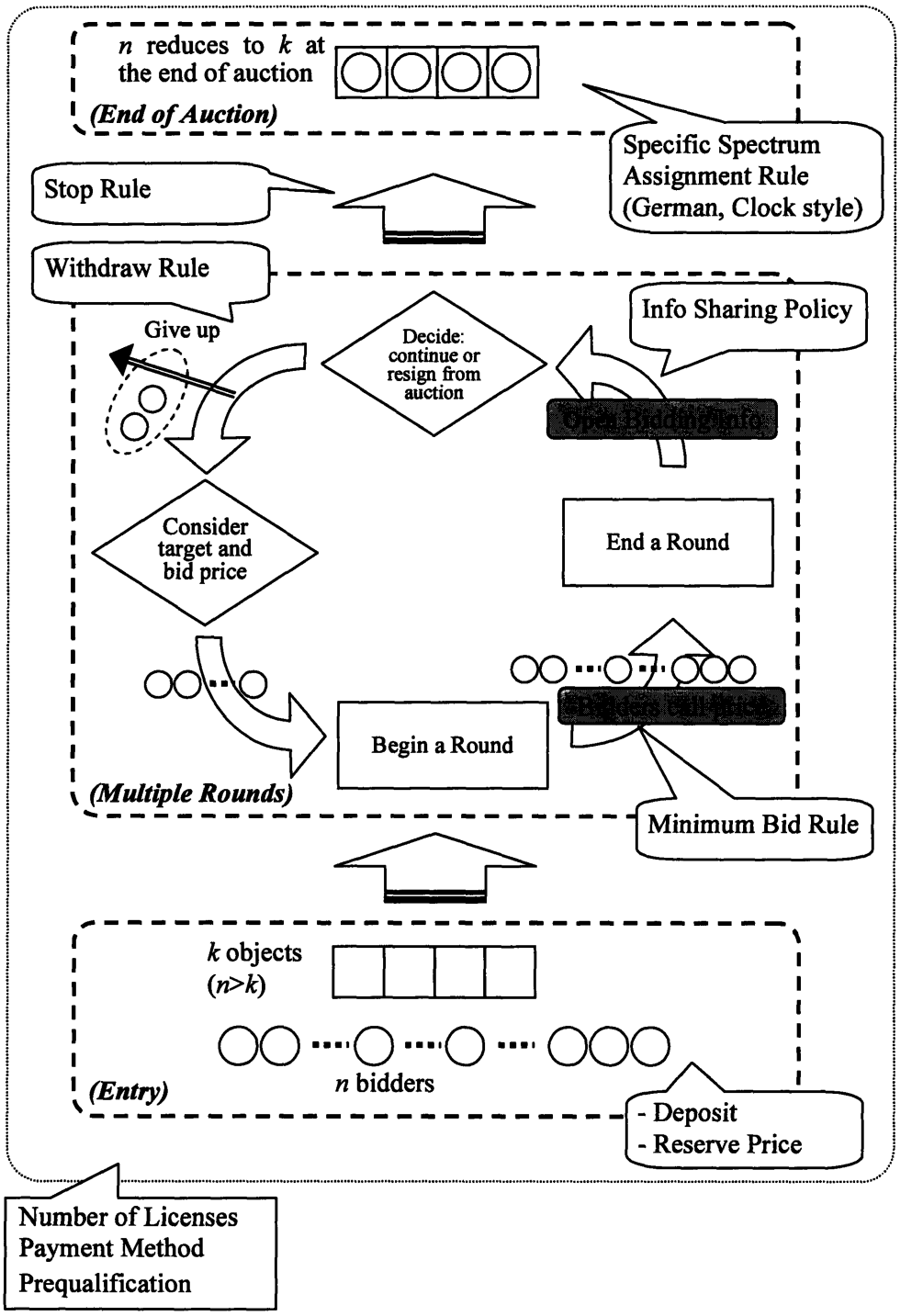
The simultaneous ascending auction did not achieve auction standards at the start. A New Zealand regulator initiated the auction in 1989 employing the second-price sealed-bid auction following the advice of a consulting firm, National Economic Research Associates (NERA) [2]. This auction brought about controversial results [1][19]. The regulator changed the design to the first-price sealed bid auction from 1991 to avoid the awful results, and then changed the design again to a semi-open ascending auction from 1995 after the success of the Simultaneous Ascending Auction by FCC [2]. The Australian Government also ran into difficulty in 1993 implementing the first-price sealed-bid auction [19]. These problems confused the both the New Zealand and Australian governments and impacted society in terms of letting know the difficulty to succeed an auction. However those failures became precious lessons to the later auction designers and implementers.

The simultaneous ascending auction was derived from the English auction as a means to sell many goods simultaneously [13]. Its essential features include: (1) the use of multi-round sealed bids rather than a single sealed bid, and (2) simultaneous rather than sequential sales. The goal of these features is to reveal information and then give the bidders the flexibility to respond to the information [3][13]. The information is available according to the rigidity of information-sharing rules, i.e., a government's decision on what details to tell the bidders about the competition. This process allows bidders to figure out other bidders' evaluation and compare their evaluations. Details of the simultaneous ascending auction process is shown in the Figure 6-1. All auctioned goods are listed at the

same time, and each has its own reserve price, which is the minimum price of each object. Bidders can bid on the goods according to the rule of an auction. For example, in the case of UK 3G mobile auction, a bidder could bid for only one license and could keep only one license.

The bidding continues until no bidder makes a higher bid on any of the goods. At this point, the auction finishes, and the bidders who bid the highest win the object such as a spectrum license and pay the bidding price following the payment rule.

Two kinds of simultaneous ascending auctions were employed in the spectrum auction: the US and UK or German type. The difference derives from how the license numbers are set. The FCC and UK type decide the number of licenses and assign specific spectrum bands at the start; the German type allows flexibility in terms of the number of licenses, (e.g., 4 to 6) and the intensity of competition in the auction comes to fix the number of license, 4, 5, or 6 at the end of auction as a result of competition. The one more practical derivation of simultaneous ascending auction is Clock auction, which was used only in Nigeria in 2001 [23] and gathers attention of economists as the next auction design. The clock auction is considered to be useful for selling combined auction licenses which have complementary character; meanwhile, the current FCC, UK and German types are appropriate for auctioning licenses with substitute goods.

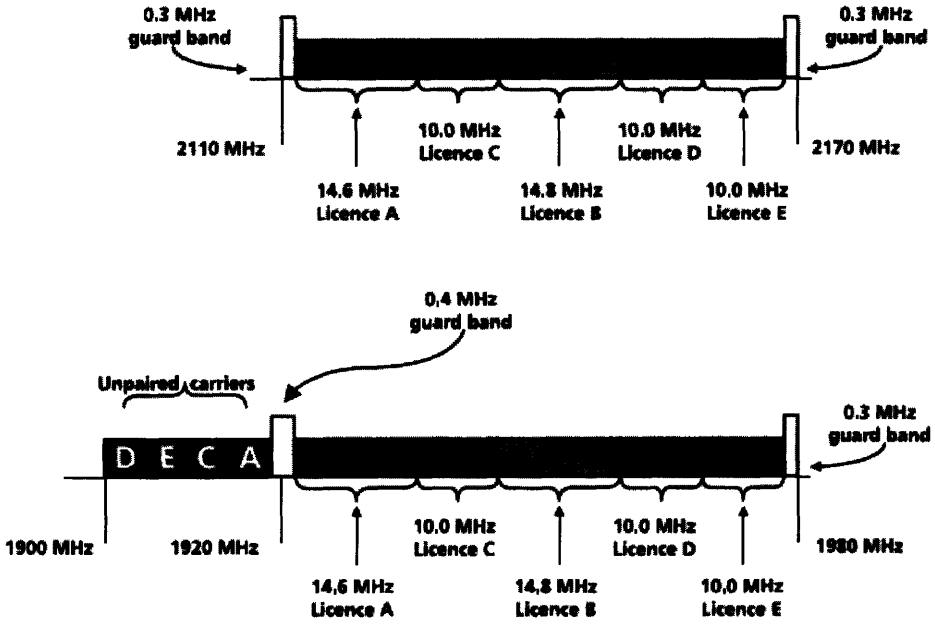


Source: Author, 2006.

Figure 6—1: The Basic Simultaneous Ascending Auction Process

6.1.1 US and UK Types

The most popular ascending auctions are the US and UK types for which regulators set the number of licenses and corresponding spectrum bands for each license in advance of the auction. Therefore, bidders compete to get licenses knowing which spectrum band they are vying for. This auction allows participants to develop a bidding strategy during the auction, and a business plan after winning a license because all conditions are fixed. In these auctions, regulators can also exert power to develop industry for their desirable industry structure. They can authorize licenses of different sizes considering the power balance of incumbents, for example.



Source: N. M. Rothschild et al., 1999 [24], p.15, Fig. 2.1.

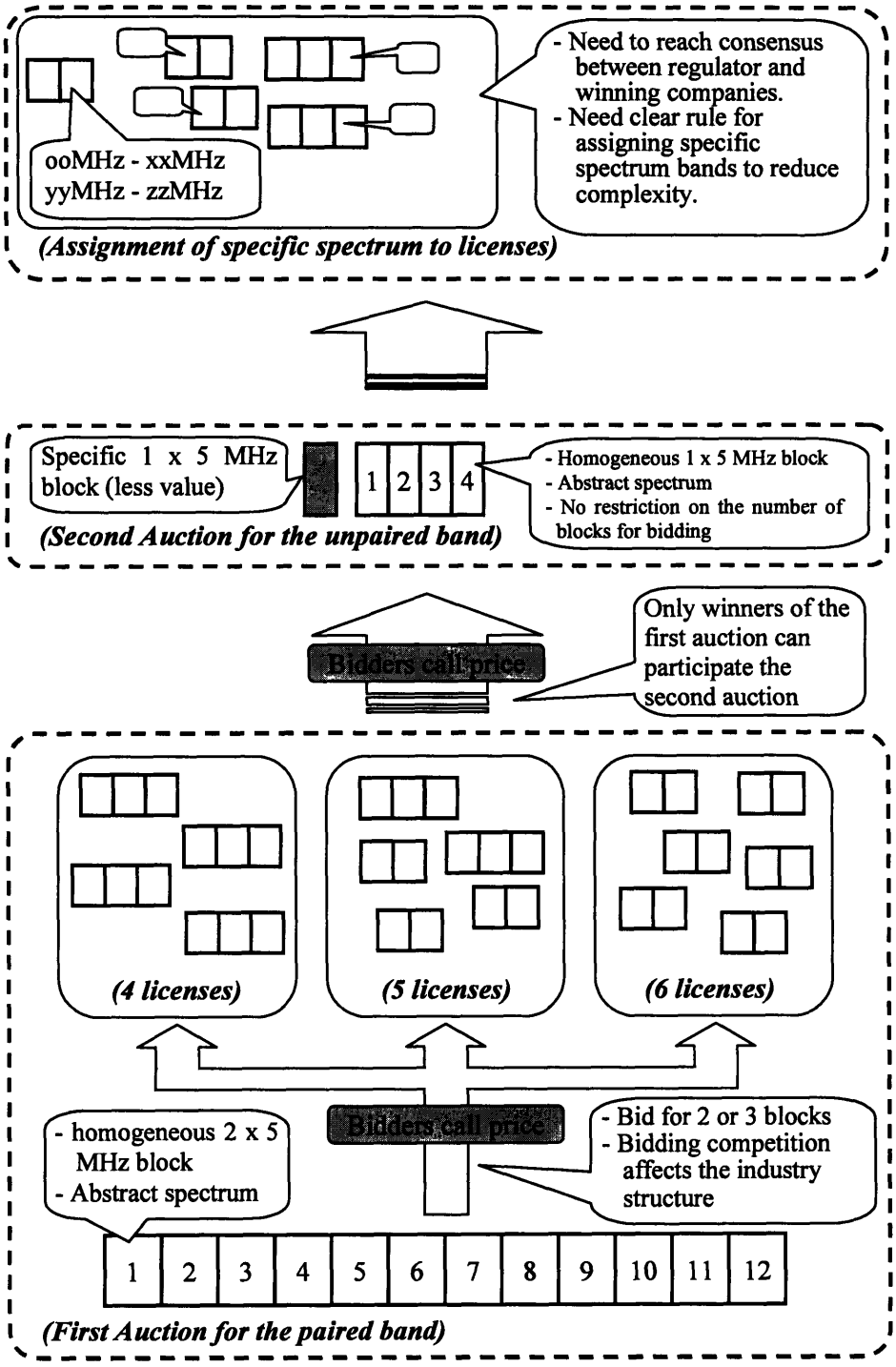
Figure 6−2: Spectrum Packaging in 3G UK Auction

In the UK auction, the regulator set the 5 licenses as shown in the figure 6-2. License A was assigned the greatest spectrum, 2 x 15 MHz (paired spectrum) + 5 MHz (an unpaired spectrum), and only newcomers were allowed to bid for this. License B was assigned 2 x 15 MHz and licenses C, D, and E were assigned 2 x 10 MHz + 5 MHz each. Licenses B, C, D, and E were open to both newcomers and incumbents. One company was allowed to bid for only one license and only five companies could bid for the 3G mobile businesses if they agreed to develop their own infrastructure [24].

6.1.2 German type

Germany and Austria employed a different simultaneous ascending auction design comparing to the US and UK type. The German type auction builds in flexibility of the number of licenses. The license number is set at the end of an auction reflecting the intensity of competition in an auction. In addition, regulators do not assign the specific spectrum bands to each license; they assign these after an auction in a coordination process involving the winners and the government.

A German regulator sold a 2 x 60 MHz paired-spectrum 1900–2025 MHz band in its first auction, and a 25 MHz unpaired spectrum band of 2 GHz in the second auction for 3G mobile service use. The Figure 6-3 describes the process. The paired band was segmented into 12 homogeneous and abstract blocks of 2 x 5 MHz without specific bands assigned (an abstract block means that the blocks are not assigned to a specific spectrum). The unpaired spectrum band was also divided into 4 blocks of homogeneous and abstract 1 x 5 MHz band, and 1 specific block. The bidders were allowed to bid for at least 2 and at most 3 blocks. If the auction finished and all bidders had 3 blocks, the license number became 4, and if the auction finished with 2 blocks of bidders, 6 licenses would be provided. The second auction



Source: Author, 2006 based on [5][25].

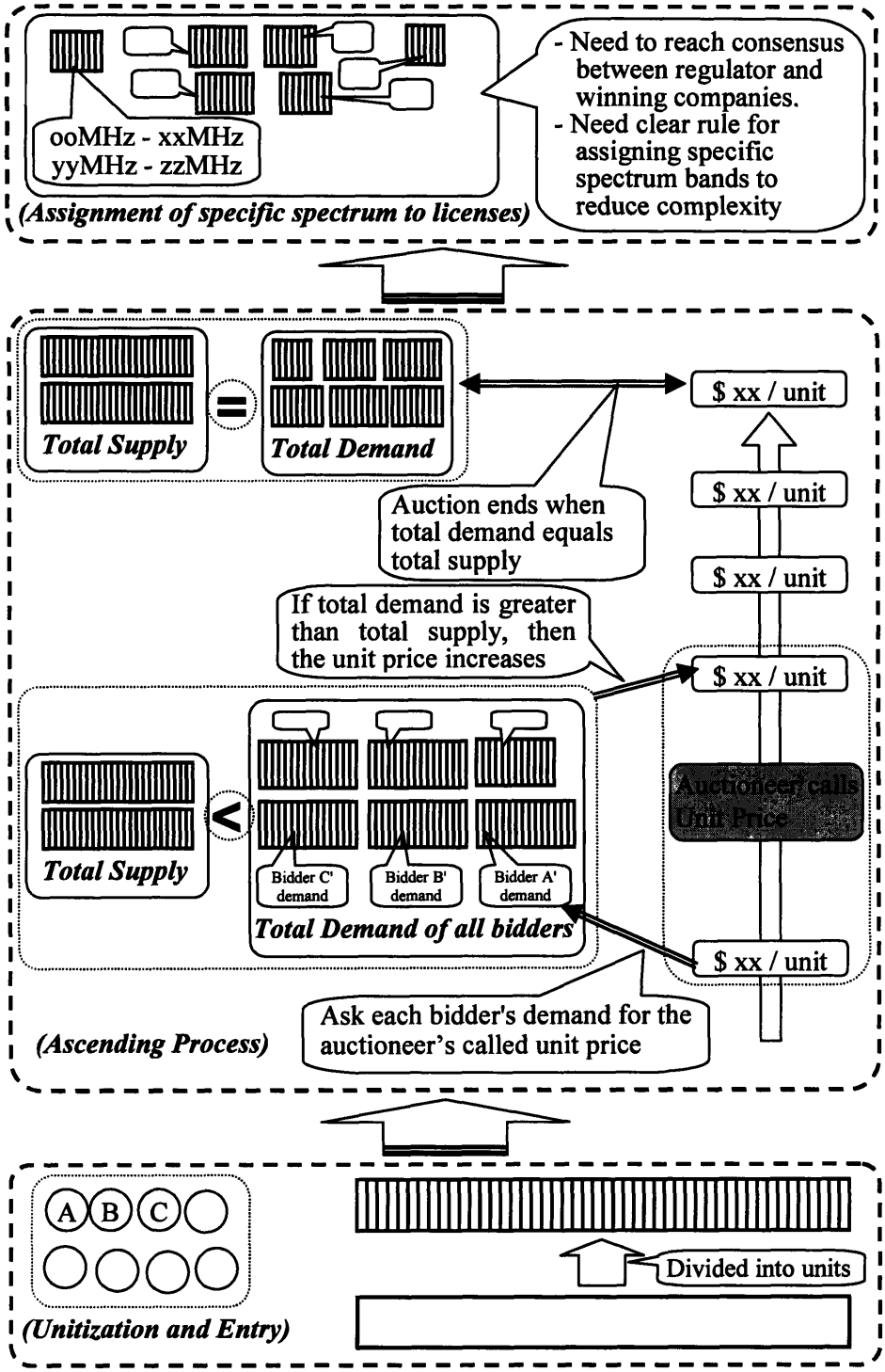
Figure 6—3: Setting the License Number and Spectrum Width in German Type Simultaneous Ascending Auction

was open only to the winner of the first auction that ranged from 4 to 6 blocks depending on the intensity of the competition [5][25]. In the case of a UMTS auction, a German regulator had a hard time assigning the specific spectrum bands to the auction winner. Even one year after the auction, the government and license holders had not reached an agreement on the assignment of a specific spectrum. In order to avoid this complication, the government should establish a clear rule to assign a concrete spectrum to the winner of the blocks.

Klemperer critiques the complexity of rules and the opacity of the bidding information provided to bidders, and the difficulty for bidders to develop a bidding strategy due to these reasons [17]. Jehiel et al. also criticizes the German type asserting that the result of both high revenue and two new entries are due to luck [25]. On the other hand, Grimm et al. and Wolfstetter state that the flexibility of the German design allowed newcomers to participate and competition to generate revenue even with a small number of entrants noting US and UK type auction results in both Austria and Switzerland [5][12]. Because the German type auction was implemented only a couple of times in Germany and Austria, it is difficult to judge whether the results in Germany and Austria were due to luck or not.

6.1.3 The Clock Auction

The clock auction is a variation of the simultaneous ascending auction and the primary feature of this auction is that an auctioneer calls a price instead of the bidders as contrasted to the US, UK and German types. The second prominent feature of this type of auction is that the auction generally does not auction a direct object such as a license with a specific spectrum but homogeneous units set by an auctioneer such as a frequency. Cramton states that the critical difference between this and other auction types is that bidders simply respond to the initial price called out by auctioneer each time revealing the desired quantity [13].



Source: Author, 2006 based on [13][26].

Figure 6—4: The Clock Auction Process

The process of the auction is shown in Figure 6-4. The auctioneer calls price beginning at a low price and raises it within a certain range. Bidders call out their prices, and demand corresponds to the call prices, stage by stage. If the sum of all bidders' quantity requests is lager than the total supply, the auctioneer continues to raise the price. The auction ends when the total quantity on the demand side or bidders' side equals that of supply or auctioneer's side.

The clock auction greatly reduces the bidders' ability to collude with each other because it limits information sharing by allowing bidders to tell only to auctioneer the quantity of demand, though demand reduction still remains a problem [13]. The clock auction can be a substitute for the current simultaneous ascending design, especially the German style auction [5][12]. Both the German and the clock auctions are designed so that bidders bid for a unit, but not for direct objects, however the price calling method is different. Another important feature is that the clock auction is expected to realize the efficient combinational auction for licenses which have complimentary character [13][26][27]. To date, only the Nigerian government employed the clock auction for a GSM spectrum auction in 2001. The Nigerian government auctioned national licenses with a substitutive character, and did not carry out combinational auctions, in which participants bid for combinations of licenses [23]. Therefore, no clock auction has been used to sell complementary goods such as combination of regional licenses.

6.1.4 Selection from the Three Types

The preceding sections have reviewed three types of simultaneous ascending auction. These can be grouped as: US and UK type, in which regulators decide the license number and size, or German and Clock auction, in which market does. Both groups have the

following advantages and disadvantages as shown Table 6-3. The market structure determines the success of German auction, and therefore, the regulator should select the type based on the market analysis.

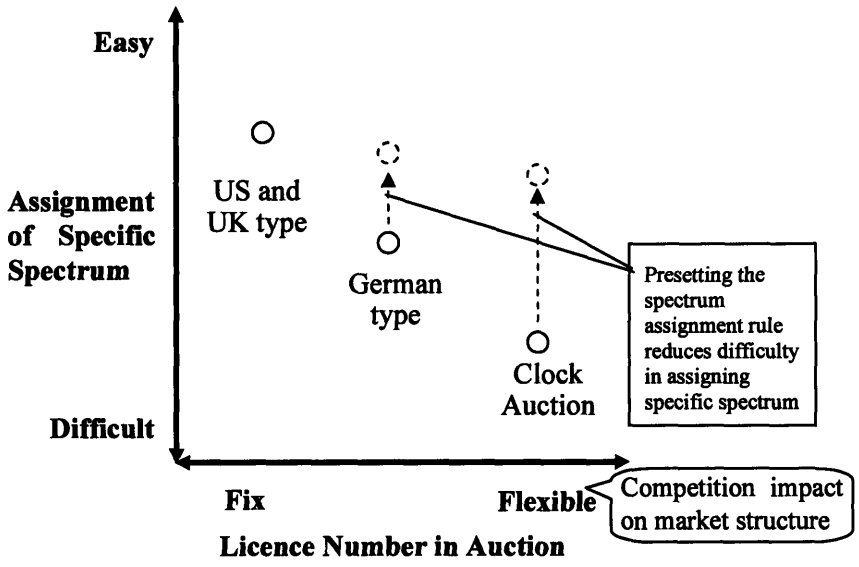
Table 6—3: Advantages and Disadvantages of License Configuration Process

	US and UK Auction Type	Germany and Clock Auction Type
Character	Completely specify the industry structure	Market (competition) determines the industry structure within narrow limits (e.g. 4 – 6 licenses)
Advantage (pro opinion)	-Possible to guarantee fewer and larger licenses [7][11] -Simple design	- More attractive for participants [12] - Flexible to bidder meltdown (decrease of registered entrant) [12] - Flexible to market situation change [5] - License number flexibility offers bidders reasonable chance of obtaining licence (incentive) [5]
Disadvantage (con opinion)	- Less attractive for participants especially for newcomers [12] - Not flexible to bidder meltdown [12] - Tendency for bidders to form fewer groups in an attempt to moderate competition [5]	- Driven by bidders' profits, not by the welfare of consumers or society [11] - Incumbents seize the license by bidding for additional capacity (blocks) [29] - Complex design and difficult to develop strategy [4]
Remarks	- Control competition by the number of licenses - UK adopted the design knowing 5 licenses are available for the market with 4 incumbents [7] - Italy reduced the licenses from 6 to 5 [11]	- Regulators should reserve blocks for newcomers - Assignment problem of specific spectrum, therefore need clear assignment process rule

Source: Author, 2006 based on [4][5][7][11][12][29].

If a few incumbents have strong power in the market, the regulator should select US-UK auction type in order to avoid the risk that a few incumbents get excessively as much spectrum band as they can in an attempt to reduce competitors' spectrum share. In that case, the regulator may remedy overconcentration of market power by giving a limited size of spectrum license to the strong incumbents. If regulators can expect balanced competition, they should select Germany or Clock auction type. The regulators cannot necessary decide the optimal number or the size of license. Market can be expected to decide the better set of

license number and size with in the predetermined range of license number and size. In addition, the flexibility of this type attracts newcomers. The section 6.2.2 discusses more on the license number, which assists to select which is better that regulator should decide or market should decide license numbers and size.



Source: Author, 2006.

Figure 6—5: Relationship between Flexibility of License Number and Difficulty of Specific Spectrum Assignment

The difference between German type and Clock auction is described in the previous sections. Both have a limited number of actual uses for the spectrum auction. Therefore, it is difficult to say which is better. However, the clock auction can greatly reduce the collusion and strategic behavior. The regulator should proactively consider employing clock auction. In addition, the regulator take on the role of assigning the specific spectrum to winning bidders' spectrum blocks or units in the most efficient way when they employ

German type or clock auction; nonetheless a risk results as it takes time to arrange agreeable assignments. The regulator thus should set rules for specific spectrum assignments if employing this design.

6.2 Enhancement of the Simultaneous Ascending Auction Based on Experience

The Simultaneous Ascending Auction has been carried out since 1994 in many countries and to sell spectrum licenses. Regulators have carefully developed this auction system based on the advice of economics theorists and actual outcomes. However, those experiences and derived knowledge have allowed design developers to improve the auction system. The Table 6-4 shows the instruments that economists recommend to make improvements [3][13][11]. Regulators can change the auction system to yield desirable result by applying those instruments; however it is difficult to guarantee results. Analyses are based on past auction results, but telecom regulators still have not been able to perform a quantitative analyses to ascertain key data and theory that can tell them what, how much and to what extent should regulators change processes to achieve desired results in the practical use. However, increasing the possibility to yield desirable or expected results means much for regulators by clarifying necessary conditions for auction based on qualitative analysis. In addition, telecommunications regulators need to be careful to change those instruments. The various factors interact intricately in many cases; therefore the apparently no-effect change can create disastrous consequences [3].

Table 6—4: Instruments to Improve the Simultaneous Ascending Auction

	Boosting the License Price	Winner's Curse: Licensee Dissatisfaction	Small Number of Participants	Collusive Bidding and Demand Reduction
Prequalification Process	Weed out speculative bidders	-	Strict prequalification reduces the number of participants	-
Number of licenses	Case by case. But the more licenses than the applicants generally cause no competition in auction	Fewer number of licenses increase the risk to miss evaluate the license value because of the stronger pressure to compete with other participants	Fewer licenses than the incumbent number greatly reduce the newcomers' motivation to participate in auction. Regulators should reserve at least one license for newcomers	Fewer licenses and larger licence size prevent collusion and demand reduction
Information Sharing	Full information revealing backs up aggressive bidding and possibly boosts the license price	Full information revealing saves bidders from Winner's Curse	Full information revealing may reduce motivation of newcomers to participate in auction	Information revealing such as bidding price and the bid license number allows signaling for collusion and demand reduction
Payment Method	Elimination of installment payments prevents speculative or over optimistic bid	Strict payment rule makes bidders estimate the license value more carefully	-	-
Reserve Price	-	-	Extremely high reserve price reduces the number of participants	High reserve price reduces the motivation for demand reduction
Withdrawals	No withdrawal rule possibly causes price boost because of strategic behavior	Appropriate withdrawal prevents winner's curse by providing escape way	-	-

Source: Author, 2006.

6.2.1 Prequalification Process

Regulators can ensure the auction bidders' various abilities higher than a certain level through a prequalification process that filters out weak potential bidders based mainly on their financial and technological abilities. The number of actual bidders may decrease through the prequalification process, thus an auction process could set up weak competition. However, this process can increase the efficiency of outcome by reducing the randomness of participation, which can also improve the security of bidders' confidential business information, and facilitate the participation of higher-value bidders [1]. In addition, the exclusion of bidders, who do not have a practical business plan and sufficient technological ability and a solid business plan and financial backing, can lead the auction to yield more serious winners for the introduction of wireless service, rather than the speculative purpose.

Auction prequalification types differ based on the filing methods used. If regulators examine detailed business plans and bidders' technological ability, prequalification is similar to that of a comparative examination. In such a case, regulators suffer from problems such as information asymmetry and imperfect ability of information processing, etc. On the other hand, when prequalification only verifies that potential bidders' financial ability satisfies certain minimum standards, the prequalification may serve simply as a check.

Regulators basically pre-qualify applicants according to the provided criteria. They can exclude speculative bidders and reduce the risk of granting licences to companies which are technologically and financially weak to develop infrastructure and start service by pre-qualification process. Overly strict and distorted criteria run a risk of excluding the potentially beneficial bidders and reduce the advantage of auction to yield the optimal licensees. Regulators should provide minimum requirement for this process.

6.2.2 Number of Licenses

When telecommunications regulators set license numbers this affects every moment of the auction process. The assignment of prepared licenses defines the industry structure and character. For example, if the government decides to give out 3 licenses for all and 1 license only for newcomers even though there are 4 incumbents, at least 1 incumbent will lose a license; however the industry can be more dynamic when newcomers can enter the market because they are expected to develop the business aggressively in order to get market shares, then incumbents also become aggressive to save or increase their share in order to survive competition. Considering the strength of incumbents, if 4 licenses are prepared for all in the market with 4 incumbents, the newcomer may lose motivation to participate in the auction because it assumes it will lose the game, and then the same incumbents will carry out business in the next generation.

In the case of the 3G spectrum license, many high-income counties followed the "n+1" model to set the number of the spectrum licenses, i.e., the number of 3G licenses equals the number of existing 2G licenses plus one [32]. The n+1 model promotes competition by attracting newcomers because at least one license is set aside for a newcomer. The exceptions were, for example, Netherlands, which set the number of 3G licenses to that equal that of 2G, i.e., the "n" model. Meanwhile, Hong Kong followed the "n-2" model. And as mentioned above, Germany and Austria set the flexible number between 4 and 6 licenses. Generally, each regulator could prepare 4 to 6 licenses, thus they could take their own desirable license number policy within the condition on the preparation of licenses.

Is it possible for governments to figure out the most effective license configuration based on the current market structure? How many licenses should be prepared? Should

the government set aside licenses for newcomers? These are critical issues for regulators to understand so they can optimally allocate spectrum resources, and keep industries competitive and innovative.

The two methods are predominantly used by the telecommunications regulators: (1) the government predetermines the number and capacity of licenses, i.e., US and UK type; (2) bidders shape the number and capacity of licenses through competition based on numbers of units which they win in the auction, i.e. German and Clock type. The section 6.1 describes the features of each design.

Telecommunications regulators select the number of licenses to auction based on the current market structure and their assessment of the market impact. Generally, incumbents have greater financial capacity and a stronger ability to estimate the spectrum value compared to newcomers due to their experience in the field. Moreover, potential newcomers have at least two disadvantages including the high fixed cost of developing a network, and incumbents' efforts to keep them out of the auction by increasing their bid amounts for new licenses [29]. Thus, newcomers can easily be discouraged from participating in auctions. At this point, it is important for regulators to make the number of licenses to be auctioned larger than the number of incumbents in order to welcome newcomers. UK regulators decided to employ the basic simultaneous ascending auction and prepare one license for newcomers after it realized that 5 licenses could be auctioned for a market with 4 incumbents [7]. As a result, many companies joined the auction which made it a competitive auction. In the case of the Netherlands, regulators decided to provide 5 licenses for a market of 5 incumbents. Though 10 companies expressed their interest in the auction by the registration deadline, only 6 companies participated because the most of

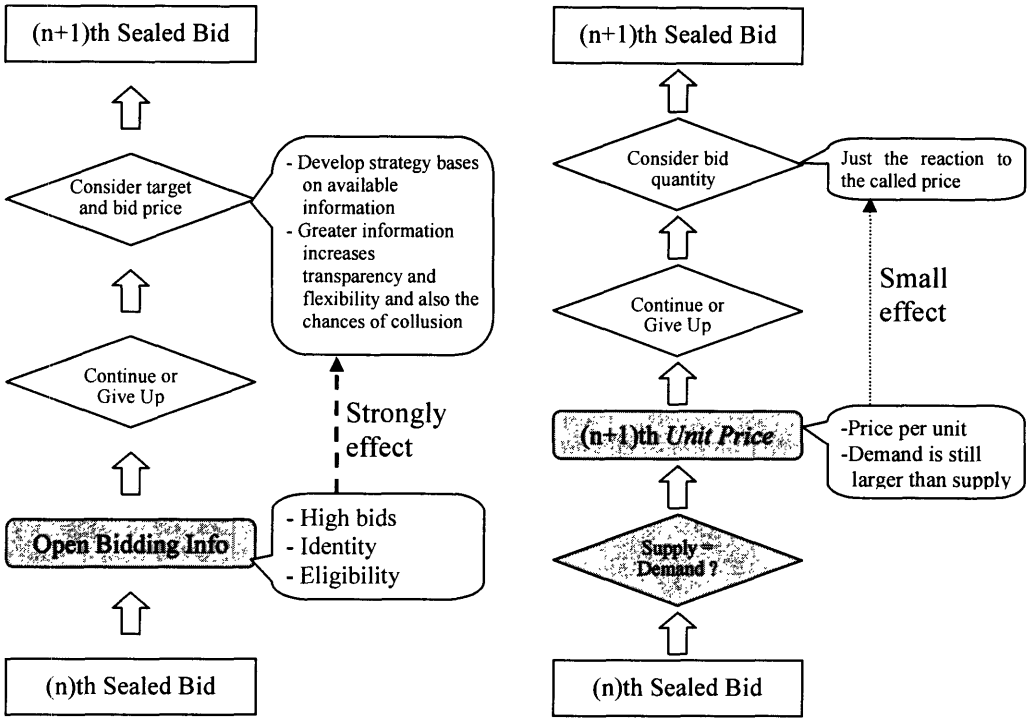
new entries considered 5 incumbents win 5 licenses eventually and then lost motivation to participate in the auction.

The German type and clock auction use the flexible number setting. Jehiel et al. note that this flexibility motivates incumbents to acquire more than the minimal capacity and to completely preempt licenses in order not to allow newcomers get into the market [25]. Cramton mentions that the German design might be improved if the regulator reserved two blocks only for newcomers [3]. However, the auction result was not as expected like that only four incumbents got licenses, but four incumbents and two newcomers got licenses. Furthermore, the German and Austrian 3G auction cases show the attractiveness for newcomers based on an analysis of Grimm et al. [5].

As long as regulators satisfy technological conditions, they should prepare the more number of licenses than incumbents. Providing at least one more license than the number of incumbent, the regulator can reserve at lease one license for newcomers and attract them to participate in auction to bring about dynamics in the market. Meanwhile, it is considered difficult to reserve a license for newcomers when regulators can prepare fewer or the same as the number of incumbents. In the case, regulators need to provide some special treatment to motivate newcomers to participate in auction.

6.2.3 Information Sharing

One notable feature of the simultaneous ascending auction is the information sharing process. The US, UK and German type of simultaneous ascending auction provide a value discovery process to bidders. This process reduces the risk of Winner's Curse by informing bidders of other bidders' evaluation and allows them to correct the bidding price so as not to overestimate a bid or become over optimistic to win by the current bid [10][11][13].



(1) US, UK, German Type **(2) Clock Auction**

Source: Author, 2006 based on [10][11][13].

Figure 6—6: The Auction Type and Information Sharing Policy

This also helps bidders to make aggressive bids because they know others' evaluation, and feel more confident about their own bid, which consequently, increases the governmental revenue.

However, information-sharing increases bidders' ability to carry out collusive bidding in which bidders can decide on a bidding strategy based on information gleaned from the previous stage such as the identity of bidders, their target objects and their bid amounts. If bidders can send signals to other bidders knowing other bidders' general business ability and spectrum evaluation, collusive results can occur such as in the German GSM case of demand

reduction. This information sharing can also bring about unnecessary price increases by bidders to deplete competitors' financial reserves needed for developing infrastructure because they know or can estimate which companies bid where and how much money they bid [28].

Cramton states that the most common implementation of information-sharing policy is full transparency. Bidders can be informed on various issues: (1) the bidders' identities and the size of deposit at the start of bidding (2) high bids and bidder identities after each round, and (3) all bids and bidder identities at the conclusion of each round. Still Cramton also notes that concealing the bidder's identities reduces the effectiveness of bid signaling and prevents collusive bidding. Anonymous auctions may be preferable as long as it is difficult to explain that revealing identity of bidders can enhance auction efficiency greatly [13]. The clock auction can realize both efficiency and reduction of collusion taking advantage of information-sharing control. Bidders only can do to reveal its demand quantity at the called price only to the auctioneer. Therefore, signaling is difficult and collusion is thus greatly reduced.

The information sharing process has a tradeoff. If regulators decide to reveal more information of auction process, they can increase transparency, but they also suffer from a risk that bidders take advantage of provided information and bidding process to collude and take strategic behavior. Within the degree that an auction can provide price discovery process for bidders, regulators should take conservative information policy. Anonymous auction is one alternative. Information sharing is greatly reduced in the clock auction than US and UK type and German type auction because of its auction process. The regulators can reduce the anxiety on information sharing issue by employing clock auction.

6.2.4 Payment Method

The payment method offered to bidders affects their motivation to bid. Winners typically pay a total of bidding price in two or three times: a refundable deposit before an auction, and a final payment in FCC auctions. Paying a refundable deposits demonstrate a bidder's seriousness and often sets the bar for bidders' eligibility. Therefore, if a bidder wants to win large services or contracts it usually needs to pay a large deposit [3][13]. In England's 3G auction, the government offered up-front payments and installment plans that allowed winning bidders to pay 50% of the bidding price over a 5-year period with interest; however the install payment seemed too costly to many companies [18]. The FCC offered installation payments until it experienced speculative bidding in the C-block broadband PCS auction. Favorable payment methods and plans boosted the bidding price because bidders could increase flexibility and the maximum amount of financing but they also caused many major bidders to default on their payments and declare bankruptcy, which led to the abandonment of the spectrum (essentially a waste of spectrums). Cramton concluded that installment payment plans are undesirable because they prompts some bidders to speculate, which leads to loan defaults and bankruptcies [3][13]. Up-front payment is currently the major payment method for most types of auctions worldwide.

The royalty payment method is popular among many economists because it facilitates auction entry for many bidders because the government essentially shares the risk to carry out the business and also enables newcomers to keep the payment small for any given royalty rate compared to incumbents [7]. However, royalty is not considered a good option by several experts [7][19] as it reduces the incentive for developing business after the auction because the bidder keeps only a fraction of the generated revenue [19]. Binmore et al.

suggests that the royalty payment method generates deadweight losses in an oligopolistic industry such as telecom, and allows bidders to default and prompts others to try to renegotiate the royalty rate in case an optimistic business plan turns out not to be realistic [7].

Payment method affects the seriousness of bidders and speculative bidding. Based on the past auction experiences, regulators should not give the option of the installation payment as long as they can not explain installation payment does not facilitate speculative bidding.

6.2.5 Reserve Price

The reserve price is an effective method to secure minimum government revenue and to prevent collusion by setting the minimum price of each license or unit. The government receives at least the amount of money as much as the reserve price multiplied by the number of licenses which it sells during an auction. The reserve price plays an important role when an auction has few contenders as in the Switzerland 3G mobile license auction. The Swiss Federal Office of Communication set a very low reserve price expecting high revenues, the same as the German or English auction did, though economists advised setting high reserve prices because this is often unfavorable to politicians and bureaucrats [17]. They think high reserve price setting brings about the impression that government exploits from private companies. As a result, the Swiss government received only SW FR 50 million from three companies and FR 55 million from a company under the condition of paying a SW FR 50 million reservation price for a license, which is quite low revenue (i.e., 19 Euros per capita compared to England's 630 Euros per capita and Germany's 615 Euros per capita) [12]. If the Swiss government required a higher reserve price, it could have raised more revenue. The Turkish government had a bitter experience brought on mainly because it had inadvertently set the reserve price for telecom licenses in 2000 [11]. The Turkish

government implemented two sequential auctions, setting the second auction's reserve price equal to the sales price of the license at the first auction. As a result, one company bid for the first license with an extremely high overly evaluated price. However, no company wanted to pay such a large amount, higher than the reserve price set equal to the extremely high overly evaluated price, for the second license for the second auction and consequently, licenses remained unsold, and as a result, the winner of the first license came to dominate the market. The lesson learned from this is that government officials should be careful in setting reserve prices and should consider the various risks they may face as a result.

The regulators can control motivation for collusion by setting a reserve price. Klemperer states that an incorrect or poorly configured reserve price facilitates predation and collusion. Strong and experienced bidders have the power to lead the auction in a short time at a low price, which can lead to demand reduction, or to the exit of weak bidders. Because the lower reserve price allow bidders to start negotiation in an auction by signaling from the lower price level, and then reach the consensus at the lower price. The lower reserve price leads demand reduction [11]. Meanwhile, setting a high reserve price reduces the incentive for demand reduction, because a higher reserve price lowers the bidder's benefit gained by reducing demand. In addition, a higher reserve price reduces the number of rounds in an auction because the bidders reach their limit of budget for the auction than starting from the low reserve price; therefore bidders have to reach a consensus on how to split the licenses in a shorter period of time [13].

The Japanese government presently administers a spectrum policy based on the revenue from current spectrum use fees. Therefore, the auction reserve price should be set to secure at least the same amount of funds if regulators plan to use the auction revenue also as an administration cost.

6.2.6 Withdraw

Simultaneous Ascending Auctions generally allow bidders to exercise the withdraw option, which essentially allows bidders to back out of a failed bid such as a bid based on an over-estimation. Bidders have used the withdraw option as a strategic instrument in one of three following ways: (1) as a bidder's signal showing its willingness to give up one license in exchange for another, (2) to maintain eligibility without bidding on desired licenses, and (3) to acquire, near the end of an auction, more preferred licenses that are freed up after the a another bidder's decline [13]. To reduce this type of strategic behavior, regulators have limited the withdraw option; for example in FCC auctions, a bidder can use it at most two times; in the UK and Belgium, regulators do not allow bidders to rejoin the main auction after they withdraw, however they provide three waivers, which allows bidders to take no action, i.e., they can not bid or withdraw in a round [24][45].

The limit to withdrawal is necessary to control undesirable gaming behavior and to increase the efficiency of an auction. Regulators need to select between giving a few chances of withdrawal and granting no withdrawal but waivers. Because withdrawal and waiver are part of the auction process, this selection depends on the choice from three types of simultaneous ascending auction.

6.3 Secondary Market

The establishment of a secondary market is the major issue for regulators and bidders when they transfer from command and control to a market-oriented regime as well as when introducing auctions. In general, secondary markets may increase the efficiency of spectrum use for those that have already have licenses, by transferring spectrum use rights

from a lower to a higher value user [46][47]. The secondary market provides a market-based opportunity cost, thus it gives current spectrum users incentive to conserve a spectrum by, for example, developing a new technology. However, this has a risk to regulators in that it can decrease the efficiency of future auctions; for example, in the case of reserving licenses for newcomers or giving special credit for them in spectrum auction, because newcomers may sell their license to an incumbent at a higher price than they paid in the auction to make an easy profit, thus enjoying the benefits of the government's reserve or credit for newcomers [46]. The secondary market breaks the governmental promotion for newcomers because it provides a chance for newcomers to escape from the market easily by making profit. Some scholars and regulators believe that the resale of licenses which have special preference should be restricted only for newcomers to use in order to prevent unjust enrichment [3]. Regulators do not want licenses to become the target of speculation in the secondary market as well as in an auction. Restrictions on license resale may allow regulators to manage the problems, thus they should set up restrictions in such a ways so as not to harm flexibility too much.

The efficiency of spectrum use is increased by enhancing the flexibility of spectrum holders' rights to produce services based on their choice to sell, subdivide, or aggregate those rights [48]. In addition, the secondary market also provides the companies, which has been considering getting into the market, chances to get a license after an auction. Thus, telecommunications regulators can expect to relax the pressure of companies which believe the auction is the last chance to get into the market, and then it can reduce the risk to boost the bidding price in auction.

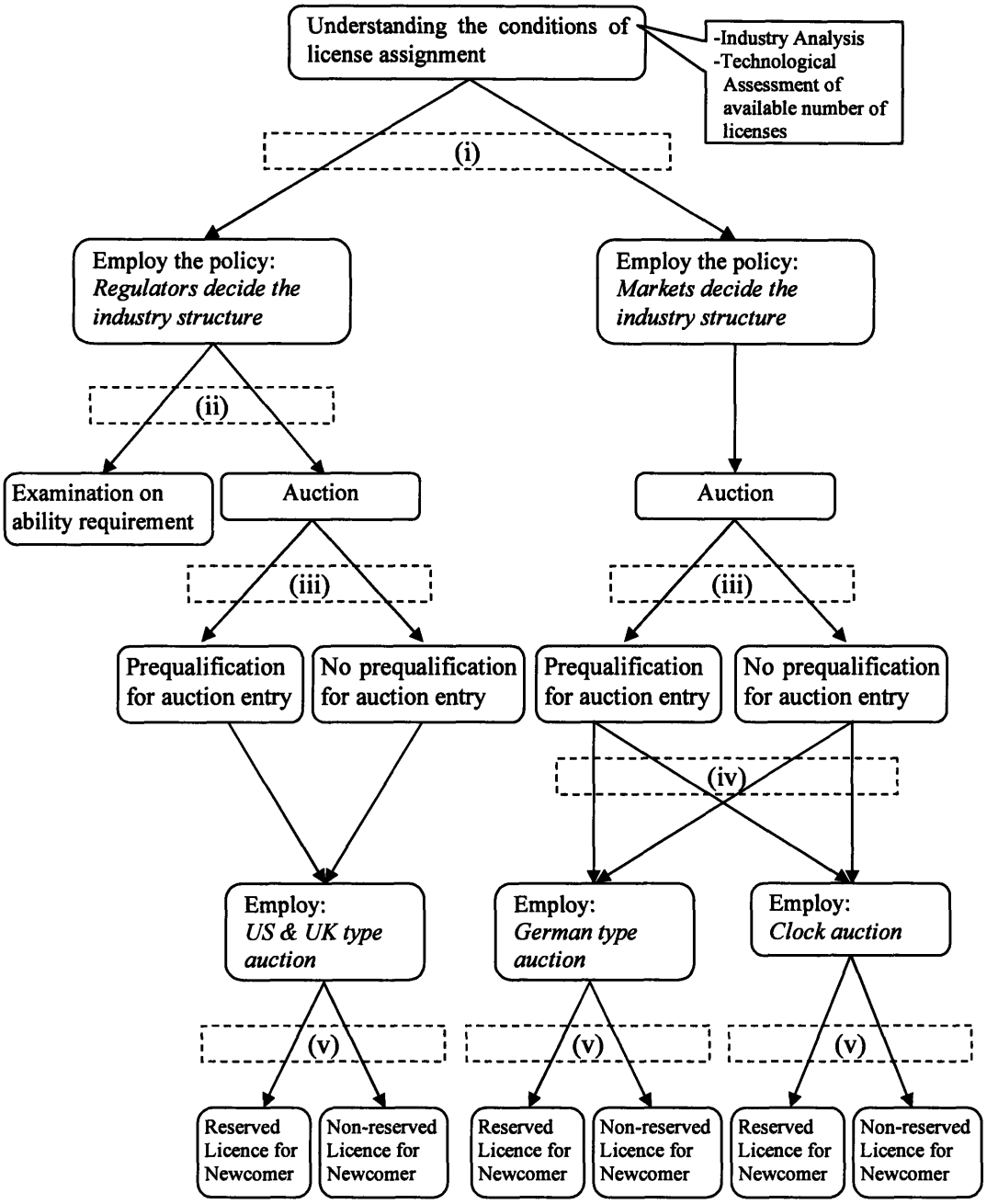
The secondary market increases this flexibility; the success of a secondary market for

spectrum license trades depends on the ability of the trading mechanism to minimize transaction costs and maximize traders' surplus [47]. Regulators can devise a market and an auction design with economists' cooperation.

6.4 The Strategy to develop auction Design

This section discusses the strategy to develop auction design for Japan. Telecommunications regulators such as FCC in US and the Office of Communications (OFCOM, RA was merged to OFCOM) in UK design auction based on the theoretical and empirical research asking the consulting for economists expecting to realize each goals such as optimal allocation of spectrum, yielding high revenue, etc. However, the auctions implemented in US and Europe did not always yield the expected results. Economists analyzed those results and the causes inherent in the auction designs, and also enhancement measures as described in the previous sections. The results of those analyses are the fundamental of the strategy.

Regulators must examine two issues with regard to license assignments. The first is how to decide the number of licenses to auction off and the size of licenses such as the assigned width of spectrum band; the second is who will receive the license and for what price [49]. The Figure 6-7 describes a framework for auction design, with which we examine the case of Japan below. It involves five decisions—Decision (i) corresponds to the first issue while Decisions (ii)-(v) correspond to the second one.



Source: Author, 2006.

Figure 6—7: The Strategy for the development of a General Auction Design

- ***Decision (i): How to decide the number and size of license***

  Regulators must decide on whether to utilize the market mechanism in deciding the number and size of licenses. The market mechanism is expected to yield optimal licensee combination. If a few incumbents dominate the market, however, the use of a market mechanism exposes regulators to a risk that incumbents preempt spectrum and exclude newcomers as described in sections 6.1.2 and 6.2.2. In deciding whether to use the market mechanism, the regulators should analyze the market structure.

- ***Decision (ii): Auction or Administrative Examination***

  In the case that regulator sets the license number and size uniformly, there is a possibility of no competition—fewer than, or as many companies as, the licenses could apply. In such situation, regulators can grant licenses through the administrative examination on capability requirement

- ***Decision (iii): Requirement of prequalification***

  The prequalification process allows regulators to limit the speculative bidding and to exclude the companies that are very vulnerable both technically and financially. Regulators should set prequalification stage if it wants to ascertain that license-winning companies would actually deploy infrastructure and start service. Prequalification process is a kind of administration examination, which suffer from problems such as information asymmetry and imperfect ability of information processing, etc. as described in section 3.3 Overly strict and distort criteria have a risk of excluding the potentially beneficial bidders and reduce the advantage of auction to yield the optimal licensees. Regulators should provide minimum requirement for this process.

- ***Decision (iv): German type auction or Clock auction***

  In the case the regulator lets market decide the license number and size; it has two alternatives for the auction design: German type auction or Clock auction. The section 6.1.2 and 6.1.3 describes the characters of those two types. German type has been used a couple of times, while the clock auction was used only once. Nonetheless, because of its stronger resistance to collusion and strategic behavior, Clock auction has many advocates. Regulators should proactively examine the employment of clock auction based on the theoretical and experimental research.

- ***Decision (v): Reserve license for newcomer or not***

  Basically, incumbents have stronger bidding positions than newcomers. Even though regulators deliberately choose auction design, it is difficult to remove the risk that incumbents preempt all spectrums. Therefore, regulator should reserve the license for newcomers based on its policy about how to develop market for the new service.

In addition, Regulator needs to take into account the following enhancement measures, which are not included in the strategy, to increase the possibility to achieve its auction goal.

- ***Information Sharing Policy***

  The outcomes of the auction change according to the degree of information openness in an auction process. The section 6.2.3 describes on the issues on information sharing. The information openness has tradeoff. More information increase transparency but brings about risk of collusion and strategic behaviors. Within the degree that price auction can provide discovery process, regulators is better to take conservative information policy.

- ***Payment method***

  Regulator should request auction participants to pay deposit, and allow auction winners only lump-some payment, but not install payments as described in Section 6.2.4. Payment method affects the seriousness of bidders and speculative bidding. Regulators should learn from the experience in US. Risk-averse regulators should employ lump-some payment.

- ***Reserve price***

  The Reserve price has two meanings for regulators. It is effective to secure minimum government revenue and prevent collusion. In addition, regulators need to set based on it monetary evaluation of auctioned spectrum. Section 6.2.5 describes points of concern. The reserve price should reflect each country's circumstance such as the result of past auction, the past spectrum use fee, etc.

- ***Withdrawal or waiver***

  No limit on the withdrawal and waiver has induced the strategic behaviors in the past auction as described in section 6.2.6. Regulators should limit the number of withdrawal or give the limited chances of waiver instead of withdrawal based on the selection of auction design from three types of simultaneous ascending auction.

Chapter 7

Designing Japanese Auction

This chapter discusses the auction design to apply for the licensee selection process in the current Japanese spectrum management system. Discussion applies the design strategy as described in Chapter 6 to develop the auction design for two Japanese cases assumed in Section 2.3.

This auction design process requires the Japanese regulator to understand various conditions of the license assignment, which derive from market and technological conditions, such as the number of incumbents, market expectations, and the number of technologically available licenses. The two cases assume to assign spectrum license for 4G mobile service in Japan. No concrete official plan has decided on the spectrum allocation for 4G mobile service that assume there is enough spectrum bandwidth that technologically allow to prepare two more licenses than the number of incumbents.

The first case assumes one very strong incumbent, two weaker incumbents in term of such as the market share, and two weak newcomers in term of such as bidding capability; the second case assumes three incumbents which are similar in strength, the one strong newcomer (such as abundant foreign capital), and the three weak newcomers.

Strategy allows us to consider decision (i) to (v) and enhance measures taking into accounts the market conditions and following government requirement on auction as described in chapter 4.

(1) Equitable and Transparent Assignment Process

(2) Optimal Assignment of Spectrum Resource

(3) Attractive to Newcomers

(4) Efficient Assignment Process

(5) Weed Out Participants with Speculative Purpose

(6) Secure Enough Government Revenue for Spectrum Administration

7.1 Case 1: One very strong incumbent, two mid-sized incumbents, and two weak newcomers

The first case assumes a large power difference among incumbents, with some newcomers interested in entering the industry.

Table 7—1: Auction Participnts in 2010 – Case1 –

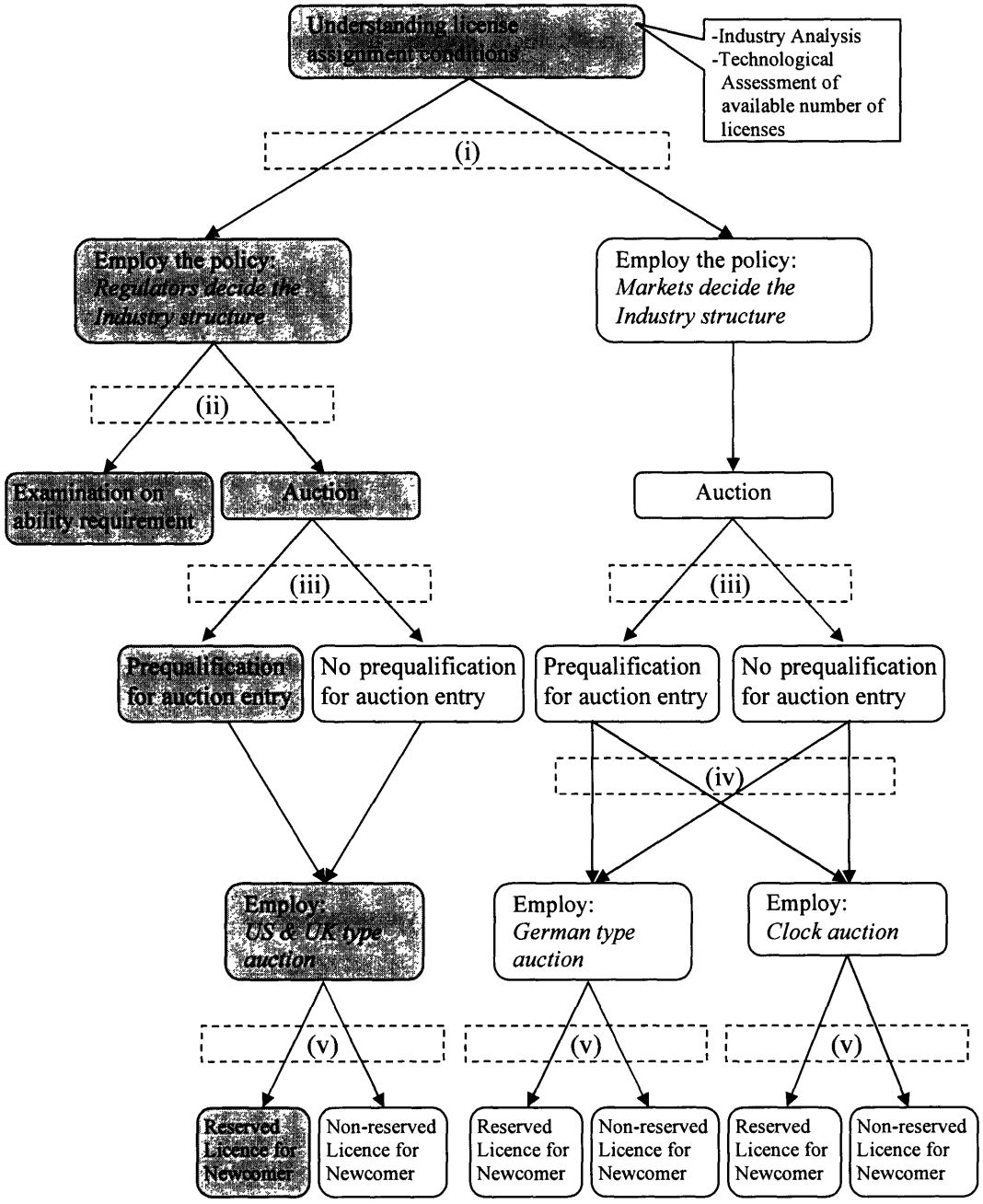
Name	Category	Subscriber (million)	Sales at 2005.3 (bUSD)	Remarks
NTT Docomo	Incumbent	65.26	53.7	-
au + Tu-Ka (KDDI)	Incumbent	37.38	29.7	-
BBmobile (Softbank)	Incumbent	24.49	20.5	Merged with Vodafone in 2006.3
eMobile (eAccess)	Newcomer	5	4	Licensed 2005.11
ipmobile	Newcomer	11	8	Licensed 2005.11

Source: Author, 2006, Based on Table 2-4.

Decision (i) requires the government to choose who will decide the industry structure based on the number of licenses and the size of license. In case 1, it is clear that three

incumbents will try to secure the license by all necessary measures, and that all of them will receive a license. Even when newcomers appear, the power difference between the incumbents and newcomers does not easily allow newcomers to win, thus they can expect the government to give special treatment to newcomers as discussed in the previous chapter. The important point is how the government decides the size of the license. As of September 2005, the market share of mobile companies was as follows: 56.0% — NTT Docomo, 23.2% — KDDI and 16.8% — Vodafone (now, SoftbankBB). NTT Docomo is clearly the largest company. Furthermore, the mobile number portability system will be introduced in November 2006. The system allows users to change mobile phone companies, for example from NTT Docomo to KDDI, without changing the mobile phone number which users use in the service of previous mobile company. Though this case assumes that NTT Docomo will still maintain a large share in the mobile market in 2010, the number portability system may give threaten the company's market share. Thus, NTT Docomo may attempt to get a license with as large as possible spectrum capacity, exerting its bidding power to secure its position in the market from the spectrum capacity perspective, if the government allows the auction to decide the license size by employing the German type or clock type auction. If NTT Docomo gets a very large spectrum capacity license, it will likely take advantage of the large license to keep its very strong position for the next generation of service.

The Japanese government should provide the same size spectrum share licenses to create a healthy competitive environment considering its objective of developing fair competition. The number of licenses depends on the total available spectrum bandwidth and technological conditions. The current 3G licenses assign the same size spectrum bands as well regardless of the huge difference of each bidder's market share, thus setting the same



Source: Author, 2006.

Figure 7—1: The Auction Design for Case 1

size license is not an issue. If the government can offer the same or more licenses than applicants, it does not need to implement auction, but just examine the required ability to implement the mobile phone service. If the license number is more than the number of applicants, the government should still carry out an auction. This is decision (ii). One of the goals of Japanese government in holding auctions is to introduce mobile service practically as soon as possible and to prevent speculation. The pre-qualification process allows the government to select auction bidders from the pool of applicants by examining the required criteria. The criterion setting reflects the government's intention. The Japanese government should employ the pre-qualification process and request bidders to submit practical business and system development plans in order to realize its purposes. Criteria should include those mentioned in a "comparative examination utilizing market mechanism" of MIC's study group, such as the population cover ratio. This is decision (iii).

When the government sets the license number and licenses' spectrum bandwidth sizes, as this design calls for, the auction design resembles the US and UK type. The basic assumption is that the design assumes a simultaneous ascending auction base, but not other designs such as the first-price or the second-price sealed-bid auction.

Newcomers have much weaker competitive power compared to incumbents in terms of financial capacity, value estimation ability and bidding strategy ability, etc. Newcomers recognize this difference and that winning licenses is difficult, and this may discourage them from participating. Thus, the Japanese government should reserve at least one license to recruit newcomers in order to maintain market dynamism and innovation, and thus enhance the economy and the nation as a whole. This is decision (v).

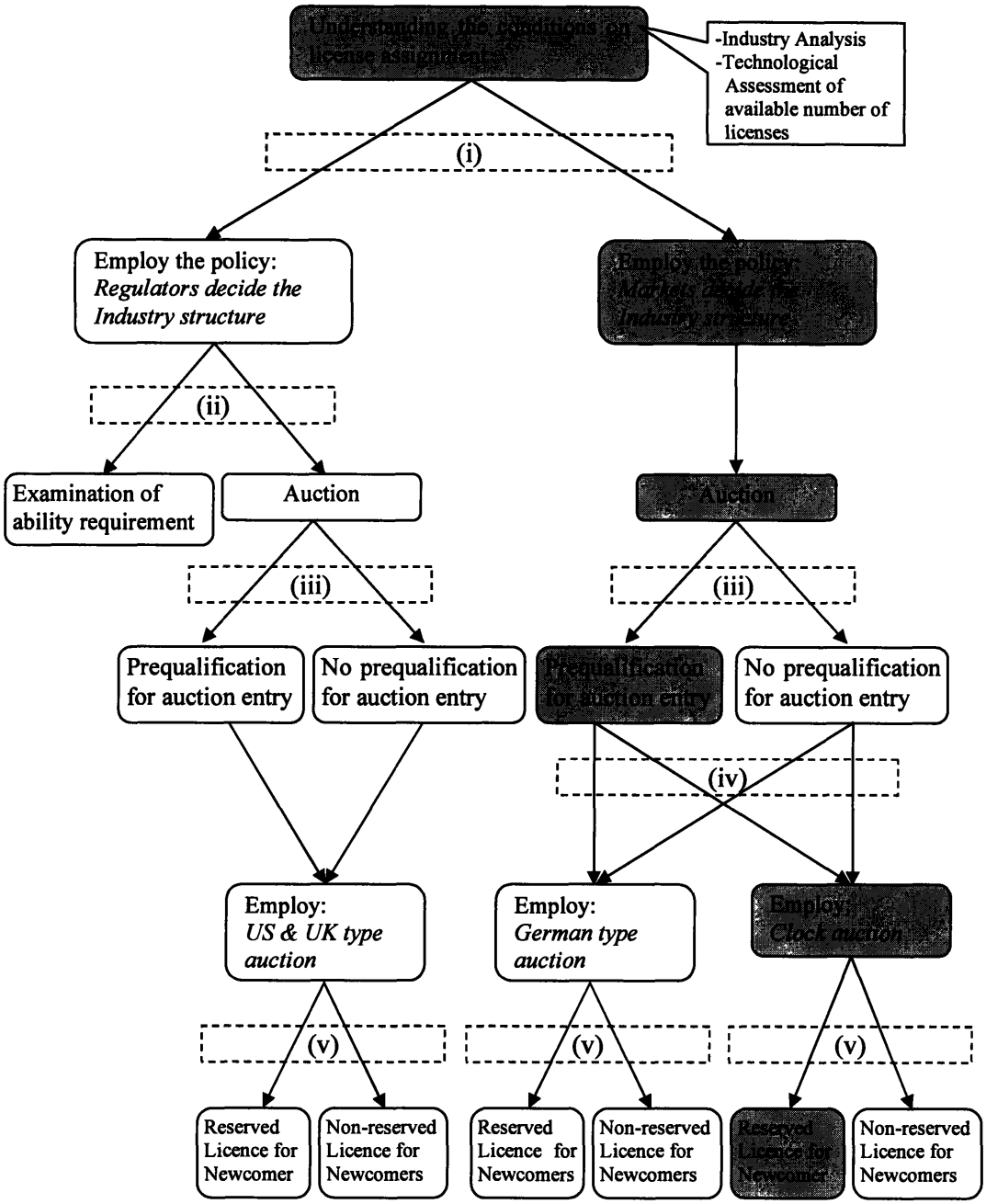
7.2 Case 2: Three same-size incumbents, one strong newcomer, and three small-sized newcomers

This second case assumes that the incumbents' powers are relatively equal. Furthermore, one newcomer has a pronounced effect on incumbents, and the other newcomers have certain powers as well but still weak comparing to incumbents. The case assumes that the introduction of the number portability system will transfer many users from NTT Docomo to other incumbents between 2006 and 2010. In addition, one more powerful newcomers showed up as well as one weak newcomer, compared to the case 1, because of the market structure changes and increases expectations for the new business.

Table 7—2: Auction Participnts in 2010 – Case2 –

Name	Category	Subscriber (million)	Sales at 2005.3 (bUSD)	Remarks
NTT Docomo	Incumbent	48.95	40.3	-
au + Tu-Ka (KDDI)	Incumbent	40.64	35.1	-
BBmobile (Softbank)	Incumbent	34.27	28.7	Merged with Vodafone in 2006.3
eMobile (eAccess)	Newcomer	6.6	5.3	Licensed 2005.11
ipmobile	Newcomer	12.6	10.1	Licensed 2005.11
Strong Newcomer	Newcomer	-	-	
Weak Newcomer	Newcomer	-	-	

Source: Author, 2006, modified from Table 2-5.



Source: Author, 2006.

Figure 7—2: Auction Design for Case 2

This situation allows the government to let the market decide the number of licenses and their bandwidth size. Klemperer and Jehiel et al. critiqued this method saying strong incumbents win the bids for licenses as explained in the previous chapter. Still the government can expect a balanced competition in this case, because the competitive powers of participating companies are relatively equal between incumbents, and many companies vie for a right to participate in the next mobile market. This is decision (i); the market decides the number of licenses and their size under the some conditions set by regulators.

The prequalification process should be introduced based on the same reason as in case 1 for the purpose of securing and facilitating the mobile phone service as soon as possible, and of preventing speculative bidding. This is decision (iii).

The government has to consider which is better — the German type or Clock auction. Both types of auctions separate the spectrum into units of bandwidths, then, auction off units. Bidders set the price in the German type; meanwhile sellers set the price in the Clock auction. This difference changes the information environment and strategic behavior of bidders. The Clock auction is more resistant to collusion than the German type, and the rules are simpler as well. The Japanese government should employ Clock auction rather than German auction mainly because it can possibly allocate spectrum resource to the more optimal set of licensees because clock auction control the strategic behavior better, and then reduce distortion of competition process more and prevent incumbents trying to exclude newcomers from market. This is decision (iv).

However, if the government wants to recruit newcomers, it should reserve some units for them even though clock auction is familiar to newcomers. Newcomers compete for the reserved license, and possibly for other licenses. This is decision (v). Furthermore, the

Japanese government has to set rules to assign specific spectrums to the unit acquired by bidders in order to avoid conflict between wining bidders and to prevent a waste (of time and resources) as occurred in German 3G auction. Table 7-3 summarizes the auction design for the case 1 and the case 2.

Table 7—3: Auction Design for the Japanese Cases 1 and 2

	Case 1	Case 2
	One strong incumbent Two mid-size incumbents Two weak newcomers	Three mid-size incumbents One strong newcomer Three weak newcomers
Type	US & UK type	Clock Auction
Prequalification	Yes	Yes
Reserve for newcomer	Yes (1 ore more)	Yes (Some units equal to 1 license or more)
Number of license	More than N+1 (Total license number depends on technological conditions)	Between N and N + α (α depends on technological conditions, this case assume two)
Info Sharing	Conservative (Open only bidding price)	Follow Clock Auction Rule
Payment	(1)Down payment soon after the end of auction (2)Lump sum payment of the rest by due date (No instalment payment)	
Reserve Price	Based on the current spectrum usage fee	Based on the current spectrum use fee (beginning call price by seller)
Withdraw or waiver	2 or 3	-
Others	-	Set a rule on assigning specific spectrum to the unit

Note: N is the number of incumbents in the market.
Source: Author, 2006.

Chapter 8

Conclusion

8.1 Summary of the Thesis

The thesis purposes to propose the introduction of an auction into the licensee selection process for the exclusive spectrum license in Japan. The mobile industry is employed as the basis for discussion. The process of spectrum license assignment directly shapes the initial market structure; this is because the spectrum resource is the prime requirement for those who engage or want to start a business in the wireless communication industry, and companies basically can't use spectrum without licenses for businesses.

The spectrum licensing policy affects the development and decline of the wireless communication industry in the first order, and those of the relevant industries in the second order. A problematic licensing process fails to assign spectrum licenses to those who may maximize the spectrum value through the proactive technology and service development activities as well as through efficient business management. In addition, the lack of transparency and fairness in the licensing process could diminish the motivations of potential newcomers to commit to the wireless communication industry. If this occurs, regulators would fail to promote the R&D of technologies and the creation of new services, and poorly grow the wireless communication industry as a result. Therefore, the establishment of an appropriate spectrum licensing system is a critical policy issue for regulators and companies in the industry.

The thesis discusses the policy environment relating to the introduction of an auction, focusing on the cases of granting spectrum licenses for 4G mobile phone service. The main

issues are the political climates affecting the legislation of the auction and auction design. The research answers the following questions.

- ***What is the problem with the current Japanese scheme?***

  The Japanese government manages spectrum resources based on the command and control, as described in Chapter 3. In the selection process, which employs comparative examination methods, there are problems with information asymmetry, imperfect information process ability, lacing transparency and unfairness, and its cost and time-consuming nature. As MIC has responsibility for spectrum licensing, this ministry carries the risk of assigning spectrum licenses inefficiently to the next optimal set of licensees.

- ***What is the alternative scheme?***

  The selection process should employ an auction instead of the comparative examination into the current spectrum management system as described in Chapter 4. The auction would enable MIC to select the best set of licensees through a transparent and fair market mechanism. US and many European countries have already introduced auctions as the exclusive use model, which grant transferable licenses with long term license periods and the (semi)-flexibility of technology and services, as described in Chapter3. The Japanese model introduces an auction into the selection process instead of comparative examination, and then keeps the license period and other constraints the same as the current system.

- ***What is the hurdle to introducing the Scheme?***

  An auction introduction faces two hurdles, as described in Chapter 4. One is the political difficulty of legislating the auction in the Japanese Diet. It will take a long

time for policy makers to accept the introduction of the auction, taking into account the current adverse attitudes of most stakeholders in Japan, and also the case of FCC in the US, which took eight years from proposal to legislation of the auction. The other problem is the difficulty of developing a design that guarantees a set of requirements for the auctions, which is described in Chapter 4. MIC has been discussed the problems caused by auction with reference to European countries, which had raised a lot of revenue from auction but weakened ICT industry in the process. Developers of auction design for Japanese spectrum licenses need to overcome those problems. These two are the focus points of this thesis.

- ***What is the political climate?***

Chapter 5 presents the stakeholders analysis of current attitudes toward the introduction of auction. The analysis is based on three sources: the discussion database of the Japanese Diet, public comments on the initial report of 2002, and on the final report of 2006, complied by the "Study Group on Policy for Effective Radio Spectrum Use." The analysis clarifies who are the most powerful stakeholders against the introduction of auction, and states that it is impossible to shift the spectrum management model as long as the current power balance is sustained. If the political environment changes because of reasons such as the deterioration of national, and if there is a more active commitment to policy making by academia and politicians, and if there is more familiarity with selling scarce national properties based on monetary evaluation, these powerful stakeholders' attitude can possibly change from con to pro.

- ***What is the optimal auction design for Japanese cases?***

Chapter 6 discusses auction design strategy based on the analyses of past

worldwide spectrum auctions. The discussion does not depend on mathematical economic theories. MIC should select a design for auctions based on the result of market structure analysis and on its industrial policy about how it wants to develop the mobile industry. Chapter 7 discusses auction design for the assumed two mobile phone market structures in 2010. The design discussion is based on the strategy developed in Chapter 6. MIC should employ the US and UK type auction when a few incumbents are very powerful than other incumbents and newcomers in the market; MIC should employ the Clock Auction if MIC can expect balanced competition when the market power balance becomes flat and a strong newcomer tries to enter the market.

8.2 What should MIC do?

MIC studied the spectrum resource management model intensively from 2002 to 2004, holding "the Study Group on Policies for Effective Radio Spectrum Use." It proposed not employing auctions in the near future, regarding them as mid and long term spectrum policy option. The stakeholder analysis clarifies that MIC is very risk-averse, in particular, on the bidding price boost which could possibly diminish the ICT industry. As long as auction design can't guarantee that the bidding price boost would never occur, and MIC maintains an anti-auction policy, then other strong incumbents would go along with MIC. Even if economic research fields advance, it may be very difficult to develop such an auction design without risk of boosting the price. However, taking advantage of established studies and advanced research, it is possible to reduce risk that causes non-beneficial competition and auction price boosts, and to increase the possibility of allowing auction participants acquire based on their honest evaluation of the spectrum license value.

Though MIC carries the risk mentioned above, associated with the auction method, MIC also carries the risk of weakening the Japanese ICT industry in the long run, by using the comparative examination process with its inherent problems as mentioned in Chapter 3. Consequently, the risk-averse policy would not necessarily work as expected. Now is the time for MIC to take a steps to use the auction method.

Thus, I recommend that: firstly, MIC should establish research projects with economists to advance theoretical and experimental studies for auction design specialized for the Japanese mobile market. This thesis presented an auction design strategy but does not touch on the mathematical economic theory. To develop an auction system for the actual needs requires detailed theoretical studies, which may be transferable to spectrum auctions for other services in the future.

Secondly, MIC should study complementary and remedy measures in case bidding prices are dramatically increased due to competition. It is impossible to know the actual auction results before auction implementation and to guarantee that problems will never occur. The establishment of deliberate counter-measures lessens the harmful impact to auction winners and ICT industries. If it introduces the auction, MIC will need a comprehensive remedial policies as well.

Thirdly, MIC should discuss the conditions of licenses such as the license period, the flexibility of technology and service, and the transferability to a third person. These conditions determine scope and characteristics of the exclusive use model, one of three spectrum management models and that uses auctions for the allocation of licences, as described in Chapter 3. If MIC provides limited conditions on licenses and allows the longer license period, the spectrum management model would have more extensive use of the

exclusive use model, and then, auctioned licenses also would have broader or more extensive property rights. The conditions on auctioned licenses increase and decrease value and affect the liability of auctions, which can cause problems. Therefore, for the success of the auction, MIC needs to decide license conditions while taking into account advantages and disadvantages of each item.

Appendix

Abbreviations and Terminologies

1G:	The First Generation Mobile Technologies
2G:	The Second Generation Mobile Technologies
3G:	The Third Generation Mobile Technologies
4G:	The Forth Generation Mobile Technologies
ADSL:	Asymmetric Digital Subscriber Line
ARIB	Association of Radio Industries and Businesses
CIAJ:	Communications and Information Association of Japan
DDI:	Daini Denden Incorporated
DTI, UK:	The Department of Trade and Industry, Government of the United Kingdom
FCC:	Federal Communications Commission
FMC:	Fixed Mobile Convergence
ICT:	Information and Communications Technology
IDO:	Nippon Idou Tsushin Corporation
ISM:	Industrial Scientific Medical band
KDDI:	KDDI Corporation
KMT:	Komeito
LDP:	The Liberal Democratic Party
MIC:	The Ministry of Internal Affairs and Communications
MOF:	The Ministry of Finance
NTT:	Nippon Telegraph and Telephone Corporation
OBRA:	The Omnibus Budget Reconciliation Act
OFCOM:	The Office of Communications
PCS:	Personal Communication Services
UMTS:	Universal Mobile Telecommunications System
WRC:	The World Radio Conference

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