

Spectrum Resource Utilization in the IT Innovation Era¹

Hajime Oniki

Department Economics, Osaka-Gakuin University
Suita-shi, Osaka 564-8511, Japan
oniki@alum.mit.edu

ABSTRACT

Spectrum resource utilization is one of the most important key factor to the next IT innovations, and the existing spectrum resource management concept is old now and has many problems. This paper proposes the necessity of spectrum resource auction and the disclosure of the spectrum management.

Last December, the Japanese government's IT Strategy Council announced its IT initiatives for the promotion and the adoption of information technology (IT) and discussed the issue of wireless broadband access to the internet. The administration of radio wave resources, however, has become obsolete. The demand for radio wave resources will continue to increase as new technologies using radio waves develop. Radical improvement of radio wave administration is urgently needed. Thus, we propose: 1. Introduce competition into the allocation of radio wave resources through auctions. 2. Promote the reallocation of radio wave resources. 3. Disclose all information on the use of spectrum

1. INTRODUCTION AND BACKGROUND

Radio waves are one of the most important resources in the fast-approaching IT society. With the advancement of technologies using radio waves, we now enjoy conveniences that were not imagined even ten years ago. Daily life and business in the 21st century most likely will be surrounded by and supported by radio waves. Making the most of radio wave resources is key to the success of the IT revolution.

At the end of last year, the government's "IT Strategy Council" announced the first part of its basic IT strategy: "Competition Policy and the Maintenance of a High-speed Network Infrastructure."² This report addresses the difficult issue of fiber optics and the so-called 'last mile' or high-speed access construction. Radio waves-capacity, construction costs, mobile and wireless usage-are a complementary means of access to fiber optics. High-speed wireless internet communications allow access that is several hundred times faster than ISDN telephone lines, and can be provided through ADSL and cable television lines-which for the time being provide the shortest distance for high-speed internet access. Whether this access is realized or not depends on whether the necessary radio frequencies are available or not. At the same time, high-speed wireless internet access also promotes efficient market competition in the last-mile portion of Internet communication and, in the end, is a principal tool in realizing the 'basic IT strategy.'

2. RADIO WAVES USAGE PAST AND PRESENT

Radio waves have been used for nearly a hundred years, but until recently, the supply of radio wave resources, much like Japan before the Edo Period and land resources in the colonial-time US, exceeded demand; new frontiers were constantly being developed. As new technologies were introduced, new methods of radio wave use also came about. The government bodies responsible for the management of radio waves divided radio wave frequencies and allocated them (issued licenses) to users so long as they did not interfere or disturb other users. Firms and others used the radio frequencies they were allocated and simply renewed their licenses when the license period was up. Since radio wave supply exceeded demand, use of radio waves was as free as the use of the ocean to sail a boat and the actual value of radio waves was zero, so free use of radio waves was unhindered.

However, recent technological progress has greatly increased the use of radio waves and the age of free usage has abruptly come to an end; radio waves are becoming a scarce resource. Nevertheless, radio wave usage is still inefficient and there is still room for expanded allocation. If one likens the radio wave usage to land in the Kanto area, the most useful areas have already been allocated (inner city and plains), and the use of less productive areas in the mountains and canyons has been expanding. Meanwhile, prime areas in downtown Tokyo and inside the Yamanote loop still have areas of low usage, and empty plots of land and old one-story buildings scattered about. However, these idle parts are fenced in (frequencies are allocated to specific uses); which means that there are no spare radio waves.

3. THE NEED FOR REFORM OF RADIO WAVE ALLOCATION

Demand for radio wave resources is certain to increase in the future, and if the present state of affairs is allowed to continue, developers will be dissuaded from developing new technologies and services because they do not have access to radio waves. Nor will they have any incentive to develop new technologies when there is no expectation that radio wave access will improve. A radical reassessment of radio wave allocation is urgently needed.

Technological advancements in the efficient use of radio wave resources already exist, and Japan has achieved the highest levels of technological achievement in this area. This means that continued research and development is a valuable part of achieving technological goals. It also means that rapid progress in high-speed usage technology is possible. However, if inefficient use of radio waves is left unreformed, and high-speed

usage technology development only takes place at the periphery, this is equivalent to focusing all efforts on building high-rise buildings without even considering the empty plots of prime real estate, and is clearly not in the best interests of country as a whole.

Radio wave resources are a public good that should be used efficiently for the convenience and benefit of the country as a whole and their usage should have the approval of the majority. This paper starts from this idea of public approval and seeks to make clear the problems surrounding radio wave usage and to suggest directions for reform.

4. PROBLEMS IN THE PRESENT SYSTEM OF ALLOCATION

Until now, radio waves were allocated at the government's discretion. Recently, a "comparative hearing" method has been introduced in a very piecemeal way, but latent pressures aside, the radio wave licensing process has not become competitive. In addition, fees for use of radio waves are collected, but most fees are far below the actual value of the radio waves resources, and the distribution of radio wave resources remained unaffected. When there were more than enough radio frequencies available, this method of allocating radio waves did not obstruct efficient use.

With the increased scarcity of radio waves, however, overall allocation is increasingly going towards inefficient uses. The biggest problem is that the same system that existed when there was a supply surplus is still in place. Returning to the analogy of land resources, this situation is equivalent to having rice fields in the middle of high-rise buildings and business centers, and to having department stores, super markets and shopping malls in a remote place in the mountains. When new services and technologies such as mobile phones have appeared, the free space has already shrunk and new radio wave users have been confined to the narrow spaces still available. The result is that highly efficient users of radio frequencies do appear and provide new services (or high rise buildings) but are surrounded by frequencies still occupied by old users (old-style wooden houses). In this way, large differences in the efficiency of radio wave use coexist with each other in what economists call a state of disequilibrium. There is always pressure to move radio wave use from low to high levels of efficiency, by legal or illegal means, in order to make private profits. These kinds of transfers will improve the efficiency of usage for the entire society, but, if free or low priced radio waves are reallocated for private profits, then there are clearly problems from the perspective of fairness. In order to put a stop to this, the government will have to increase supervision, and enforce regulations both before and after allocation, and administrative costs for radio wave management will necessarily increase. That is to say, under the present system, improvements in efficiency are in conflict with protecting the principles of fairness.

In short, the old system of radio wave allocation has created a vested interest group, which in turn has prevented the necessary reallocation of radio wave resources to more efficient users. When the actual value of radio waves was close to zero, license renewal was no problem and the renewal process became a mere formality after many such renewals. By the time radio wave resources became scarce, automatic renewal and the vested interests were firmly established. From now on, as the IT revolution progresses and the importance of scarce radio wave

resources increases, the present system of government oversight will not only allow inefficient usage, but also will negatively affect the creation of new business and new technology, and the development of new products. That is, under this old system of government discretion, even if a new business or technology is developed, there is a risk that the necessary radio waves will not be available. This in turn will weaken the very factors that bring about development. Furthermore, since the process of radio wave allocation is not transparent, small and medium manufacturers and venture capitalists are not able to make sound judgments about the business opportunities to develop new products using radio waves, thus effectively destroying the incentives to develop new business. There are specialized business for products for which the radio waves are indispensable. Compared to service and general manufacturing firms that do not have this limitation, there are real differences in the creative environment for new technologies and methods because government agencies are partly responsible for their management.

The old system has been criticized on several counts. One is that private firms are using public radio wave property without paying a fair compensation for their use—that is, there is a one-way transfer of wealth that occurs with this unfair and unjust distribution. Another criticism is that because the old system generates these vested interests, it creates a situation that often breeds scandal.

In short, the effects of the present system are overwhelmingly negative: inefficient use, obstructing business and technological development, increased administrative costs, and unfair transfers of wealth. With a better system, most likely there would already be all kinds of new technologies and businesses. Moreover, the nearness of the IT revolution leaves us little time. Clearly, the system of allocation of radio wave resources requires immediate reform.

5. ALLOCATION IN OTHER COUNTRIES

The United States and a majority of other advanced countries are in the midst of reforming the system of radio wave allocation by introducing greater competition. In the US, the reform of the communications act in 1993 established an auction system for the allocation of radio waves needed for personal mobile phones (PCS), direct satellite television (DBS), next generation mobile phones (3G), etc. Auctioning of next generation mobile telephones is under way in several European countries as well. There have been some problems such as high auction prices, but increased competition, provision of services at low prices, and transparency of information have all worked to stimulate the growth of new businesses and technologies and more than make up for any negative aspects of the auction system. Japan is in a position to learn from these countries' experiences and exploit the benefits of being a late-developer.

6. ALLOCATION OF RADIO WAVES BY AUCTION

In order to correct the problems that accompany the old system of radio wave allocation and promote efficient usage and business growth, the first step is to introduce competition into the system of allocation, second, to make clear the value of radio frequencies and promote redistribution, and third, to make the conditions of radio wave usage open to the public.

Firstly, most would agree that introducing competition is a necessary condition for more efficient use and business growth. As experience has shown, when competition is absent in economic activities, new enterprises are prevented from entering the market, bringing about stagnation and rigidity. To make the allocation of radio waves more competitive, allocation needs to occur through fair competition. That is, all users, new and old, must be given equal access to radio wave resources (frequencies). The radio waves that can be immediately allocated competitively are the frequencies that are being reassigned. The best way to introduce competition into the distribution of these new frequencies is through an auction. In the auction system, radio waves are auctioned off to the firm that pays the highest price, that is, to the firm that makes the most profits by providing the most value to consumers.

Compared to the old system of government discretion and comparative judgment, an auction system will generate the following benefits:

1. Effect an efficient allocation of radio waves. (Maximize the benefits of radio waves for the nation as a whole).
2. Make it possible for new firms to acquire radio wave access, promote competition and raise benefits for consumers and users.
3. Effect a fair and just competition among firms using radio waves.
4. Prevent unfair transfers of wealth, and reduce the possibility of scandal that accompanies vested interests.
5. An auction system requires transparency of information on radio wave use, which reduces the risks and uncertainties for businesses, and strengthens the factors that contribute to creation of business and technological development.
6. A by-product of the auction system is that the successful bids generate revenue for the government.

When radio wave resources are allocated by auction, it is common to allow the transfer and resale of resources. When resale is not allowed and the first successful bidder badly miscalculates, s/he still has to keep possession of radio waves that s/he can no longer use. In this situation, if the first successful bidder can transfer the radio waves to another firm, part of the investment can be recovered and the firm that accepts the transfer uses the radio waves, which is the best outcome for both the bidder and society as a whole. For example, in the case of a call option, firms that use radio waves can procure additional radio waves if necessary (for example when there is a sudden increase in the number of subscribers).

7. PROBLEMS WITH AUCTIONING OFF RADIO WAVES

The auction system does present some problems and shortcomings that do not exist in a system of direct allocation by the government. Among these, the problems most frequently cited are that the high auction prices paid by firms will be transferred to consumers and users in the form of higher costs and that uncertainties and miscalculation may lead bidders to bid too high (the so-called 'winner's curse').

Whether the costs to the successful bidder will be transferred to the consumer and to what extent depends on various conditions. In the example of band waves being auctioned by mobile phone companies, this depends on factors such as whether or not the mobile phone market includes companies that have been allocated radio waves for free, the extent of competition in that market (e.g. lowering prices to attract new customers), and how

sensitive mobile phone users are to changes in prices (elasticity of demand). It also depends on the extent to which the successful bidder is able to accurately predict future developments. However, if one looks at the US and other places where the auction system is already in place, cases of the auction cost being shifted directly onto consumers have yet to be observed. Nor is there any theoretical basis for thinking that the bidding price will be shifted directly to consumers. In short, the degree to which these costs are shifted is determined by various factors and the level of competition in the market.

Even if costs are shifted, the price bidders pay is added to the government's revenue and can be returned to consumers in the form of a tax deduction or by reducing the issuance of government deficit bonds. In other words, even if costs are shifted and the burden on consumers and users increases, the government's revenue will increase by the same or a greater amount. If this amount is restored to consumers and users, even if the burden is not evenly distributed among consumers and users, the total burden for consumers and users will stay the same or decrease. Thus, the overall effect of radio wave auctions is that firms earning rents from the use of free radio wave resources have to pay part of those rents to the government.

In addition, if revenues from auctions are invested in research and development rather than to reduce the deficit or a tax reduction, consumers and users can still enjoy the long-term and indirect benefits of new services.

The problem of the winner's curse has received a lot of attention because of the huge bidding prices in the auction of third generation mobile phone radio waves in Germany and Britain last year. Debt-ridden British Telecom and Deutch Telecom both suffered a major downgrading in their financial ratings. However, in other European countries, the bidding prices were far lower. Moreover, in the auction of the wide-band PCS waves beginning in 1994 in the US, there were large differences in bidding prices depending on the block of frequencies. In what was called the C block auction in US, there was a jump in bidding prices and a majority of bidders were unable to pay or fell into bankruptcy.

These cases of auction bidders misjudging the situation are exceptional. Bidding prices were far lower in European countries outside of Britain and Germany, and in the US, unusually high bidding prices only occurred in a very few of the auctions. It is also important to note that even when the winner's curse occurred in some form, the burden fell upon the company or enterprise, not on consumers or users. In most auctions, multiple permits are issued for the same service to encourage competition. This forces companies to compete with other companies at normal prices and thus prevents them from shifting the burden of the winner's curse onto consumers and users.

If Japan does implement the auction system, it should take the experiences of other countries into consideration and design a system that curbs the occurrence of the winner's curse.

Another shortcoming of radio wave auction, or a cost that has to be paid, are the costs of conducting auction. In order for auctions to be carried out fairly, smoothly and without mishap, careful preparation at both the legislative and administrative level is needed, and these preparations can be costly. However, compared to the profits gained from increased efficiency in distribution of radio waves, these costs are far and away lower.

Finally, consider one other problem that occurred with auctions in the US and Europe—that is the inflexibility that occurs when radio waves are awarded on a semi-permanent basis. In the US and in Europe, it is not clear that licenses acquired through auction come up for auction again when they expire. This

generated an expectation that enterprises that acquire licenses would be able to renew the license without going through another auction and that, through repeated renewals, they effectively could acquire semi-permanent rights to the radio waves. This is one factor driving bids so high in auctions.

The creation of semi-permanent rights to use radio waves, however, may become the single biggest hindrance to efficient use of radio waves in the future. That is, there is possibility that in the future, new technological uses will appear and reuse and expropriation may bring about the great benefits for the country. At that point, if there are semi-permanent rights, as in the real estate example, it is impossible to avoid the troubles that accompany expropriation (that is, those who suffer losses will make so much trouble that it is easier to give into their demands). In the US and Europe, the auction system was hastily introduced to make way for next generation mobile phones, and there was not much time to consider these issues. When introducing the auction system into Japan, it is important to prevent this kind of semi-permanent right from emerging.

8. INTRODUCE COMPETITION INTO THE ALLOCATION OF RADIO WAVE RESOURCES THROUGH AUCTIONS

As seen above, the auction system has some drawbacks, but overall they are outweighed by the benefits. A competitive auction will bring benefits to citizens, and also achieve large, long-term positive effects. Auctions may temporarily lead to higher mobile phone fees, but these can be countered through lower taxes. In addition, the increased competition brought about by auctions will drive prices down, and raise the level of service through the generation of new technologies and businesses. In contrast, under the old system, there is almost no possibility of reaping the benefits of competition and new entrants. In order to realize the IT revolution quickly, we propose that the government adopt the following measures:

- 1) Investigate the adoption of the auction method for issuing new licenses in the future.
- 2) This investigation should establish a platform for public participation and opinion.
- 3) Draw up proposals to revise and maintain the laws and the rules on radio wave auction.
- 4) Investigate how to implement the system of auction and its budget, and how to handle revenue from auctioning radio waves.

As already mentioned, there are many choices when it comes to considering the actual system of auction and procedures. The stock auction system adopted in the US and in Europe is not necessarily the best system. In fact, various rights can be issued through auction. Rather than the exclusive and semi-permanent rights in the stock auction system, it is also possible to issue rights for a fixed period of time in a lease auction, and rights which would allow multiple enterprises to share radio waves jointly. When it becomes time to use radio waves through packet switchings, some argue it is possible to allow open access and only to limit the total volume of packet transmission. Others argue that licenses altogether are not necessary.

9. PROMOTE THE REALLOCATION OF RADIO WAVE RESOURCES

Presently, there are both highly efficient users and inefficient users of radio waves in Japan. The frontier of radio wave resources is running out, leaving no superior frontier. Therefore, there is no other choice but to carry out the reallocation of radio wave resources in order to meet the increasing demand created by the development of an IT society.

10. DISCLOSE ALL INFORMATION ON THE USE OF SPECTRUM

Disclosure of radio wave usage is a prerequisite for achieving the efficient use of radio waves and also for promoting research and development of new uses of radio waves. With the exception of radio waves used for security reasons, the government should disclose all information concerning the current use of radio waves including detailed information on who uses radio wave resources, for what purpose, how often, etc..

¹ This presentation is based on a policy proposal made public on January 31, 2001, by Communication and Broadcasting Study Group. The title of the proposal is "Proposal for Radio Waves Policies to Achieve an IT Revolution." The members of the Study Group are: Co-chairs: Hajime Oniki (Osaka-Gakuin University) and Masahiro Okuno-Fujiwara (University of Tokyo); Members (in alphabetical order): Koichiro Hayashi (Keio University), Nobuo Ikeda (International University), Ken-ichi Imai (Stanford University, Stanford University Japan Center), Kenji Kohiyama (Keio University), Takuya Nakaizumi (University of Tokyo), Michiaki Takemura (University of Tokyo), Tatu Tanaka (Keio University), and Shin Yasunobe (Stanford University). Hajime Oniki drafted the original text of the proposal in Japanese, which was signed by the group members after thorough discussions and repeated revisions. This paper is an abridged version of the text translated into English. The full text of the proposal in Japanese is posted at: <http://www.telecon.co.jp/ITME/page7.htm>.

² The IT Strategy Council's Basic IT Strategy was made public on November 27, 2000 and appears at the following website: <http://www.kantei.go.jp/it/goudoukaigi/dai6/6siryou2.html>. The report states, "Japan needs to construct advanced high-speed wireless access to the Internet in which data initiated from wireless access can be transmitted to the Internet core efficiently through Ipv6 protocol, to provide seamless mobile services" (No. 4 in II (2)). With respect to radio frequency spectrum resources, the report also calls for "the timely revision of radio wave allocation including periodic relocation. In order to accomplish this, the government should investigate and implement a fair and transparent system for radio wave assignment such as the auction system" (Item C of II (3) 1).