From 'Command and Control' Methods to 'Flexible' Spectrum Management: Comparing Turkey with other Markets

by

Yusuf Korhan SELEK

Registration Number: 11426233

The Dissertation Thesis Submitted to the School of Media, Arts and Design,
Department of Journalism and Mass Communication
in Partial Fulfilment of the Requirements for the Degree of

Master of Arts in Communications Policy

at

University of Westminster

Supervisor: Prof. Dr. Daya Kishan THUSSU

Harrow-on-the-Hill, London
28th August 2008

TABLE OF CONTENTS

Page

ABSTRACT

Radio spectrum is a natural scarce resource which should be used efficiently and effectively. In spectrum management field, traditionally the so-called ‘command and control’ approach has been implemented. This method has some shortcomings, especially in terms of inefficiency and inflexibility on one hand and the need of finding sufficient frequencies to satisfy ever increasing demand for additional frequencies resulting from the widespread deployment and use of wireless networks on the other hand. Thus new approaches that favour market-based mechanisms such as auctioning and trading have been proposed to be used in management of radio spectrum. In this thesis, the advantages and disadvantages of policies that use market-based mechanisms have been analysed in general. In this context, some country practices and the practices in Turkey have been examined specifically. After discussing the findings, in the light of discussions, some proposals have been made regarding the better implementation of market-based mechanisms in Turkey.

Key words : auctioning, spectrum trading, flexible spectrum management, regulation.

Number of pages : 72

Supervisor : Prof. Dr. Daya Kishan THUSSU

ACKNOWLEDGEMENTS

I would initially like to express my sincere thanks to Prof. Dr. Daya Kishan THUSSU, who accepted to become my thesis supervisor. He was immensely helpful. His valuable academic comments and insights improved the quality of this document.

I would like to specially thank to Dr. Maria MICHALIS, who was the Director of MA Communications Policy program. She was greatly helpful throughout my study too. The most important of all, her ever-smiling face was a source of motivation.

I would like to express my heartfelt thanks to Dr. Winston MANO, who provided valuable guidelines in preparation of the Dissertation Proposal. I will always remember the warmth and openness he showed me.

I owe a debt of gratitude to Kerim ÖZSÖZ who was my classmate. He always supported me in terms of taking everything easy ☺. Thank you very much for everything.

I would also like to express my sincere appreciation to my sponsoring employer, the TELECOMMUNICATIONS AUTHORITY of TURKEY, which always created exiting opportunities for me, to which I dedicate this thesis.

Finally, I would like to thank my mother, Feriha BARDAKÇI, who always stood by me and supported me at the expense of everything.

"imagination is more important than knowledge.
knowledge is limited but imagination encircles the world."
albert einstein

Philadelphia *Saturday Evening Post*, October 26th, 1929.

LIST OF TABLES

Page

LIST OF ABBREVIATIONS

2G	Second Generation mobile communications systems
3G	Third Generation mobile communications systems
AT&T	American Telephone and Telegraph
BT	British Telecom
CEPT	European Conference of Postal and Telecommunications Administrations
DECT	Digital European Cordless Telephone
EC	European Commission
ECC	Electronic Communications Committee
ERMES	European Radio Messaging System
EU	European Union
FCC	Federal Communications Commission
FWA	Fixed Wireless Access
GSM	Global System for Mobile communications
ITU	International Telecommunication Union
ITU-R	ITU Radio Communications Bureau
OFCOM	Office of Communications
PAMR	Public Access Mobile Radio
PBR	Private Business Radio
PMSE	Programme Making and Special Events
PTT	General Directorate of Post, Telegraph and Telephone
RSPG	Radio Spectrum Policy Group
SAA	Simultaneous Ascending Auctions

SMA	Spectrum Management Authorities
TA	Telecommunications Authority of Turkey
TFTS	Terrestrial Flight Telecommunications System
WAPECS	Wireless Access Policy for Electronic Communications Services
WiFi	Wireless Fidelity
WiMAX	Worldwide Interoperability for Microwave Access
WRC	World Radiocommunication Conferences

1. Introduction

1.1. Driving forces

Radio spectrum is a natural scarce resource, which can not be depleted by use. Radio spectrum is a key resource to all kind of radiocommunications and should be used effectively and efficiently. This is achieved by the spectrum management authorities of countries.

The mobile communications became almost as an indispensible part of daily life and today, it is widely deployed across the world. For example, if we take only the GSM[1] case into account, it is a mobile communications industry that today serves more than 2.5 billion people across 218 countries and territories (GSMA, 2007:1).

With the growing importance of mobile communications, the importance of the enabling tool, the radio frequencies, has also risen for global mobile communications service providers. Especially for the last 20 years, new forms of spectrum management, which are favouring the use of market-based mechanisms, have been proposed and started to be used such as spectrum auctions or spectrum trading. But what were the underlying theories to such proposals? It can be argued that at this point, the ‘liberalism’ and the 'neoliberalism’ have their roles to play.

McLaughlin (2001) summarises the liberalism, on the basis of three concepts, as the ‘political’ philosophy of ‘individual’ ‘liberty’ (p.4). From the International Liberal Conference at Wadham College, Oxford, in April, 1947, we can understand that liberalism emphasizes individual rights and equality of opportunity and it promotes some principles including extensive freedom of thought and speech, limitations on the power of governments, the rule of law, the free exchange of ideas, a market or mixed economy, and a transparent system of government (Liberal International, 2008).

Over the course of time, many forms of liberalism have been formed. Neoliberalism is one of them. According to McCarthy and Prudham (2004) the term ‘neoliberalism’ stands for a complex assemblage of ideological commitments, discursive representations, and institutional practices, all propagated by highly specific class alliances and organized at multiple geographical scales (276). However, in order to give a brief distinction between ‘liberalism’ and ‘neoliberalism’ Martinez and García (2000) state that

[1] Global System for Mobile communications.

> "Neoliberalism is a set of economic policies that have become widespread during the last 25 years or so. [Y]ou can clearly see the effects of neoliberalism here [Latin America] as the rich grow richer and the poor grow poorer....Around the world, neo-liberalism has been imposed by powerful financial institutions like the International Monetary Fund, the World Bank and the Inter-American Development Bank....the capitalist crisis over the last 25 years, with its shrinking profit rates, inspired the corporate elite to revive *economic* liberalism. That's what makes it 'neo' or new" (p.1).

In neoliberalism, there is great emphasis on market-forces and economics. Some describe neoliberalism as a political movement that favours economic liberalism as a means of promoting economic development and securing political liberty (Portes, 1997:229). McCarthy and Prudham (2004) argue that neoliberalism is the most powerful ideological and political project in global governance to arise in the wake of Keynesianism, a status conveyed by triumphalist phrases such as 'the Washington consensus' and the 'end of history' (p.275). According to Susan (1999) neolibealism espouses the idea that the market should be allowed to make major social and political decisions; the idea that the State should voluntarily reduce its role in the economy (p.1).

1.2. Developments in telecommunications

As a service, telecommunications density increased above the 60 per cent mark in all First World nations by the late 1970s. For much of the rest of the world, however, state control of the telecommunications infrastructure did not necessarily translate to the state's prioritization of the sector. This was especially the case for nations where other more vital areas such as energy and water as well as health and education were more pressing priorities for governments with limited resources (Chakravartty and Sarikakis, 2006:61).

By the late-1970s, the logic and scope of the national monopoly model of the telecommunications began to be seriously challenged by the regulatory shift. Technological advances stemming from research in the defence-related electronics sector introduced new satellite, cellular radio, fibre-optic and digital exchange technology, which became increasingly vital components of all sectors of economic activity. This was true not just in the First World where most transnational firms were based but also in Asian and Latin American economies where firms began to relocate production. These new technologies led to the potential for the provision of segmented and differentiated services, thereby undermining the assumptions about the need for a 'natural' monopoly in the sector (Chakravartty and Sarikakis, 2006:62)

For most Western nations, these technological changes coincided with the fiscal crises of the 1970s, creating a crisis of legitimacy for the welfare state. The failures of the postcolonial state to deliver equitable modern telecommunications infrastructure became acute, compounded by the debt crisis of the 1980s and new pressures for privatisation of national monopolies. The eventual collapse of Eastern European communism further reinforced the need for reformulating the state's role in regulating industry, especially infrastructure areas like telecommunications that were by the 1980s recognised by powerful governments in the West as well as multilateral organisations as crucial to new developmental imperatives (Chakravartty and Sarikakis, 2006:62).

For the organisation and supply of telecommunications services, reformers from the US, the UK and in the World Bank and International Telecommunication Union (ITU) argued that cost-based tariffs should replace the regulatory logic of cross-subsidy; in other words, business and other larger users of services should not have to subsidize smaller, less remunerative users or customers. In this same period, transnational telecommunications firms found a receptive climate for their demands to enter unsaturated national markets and for advanced networks that were seamless in order to facilitate coordination of production as well as transactions across national borders. The dominant global policy consensus posited that state regulation and ownership stunted innovation and led to the inefficiencies in resource allocation and distribution (Chakravartty and Sarikakis, 2006:63).

In 1980s the examples of policy shifts in telecommunications governance have started to be seen notably in the US, the UK and the Japan. In the US, Federal Communications Commission (FCC) decided to break up AT&T[2] into twenty-two local companies in 1984 (Hamelink, 1994:68). The deregulation of AT&T's monopoly had the knock-on effect across the world (Hills, 1986:2). In 1985 the sale of 51% of UK's state owned British Telecom (BT) shares to private sector was authorised by the UK government. Also in 1985 Japan developed a new policy towards liberalisation of its telecommunications sector. Part of the government's ownership of Nippon Telephone & Telegraph was sold to the private sector and new local voice carriers were allowed in the market with liberalisation (Hamelink, 1994:69).

The paradigm shift in regulatory norms favouring market-based competition had a profound impact beyond the national boundaries of the Northern nations. In harmony with the emerging 'neoliberalist climate', with the end of the Cold War and the shift in discourse of

[2] American Telephone and Telegraph.

‘free’ markets, policy-makers around most of the world fell in line with the strategic consensus about the failure of state-operated monopolies, promoting instead a new faith in free trade. In terms of telecommunications policy, traditional concerns for establishing what is considered ‘fair’ prices and maximum access to services was replaced by a new emphasis on the performance of home-based corporations in global trade, procuring favourable balance of payments and ensuring consumer sovereignty in a competitive market (Chakravartty and Sarikakis, 2006:63).

To sum up, fundamental ideological changes in the global political arena in the 1980s and 1990s led to creation of pro-market international trade regimes which had enormous impact on international communication. As a result of deregulation and privatisation in the communications industry combined with new digital information and communication technologies, globalisation of telecommunications revolutionised international communication. At the same time, there has been a change from state to private control and from a state-centric view of communication to one governed by the rules of free market (Thussu, 2006:66).

1.3. Spectrum management side

After the policy shifts in telecommunications regulation, especially in wireline networks, over the course of time, these policy shifts started to affect the wireless counterpart, the radiocommunications networks. Spectrum management is at the heart of radiocommunications. Particularly with the auctioning of spectrum, the uses of market-based mechanisms have also started in this field. In order to be more specific, one should understand why governments have begun to market the spectrum.

Spectrum management has traditionally followed a so-called ‘command and control’ model. In its most traditional form, this model means that administrations are both responsible for negotiating frequency allocations internationally, and deciding on precise use of the bands as well as on the users allowed using the frequencies. In case of spectrum scarcity, a beauty contest is usually held to decide who receives a license to use the spectrum. In a market with relatively few players, this is a system that gives administrations maximal knowledge on spectrum activity, relatively large degrees of control over spectrum usage and minimises interference between services (Delaere and Ballon, 2007:58).

Some of the main concerns over the traditional command and control approach in spectrum allocation policies and management is that the traditional approach:

- does not ensure spectrum is used efficiently (or even used) after licenses are issued,
- is too slow and inflexible,
- prohibits licensees from being able to change spectrum use to offer new services,
- limits innovative uses of new technology,
- is too restrictive on entry of new technologies, such as low-powered devices (Xavier and Ypsilanti, 2006:34).

Cave et al. (2007) argue that it is unlikely that command and control method achieves the full objective of a spectrum manager of maximising the economic value derived from the spectrum. He further argues that since it is almost impossible to predict the value that each different service provides under any given spectrum allocation it is difficult to see how a command and control approach to managing the radio spectrum could maximise value (p.7).

In terms of inefficiency and inflexibility, there have been many pieces of evidence which suggest that regulators are failing to maximise the value under command and control approach. For example, some regulatory decisions, such as the allocation of spectrum to the ERMES[3] paging system or the TFTS[4] in-flight phone system in Europe, have resulted in spectrum being unused for over a decade. Another example can be new applications. Many emerging applications or technologies, such as mobile TV systems, have had great difficulty in gaining access to spectrum. While it is not certain that these would increase the value of spectrum, their difficulty in entering the market was a result of an excessively rigid (inflexible) system (Cave et al., 2007:7).

Forge and Blackman (2006) argue that it seems increasingly likely that command and control method will be inadequate for the future for two main reasons. First, over the next 25 years, the user population worldwide is set to grow significantly leading to a massive expansion in demand for services using the radio frequency spectrum. Second, the future will also see demand for new types of service that will require much wider bandwidth to support richer content (p.6).

The spectrum is widely used for radio and television broadcasting and by the military, and is essential for a broad range of other activities including law enforcement, energy and

[3] European Radio Messaging System.
[4] Terrestrial Flight Telecommunications System.

transportation, manufacturing, medical diagnosis and therapy, global positioning, navigation aids, meteorology, disaster warning, and astronomy, among others. (Wellenius and Neto, 2006:18). Although radio spectrum is widely used in these areas which contribute the increasing demand for spectrum, another important area, the telecommunications, can also be taken as a case to look at increasing demand for spectrum.

As regards the user population, Forge and Blackman (2006) argue that future telecommunications infrastructures will be shaped and driven by the needs for accessibility for the large mass of the unserved world – broadly speaking, that amounts to 3.5 billion potential users beyond the 2.5 billion or so current users of mobile telecommunications. In consequence, after 2015 or 2020, the developing countries and their requirements will shape future telecommunications infrastructures (p.7).

Wellenius and Neto (2006) argue that especially during the last ten years, the spectrum has come under pressure from rapid demand growth for wireless services and changing patterns of use. Mobile phone service took off in the mid-1990s, developed at an unprecedented pace, and is still growing. Wireless has become the technology of choice to develop existing and new networks by incumbents as well as new entrants in fast-growing competitive telecommunications markets. New wireless devices (e.g. cordless phones, computer routers, internet hot spots, mobile internet) have proliferated requiring ever greater spectrum resources (p.19).

It is mostly important that, the future new infrastructure for the developing world will be dominated by mobile rather than fixed infrastructure. This is because future mobile networks, including alternative wireless technologies (such as WiMax[5] and WiFi[6]) will be much quicker and cheaper to roll out than today's fixed line and cellular (Bohlin et al., 2006:65).

As regards the demand for new types of services in telecommunications that will require much wider bandwidth to support richer content, it can be claimed that in a converging environment, a move towards multimedia content with mobility will grow as prices fall and as more and more consumers perceive them to offer good value (Forge and Blackman, 2006:7). With increasing number of users, there will be also need for richer content in terms of applications in health and social care to support the elderly and emergencies, both man-

[5] Worldwide Interoperability for Microwave Access. WiMAX is a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to wired broadband like cable and DSL (WimaxForum, http://www.wimaxforum.org/technology/)

[6] A term developed by the Wi-Fi Alliance to describe wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards (Wi-Fi Allicance, http://www.wi-fi.org)

made and natural. These needs will be satisfied mobile applications which require much wider bandwidth in spectrum (Bohlin et al., 2006:10). The need for much wider bandwidth may result in scarcity in spectrum, which may put regulators in difficult position to find required frequencies. Cave et al. (2007) argue that as the number of spectrum-using services increased, the demand for spectrum has grown increasingly (p.7).

On the other hand, Cave et al (2007) also argue that the old model has become increasingly difficult for the spectrum managers to implement. They receive frequent requests for new spectrum or to allow existing users to change application, which are all difficult to resolve (p.8).

It is also important to note that, over the course of time, some advanced forms of wireless technologies have been developed such as Software Defined Radios and Cognitive Radios, which technically formed the basis of using the radio spectrum more efficiently and effectively. Since these technologies can use the different parts of spectrum and the standards for providing services, they enable users of spectrum to make more 'flexible' arrangements in their wireless network designs (Selek, 2005:86).

In short, dissatisfaction with the old model on the grounds that the inflexibility in terms of changing frequencies assigned and its associated services and technologies in the market; inefficiency caused by ineffective use of spectrum i.e. not making use of the unused parts of spectrum; and finally and may be the most importantly, the increasing demand for radio spectrum fundamentally formed the basis of the reasons for governments to begin to market the spectrum, thus opening gates to debates on alternative spectrum management regimes that are often referred to as 'flexible spectrum management'.

It should be noted that because all spectrum stakeholders legitimately wish to maximise the degree of flexibility that is given to them, the term 'flexibility' may be understood differently by various stakeholders. Therefore 'flexibility' should be understood as the ability of the spectrum regulatory framework to facilitate and adapt, in a timely manner, to user requirements and technological innovation by reducing constraints on the use of spectrum and barriers to access spectrum (CEPT, 2006:4).

1.4. Structure of the thesis

In this chapter of the thesis, the underlying theories of the transition form full state controlled approaches in regulations to the market-based forms have been briefly provided in general.

Then policy shifts in telecommunications governance and specifically the reasons of starting to market the spectrum allowing the introduction of the market-based mechanisms in spectrum management field have been examined.

In the second chapter of the thesis, the role of auctions in spectrum management has been studied. In this context, the design of the auction mechanism, which often referred to as ‘a strategic issue’ affecting the effectiveness, efficiency and thus the outcomes, has been examined. Then, the advantages and the disadvantages of such a policy has been analysed.

In the third chapter, another element of market-based mechanisms, the spectrum trading has been studied. After, documenting the concept of spectrum trading, the advantages and the disadvantages of such a policy has been analysed. Then, the implementation matters of the spectrum trading have been examined.

In the fourth chapter, the efforts on introducing the flexibility in spectrum management have been documented in terms of international, regional and national levels. At the national level, the auction and spectrum trading country practices have been examined in terms of case studies. Then the market-based mechanisms in Turkey have been examined.

The final chapter provides the conclusions of the analyses done in the previous chapters. In this context, some proposals have been made regarding the better implementation of market-based mechanisms in Turkey.

2. The auctions

2.1. The auctions in spectrum management: introduction

McAfee and McMillan (1987) describe an auction as a market institution conducted on the basis of explicit set of rules, determining resource allocation and prices by revealing the bids submitted by market players (p.701). Why are auctions used rather than other selling goods such as posting a fixed price? According to Cassady (1967:20): "One answer is, perhaps, that some products have no standard value. For example, the price of any catch of fish (at least of fish destined for the fresh fish market) depends on the demand and supply conditions at a specific moment of time, influenced possibly by prospective market developments. For manuscripts and antiques, too, prices must be remade for each transaction. For example, how can one discover the worth of an original copy of Lincoln's Gettysburg Address except by auction method?" (p.701).

In principle, as far as radio spectrum is concerned, the fact that 'being a good' was valid for the radio spectrum too. In the academic literature, the auctioning of the spectrum was first discussed and proposed in 1959 in an article dealing with the political economy of broadcasting[7] (Coase, 1959:1). However, over the course of time, radio spectrum administrators have applied many different ways to assign radio spectrum rights to users. Until the late 1980s administrators assigned licences (with frequencies attached) using administrative processes that included lotteries, beauty contents and awards on first-come first-served basis. In the early 1990s a few administrators chose to auction spectrum rights (Cave et al., 2007:43). The early pioneers in spectrum auctioning were New Zealand and Australia in the late 1980s and early 1990s and they used fairly simple auction designs - either oral outcry bidding or sealed tenders (Munro, 2000:1).

Following the large revenues raised in auctions for spectrum rights in the U.S. in mid 1990s, interest in using auctions to assign frequency rights increased markedly around the world (Cave et al., 2007:43). For example in 1995, with the Broadband C Block Auction USD 10.1 billion has been raised (Scanlan, 2001:692).

[7] In 1959 the FCC invited the economist Ronald Coase to testify about his proposal for market allocation of radio spectrum rights made in an article published in Journal of Law and Economics, titled as FCC. The FCC Commissioners' first question to Coase was "Is it a big joke?". In work that would lead to his theory which is called as "Coase Theorem" following year, Coase discovered the inefficiencies of administrative methods and won the Noble Prize in 1991 (Hazzlet, 2001:1).

Regarding the large revenues raised in auctions, it should be interesting to note that in March 2008 USD 19.5 billion has been raised by 700 MHz auction in the U.S.; while all other FCC auctions from 1968 to date had generated total of USD 91.1 billion[8].

A review of radio spectrum management in UK, which was prepared in 2002, strongly supports the use of auctions to assign spectrum licences to competing players in the market. It is concluded in the review that auctioning should become the default means of assigning licences to exclusive frequency bands. It is recommended that the specific design of individual auctions should be decided on a case by case basis, taking account of competition, marketing and technical analysis (Cave report:2002:20).

From a political point of view, an auction theorist, Cramton (2001) argues that in most cases, the greatest room for improvement in wireless markets lies not in the auction design, but in the frequency allocation process. He further argues that spectrum allocations often are the result of political forces that ignore the underlying economics. Therefore, he suggests that governments would do well to let competitive market forces, not political lobbying, determine spectrum use (p.35).

Auctions typically involve either a large number of sellers and one buyer (often referred to as a reverse auction or procument auction), or a large number of buyers and one seller. Radio spectrum auctions typically involve a large number of buyers (for example mobile operators or broadcasters) and one seller (the radio spectrum agency-government). Auctions can take many different formats and over the past two decades a number of different auction formats have been used to assign radio spectrum licences (Cave et al., 2007:49).

In general there are two main forms of spectrum auctions: (i) interactive or open auction and (ii) sealed bid auctions. Interactive auctions are where bidders interact with the auctioneer through a price discovery process that typically features either ascending or descending bids. Sealed bid auctions are where bidders submit their bid only once in a sealed envelope or via electronic means. The amount a successful bidder pays depends on whether it is a first- or second-price auction. In a first price auction successful bidders are required to pay the amount bid, whereas in a second-price auction the successful bidder pays an amount equal to the second highest bid submitted (Cave et al., 2007:49).

---

[8] Source: FCC <http://wireless.fcc.gov/auctions/default.htm?job=auction_summary&id=73>. On March 18, 2008, the FCC completed the auction of 1090 licenses in the 698-806 MHz band (700 MHz Band), designated as Auction 73. All details can be reached from the mentioned web site.

An example of a popular interactive auction is the English auction in which bidders submit bids in an ascending manner until the number of bidders remaining equals the number of licences for sale. Another example of interactive auction is the Dutch auction, where the auctioneer starts with a high price and reduces this over time until a bidder accepts the posted price (Cave et al., 2007:49).

Cave et al. (2007) state that there are ten different types (formats) of auction which can be applied in radio spectrum field:

1. First-price sealed bid auction (equivalent to Dutch auction)
2. Second-price sealed bid auction (equivalent to English auction)
3. Simultaneous ascending auctions (SAA)
4. Ascending clock auction (Japanese auction or button auction)
5. Revenue share auctions
6. Hybrid auctions
7. Combinatorial auctions
8. Sequential auctions
9. Anglo-Dutch auction (an SAA auction followed by a sealed bid auction)
10. Clock-proxy auction (p.53-76).

Radio spectrum auctions are a special case of spectrum pricing in which the price paid for the spectrum is determined directly by market participants instead of being determined by the regulator and licences are placed in the hands of those valuing them most (ECC, 2006:43). Spectrum auctions can be designed to incorporate a wide range of policy objectives and can be tailored to the particular needs of individual administrations (Munro, 2000:1).

2.2. The strategic issue in spectrum auctions: the design

Auctions are increasingly used by regulators to grant spectrum licences to the highest bidders. In the case of auctions, the market ultimately determines who will hold the spectrum licences. However, with the experience gained in spectrum auctions over time, in many auction schemes, bidders are pre-qualified using criteria similar to those used in comparative evaluation processes such as beauty contest. As a result, participation in some auctions is limited to bidders with proven financial and technical capabilities (Intven,

2000:2-14). This pre-qualification procedure can be regarded as hybridization of auction with comparative selection process.

In general, the objective of most spectrum auctions is two-fold. The primary goal is efficiency – getting the spectrum in the hands of those best able to use it. A secondary goal is revenue maximization. In designing the auction, the governments should care about revenues since auction revenues are less distortionary than the principal source of government revenues –taxation (Crampton, 2001:4). For example, economists estimate that the welfare loss from increasing taxes in the U.S. is in the range of 17–56 cents per dollar of extra revenue raised (Ballard et al. 1985:128). In addition to these objectives, regulators also seek to increase competition for wireless services (Crampton, 2001:4).

Melody (2001) argues that one of the most important factors in auction design is the structure of competition in the bidding process, and the alternatives available to the likely bidders. If the goal is efficient spectrum allocation, then the design will be to minimize barriers to entry to the bidding process, to maximize flexibility and substitutability for all bidders, and to establish all possible conditions to make the bidding conditions approximate those in a competitive market. If the goal is to maximize the revenues that the government can extract from successful bidders, then the auction will be designed to create a relationship of maximum dependency upon winning licences among the key bidders, and a bidding environment that invites the dependent bidders to overbid (p.8).

As regards the increasing competition in the market, the auction rules can be set to achieve this objective. For example, if there is a desire to bring new entrants into the market, some licences can be reserved for them, or they might receive special benefits in the auction process such as adding a notional monetary sum to their bids. Similarly, other policy objectives can also be built into an auction process by imposing appropriate licence conditions. Suppose, for example, it is an objective of policy to ensure a fast network rollout, perhaps faster than a licensee would choose to go in its private interests. Then a licence can be allocated subject to roll-out conditions. Thus auctions are an unusually flexible means of allocating resources in ways designed to achieve a range of policy objectives (Cave and Valletti, 2000:348). In this context, spectrum auctions are described as ‘a flexible policy tool’ in spectrum management field (McMillan, 1995:194).

Just because one type of auction format worked well for a particular licence in one country is no guarantee that it will produce a positive outcome elsewhere. Furthermore, selecting the most appropriate auction format is not enough to ensure a good outcome. Decisions

on detailed rules procedures can have as big an impact on both the auction outcome administrative burden of running the contest as the overall format (A-focus et al., 2004:4). Munro (2000) argues that experience shows that the degree to which an auction is successful in achieving a regulatory body's objectives is dependent on the attention paid to the details of the auction rules and procedures (p.3).

The auction design is simply crucial for its success. In other words, it may be argued that in most cases, the advantages and disadvantages of auction mechanism significantly depend on auction design. However, this is a particularly difficult task. The auction must not only attain some of the objectives mentioned earlier, but must be easy to implement as well (OECD, 2001:17). Another auction theorist, Klemperer (2004), argues that what really matters in practical auction design are the same issues that any industry regulator would recognize as key concerns: robustness against collusion and attractiveness to market entry (p.104).

Since the detailed design of an auction is very important, every aspect of the rules must be correctly structured in order to generate appropriate incentives for bidders and efficient outcomes. It is argued that even small changes in auction rules can significantly affect outcomes, benefiting some parties at the expense of others. It is therefore critical to ensure that the assignment method adopted enables the spectrum management body to achieve its core objectives (A- focus et al., 2004:14).

More specifically, a study on the use of auctions in spectrum assignment methods suggests that auction design should:

- provide appropriate incentives for bidders to bid in a manner that leads to efficient outcomes;
- be fair and reasonably transparent, in order to eliminate any suspicions amongst bidders of unequal treatment;
- be reasonably easy for bidders to understand, so that they can execute coherent bidding strategies and are not deterred from participating in the process;
- be quick and cost-effective to implement, reducing expense and uncertainty for both the allocation body and the buyers, thus encouraging participation; and
- minimise the danger of strategic manipulation and collusion between bidders (A-focus et al., 2004:14)

Although the advantages and disadvantages of auction mechanisms may vary depending on the type and design of the auction being implemented, it is still possible to cover them from the general perspective.

2.3. Advantages of auction mechanism

In the auction mechanism, revelation and use of information removes the uncertainty in the sector. For example, licences for next generation mobile communications have some uncertainty because of the new technology, new market and services. Given that market player's future depends on their own internal predictions on profitability and market demand, operators have an incentive to ensure that their predictions about future demand and future opportunities are as accurate as possible (OECD, 2001:11). Besides, Crampton (2000) argues that by revealing information, since the bidder uncertainty is reduced, the bidders safely can bid more aggressively (p.1)

An auction obliges the participants to reveal, via their bids, the future expected stream of profits. Their bids reflect this information. If well-designed, the auction gives a clear ranking of operators, which should result in the most competitive suppliers obtaining a licence. They are therefore more likely to use the spectrum more efficiently (OECD, 2001:12, A-focus et al., 2004:5). Additionally, within the context of a competitive marketplace, since the firms who place the highest value on spectrum will be those who are best able to offer the services consumers demand, at the lowest cost, what economists refer to as an economically efficient allocation of spectrum resources can be realized (Munro, 2000:2).

Assigning the spectrum to the user who values it the most in turn serves as a proxy for judging which particular user will contribute most to overall economic welfare (Cave, 2002:119). By contrast, with administrative approaches, it may be difficult for regulators to define objective criteria to distinguish between competing bidders (A-focus et al., 2004:5). In terms of ensuring best use of scarce spectrum resources an auction has also the benefits of transferring rent from shareholders to the public (government) and this is therefore a particularly advantageous way for governments to raise revenues in order to finance their expenditure (OECD, 2001:12; A-focus et al., 2004:5).

Auctions promote equity and transparency. Auctions rely on relatively simple and transparent rules that apply equally to all participants. As such they are fair and transparent. Given that bids are observable and verifiable by a court or any third party, the

final allocation is less likely to be legally contested relative to an administrative process such as beauty contest (OECD, 2001:12). By contrast, beauty contests are acutely vulnerable to criticism and accusation. Many governments chose not to publish the criteria on which comparative selections are made. This risks creating the appearance that the government is making decisions that are biased towards or against particular industry players. Even where both criteria and scoring details are published, losing applicants may seek to challenge aspects of the process. This could result in legal delays to assignment, with detrimental effects for industry development and competition (A-focus et al., 2004:6).

For example, regarding the transparency of auctions, there were cases in a number of countries, in the case of 3G auctions, where the auction ended very quickly and there was concern that collusion had taken place among bidders. However, investigation by competition authorities showed that no collusion had taken place, which reinforced the transparency of auctions (OECD, 2001:12).

Auction mechanisms help avoiding corruption. In an auction, the final bids are all that matters for the final allocation of a licence. Since these bids are observable and verifiable, the scope for corruption in licence allocation is minimised and it would not affect the ranking of bids (OECD, 2001:12). For instance, Cave and Valletti (2000) argue that as an administrative process the beauty contest opens the door to favouritism and corruption (p.348).

Because operators determine the price and allocation of licences through bidding, the government does not need to rely on technical and financial experts to identify the most competent operators. Thus, an auction does not require any intermediate third party acting in between the government and the operators. This reduces the cost of allocating licences and eliminates possible 'moral hazard' problems[9] (OECD, 2001:12).

Auctions generally reduce the time to award licenses. Using auctions can be significantly faster and less-resource intensive than administrative methods in assigning licences. Even quite complex auctions, such as the simultaneous sale of many different spectrum licences, can be completed in just a few days using specialised auction software and bidding over the internet or private networks (A-focus et al., 2004:5). For example, in U.S. under administrative processes the average number of days, from application to grant of

[9] Moral hazard refers to a situation where the government is not able to verify the experts' actions after they have been contracted (e.g. inability to verify whether the expert receives bribes, or inability to verify the amount of time dedicated to the evaluation of candidates).

construction permit per cellular license, was 720 days. Similarly, under the lottery system, the average number of days 412 days. In 1997, the average number of days for FCC auctions, from the filing of an application to license grant, was 233 days (FCC, 1997:22).

Auctions have a particular advantage when multiple licences are being assigned across a number of geographic areas within a country. The auction mechanism allows each bidder to bid for the precise combination of spectrum blocks and geographic areas that it requires for its business plan. In contrast, under a beauty contest process, it is exceptionally difficult for spectrum managers to determine the precise combination of spectrum blocks and geographic areas for each bidder that would be most efficient and generate the greatest benefits for consumers (Munro, 2000:2). In this context, combinatorial auctions, in which bidders can place bids on combinations of items, called ‘packages’, rather than just individual items, are getting special attention and the implementation of it has grown rapidly in the past ten years (Cramton et al. 2006: 1,11).

2.4. Disadvantages of auction mechanism

An inverse relationship between number of firms in the market and licence fee paid may lead to ‘overbidding’. This occurs when the licence fees paid are too high compared to the number of firms in the market. Therefore, auctions may lead to high licence fees (Gruber, 2002:56). For example, it is now widely perceived that licence winners in the UK and German 3G auctions, which collectively raised 80 billion US dollars, overpaid (A-focus et al., 2004:6). High licence fees hinder the rapid use of spectrum, the roll-out of new networks and services and the promotion of competition and lead to high debts, which reduce the making further investments, and increase the risk of financial instability, which, in turn, have negative impacts on the development of reliable, efficient and competitive services. (OECD, 2001:13).

If there are expectations that the final price for a licence will be high, then the number of participants in an auction may be limited. This could occur if the auction is structured so that there is a minimum threshold bid which is too high. The reduction in the number of participants can reduce the level of bids to be made and, therefore, revenue maximisation, which is one of the objectives of most spectrum auctions, may be reduced (Cramton, 2001:607, OECD, 2001:16). Besides, since high auction fees may discourage smaller participants from entering the market, the result may be increased market concentration, and ultimately also higher consumer prices (Intven et al., 2000:2-15).

For example, work by Sutton (1991) and Gruber (2002) shows that under real world conditions of imperfect information and imperfect capital markets bids may systematically deviate from their competitive level and, consequently, increase concentration in the post-auction market (Bauer, 2002:120).

As mentioned, higher licence fees may lead to higher prices to consumers. However, this may not always be the case for sufficiently competitive markets, such as mobile communications services in the U.S.. In U.S. prices of mobile communications services continued to drop despite the billions of dollars paid for licences in FCC auctions. But, given that the number of licences issued is usually limited either by the government and/or by the availability of spectrum, there may not be sufficiently competitive market. In this case, since all firms with a licence face a similar level of licence fees the possibility exists that all firms shift the costs of the licence to users (Munro, 2000:2, OECD, 2001:16, Kwerel, 2000:3).

Further, if the investment possibilities of operators are constrained as a result of overbidding, or if operators need immediate revenue inflow to remain in the market, they may postpone costly objectives such as universal coverage (OECD, 2001:15). Supportingly, Gruber (2002) argues that if overbidding has taken place, this may result in slowing down the roll-out of infrastructure and in concentrating on the most profitable regions only (p.56).

Auction outcomes may also have some negative social implications. Assignment by auction may be perceived as conflicting with broader public policy goals, such as promoting new entry, rules on broadcasting plurality or use of spectrum for public safety services. An auction solely based on bidders' willingness to pay will not capture the impact of any social externalities, so may not be fully efficient (A-focus et al. 2004:6).

However, it may be possible to amend the design of the auction to take into account such factors, for example by using a hybrid process that combines willingness to pay with offers on other service attributes, such as roll-out. Also, there are simple solutions to the problem of socially provided services, such as providing subsidies to the public bodies charged with providing these services in order to acquire spectrum. Such an approach is: transparent; identifies the cost of the social obligation; is consistent with State Aid rules; and provides good incentives to minimise unnecessary use of spectrum (A-focus et al. 2004:6).

It should be noted that, assuming the participants in the auction behave rationally, the outcome will generally be an assignment of spectrum that is economically efficient at time the auction takes place. If this is the case, there will be no incentive to trade spectrum – which is another element of market-based approach in spectrum management and will be dealt with in next chapter – immediately after the auction has ended because of high amounts of money already paid; any incentive for secondary trading will depend on future developments. If the auction succeeded in finding the market-clearing price, it will only be possible to make a profit if the market outperforms expectations (Marcus et al., 2005:13).

3. Spectrum trading

3.1. The concept of spectrum trading

As mobile communications become more needed and valuable by consumers and service providers, not only is access to more spectrum required in many countries, there is pressing need to flexibly reassign unused and underused spectrum to users that will use it most effectively and efficiently. An aspect of market-based mechanisms in spectrum management reform receiving increasing attention is the introduction of secondary markets for spectrum (Xavier and Ypsilanti, 2006:34).

In the traditional command and control approach to assignment and authorisation system, spectrum is first allocated specified uses and then assigned to particular firms or public organisations to carry out the authorised use with specific obligations laid down in a licence or permit. Secondary trading of spectrum which permits the purchaser to change the use to which the spectrum was initially put while maintaining the right to use is viewed by many as the key step to be taken in the reform of spectrum management regulatory practice, capable of unlocking the potential of new technologies and of eliminating artificial scarcities of spectrum which find expression in inflated prices for spectrum-using services (InfoDev, 2008). It is argued that spectrum use can be improved through trading (Wellenius and Neto, 2006:20).

As mentioned in previous chapter, when licences for spectrum are being initially offered, auctions can create competition for spectrum; however it is often the case that the successful licensee is precluded from trading the licence at anytime afterward. Continuous reselling of spectrum becomes possible when a secondary market operated in respect of either spectrum that has been auctioned or of spectrum allocated initially by administrative methods. When a secondary market is combined with flexibility in spectrum use, licences can be deployed by the original licensee or, after a trade, by another firm in a new innovative use. Auctions alone merely introduce an initial market-based selection by organizations that will exercise highly specified spectrum usage rights, whereas secondary trading seeks to develop a primarily market-based solution both for spectrum assignment and for spectrum allocation, on the condition that flexibility in use is permitted (InfoDev, 2008).

As one way of introduction market mechanisms in spectrum management, spectrum trading allows spectrum licenses to be traded between market players, meaning that spectrum

usage rights are transferred from one party to another in a ‘secondary’ market (Delaere and Ballon, 2007:58). The economic significance of this is that, apart from confronting the cost of acquiring spectrum through an auction, the licensee also needs to address the cost of retaining its spectrum (Marcus et al., 2005:12).

In order to have more flexibility in spectrum management, under the spectrum trading concept, it is argued that markets should become the primary means to attribute spectrum among uses and users. At this point, the general idea is that the rights generally granted to licensees should be broadened, permitting flexible use of the allocated spectrum and eliminating all licensing requirements that are not related to interference or anti-competitive concentration (Rosston and Hazlett, 2001).

The ideas of introducing secondary markets have led to proposals for developing markets for spectrum property rights akin to those in place for most other industries. A licensee would have exclusive and transferable rights to use specified frequencies within a geographic area, with flexible rights of use governed primarily by technical rules to protect against interference. Licensees would be free to sell, lease, divide, and aggregate spectrum parcels without limitation as to uses or technologies other than to comply with interference and competition rules. Other prospective users of these frequencies would need to obtain the licensee’s approval and agree on terms and conditions (Wellenius and Neto, 2006:21).

Actually, there has been considerable debate in the literature over the need for and appropriate approach to spectrum reform. On one side are the proponents of open spectrum ‘commons’ (e.g. Reed, 2002; Benkler, 2002; Ikeda, 2002) who contend that it would increase spectrum utilisation and stimulate innovation by facilitating entry of sophisticated devices based on new advanced technology. On the other hand, proponents of the ‘exclusive’ spectrum usage rights approach (e.g. White, 2001; Hazlett, 2001; Faulhaber and Farber, 2002) predict ‘tragedy’ under an open commons regime, arguing that growth in demand will lead eventually to scarcity. In this view, the solution is greater use of market forces that would enable faster, flexible and efficient access and utilisation of spectrum (Xavier and Ypsilanti, 2006:35).

These divergent views have contributed to uncertainty over the appropriate nature and direction of reform. The arguments put by supporters of the different approaches point to persuasive benefits of each system. Indeed, the policy challenge is to determine a regime comprising the optimal mix of these approaches, drawing upon the benefits of each approach while minimising the costs (Xavier and Ypsilanti, 2006:35).

Moving to a regime for secondary trading of spectrum requires a clear definition of transferable property rights. Introducing such a system under the command and control regime, in which spectrum licences are held on the basis of annually renewable licences, the licensee having further unspecified protection based upon a 'reasonable expectation' of longer tenure, would clearly create major and avoidable uncertainty in the spectrum market, and deter both transactions and the collateral investment necessary to put the spectrum to work. It is thus universally recognised that a trading regime requires a detailed specification of rights (Cave and Webb, 2003:2). Detailed specification of rights is necessary to have the common understanding of the bundle of rights and obligations which are changing hands among buyers and sellers as well as the regulator and the courts where appropriate. Clearly defined property rights are thus a precondition for efficient spectrum markets (InfoDev, 2008).

Internationally recognized elements of rights and obligations in a spectrum licence include:

1- The band which is available for use;
2- The geographical area in which it can be used;
3- The period for which the licence is entitled;
4- The uses to which it can be put;
5- The licensee's degree of protection from other users;
6- The licensee's obligation not to interfere with other spectrum user's rights (InfoDev, 2008).

There is a wide range of options for spectrum trading. Spectrum trading may be restricted to the lease or sale of certain types of whole licenses with no other changes permitted. Or greater freedom may be allowed, such as reconfiguring licenses (sub-dividing and aggregating by geography or frequency), short- or long-term leasing or sharing of some of the license rights, and changing use or technical standards to several degrees (Wellenius and Neto, 2006:20, ACA, 2002:143-149).

Once a spectrum trading market is in place, markets can be left to develop on their own through private sector mechanisms. Some form of spectrum trading is already in use in several countries[10] across the world. Although so far only some parts of the spectrum are being traded, by some estimates much of the spectrum can be tradable in a few years (Wellenius and Neto, 2006:20).

[10] For example Australia, New Zealand, Guatemala, the USA, the UK, France and Germany (Analysys et al., 2004:49,51)

The argument for spectrum trading is that it can correct for economic inefficiencies of initial spectrum assignments to users and respond to changing user needs over time (Wellenius and Neto, 2006:21). Cave et al. (2007) claim that the essential idea in marketing the spectrum is to allow pricing mechanisms to act as an incentive for holders of spectrum to optimise their use by buying more if their business case can justify it, selling spectrum if they have excess, and adopting new technologies that can use spectrum more efficiently where economically viable (p.8).

Another aspect of introducing flexibility to management of radio spectrum is combining the trading with the spectrum liberalisation. Liberalisation is the relaxation of restrictions on the services and technologies associated with spectrum usage rights, as well as the possibility of reconfiguring usage rights. Without liberalisation, secondary market activity is limited to transfers of existing usage rights. Without trading, liberalisation only enables existing users to switch services and technologies; however alternative users would not able to access the spectrum[11] (Analysys et al., 2004:4, 36).

Analysys et al. (2004) argue that spectrum trading, together with liberalisation, provides greater flexibility to all parties involved in spectrum use, including incumbents, potential new market entrants and equipment manufacturers. They further argue that removing obstacles to trading brings more general welfare benefits for society by enabling the more efficient uses of scarce radio spectrum. Secondary trading of spectrum can potentially deliver gains in efficiency, especially if spectrum use liberalised (p.60)

Analysys et al. (2004) observe that there are strong grounds for believing that spectrum trading could promote more efficient use of spectrum for many downstream services, but that it is not appropriate in all circumstances (p.35). This observation suggests that there are advantages as well as disadvantages of the policy of introducing spectrum trading.

3.2. Advantages of spectrum trading

It is estimated that spectrum trading creates direct pressure on users to improve efficiency because they will have incentive to achieve a more efficient balance between capital and spectrum as factors of production. For example, an incumbent user could invest more in

[11] Introducing trading of rights devolves decision over *assignment* of usage rights to actual users, allowing market to determine who has access to spectrum. Liberalisation of spectrum use devolves decisions over *allocation* of spectrum to users, allowing market to determine how spectrum is used (Analysys et al., 2004:vii).

spectrally efficient technologies, which could increase potential output or free up some spectrum for alternative uses (Analysys et al, 2004:37).

Secondary markets in spectrum helps to promote efficient allocation, assignment and use of spectrum. They offer opportunities for licence holders to trade licences when demand and supply conditions change. As a result of changes in technology, business strategy and/or market share, some licensees may hold spectrum they no longer need. For example, they can on-sell or sub-let their surplus spectrum to licensees who desire access to that spectrum. Secondary markets also allow the emergence of intermediaries that may trade in spectrum or lease it to third parties (Xavier and Ypsilanti, 2006:34). To the extent that the rules allow for changes in use, spectrum trading may also correct some of the artificial scarcities arising from the administrative allocation of spectrum among different classes of uses (van Caspel, 2002 cited in Wellenius and Neto, 2006:21).

Spectrum trading creates transparency regarding the value of spectrum. This transparency in market enables market players to have greater awareness of market entry opportunities and have the knowledge of the true costs as trading will provide information on potential market value (Analysys et al. 2004:37). Moreover, companies might be able to use their resources more efficiently if they were able to purchase spectrum closer to the time it is used (at which time their plans and needs would also be clearer). Instead, without a secondary market facility, they are forced to acquire spectrum according to the country's allocation programme. (OECD, 2005:17). It is also believed that the reduced likelihood of illegal operation in licensed frequency bands is ensured through market mechanisms (Mott MacDonald et al., 2006:26).

Efficiency benefits can be achieved by spectrum trading generating increased competition in the markets. Spectrum trades facilitate competition in three main ways. First it enables new or existing operators to realise cost reductions that can be passed on to consumers. Second, it lowers barriers to entry and expansion, as acquiring suitable spectrum through a trade may be significantly easier than pursuing spectrum through a regulator. Supportingly, Cave (2002) argues that spectrum trading can lower barriers to entry by reducing the risk of initial investment in licenses as these can be resold and by allowing new entrants to acquire spectrum in the market rather than lobbying and waiting for new administrative assignments (p.106). Finally, it increases the number of competing players in the market (Analysys et al., 2004:37).

In the context of promoting competition, in particular, if the trading is combined with liberalisation, then liberalisation has the potential to remove artificial scarcity of spectrum, thereby permitting possible new entry or expansion by existing players. Where spectrum is not tied to a specific technology or service, there is much greater opportunity for allowing technological change. For example, there are variety of high-technologies currently competing to provide wireless broadband services (sometimes referred as '4G'). These can operate at variety of frequencies, subject to appropriate propagation characteristics. With a sufficiently liberal spectrum regime, it is possible to use these technologies to provide a service that competes with 3G, public wireless local area networks and fixed broadband services (Analysys et al., 2004:103). It is claimed that competition in high-tech industries, as an instigation to innovation, is important in order to secure for consumers the benefits of the innovation that drives economic growth (Baer and Balto,1999:90).

Competitive trading allows licensees themselves to evaluate the opportunity cost of spectrum, creates financial incentives to utilize their spectrum efficiently, and may result in unused spectrum being released into the market. Efficiency means that consumers get their preferred goods and services, and firms employ the most efficient techniques to supply those goods and services. Efficiency is the objective that regulators should promote, since societal well being (given by the sum of consumer and producer surplus) is maximised at efficient allocations (Valletti, 2001:657).

Spectrum trading is also a way of ensuring efficient reallocation or reassignment of spectrum in response to innovative developments. Moreover, by increasing the scope for spectrum reallocation or reassignment, trading facilitates a virtuous cycle of innovation and efficiency gains, with increased demand for new and improved technologies encouraging investment by equipment manufacturers (Analysys et al., 2004:38). It is believed that trading permits more rapid redeployment and faster spectrum access for innovators and new players (RSPG, 2004:17).

It is argued that, in the medium term, exclusive spectrum rights (either under government administration or a property rights regime) might be appropriate where large-scale investments in network infrastructure are needed. In other words, this type of flexible spectrum management would be cost effective for investments which require high financial support by enabling trading of spectrum among market players (Wellenius and Neto, 2006:21).

3.3. Disadvantages of spectrum trading

Besides the advantages described above, there are also some concerns about spectrum trading that may have also disadvantages.

First concern relates to risk of increased interference. Cave and Webb (2003) consider that the determination of interference rights or, equivalently, rights to be free from interference is the most difficult issue of spectrum trading concept (p.2). The risk of interference may be especially great in bands that are currently subject to a high degree of planning and coordination in making assignments, such as private business radio, TV broadcasting and terrestrial point-to-point fixed links (Xavier and Ypsilanti, 2006:48). For instance, imagine a situation with some operators using low power devices in neighbouring bands. At some stage, one operator would like to use part of those frequencies for high power TV broadcasting that would most likely interfere with neighbours. (Valletti, 2001:658). In addition, there is also the international dimension: it will be impossible to define property rights that will follow national borders, and international coordination is therefore needed and crucial (Falch and Tadayoni, 2004:203)

Second concern is related to standardization of equipment and services. Standardization is more complicated if the same services are provided at different frequencies in both nationally and internationally (Falch and Tadayoni, 2004:203). For example, consider FM radio: if significant number of radio operators traded their frequencies to alternate uses, then consumers could be left with unusable receiver terminals (Analysys et al., 2004:40). Although this may be profitable for manufacturers, but it may bring significant costs to consumers (OECD, 2005:31). Thus, with a market-based mechanism, there is a risk that operators may pursue incompatible approaches, such that benefits of standardisation will not be realised (Analysys et al., 2004:40).

Third, there are concerns that spectrum trading allows some operators to acquire market power by buying a disproportionate amount of spectrum or by buying spectrum necessary to provide certain services with the only purpose of taking such vital input away from potential competitors (Valletti, 2001:662). Excessive market power can lead to concentration, spectrum hoarding and anti-competitive conduct, which could exclude commercial competitors as well as innovative, non-profit, public-service, or other uses of the spectrum that benefit society as a whole (Xavier and Ypsilanti, 2006:51; Wellenius and Neto, 2006:21).

Transaction costs in secondary markets for spectrum include search costs, the cost of due diligence, regulatory compliance, legal costs, brokerage, stamp duties, and other taxes. Trading would only take place when the benefits are expected to outweigh these transactions costs. Thus when transaction costs are high, this may result in low spectrum trading activity in the market (Xavier and Ypsilanti, 2006:38). Moreover, there are concerns that incentives to invest and innovate can be negatively affected by uncertainty over costs (Xavier and Ypsilanti, 2006:46).

High transaction costs can also serve as a barrier to market entry (Xavier and Ypsilanti, 2006:49). Where such costs represent a significant proportion of the total value of exchange, otherwise efficient transactions may fail to materialise. In this case, buyers reduces their willingness to pay to reflect these costs, and thus potential sellers will not be exposed to full opportunity cost of their spectrum use (Analysis, 2004:39).

Finally, in most countries, public services are allocated a significant portion of valuable spectrum. Important services such as defence, law enforcement, public safety, public service broadcasting and air traffic control rely on spectrum for much of their communications needs. Under the old model, spectrum bands are reserved for the delivery of such services by government. There are also concerns about whether this reserved spectrum for public services will be lost under a system of spectrum trading (Xavier and Ypsilanti, 2006:52). At this point, it can be concluded that the regulatory bodies still remain the guardian of public policy objectives.

3.4. Implementation matters

As mentioned, in order to facilitate spectrum trading, participants (both buyers and sellers) require legal certainty over the rights and obligations that will be transferred. Additionally, in order for a secondary market to run smoothly, potential buyers and sellers of spectrum need be able to identify each other and readily obtain information about the usage rights that could be traded. A study conducted for European Commission on how to implement the spectrum trading across Europe suggests that there are number of basic steps in establishing a framework for trading spectrum:

- creating the tradable usage rights and defining associated rights and obligations
- permitting various forms of trading of these rights
- establishing rights to protection from and obligations not to create harmful interference in relation to liberalisation of use

- clarifying rules on the expiry of usage rights and regulatory powers to reclaim them
- developing clear rules to ensure effective enforcement of rights and obligations (Analysys et al., 2004:63,87).

After having a legislative framework for spectrum trading, it is recommended that regulatory bodies consider managing the introduction of the relevant policies, processes and systems in phased transition. Phased approach for implementation of spectrum trading is seen in Table 1[12] (Analysys et al., 2004:63).

Table 1- Phases in implementation

	Action	**Key policy issues**
Phase 1	Implement legislative framework supporting principle of spectrum trading	Forecast future demands for spectrum and volume of spectrum trades for individual services
Phase 2	Review and implement trades on a case by case basis	Windfall gains of existing licences, anti-competitive behaviour
Phase 3	Establish trading systems for services where trading volumes suggest this would be granted	Switch of service or technology from original licence conditions
Phase 4	Division of spectrum into standard units (by frequency and geography)	Minimisation of interference and frequency co-ordination
Phase 5	Make majority of commercial spectrum open to trading	Repossession of harmonised spectrum in future

In establishing a framework for trading and liberalisation of spectrum usage rights, there are several forms that trading could take. Indeed, spectrum management policies of regulatory bodies shape the basics of what forms are possible. These forms include:

- the type of transfer mechanisms, i.e. sale, lease and/or buy-back
- the extent to which existing usage rights can be reconfigured, for example by time, geographical area and frequency band
- the systems and rules for transferring associated rights and obligations along with usage rights between participants in trade
- creation of management rights alongside usage rights (Analysys et al., 2004:68).

[12] Adapted from (Analysys et al. 2004:63)

In general, it is claimed that the greater the degree of flexibility that the holder of usage rights has in determining how a trade is formulated, the greater the scope for efficient market outcomes over time (Analysys et al., 2004:68). But at this point, care needs to be taken by regulators in terms of preventing harmful interference issues from occurring resulting from the changes of use of radio spectrum.

4. Seeking the flexibility in spectrum management

This chapter of the thesis contains four sections. First three sections try to explore the efforts for seeking the flexibility in spectrum management field in international, regional[13] and national levels respectively. The last section tries to provide a history of spectrum management and to give information on the status of market-based mechanisms in Turkey.

4.1. International level: the ITU

Today, spectrum at the international level is managed within the framework of the ITU. This specialized agency of the United Nations has among its major purposes the avoidance of radio interference and the equitable and efficient use of spectrum. This mission is conferred mainly to its Radiocommunication Sector (ITU-R) (ITU, 2004:6).

ITU-R develops and adopts the Radio Regulations, a voluminous set of rules that serve as a binding international treaty. It essentially governs the use of spectrum by allocating spectrum to some 40 different services around the world. The ITU-R also holds World Radiocommunication Conferences (WRC) once every three years, which update the Radio Regulations in response to changes in the needs and demands for spectrum (ITU, 2004:6).

In February 2004, the ITU responding to growing interest on market forces in spectrum management convened a Workshop on 'Radio Spectrum Management for a Converging World' which was aimed at drawing attention to the need for spectrum management reform (Xavier and Ypsilanti, 2006:36).

It was concluded in the workshop that the spectrum management process was a mammoth task that governments were beginning to acknowledge they could not tackle alone. Technological progress and marketplace change have placed an increasing strain on the traditional spectrum management approaches that governments have resorted to for almost 100 years. In the same way as the wave of liberalization, deregulation and privatization has had swept over the telecommunications sector as a whole, the regulatory approach to spectrum management was poised to follow (ITU, 2004:28).

[13] Since the writer is from Turkey, a country from Region 1 in terms of frequency regions, regional developments are from Europe.

It was also concluded that while the need for regime change was clear, there nevertheless did not appear to be one single spectrum management regime that would bring about complete technical and economic spectrum efficiency. Constant changes to the paradigm as well as inherent differences in each regime would mean that spectrum management reform might have to be pursued in a continuously progressive fashion, by adopting different approaches in different spectrum bands over different periods of time (ITU, 2004:28).

In January 2007, the ITU held another Workshop on 'Market Mechanisms for Spectrum Management', as a continuation of the previous workshop, to discuss the developments and practices that have been experienced since the last one.

At the conclusion session of this workshop, while participants could agree on the need to reform spectrum management regimes to enable the commercialization of more spectrum sharing, they differed with respect to whether reforms ought to be more evolutionary or revolutionary. Generally, incumbent mobile operators and broadcasters appealed for a more evolutionary approach that would ensure protection for legacy interests. Possible new entrants and equipment vendors of new technologies – especially the new and advanced forms of mobile communications- called for a faster transition (ITU, 2007:41).

A number of speakers stressed the importance of considering more than just commercial interests and market efficiency when weighing spectrum management reforms, pointing to the needs for public safety and broadcasting as important categories of concerns (ITU, 2007:42).

It was highlighted that there was a need in balance between harmonization to realize market economies and flexibility to support entry of innovative technologies. A number of reform options were presented, highlighting again that there was no single approach that was best for all situations. It was claimed that there was role for command and control, market-based flexible licensing, and unlicensed regimes. With respect to auctions, a number of speakers suggested alternative approaches that might be used to limit the drain on industry resources and thus upfront risks borne by participants, such as bids that are based on a percentage royalty for future revenues. The possibility of using Administrative Incentive Pricing for spectrum that is not actively traded (and thus, lacks a clear market price) was suggested as means for improving incentives for sharing spectrum. And, finally, a recurring theme was how to measure spectrum scarcity and assess opportunities for sharing that balances the needs for interference protection and clear regulatory rules with market flexibility (ITU, 2007:42).

4.2. Regional level: the EU and the CEPT

In March 2002, the European Commission released its Radio Spectrum Decision[14] relating to the development of a regulatory framework for radio spectrum (Xavier and Ypsilanti, 2006:35). By this decision, the European Union (EU) - with the expert assistance of the European Conference of Postal and Telecommunications Administrations (CEPT) – aims to make the use of radio spectrum more flexible and ensure the development of a European single market for equipment and services, stimulating growth in this vital sector (EU, 2006:1).

The Commission subsequently established a Radio Spectrum Policy Group to co-ordinate work on spectrum and, in May 2004, published a consultancy report that recommended the Commission mandates the introduction of both spectrum trading and liberalisation across the EU (OECD, 2005:8).

In this context, the European Commission requested the RSPG to develop and adopt an opinion on a coordinated EU spectrum policy approach for wireless electronic communications radio access platforms, to be addressed to the European Commission. The objective was to ensure that spectrum is available for a wide variety of services and applications to meet the requirements of the Lisbon agenda, and to comply with the overall policy goal of developing the EU internal market and European competitiveness. This project has become widely known as WAPECS (Wireless Access Policy for Electronic Communications Services), which is also known as 'A More Flexible Spectrum Management Approach' (RSPG, 2005:2). An illustration of WAPECS concept is shown in Annex I.

WAPECS is a framework for the provision of electronic communications services within a set of frequency bands to be identified and agreed between EU Member States in which a range of electronic communications networks and electronic communications services may be offered on a technology and service neutral basis, provided that certain technical requirements to avoid interference are met, to ensure the effective and efficient use of the spectrum, and the authorisation conditions do not distort competition (RSPG, 2005:2).

In March 2006, Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT), published a report on 'Enhancing Harmonisation and Introducing Flexibility in the Spectrum Regulatory Framework'.

[14] (Decision No. 676/2002/EC of 7 March 2002).

In the report, it is concluded that the changing spectrum management environment and the increasing pace of change require improvement of the spectrum management system, including increased flexibility, in order to be able to respond quickly to new technological and commercial developments so as to make optimal use of the radio spectrum and promote European competitiveness (CEPT, 2006:59).

ECC suggests that the aim of the spectrum management authorities (SMA) should be to secure technical and economic efficiency in use of the radio spectrum. In this context, it is concluded that flexibility may be increased by removing unnecessary restrictions from licences, either through case-by-case variation to permit change of use or by making licences generically more flexible. In so doing, it is further concluded that care needs to be taken not to increase interference to an unacceptable degree and to the impact on harmonisation (CEPT, 2006:61).

In response to the mandate of EC on WAPECS, CEPT published a report[15] in December 2007, which primarily describes technical aspects of flexible spectrum usage. CEPT believes that WAPECS is one approach that the EC has mandated CEPT to explore in order to have the possibility of realising potential gains with the introduction of more flexibility into the way spectrum is allocated and utilised and more liberal regulatory rules in the field of spectrum management (CEPT, 2007:8). In this report, some frequency bands have been identified, which are suitable from a technical perspective for the introduction of flexibility in spectrum management. The list of these frequencies is shown in Annex II.

4.3. National level:

4.3.1. Country practices in auctioning

The UK

Auctions were first used for the assignment of spectrum licences in the UK in 2000 with the high profile sale for £22.5bn of five licences to use spectrum for 3G mobile telephones (Cave, 2002:20).

Given that there were four incumbents, the initial auction design tried to focus on how to encourage new entrants' participation. Therefore, five national licences that are valid twenty

[15] Report from CEPT to the European Commission in response to the Mandate to develop least restrictive technical conditions for frequency bands addressed in the context of WAPECS. CEPT Report 19, approved on 21 December 2007.

years were made available and the frequency capacities attached to each licence are shown in Table 2[16] (Cave et al., 2007:62, OECD, 2001:21).

Table 2- Licence types

Licence type	Paired (2x) - MHz	Unpaired - MHz
A (Reserved for a new entrant)	15	5
B	15	-
C	10	5
D	10	5
E	10	5

There were minimum roll-out conditions attached to the licences. In addition, new entrant winners were guaranteed the right to roam on either BT or Vodafone's networks for up to seven years while they rolled out their own infrastructure (A-focus et al., 2004:31).

By reserving the largest licence for a new entrant, the UK design tried to level the playing field among incumbents and new entrants. The auction was an SAA, in line with what the FCC had been experimenting with in the US (OECD, 2001:22). Thirteen bidders competed in the auction, of which nine were new entrants; four were incumbent 2G network operators (Cave et al, 2007:62). Result of the auction is shown in Table 3[17] (NAO, 2001:18).

Table 3- Auction results

Licence type	Price (£bn)	Price per MHZ (£mn)	Winners
A	4.385	292	TIW
B	5.964	398	Vodafone
C	4.030	403	BT
D	4.004	400	One2One
E	4.095	409	Orange
Total	**22.478**		

The auction lasted for 150 rounds over 39 days. Strict rules were developed to deny the participation of 'associated' bidders, as part of the efforts to prevent any collusion between bidders and most operators followed the natural strategy to bid the minimum increments in each round (5%) until they reached their reservation value, in which case they dropped out (A-focus et al., 2004:32,33, OEDC, 2001:22). This auction was one of the first European spectrum auctions to be conducted by remote bidding, rather than co-location of bidders. This method was effective in terms of increasing convenience for the bidders and reducing costs for the auctioneer (A-focus et al., 2004:37).

[16] Source: Adapted from A-focus et al., 2004:31.
[17] Source: Adapted from National Audit Office (NAO), 2001:18.

The advantages which are specific to SAA can be summarised in six elements. First, it is efficient and exhibits Vickrey properties which encourage bidders to reveal true valuations as paying according to the 'second valuation principle' safeguards against the winner's curse[18], leading to an efficient outcome. Second, this design can accommodate many spectrum blocks in one auction and blocks can be substitutes and complements. Third, different prices paid reflect differences in values between licenses in auction. Fourth, it works effectively when the competition is intense for spectrum. Fifth, the price discovery[19] is possible, which is especially significant where bidders seek to buy packages of licences. The last, activity rules can be designed to promote bidding with a view to accelerating completion of the assignment process (Cave et al., 2007:57).

The disadvantages which are specific to SAA can be summarised as following: First, it may be time consuming. Second, bidders may seek to collude by submitting bids which acts as signals, a small number of participants may encourage tacit collusion. Third, demand reduction may happen, which means 'large' bidders may understate demand early on. Fourth, if some spectrum licences are complementary, a bidder may end up paying too much for some licences if the prices of complementary licences become too high in subsequent rounds, which is known as exposure problem. Fifth, opportunistic bidders might seek to target certain desirable bands, which may lead hoarding. Sixth, bidding strategies may be complex and the auction is vulnerable to collusion when competition is weak. The last, price discovery may be of limited benefit in auctions where there are only a few licences available and where each successful bidder is restricted to one licence (Cave et al., 2007:57,58).

Regarding the overall assessment of UK 3G auction results, it is considered that the detailed auction rules and procedures appear to have worked well, contributing to the successful outcome. Notably, full transparency was effective in allowing bidders to learn from each others' bidding behaviour and firm up their valuations accordingly (A-focus et al., 2004:36).

In April 2006, UK regulator OFCOM held its first spectrum auction and used first-price sealed bid auction. The auction was for low power services for the frequencies 1781.7-1785 MHz, paired with 1876.7-1880MHz. Possible uses include private GSM mobile phone networks in office buildings or campuses (OFCOM, 2006b).

---

[18] Winners curse is a price estimation problem in auctions which arises because the winner tends to be the bidder with the most overly optimistic information concerning the item's value. Generally due to the difficulty in determining the item's value, the winner tends to overpay (Hong and Shum, 2002:871).

[19] 'Price discovery' refers to the process by which asset prices are formed and impound available relevant information about the value of the assets (Barkham, R. and Geltner, D. 1993:1)

The bidding companies which were each awarded a licence and the amount paid by them are shown in Table 4[20] (OFCOM, 2006a:3).

Table 4- Bidding companies and the amount paid

Bidders	**Amount paid (£)**
British Telecommunications PLC	275,112
Cable & Wireless UK (England)	51,002
COLT Mobile Telecommunications Ltd	1,513,218
Cyberpress Ltd	151,999
FMS Solutions Ltd	113,000
Mapesbury Communications Ltd	76,660
O2 (UK) Ltd	209,888
Opal Telecom Ltd	155,555
PLDT (UK) Ltd	88,889
Shyam Telecom UK Ltd	101,011
Spring Mobil AB	50,110
Teleware PLC	1,001,880

Cave et al. (2007) note that the outcomes of first-price sealed bid auction illustrates how different bidders can pay very different prices for the same licence (p.54). As shown in Table 4, the bidder COLT Mobile paid £1,513,218, whereas the Spring Mobil AB paid £50,110 for same licence.

The advantages specific to first-price sealed bid auction include: the simplicity; quick conduction, being ideal for small packages of spectrum and where each bidder receives one license in a given region; being good for competition, which means new entrants are more likely to enter and compete against incumbent operators (Cave et al., 2007:53).

The disadvantages include: bidders may shave bids to avoid the winner's curse, which in an uncertain environment could lead to much reduced bids; bidders winning near identical licenses may pay widely different amounts which could result in difficulties subsequently for managers or politicians; no price discovery process is possible; reverse price[21] needs to be carefully assessed (Cave et al., 2007:53).

[20] Source: OFCOM, 2006:3.

[21] The purpose of a reverse price is to reflect the value of spectrum to 'society' and to ensure that it is not transferred at knock-down prices below the true economic value which is its opportunity cost. In deed, if reverse prices are set too low, this could encourage unhealthy tacit collusion as bidders may benefit significantly from an early conclusion to an auction. An example is Swiss 3G auction in 2001. (Cave, 2007:65).

The Netherlands

In Netherlands 3G auction in 2000, there were five licences that are valid for 15 years and the auction was again an SAA. Frequency capacities attached to each licence are shown in Table 5[22] (OECD, 2001:23).

Table 5- Licence types in Netherlands 3G auction

Licence type	Paired (2x) - MHz	Unpaired - MHz
A	15	5
B	15	5
C	10	5
D	10	5
E	10	5

There was one crucial difference that made the situation in the Netherlands different from the UK. Because the Competition Authority and the independent telecommunication regulator saw the mobile market in the Netherlands as very competitive, with five operators active in the country already, there were five incumbent operators, and exactly five licences on sale (OECD, 2001:23, EC, 2002:17). In this context, Klemperer (2004) argues that the Netherlands 3G auction provides good example of over-sensitivity to the significance of information revelation and affiliation at the expense of insensitivity to the more important issue of entry to market (p.133). Although new entrants could in any case bid for the licences, given incumbency's advantages, the interest of outsiders was not particularly high, since they probably felt that incumbents in the end would have obtained the licence anyway (OECD, 2001:23).

Melody (2001) argues that by restricting the number of 3G licences so severely, Netherlands lost auction revenue, spectrum efficiency and the opportunity to increase competition (p.9).

In the end just one new entrant (VersaTel) competed with the incumbents, and stopped bidding after receiving a letter from an incumbent (Telfort) threatening legal action for damages if VersaTel continued to bid (Klemperer, 2002:833). Van Damme (2000) argues that VersaTel had indicated that it was willing to step out, if given sufficient compensation. After the auction had been going on for two weeks, the lawyer of Telfort wrote a letter to VersaTel indicating that it had understood VersaTel's motives. VersaTel interpreted the letter as a 'threat' and quit the auction, hence, the auction ended suddenly and unexpectedly (p.7).

[22] Source: Adapted from OECD, 2001:23.

The result was that the auction raised less than 3 billion Euros. The auction lasted for 305 rounds in 13 days until VersaTel did not top any of the rivals' bids. Assigned licences are shown in Table 6[23] (OECD, 2001:23).

Table 6- Auction results

Licence type	Price[24] (€ mn)	Winner
A	713,80	Libertel
B	711,07	KPN Mobile
C	435,63	Dutchtone
D	430	Telfort
E	395,02	3G Blue
Total	**2.684,52**	

As in the UK, larger licences sold for higher prices, and similar licences (A and B, or B, C and D) for similar prices. The Netherlands government did not set a financial goal for the 3G auction and maximising profit was not a criteria, but total revenues were significantly short of expectations (OECD, 2001:24).

4.3.2. Spectrum trading practices

4.3.2.1. Overview

Spectrum trading has been introduced in several countries around the world. Specifically in EU, 12 countries already decided to introduce spectrum trading as of February 2005. Some examples include France, Germany, Italy, Norway, Spain and UK (IDATE et al, 2005:54). Changes in spectrum ownership or licensee through secondary trading have also been permitted in some bands in Australia, Canada, New Zealand and the USA as well as Guatemala (Xavier and Ypsilanti, 2006:44). In this thesis, the case of UK practice has been examined in detail in next section.

In 2004, regarding the promoting efficient use of spectrum through elimination of barriers to the development of secondary markets issue in US, the FCC Chairman, Michael Kevin Powell, observed that the Commission took an ambitious and pro-competitive step by creating secondary markets, placing a greater emphasis on allowing parties to lease their spectrum rights to third parties better positioned to utilize the spectrum in the most efficient

[23] Source: Adapted from OECD, 2001:23.
[24] The Dutch Guilder (NLG) is obsolete. It was replaced with the Euro (EUR) on January 1, 1999. Conversion done according to 1 EUR is equivalent to 2.20371 NLG.

manner. He believed that spectrum trading rules would allow potential entrants greater opportunities to obtain much needed spectrum and create an environment where they could tailor their services according to consumers' needs (FCC, 2004:145).

Moreover, regarding the introduction of spectrum trading, one another Commissioner of that time, Kathleen Q. Abernathy, stated that

> "...[A]n open, market-based regulatory approach is the best way to ensure the health of our [wireless telecommunications] industry and the robustness of its consumer offerings. Already, we have seen promising activity in the secondary markets for spectrum; in less than five months, at least 54 spectrum leasing applications have been filed. As the markets mature – and as we continue to maintain an open, market-based regulatory approach – I anticipate even greater reliance on our secondary-markets system." (FCC, 2004:145).

In Norway spectrum trading has been explicitly permitted since the implementation of the new directives in 2004. There is no restriction on the form of trade or the kind of rights that may be traded. Leasing has been widely used in connection with the establishing of fixed wireless access (FWA) in rural areas, especially in the 3.5 GHz band. Sales involve both low-valued usage rights and higher value rights (including GSM and FWA licences). Most sales occur in connection with re-structuring of firms or liquidation (bankruptcy). In most cases radio equipment is sold along with the licence as well (NPT, 2004:1).

In Germany, the German Telecommunications Act – TKG- creates a framework in which a more flexible system of spectrum regulation can be structured. The key legal provisions for spectrum policy are set out in sections 52-65 of TKG. Under the section 55(7) of the TGK, spectrum usage rights can be transferred, to the extend that this does not distort competition in the relevant market and if efficient and interference-free use can be secured (Marcus et al., 2005:40).

4.3.2.2. The UK case

In 2004, OFCOM published an official statement document on spectrum trading that formed one of a series setting out OFCOM's new approach to management of the radio spectrum, which is intended to promote innovation and competition in the provision of wireless services across the UK. The statement also documented the Spectrum Trading Regulations which were indented to be implemented in the UK market. These regulations, and the accompanying Register Regulations, came into force in December 2004 (OFCOM, 2004a:14).

Spectrum trading is described as the transfer of rights and associated obligations arising by virtue of a Wireless Telegraphy (WT) Act 1949[25] licence. It allows holders of certain WT Act licences to transfer some or all of the rights and associated obligations that they have as a result of those licences, to third parties. Associated obligations are those obligations that are necessarily and properly associated with a right, for example a limitation not to operate outside prescribed power levels (OFCOM, 2004a:14).

In parallel with the introduction of spectrum trading, OFCOM also allows licensees requesting a change in the use of their licence. This is referred to as 'liberalisation' and was being introduced in parallel to the procedures for spectrum trading. It is anticipated that liberalisation provides an additional impetus for spectrum trading and generates additional benefits (OFCOM, 2004a:33). Regarding the importance of spectrum trading, OFCOM believes that in combination with spectrum liberalisation, which enables spectrum to be put to the best use, it enables spectrum to migrate to users that will use it most efficiently (OFCOM, 2008).

In the regulatory context, spectrum trading is entirely voluntary and OFCOM is not concerned with the underlying contractual arrangements which relate to the transfer of rights. Therefore, companies are free to structure these arrangements as they wish. OFCOM believes that such a flexible approach will support various commercial arrangements between parties which can be adapted as necessary to reflect market conditions. (OFCOMa, 2004:4). OFCOM estimates that the benefits of spectrum trading and liberalisation could amount £1bn per year for the UK (OFCOM, 2008).

OFCOM states that it is desirable to give spectrum users as much freedom as possible to adopt new technologies and offer new services. Spectrum trading combined with liberalisation, over time, enable the market to decide how much spectrum should be allocated to different uses and maximise the economic value of the spectrum. Spectrum trading and liberalisation can facilitate greater innovation, investment and competition in the supply of wireless services. They also state that it provides an environment of faster access to spectrum and foster a more entrepreneurial approach to developing spectrum-based products and services. Therefore, on demand side, consumers can have access to new services more quickly, and pay less for the services they already subscribed (OFCOM, 2004a:33).

[25] Specific regulatory provisions related to spectrum trading are set out in Article 168 of the Communications Act 2003, which entered into force on 17th July 2003 and in Wireless Telegraphy (Spectrum Trading) Regulations December 2004, which entered into force on 23 rd December 2004.

The timetable for the phased introduction of spectrum trading in the UK is shown in Table 7[26].

Table 7 - The timetable for the phased introduction of spectrum trading in the UK

2004	2005	2006	2007	Other
Analogue PAMR[27]	Wide area PBR[28]	Emergency services	2G and 3G mobile	Mobile satellite
National paging	On-site PBR		PMSE[29]	Satellite shared with terrestrial services
Data networks	Digital PAMR		Aviation and maritime communication	Radio broadcasting
National and regional PBR	10 GHz FWA		Radionavigation (Radar)	Television broadcasting
Common Base Stations	32 GHz			
Fixed wireless access	40 GHz			
Scanning telemetry				
Fixed terrestrial links				

All licence classes and associated frequency bands which were made tradable in December 2004 are shown in Annex III. Besides, the OFCOM's Spectrum Trading Application Form is in Annex IV.

OFCOM is making the spectrum trading activities publicly available by Transfer Notification Register web page[30] which displays details of proposed trades notified to OFCOM, trades in progress and completed trades. It can be seen from the mentioned web page that trading activities are generally being done in the mobile communication sector as it is expected due to the growing implementation and importance of mobile services.

OFCOM states that the three main spectrum management mechanisms that are in use currently in UK are command & control; licence exempt and market mechanisms. A key

[26] Adapted from OFCOM 2004a:4.

[27] Public Access Mobile Radio. This service consists of a number of transmitters that are linked together to form a regional or national wireless network

[28] Private Business Radio. Another form of regional or national wireless network operated in different frequency bands.

[29] Programme Making and Special Events. Some examples include broadcast production for TV and radio, theatre, live music and other entertainment, movie films, conferences and corporate events, motorsport teams, public addresses.

[30] http://www.ofcom.org.uk/radiocomms/isu/ukpfa/intro. Additionally, the information on spectrum trading is also provided via web sites of regulatory bodies in Denmark and the Netherlands (IDATE,2005:56)

decision for OFCOM to make is the balance between these different approaches (OFCOM, 2004b:3). The objective set by OFCOM for 2010 regarding the balance between three main mechanisms is shown in Table 8[31].

Table 8- The objective percentages set by OFCOM

	2000	2010
Command&Control	95,7 %	21,6 %
Market mechanisms	0 %	71,5 %
Licence exempt use	4,3 %	6,9 %

4.4. Spectrum Management in Turkey: Planning flexibility

4.4.1. A brief history

The very first frequency related activities can be associated with the introduction of wireless telegraphy in the evolution framework of wired telegraphy in Ottoman Empire. The Tanzimat Period (1839-1876) witnessed the modernisation efforts of Ottoman Empire. It also includes the Ottomans' contacts with the western technology, such as the telegraph, the railroad system and the photography (Ata, 1997:16).

The first attempt to construct a telegraphy network in Ottoman Empire was in 1830. However this attempt failed due to the disorder in the internal provinces at that time. The second attempt for the construction of a telegraphy network was initiated by a proposal made by the British on 14 May 1854. Actually they made two proposals; one for the establishment of electric telegraph and one for the semaphore telegraph. The British recommended that the using of the semaphore telegraph in the time of war was better than the other due to the security of the network (Ata, 1997:27). As a result of this initiative, the Telegraph Administration was established in 1855. Later, the Post Administration, which was established in 1840, and the Telegraph Administration were merged to create the Ministry of Post and Telegraph in 1871 (Ata, 1997:57, 108). Meanwhile, Ottoman Empire became one of the founders of today's ITU in 1865 (Ata, 1997:32). The first line between Europe and India in 1865 was passing through Ottoman Empire (Thussu, 2006:4). Ottoman Empire was one of the signatories of International Radiotelegraphic Convention[32] which was signed at Berlin on 3 November 1906 (Crocker, 1908:875). Especially, after signing the mentioned Convention, the efforts of introduction of the wireless telegraphy were being accelerated. The first usage

[31] Adapted from OFCOM, 2005:3
[32] This Convention is the basis of today's Radio Regulations of ITU.

of wireless telegraphy in the Ottoman Empire was in 1912 (PTT, 2008). From that date, all the frequency related activities were being coordinated with the ITU.

The Ministry of Post and Telegraph became the Ministry of Post, Telegraph and Telephone in 1909. Four years later, in 1913, the Ministry of Post, Telegraph and Telephone was transformed into a General Directorate of Post, Telegraph and Telephone (PTT) under several Ministries. Sixteen years after the establishment of Republic of Turkey in 1923, the PTT was connected to the Ministry of Transport in 1939 (PTT, 2008).

Liberalization of telecommunications equipment occurred early on in the 1980s, along with the privatization of equipment manufacturers that were subsidiaries of PTT (Atiyas and Dogan, 2007:503). Since deployment and the usage of wireless equipments was not widespread across the country, it may not be wrong to argue that one can not talk about a 'real spectrum management' until 1983, when the General Directorate of Radio was established, in the sense that we are experiencing today. Until 1983, the civil usage of radio spectrum was managed primarily by PTT in accordance with the provisions of ITU and CEPT[33].

Historically, the establishment of General Directorate of Radio under the Ministry of Transport in 1983 with the Radio Law marks the beginning of the proper management of radio spectrum in Turkey. Later, in accordance with the widespread liberalisation and privatisation of telecommunication markets policies around the world, the Telecommunications Authority, which has administrative and financial autonomous in conducting its duties and responsibilities for regulation and supervision of telecommunications sector, was established in 2000. Today, the Spectrum Management Department within the TA is responsible for both the national and the international aspects of spectrum usage (TA, 2008).

4.4.2. First auction practice

In May 1993, Türk Telekom[34] awarded two 15-year contracts -not licenses- to build and operate cellular network based on the European GSM standard (GSM 900 MHz). The two operators Turkcell and Telsim were chosen after an international tender. The contracts were built on a compound of revenue-sharing and build-operate-transfer models. According to the

[33] Turkey is one of 19 founder members of CEPT that was established in 1959.

[34] In Turkey, a major structural change toward liberalisation started with enactment of Law 4000 in June 1994 to separate telecommunications services from the PTT, which aimed the removal of the direct involvement of the government, by establishing TurkishTelecommunications Inc. (Türk Telekom) as a state economic enterprise (OECD, 2002:8).

initial agreements, the two consortia would be permitted to buy outright licenses for USD 500 million at each in April 1998. Turkcell and Telsim were granted 25-year licenses as a result of their capital investment, but were required to pay USD 500 million each as a license fee to the Treasury (Emek, 2002:11).

Due to the rapid growth of GSM sector in Turkey, there were new players which were willing to enter the GSM market. Because of widespread implementation of spectrum auctions, government decided to award the licences with auction and announced that two more licenses would be sold with the auction (Gunay and Meng, 2008:2). First spectrum auction in Turkey was held on April 3, 2000 and it was a sequential auction (Cave et al., 2007:73).

The basic specifications of the first auction were as follows:

- Two GSM 1800 MHz licenses were to be auctioned.
- The conceding authority was the Ministry of Transportation.
- Incumbent operators were not allowed to enter the auction.
- The auction method was a first-price sealed bid auction which was to be sequentially held.
- Depending on the discretion of the conceding authority, after opening bids taken from the bidders, the owner of the highest bid and next highest bid might be invited to a competitive negotiation.
- After completing the first round of the sequential action, the rest of bidders were going to bid in a first-price sealed bid auction with a reserve price at the winning price of the first license.
- One GSM 1800 license was to be awarded to Türk Telekom (state owned telecom monopoly) at the winning price of first license.

Emek (2002) argues that from competitiveness point of view there was no entry deterrence problem in the first auction. Since incumbent operators were not allowed to enter the auction, and there was seemingly no advantaged firm between bidders, the auction attracted sufficiently enough bidders -five bidders for two licenses (p.14). Licence types are shown in Table 9.

Table 9- Licence types

Licence type	**Paired (2x) – MHz from 1800 MHz band**	**Paired (2x) – MHz from 900 MHz band**
A	15	1.3

B	15	1.3

After Turkcell and Telsim, the third national GSM license was awarded to Is-TIM[35] for staggering USD 2.525 billion plus 17 per cent in value added tax for a total price tag of USD 2.954 billion. The high price Is-TIM offered caught many market players -as well as government by surprise, especially given the huge gap between its bid and next higher offer of USD 1.350 billion (Emek, 2002:12).

The mentioned 'high' bid became the reserve price in the second auction. No firm participated in the second auction since benefit of the second license (profits) would not justify the cost (paying the second auction's 'high' reserve price). Although there was no entry deterrence problem in the first auction, Is-TIM was therefore able to deter the entry of another firm by strategically bidding in the second auction (Gunay and Meng, 2008:2). Klemperer (2002) argued that the firm rightly figured that no rival would be willing to bid that high for the second licence, which therefore remained unsold, leaving the firm without a rival operating the second licence (p.176). Turkish government, fearing law suits or reputation concerns, did not try to auction the unsold license B later (Gunay and Meng, 2008:2). Results of the first auction are shown in Table 10[36].

Table 10 - Auction results for Licence A

Bidders	**Bids[37] (USD bn)**
Is Bankasi- Telecom Italia Mobile	2.525
Dogan Holding- Dogus Holding- Sabanci Holding- Spain Telefonica	1.350
Genpa-Atlas yapi- Atlas Finans-Demirbank- Norway Telenor Mobile Communications	1.224
Koc Holding- Medya Holding- SBC Communications	1.207
Fiba Holding- Suzer Holding- Finansbank- Kentbank-French Telecom	1.017

The auction was held seven years after two GSM 900 MHz had been awarded and in the face of the uncertainty of when, how and how many 3G licenses would be awarded. Moreover, GSM 1800 MHz operators arrived much later in market than their GSM 900 MHz rivals, Turkcell and Telsim who have already signed up the 'best' customers; and they had to invest more heavily in their networks than their incumbent rivals. So, GSM 1800 MHz

[35] Is-TIM was a joint venture between a Turkish Bank, Türkiye İs Bankasi, and an Italian mobile operator Telecom Italia Mobile (TIM).
[36] Adapted from Emek, 2002:29.
[37] Figures do not include 17 per cent Value added tax –VAT.

operators in Turkey have already had disadvantages as compared to incumbent operators (Emek, 2002:19).

As mentioned above, the auctioning authority was the Ministry of Transportation. The one of main reasons of why the auction is chosen over beauty contest is the fear of allegations of favoritism and corruption (Emek, 2002:20). Regarding the fear of allegations of favoritism and corruption Emek (2002) makes an important observation in light of Turkish GSM 1800 auction:

> "Indeed, right after auction outcomes had appeared, Mr. Oksuz, the Minister of Transportation said that 'our honest auction argument has been corrected, and no one can accuse us of favoritism and corruption'. What this statement shows is Mr. Oksuz's reasonable anxiety against potential allegation of favoritism and corruption. What else from this statement could be derived? Politicians in developing countries are under pressure while allocating public assets. That's why their main concern is the explanatory power of any outcome resulting from an awarding process rather than the correct market value of awarded asset." (p.21).

While CEO of Is-TIM and Minister of Transportation were characterizing the outcome of the auction as a success story, some theorists like Klemperer (2002) considered it as a failure rather than a success (p.176). Emek (2002) argues that Is-TIM made a bid far more for the first license than it could possibly worth if it had to compete with a rival holding the second license (p.12). A study evaluating the Turkish GSM 1800 auction argues that the initial costs of network deployment, which could run as high as USD 2 billion, along with the realities of a slowing rate of subscriber expansion and stiff competition from well entrenched incumbents cast doubts over whether Is-TIM paid a reasonable price for the license (MEC, 2001:31-35 cited in Emek, 2002:12). In addition, Gunay and Meng (2008) argue that the design of Turkish GSM 1800 auction gave predatory bidding incentives to the bidders which resulted in only one license being sold (p.9). Besides, Cave et al. (2007) argue that Is-TIM strategically generated a more concentrated market structure as a result of poor auction design. Furthermore, a part of valuable spectrum was left idle and government lost revenue (p.73).

After the GSM 1800 licences awarded to Is-TIM and Türk Telekom, the two licensees started operation in 2001 with trade names Aria (in March) and Aycell (in December) respectively (OECD, 2002:8). Because of the very strong competition with the incumbents, the two merged in February 2004 with trade name AVEA[38] to minimize costs and increase revenues, and to obtain access rights for national roaming (Evci et al. 2004:3).

[38] The official name of the company which was established after the merger of Türk Telekom and Is-TIM was TT&TIM. TT&TIM was officially founded on 19th February 2004 with TIM (Telecom Itaila Mobile) and Turk Telekom each owning a 40% stake in the merger, while Türkiye Is Bankasi holds 20%.

TA is planning to grant 3G licences with auction, in the second half of the 2008 or in the first half of 2009. Actually, TA announced the date of auction two times in the first half of 2008. But, auctions could not be held due to the fact that there were not enough bidders that would enable the competitiveness in the tender.

4.4.3. Spectrum trading

The primary legislations that are in force do not allow licence holders to trade their rights regarding the spectrum usage in Turkey. Therefore, there is no spectrum trading activity in the mobile communications market yet.

However, it is important to note that the number of subscribers in the mobile communications sector in Turkey is 63,1 million as of March 2008 and the total value of the telecommunications market is USD 23 billion. 205 operators out of 244 telecommunications operators are doing business directly or indirectly in mobile communications market. Moreover, the average revenue per user –ARPU- of three GSM operator has increased from USD 11,7 in 2006 to USD 13,9 in 2007 (TA, 2008). These figures indicate that the size of the mobile communications market is big enough to introduce spectrum trading, which can contribute the economy positively.

If the three GSM operators are taken into account, these operators may lease their surplus frequencies in relatively small provinces (rural areas) to local mobile operators, which may be in need of additional frequencies. This will not only enable the spectrum to be put to the best use, it will also enable the spectrum to migrate to operators that will use it most efficiently. This would apply not only to GSM market but also to the other parts of mobile communications market.

In January 2007, Telecommunications Authority of Turkey declared to the public at the ‘National Frequency Spectrum Strategies’ briefing meeting that the Authority were planning to introduce the spectrum trading in some bands of the spectrum (TA, 2007). As mentioned, the introduction of the spectrum trading needs some amendments to the existing primary legislations, which will give the duty and the necessary authorisations and responsibilities to the TA. The list of frequencies that were intended to be put into spectrum trading is shown in Annex V.

5. Discussion and Conclusions

Radio spectrum is a natural scarce resource which is an indispensable element of all kinds of radiocommunication services. As it is the case for all scarce resources, ensuring the effective and efficient use of radio spectrum is one of the main responsibilities of spectrum management authorities (SMA). Mobile services derived from the spectrum underpin the economic growth of the radiocommunication market. Today, many other industries contributing the general economic growth such as energy, transportation and manufacturing rely on radio spectrum.

It is expected that the future telecommunications infrastructures will mainly be formed by wireless technologies rather than wireline. Ever growing demand for mobile technologies is the apparent evidence for this. This means that the management of radio spectrum will be more important, as it will be difficult to find appropriate frequency band for mobile services. Because there are physical limitations on the radio spectrum that can be used for radiocommunications, it is and still will be the main responsibility of SMA to find sufficient spectrum (supply) to satisfy the demand.

Traditional method in the management of spectrum was what is generally referred to as ‘command and control’ method. In this method, government decides how spectrum is used (allocation of frequencies to services) and who accesses the spectrum (assignment of frequencies to users).

Shortcomings of the command and control method, especially in terms of inefficiency and inflexibility on one hand and the ever increasing demand for additional frequencies arising from the widespread deployment and use of radiocommunications on the other hand, led to ideas that favour market-based mechanisms. But it should be noted that these are the reasons from practical point of view, i.e. these are problems identified during application of command and control method over the course of time.

Were these only factors that gave rise to market-based mechanisms? If we analyse this regulatory shift, in line with most international experience in other industries, from theoretical point of view, it may be argued that liberalism and neoliberalism affected the transition ideas from command and control methods to flexible management methods which favour using market forces in regulation of radio spectrum.

From the political economy point of view, it may be argued that the big telecommunications companies, most of which are transnational today, did and still do explicitly try to take the frequency spectrum, which was a public good, from the hands of governments and to give it to the control of purely market forces. What kind of implications does this have on consumers? It is obvious that, like in other markets that were liberalised and privatised, main role and the responsibility should be of regulatory bodies in terms of protecting public interests. In this context, special care should be given to allocation of scarce resources, especially which are common to public, in terms of increasing the social welfare.

The market-based mechanisms proposed were auctioning and the trading of radio spectrum, former one being the first practices implemented in spectrum management field. The spectrum trading is relatively new concept compared to auctioning, being discussed and implemented in the last ten years. Auctioning has been discussed for approximately fifty years and implemented for approximately twenty years.

Due to the highly successful auctioning practices in several countries in the world, there is a growing tendency to use auctions as one of assignment methods of radio spectrum in market-based approaches. If well-designed and conducted, auctions can help using the spectrum efficiently in both technical and economical points of views. It should be noted that the advantages and disadvantages of auction mechanisms may vary depending on the type and design of the auction being applied. In other words, outcomes of the auctions depend on the design of auction itself very much. In auction designs, there should be a careful balance between the aims of auctioning in terms of spectrum efficiency and the revenue maximization.

It may be argued that the most important advantages of the auctioning mechanism are to provide equity and transparency and, in turn, to eliminate the probability of favouritism and corruption in the process of assignment. The transparency of auctions facilitates the revelation and use of information that removes the uncertainty in the market. This results in increase in levels of competition among market players. Eliminations of the probability of favouritism and corruption give confidence to market players. From the implementation point of view, the auctions are time effective and, once well-designed, can be cost effective as well for both regulatory body and the participants.

On the other hand, auctions may end up with very high licence fees because of overbidding. This may bring significant amounts of debt and financial instability to market players, which may cause delays in roll-out or use of spectrum. Additionally, in some markets which are not

competitive enough, overbidding may result in high consumer prices. Because of high licence fees, auctions may also lead to market concentration by causing the reduction in the number of new entrants to the market. If not carefully planned, auctions may negatively affect public policy objectives such as universal service and public safety. With the examination of UK and Netherlands 3G auctions, it may be argued that the balance between not creating a market entry barrier and forming a competitive market with a view to achieving spectrum efficiency needs to be carefully considered by regulatory authorities.

In addition to auctioning, spectrum trading, as another market-based mechanism, has also some advantages and disadvantages that are specific to it. Some advantages include direct pressure on users to improve efficiency, transparency, increased competition and innovative developments. Disadvantages include risk of increased interference, standardization, abuse of market power, high transaction costs and concerns about public interest objectives.

Having examined the some advantages and disadvantages of policy of marketing the spectrum, a question may come to one's mind: which one outweighs the other? For this, it may be interesting to note the results of a consultancy report submitted to European Commission. The report estimates that the annual benefits to the European Union of introducing spectrum trading and liberalisation would amount to around EUR 9 billion whereas the benefits from trading alone would be 10 percent of that amount. The study also estimates that the additional costs of liberalisation, for example in terms of additional interference coordination, would amount to less than EUR 100 million a year across the EU and so would be small relative to the potential benefits (Analysys et al., 2004:222). So it is argued that advantages of marketing the spectrum outweigh the disadvantages.

Besides, Faulhaber and Farber (2002) argue that, in the short run, market-based mechanism is likely to free up so much spectrum that this resource will be in excess supply. In the long run, as this resource becomes better utilized and spectrum becomes scarce, they argue that owned spectrum becomes more attractive as a superior method to manage scarcity (p.27).

As it was argued by Thussu (2006), the biggest beneficiaries of the process of liberalisation, deregulation and privatisation and the resultant World Trade Organisation agreements in the communications field have been the transnational companies which dominate global trade (p.95). In this context, in the long term application of marketing the spectrum, it may not be wrong to argue that the biggest beneficiaries will be the companies who have got the most of the spectrum through the rules of free trade.

In line with most international experience, the spectrum management in Turkey has also followed a command and control approach. When compared with other markets, it can be concluded that the experience in implementing the market-based mechanisms in spectrum management in Turkey market is not as advanced as in other markets. There was only one spectrum auction practice in GSM 1800 MHz and no spectrum trading implementation.

However, as mentioned in the previous chapter, TA is planning to grant 3G licences with an auction in the second half of the 2008 or in the first half of 2009. So in the upcoming 3G auctions, some regulatory points should be paid attention in the light of lessons that were taken in other markets.

First, revenue maximisation should not be the only priority of the TA. Other aspects of the auction outcomes such as bringing new-entrants to market, improving quality of service requirements and paying attention to the universal service obligations that would be imposed to players need to be considered. Second, because the most fundamental and influential element of the auction mechanism is the auction design, regardless of the auction type that will be applied, the designation of the auction needs to be considered very carefully. Addition of a pre-qualification round, such as a beauty-contest, is important in terms of verifying the financial and technical capabilities of the bidders. Therefore, auction design should be combined with a pre-qualification process.

Besides, it can be inferred from Turkish GSM 1800 auction practice that the politicians, especially in developing countries, may be under pressure while auctioning the public assets. Or if the Netherlands 3G auction is taken into consideration, it can be inferred that collusions may take place or cast doubt on allocation process opening gates to some allegations. So the explanatory power or the transparency of any outcome resulting from an awarding process may be policy makers' main concern rather than selling the asset with real market value. That's why it may be argued that the hybridization of auction with comparative selection processes, such as a beauty-contest, can significantly underpin the transparency of auction practices while creating complacency for policy makers for their decisions.

Since the trading of spectrum is not permitted by the law in Turkey, there is no spectrum trading activity. However, Turkish mobile communications market is one of the most developed markets in Europe[39] which suggests that there exist feasible market structure and

[39] For example Turkey's largest mobile network operator, Turkcell, is third in Europe's top 10 networks while Turkey's second largest mobile network operator, Vodafone Turkey, is fourteenth in Europe's top 20 networks as of Q4 2007. Source: Cellular-news (2008) <http://www.cellular-news.com/story/30567.php>. On the other hand, according to a study done by

opportunities to introduce spectrum trading. For the introduction of spectrum trading it is important to establish a legal framework. In order to establish a legal framework, an amending law may be prepared in which some regulatory provisions can be set to allow spectrum trading. After establishing the legal framework, additional regulatory provisions can be set in secondary legislations.

Since it needs further evaluations of regulatory settings and involves further policy implications, spectrum liberalisation which requires giving the licence holders the permission of changing frequencies between different services and technologies should be thought as a next step after the successful introduction of trading in the market.

In the light of analyses done in relation to implementation practices of spectrum trading in other markets, it is recommended that introduction of the spectrum trading should be phased rather than in the form of sudden practice. Transition should take place gradually, taking into account necessary regulatory provisions such as identification of frequency bands, the forms of trading that will be allowed and the administration of the processes. In this context, applying incentive regulations, for example not taking income taxes from operators for spectrum trading transactions, may be a starting point of action. In this regard, allowing operators to use the unused parts of their spectrum for provision of other types of mobile services which would create value addition to total market may be another option to choose.

It should be noted that it is necessary to conduct market analyses regarding whether there is demand, if so in which bands, for spectrum trading and whether it will create value added services in the relevant market or not. Since spectrum liberalisation includes much more complex policy implications than trading, for example letting the market to decide which frequency bands should be used for wireless services and technologies, it should be thought as a next step after successful introduction of trading.

Finally, it may be argued that although market-based mechanisms have significant benefits, healthy operation of the system still requires fastidious supervision both from a regulatory and technical perspective (management, monitoring and inspection) by spectrum management authorities.

Yale University, Turkey, as a Newly Industrialised Country, is in top 10 emerging markets in worldwide. Source: Yale Universiy (2007), <http://www.library.yale.edu/socsci/emerge/bigten.html>.

BIBLIOGRAPHY

A-Focus et al., (2004). *The use of auctions in spectrum assignment*. Sweden: A-Focus AB. April 2004.

Analysys *et al*., (2004). *Study on conditions and options on introducing secondary trading of radio spectrum in the European Community*. London: Analysys Consulting. May 2004.

Ata, B., (1997). *The Transfer Of Telegraph Technology To The Ottoman Empire In The XIXth Century*. Thesis of Master of Arts in History at Bogazici University.

Atiyas, İ. and Doğan, P., (2007). When good intentions are not enough: sequential entry and competition in the Turkish mobile industry. *Telecommunications Policy*. **31** (8-9), 502-523.

Australian Communications Authority (ACA), (2002). *Review of Radiocommunication Acts and of the Market Based Reforms and Activities Undertaken by the ACA*.Report No. 22. [online] Melbourne: ACA. Available from: < http://www.pc.gov.au/__data/assets/pdf_file/ 0020/35543/radiocomms.pdf> [Accessed 07 June 2008].

Baer, W. J. and Balto, D. A., (1999). Antitrust Enforcement and High-Technology Markets. *Michigan Telecommunications and Technology Law Review*. **5**, 73-90.

Ballard, L. C. et al., (1985). General equilibrium computations of the marginal welfare costs of taxes in the United States. *The American Economic Review*. **75** (1), 128-138.

Barkham, R. and Geltner, D., (1993). *Price Discovery and Efficiency in American and British Property Markets*. [online] Connecticut: RERI. Available from: <http://www.reri.org/ research/abstract_pdf/wp18.pdf> [Accessed 07 June 2008].

Bauer, J. M. (2002). Spectrum management: private property rights or commons. In: (eds) Mansell, R., Samarajiva, R. and Mahan, A. *Networking Knowledge for Information Societies: Institutions & Intervention*. Netherlands: Delft University Pres.

Benkler, Y., (2002). Some economics of wireless communications. *Harvard Journal of Law and Technology*. **6** (1), 16-25.

Bohlin, E. *et al*., (2006). *Mapping European wireless trends and drivers: synthesis report*. Spain: European Commission. EUR 22250 EN.

Cassady, R. Jr., (1967). *Auctions and auctioneering*. Berkeley: University of California Press.

Cave, M., (2002). *Review of Radio Spectrum Management: An Independent Review for Department of Trade and Industry and Her Majesty's Treasury*. March, London: OFCOM.

Cave, M. and Valletti, T., (2000). Are spectrum auctions ruining our grandchildren's future? *Info*. **2** (4), 347-350.

Cave, M. and Webb, W., (2003). Designing property rights for the operation of spectrum markets. Papers in Spectrum Trading No.1. Centre for Management under Regulation Warwick Business School.

Cave, M. et al., (2007). *Essentials of Modern Spectrum Management*. London: Cambridge University Press.

CEPT-European Conference of Postal and Telecommunications Administrations-, Electronic Communications Committee. (2006). *Enhancing harmonisation and introducing flexibility in the spectrum regulatory framework*. Kopenhagen: CEPT, ECC Report 80.

CEPT (2007). *Report from CEPT to the European Commission in response to the Mandate to develop least restrictive technical conditions for frequency bands addressed in the context of WAPECS*. Kopenhagen: CEPT, CEPT Report 19. ECC Doc. ECC(07)116 Annex 10.

Chakravartty, P. and Sarikakis, K., (2006). *Media Policy and Globalization*. Edinburgh: Edinburgh University Press.

Coase, R. H., (1959). Federal Communications Commission. *Journal of Law and Economics.* **2**, 1-40.

Cramton, P. (2000). *Lessons from the United States spectrum auctions*. Maryland: Market Design Inc.

Cramton, P., (2001). Spectrum Auctions. In: Cave, M., Majumdar, S. K. and Vogelsang, I. (eds). *Handbook of Telecommunications Economics*. Amsterdam: Elsevier, pp.605-639.

Cramton, P. et al., (2006). *Combinatorial Auctions*. Massachusetts: The MIT Press.

Crocker, H. G. (1908). Chronicle of international events. *The American Journal of International Law*. **2** (4), 866-886.

Delaere, S. and Ballon, P., (2007). The business model impact of flexible spectrum management and cognitive networks. *Info*. **9** (5), 57-69.

Emek, U., (2002). *The Role of Auction Design in Awarding Spectrum Concessions: Turkish GSM Experience*. Ankara: Prime Ministry State Planning Organisation. Pub. No SPO: 2658.

Ecvi, C. et al., (2004). *Wireless Networks in Turkey: A Jewel in the Crowd*. Strategy White Paper, Alcatel Telecommunications Review. 2004/3. Paris: Alcatel.

Falch, M. and Tadayoni, R., (2004). Economic versus technical approaches to frequency management. *Telecommunications Policy*. **28** (2), 197–211.

Faulhaber, G. R. and Farber, D. J., (2002). *Spectrum management: property rights, markets, and the commons*. Washington, D.C.:AEI-Brookings Joint Center for Regulatory Studies. Working Paper 02-12.

FCC-Federal Communications Commission-, (1997). *The FCC Report to Congress on spectrum auctions*. Washington D.C.: FCC. FCC 97-353.

FCC (2004). Promoting Efficient Use of Spectrum Through Elimination of Barriers to the Development of Secondary Markets. Washington D.C.: FCC. FCC 04-167.

Forge, S. and Blackman, C., (2006). Spectrum for the next radio revolution: the economic and technical case for collective use. *Info*. **8** (2), 6-17.

George, S., (1999). A short history of neo-liberalism: twenty years of elite economics and emerging opportunities for structural change. Paper presented at the Conference on Economic Sovereignty in a Global Sing World, Bangkok, 24-26 March, Vol. 1999.

Gruber, H., (2002). Endogenous sunk costs in the market for mobile telecommunications: the role of licence fees. *The Economic and Social Review*. **33** (1), 55-64.

GSM Assosiation (GSMA)., (2008). *20 facts for 20 years of mobile communications*. [online] Georgia,USA: GSMA. Available from: <http://www.gsmtwenty.com/20facts.pdf> [Accessed 07 June 2008].

Gunay, H. and Meng, X., (2008). *The 2000 Turkish Cell-Phone License Auction*. The paper presented at University of Winnipeg and the University of Manitoba.

Hamelink, C. J., (1994). *The Politics of World Communication*. London: SAGE.

Hazlett, T., (2001). The wireless craze, the unlimited bandwidth myth, the spectrum auction faux pas, and the punchline to Ronald Coase's 'big joke': an essay on airwave allocation policy. *Harvard Journal of Law and Techology*. **14** (2) 335-545.

Hills, J., (1986). *Deregulating Telecoms : Competition and Control in the United States, Japan and Britain*. London : Pinter.

Hong, H. and Shum, M., (2002). Increasing competition and the winner's curse: evidence from procurement. *Review of Economic Studies*. **69** (4) 871–898.

IDATE et al., (2005). *Study on information on the allocation, availability and use of radio spectrum in the Community*. Montpellier: IDATE. Final Report, No. 30068/V5/FP.

Ikeda, N., (2002). *The Spectrum as Commons: Digital Wireless Technologies and the Radio Policy*, RIETI Discussion Paper Series 02-E-002, RIETI, Tokyo, March.

Information for Development Program (InfoDev)., (2008). *Secondary Markets and Defining Property Rights for Spectrum Trading*. [online] Washington, DC: InfoDev and ITU. Available from: <http://www.ictregulationtoolkit.org//en/Section.1300.html> and <http://www.ictregulationtoolkit.org//en/Section.1704.html> [Accessed 07 June 2008].

Intven, H. et al., (2000). Licensing telecommunications services. In: Intven, H. (ed). *Telecommunications Regulation Handbook*. Washington D.C.: World Bank.

ITU (2004). *Background paper: radio spectrum management for a converging world*. Paper presented at Workshop on Radio Spectrum Management for a Converging World [online] Geneva: ITU Available from: <http://www.itu.int/osg/spu/ni/spectrum/RSM-BG.pdf> [Accessed 07 June 2008].

ITU (2007). *Market Mechanisms for Spectrum Management*. Geneva: ITU Press.

Klemperer, P., (2002). What really matters in auction design. *The Journal of Economic Perspectives*. **16** (1), 169-189.

Klemperer, P., (2004). *Auctions: Theory and Practice*. USA: Princeton University Press.

Kwerel, E., (2000). *Spectrum Auctions Do not Raise the Price of Wireless Services: Theory and Evidence*. FCC White Paper. [online] Washington, DC: FCC. Available from: <http://wireless.fcc.gov/auctions/data/papersAndStudies/SpectrumAuctionsDoNotRaisePrices.pdf> [Accessed 07 June 2008].

Liberal International., (2008). *Oxford Manifesto 1947*. [online] London: Liberal International. Available from: <http://www.liberal-international.org /editorial.asp?ia_id=535> [Accessed 07 June 2008].

Marcus, S. J. et al., (2005). *Towards More Flexible Spectrum Regulation*. Bad Honnef: WIK Consult.

Martinez, E. and García, A., (2000). *What is "neo-liberalism"?:a brief definition*. [online] California: Global Exchange. Available from: <http://www.globalexchange.org/campaigns/ econ101/neoliberalDefined.html> [Accessed 07 June 2008].

McAfee, P. and McMillan, J., (1987). Auctions and bidding. *Journal of Economic Literature*. **25** (2), 699-738.

McCarthy, J. and Prudham, S., (2004). Neoliberal nature and the nature of neoliberalism. *Geoforum*. **35** (3), 275-283.

McLaughlin, P., (2001). *A critical introduction to liberalism*. *On-Line Philosophy Journal*. **2** (7), 1-8. Available from: <http://examinedlifejournal.com /archives/vol2ed7/liberalism.shtml> [Accessed 07 June 2008].

McMillan, J., (1994). Selling spectrum rights. *The Journal of Economic Perspectives*. **8** (3), 145-162.

Melody, W. H., (2001). Spectrum auctions and efficient resource allocation: learning from the 3G experience in Europe. *Info*. **3** (1), 5-10.

Munro, I., (2000). *Auctions as a spectrum management tool*. Geneva: Charles River Associates. ITU Radiocommunication Bureau Seminar, 8 November 2000.

Mott MacDonald et al. (2006). *Study on legal, economic & technical aspects of 'collective use' of spectrum in the European Community*. London: Mott MacDonald Group Ltd. November 2006.

NPT- Norwegian Post- and Telecommunications Authority, (2004). Comments to the recommendations of the report regarding the study on conditions and options in introducing secondary trading of radio spectrum in the European Community. [online] Brussels: EU. Available from: <http://ec.europa.eu/information_society/policy/radio_spectrum/docs /secondtrad_study_comments/comments_npt.pdf> Accessed on [07 June 2008].

Office of Communications (OFCOM) (2004a). *A Statement on Spectrum Trading: Implementation in 2004 and beyond*. London:OFCOM. August 2004.

OFCOM (2004b). *Spectrum Framework Review, A consultation on Ofcom's views as to how radio spectrum should be managed*. London:OFCOM. November 2004.

OFCOM, (2006a). *Ofcom awards 12 licences following spectrum auction*. [online] London: OFCOM. Available from: <http://www.ofcom.org.uk/media/news/2006/05/ nr_20060503> [Accessed 07 June 2008].

OFCOM, (2006b). *1781 award – publication under regulation 30 of the Wireless Telegraphy Licence Award Regulations 2006*. London: OFCOM. May 2006.

OFCOM (2008). What is the policy and legal framework for spectrum trading?. [online] London: OFCOM. Available from:<http://www.ofcom.org.uk/radiocomms/ifi/trading /tradingguide/framework/> [Accessed on 07 June 2008].

Organisation for Economic Co-operation and Development (OECD), (2001). *Spectrum allocation: auctions and comparative selection procedures*. Paris: OECD. JT00118426.

OECD, (2002). *OECD Reviews of Regulatory Reform, Regulatory Reform in Turkey: Regulatory Reform in the Telecommunications Industry*. Paris: OECD.

OECD, (2005). *Secondary markets for spectrum: policy issues*. Paris: OECD. JT00182737.

Paula Chakravartty, P. and Sarikakis, K. (2006). *Media Policy and Globalization*. New York: Palgrave Macmillan.

Portes, A., (1997). Neoliberalism and the sociology of development: emerging trends and unanticipated facts. *Population and Development Review*. **23** (2), 229-259.

PTT- General Directorate of Post and Telegraph Administration of Turkey (2008). *Tarihçe*. Ankara: PTT. Available from: < http://www.ptt.gov.tr/tr/kurumsal/tarihce.php> Accessed on [07 June 2008].

Radio Spectrum Policy Group, European Union (RSPG), (2004). *The RSPG opinion on Secondary Trading of Rights to Use Radio Spectrum*. Brussels: EU, RSPG04-54 Final.

RSPG, (2005). *The RSPG opinion on Wireless Access Policy for Electronic Communications Services (WAPECS): A more flexible spectrum management approach*. Brussels: EU, RSPG05-102 Final.

Reed, D. (2002). *How wireless networks scale: the illusion of spectrum scarcity*. Presentation to FCC Technological Advisory Council, April 26. [online] Maryland,USA: Jackson Telecom Consulting. Available from:<http://www.jacksons.net/tac/Spectrum%20capacity%20myth %20FCC%20TAC.pdf> [Accessed 07 June 2008].

Rosston, G. and Hazlett, T. (2001). *Comments of 37 concerned economists.* In the matter of promoting efficient use of spectrum through elimination of barriers to the development of secondary markets, FCC. [online] Washington, DC: Reg-Markets Center. Available from:< http://aei-brookings.org/admin/authorpdfs/redirect-safely.php?fname=../pdffiles/phpkx.pdf> [Accessed 07 June 2008].

Scanlan, M., (2001). Hiccups in US spectrum auctions. *Telecommunications Policy*. **25** (10), 689-701.

Selek, Y. K., (2005). *Yazılım Tanımlı Telsiz Cihazları ve Spektrum Kullanımı*. (Software Defined Radios and Spectrum Utilisation). Telecommunications Expertise Thesis (In Turkish). [online] Ankara: Telecommunications Authority of Turkey. Available from: <http://www.tk.gov.tr/Yayin/Uzmanlik_Tezleri/tktezler/ykorhan_selek_uzmanlik_tez.pdf> [Accessed on 07 June 2008].

Sutton, J., (1991). *Sunk Costs and Market structure: Price competition, Advertising, and The Evolution of Concentration*. Cambridge, MA: The MIT Press.

Telecommunications Authority of Turkey (TA), (2007). *Milli Frekans Spektrumu Stratejisi Bilgilendirme Toplantısı*. [online] Ankara: TA. Available from: <http://www.tk.gov.tr /Etkinlikler/Ulusal_Etkinlikler/Sempozyum/2007/mfss.htm> [Accessed on 07 June 2008].

TA, (2008). Telekomünikasyon Kurumu 2008 İş Planı ve Sürdürülmekte Olan Faaliyetler. Presentation Slides to Pres Conference on April 03, 2008. [online] Ankara: TA. Available from: <http://www.tk.gov.tr/Etkinlikler/Ulusal_Etkinlikler/basin-toplantilari/2008/sunumlar/03_04_2008_basin_toplantisi_sunum.pps> [Accessed on 07 June 2008].

Thussu, D. K., (2006). *International Communication Continuity and Change*. London: Hodder Arnold.

Valletti, T. M., (2001). Spectrum trading. *Telecommunications Policy*. **25**, (2001), 655–670.

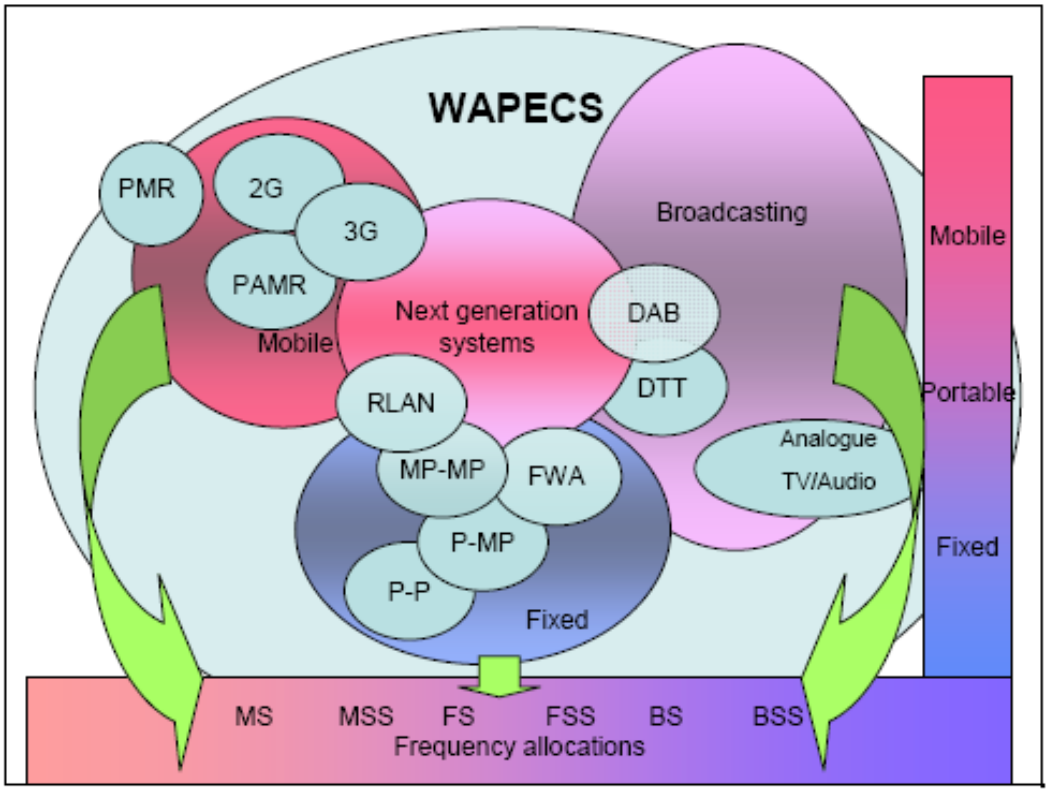
van Caspel, M., (2002). *Spectrum trading: increasing the efficiency of spectrum usage*. Analysys Response to 'Radio Spectrum Management Review, An Independent Review for DTI and HM Treasury', Industry Comment. [online] London: Analysys. Available from:<http://www.ofcom.org.uk/static/archive/ra/spectrum-review/comments/analysis.doc>

Wellenius, B. and Neto, I., (2006). The radio spectrum: opportunities and challenges for the developing world. *Info*. **8** (2), 18-33.

Xavier, P. and Ypsilanti, D., (2006). Policy issues in spectrum trading. *Info*. **8** (2), 34-61.

ANNEX I

Illustration of WAPECS (Wireless Access Policy for Electronic Communications Services) Concept[1]



WAPECS Concept

Abbreviations			
2G	Second generation mobile	MP-MP	Multipoint to Multipoint fixed links
3G	Third generation mobile	MS	Mobile Service
BS	Broadcasting Service	MSS	Mobile Satellite Service
BSS	Broadcasting Satellite Service	P-MP	Point to Multipoint fixed links
DAB	Digital Audio Broadcasting	P-P	Point to Point fixed links
DTT	Digital Terrestrial Television	PAMR	Public Access Mobile Radio
FS	Fixed Service	PMR	Professional (Private) Mobile Radio
FSS	Fixed Satellite Service	WAPECS	Wireless Access Policy for Electronic Communications Services
FWA	Fixed Wireless Access	RLAN	Radio Local Area Networks

[1] Source: Radio Spectrum Policy Group, European Union RSPG, 2005:4. Document No RSPG05-102 Final.

ANNEX II

On the basis of considerations such as existing related work within CEPT on some of these bands, current and expected use in the near future, it has been agreed to set up a priority order amongst those bands. However, the prioritisation does not pertain to the relevance of introducing flexibility into the bands (CEPT, 2007:31).

List of some frequency bands that have been identified for the introduction of flexibility in spectrum management field in Europe:

Frequency bands	**Remarks**
3.4-3.8 GHz	This was seen as a top priority band considering that some work has already been done towards bringing some technology neutrality.
2500-2690 MHz	This band is currently considered by some CEPT administrations to be made available.
880-915 MHz	These bands have been addressed in the recent EC Decision on the harmonisation of the 900 MHz and 1800 MHz frequency bands.
925-960 MHz	
1710-1785 MHz	
1805-1880 MHz	
1900-1980 MHz	These are the core IMT-2000 bands that are subject to ECC/DEC/(06)01.
2010-2025 MHz	
2110-2170 MHz	
470-862 MHz	This band is the subject of digital dividend studies of WRC-11.

Source: Adapted from CEPT, 2007:31. CEPT Report 19. ECC Doc. ECC(07)116 Annex 10.

ANNEX III

All licence classes and associated frequency bands which were made tradable by OFCOM in December 2004 are listed below (OFCOM, 2008).

Licence sector	Licence class	Types of Trade	Frequencies
Public Mobile Operator	• Public Wide Area Paging (National Paging) • Public Mobile Data, Non-Voice Only Operations • Public Access Mobile Radio (PAMR) • CMDA Spread Spectrum Data/ Asset Tracking Systems • Common Base Station	Outright* Concurrent* Partial trade** - Spectrum segmentation to 12.5 kHz	• 55.75–87.5 MHz • 136-208 MHz • 450-470 MHz • 133-134 kHz • 146-147 kHz Excludes: • 420 – 450 MHz • 866 – 868 MHz
Private Business Radio	• National & Regional Private Business Radio (PBR)	Outright Concurrent Partial trade - Spectrum segmentation to 12.5 kHz	• 55.75–87.5 MHz • 136-208 MHz • 450-470 MHz Excludes: • 20 – 450 MHz
Fixed Wireless Access (FWA)	• 3.4 GHz • 28 GHz (Broadband FWA)	Outright Concurrent Partial - Spectrum and geographical.	• 3480-3600 MHz • 28.0525-28.4445 GHz • 29.0605 - 29.4525 GHz
Fixed Wireless Access (FWA)	• 3.6 GHz	Outright Concurrent	• 3605 – 4009 MHz
Fixed Services	• Scanning Telemetry	Outright Concurrent Partial trade - Spectrum segmentation to 12.5 kHz	• 457.5 -464 MHz

continued

Licence sector	Licence class	Types of Trade	Frequencies
Fixed Services	• Point to Point Fixed Links	Outright Concurrent Partial trade – Partial Transfer of individual links under a licence	• 1350 –1530 MHz • 1672 – 1690 MHz • 3600 – 4200 MHz • 5925 – 6425 MHz • 6425 – 7125 MHz • 7425 – 7900 MHz • 10.7 – 11.7 GHz • 12.75 – 13.25 GHz • 14.25 – 14.5 GHz • 14.5 – 15.35 GHz • 17.3 – 17.7 GHz • 17.7 – 19.7 GHz • 21.2 – 22 GHz • 22 – 23.6 GHz • 24.5 – 26.5 GHz • 32.319 – 32.571 GHz • 33.131 - 33.383 GHz • 37 – 39.5 GHz • 49.2 – 50.2 GHz • 51.4 – 52.6 GHz • 55.78 – 57 GHz
Mobile & Broadband	• 1785MHz NI Award	Partial Trade Total Trade** Concurrent Outright	• 1785-1805MHz
Mobile & Broadband	• Concurrent Spectrum Access	Outright	• 1781.7-1785 MHz • 1876.7-1880 MHz
Mobile & Broadband	• Spectrum Access for frequencies for 412-414MHz	Partial Trade Total Trade Concurrent Outright	• 412-414MHz

* ‘Outright’ or ‘Concurrent’ trades: Transfers such that the acquirer of the rights and associated obligations holds them to the exclusion of the original holder, or concurrently with them.

With an outright transfer, the rights and obligations of the person making the transfer become the rights and obligations of the transferee to the exclusion of the person making the transfer.

After such a transfer, the original licensee (that traded the licence) no longer has any rights and/or obligations under the traded licence.

In contrast, with a concurrent transfer, the transferred rights and obligations become rights and obligations of the transferee while continuing, concurrently, to be rights and obligations of the person making the transfer. Such a transfer enables licensees to share rights to use spectrum.

** ‘Total’ or ‘Partial’ trades: Transfers for all or only certain parts of the rights and associated obligations under a licence.

Source: OFCOM (2008). What is the policy and legal framework for spectrum trading?. [online] London: OFCOM. Available from:<http://www.ofcom.org.uk/radiocomms/ifi/trading /tradingguide/framework/> [Accessed on 07 June 2008].

ANNEX IV

www.ofcom.org.uk OfW206 (Dec04)

Application for Spectrum Trading

For the transfer of rights and obligations under Wireless Telegraphy Act licences in accordance with The Wireless Telegraphy (Spectrum Trading) Trading Regulations 2004 (SI 3154)

Section A Instructions for Completion

- General guidelines on Ofcom's policies and procedures as relating to spectrum trading can be found in the document Trading Guidance (OfW224).
- Print clearly. Illegible, unclear or incomplete application forms may delay processing.
- Please read the notes on completing the application form at the back of this document before completing this form.
- A separate form must be completed for each part of a licence being traded and for each trade.
- Applications cannot be progressed unless the form is signed by all relevant parties.
- The date of effect cannot be back-dated.
- Completed forms must be forwarded to:

  Ofcom
  Spectrum Trading Desk, Riverside House
  2a Southwark Bridge Road, London SE1 9HA
- Please note that Ofcom may request further information in order to determine whether it consents to a trade.

Section B Licence Holder Details

B.1 Please enter details of the current licence holder(s) (the 'Licence Holder(s)')

If the licence is held by more than one person concurrently ('Concurrent Licence Holders') please tick here and provide details of each such Concurrent Licence Holder on a separate sheet. ☐

Surname

Initials

Title (e.g. Mr, Mrs, Miss, Ms, Dr, other)

Company name

Please state address

Address

Postcode

Tel

Fax

E-mail

Ofcom
OFFICE OF COMMUNICATIONS

B.2 Please enter your Ofcom customer reference number

B.3 Please enter your Company Registration Number

Section C Proposed Transferee Details

C.1 Please enter details of the proposed transferee ('Transferee')

If the proposed transfer is a concurrent transfer to more than one person ('Concurrent Transferee') please tick here and provide details of each such Concurrent Transferee on a separate sheet.

- ☐ Individual or sole trader
- ☐ Limited company
- ☐ Incorporated association
- ☐ Partnership
- ☐ Public limited company
- ☐ Registered charity
- ☐ Other legal entity (please state)

Surname

Initials

Title (e.g. Mr, Mrs, Miss, Ms, Dr, other)

Company name

Trading Name

Please state address

Address

Postcode

Tel

Fax

E-mail

C.2 Is the Transferee an existing customer of Ofcom?

- ☐ No
- ☐ Yes (please state customer reference number)

Section D Licence Details

D.1 Please provide details of the licence which contains the rights and obligations which you wish to transfer

Licence No.

Licence Type

Section E Description of Transfer

E.1 Please state the type of transfer you wish to complete

- ☐ A transfer of all rights and obligations (a full transfer) (Go to section F)
- ☐ A transfer of part of the rights and obligations (a partial transfer) (Go to E.2)

E.2 Please state the type of partial transfer you wish to complete

- ☐ A partial transfer of frequency (please complete E.3)
- ☐ A partial transfer of a geographical area (please complete E.4)
- ☐ A partial transfer of both frequency and a geographical area (please complete E.3 & E.4)

E.3 Please provide details of your partial transfer of frequency using the appropriate section below

E.3.1 For channelised licences please enter channel centre frequencies. Please continue on a separate sheet of paper if necessary.

Transmit (MHz)	Receive (MHz)	BW (KHz)

Please enter additional information on the proposed frequency partition in the box provided

E.3.2 For Fixed Wireless Access licences please enter the details of the frequency range you wish to transfer including units. Please continue on a separate sheet of paper if necessary.

Lower ____ to Upper ____

Lower ____ to Upper ____

E.3.3 For Fixed Point-to-Point licences please enter the Link Reference Number. Please continue on a separate sheet of paper if necessary.

Link Reference Number(s) ____

E.4 For a partial geographical transfer please provide details in the box provided and attach additional information as required. Geographical information can be complex and we strongly recommend that you read the guidance notes for completion of this application at the back of the form and contact Ofcom prior to submitting this form.

Section F Timing of Transfer

F.1 When would you like the transfer to take effect?

- ☐ Immediate
- ☐ Postdated (please state proposed date)

____

Section G Statistical Information

G.1 Pricing and transfer information data is requested by Ofcom on a voluntary basis along with details of any other relevant contractual arrangements. Such information collected by Ofcom will be treated as confidential and any published material will be based on aggregated data to ensure that the confidentiality of individual transactions is preserved.

Price paid for spectrum: £

Any other relevant information relating to contractual arrangements:

Section H Declaration from Licence Holder

Primary Contact

The Licence Holder (and each Concurrent Licence Holder, if any) hereby confirms it has not requested Ofcom to revoke or vary the licence where that revocation or variation has not yet been made.

The Licence Holder (and each Concurrent Licence Holder, if any) hereby warrants that it consents to the transfer detailed in this application;

The Licence Holder (and each Concurrent Licence Holder, if any) indemnifies and holds harmless Ofcom from and against any loss, liability, damages, expenses or costs (including legal costs and expenses on a solicitor/client basis) arising in connection with any inaccurate or misleading information contained in this application (other than in Section C) or with its consent to the transfer.

Signed for and on behalf of the Licence Holder

Date of application / /

Full name (in block capitals)

Concurrent Licence Holders

Each Concurrent Licence Holder must sign this form. A director or authorised person must sign for public limited companies, limited companies and other legal entities. Ofcom will, however, address all correspondence to the Primary contact as identified above.

Signed for and on behalf of each Concurrent Licence Holder

Date of application / /

Full name (in block capitals)

Company

If the number of Concurrent Licence Holders exceeds the space above, additional details should be provided on a separate sheet of paper in the format given above and attached to this form.

Section I Declaration from Transferee

Primary Contact

The Transferee (and each other Concurrent Transferee) hereby warrants that it consents to the Transfer.

Signed for and on behalf of the Transferee

Date of application ☐☐ / ☐☐ / ☐☐☐☐

Full name (in block capitals)

Concurrent Transferees

All Concurrent Transferees must sign this form. A director or authorised person must sign for public limited companies, limited companies and other legal entities. Ofcom will, however, address all correspondence to the Primary contact as identified above.

Signed for and on behalf of each Concurrent Transferee

Date of application ☐☐ / ☐☐ / ☐☐☐☐

Full name (in block capitals)

Company

If the number of Concurrent Transferees exceeds the space above, additional details should be provided on a separate sheet of paper in the format given above and attached to this form.

FOR OFFICIAL USE ONLY

Application received by Ofcom

Licence Renewal Date

Case Number

Stage Payment Customer

Notes on Completing an Application for Spectrum Trading

For the transfer of rights and obligations under Wireless Telegraphy Act licences in accordance with The Wireless Telegraphy (Spectrum Trading) Trading Regulations 2004 (SI 3154).

How to Fill in Your Application for Spectrum Trading

These notes provide step by step instructions to help you fill in your OfW206 Application for Spectrum Trading. It is particularly aimed at applicants who are less familiar with the spectrum trading process.

If, after reading this guide, you need more help, please telephone the Spectrum Trading Desk during office hours on 020 7981 3083 or write to us at the address at the bottom of this page.

Contact the Ofcom Contact Centre on 0845 456 3000 for any other Ofcom forms, or information sheets referred to within these guidance notes. All information sheets are also available on the Ofcom website www.ofcom.org.uk. From time to time this form may change, for example due to policy changes, etc. Therefore please check that you have the latest version.

1.0 Introduction

OfW206 can be used for any form of spectrum transfer, both full or partial, permitted by the Spectrum Trading Regulations[1]. The types of trades that are permitted by the regulations are summarised in Ofcom's Trading Guidance Notes (OfW224).

Ofcom has introduced spectrum trading to a wide range of different types of licence class and has also enabled a number of different transfer options (e.g. full or partial transfers of frequency and geography). These trading options will apply in different ways to different licence classes. Consequently the information Ofcom will require to process an application may differ depending on the nature of the proposed transfer. Ofcom has attempted to design the application form in such a way as to request and gather this information in the clearest and simplest way possible. We do, however, strongly recommend that you read this guide prior to completing your application.

1.1 Who should complete the form?

The application form must be completed and signed by all parties to a trade (i.e. both the 'Licence Holder' and the 'Transferee'). If the licence to be sold is held concurrently by more than one Licence Holder, each Concurrent Licence Holder must sign the application. Similarly, if the licence is to be acquired by more than one party simultaneously (i.e. they intend to hold the licence as Concurrent Licensees) each of these should also sign the form.

1.2 How many forms should be completed?

A separate form must be completed for each licence being transferred and for each transfer. So, for example, if you intend to sell two of your licences to another party, a separate application would be required for each licence. Similarly, if you intend to sell half the frequencies on your licence to one party, and the other half to another party, a separate application would be required to cover your proposed trade with each party.

1.3 Handling Your Application

We aim to meet our published Quality of Service targets which will apply when we receive a correctly completed application. In cases of uncertainty or missing information we may attempt to contact you to resolve any points of detail or simply return the form.

When we are satisfied that all the correct details have been provided we will acknowledge this by email to all parties to a trade using the addresses stated in Sections B and C.

1.4 Application Fees and Licence Fees

Ofcom does not charge a fee for processing applications for spectrum trades. However, please note that all licence fees must be paid at the the time of transfer. Ofcom is not able to authorise a transfer if licence fees are outstanding. You should ensure that all fees are paid using the normal mechanisms .

1.5 Additional Information

In order to properly process your application it may be necessary for Ofcom to contact you to request additional information.

1.6 Surrender of Licence

Please note that if the transfer is approved by Ofcom the Licence Holder must surrender its licence to Ofcom in order for Ofcom to put the transfer into effect. Please note also that in the case of a partial transfer the licence will be replaced by a new set of rights and obligations relating to the non-transferred element of your existing licence.

1.7 How to answer the questions

We suggest you start by answering Section A working sequentially through the sections to Section I, answering all relevant questions.

Useful contacts for further advice on completing OfW206

The Spectrum Trading Desk can be contacted on 020 7981 3083
Email: spectrum.tradingdesk@ofcom.org.uk
Fax: 020 7981 3921
Website: www.ofcom.org.uk

Completed applications should be sent to:

Ofcom
Spectrum Trading Desk
Riverside House
2a Southwark Bridge Road
London SE1 9HA

[1] The Wireless Telegraphy (Spectrum trading) Regulations 2004 (2004 NO.3154)

Section B Licence Holder Details

B.1 Please enter details of the current licence holder(s) (the 'Licence Holder(s)')

Please enter full details of the current licence holder(s).

B.2 Please enter your Ofcom customer reference number

Please enter your Ofcom customer reference number – you can find this on your licence renewal documentation.

B.3 Please enter your Company Registration Number

Having a registration number is very much dependent on your legal status. You should check whether your legal entity requires you to do so. If so, please enter this in the box provided.

Section C Proposed Transferee Details

C.1 Please enter details of the proposed transferee (the 'Transferee')

Please enter details of who the new licence, i.e. that which results from the transfer of rights and obligations, will be issued to – If you are applying for a concurrent transfer tick the relevant box and provide details of each Concurrent Transferee on a separate sheet.
Legally this 'person' may be an individual operating a business from one of their own premises or two or more people acting together as a Partnership, Company or an Incorporated Association. The WT Act licence must state the full name of the specific person, company or organisation so that the licence is quite clear. A list of legal entities is provided and you should choose one from the list. If not listed then you should specify this against 'Other legal entity'.

C.2 Is the Transferee an existing customer of Ofcom?

If the Transferee is an existing customer of Ofcom please enter your Ofcom customer reference number – you can find this on any licence renewal documentation.

Section D Licence Details

D.1 Please provide details of the licence which contains the rights and obligations which you wish to transfer

Please enter the licence number for the licence to be transferred. This can be found in your licence documentation.

Please also provide details of the type or 'class' of licence to be transfered, details of this can also be found in your licence documentation. It is important to establish what class of licence you possess as this will dictate the types of transfer you are permitted to undertake.

Section E Description of Transfer

E.1 Please state the type of transfer you wish to complete

A licence can be traded in its entirety or, depending on the licence class, part of the rights and obligation under a licence can be traded. More details on the types of partial trades permitted can be found in Ofcom's Trading Guidance OfW224.

If you wish to transfer a licence in its entirety (full transfer) please tick the appropriate box and proceed directly to Section F. If you wish to transfer part of a licence (a partial transfer) please tick the appropriate box and proceed to Section E.2.

E.2 Please state the type of partial transfer you wish to complete

Ofcom currently allows certain licences to be partitioned by frequency (spectrally partitioned – so for example trading half the frequency channels under your licence) or by geographical area (geographically partitioned – trading part of the area you have rights to operate in). It is also possible to combine both of these options (for example, selling some spectrum in part of the area you have rights to operate in). Not all options are available to all licence classes; please consult Ofcom's Trading Guidance carefully to see what is permitted under the licence class you possess.

E.3 Please provide details of your partial transfer of frequency using the appropriate section below.

Different types of licences specify the frequency permitted for use in different ways. For example, licences in the Common Base Station class specify the centre frequency, and bandwidth of a channel. Alternatively in the Fixed Wireless Access class the licence will specify a range of frequencies in which transmissions are permitted. For the purpose of this form the following tradable licence classes should use the following parts of E.3.

E.3.1

Analogue PAMR – Public Mobile Operator (for public access mobile radio)

National & Regional Private Business Radio

Common Base Station Operator

Scanning Telemetry

E.3.2

Fixed Wireless Access (including point-to-multipoint)
3.4 GH
3.6 GHz
28 GHz

E.3.3

Fixed Terrestrial Links – Point-to-Point Fixed Links

E.3.1 For Channelised Licences. Please continue on a separate sheet of paper if necessary.

Enter the centre frequency of the channel as shown on your licence schedule and the bandwidth of the channel. If the channel is duplex enter both the base transmit and receive frequency, for simplex channels enter only the base transmit frequency.

Frequency partitioning for channelised classes is limited to a minimum frequency bandwidth of 12.5 kHz. If you intend to partition an existing channel, for example splitting a 25 kHz channel in half, please note that channel arrangement must comply with the existing channel raster. You must state in the additional information box the proposed new centre frequency and bandwidths for the channels resulting from this kind of partition. You must also identify what frequency is to be transferred from the existing licence. If you wish to discuss this further please contact the Spectrum Trading Desk.

E.3.2 For Fixed Wireless Access licences please enter the details of the frequency range you wish to transfer including units. Please continue on a separate sheet of paper if necessary.

For Fixed Wireless Access type licences simply enter the lower and upper frequency of the band to be transferred through a partial trade. If your licence has a duplex element please identify the partition for both the base transmit and receive band. Please also enter the frequency units you are using; e.g. MHz, GHz etc.

E.3.3 For Fixed Point-to-Point licences please enter the Link Reference Number. Please continue on a separate sheet of paper if necessary.

For Fixed Point-to-Point licences please enter the Link Reference Number(s) for the link to be traded – this can be found in your licence documentation.

E.4 For a partial geographical transfer please provide details in the box provided and attach additional information as required. Geographical information can be complex and we strongly recommend that you read the guidance for completing this application at the back of the form and contact Ofcom prior to submitting this form.

For those licences where it is possible to geographically partition the licence, initially this is restricted to certain types of Fixed Wireless Access licence, please summarise details of the geographical area to be transferred in the box provided. Please note however that the adequate capture of geographical information for licensing purposes can be complex and we will require additional information to ensure that we have accurately captured the proposed transfer in order for new licences to be issued. We strongly recommend that you contact the Spectrum Trading desk prior to submitting your application.

Section F Timing of Transfer

F.1 When would you like the transfer to take effect?

If you wish the trade to take effect immediately Ofcom has finished processing the application simply tick the 'Immediate' box.

It is possible to schedule the date you require the transfer to become effective. To do this simply enter the date in the box marked 'Postdated'. Please note that the date specified should be a working day and give Ofcom reasonable time to properly process your application. The date must be later than 42 calendar days after application and before the expiry of 3 months after application.

Ofcom cannot guarantee meeting any such date since timing will depend on the issues that arise on any particular transfer application. However, Ofcom will take the parties' desired date into account. If the exact date when transfer is to be put into effect is of significance to parties, Ofcom recommends that you liase with a member of the spectrum trading team.

Section G Statistical Information

Pricing and transfer detail information data is requested by Ofcom on a voluntary basis along with details of any other relevant contractual arrangements. Such information collected by Ofcom will be treated as confidential and any published material will be based on aggregated data to ensure that the confidentiality of individual transactions is preserved.

Section H Declaration from Licence Holder

Licence Holder(s) should read the declaration carefully and sign the form. If the licence is held by Concurrent Licence Holders, each of these should sign the declaration, copying and signing it on separate sheets if necessary.

Section I Declaration from Transferee

Transferees should read the declaration carefully and sign the form. If the licence is to be held by Concurrent Transferees, all of these should sign the declaration, copying and signing it on separate sheets if necessary.

ANNEX V

The list of frequencies that were intended to be put into spectrum trading by Telecommunications Authority of Turkey:

Frequency Bands	**Existing national usage**
146-174 MHz	Mobile services
406-470 MHz	Fixed, Mobile, Amateur, Radar, Meteorological services
470-862 MHz	Broadcasting (TV) services
880-915 MHz	Fixed, Mobile, Radar services
1710-1785 MHz	Fixed, Mobile services (GSM 1800)
1805-1890 MHz	Fixed, Mobile (GSM 1800 and DECT)
1900-1980 MHz	Fixed, Mobile services
2010-2070 MHz	Fixed, Mobile services
2110-2170 MHz	Space research, Fixed, Mobile services
2500-2690 MHz	Mobile satellite, Fixed, Mobile services
3.4 – 3.8 GHz	Fixed services

Source: Telecommunications Authority of Turkey,
Available from <http://www.tk.gov.tr/Duzenlemeler/teknik/marfl/_marfl1.asp>