The Theory and Practice of Spectrum Allocation

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[Summary]

The widespread diffusion of cell phones and internet wireless access and other technology has exposed the scarcity of spectrum. The substantial increase in the downloading of music and movies through radio transmission is likely to make this situation worse. Therefore, there is a need to examine the efficient use of spectrum, for which there are two main measures available. The first is the development of new technology for using spectrum, and the second is the revision of the method used of allocating spectrum. The latter in turn may encompass the moving of some traffic to wired lines and to changes in the auction methods used for selecting licensees.

Auctions have been widely used for the allocation of various resources and properties, including oil concessions and airport landing slots. As a recent example, auctions have been used for spectrum allocation in several developed countries, including the United States (U.S.), the United Kingdom (U.K.), Germany, and Australia. A primary motivation is that it is accepted that auctions have a number of advantages, in terms of both experience with their use and considerations of economic theory. Afualo and McMillan (1998, p. 126) summarize these as follows: "Auctions can not only raise revenue for the government, but can also generate an efficient allocation: that is, assign the licenses to the firms able to make the best use of them. The government can also design the rules of the auction to address various policy goals, such as avoiding monopoly and directing licenses to minority-owned firms. In addition, the results of an auction can provide policy-makers with useful information." In other countries, such as France, the economic value (market price) of the spectrum is calculated and charged back to the licensee-to-be.

Conversely, in Japan, spectrum allocation has been decided not by auction or some other price-based mechanism, but by administrative comparative judging. For example, in the spectrum allocation for the next generation mobile broadband communications (NGMBC, as represented by Wimax), "… the appropriateness to arrange base stations and the reliability to carry out the plan" are decision criteria. Moreover, in order to promote competition in the mobile market, the incumbent carrier is only allowed to apply for a license through a company in which it holds less than a one-third share. From the other perspective, a spectrum usage charge that only reflects administrative costs is imposed on the selected licensee. Although this measure is flexible in that the decision maker is able to set various criteria, it is argued to have "significant drawbacks" (Afualo and McMillan 1998, p. 125), in that it takes time to decide a licensee. The process also lacks transparency.

Afualo and McMillan (1998) place a relatively high value on the functions of an auction and conclude that the reason why it is not more widely employed for the allocation of resources and properties is not because of any innate disadvantage, but rather because of political resistance towards it (see also Hazlett (1998)). Is this evaluation correct? In this research, we survey past instances of auctions and reveal any problems, especially the negative effects on the contract price of business developments by the successful bidder. We then propose some measures to compensate for some of the deficiencies of administrative comparative judging through which licenses are freely issued. Finally, we examine how spectra for the NGMBC should be allocated. Our study will be useful in Japan as wireless business is expanding and the available range of frequencies is now being reexamined. Our research focuses on the fact that since new telecom business requires large amounts of investment (the NGMBC alone is argued to need several hundred billion yen), a successful bidder sometimes suffer a "winner's curse" and the retardation of business development involved could cause huge welfare losses.

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1. Introduction

The spread of mobile phones and mobile internet access has intensified the scarcity problem with frequency and the popularization of video transmission and reception has further deteriorated this situation. Policies to use spectrum more effectively are then called for. These are divided into the following classes: those including the development of technology to use spectrum; and those that revise the method used to allocate or allot spectrum. The latter contains the switchover of some uses to the wire system and the adoption of auctions to decide who uses what spectrum. Auctions are already found in the allotment of many different resources and estates, including oil concessions and airport slots. More recently, in the U.S., U.K., Germany, Australia, and elsewhere, auctions are used for spectrum allotment. This may result from recognition of their advantages. In some other countries (France), the government calculates the economic value (market price) of the spectrum, and charges it to the licensees. However, in Japan, the allotment of the spectrum is enforced not by auctions or some other price mechanism but by administrative comparative hearings. Licensees are also only charged a spectrum usage fee that is used for the payment of administrative affairs that benefit all radio stations, such as radio monitoring. Certainly, comparative hearings are flexible in that they are able to set various investigation standards. However, they have several disadvantages in that they take time and lack investigation transparency, among other things. For these reasons, they are generally viewed as an inferior and antiquated method of allotment (e.g., Afualo and McMillan 1998).

This article aims to reconsider the soundness of comparative hearings with reference to the Japanese context. In the second section, the impact of paying a contract price on the licensee's business and its effect on the opportunity for technological development is discussed. The third section presents ways to improve and complement comparative hearings. In the fourth section, the focus of discussion moves from allotment to allocation (allocation is decisions on uses, while allotment is decisions on users) of some resources and estates.[1] The issues of allocation methods based on auctions are first examined; alternative methods that are not based on auctions are then presented. The final section concludes the article with a summary.

2. Auctions

2.1. An Outline and the Circumstances of their Adoption

Auctions are price mechanisms or systems used to allot a subject to the bidder who bids the highest (or second highest) price. In recent years, the spectrum has become a target of auctions in the U.S., the U.K. and elsewhere. There are various types of auctions, and the U.S. has used multiple-round simultaneous auctions for some licenses for several spectra to cope with the so-called winner's curse and the complementariness of licenses.[2] The adoption of auctions for spectrum allocation owes much to the academic contribution of Ronald Coase and especially results from widespread dissatisfaction with comparative hearings (and lotteries). The main reasons for dissatisfaction with comparative hearings are as follows: (1) examination standards are ambiguous, so an examination is susceptible to politics (special interest parties), and the result does not guarantee the efficient use of the resource; and (2) examination takes time and is costly when the number of applicants are large. Regarding (1), Hazlett (2001) reveals that political influence was used to protect existing licensees from potential rivals in many cases, including radio (AM v. FM) and TV (VHF-TV v. CATV). The fact that the money received goes into the national treasury is raised as a secondary concern.

However, comparative hearings and an auction are not always strictly enforced. Countries that adopt comparative hearings, such as France and Japan, collect a spectrum usage fee, and in South Korea, a donation is taken as an examination standard. Meanwhile, preference has been given in the U.S. to minority and female owned firms, small businesses and rural telephone companies in auctions. Accordingly, in practical terms comparative hearings and auctions are not completely different methods for the allotment of resources as they share some advantages and disadvantages. An auction is said to be transparent because its rules are published beforehand, but it does not exclude political influence in the rulemaking process. A complex auction also takes time for design and enforcement.

2.2. Issue 1: The Effect on the Licensee's Business

The greatest concern with auctions is that a successful bid could have a negative effect on competition and/or the licensee's business. In terms of competition, as many economists regard the contract price as a sunk cost, it does

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[1] Auctions are applicable not only to allotments but also to allotment and allocation collectively. In the latter, the licensor leaves everything to the market.

[2] Many studies concern auction systems. See, for example, Milgrom (2004).

not affect service prices. However, Noam (1998, p. 774) argues that "firms may price temporarily without regard to fixed cost, but they could not survive doing so in the long run. Hence an auction payment will be reflected in prices." Using a simple Cournot model, Gruber (2001) demonstrates that the successful bid, not the number of licenses that the government decides for a certain service, determines the equilibrium or long-run market structure, and points out that a high contract price could result in an oligopolistic market structure and collusive agreements among carriers. Collusion prevents not only price competition but also capital investment (service) competition (Fig.1). An executive of the Japanese Ministry of Internal Affairs and Communications (MIC) commented that "U.S. carriers who like to keep 3G systems alive which they got at a huge expense, are negative about international grappling with a transition to 4G." (Nihon Keizai Shimbun, 2007.12.19) Hazlett (2001) considers "more liberal spectrum allocation," or the relaxation of use restrictions in each frequency band, as a remedy for the issues of oligopolistic market structures and "excessive consumer prices." However, it is not a panacea in view of the opportunity for technological development discussed in subsection 3.2. This opinion is reconsidered in subsection 4.1.

Table 1.: 3G Customer Base and Spectrum Allotment Methods

	3G Customers (thousands)			Percent*	Allotment
	Dec. 2004	Dec. 2005	Jun. 2006	Jun. 2006	
Japan	10,898	29,197	39,392	43.0	C.H.
South Korea	9,539	12,518	13,961	35.4	C.H. + Fee
Italy	2,615	10,303	13,942	18.5	Auction
U.K.	2,832	7,352	7,607	10.9	Auction
Sweden	279	522	1,010	10.1	C.H.
Austria	225	535	845	9.5	Auction
Australia	413	736	1,732	8.9	Auction
France	26	1,590	2,700	6.5	C.H. + Fee
U.S.	125	1,000	10,900	5.0	Auction
Netherlands	12	230	820	5.0	Auction
Germany	195	2,072	3,955	4.8	Auction
Spain	68	854	1,868	4.1	C.H.

*: Percent of all mobile customers

Sources: IDATE (Britton and McGonegal 2007, p. 51) and Kruse (2004), Table 10.4.

Regarding licensee's business, if the payment for spectrum increases the licensee's credit is lowered and the financing cost increases, *ceteris paribus*. Then if the expected profit of the spectrum-using business is fixed, capital investment decreases (particularly if it is restricted to some large cities). A bid also depends on the state of mind about the *expected* profit of the spectrum-using business. Consequently, when uncertainty about supply and demand is high, the formation of expectations becomes difficult and the "winner's curse" is likely to result.[3] Because of this, the licensee may be forced to amend or withdraw their business plan. Dempa Yukō Riyō Seisaku Kenkyūkai (2004) found that after the auctions of the 3G mobile phone (UMTS) licenses in the U.K. and Germany in 2000—licenses for €37 and €50 billion in total were sold in the U.K. and Germany, respectively—the Moody's Investor Service downgraded telecom carriers so much (e.g., Deutsche Telekom: Aa2 (00.3) → A3 (01.12.) → Baa3 (03.5.), British Telecom: Aa1 → Baa1 → Baa1) that four years after the auctions, only one carrier was still offering services (Hutchison, mostly in the London area) and two German carriers (Quam and Mobilcom) had withdrawn from the business. Kruse (2004, pp. 200–201) explains uncertainties the carriers faced in some detail:

Product and service characteristics, market opportunities and demand as well as technical specifications and restrictions, potential problems, costs, cost structures (scale economies), availability of handsets and third-party services, competitive relationships to the GSM based GPRS (General Packet Radio Service) and W-LAN (Wireless Local Area Network) have been rather unclear when the first auctions started in the year 2000. Thus, assessing the value of a UMTS license (and the value of a specific amount of spectrum) was rather difficult in general. Therefore UMTS bidders were particularly subject to the risk of the winner's curse of "paying too much".

[3] The winner's curse takes place when a successful bidder regrets his/her bid afterwards. Thaler (1988) presents some evidence from both experiments and field studies that suggest that the winner's curse may be a common phenomenon. Auction advocates refer to it perfunctorily. McMillan (1995) maintains that the winner's curse can be avoided by a properly designed auction mechanism.

Though a sluggish carrier may be allowed to transfer the license to another carrier through resale or merger and acquisition, the sluggishness of business still involves social costs at the time.

2.3. Issue 2: The Effect on the Opportunity for Technological Development

Allocation by auction is related to the degree of technological development. Even if a certain technology is promising though still immature, it is unlikely that a financially weak company will make a high bid for the service that uses the technology. Meanwhile, incumbent companies could preempt many spectra through auction, and prevent technological development.[4] Hazlett (2001) considers the example of FM broadcasting as a good example of the serious issues involved with comparative hearings. Though FM broadcasting is superior in quality, incumbent AM broadcasters resisted it and were supported by the FCC (Federal Communications Commission). However, as Lessig (2001) argues, there is the real possibility that this could also occur with auctions.

In the past, certain band frequencies have been distributed to commons where everyone has the right to use the resources. In Japan, the 2.4 GHz/5.8 GHz bands are allocated to ISM (Industry–Science–Medical) uses, and the former is used for public wireless LAN services,[5] microwave ovens and so on. Though it is difficult to forecast technological development and the value of commons, Lessig (2001), from the perspective of the ill effect of market dominance in the past, by AT&T and Microsoft on technological innovation, and Gilder (2000), in view of various technological developments in high-frequency radio (aside from their practical application), emphasize the importance of commons. In practice, commons are created in high-frequency domains, but as frequency characteristics differ by band, there may be some services that are currently not suited to frequency bands in commons. For unfettered technological development, it may then be desirable to create commons in various bands.

Another policy is to allocate spectra to specific uses, and retain certain spectra for promising technologies. Because the exclusive right of use is generally allotted to carriers, the issue of electromagnetic interference is avoided, which auction advocates regard as a serious defect of commons.[6] One example where the specification protects a certain technology and provides service diversification are personal communications services (the Personal Handyphone System (PHS) in Japan).[7] Three groups, NTT Personal (now NTT DoCoMo), DDI Pocket (now WILLCOM) and Astel, were each granted licenses in the 1.8 GHz band and commenced PHS services in 1995. At first, they smoothly increased users taking advantage of their low charges, reaching a combined peak in September 1997 of over 7 million users. However, thereafter PHS lost out to mobile phones and DSL. Now only WILLCOM remains in the PHS business,[8] though with a change in its main stockholder from KDDI to Carlile Group, a U.S. investment company. Drawing on the advantage of PHS (microcellular system) in that it is capable of handling traffic increase on its own IP network, in 2005 WILLCOM initiated a flat-rate voice service between its subscribers. This contributed to a large increase in subscribers (see Table 2). WILLCOM also introduced a nanocellular system with an automatic distributed control function that enables many workers in the same office to call at the same time. Moreover, in 2006 it started an advanced PHS (WILLCOM Optimized Adaptive Modulation: W-OAM) service with increased transmission speed in 1.9 GHz band. WILLCOM fought with three groups over two licenses in 2.5 GHz for BWA, planning to adopt the next generation PHS (NG-PHS) (which had been developed in Japan), while the other groups planned to adopt Wimax, an international standard promoted by Intel.[9] If mobile phones and/or DSL spread faster than PHS, and if the 1.8 GHz band is auctioned with no restriction on use, it is not clear if PHS will get to the market. In addition, PHS has become widespread in China, Chinese Taipei and Thailand among other countries, with China alone having more than 90 million users (PHS MoU Group).

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[4] Moreover, Noam (1998, p. 774) points out that auction revenues could yield its own interest groups who "… resist new technologies if they threaten auction revenues."

[5] Public wireless LAN carriers include NTT Communications, NTT Docomo, NTT East and West, Softbank Telecom, and Livedoor among others. The number of access points in Japan is less than in the U.S., but as at November 2005, "Japan was the only country where wireless LAN was available in subways and trains." (Greg Pierson, ex co-president of Intel K.K. (Japan)). Service at 54 Mbps based on the IEEE802.11g standard is now available.

[6] See Baumol and Robyn (2006) for criticism of commons-based interference by advocates of auctions.

[7] The following owes much to Nikkei Communications (2005).

[8] K-Opticom in the Astel group offers data service.

[9] The three groups are Wireless Broadband Planning (KDDI and others), Acca Wireless (AccaWireless, NTT Docomo and others) and Open Wireless Network (Softbank, eAccess and others).

Table 2. Accumulated Number of Contractors of Mobile Phones and PHS (unit: 1,000)

	1997.3	1998.3	1999.3	2000.3	2001.3	2002.3	2003.3	2004.3	2005.3	2006.3	2007.3	2008.3
Mobile Phone	20,878	31,527	41,530	51,141	61,137	69,349	75,944	81,921	86,998	91,792	96,718	
PHS	6,030	6,728	5,780	5,708	5,842	5,698	5,462	5,136	4,476	4,692	4,980	
WILLCOM	2,882	3,487	3,458	3,293	3,123	2,942	2,975	2,897	3,032	3,892	4,527	

Source: Telecommunications Carriers Association (www.tca.pr.jp)

3. The Improvement and Complement of Comparative Hearings

Milgrom (2004) explains various improvements since auctions were adopted for spectrum allotment in New Zealand in 1990. However, improvements are not confined to auctions. Comparative hearings can also be improved, or complemented by other policies, to help counter their aforementioned deficiencies.

3.1. The Improvement of Comparative Hearings

3.1.1. The Transparency of an Examination

In Japan, four groups applied for two licenses for BMA.[10] Before the acceptance of applications in September 2007, the MIC published examination standards, including the appropriateness of the plan of establishing base stations and the reliability of enforcing the plan, and held an open conference in November 2007 in response to a request by two of the carriers. During this conference, the four carriers who had made an application explained their business plans and discussed these freely among themselves. For example, KDDI publicized "… regarding network construction, we have gotten places to establish 6,000 outdoor base stations, and we will deploy 38,000 stations in the whole country till the end of 2012 fiscal year." (Sekiguchi 2007) The MIC eventually selected KDDI and WILLCOM as licensees, and published the result of their examination in five grades across 11 categories (population coverage, capital investment, financial condition, etc.) for all applicants to guarantee transparency and fairness.

There is some criticism of this investigation that it was eventually a decision made in a secret room, but this is going too far. Mr. Son, the president of Softbank, took the conference as a battlefield, and "… fired questions at [other applicants, especially] WILLCOM and [KDDI]" (*id*.). Such an attitude is effective in highlighting the differences between applicants that are not exactly clear on paper. Moreover, as the conference was open, the Japanese public was knowledgeable of what was discussed. The MIC was then placed under some pressure to publicize the result of the examination in detail according to the predetermined examination standards, and the scope of the MIC's discretion and political intervention was narrowed.

3.1.2. The Execution of a Contract

Though this particular comparative hearing had no rule because the government takes each business plan as the basis for judgment, it is advisable to examine carefully the ability of each applicant to perform their business plan from a financial standpoint. This involves regarding the winner's business plan as a written contract between it and the government,[11] and to award penalties for nonperformance of the contract[12] (note that attaching importance to financial standing may encourage cooperation between an innovative entrant and an incumbent with deep pockets). Enforcing deliberation of the business plan on each applicant also brings about differentiation among the applicants, and help ease comparative hearings to some extent.[13] Of course, there can be unforeseeable events, so the strict performance of a contract is not always effective (Cooter and Ulen 1997, Yanagawa 2006), and there

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[10] This is the first time there has been more applications than licenses in a spectrum allotment in Japan.

[11] In France, Orange and SFR, who each obtained licenses in August 2001, were later set a deadline for starting 3G services and required to cover 58% of the population by the end of 2005.

[12] Though KDDI was allotted the 2 GHz band for 3G in June 2000, it only deployed about 6,200 stations in seven years. As far as this investigation is concerned, it should be regarded negatively in this respect.

[13] In the allotment process of 2.5 GHz band in Japan, each incumbent carrier was allowed to apply for a license only through an affiliated company in which it held no more than one-third of the stock. Various companies then joined with each applicant and contributed to the differentiation of the business plans. Though the unsuccessful carriers expressed their dissatisfaction, no carrier filed a lawsuit as Hatfield (1993) feared may be partially due to the possibility of the business as a MVNO as discussed in section 3.2. However, it should be noted that administrative suits are rare in Japan. An exception is that Softbank sued the MIC for an injunction after it decided to allot the 800 MHz band to other mobile phone carriers (the action was later withdrawn).

should be room for renegotiation. However, if a licensee's business plan is connected with prices (a supply index) and/or economic activities (a demand index) there is little, if any, need of renegotiation.
Regarding the effectiveness of a contract, Williamson (1976) points out that the CATV franchise contracts in Oakland were often not performed due to issues peculiar to long contracts, such as uncertainties and opportunism, and the city of Oakland did not force operators to perform contracts because it was not always easy to do so. Bjuggren (2006) uses this to question the effectiveness of contracts in the process of comparative hearings and comparative hearings themselves. However, Zupan (1989a, p. 439) argues that "operators [fulfill their contracts] much better than is commonly believed," and opines that having other contract opportunities raises the value of a good reputation and restrict operators to behave opportunistically (see also Zupan 1989b and Prager 1990). This opinion is consistent with the result of a repeated game. Meanwhile, auctions do not generally fetter licensees' business and we have noted the conditions of the 3G mobile phone business in the U.K. and Germany in subsection 2.2. In the U.S., Sprint Nextel agreed with Clearwire to construct a network for WiMAX in July 2007, but cancelled it only four months later and modified its business plan. Its capital investment had been behind the original plan.

3.1.3. Cost of Regulation

Generally, a comparative hearing involves greater costs in implementation than an auction. In evidence, Oniki (2006) finds that the length of the documents describing the method of implementation for comparative hearings is longer than for auctions, and that the number of letters tend to be gradually increased. Table 3 presents the license allotment process of the 2.5 GHz frequency bandwidth for BWA in Japan. It would appear that the comparative hearing procedure is also longer than for an auction. However, the procedure related to institutional design (i.e., the acceptance for a license application) is also required for the auction method, and it takes only two months to publish a final report on license allotment after acceptance of a license application. In addition, it does not involve a large amount of administrative cost in this case because there are only four applicants. Further, the government can obtain various kinds of information about regulated carrier during these two months. Therefore, we are suspicious about claims that the comparative hearing method is out of date and not always favored.

Table 3: License Allotment Process of 2.5 GHz frequency bandwidth for BWA

2006.12.5.	Conference for BWA (public hearing about operation)
2007.5.15.	Disclosure of license policy
2007.6.15.	Acceptance for public comment
2007.8.10.	Constitution of policy
2007.9.10.–2007.10.12	Acceptance of license application
2007.11.14.	Hearings for four applicants (the first time for a total of four times)
2007.11.22.	Public conference (public debate by the four applicants)
2007.12.21.	Report by radio regulatory council (on license allotment)

Source: Various materials including newspapers.

3.2. The Complement of Comparative Hearings

3.2.1. License transfer by M&A

When the licensee is unable to implement their business plan smoothly, it takes a long time for the government to withdraw the allocated license and to reallocate it to another carrier through a series of comparative hearing processes. If this policy is taken, the consumer has to change carrier and this may be a burden. Therefore, it may be efficient for the government to approve licensee transfer for the business plan or to approve merger and acquisition (M&A) by another telecommunications carrier. In Japan, for example, Vodafone bought the mobile phone carrier J-Phone Ltd., and Softbank mobile subsequently purchased this new company, Vodafone K.K.[14]. The number of Vodafone K.K. subscribers grew at a sluggish pace (with 15,210,000 subscribers and a market share of only 16.6% just before acquisition, against NTT DoCoMo and AU with respective market shares of 55.7% and 24.7% at the end of March 2006). It is argued that this poor situation was the result of the following:

[14] Softbank Corporation is a pioneer in the Japanese ADSL market. Softbank also operates Yahoo! JAPAN in cooperation with U.S. Yahoo!, the No. 1 portal site in Japan.

(1) the developed mobile phone terminal based on group strategy, known as Vodafone Global Standard, did not to match the needs of Japanese consumer (Nikkei Communications (2005); (2) the pace of infrastructure construction was delayed. Softbank mobile began to provide low-priced services with fixed fees in sequence. The introduction of a mobile number portability system in October 2006 brought about a competitive advantage for Softbank mobile and the number of subscribers grew to 17,814,000 alongside its market share of mobile phones (17.7%). However, as mentioned in section 3.1.2., we consider that the contracts made and concluded between the licensee and regulatory authorities should be with license transfer by M&A in order to ensure the efficient use of the license and to avoid any inadequate windfall for the licensee.

3.2.2. Mobile Virtual Network Operator

A Mobile Virtual Network Operator (MVNO) is a carrier who borrows communication lines from an incumbent carrier to provide mobile communication services. MVNOs do not have to obtain a frequency license or undertake a large amount of investment. Internationally, MVNOs grew rapidly and by late 2007 held a 10% share of the European mobile phone market and a 7–8% share in the U.S. However, MVNOs have only just begun to provide services in Japan and are still relatively small. The carrier who lends out telecommunications equipment can improve utilization efficiency. In addition, the entrance of MVNOs into the telecommunications market is expected to promote competition by introducing new entrants from outside the telecommunications industry.

Business development in MVNOs closely relates to the capability of the incumbent's telecommunications equipment upon which the MVNO depends. For example, in the U.S., the Walt Disney Company entered the mobile phone market in 2006. Its primary competitive advantage was an animated character download service, but ultimately exited the market at the end of 2007. In addition, Amp'd Mobile, which "attracts especially young generation providing contents such as games (Nikkei Sangyo Shimbun 2007.11.3)," went bankrupt in June 2007. One reason was that its ability to distribute contents through the mobile phone network was quite restricted by the slow speed of its 2G technology and it was difficult to undertake a differentiation strategy with the incumbent carrier. MVNOs in the U.S. (and U.K.) primarily provide voice services with low price or prepaid methods. However, in Japan MVNOs began providing services in March 2008 using the Softbank mobile network after The Walt Disney Company decided to exit the U.S. market. It is expected that "MVNO takes service differentiation strategy such as expedited delivery of Disney animation, instead of low price strategy (Nihon Keizai Shimbun 2007.11.11)." Further, some carriers, including internet access providers, announced that they had a plan to provide high-speed wireless data communication as MVNOs. The following services are also included as promising services to be provided by MVNO: network connection functions for mobile information devices; machine remote control functions; FMC (fixed–mobile convergence) services; devices for consumer relationship management; devices for regional information distribution; and work management services for enterprises (Nikkei sangyo shinbun, 2007.9.25). The contrasting of the situation of Japanese and U.S. MVNOs shows that investment by telecommunications carriers not only affects the telecommunications carrier, but also the MVNO.

4. The Reallocation of the Spectrum

The discussions thus far relate to the allotment of spectrum. In summary, although comparative hearings are regarded as inferior methods of allotment when compared to auctions, the following points are also noted.

(1) Comparative hearings and auctions are not very different methods of allotting resources.

(2) Auctions can have negative effects on a licensee's business and the opportunity for technological development.

(3) Comparative hearings can enforce a licensee to perform their submitted business plan.

(4) Comparative hearings can also force a licensee to open its communications facility by making it a subject of investigation.

Accordingly, we cannot always say that auctions are clearly superior allotment methods to comparative hearings. Moreover, when new and attractive uses of the spectrum develop through technological innovation and other means, the allocation and reallocation of the spectrum becomes more important.[15]

The major concern with allocation is that a spectrum allocated to a certain use is not easy to reallocate to other uses. It may also take a substantial amount of time (in Japan, generally more than 10 years) to accomplish this. In this section, we make a survey of policies to realize the smooth reallocation and efficient use of spectrum, and propose some practical solutions.

[15] If the subject is not the right of use of a certain spectrum, rather the right of ownership, allotment and allocation have the same meaning. In the U.S., some propose that the allotment of the use of ownership of the spectrum also be by auction.

4.1. A Survey of Proposals

When the Japanese government enforces evacuation (and removal to another frequency band) on a licensee, the licensee is compensated for the residual value of their facilities and any removal costs associated with the storing of the spectrum usage fee. Ikeda (2006, p. 149) argues that evacuation "… in practice, requires an agreement with a licensee," even though it would be done after the expiration of the term of license, and doubts that there is a licensee who would agree to move without compensation for the right of business. As a solution, Ikeda (2006) proposes a "reverse auction" in which licensees become sellers and the government becomes a buyer. Any bids made by a licensee not using the spectrum efficiently would be comparatively low. The government can then buy back the right to use the spectrum from the licensee. It can then either make it a common or reallocate it to other uses. Kwerel and Williams (2002) propose an auction in which the licensee can offer a spectrum and the use restrictions of any licenses offered is relaxed. A licensee who offers a spectrum can then participate in the auction to bid for the license, and even if unsuccessful, can obtain the whole or part of the contract price. The incentive for a licensee to participate will then be higher than under Ikeda's (2006) reverse auction where a licensee is not allowed to offer its own license and continues to use it for the restricted use. However, both proposals may be criticized in that a licensee who obtains a license free of charge will receive money for its return.

Rothkopf and Bazelon (2003), who take maximizing auction revenues for the treasury as the main policy object, oppose the large-scale liberalization of licenses, and propose that some licensees be given the right to relax the use restrictions of their licenses through auction. However, the criticism of auctions noted in subsection 2.2 is applicable to this proposal. Alternatively, Hazlett (2003) criticizes limited liberalization for "protect[ing] a system of exclusion [and] imposing monopoly distortions," a the repeal of restrictions changes the business environment and could especially disturb an incumbent carrier that implemented its business plan despite an oligopolistic market structure and would thus prevent continuous service supply and capital investment. Meanwhile, and in relation to Gruber (2001), it would only bring about mergers and acquisitions among rival carriers.[16] Opposing the simple policies that make use of auctions, Oniki (2003) proposes that each licensee is offered insurance to cover against any loss from the denial of its license renewal. The essence of this policy is to have the licensee report the true estimated value of the loss through the selection of the insurance benefit. The government is then able to offer appropriate compensation based on the information. An issue is how to set the insurance premium for every licensee that balances the budget. Further, the new organization required to manage the insurance could involve some social burden (some criticisms of comparative hearings may also apply to this system).

4.2. Tentative Proposals

In this section, we present some tentative proposals to achieve the efficient reallocation of frequency as based on systems adopted in several advanced countries, including Japan.

4.2.1. Voluntary Restitution and Reallocation of Licenses

In Japan, a frequency-usage fee system collects from users the administrative costs needed for supervising frequency. In terms of the total administrative cost, some cost proportional to the volume of data is allocated to radio stations in different amounts, while other costs are allocated to all radio stations in the same amount. Wireless radio stations are classified in 10 classes, including broadcasting station, base transceiver station, artificial satellite and comprehensive license (e.g., mobile phone). In fiscal year 2002, the government received 87.3% of 47.52 billion yen from mobile phones as a frequency usage fee and only 0.9% from broadcasting stations. However, broadcasting stations currently use a relatively large proportion of radio frequencies and this is the source of a sense of inequity with the existing fee system. In addition, there is inconvenient problem with the frequency-usage fee system; i.e., the frequency-usage fee increases if a carrier sets up a wireless station for the more efficient use of frequency and a carrier does not have to pay fines if the frequency is used inefficiently. To improve these problems, frequency usage fees paid by broadcasting stations were raised in fiscal year 2003 and their share of total frequency usage fees is now 6.4%.

This measure should now be implemented as formal regulation. We support the method that the licensee (carrier) has to pay a frequency usage fee based on the frequency used and the bandwidth, as already the case in the U.K. and France. This method provides an incentive for the licensee to either use frequency efficiently or restitute the license to the government. With respect to this method, Oniki (2006, p. 137) points out that "… this method

[16] Noam (2003) concludes that "… the [Telecommunications Act of 1996], by encouraging entry … has created pressure on companies to merge in order to re-establish stability in their market." Noam (2003) also attributes instability to "… the economic characteristics of their markets – high fixed costs, low incremental costs …" and competition.

doesn't include market mechanism such as demand–supply adjustment process, actual price in crowded bandwidth is set at the quite low level below 'equilibrium price' by MIC"; in short, the reallocation of frequency tends to be insufficient. It is true that this method has a problem in the sense that it does not have a logical rule. On the other hand, this method has an advantage in that it can be implemented relatively easily and is able to be complemented by the other methods introduced in section 4.2.2. Note that there is the risk that the reallocation of frequency cannot be achieved solely by this method because the frequency usage fee needs to be set at a low level so as not to restrict the licensee's facility investment (as with an auction). In fact, Marks and Yuguchi (2004, p. 96) evaluate this method, arguing that the frequency usage fee system does not appear to affect decision making on the use of frequency in the U.K., probably because the fee is set at relatively low level. In Japan, it is said that "frequency is more than enough to be allocated to broadcasting stations (i.e. Ikeda (2006), p. 27)." In Japan, frequency usage fees paid by key broadcasting stations was raised by 310 million yen, while that paid by medium or small-size stations remained at almost the same level (23.8 thousand yen per station). If the government needs an incentive for carriers to restitute license, it could also offer the restitution of the frequency usage fee (over several years) to encourage exit from the licensee's frequency bandwidth[17]. Note that there are carriers who offer various contracts with restriction of their business and who do not offer restriction of their business in the process of comparative hearings. If the rule is open in advance, we may apply for the same frequency usage fee. In addition, frequency is also used in the public sector, including police and fire services. If frequency usage fees were collected from the public service, it would arouse the interest of users and the public in the opportunity cost of spectrum and help to remove inefficiency.

4.2.2. Compulsory Restitution and Reallocation of Licenses

In Japan, the number of wireless stations or the quantity of average traffic are investigated in each segmentalized frequency, and substitutability by another media such as optical fiber is examined. On the other hand, based on the forecasting method by International Telecommunications Union (ITU), future demand on frequency usage is forecasted (see table.4). Therefore, the MIC can obtain information about which frequency bandwidths are not efficiently used and which are the most promising frequencies for future needs, so it can forcefully and efficiently implement the reallocation of frequency within a certain preparatory period. (Note that it would be necessary to investigate from a long-term viewpoint if the reason for allocation draws on the technology's potential.) Similar investigations have been implemented in other countries, though not periodically: for example, in New Zealand the result of the investigation is reflected in the policy of frequency reallocation [see Cave (2005), Marks and Williamson (2007)]. A "finder's preference program" has been previously used in the U.S. This is a program where a carrier detecting the inefficient use of frequency (the "finder") has the right of preferential frequency allocation. This is designated to reduce the burden of the regulator (regulatory cost), but there is the condition that the finder can undertake the efficient use of frequency. If not, yet another coordination problem results.

Table 4: Forecast on Demand

	2003	2008	2013
Mobile Phone・PH	270MHz[1]	330-340MHz	1.06-1.38GHz
Wireless LAN・WAN	160MHz[1]	240-300MHz[2] 380-480MHz[3]	540-740MHz[2] 1.30-1.80GHz[3]

Note) 1: Actual volume of allocation, 2: best effort type, 3: frequency band assured type.

Source) Information and Communications Council (2003)

5. Concluding Remarks

It has been argued that frequency is similar to land because it is used as a factor of production. For example, land is traded on the market, but it is often restricted to a specific use or city planning obligations are invoked to ensure parks and other green space is allowed for. However, many owners generally own the land used for certain purpose in a given area, while licenses for frequency used for certain purposes are usually restricted to a small number of carriers. Therefore, the decision made by a frequency licensee can have a larger influence on the society than landowners can. In addition, and as pointed out in this paper, investment for information equipment can be reduced, business development delayed, and collusion among carriers raised if the government charges large frequency usage fees. Further, there is a requirement for the government to secure frequency bandwidths for promising technology from a long-term viewpoint. Therefore, we argue that the government should adopt

[17] Currently, new licensees in Japan bear one-half of the financial compensation.

comparative hearings for frequency allocation, and should force licensees to implement their business plans. Further, voluntary restitution (through the positive use of the frequency-usage fee system) and compulsory restitution (based on the investigation of frequency demand in each bandwidth and its use) should be implemented so that the government can reallocate frequency to high needs area.

Comparative hearings will only be effective where the number of applicants is small. If there are many applicants, the government needs to examine many documents, evaluate the advantages and disadvantages of each, and make a final judgment from a comprehensive viewpoint. This is difficult work and involves potentially large costs. In the case of the Japanese frequency bandwidth used for high-speed wireless communication in the next generation, there are only four applicants for the two licenses. However, the government does not know in advance how many carriers will apply for licenses in each frequency bandwidth. Therefore, it will be necessary for the government to set up the requirements and disclose its screening standard in order to secure the feasibility of the comparative hearings, or tighten these requirements or standards after considering the records of application.

References

[English]

Afualo, V. and J. McMillan (1998) "Auction of Rights to Public Property" in P. Newman ed., *The New Palgrave Dictionary of Economics and the Law*, Macmillan.

Baumol, W. J. and D. Robyn (2006) *Toward an Evolutionary Regime for Spectrum Governance: Licensing or Unrestricted Policy?*, AEI-Brookings Joint Center for Regulatory Studies.

Bjuggren, P-O. (2006) "The Swedish 3G Beauty Contest: A Beauty or a Beast?," in B. Johansson, C. Karlsson and R. Stough eds., *The Emerging Digital Economy: Entrepreneurship, Clusters, and Policy*, Springer.

Britton, D. B. and S. McGonegal (2007) *The Digital Economy Fact Book*, 9th ed., Progress and Freedom Foundation.

Cave, M. (2005) *Independent Audit of Spectrum Holdings*, (www.spectrumaudit.org.uk)

Coase, R. H. (1959) "The Federal Communications Commission," *Journal of Law and Economics*, Vol.2.

Cooter, R. D. and T. S. Ulen (1997) *Law and Economics*, 2nd ed., Addison-Wesley.

Gabathuler, D. and W. Sauter (2004) "The Allocations of Scarce Resources, Spectrum Assignment and Competition in Mobile Communications: The Case of UMTS," in P. A. Buigues and P. Rey eds., The Economics of Antitrust and Regulation in Telecommunications: Perspectives for the New European Regulatory Framework, Edward Elgar.

Gilder, G. (2000) Telecosm: How Infinite Bandwidth Will Revolutionize Our World, ???.

Gruber, H. (2001) "Spectrum Limits and Competition in Mobile Markets: The Role of License Fees," *Telecommunications Policy*, Vol.25, Issues 1-2.

Lessig, L. (2001) *The Future of Ideas: The Fate of the Commons in a Connected World*, Vintage Books.

Hatfield, D. N. (1993) "Spectrum Issues for the 1990s: New Challenges for Spectrum Management," paper prepared for the conference; National Spectrum Management: Policies and Strategies for the 1990s and Beyond, held at Centre for International Research on Communications and Information Technologies, South Melbourne, Australia, November 23.

Hazlett, T. W. (1998) "Assigning Property Rights to Radio Spectrum Users: Why Did FCC License Auctions Take 67 Years?," *Journal of Law and Economics*, Vol.41, No.1.

Hazlett, T. W. (2001) "The Wireless Craze, the Unlimited Bandwidth Myth, the Spectrum Auctions Faux Pas, and the Punchline to Ronald Coase's "Big Joke": An Essay on Airwave Allocation Policy," *Harvard Journal of Law and Technology*, Vol.14, No.2.

Hazlett, T. W. (2003) "Painful Extractions," FT.com, Aug 26.

Kruse, J. (2004) "Competition in Mobile Communications and the Allocation of Scarce Resources: The Case of UMTS," in P. A. Buigues and P. Rey eds., The Economics of Antitrust and Regulation in Telecommunications: Perspectives for the New European Regulatory Framework, Edward Elgar.

Kwerel, E. and J. Williams (2002) "A Proposal for a Rapid Transaction to Market Allocation of Spectrum," Federal Communications Commissions, OPP Working Paper Series No.38.

Marks, P. and K. Yuguchi (2004) "Spectrum Policy in Transition," *Keio Communication Review*, No.26.

Marks, P. and B. Williamson (2007) "Spectrum Allocation, Spectrum Commons and Public Goods: The Role of the Market," *Communications & Strategies*, No.67(3).

McMillan, J. (1995) "Why Auction the Spectrum?," *Telecommunications Policy*, Vol.19, No.3.

Milgrom, P. (2004) *Putting Auction Theory to Work*, Cambridge University Press.

Noam, E. (1998) "Spectrum Auctions: Yesterday's Heresy, Today's Orthodoxy, Tomorrow's Anachronism. Taking the Next Step to Open Spectrum Access," *Journal of Law and Economics*, Vol.41, No.1.

Noam, E. (2003) "The Bursting of the Deregulation Bubble," FT.com, Jan 8.

Oniki, H. (2003) "Modified Lease Auction and Relocation: Proposal of a New System for Efficient Allocation of Radio Spectrum Resources," (www.osaka-gu.ac.jp/php/oniki).

Oniki, H. (2006) "Spectrum Policy," in R. Taplin and M. Wakui eds., *Japanese Telecommunications: Market and Policy*, Routledge.

Prager, R. A. (1990) "Firm Behavior in Franchise Monopoly Markets," *Rand Journal of Economics*, Vol.21, No.2.

Rothkopf, M. H. and C. Bazelon (2003) "Interlicense Competition: Spectrum Deregulation without Confiscation or Giveaways," New American Foundation, Spectrum Series Working Paper, No.8.

Thaler, R. H. (1988) "The Winner's Curse," *Journal of Economic Perspective*, Vol.2, No.1.

Williamson, O. E. (1976) Franchise Bidding for Natural Monopolies—in General and with Respect to CATV," *Bell Journal of Economics*, Vol.7, No.?.

Zupan, M. A. (1989a) "The Efficacy of Franchise Bidding Schemes in the Case of Cable Television: Some Systematic Evidence," *Journal of Law and Economics*, Vol.32, No.?.

Zupan, M. A. (1989b) “Cable Franchise Renewals: Do Incumbent Firms Behave Opportunistically?,” *Rand Journal of Economics*, Vol.20, No.4.

[Japanese]
Dempa Yūkō Riyō Seisaku Kenkyūkai (2004) Saishūhōkokusho: Dempariyōryōkinseido no Minaoshi ni tuite no Kihonteki na Kangaekata.
Ikeda, N. (2006) Dempa Riken, Shinchōsha.
Information and Communications Council (2004) *Chū-Chōki ni okeru Dempa Riyō no Tembō to Gyōsei ga hatasubeki Yakuwari: Dempa Seisaku Vision*──.
Nikkei Communications (2005) Hūunji Tachi ga Makiokosu Keitai Denwa Hōkai no Jokyoku: Shirarezaru Tsūsin Sensō no Shinjitsu, Nikkei BP.
Sekiguchi, T. (2007) “OpenWin Son si, “Tasha ni makeru Riyū nashi,”
(k-tai.impress.co.jp/cda/article/event/37350.html). 11/22.
Yanagawa, N. (2006) Hō to Kigyō Kōdō no Keizai Bunseki, Nihon Keizai Simbunsha.