

# Spectrum Policy in Transition

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## Introduction

The liberalization of telecommunications and broadcasting markets has resulted in rapid growth in the number of operators since the second half of the 1980s, and this has led to a sudden increase in spectrum demand. In addition, technological change in the 1990s and 2000s in wireless communications, such as mobile telecommunications and wireless LANs, has also greatly increased demand for spectrum and changed the ways spectrum is used. In this environment governments around the world have been compelled to review their spectrum policy, in order to assure to spectrum access to spectrum users. It has become increasingly important that all users face incentives for more efficient use of the spectrum resource.

The Independent Spectrum Review (2002) in the U.K. and the FCC Spectrum Policy Task Force (2002) have suggested adoption of either the exclusive use model or the commons model i.e. the open access model in some bands of spectrum in addition to and/or instead of the traditional command-and-control model. The exclusive use model permits spectrum licensees to trade all or part of their licenses (or their granted spectrum rights) with third parties. Under the commons model spectrum users do not have exclusive access to the spectrum (through a license) but rather share the spectrum on the basis that they do not receive protection from interference. There is open access to the spectrum so long as certain technical conditions (e.g. power limits) are met by users. An example is given by the use of the spectrum-spread technology such as the ultra wide band (UWB).

Introduction of these models will involve a radical change in spectrum management policy in most countries. Thus governments are now studying these policy alternatives carefully. It will take several years to reach conclusions and

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then implement new methods. However governments have to respond to the scarcity problem before them with other political alternatives in short or medium term. Alternative options being considered that could be implemented within existing management frameworks are spectrum relocation through the payment of subsidies to enable early refarming of spectrum and/or changes in license conditions and spectrum pricing.

This paper presents the transitional spectrum management policies in three countries, the UK, France and Japan, with particular focus on the taxes and/or fees levied on spectrum users. The UK is a country that has succeeded in moving from cost-based pricing to economic-value-based pricing. Japan currently has cost-based pricing, but is revising the pricing method. France has a unique system that combines two pricing methods. In the concluding section of the paper we compare the systems and provide our conclusions.

## The UK System

### Introduction

Before 1998 spectrum charges in the UK were based on the administrative costs of managing spectrum. Spectrum was assigned on either a first come, first served basis or by beauty contests. However, rapid growth in demand for spectrum occurred during the 1980s and 1990s as a result of market liberalization, economic growth and technology change. There was growing congestion in many bands and no way of rationing demand except through administrative rules. It was recognized that these rules gave few incentives for users to economize on spectrum use and did not lead to an efficient assignment of spectrum between users.

In response to these issues, the UK Radiocommunications Agency (RA) (1994) consulted on possible changes in management to meet future demands, including administrative incentive pricing, auctions and secondary trading with particular emphasis being given to the possible introduction of administrative incentive pricing and auctions. It was decided that auctions would be used to assign vacant spectrum and administrative pricing would apply to spectrum that had already been assigned to users. Users of auctioned spectrum would not pay administrative incentive prices.

A study by NERA-Smith (1996) developed a methodology for setting administrative incentive prices and applied the methodology to two case studies, namely mobile radio (public and private) and fixed links. Following the NERA-Smith study, further consultation by the RA (1997) on the proposed pricing approach and the passing of enabling legislation (i.e. the Wireless Telegraphy Act 1998), spectrum pricing was introduced for a number of services in 1998 with

the objective of promoting greater efficiency in the use of spectrum<sup>1</sup>.

In this section we discuss the NERA-Smith methodology, its practical application, a recent government review of the pricing approach and its possible revision. The terminology used to refer to spectrum pricing in the UK has changed somewhat over time. For clarity the following definition is used below: administered incentive prices (AIP) are fees charged to spectrum licensees that are set by the regulator and are intended to reflect the opportunity cost of spectrum use (and thereby provide effective incentives for efficient use of spectrum)<sup>2</sup>.

### Approach to setting AIP

AIP were conceived as a means of promoting more efficient use of spectrum and NERA-Smith proposed a method for evaluating AIP based on opportunity costs. The approach focused on providing incentives to users to economize on their spectrum use and moving spectrum from low to high value users. Thus the primary focus was on assignment within frequency bands and not allocation of spectrum between different uses.

Prices were calculated for mobile services (i.e. private mobile radio (PMR), public access mobile radio (PAMR) and cellular services) and fixed links. In doing this it was assumed that the allocation of spectrum to these services could not be changed. NERA-Smith also suggested that mobile and fixed link prices could in principle be used to set benchmark prices for other spectrum that could be used by either mobile or fixed link services respectively<sup>3</sup>. However, this would mean assuming that spectrum allocations could be changed so that mobile and fixed services could replace the existing uses of the spectrum.

The following hypothetical example illustrates the NERA-Smith method. Assume radio spectrum is characterized as three frequency bands *A*, *B* and *C*. Further assume there are three competing uses for radio spectrum: I, II and III. The allocation of spectrum is as follows: Use I is allocated frequency band *A*, Use II is allocated frequency band *B*, and Use III is allocated frequency band *C*. Finally, assume that in each Use area, spectrum users differ in their abilities to produce final goods and services, with some users being more efficient than others.

NERA-Smith set the price of spectrum equal to the estimated marginal benefit to a user of average efficiency of an additional unit of spectrum, assuming output and service quality are kept constant. The marginal benefit of spectrum is then equal to the cost savings the firm would enjoy were it to have the additional unit of spectrum. This means that if the firm were granted a marginal unit of spectrum its costs would not fall at the margin, as cost reductions would be transferred to the agency that prices spectrum. The spectrum price calculated in this way would achieve efficiency in assignment, as the most efficient firms would have the highest marginal benefits.

In Table 1 presents hypothetical estimated marginal benefits for the different frequency bands in each Use. In the example in Table 1, the price of frequency band *A* would be 100 and the price for *B* equal to 60. We can think Use I as being mobile and Use II being fixed links. The marginal benefit for Use III was not calculated.

Table 1: Estimated marginal benefits

Uses	Frequency bands		
	<i>A</i>	<i>B</i>	<i>C</i>
I	100	–	–
II	–	60	–
III	–	–	–

The extension of the mobile and fixed link prices to other spectrum bands and uses can also be illustrated using the example given above. Assume that band *C* can be used by mobile services i.e. Use I in addition to Use III. Smith-NERA assumed that the value of band *C* to mobile services was the same as that for band *A*. The situation was as shown in Table 2.

Table 2: Spectrum prices based on the marginal benefit in Use I

Uses	Frequency bands		
	<i>A</i>	<i>B</i>	<i>C</i>
I	100	–	–
II	–	60	–
III	–	–	100

The price for frequency band *C* was set at 100, based on the estimate for Use I in frequency band *A*. If the value of band *C* to all users for Use III was substantially below 100 then this would have the effect of clearing band *C* so that it could be used by Use I i.e. the spectrum could be reallocated. If the value of band *C* for Use III was greater than 100 then some reassignment of spectrum between Use III users is possible. Note that the pricing shown in Table 2 does not allow for the possibility that the allocation of band *C* spectrum to Use I may reduce the marginal value of spectrum in Use I.

### AIP in Practice

Marginal values and so prices determined by NERA-Smith (1996) were based on the cost to the user of the next best or least cost alternative. This involved estimating the marginal value of spectrum as the additional cost (or

cost saving) to an average or reasonably efficient user as a result of being denied access to a small amount of spectrum (or being given access to an additional small amount of spectrum). The additional cost (cost saving) depends on the application and is calculated as the estimated minimum cost of the alternative actions facing the user. These alternatives may include:

- investing in more/less network infrastructure to achieve the same quantity and quality of output with less/more spectrum;
- adopting narrower bandwidth equipment;
- switching to an alternative band; or
- switching to an alternative service (e.g. a public service rather than private communications) or technology (e.g. fiber or leased line rather than fixed radio link).

As a practical matter the alternatives that are considered are those for which reliable cost data can be obtained and this generally means future technologies are not be taken into account. Taking the example of fixed links, the alternatives considered were use of narrowband technology, moving to a higher uncongested band (that would have involved an additional hop to provide the link) and wired alternatives.

The prices obtained are shown in Table 3 together with the actual 2002 prices for mobile and fixed services. As can be seen, the application of AIP has resulted in prices that are substantially lower than those proposed. The government set the prices below the estimated values (by at least 50%), and the estimated values were modified further to take account of other factors (usually in a downward direction) following consultation with industry<sup>4</sup>. This deliberately cautious approach was adopted in part because of concerns that the NERA-Smith estimates might be too high and so result in many users having to move to other technologies or services. In fact so far spectrum pricing does not appear to have had a material impact on spectrum use. There is some anecdotal evidence of spectrum having been returned to the RA but there impacts have not been analyzed systematically.

Table 3: Spectrum prices as recommended by NERA-Smith and current prices

	NERA-Smith (1996)	Current prices
Cellular - 900 MHz	£ 1.625m/ 2x1 MHz	£ 0.712m/ 2x1 MHz
Cellular - 1800 MHz	£ 0.81m/ 2x1 MHz	£ 0.554m/ 2x1 MHz
PAMR	£ 34,000/ 2x25 kHz	£ 22,000/ 2x25 kHz
PMR	£ 22,000/ 2x2.5 kHz	£ 9,000/ 2x12.5 kHz
Fixed links	£ 5,300/ 2x14 MHz link	£ 1,230/ 2x14 MHz link <sup>5</sup>

Sources: NERA-Smith (1996) and Wireless Telegraphy (License Charges) Regulations 2002, SI 2002 No 1700.

## Services subject to AIP

AIP was introduced in 1998 and was initially applied only to mobile and fixed services, as these services were thought to experience the most acute congestion problems. Since 1998, AIP have been extended to other services and are now applied to some or all spectrum allocated to: defense; fixed links; maritime business radio; private business radio; program making and special events; public mobile networks; public safety services (police, fire, ambulance services); satellite uplinks (permanent and transportable earth stations and VSATs); and scanning telemetry (RA (2002: Appendix D)). AIP was not applied to broadcasting use of spectrum, although two of the four TV broadcasters (Channel 3 and Channel 5) and the national radio operators (but not the local radio operators) paid for their licenses through auctions and so AIP does not apply in these cases.

In deciding the frequency bands and services which should be subject to AIP the RA applies the following tests:

- Is there excess demand for spectrum now or in the near future from existing uses of the spectrum?
- Can the spectrum be used for another purpose<sup>6</sup> and, if so, is there excess demand from these other uses?
- Is it practically feasible to collect AIP fees<sup>7</sup>?
- Are there any policy or political factors that prohibit the use of spectrum pricing?

If the answers to the first or second questions and the third question are positive and the answer to the final question is negative, then AIP are applied to the service/frequency band in question. AIP generally include a geographic dimension, in that they are only applied in geographic areas where there is or may in future be excess demand for spectrum. To assess the extent of congestion in a particular location usage data (e.g. number of mobiles per channel, number of links per square km) and information on the difficulty of making new assignments was used.

## The Independent Spectrum Review

In 2002, the UK Government commissioned an Independent Spectrum Review (2002) to advise on the principles that should govern spectrum management and what more needed to be done to promote efficient spectrum use. The Review concluded that there was a need to make the spectrum management system more flexible and proposed a number of measures aimed at deregulating spectrum use. It was recommended that for spectrum used by commercial services markets (auctions and trading) should replace existing administrative management, while spectrum should continue to be reserved for public service users

but they should pay AIP where the spectrum has an alternative use (i.e. the opportunity cost is non-zero).

The Review recommended that spectrum prices should be set on the basis of opportunity cost and noted that existing prices could be below this level i.e. are too low to create incentives for efficiency. The Government has endorsed the use of opportunity cost pricing and has proposed that the approach to setting AIP should be reviewed (see below) (Department of Trade and Industry and Her Majesty's Treasury (2002)). The Review recommended that AIP should be applied if the opportunity cost of spectrum is greater than zero (Independent Spectrum Review (2002: Recommendation 7.1)) and that spectrum pricing should be extended to broadcasting services, some maritime radar services, aeronautical communications and radar services, and radio astronomy. It also suggested that opportunity cost pricing should only apply to satellite systems that share spectrum with and constrain the deployment of UK terrestrial services i.e. in shared but not exclusive satellite bands (Independent Spectrum Review (2002: Recommendation 7.1)).

The Review recommended the introduction of spectrum access licensing to clarify the rights and responsibilities of satellite transmissions from outside the UK to UK based receivers and that, where appropriate, opportunity cost pricing should apply to such spectrum use. This recommendation has been accepted by Government and is covered by the recognized spectrum access provisions in the Communications Act 2003. Since protection from interference implies a constraint on the use of spectrum by other services, recognized spectrum access would therefore be subject to the same pricing principles as other forms of spectrum licensing.

## Review of Spectrum Pricing

In April 2003, the RA announced the appointment of Indepen Consulting to carry out a study to review administrative incentive pricing of spectrum. The remit of the study is as follows:

- to review the current pricing regime;
- to formulate a set of guiding principles and a theoretical perspective to guide the setting of administrative prices for radio spectrum in the future;
- to advise on whether and under what circumstances administrative pricing would be charged to licensees with tradable licenses; and
- to develop illustrative charges for broad categories of use.

The study is expected to be published in early 2004. There is an expectation that there could be an increase in prices in areas of high demand, given that the existing prices are well below the NERA-Smith recommendations (see Table 3).

However, in November 2003 Office of Communications (Ofcom) published proposals on spectrum trading and the introduction of spectrum trading may

affect the services which will in future be subject to AIP<sup>8 9</sup>. It is argued by some users that spectrum trading is sufficient to provide incentives for efficient spectrum use and that AIP is therefore redundant. However, Ofcom has proposed that AIP will be applied to spectrum which is tradable as it regards these two mechanisms as complementary, in the sense that AIP helps to strengthen the incentives for efficient use of spectrum that trading provides. Ofcom draws attention to the likelihood that trading markets could be thin (as has been experienced in Australia, New Zealand and the US) and that some users may not take more account of the cash cost of spectrum (i.e. AIP) as opposed to the opportunity cost implied if the spectrum is tradable.

## The French System

### Introduction

In France the radio network licenses are assigned based on the applicants' qualifications, except in some cases where comparative hearings are used (e.g. the IMT 2000 (UMTS)) when the number of applications is estimated to exceed the supply of licenses. Auctions were proposed as a selection method in the Electronic Communications and Audiovisual Communication Services Bill.

The French government has traditionally adopted a complex charging system for radio spectrum or frequency users. This system consists of taxes, based on the modified Finance Law, 1987, and fees, based on the modified decree of 3 February 1993. Some users including the national government and broadcasters do not face charges. Broadcasters, more precisely the audiovisual transmission, are exonerated from paying these taxes and fees in exchange for a heavy levy and duty to contribute the production of French and European culture. Although this system has generally worked well, the French government and the independent regulatory bodies are now facing difficulty in reforming the charging system in the context of international harmonization, the convergence of broadcasting and telecommunications, and the rapid development of wire and wireless communication tools. This section presents the current charging system and debates on its reform.

### Current system

The French government defines the radio frequency as "un patrimoine de l'Etat" (a national heritage) and the annual fees as its rent, and considers fees paid by its users as taxes. The independent telecommunications regulatory body called Autorité de Régulation des Télécommunications (ART) collects the fees and taxes mainly from public mobile networks, except the IMT 2000 (UMTS)

fees which are collected directly by the Ministry of Economy, Finance and Industry. On the other hand the agency called Agence Nationale des Fréquences (ANFr) collects fees mainly from independent wireless operators. Table 4 shows the complete list of taxes and fees.

The spectrum is managed at two levels; the general coordinator (ANFr) and plural assignors called “affectataires.” The latter comprise seven ministries, which use the spectrum for their own purpose, and the regulatory bodies for telecommunications (ART) and broadcasting (Conseil supérieur de l’audiovisuel: CSA), which assign frequencies to third parties such as telecom operators and independent users. Only spectrum users under the licenses issued by ART have to pay fees now. A framework in which all spectrum users (assignors) except CSA face fees was introduced in 1997 with decree No. 97-520 on the generalized fee called “redevance généralisée” of 22 May 1997. However, this decree has not been implemented.

The fees are composed of the rent called “redevance de mise à disposition,” and the administration fee called “redevance de gestion.”

The rent has a very complex structure. In general, public networks, independent networks using the frequency bands exclusively, and experimental networks are subject to the rent which is decided respectively in specifications attached to the ministerial ordinance for licenses. As for the other independent networks including fixed services for public networks, the annual rent is calculated using one of the formulas or by applying one of the tables.

Table 4: Taxes related to the wireless communications

Nom des Taxes	Name of Taxes	Objective of Payments
Taxe de Constitution de Dossier (Art. 45 I.)	Application Tax	Establishment of public networks and public telephonic services
Taxe du Brouillage et de la Non-conformité (Art. 45 II.)	Interference and Non-conformity Tax	Exceptional intervention because of the interference and the non-conformity
Taxe des Postes CB (Art. 45 III.)	CB Terminal Tax	Acquisition of terminals used in the citizen’s bands
Droits d’Examen de Radioamateur (Art. 45 IV.)	Examination Tax of Amateur Radio Operators	Examination of amateur radio operators’ license
Taxes (annuelles) de Licence des Radioamateurs (Art. 45 IV.)	Amateur Radio Operators Taxes (annual)	Annual license fee of amateur radio operators
Taxe (annuelle) de Gestion et de Contrôle de l’Autorisation (Art. 45 VII.)	License Management Tax (annual)	Operation of public networks and public telephonic services

Note: Art. 45 = article 45 of the modified “Finance Law, 1987”

A typical formula is

$$\text{Rent} = A \times (\text{DF}/F)$$

where A is a parameter fixed with the ministerial ordinance (actually 208 million francs) after the budgetary consideration, DF is the bandwidth, and F is the central frequency of the band of the fixed service employed by the licensee in the National Frequency Plan. Table 5 and Table 6 represent typical tables. The price per link falls as the number of links increases (i.e. The system is regressive).

Table 5: Rent for bilateral fixed links (francs/link)

BF: Frequency Band L: Band Width	1GHz<BF<10GHz	10GHz<BF<20GHz	20GHz<BF<30GHz	30GHz<BF
L ≤ 25kHz	1,050			
25kHz < L ≤ 125kHz	2,100			
125kHz < L ≤ 250kHz	4,200	4,200	2,800	2,100
250kHz < L ≤ 500kHz	6,300			
500kHz < L ≤ 1.75MHz	8,400			
1.75MHz < L ≤ 3.5MHz	10,500	6,300	4,200	2,800
3.5MHz < L ≤ 7MHz	16,800	12,600	8,400	5,600
7MHz < L ≤ 14MHz	23,100	18,900	12,600	8,400
14MHz < L ≤ 28MHz	29,400	25,200	16,800	11,200
28MHz < L ≤ 56MHz	35,700	31,500	21,000	14,000
56MHz < L	42,000	37,800	25,200	16,800

Rent = A/208 million francs x (amount indicated in Table 2) - this seems to be different from the formula given above

Table 6: Rent for fixed links (francs/link)

Maximum Distance	Unidirectional Links		Bidirectional Links	
	P to P	P to M or M to M	P to P	P to M or M to M
2km	330	190	495	285
5km	730	360	1,095	540
10km	1,450	500	2,175	750
30km	3,300	750	4,950	1,125

P: point, M: mobile

The rent is proportional to the occupied spectrum resource and inversely proportional to the spectrum location (i.e. frequency). It also depends on the substitutability of wired links. So it is said that the rent has a demand incentive structure.

The administration fee, on the other hand, generally has a simple structure. The fee is constant for networks, or proportional to the number of radio stations with some gradual diminution.

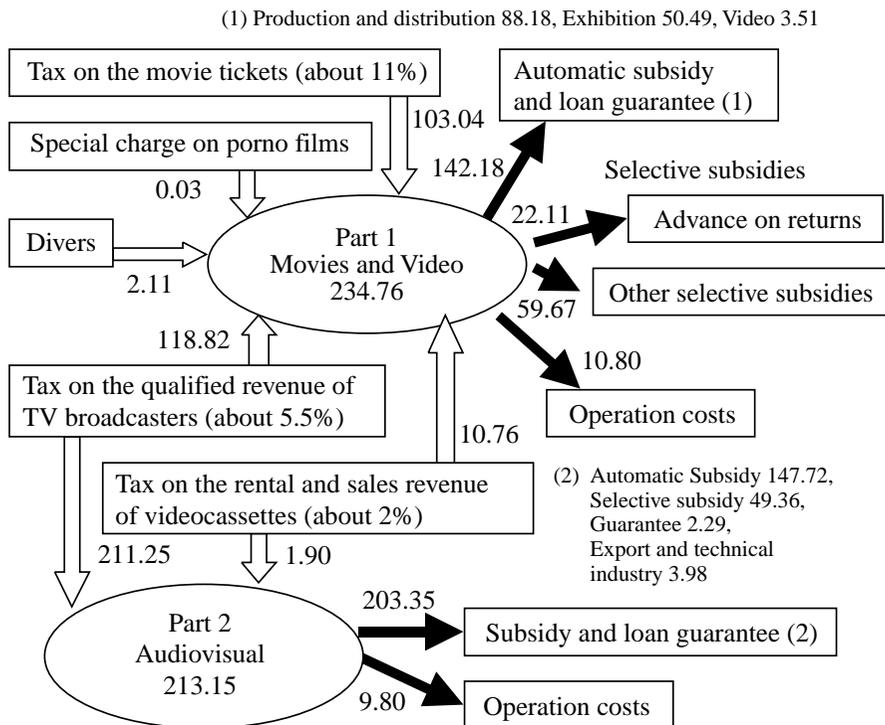
It is not clear how the total revenue from taxes and fees is decided. Subject to article L.36-4 of the Telecommunications Act of 26 July 1996, the resources of ART shall include payments for services provided (31,640 euros) and the taxes (19 million euros) and fees (61.5 million euros). The two fees related to the use of the radio frequencies account 47 million euros and are included in the 61.5 million euros (Others are fees related to the use of the national numbering plan etc). Then ART submits its funding proposals to the Telecommunications Minister. The method for allocating resource to ART, however, differs from this procedure in practice, and its annual budget (16.08 million euros in the initial Budget Act for 2002) is included in a single chapter of that of the Ministry of Economy, Finance and Industry (ART (2003: pp.173-174)). The disequilibrium is found in the budget of ANFr, where the costs (81.6 million euros) including its payment (40.0 million euros) for the Spectrum Relocation Fund called “Fonds de Réaménagement du Spectre” (FRS) exceed the revenue from two fees (25.6 million euros) and taxes (0.86 million euros). The FRS is a unique system in France, in which the government pays temporarily the spectrum relocation cost, and the beneficiaries (new comers) pay the amounts back to the government thereafter.

### Cultural Policy and Special Treatment of Broadcasters

Broadcasters can use the spectrum freely even if they distribute their services through the network operated by Télédiffusion de France (TDF). Instead of the free use of spectrum, broadcasters are obliged to contribute the development of the French cultural industry, i.e. movie and audiovisual industry.

The government established under the Finance Law, 1960, “Compte d’affectation spéciale du Soutien financier de l’industrie cinématographique et l’industrie audiovisuelle,” i.e. the dedicated fund for subsidy of the movie and audiovisual industry, which is managed by Centre National de la Cinématographie (CNC). Figure 1 shows the revenue sources and expenditures of the fund. Movie theater entrants (about 11% of the ticket price) and broadcasters (about 5.5% of their qualified revenue) are the main contributors. In addition commercial television broadcasters are required to invest 3.2% of their qualified revenue in French or European movies and 16% of their qualified revenue in French programs. They must also ensure that 60% of movies broadcast are European films of which 40% must be French-originated films.

Figure 1: Compte d'affectation spéciale du Soutien financier de l'industrie cinématographique et l'industrie audiovisuelle



Data: CNC info 287 "Bilan 2002"; p.67

Unit: Million euros

Many movie producers, especially the independents are beneficiaries of the fund. They can receive automatically a subsidy if they meet certain conditions when they make the next film and some of them succeed in obtaining the selective subsidy through a judging process. This system has a significant impact on the development of the French movie industry; French films account for around 35% of the national market.

To keep this mechanism by assuring the satisfactory revenue for broadcasters, the French government and CSA have made a considerable effort to coordinate and harmonize the media market including the radio and the newspapers. The number of television broadcasters has been limited until a few years ago.

However the CSA has awarded digital terrestrial television broadcasting (DTTB) licenses to twenty three private service providers. It is probable that the average revenue of the existing broadcasters will decrease dramatically even if the broadcasting market as a whole expands as a result of synergy among providers. The CSA has liberalized advertising under certain conditions and in

the near future broadcasters will be able to broadcast commercials for some industries that were formerly not permitted. Nevertheless these changes may not remove the risk to the dedicated fund system, because it is possible that DTTB broadcasters will face financial difficulties in bearing the initial costs of DTTB rollout.

## Debate on the Reform of Taxes and Fees

ART recognizes that the rent and the administration fee function as

- A mechanism for the recovery of the administrative costs of spectrum management
- a regulatory tool for the efficient use of spectrum
- a method to make users aware they are using the spectrum
- the valuation of the public resource.

Based on this recognition, ART has indicated that the generalized fee would affect all spectrum users at least in the second and third aspects listed above, and the exemption of audiovisual transmission results in a lack of equality between telecom operators and broadcasters especially in respect of fixed links. ART prefers a simple common fee system, which realizes transparency and equity, and proposes to harmonize the levy systems applicable to the telecommunications and the broadcasting<sup>10</sup>.

The CSA takes a different position. It is not a simple problem of the spectrum usage but a profound one related to the French cultural policy. This is a very delicate and critical topic in France.

Digital terrestrial television broadcasters will not pay the rent continually as the actual analogue broadcasters, but they have to share the costs of the analog-to-analog channel shifting. This means that the broadcasters pay for spectrum. To harmonize two different systems between two sectors in the convergent age, the government may have to start by revising the dedicated fund system for the movie and audiovisual industry which in practice depends on the broadcasting industry. The digitalization of the terrestrial television might be a trigger for this harmonization.

## The Japanese System

### Introduction of Spectrum Users Fee

The Spectrum User Fee system was introduced in April 1993<sup>11</sup>. Its objectives are

- to secure a radio user environment without interference and jamming by controlling further illegal and/or non-conformity uses

- to introduce the digital licensing procedures
- to promote a more efficient use of the spectrum resource,
- to recover administrative costs

in order to cope with the sudden increase in radio stations.

Prior to the introduction of the Spectrum Users Fee, the Minister of Posts and Telecommunications organized a private “Consultation group on the spectrum policy” between September 1990 and March 1991. This group examined spectrum management policy issues and proposed the creation of a beneficiary-pays system, based on the doubling of spectrum user numbers in the five years from 1986 and the estimation that the number of users would exceed 50 millions in 2001 (in fact there were 74 millions).

The principle of the Spectrum User Fee system has had few changes from its beginning. All of the spectrum users are considered as beneficiaries, and bear jointly the expenses related to spectrum management. The article No.103-2 of the Radio Law stipulates that the expenses (57.8 billions yen) borne by the spectrum users are those associated with

- 1) Monitoring and adjustment of radio waves, search for illegally installed radio stations i.e. maintenance and operation of radio monitoring facilities (7.2 billions yen)
- 2) Establishment and management of the Integrated Radio Stations Database System (PARTNER) (12.7 billions yen)
- 3) Examination, and analyzing the results thereof, for establishing the technical standards of radio equipment using technologies that contribute to efficient utilization of radio (10.3 billions yen)
- 4) Specific frequency change support service (Mainly the analog frequency change support service to introduce digital terrestrial television broadcasting which is estimated to be 180 billions yen for 10 years) (19.5 billions yen)
- 5) Others (8.2 billions yen)

The amounts in parentheses show the initial budget for the fiscal year 2003. The Japanese Spectrum User Fee is thus adopted as a dedicated fund system.

The fee for each user is calculated as a sum per radio station. The expenses, except a part of item 2 above, are allocated equally between radio stations. The Ministry estimates the total expenses and the total number of radio stations over 3 years. The actual fee is based on the estimation of 169.3 billions yen during the 3 years from FY 2002, and this amount is 540 yen per station. The rest of the expenses of the item 2 are allocated according to the quantity registered in the database by category of station. The amounts vary from 0 yen (blanket licenses of cellular terminals) to 23,510 yen (satellite stations). After adding the two parts and rounding, the fee for each category of stations is stipulated in the Radio Law as show in Table 7<sup>12</sup>.

Radio stations used by the State and some public radio stations are exempted the fee or pay a discounted fee, because a small part of the administrative expenses (about 1.2 billions yen) is covered by general funds, which offset these exemptions and discounts.

Table 7: Spectrum User Fee Schedule

Classification	Spectrum user fee (Annual: yen/station)	Examples of stations
1. Mobile radio stations (except for those classified in items 3,4,5 and 8. The same applies in item 2.)	600 yen	Land mobile stations Ship stations
2. Immobile radio stations on land for the purpose of communicating with mobile radio stations or receiving equipment for portable use (except for those classified in item 8)	5,500 yen	Base stations Paging stations Coastal radio stations
3. Satellite stations (except for those classified in item 8)	24,100 yen	Communications satellites Broadcasting satellites
4. Radio stations whose communications are relayed by transponders on satellites (except for those classified in item 5 or 8)	10,500 yen	Earth stations
5. Radio stations on mobile objects such as automobiles or ships, or for portable use where communications are relayed by transponders on satellites (except for those classified in item 8)	2,200 yen	Ship earth stations Aircraft earth stations Portable/mobile earth stations
6. Broadcasting stations (except for those classified in item 3, item 7 or radio stations for telecommunications business)	23,800 yen	Television broadcasting stations Radio broadcasting stations
7. Multiplex broadcasting stations (except for those classified in item 3)	900 yen	Teletext broadcasting stations
8. Radio stations for experimental use and amateur radio stations	500 yen	Experimental stations Amateur radio stations
9. Other radio stations	16,300 yen	Fixed radio stations
10. Blanket licensees provided under Radio Law Article 27-2, irrespective of the above classification	The amount calculated by multiplying 540 yen by the number of operating radio stations	Cellular phones MCA mobile stations Satellite cellular telephones

Quoted from <http://www.tele.soumu.go.jp/e/fees/sum/money.htm>

## Declaration of the Spectrum Release

The Japanese Spectrum User Fee system has the property of cost-allocation between all spectrum users i.e. stations except license exempt services, and provides little economic incentive for the efficient use of radio frequencies. It has many advantages for cellular operators. Instead of paying out a large initial license fee, operators can pay as their business goes. Based on the success of spectrum auctions in other countries and the fiscal difficulties of the State, many economists and some politicians advocated the introduction of spectrum auctions.

The Director of Telecommunications Bureau and the Director of Broadcasting Administration Bureau organized a “Consultation group on the effective usage method of the spectrum resource” between April 1996 and January 1997. This group analyzed future demand and assignment methods for the spectrum. It suggested that spectrum auctions had many merits such as speed, transparency and inducing competition between operators, but it might have also a number of problems such as contributing to higher service prices, inhibiting the introduction of services, the potential monopolization of scarce resource for a long time, and the long-term disincentive for innovation. The group concluded that it was necessary to further study the introduction of auctions, with a view to improving the transparency of the licensing framework. Japan chose finally the comparative hearing as a selection method for the IMT 2000 operators, and only three operators applied for three licenses; there was no competition.

The penetration of license-exempt devices such as wireless-LANs increased suddenly and significantly in 2000s. In order to expand the bands for these devices and to allocate bands to fourth generation (4G) mobile services, it will be inevitable that some existing users will have to be relocated in a period that is less than their license term (5 years).

The Ministry of Public Management, Home Affairs, Posts and Telecommunication (MPHPT) organized a “Study-group on the publication of the information on the spectrum usage” in September 2001, in order to examine the principle of the publication of the information on licensees (radio stations) and spectrum usage. Based on a public consultation and the final report of the study group in December 2001, the Radio Law was modified and a spectrum audit was introduced in May 2002. MPHPT conducted the pilot audit on the 4GHz~6GHz band for fixed telecommunications services in October 2002, published its results in April 2003 and then announced the plan for reorganizing the spectrum in these bands in October 2003. MPHPT will continue to conduct spectrum audits periodically every 3 years for each band of spectrum.

MPHPT then organized a “Study group on the policy on the effective use of spectrum” in January 2002 with two working groups on relocation and technology. These groups discuss the length of the preparatory period, methods of compensation and its resourcing in order to assure the relocation of existing

licensees, and methods of promoting the shared use of the same band by different services. After the publication of consultation papers in June and November 2002 and the following public consultations, these groups published their first report in December 2002 (MPHPT (2002)). This report did not support the introduction of auctions, but proposed a further study on the compensation system including its resourcing, and the revision of the Spectrum User Fee system.

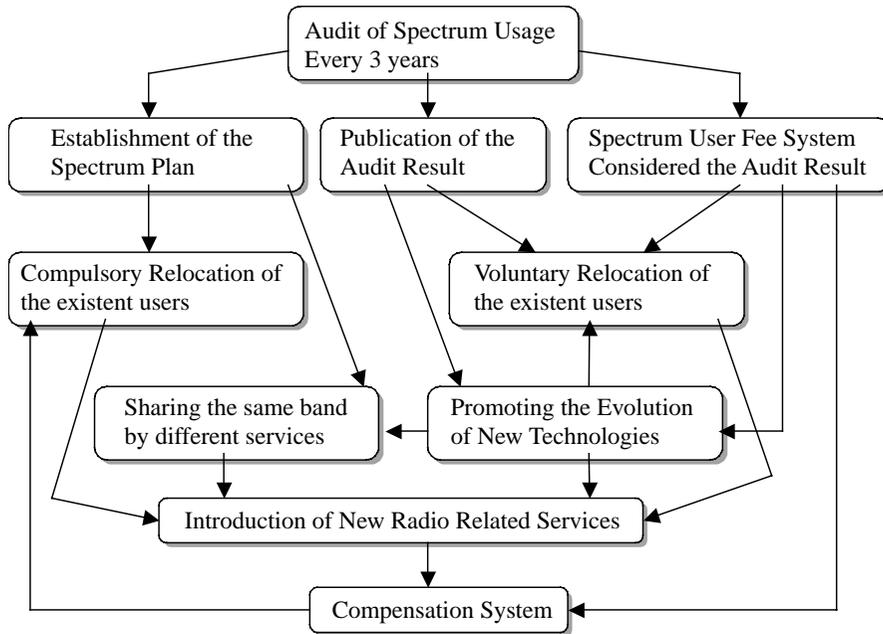
MPHPT then organized two sub-groups on the license-exempted stations and the Spectrum User Fee system under the study group in February 2003 and a sub-group on the multiple usage of a band by different systems in May 2003. In addition another study group on the realization of the compensation system was started in 2003. The second report (consultation paper) of the "Study group on the policy on the effective use of spectrum" was published in June 2003. The report proposed the introduction of shared use of the same band by different systems in different regions and the creation of a registration system which can be thought of as lying between the license system and the license-exempt system. It means that MPHPT permits the use of radio devices without any individual examination of stations as occurs for licensed stations, while it has the detailed list of users and reserves the right of inspection in case of interference. MPHPT will apply this system to high power (more than 10mW) wireless-LANs after the modification of the Radio Law in 2004.

Mr. Hiroki SUMIDA, Planner of Radio Department of MPHPT, announced the subsequent policy initiatives as the "Declaration of the Radio Spectrum Release" in a conference organized by the Association of Radio Industries and Businesses (ARIB) on July 1, 2003. The change in policy stance surprised the audience. According to his response to a question from a journalist, the trigger was the sudden evolution of the wireless-LAN.

The third report (consultation paper) of the "Study group on the policy on the effective use of spectrum" was published in October 2003. It proposes methods of compensation for relocation of existing licensees; the new users should pay at least 50% of the compensation while the revenue fund of the Spectrum User Fee will pay the rest; in the case of new users that are exempted from licensing, the manufacturers or the importers pay. This contribution may be counted as a factor in the evaluation of applicants in comparative hearing.

The revision of spectrum management policy has been adopted as a topic in the Info-communications Council. This council organized a special sub-council on spectrum policy and a committee on the future vision for spectrum uses. These groups analyzed the future demand for spectrum and related markets, and then proposed guidelines on the desired spectrum policy in the "Spectrum Policy Vision" published in July 2003 (Info-communications Council (2003)). The proposed policy has been developed in parallel with the reports published by the "Study group on the policy on the effective use of spectrum." Figure 2 shows the possible policy tools.

Figure 2: Possible Policy Tools



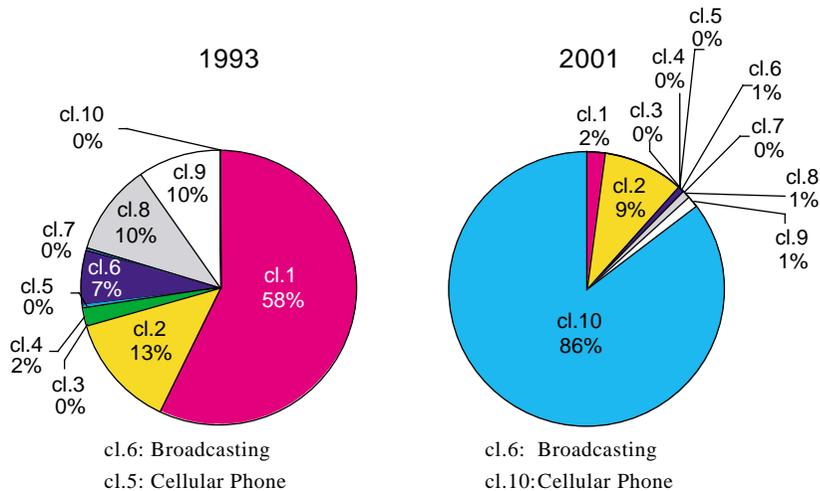
### Revision of Spectrum User Fee system

After ten years experience of the Spectrum User Fee System, there are now many debates on the future of the system among economists, politicians and industry.

- The evolution of radio-communications technology and markets have changed the initial preconditions of the fee system; the revenue from portable telephone users has increased dramatically while that from broadcasters has been stable (c.f. Figure 3). In particular broadcasters are beneficiaries of the fund of the Spectrum User Fee because of the analog frequency change, but they contribute only 1% of the fund<sup>13</sup>.
- These environmental changes raise the issue of unfairness between spectrum users such as between telecommunications operators (or users) and broadcasters, and between commercial users and public users, who either pay no fees or whose fees are discounted.
- While the demand for spectrum is increasing in the age of “ubiquitous” (pervasive) access to the broadband, its supply is limited physically, and new assignments for new services thus become difficult without relocation of existing spectrum users.
- There is a desire for spectrum users to use the spectrum more effectively

by facing some incentives, and for new, more spectrally efficient technologies to be adopted, especially those using the unused high frequency bands.

Figure 3: Revenue of the Spectrum User Fee by category of station



MPHPT is concerned about the disincentives resulting from the actual fee system. Because the fee paid by each operator is based on the number of radio stations; as the number of mobile terminals increases, the mobile operators have to pay more, while they use the same amount of spectrum and they are forced to invest in the micro-zoning of cells. In addition, operators do not face any penalty if they do not start investing or their services after receiving the (preliminary) license, because they do not have to pay any fee unless they construct base stations or they have subscribers.

A working group under the “Sub-group on the Spectrum User Fee system” proposed a model that reflected the economic value of spectrum in September 2003. This group recognizes the spectrum resource as a “space resource.”<sup>14</sup> This means that the value of the resource is attributed to its usage and depends on its scarcity. If the spectrum is priced by its value, the price varies with the spectrum location and the geographic location, and if services in particular bands are fixed, it depends also on the services. MPHPT expects that this pricing method will give spectrum users an incentive to avoid hoarding spectrum during the initial license periods and to return part of their licensed bands as terminal users i.e. clients under their systems decrease as a result of technical or commercial innovation.

Many criticisms and anxieties concerning this alternative pricing system were presented in the meetings of the “Sub-group on the Spectrum User Fee system” from operators and the ministry including:

- Application of the same criteria for all users including different services (mobile, fixed, radar etc.) and the different type of users (commercial users, independent users, public users etc.) Different users have argued that they should be treated differently because of differences in their use of spectrum (e.g. temporary use).
- Elasticity of demand to the fee (In the case of users with a very low elasticity, such as services whose bands of frequency are internationally allocated or have few alternatives, they can not change their current use of spectrum even if their fees are set very high. In that case the fee does not function as an incentive mechanism.)
- Increase in the revenue level without any ceiling compared with the current system
- Introduction of the charging system for use of spectrum, which permits some property rights to users

The approach to harmonizing the actual and the new model through a new system for calculating fees will be debated in 2004 and introduced in 2005.

## Concluding comments

The review of spectrum policies given in the previous three sections indicates that different countries are taking different approaches to dealing with the issue of spectrum congestion and the need to reform spectrum for new services.

The UK has gone furthest in terms of implementing a range of economic incentives to promote efficient use of spectrum. Auctions and AIP have been applied and it is intended that spectrum trading will be introduced from 2005 onwards. Experience with AIP has been mixed in the sense that it appears to have had relatively little impact on spectrum use decisions. This is probably because prices were set at a relatively low level - at least half the level that was initially calculated. There is now a review of the pricing approach being undertaken and the outcomes will be of relevance to the Japanese government in its deliberations over spectrum pricing in 2004.

The French system is unique in that they combine the rent i.e. the economic value and the fee i.e. the administrative charge, and charge users separately. To pursue economic efficiency and the recover of administrative costs at the same time, this combination seems to be one of the relevant solutions.

Economic mechanisms are used to speed up the reforming of spectrum in all three countries reviewed, though the approaches differ. In France the government temporarily subsidizes migration of users to new bands but the new users of the band pay these costs in time through an additional payment (in addition to taxes and fees). This approach has the advantage of not unduly burdening the new users of the band with a large initial cost, but has a cost for the

French tax payer (i.e. the cost the “loan” to the new users). Japan has an intermediate approach in which new users pay at least 50% of the cost of moving incumbent users and in future in the UK companies wanting access to tradable spectrum will pay the full cost of moving incumbents. The key point is that all three governments have recognized that traditional administrative means of moving incumbents are too slow given the pace of technology and service development in the communications sector.

The other main issue that is common to the three cases we have examined is the difficulty in achieving comparable treatment of broadcasters and telecom providers. In all three cases broadcasters are either exempted from the system of fees or pay reduced rates. While there are clearly significant political issues to be addressed in changing the regime for broadcasters, economic analysis suggests that efficiency is best promoted by pricing inputs at their opportunity cost. Economic welfare is maximized if externalities or any other market failures that may arise in broadcasting markets are addressed through other policy instruments (e.g. subsidy from TV license fees, content regulation). Because this problem might be related more or less to the market structure (e.g. separation of the infrastructure and the content), careful consideration is needed.

## NOTES

- 1 The Wireless Telegraphy Act (1998) allowed the introduction of administrative pricing and auctions.
- 2 It is important to distinguish between administrative incentive prices (i.e. fees for rights of use for radio frequencies) which reflect the need to ensure optimal use and administrative charges which are intended to recover spectrum management costs. This distinction is made in European legislation, namely in the Framework Directive (Article 13) and the Authorization Directive respectively.
- 3 As a general rule mobile prices were applied below 2GHz while fixed link prices were applied above 2GHz. See section 3.7, NERA-Smith (1996), for the list of services to which either mobile or fixed prices could be applied.
- 4 For example, in the case of mobile services values were modified based on the propagation characteristics of the spectrum, whether allocations were fragmented or not (in the case of cellular operators) and constraints on spectrum use resulting from international interference and co-ordination requirements. See RA (1998).
- 5 This is for a link in the 7.5 GHz. Values decline as the frequency increases.
- 6 Users may not be able to modify their use of spectrum in response to spectrum pricing in a variety of circumstances, such as when their use is determined by international requirements (e.g. bands used for aeronautical and

- maritime safety and defence bands used by NATO).
- 7 This may not be possible because of problems of avoidance or illegal use.
  - 8 Ofcom (2003: Section 8.6) deals with spectrum pricing issues. See the website of Ofcom <http://www.ofcom.org.uk/>.
  - 9 The Wireless Telegraphy Act (1998) allowed the introduction of administrative pricing and auctions.
  - 10 ART (2002 : pp.18-20). Ms G. Gauthey, member of the Board of ART, also underlined this harmonization in the TDF Broadcast and Telecom Synergy/Convergence symposium in Metz on October 23, 2003.
  - 11 See <http://www.tele.soumu.go.jp/e/index.htm>. The Ministry of Public Management, Home Affairs, Posts and Telecommunication presents its spectrum management policy including the Spectrum User Fee system very detailed on this website.
  - 12 See <http://www.tele.soumu.go.jp/e/fees/sum/calc.htm>.
  - 13 The additional fee is applied to these licensees in the simulcasting period (between 2003 to 2010).
  - 14 This is an idea of Professor Hajime ONIKI. See H. Oniki (2002). See also his website: <http://www.osaka-gu.ac.jp/php/oniki/noframe/eng/index.html>

## REFERENCES

- Autorité de Régulation des Télécommunications (2002). *Rapport de l'ART sur l'adaptation de la régulation: Adapter la régulation au nouveau contexte du marché télécommunications* [Repport by ART on the regulatry adaptation]. Paris: Author.
- Autorité de Régulation des Télécommunications (2003). *Annual Report 2002* (English version). Paris: Author.
- Centre National de la Cinématographie (2003). *Bilan 2002* (CNC info 287) [Result in 2002]. Paris: Author.
- Department of Trade and Industry and Her Majesty's Treasury (2002). *Government Response to the Independent Review of Spectrum Management*, London: Author.
- FCC Spectrum Policy Task Force (2002). *FCC Spectrum Policy Task Force Report*. Washington: Author.
- Independent Spectrum Review (2002). *Review of Radio Spectrum Management*, by Professor Martin Cave, for Department of Trade and Industry and Her Majesty's Treasury. London: Department of Trade and Industry and Her Majesty's Treasury.

- Info-communications Council (2003). *Chutyoki ni okeru Denpariyō no Tenbo to Gyōsei ga Hatasubeki Yakuwari: Denpa Seisaku Vision* [Spectrum Policy Vision]. Tokyo: Ministry of Public Management, Home Affairs, Posts and Telecommunication.
- Ministry of Public Management, Home Affairs, Posts and Telecommunication (2002). *Denpa Yukoriyo Seisaku Kenkyukai Hokokusho* [Study group on the policy on the effective use of spectrum Report]. Tokyo: Author.
- NERA-Smith System Engineering (1996). *Study into the Use of Spectrum Pricing*. London: Radiocommunications Agency. <http://www.radio.gov.uk>.
- Office of Communications (2003). *Spectrum Trading Consultation*, London: Author.
- ONIKI Hajime (2002): *Denpa Shigen no Economics* [Economics of the Spectrum Resource]. Kanagawa Japan: Gendaitosho.
- Radiocommunications Agency (1994). *The Future Management of the Radio Spectrum, A Consultative Document*. London: Department of Trade and Industry.
- Radiocommunications Agency (1997). *Implementing Spectrum Pricing*, London: Author.
- Radiocommunications Agency (1998). *Report on Modifiers to be used in determining Administrative Pricing fee charges for mobile services*, London: Author.