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| **The South Asian Telecommunication Regulator’s Council (SATRC)**  |  |
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**SATRC REPORT ON**

**MARKET BASED METHODS OF SPECTRUM MANAGEMENT**

**Prepared by**

**SATRC Working Group on Spectrum**

Adopted by

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Contents

[**EXECUTIVE SUMMARY** 1](#_Toc392520801)

[**CHAPTER-I: INTRODUCTION** 5](#_Toc392520802)

[**A. General: 5**](#_Toc392520803)

[**B. Requirement for adopting Market based Mechanism 5**](#_Toc392520804)

[**C. Moving towards Market based approach 6**](#_Toc392520805)

[**CHAPTER-II: ASSIGNMENT OF SPECTRUM** 7](#_Toc392520806)

[**A. METHODS OF ASSIGNMENT 7**](#_Toc392520807)

[**B. MARKET-BASED ASSIGNMENT APPROACH 8**](#_Toc392520808)

[**C. AUCTION FORMATS: 9**](#_Toc392520809)

[**First-price sealed bid auction: 9**](#_Toc392520810)

[**Second-price sealed bid auction (Vickrey auction): 9**](#_Toc392520811)

[**Dutch auction (descending price auction): 9**](#_Toc392520812)

[**English or Japanese auction (ascending price auction): 10**](#_Toc392520813)

[**Simultaneous Multiple Round Ascending (SMRA) auction: 10**](#_Toc392520814)

[**Combinatorial clock auction (CCA): 12**](#_Toc392520815)

[**Concerns arising out of the Auction Process 13**](#_Toc392520816)

[**D. Proper Design of Spectrum 13**](#_Toc392520817)

[**Spectrum Cap and Set Asides 14**](#_Toc392520818)

[**Bidding Credits 14**](#_Toc392520819)

[**Reserve Price and Other factors 16**](#_Toc392520820)

[**CASE STUDIES 17**](#_Toc392520821)

[**AUSTRALIA 17**](#_Toc392520822)

[**INDIA 19**](#_Toc392520823)

[**CHAPTER-III: MARKET BASED SPECTRUM MECHANISM-OTHER DIMENSIONS** 27](#_Toc392520824)

[**A. LIBERALISED USE OF SPECTRUM 27**](#_Toc392520825)

[**Denmark 29**](#_Toc392520826)

[**Sweden 31**](#_Toc392520827)

[**Ireland 33**](#_Toc392520828)

[**UK 34**](#_Toc392520829)

[**B. SPECTRUM TRADING 35**](#_Toc392520830)

[**Benefits of Trading 36**](#_Toc392520831)

[**Types of Trades 37**](#_Toc392520832)

[**Various mechanism of Spectrum Trade 37**](#_Toc392520833)

[**Issues that needs to be addressed by the NRAs 38**](#_Toc392520834)

[**INTERNATIONAL PRACTICES 39**](#_Toc392520835)

[**EU 40**](#_Toc392520836)

[**United Kingdom: 41**](#_Toc392520837)

[**Australia 42**](#_Toc392520838)

[**New Zealand: 43**](#_Toc392520839)

[**USA: 44**](#_Toc392520840)

[**Canada: 46**](#_Toc392520841)

[**C. SPECTRUM SHARING 47**](#_Toc392520842)

[**CHAPTER-IV: SATRC COUNRIES PERSPECTIVE AND THE RECOMMENDATIONS** 49](#_Toc392520843)

[**a) INDIA 49**](#_Toc392520844)

[**b) BANGLADESH 55**](#_Toc392520845)

[**c) PAKISTAN 57**](#_Toc392520846)

[**d) SRI LANKA 61**](#_Toc392520847)

[**e) NEPAL 65**](#_Toc392520848)

[**f) AFGHANISTAN 68**](#_Toc392520849)

[**g) IRAN 70**](#_Toc392520850)

[**h) MALDIVES 71**](#_Toc392520851)

[**i) BHUTAN 71**](#_Toc392520852)

[**CONCLUSIONS** 73](#_Toc392520853)

# EXECUTIVE SUMMARY

1. 13th SATRC Meeting held from 18-10 April 2012 at Dhaka adopted the SATRC Action Plan Phase IV for the implementation year 2012-2014. Under this Action Plan, one of the items assigned to the Working Group (WG) on Spectrum was MARKET BASED METHODS OF SPECTRUM MANAGEMENT.

1. The purpose of the work item was to study the suitability of market based method of Spectrum Management in SATRC countries.
* To study the current spectrum management approach in SATRC countries
* To analysis the pros and cons of the market based method with examples
* To analyse the possible liberalisation of spectrum in certain bands such as 800 MHz, 900 MHz etc.
* Suggesting way forward to SATRC countries
1. In most of the SATRC countries command and control framework has been the predominant method of spectrum management. However, the huge demand for new spectrum uses, have confronted regulators with the need to manage spectrum more efficiently. In many countries around the world spectrum policy is shifting away from traditional methods to market-based method. Unlike administrative decisions which are also vulnerable to bureaucratic delays, market dynamics can allow rapid redeployment of scarce resources to more efficient use by using better technologies.
2. When we talk about market based methods of spectrum management, first and foremost issue is the assignment of spectrum through auctions, rather than following any administrative mechanism. It provides a most transparent and efficient process of assignment of spectrum in the hands of user who values it the most. Howeverm auction *par se* does not take care of some other priorities that a administration or a regulator may have. Eg. Regulator will be interested in the introduction of a new telecom operator to promotr competition. Providing universal reach to telecom services may very well be one of its priorities. These concerns may be addressed by incorporating suitable provision attached to the spectrum. Whosoever wins the spectrum should be bound with these obligations and all the bidders should have complete knowledge before participating in the auction, so that they can factor-in all the factors while bidding and nothing comes as a surprise to them.

1. Auction design plays a crucial role in the conduct of successful auction. Some of the competitive concerns such hoarding of spectrum in a single hand may be addressed by the way of auction design. Fixation of reserve price is a critical factor and should be fixed with lots of considerations. It should not be very high otherwise not many operators will be willing to take part in the auction. On the other hand, it should not be too low to avoid the entry of non-serious bidders and also to protect the revenues of the Government. Two case studies viz. recent auctions held in Australia and India, have been presented in this report to highlight the importance of fixation of reserve price at right level.
2. Market based methods of spectrum management is not limited to the initial assignment of spectrum through auctions. But it has other dimensions also viz. (a) Liberised Use of Spectrum, (b) Spectrum Trading and (c) Spectrum Sharing. Along with the assignment of spectrum through auction, removal of restrictions on the usage of spectrum rights, allowing the change in the ownership through spectrum trading and also permitting spectrum sharing are important tools of spectrum management through market based methods.
3. Earlier, in most of the countries, technology specific licences were issued to the operators, under which, operators were bound with using a particular technology. Liberalised used of spectrum removes that restricts and permits them to use to use any technology. Various countries have adopted different approaches while liberalising the use of spectrum, the use of which was, hitherto, restricted to using GSM technologies. Some countries have amended technology specific existing licences to allow deployment of new technology. e.g. France and Finland amended the technology specification of the 900 licenses for their three existing licensees to allow them to use the 900 band for both GSM and UMTS/HSPA. Some countries have completely abolished technology/service restrictions to make existing licences technology/service neutral, e.g. in Sweden, a combined renewal and refarming process was implemented by PTS and allowed new licensees to choose technology.
4. While in some countries e.g. in UK, the spectrum in 900/1800 MHz bands have been liberalised in the hands of incumbent operators, regulators in some countries felt that liberalising the use of spectrum in 900/1800 MHz bands in the hands of incumbents may give rise to serious competitive issues, as it may give undue benefits to the operators having access to these bands as compared to those who don’t have. To address this issue, these regulators have first refarmed the spectrum and redistributed it to give equal opportunities to all operators. Approach adopted for liberalising the use of spectrum in Denmark, Sweden, Ireland and UK have discussed in detail in this report.
5. Spectrum trading is a mechanism whereby rights and any associated obligations to use spectrum can be transferred from one party to another by way of a market-based exchange for a certain price. Spectrum trading seeks to ensure that operators are constantly encouraged to target optimal use of the spectrum because incentive for selling unused spectrum is always available to them. As such, trading is likely to result in more efficient use of spectrum. It also allows flexibility and speedy re-assignments between users helping the facilitation of new services being launched.

1. Spectrum trading has been introduced in Australia, Canada, Guatemala, New Zealand, Norway, USA and UK, Austria, France, Germany, Netherlands and Sweden. In some other countries, individual spectrum trades have sometimes been allowed after regulatory review. However, the number of countries allowing spectrum licensees to trade spectrum on the secondary market has been steadily rising since 2005, showing that this is an area with great potential for further flexibility and liberalization.
2. India had recently adopted the Unified Licensing regime. Now spectrum has been delinked from the licence. Licensee has to separately acquire the spectrum through auction. Concept of spectrum cap has been used to limit the hoarding of spectrum in one or fewer hands. Use of auctioned spectrum has been liberalised since 2012 auctions. Spectrum Trading and Spectrum Sharing has been permitted in principal and the detailed guidelines are being finalised.
3. With the increasing demand for mobile services, demand for spectrum and its value has also increased manifold. In this environment, administrative method of assignment may not be suitable in the countries where there is a competitive environment and there is sufficient number of Telecom Service Providers (TSPs). However, there cannot be a There cannot be a framework or time line suitable for each and every country. Therefore, each country may define its own time frame to move forward for the adoption of market based method of spectrum management.

# CHAPTER-I: INTRODUCTION

1. **General:**
2. The traditional approach to spectrum management is based on deciding the allocation and assignment of the spectrum administratively i.e. who has the right to use a particular block of spectrum and for what exact purpose. Historically, regulators have assigned frequencies by issuing licences to specific users for specific purposes. It may also involve specifying what equipment a licensee can use and at what power levels it can be used. Though it may be an effective way to control interference, yet such methods are often slow and unresponsive to new technological opportunities, as the spectrum regulator may not always have all the information to make best use of the spectrum.
3. Over a period of time there is shift towards adopting market mechanisms as an alternate to the traditional command and control mechanism of spectrum management.

1. **Requirement for adopting Market based Mechanism**
2. When the demand for the spectrum in any band is less than its availability, definitely, assignment of spectrum needs to be done over the counter on an administratively determined price. But, when the demand for a spectrum in band outstrips its availability considerably, the market based approach is best suited for ensuring the optimal use of the spectrum. The emergence of new services, particularly mobile wireless broadband, is constantly fuelling commercial demand for spectrum. Demand for internationally harmonised spectrum now outstrips supply. Unlike administrative decisions which are also vulnerable to bureaucratic delays, market dynamics can allow rapid redeployment of scarce resources to more efficient use by using better technologies.
3. There is trend towards converging markets for integrated services through different communication technologies. Networks and services convergence and the rapid innovation have created a need for more flexible access to spectrum, than is possible under traditional methods. All these developments point to the need for greater flexibility in the management of spectrum resources, while maintaining harmonisation. The trend towards greater flexibility and more competition in spectrum use is facilitated through a market-based approach to individual rights of use. The market based methods puts resources in the hands of those who value them the most.
4. **Moving towards Market based approach**
5. There has been a gradual shift from administrative approach towards the market based approach of spectrum management. There are some countries which allowed the auctioning of licences but did not permit trading and change of use. On the other hand, there are some markets for spectrum and spectrum licences under which both the ownership and use of spectrum can change in the course of a licensee's operation. Methods of Assignment of frequency, removal of restrictions on the usage of spectrum rights, allowing the change in the ownership through spectrum trading are important tools that have been instrumental for this shift of approach, each of them in the subsequent chapters.

# CHAPTER-II: ASSIGNMENT OF SPECTRUM

1. **METHODS OF ASSIGNMENT**
2. Traditionally, non-market-based assignment approaches (administrative methods) were adopted by a number of countries for the assignment of spectrum. Minimizing harmful interference is the focal point in the traditional model which places an emphasis on the technical management of radio spectrum. As a consequence, different services are sometimes allocated to different frequency bands.
3. In the administrative method, there are two stages involved in authorizing spectrum use viz. the allocation stage and the assignment stage. At the allocation stage, broad decisions on spectrum use are made on ITU radio-communication conferences. National spectrum regulators prepare their own allocation decisions, which are published in form of a National Frequency Allocation Table.
4. Once an allocation has been determined, licences are issued to authorize the use of spectrum to particular users at the assignment stage with the issuance of a license(s) which is assigned. Historically, assignments were made by methods such as first-come, first-served basis or by way of comparative evaluation (also known as ‘beauty contests’) and/or consultation rather than by market based methods.
5. In the first-come, first served (FCFS) method, first an eligibility criteria is set. Subsequently, blocks of spectrum are assigned to eligible seekers on first-come first served basis. Where spectrum is not scarce and there is enough to meet the demand from all those who want it, FCFS may be suitable method for the assignment of spectrum.
6. “Beauty contests” is another commonly used administrative method for the assignment the spectrum. It requires those, who are interested in a particular tranche of spectrum, making proposals for how they intend to use it. The regulator evaluates the proposals according to certain criteria, which may include proposed coverage commitments, speed of rollout, end-user prices, quality and range of services offered etc. The spectrum management authority determines who the best qualified applicant to use the spectrum is and awards the licence. Beauty contests were used to award majority of initial GSM licenses in Europe and around half of the 3rd Generation (3G) mobile licenses.
7. The main problem with beauty contests is that, it is difficult to keep the selection procedure objective because they involve evaluation across a range of criteria which essentially have a subjective element. They are often subject to successful legal challenge and may delay the development of a truly competitive market, to the detriment of consumers’ interest. Beauty contests are also necessarily slow, since all the criteria must be evaluated in a way which will stand up to legal scrutiny.
8. **MARKET-BASED ASSIGNMENT APPROACH**
9. Auction is a preferred market-based assignment method. In an auction, spectrum is allocated by bidding among competing spectrum applicants. Auctions award spectrum to those who value it the most while simultaneously generating revenues for the spectrum authority. However positive outcome of auction method is possible only when the demand for spectrum exceeds the available supply i.e. there are sufficient viable bidders. Avoidance of collusion between participants, encouraging a sufficient number of bidders particularly new market entrants, setting of appropriate reserve prices etc are key to successful auction. Several types of auctions have been used by different countries: Sealed-bid auction, Ascending-price auction (English format), Descending-price auction (Dutch format), Simultaneous multiple round auction (SMRA) and Anglo-Dutch auction. There is now substantial agreement among economists/ regulators that auctions are the best way to assign scarce spectrum resources, and most regulators, now frequently use auctions to determine who gets to use spectrum.
10. There are certain fundamental advantages of auction process such as it is a transparent, fair and objective allotment process. It is a rather quick process of allotment process as compared to beauty parade. It ensures allocation of resources to the players who will use it most efficiently and generates maximum revenue to the Government.
11. **AUCTION FORMATS:**
12. There are many formats of auction, differing in their input and output that achieve efficiency. Some of the commonly used auction formats are described below:-

**First-price sealed bid auction**:

1. In this auction, each bidder is asked to submit a bid. The highest bidder wins the auction and pays an amount equal to his bid amount. The first-price sealed-bid auction has the merit of being extremely simple.

**Second-price sealed bid auction (Vickrey auction)**:

1. The second-price sealed-bid auction also asks buyers to place a bid on the object. The highest bidder wins the object but pays an amount equal to the second highest bid.

**Dutch auction (descending price auction)**:

1. A popular auction is the descending price auction, also known as the Dutch auction - The auctioneer sets a high price on the object initially and lowers it continuously. A bidder who expresses his willingness to buy the object first wins the auction at the current price. Theoretically, this auction is equivalent to the first-price sealed-bid auction.

**English or Japanese auction (ascending price auction):**

1. The ascending price auction is the ascending counterpart of the Dutch auction. There are two commonly used variants of this format. The first variant called the English auction, works as follows. The seller starts the auction at a very low price (possibly zero). The bidder who wants to win the object increases the price. The auction ends when there is no price increase. The last bidder to bid wins the object and pays his bid amount. In another variant, called the Japanese auction, the seller starts the auction at a low price (possibly zero). Bidders express their willingness to buy the object at every price. If the number of bidders who want to buy the object at the current price is more than one, then the seller increases the price by a pre-determined amount, called the bid increment. The auction stops when there is exactly one bidder who wants to buy the object. Usually, there are activity rules which require each bidder to express his willingness to buy the object at every price in the auction, and once a bidder says no to buy the object at a price, he is no longer allowed to participate in the auction. Theoretically, this auction converges to the outcome of the second-price sealed-bid auction if the bid increment is small enough. As soon as the price in the auction crosses the second highest value, exactly one bidder is interested in the object, and the auction stops. The highest value bidder wins the object and pays a price (close to the) equal to the second highest value. The Japanese auction is also referred to as the clock auction.

**Simultaneous Multiple Round Ascending (SMRA) auction**:

1. The auction formats discussed so far are meant for the auction of single object. In an SMRA auction, all spectrum blocks are auctioned simultaneously over a series of rounds. In each round, bids are submitted on individual blocks at the announced prices. At the end of each round, a standing high bidder is identified for each spectrum block. The standing high bidder is then committed to the licence and cannot withdraw its bid without the possibility of incurring a penalty. The standing high bidder is released from its commitment when outbid by another bidder. When a licence receives at least one bid, the price for the licence increases in the next round. As the prices rise gradually over multiple rounds, bidders gather information about how the other auction participants value the licences. This price discovery helps to reduce a bidder’s uncertainty regarding the value of the licences. Bidders are able to respond to these changes in prices accordingly, shifting their bids to licences that continue to be consistent with their business objectives. Activity rules are in place to compel active bidding and encourage truthful bids throughout the auction, that is, bidding that is consistent with how they truly value the licences. The auction ends when a round passes in which no new bids are received on any licences.
2. The SMRA auction format is a well understood, effective approach to assigning spectrum licences and it remains popular to date; however, it does have some weaknesses. The most notable weakness is the exposure risk, that is, the possibility that a bidder will win some but not all of the spectrum blocks needed for its business case and may be left stranded with licences that cannot be used as effectively. In an SMRA auction format, bidding is for individual licences only, leaving bidders which seek to aggregate blocks of licences that are contiguous and/or across multiple service areas, vulnerable to the exposure risk.
3. In an SMRA auction, in order to mitigate the exposure risk, bidders are able to withdraw their standing high bids, switching to other desired licences or withdrawing from the auction altogether. However, they may be subject to withdrawal penalties, which are in place to discourage bidders from bidding frivolously and then withdrawing their bids.

**Combinatorial clock auction (CCA):**

1. It is a variation of the SMRA format in that all spectrum blocks are auctioned at the same time over multiple rounds. Similar to the SMRA format, the CCA format provides a simple bidding process for participants, including a price discovery stage; however, instead of bidding on individual spectrum block, bidders express their demand for a package of blocks at the prevailing prices. The use of package bidding eliminates the exposure risk inherent in the SMRA format. Furthermore, unlike the SMRA format, the CCA format does not require the identification of a "standing high bidder" that is held responsible for individual blocks at the end of each round, which makes it easier for bidders to move to substitute blocks in response to price changes.
2. A key benefit of the CCA is that it enables bidders to bid for any combination (or package) of the spectrum on offer that is best suited to their business requirements. As the CCA is a package bidding auction format, it ensures that a bidder can only secure the entire package. This means there is no risk of the bidder securing some of the spectrum in the package but not all of it, as would be the case with more traditional auction formats. The auction awards the spectrum to the highest value combination of packages.
3. The CCA also provides incentives for bidders to bid truthfully and it reduces the risk of gaming behaviour. bidders can bid on the combination, or ‘package’, of lots from each band that is best suited to their business needs. Bidders have certainty that if they win lots, they will win all lots in a package. This means they do not risk exposing themselves to winning only part of a package. This feature makes the CCA format well suited to auctions where potentially complementary offerings (such as the 700 MHz and 2.5 GHz band spectrum) are available.

**Concerns arising out of the Auction Process**

1. Auction is, no doubt, a transparent mechanism for the award of spectrum to the bidders who value it the most. But, this is not to say that there are no problems associated with auctions. Each administration may have also some other policy objectives. Policy objectives may differ from one country to another such as maximization of immediate revenue generation from a spectrum auction, specific requirements regarding geographic coverage, making spectrum available to mobile operators at affordable rates, increase mobile broadband access in rural areas, increase competition in the market, discovery of market discovered valuation of the spectrum, objectives relating to quality of service, encouraging innovation and investment in the telecommunications sector etc. These objectives are not met directly by auction process, but such objectives can be met through the use of other policy instruments (regulations, licence conditions, standards, etc.) which are fully compatible with spectrum auctioning.
2. Auctions may raise competitive concerns. For example incumbents may be willing or able to bid more than new entrants to strengthen their monopoly or oligopoly (limited number of competitors) positions. Therefore, in order to promote competition, it may be necessary to impose additional safeguards such as “Bidding credits” (discounts) and installment payments to new players and limits on how much spectrum an entity may purchase.
3. **Proper Design of Spectrum**
4. The Simultaneous Ascending Auction has emerged as the standard approach to spectrum auctions in which groups of related licenses are auctioned simultaneously over many rounds of bidding. Some of the important elements of auction design are given below:

**Spectrum Cap and Set Asides**

1. With the objective of promoting competition, regulatory authorities use Spectrum Cap and Set Asides in auction. In Set Asides, spectrum is put aside for new entrants where as in a Spectrum Cap a firm is limited in the quantity of spectrum that it can hold in any market. Spectrum Caps and Set Asides promote competition in the wireless service.
2. FCC has used both Spectrum Cap and Set Asides in its spectrum auctions. For the broadband PCS A and B blocks, incumbent cellular carriers were prevented from buying “in-region” licenses because of a 45 MHz spectrum cap. In that auction, FCC also set aside the Broadband PCS C block for small businesses.
3. FCC placed important rules on public safety for the auction of 700 MHz spectrum conducted in 2008. 20 MHz of the valuable 700 MHz spectrum were set aside for the creation of a public/private partnership that would eventually roll out to a new nationwide broadband network tailored to the requirements of public safety.

**Bidding Credits**

1. Bidders of a favored type get a percentage discount on a winning bid. For example, new entrants may get a 30% bidding credit. In this case, a new entrant submitting a bit of $2000 would only have to pay $1400 if the bid won. Bidding credits differ from set asides and binding spectrum cap in that they do not ensure that a new entrant would win the auction. They serve the dual purpose of encouraging competition and assigning value on having a new entrant.
2. To explain the above concepts, an example of recent auction held in the Ireland is given below. Irish Regulator ComReg conducted a multi-band spectrum auction in 2012. This auction awarded spectrum rights in 900 MHz, 1800 MHz and in the 800 MHz band. The auction process determined assignments of rights of use of spectrum across these three critical bands from 2013 to 2030.
3. Some of the important features of this auction are given below:
* To safeguard competition, competition caps placed on the spectrum that bidders, either as a single entity or in combination with other bidders, can acquire:
* 2 × 20 MHz of sub-1 GHz spectrum (i.e. 800 MHz and 900 MHz spectrum);
* 2 × 50 MHz of total spectrum in these bands; and
* to safeguard competition and spectrum efficiency, a minimum price was applied, which was €20M per 5 MHz band of paired sub-1 GHz spectrum, and €10M per 5 MHz band of paired 1800 MHz spectrum; the minimum fee will comprise two equal parts, being the upfront reserve element, and a Spectrum Usage Fee (SUF) to apply over the duration of the licence, appropriately adjusted for the time value of money.
* All licence holders must attain and maintain a minimum coverage of 70% of the population. The existing GSM and 3G licence holders are to attain this coverage obligation within 3 years, while new entrants who do not currently hold an existing GSM or 3G licence are to attain this coverage obligation within 7 years, along with an interim coverage milestone of 35% of the population within 3 years;
* licence holders may use multiple bands to achieve coverage targets, but at least 50% of the coverage requirement (i.e. 35% of the population) must be met using the 800 MHz, 900 MHz and/or 1800 MHz bands;
* Minimum quality of service conditions shall require that:
* The network unavailability will be less than 35 minutes per 6 month period;
* The minimum voice call quality standard will be in line with the standard as set out in the existing GSM licences;
* The 900 MHz and 1800 MHz bands were earlier reserved for GSM use only but the EU has mandated that both bands be ‘liberalised‘, meaning that they can be used in future for providing advanced mobile services such as mobile broadband data, utilising ‘3G‘ and ‘4G‘ technologies alongside GSM. After the auctions, the licensee would be free to use the spectrum for any technologies.

**Reserve Price and Other factors**

1. For an auction to be successful, there are many factors which should be kept in mind. First and the foremost is the setting of the reserve price at appropriate level. The purpose of setting a reserve price is (a) to safeguard the government revenues and (b) to get rid of non-serious bidders. The most important is the level at which the reserve price should set.
2. The value of spectrum changes over time, a product of both evolving economic circumstances and rapid technological change. It is impossible to predict what the value (price) of spectrum would be 5 or 10 years from now, much less 20 years, the terminal date for a spectrum license. In fact, valuations 5 to 10 years forward may be far higher than today’s estimates. Valuing spectrum and setting reserve prices is part science and part art. Moreover, there is no single correct and precise valuation of spectrum or the reserve price. There are different ways of arriving at the value of the spectrum, all of which have their merits as well as their drawbacks. Only what can be said that the reserve price should be set at a optimal level. *(Indian Sector Regulator TRAI’s recommendations on ‘Valuation and Reserve Price of Spectrum’ dated 9th September 2013)*
3. If it is set at a very low value, there are chances of collusions amongst the bidders and the spectrum could be sold at a very low prices. On the other hand, if the prices are set very high, you may find that there are no takers of the spectrum at that price.
4. There are other factors also like the virtues or the embedded flexibility in the use spectrum which affect the valuation of the spectrum. These factors are discussed in detailed in Chapter-III.

**CASE STUDIES**

1. An example of the recently concluded auction in Australia is given below followed by a case study of Indian Auctions to show that how crucial is the design of the auction, particularly setting of the reserve price at the appropriate level.

### AUSTRALIA

1. In 2013, the Australian Communications and Media Authority (the ACMA) conducted auction of spectrum in the 700 MHz band (and the 2.5 GHz band. The 700 MHz band became available as a result of Australia switching from analog to digital television services. The licences issued in both bands will be of 15 years duration.
2. The auction used a combinational clock auction (CCA). This is a price clock-based auction method used to sell multiple items in a single process and designed to create incentives for bidders to bid their full value for the spectrum. However, it makes it difficult (if not impossible) to assign a value to each band separately. CCA consisted of two major stages:
* an allocation stage, which determines the spectrum that each bidder secures
* an assignment stage, which determines the specific frequency ranges awarded to each successful bidder from the allocation stage.
1. ACMA imposed [‘competition limits’](http://engage.acma.gov.au/digitaldividend/ministerial-directions-for-the-digital-dividend-auction), which limited the total amount of spectrum that a single bidder can acquire in each band in the auction.
* 25 MHz paired (50 MHz in total) in the 700 MHz band
* 40 MHz paired (80 MHz in total) in the 2.5 GHz band.
1. Reserve price was set at AU$1.36/MHz-PoP for the 700 MHz band and AU$0.03/MHz-PoP for the 2.5 GHz band. Based on this, the auction was expected to generate AU$2.89 billion, but with the unsold allocation in 700 MHz only AU$1.96 was raised: AU$ 929 million less than expected. Setting a high reserve price has evidently backfired resulting in lower total proceeds. Three operators have won spectrum in Australia's digital dividend auction, in the 700MHz band, but a 2x15MHz chunk - one-third of the total - has gone unsold because of the high reserve prices set by regulator ACMA.



**INDIA**

1. Consider the Spectrum auctions of India held in the month of November 2012. These auctions were held after the cancellation of 122 licences of Telecom Service providers (TSPs) by the Hon’ble Supreme Court of India. The licensees, whose licences were cancelled, were allowed to continue providing the services till the auctions are over. TRAI (Sector Regulator) was asked to make recommendations for these auctions. After considering the recommendations of TRAI[[1]](#footnote-1), the Government made the following provisions in the auction:
* There are no restrictions on the technology to be adopted for providing services within the scope of the service license using spectrum blocks allotted through this auction. The technology should be based on standards approved by ITU/TEC or any other International Standards Organization/ bodies/ Industry.
* Existing Licensees will be allowed to convert their entire existing spectrum holding in 1800MHz band into liberalised spectrum after payment of auction determined price.
* Following were the limits imposed on the quantum of spectrum that a bidder could procure through these auctions:

**Table 2.1**

|  |  |  |
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|  | **Auction of spectrum in 1800 MHz band**  | **Auction of spectrum in 90 MHz band** |
| **Block Size**  | 1.25 MHz | 1.25 MHz |
| **Cap for Existing Players**  |  Min.1 Block | Min. 2 Blocks |
| **Cap for New Entrants**  |  Min. 4 Blocks; Max 5 Blocks |  Min. 2 Blocks; Max 3 Blocks |
| **Total Spectrum put to auction**  | 8 to 11 Blocks(10 MHz to 13.75 MHz) in each Circle  | 3 to 4 Blocks (3.75 to 5 MHz) in each Circle  |

* Reserve Price was set as given below:
* **1800 MHz Band**: Rs. 14000 crore (US$ 2333 mn) for 2x5 MHz.
* **800 MHz Band:** Rs. 18200 crore (US$ 3033 mn) for 2x5 MHz (i.e. 1.3 times that of spectrum in 1800 MHz band).
* Apart from the spectrum acquisition fee, TSPs shall be liable to pay Spectrum Usage Charges (SUC) as a percentage of the Adjusted Gross Revenue (AGR) as per the following slab rates. For the purpose of calculation of spectrum usage charge, minimum AGR shall be not less than 5% of the bid amount.

**Table 2.2**

|  |  |
| --- | --- |
| **Spectrum slab** | **Annual spectrum charges (as a percentage of AGR)** |
| **GSM** | **CDMA** |  |
|  Up to 4.4 MHz  |  Up to 5 MHz  | 3 |
|  Up to 6.2 MHz  |  Up to 6.25 MHz  | 4 |
|  Up to 8.2 MHz  |  Up to 7.5 MHz  | 5 |
|  Up to 10.2 MHz  |  Up to 10 MHz  | 6  |
|  Up to 12.2 MHz  |  Up to 12.5 MHz  | 7  |
|  Up to 15.2 MHz  |  Up to 15 MHz  | 8  |

* **Duration:** The validity period shall be 20 years from the date of issue of Letter of Intent (LoI) (the ‘Effective Date’).
* **Deferred Payment Option:**  (i) An upfront payment of 33% in the case of 1800MHz Auction and 25% in the case of 800MHz Auction of the final bid amount; (ii) Moratorium of 2 years for payment of balance amount, which shall be recovered in 10 equal annual instalments.
* **Spectrum Sharing**: Operators whose entire spectrum holding in a particular band (900MHz/ 1800MHz and 800MHz) is/ has been liberalized would be permitted to share spectrum without any additional one time spectrum charge.
* Spectrum trading will not be allowed in India.
1. There was no bidder for the 800 MHz band. For 1800 MHz spectrum, there were five bidders. Spectrum in LSAs of Delhi, Mumbai, Karnataka and Rajasthan in 1800 MHz remained unsold. Except in Bihar, spectrum in all other LSAs was sold at the reserve price. LSA wise details of reserve price and auction discovered price are given below.

**Table 2.3**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Type** | **Circle** | **Reserve Price (For 2x1.25 MHz)** | **Auction Price (2x1.25 MHz)** | **Spectrum offered for sale** | **Spectrum sold** | **No. of successful bidders** |
|  |  | **US$ (in mn)** | **US$ (in mn)** | **In MHz** | **In MHz** | **Numbers** |
| Metro | Delhi | 115.5 | No Sale | 10.00 | 0 | 0 |
| Metro | Mumbai | 113.1 | No Sale | 10.00 | 0 | 0 |
| Metro | Kolkata | 19.0 | 19.0 | 13.75 | 5 | 1 |
| A | Maharashtra | 43.8 | 43.8 | 13.75 | 6.25 | 2 |
| A | Gujarat | 37.5 | 37.5 | 13.75 | 10 | 2 |
| A | Andhra Pradesh | 47.8 | 47.8 | 13.75 | 5 | 1 |
| A | Karnataka | 55.0 | No Sale | 13.75 | 0 | 0 |
| A | Tamil Nadu | 51.0 | 51.0 | 13.75 | 5 | 1 |
| B | Kerala | 10.9 | 10.9 | 13.75 | 1.25 | 1 |
| B | Punjab | 11.2 | 11.2 | 13.75 | 1.25 | 1 |
| B | Haryana | 7.8 | 7.8 | 13.75 | 7.5 | 2 |
| B | Uttar Pradesh (W) | 17.9 | 17.9 | 13.75 | 12.5 | 3 |
| B | Uttar Pradesh (E) | 12.7 | 12.7 | 13.75 | 11.25 | 3 |
| B | Rajasthan | 11.2 | No Sale | 13.75 | 0 | 0 |
| B | Madhya Pradesh | 9.0 | 9.0 | 13.75 | 7.5 | 2 |
| B | West Bengal | 4.3 | 4.3 | 13.75 | 8.75 | 2 |
| C | Himachal Pradesh | 1.3 | 1.3 | 13.75 | 1.25 | 1 |
| C | Bihar | 7.1 | 7.7 | 13.75 | 13.75 | 4 |
| C | Orissa | 3.4 | 3.4 | 13.75 | 7.5 | 2 |
| C | Assam | 1.4 | 1.4 | 13.75 | 8.75 | 3 |
| C | North East | 1.5 | 1.5 | 13.75 | 7.5 | 2 |
| C | Jammu & Kashmir | 1.1 | 1.1 | 13.75 | 7.5 | 2 |
| **Total**  | **583.3** | **1735.2** | **295** | **127.5** | **35** |

**Auction of Spectrum held in March, 2013**

1. In March 2013, the Government decided to conduct another round of auction. This time the spectrum in 900 MHz band in 4 metros where licence renewal is due in 2014, 1800 MHz in 4 Licenced Service Areas (LSAs) where spectrum could not be sold in the last auction and 800 MHz band in all LSAs was put for auction with reduced reserve prices. The Government decided that the reserve price for 1800 MHz band in the service areas of Delhi, Mumbai, Karnataka and Rajasthan be reduced by 30 percent from the previous reserve price and the reserve price for 900 MHz spectrum in Delhi and Mumbai be twice such revised reserve price for the 1800 MHz band and the reserve price for 900 MHz spectrum in Kolkata be twice the price obtained for the 1800 MHz band spectrum for this LSA in the auction held in November 2012. The Government also decided that the reserve price for 800 MHz band spectrum in all LSAs be reduced by 50 percent from the previous reserve price of US$ 3033 mn per 2x5 MHz (US$ 1517 mn per 2x5 MHz).
2. This time there was no bidder in the 900 MHz band and 1800 MHz band. In the 800 MHz band, M/s Sistema Shyam Tele-Services Limited (SSTL) was the sole applicant and it obtained 2x3.75 MHz of spectrum in 800 MHz band in eight (8) LSAs, all at the reserve price. LSA wise details of reserve prices and auction discovered prices are shown in table below.

**Table 2.4**

**Auctions held in March 2013**

|  |  |  |
| --- | --- | --- |
|  | **Auction Reserve prices per MHz (paired)**  | **Winning Price per MHz block (paired+**  |
| **LSA** | **1800 MHz Band**  | **900 MHz Band** | **800 MHz Band** | **1800 MHz Band**  | **900 MHz Band** | **800 MHz Band** |
|  | **US$ (in mn)** | **US$ (in mn)** | **US$ (in mn)** | **US$ (in mn)** | **US$ (in mn)** | **US$ (in mn)** |
| Delhi | 64.7 | 129.4 | 60.1 | No Sale | No Sale | 60.1 |
| Mumbai | 63.3 | 126.6 | 58.8 | No Sale | No Sale | No Sale |
| Kolkata |   | 30.3 | 9.9 |   | No Sale | 9.9 |
| Maharashtra |   |   | 22.8 |   |   | No Sale |
| Gujarat |   |   | 19.5 |   |   | 19.5 |
| Andhra Pradesh |   |   | 24.9 |   |   | No Sale |
| Karnataka | 30.8 |   | 28.6 |   |   | 28.6 |
| Tamil Nadu |   |   | 26.5 |   |   | 26.5 |
| Kerala |   |   | 5.7 |   |   | 5.7 |
| Assam |   |   | 0.8 | No Sale |   | No Sale |
| Punjab |   |   | 5.8 |   |   | No Sale |
| Haryana |   |   | 4 |   |   | No Sale |
| Uttar Pradesh (E) |   |   | 6.6 |   |   | No Sale |
| Uttar Pradesh (W) |   |   | 9.3 |   |   | 9.3 |
| Rajasthan | 6.3 |   |   |   |   |   |
| Madhya Pradesh |   |   | 4.7 | No Sale |   | No Sale |
| West Bengal |   |   | 2.2 |   |   | 2.2 |
| Himachal Pradesh |   |   | 0.7 |   |   | No Sale |
| Bihar |   |   | 3.7 |   |   | No sale |
| Orissa |   |   | 1.8 |   |   | No Sale |
| North East |   |   | 0.8 |   |   | No Sale |
| Jammu & Kashmir |   |   | 0.5 |   |   | No Sale |
| Total | 165.1 | 286.3 | 297.7 | 0 | 0 | 161.8 |

1. In July 2013, the Department of Telecommunications (DoT) had sought TRAI’s recommendations on applicable reserve price for auction of spectrum in 1800 MHz, 800 MHz and 900 MHz bands. After considering the recommendations dated 9th September 2013, the Government has taken the following important policy decisions:
* The entire available spectrum with the DoT to be put up for auction.
* There will be no reservation of spectrum for the Renewal Licensees in 900 or 1800 MHz bands.
* **Spectrum trading** should be permitted in the country. Initially, only outright transfer of spectrum should be permitted.
* **Spectrum usage charge (SUC)** for spectrum acquired through current auction will be charged at 5% of Adjusted Gross Revenue. There is no change in the existing slab rate of Spectrum usage charges for the Licensees who do not acquire spectrum through current auction. In cases of combination of existing spectrum in 900 MHz and 1800 MHz bands and spectrum acquired through current auction, the weighted average will apply to both the spectrum held by the operator.
* The pan-India reserve price of the spectrum was reduced by around 50% in the 1800 MHz band. Similarly, the reserve price for the 900 MHz band for the three metros, where it was being pit up for auction, was reduced by an average of more than 50%. Details of the reduction of the reserve price is given below:

**Table 2.5**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Cat** | **Circle** |  **1800 MHz Band Reserve Price per MHz (paired)** | **900 MHz Band Reserve Price per MHz( paired)** | **% Reduction in 1800 Reserve Price** | **% Reduction in 900 Reserve Price** |
|  |  | **US$ (in mn)** | **US$ (in mn)** |   |   |
| Metro | Delhi | 37 | 60 | 7.3 | 10.5 |
| Metro | Mumbai | 35 | 55 | 7.6 | 10.9 |
| Metro | Kolkata | 12 | 21 | 3.3 | 7.5 |
| A | Maharashtra | 29 |   | 3.0 |   |
| A | Gujarat | 24 |   | 3.4 |   |
| A | AP | 27 |   | 4.8 |   |
| A | Karnataka | 26 |   | 2.7 |   |
| A | Tamil Nadu | 35 |   | 2.5 |   |
| B | Kerala | 9 |   | 0.1 |   |
| B | Punjab | 9 |   | -0.1 |   |
| B | Haryana | 5 |   | 4.6 |   |
| B | UP(W) | 10 |   | 4.6 |   |
| B | UP(E) | 10 |   | 0.0 |   |
| B | Rajasthan | 4 |   | 5.1 |   |
| B | MP | 7 |   | 0.1 |   |
| B | West Bengal | 4 |   | -0.3 |   |
| C | HP | 1 |   | 0.6 |   |
| C | Bihar | 6 |   | -1.5 |   |
| C | Orissa | 3 |   | 0.2 |   |
| C | Assam | 1 |   | -0.2 |   |
| C | North East | 1 |   | 0.2 |   |
| C | J&K | 1 |   | 0.2 |   |
| **Total**  | **294** | **136** | **53.1** | **52.7** |

1. The auctions were held in the February 2014. After two nearly failed or not so successful auctions, these auctions were very successful in terms of the quantum of spectrum sold and the revenue generated to the Government. The government raised Rs 612bn (around US$10bn) after 68 bidding rounds. During the 10-day auction, eight telecom companies competed for 20-year spectrum licences in the 1800 MHz band pan-India and the 900 MHz band in three key cities of Mumbai, Delhi and Kolkata. Eight companies participated in the auction: Bharti, Vodafone, Idea Cellular, Reliance Jio, Aircel, Tata Teleservices, Telewings (Uninor) and Reliance Communications.
2. The winning price for pan-India 1800 MHz spectrum was also 29% higher than the reserve price whereas prices in the 900 MHz band were 84% higher prices than the reserve price and 2.3 times the price of 1800 MHz spectrum in those circles.
3. India’s three large telcos Bharti Airtel, Vodafone and also Idea had compelling reason to bid aggressively. Many of their existing telecom licences will begin to expire starting November 2014, meaning that companies will have to surrender the spectrum they had received bundled with those licences. Bharti’s and Vodafone’s original licences in Delhi, Mumbai and Kolkata expire in November 2014, when they must return to the government spectrum they hold within the 900 MHz band. Since the government refused to reserve spectrum for them, they had little choice but to bid aggressively, or risk losing spectrum altogether, a disastrous outcome for their existing businesses. Other companies (e.g. Idea) whose licences are due to expire in near future, also obtained spectrum in the 1800 MHz band. There was one new entrant (Reliance Jio) in these bands, which was having only 2300 MHz spectrum in all the LSAs. It opted to acquire spectrum in 1800 MHz band in 14 LSAs in these auction.

**Table 2.6**

**Outcome of Auctions held in February 2014-1800 MHz Band**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cat** | **Circle** | **Quantum of spectrum put to auction in 1800 MHz band** | **Total Spectrum Sold in 1800** | **Winning Price per MHz (1800)** | **% Increase from Reserve Price (1800)** | **Total Cost in 1800** |
|  |  | **In MHz** | **MHz** | **US$ mn** |   | **US$ mn** |
| Metro | Delhi | 22.8 | 21 | 60.7 | 66% | 1274.0 |
| Metro | Mumbai | 25.2 | 23.4 | 45.3 | 31% | 1060.8 |
| Metro | Kolkata | 26.8 | 18 | 12.2 | 0% | 219.0 |
| A | Maharashtra | 14 | 14 | 48.4 | 68% | 677.5 |
| A | Gujarat | 12 | 12 | 39.6 | 66% | 475.6 |
| A | AP | 22.6 | 22.6 | 27.2 | 0% | 614.0 |
| A | Karnataka | 24.6 | 23.8 | 25.8 | 0% | 614.8 |
| A | Tamil Nadu | 30.2 | 11.2 | 34.7 | 0% | 388.3 |
| B | Kerala | 28 | 27 | 8.7 | 0% | 234.0 |
| B | Punjab | 18.4 | 16.8 | 9.0 | 0% | 151.2 |
| B | Haryana | 16.4 | 8.4 | 4.5 | 0% | 37.8 |
| B | UP(W) | 2.4 | 2 | 15.8 | 53% | 31.7 |
| B | UP(E) | 9.8 | 7.6 | 10.7 | 5% | 81.1 |
| B | Rajasthan | 20.8 | 10.6 | 4.3 | 0% | 45.9 |
| B | MP | 19.2 | 19.2 | 8.4 | 17% | 161.3 |
| B | West Bengal | 13 | 11.2 | 4.1 | 17% | 45.9 |
| C | HP | 20.4 | 10.2 | 1.0 | 0% | 10.2 |
| C | Bihar | 4.2 | 2.2 | 7.2 | 16% | 15.8 |
| C | Orissa | 28 | 10 | 2.7 | 0% | 26.7 |
| C | Assam | 11.4 | 11.4 | 6.0 | 416% | 68.6 |
| C | North East | 26.8 | 20.2 | 1.2 | 0% | 23.6 |
| C | J&K | 6.2 | 4.4 | 1.0 | 22% | 4.5 |
| **Total**  | **403** | **307** | **378.4** | **52%** | **6262.1** |

**Table 2.7**

**Outcome of Auctions held in February 2014-900 MHz Band**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Cat** | **Circle** | **Quantum of spectrum put to auction in 900 MHz band** | **Total Spectrum Sold in 900** | **Winning Price per MHz (900)** | **% Increase from Reserve Price (900)** | **Total Cost** |
|  |  | **In MHz** | **MHz** | **US$ in mn** |  | **US$ in mn** |
| Metro | Delhi | 16 | 16 | 123.5 | 106% | 1975.9 |
| Metro | Mumbai | 16 | 16 | 93.8 | 72% | 1501.6 |
| Metro | Kolkata | 14 | 14 | 32.4 | 56% | 454.1 |
|  **Total** | **46** | **46** | **249.8** | **131%** | **3931.6** |

# CHAPTER-III: MARKET BASED SPECTRUM MECHANISM-OTHER DIMENSIONS

1. The auction provides a transparent and efficient mechanism for the initial assignment of spectrum resources. However, the spectrum is assigned for a long duration. There are many factors which help in ensuring that not only the initial spectrum assignment is efficient but the spectrum is put to efficient and optimal use throughout the licence period. These factors viz. liberalised use of spectrum, spectrum trading and spectrum sharing have been discussed in this chapter one by one.
2. **LIBERALISED USE OF SPECTRUM**
3. Liberalisation of spectrum refers to the removal of technology restrictions to give the licensee an option to deploy latest and more spectrum efficient technologies, which shall result in optimal use of spectrum. Change of use (also known as service neutrality) allows different types of services and technologies to compete for the same spectrum.
4. In the 1990s, during the evolution phase of 2G mobile communication, spectrum was assigned mainly using command and control approach. The use of spectrum was restricted to using a particular technology. Over a period of time, the use of 900 and 1800 MHz bands has been liberalized in many countries.
5. In Europe, until the latter part of 2009, 900 MHz band could only be used for the provision of GSM mobile telephony services – i.e. 2G comprising traditional voice and text services and 2.5G comprising limited data services. In the third quarter of 2009, two pieces of legislation were adopted at a European level which provided for liberalisation of the 900MHz band and harmonisation of the 900 and 1800 MHz frequency bands. As a result, it is now possible to introduce other terrestrial systems capable of providing electronic communications services that can co-exist with GSM systems in the 900 MHz and 1800 MHz bands. These pieces of legislation are:
6. European Directive 2009/114/EC, adopted on 16 September 2009, which amended the existing GSM Directive and removed the exclusive reservation of the 900 MHz band for GSM services (GSM Amendment Directive); and
7. European Commission Decision on the harmonisation of the 900 MHz and 1800 MHz frequency bands for terrestrial systems capable of providing pan-European electronic communications services in the Community (2009/766/EC), adopted on 16 October 2009, which sets out the technical harmonisation measures for the introduction of other terrestrial systems capable of providing electronic communications services that can co-exist with GSM systems in the 900 MHz and 1800 MHz bands (the EC Decision on the 900 and 1800 MHz bands)
8. The spectrum liberalisation/refarming poses quite a few challenges for the operators, particularly in the transition phase There can be many alternative approaches, like
9. Reshuffling/Redistribution of spectrum: GSM channels are 200 kHz, UMTS/HSPA channels are 5 MHz, LTE is standardized with different channel width including 5, 10 and 20 MHz.
10. Withdrawing and re-assigning spectrum: Some countries have considered withdrawal of GSM licenses (partly/wholly) for re-planning the frequency bands and then issue licenses that make deployment of UMTS/HSPA and/or LTE possible
11. Some of the country specific cases, which have adopted different approaches for the liberalization of the spectrum in the 900/1800 MHz band, have been discussed below.

**Denmark**[[2]](#footnote-2)

1. In line with the European decision to amend the GSM Directive, in which the 900 MHz frequency band was made service and technology neutral, the National IT- and Telecom Agency (NITA) decided that it was necessary to refarm the 900 MHz and 1800 MHz frequency bands to comply with the competitive challenges derived from the amendment. The Danish refarming process consisted of redistribution of spectrum to accommodate new entry licensees in both bands, reshuffling of existing licensees meaning all operators had to spectrally move their current operations, lifting technology restrictions and adjusting to a more technology neutral approach to license design and adjusting expiry dates of existing licenses. The process freed 2 x 5 MHz in 900 MHz band and 2x10 MHz in 1800 MHz band for the benefit of a new entrant from 1 January 2011.
2. Prior to the refarming, almost all the spectrum in the two bands was licensed to Denmark's three GSM operators: TDC, Telia and Telenor. Since a UMTS operator without licenses in the two frequency bands (Hi3G) had expressed an interest in these bands once the frequency band was made service and technology neutral, NITA deemed it necessary to ensure, that the competition on the market for mobile communication was not distorted.
3. In the redistribution of the spectrum in the 900 MHz band, the total bandwidth of the operators TDC and Telenor were increased by 2x0.2 MHz each, while Telia’s bandwidth was reduced leaving the three existing licensees with 2x9 MHz contiguous bandwidth, 2x9 MHz contiguous bandwidth and 2x11.8 MHz contiguous bandwidth respectively. All existing licensees were spectrally moved. NITA decided to remove existing guard bands between licensees (but not guard bands at the edges of the 900 MHz band). Before refarming, a total of 2x2.6 MHz bandwidth was used for guard-bands, while the re-planning of the band reduced bandwidth used for guard-bands to 2 x 0.2 MHz. Thus a block of 2 x 5 MHz contiguous spectrum in 900 MHz band was released for award to a new licensee by an auction. The licensees were given one year time period for the required spectral moving of their operations.
4. Coverage Requirements and obligations were amended so that existing licensees now were permitted to use any technologies including GSM to fulfil its obligations.
5. The licence of the new entrant as a result of freed up spectrum (2 x 5 MHz) is expected to run until the end of 2034. Existing licenses were expiring in 2011 or 2012 prior to the refarming decision but NITA did prolong and synchronize the duration so that all existing licenses now expire by end of 2019 and NITA made it clear that there will be no renewals and only new awards when prolonged licenses expire by end 2019. In 2019, new licenses will be handed out either by a beauty contest or an auction, with a licence term of an expected 15 years, until the end of 2034. Thereby the licence terms of these licences will be synchronized with the new entrant's licence terms.
6. It was decided by NITA that only after 1 May 2011, existing licensees can use the 900 MHz band for deployment of other technologies that can co‐exist with GSM. This was done with the intention of creating competitive playing level field for all licensees. By Dec 2010, new licence would be awarded and the new licensee would also get approx. 6 months time to start commercial operations simultaneously along with existing operators. In the similar fashion, 2x10 MHz spectrum was freed in the 1800 MHz band for a new entrant.
7. **Auction**[[3]](#footnote-3): On 8 September 2010, the Danish National IT and Telecom Agency published the dates for the upcoming auctions on frequencies in the 900 MHz and 1800 MHz frequency bands.
The auctions were planned to be held as online auctions on 20 October 2010 and 25 October 2010 respectively.
8. In order to prevent potential distortion of competition in the mobile markets concerned, the mobile service providers already holding licenses in the 900 MHz and 1800 MHz frequency bands were excluded from participating in the upcoming auctions.  On 18 October 2010, the licenses were issued to Hi3G.

**Sweden**

**Refarming of 900 MHz band**[[4]](#footnote-4)

1. In May 2011, the Post and Telecom Authority (PTS), Sweden, implemented the refarming of 900 MHz band along with the process of renewing incumbents licenses, expanding the 900 MHz mobile band from 2x30 MHz to 2x35 MHz, assigning additional bandwidth for incumbents, introducing a new 900 MHz band licensee via a process of transferring part of spectrum held by incumbents to the new licensee via a trading arrangement approved by and lifting the GSM only restrictions simultaneously for all five 900 MHz band licensees[[5]](#footnote-5).
2. Prior to refarming, there were 4 mobile operators in 900 MHz band (880-915 MHz/925-960 MHz); Swefour, Tele2, Telenor and TeliaSonera. Tele2, Telenor and TeliaSonera were each assigned 2x7.2 MHz, and Swefour 2x6.8 MHz. All licences, with the exception of Swefour's licence were due for expiry on 31 December 2010. Swefour's licence had validity till 31 May 2017, although the frequency assignment was to expire earlier, on 31 December 2010. There are 3 UMTS operators in 2.1 GHz band. HI3G, Svenska UMTS Licens AB (TeliaSonera and Tele2) and Telenor. Therefore, HI3G was the only licensee having spectrum in 2.1 GHz band, but no spectrum in 900 MHz band.
3. On 20 November 2008, all 4 incumbents of 900 MHz band (Swefour, Tele2, Telenor, TeliaSonera) and HI3G jointly applied to PTS for license renewal for the four incumbents having 900 MHz spectrum and an arrangement on partial trading of usage rights to be able to introduce the fifth licensee (ie HI3G) in the 900 MHz band.
4. The joint application was submitted specifically for extending the term of validity for the incumbent 4 operators' licences for the use of radio transmitters in the 900 MHz band up to 31 December 2025 with the distribution of spectrum as per details given below:

 Tele2 : 2 x 10 MHz

 Telenor : 2 x 10 MHz

 Swefour : 2 x 5 MHz

 TeliaSonera : 2 x 10 MHz.

1. Their justification was that GSM networks in Sweden basically cover the entire country and consequently have very extensive area coverage. The migration of subscribers to the licence holders' UMTS networks, in relevant cases, will be far from complete by the end of 2010. Also, the companies would be adversely affected by substantial operational and financial problems if these licences were not extended. They also requested PTS to make their licences technology- and service-neutral in line with the European Commission's statements.
2. Furthermore, Telenor, Tele2 and HI3G also requested that PTS allows Telenor and Tele2 to transfer the 2 x 2.5 MHz each to HI3G and that a licence is issued to HI3G. If HI3G gains access to frequencies in the 900 MHz band, this would eliminate the risk of the competitive disadvantages.
3. PTS concluded that continued use for securing GSM services being offered and renewing the incumbents licenses were the most efficient use of the 900 MHz band resources. Also, need for continuing the provision of GSM services was considered very important to the Swedish society and its consumers. Therefore, renewal of the licenses and assignment of some additional bandwidth was granted. Assignment of some additional bandwidth was possible after the band was expanded from 2x30 MHz to 2x35 MHz.
4. The first phase of the Swedish 900 MHz band restructuring process was about renewing incumbent’s licenses and granting them some additional bandwidth. The second phase of the restructuring process was about two incumbent operators each transferring 2x2.5 MHz of spectrum to the mobile operator without access to 900 MHz band spectrum. HI3G became the fifth 900 MHz band licensee controlling 2x5 MHz of bandwidth through the secondary market transaction. In the process of reconfiguring the 2x35 MHz 900 MHz band, all four incumbents had to move spectrally and consequently engage in adjusting their existing networks etc. The third phase of the restructuring process was to lift the GSM technology restrictions simultaneously when the reconfiguration of the band was finalized.

**Ireland**

1. Irish Regulator ComReg conducted a multi-band spectrum auction in 2012. This auction awarded spectrum rights in 900 MHz, 1800 MHz) and in the 800 MHz band.
2. The core proposition followed was not to make any administrative assignment to incumbents of 900/1800MHz on expiry of their licences or to new entrant, but all the spectrum held by them was put up for auction. Two of these three spectrum bands (900 MHz and 1800 MHz) are used for providing the 2G mobile services); the third band (800 MHz) was used for broadcasting analogue terrestrial signals. After the auction, the licensees are free to launch any technology.
3. The Award Process includes an “early liberalisation option” whereby an existing GSM licensee has the option to surrender their 2G licences before their expiry and take part in auction and thus getting the opportunity to getting liberalised spectrum instead of 2G restricted spectrum. In case, these licensees fail to acquire spectrum through the auction, they will be allowed to hold their spectrum but its use will be restricted to 2G only. For this purpose, a concept of ‘Party-specific Lots’ has been introduced in the auction which refer to the lots which can be acquired by the existing licensees opting for “early liberalisation option.”

**UK**

1. In their February 2009 consultation, OFCOM said that they believed that liberalisation of the 900MHz and 1800MHz spectrum had the potential to bring significant benefits to consumers but they were also concerned that liberalisation of the 900MHz spectrum in the hands of the incumbent holders could lead to competition issues. To address this risk, OFCOM proposed that O2 and Vodafone release 1 block (2x5 MHz) of 900MHz spectrum in total (i.e. 2x2.5 MHz each) and that this spectrum be awarded to a third party.
2. In the OFCOM’s subsequent assessment, the likelihood and size of a competitive distortion arising out of the liberisation of 900/1800 MHz bands was significantly reduced when it prepared the advice to the Government in October 2010. The most important factor contributing to the change in the perception of OFCOM is the merger between Orange and T-Mobile creating Everything Everywhere (EE) which has the largest amount of 2100 MHz spectrum and access to the largest number of base station sites.
3. Accordingly, 2G licences (900/1800 MHz) were liberalised in the hands of existing licence holders.
4. Our market-led approach to spectrum management was articulated in the 2005 Spectrum Framework Review. In it, we set a series of objectives around the introduction and extension of market mechanisms, including:
5. Regulators in at least 73 countries and territories allow or are considering UMTS900 deployments: Angola, Armenia, Australia, Austria, Belgium, Benin, Bosnia & Herzegovina, Bulgaria, Croatia, Cyprus, Denmark, Dominican Rep, Egypt, Estonia, Faroe Isles, Finland, France, French Guiana, Georgia, Germany, Ghana, Greece, Greenland, Guadeloupe, Hong Kong, Hungary, Iceland, Indonesia, Ireland, Israel, Italy, Japan, Kazakhstan, Kosovo, Kuwait, Latvia, Lithuania, Luxembourg, Macedonia, Malaysia, Malta, Martinique, Mozambique, Netherlands, New Caledonia, New Zealand, Norway, Oman, Papua New Guinea, Paraguay, Philippines, Poland, Portugal, Qatar, Réunion, Romania, Russia, Saudi Arabia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Tanzania, Thailand, Tunisia, Turkey\*, UAE, UK, Ukraine\*, Venezuela (\* = under consideration). As on February 2014, 80 commercial UMTS networks have been deployed in 53 countries and around 1500-2000 UMTS900 user devices have been announced.
6. **SPECTRUM TRADING**
7. Spectrum trading is a mechanism whereby rights and any associated obligations to use spectrum can be transferred from one party to another by way of a market-based exchange for a certain price. In contrast to spectrum re-assignment, in a spectrum trade, the right to use the spectrum is transferred voluntarily by the present user either in full or in part of its total holding in exchange of its monetary value.

### Benefits of Trading

1. While spectrum auctions initially help to achieve an economically efficient allocation of spectrum, spectrum trading seeks to ensure that operators are constantly encouraged to target optimal use of the spectrum because incentive for selling unused spectrum is always available to them. As such, trading is likely to result in more efficient use of spectrum. It can also help in introducing new players, thereby promoting the competition in the market. Spectrum trading may facilitate optimal use of spectrum by way the consolidation of spectrum or by encouraging the licensees to retain the minimum amount of spectrum with it and trade the rest.
2. Secondary trading in spectrum can overcome inefficiencies in the initial allocation of spectrum. Operators will be more willing to invest in spectrum with the knowledge that they have the opportunity to sell the spectrum rights, in case their business models are not successful. It also allows flexibility and speedy re-assignments between users helping the facilitation of new services being launched. In short, spectrum trading may lead to greater competitions provide incentives to innovation, greater certainty to service providers over their rights on spectrum, access to spectrum by those who value it most, greater return to service providers, better/new services being available to consumers at cheaper tariffs, greater choice to consumers, etc. A report on spectrum trading to the European Commission[[6]](#footnote-6) identified four mechanisms through which trading could increase welfare:
* **Direct effects** – incumbents have incentives to put spectrum to the most efficient use or to trade to a party who will.
* **Transparency of opportunity cost** – increased understanding of the value of the spectrum reduces entry barriers, raises awareness of entry opportunities, and helps identify the value of government-held spectrum.
* **Competition** – trading can encourage new entry or expansion.
* **Innovation and shifts in market demand** – changes in market demand or technology can be accommodated with changes in use or user, and this also enhances incentives to innovate.
1. While the benefits of trading are well acknowledged, many regulators are still working through issues involved with practical implementation.

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### Types of Trades

1. ‘**Spectrum transfers**’ is one form of spectrum trading, wherein the ownership of the usage right is transferred to another party. It may necessitate the issuance of a new licence for the operator who has acquired the spectrum. Another form of spectrum trading is ‘**spectrum leases’**, wherein the right to exploit the usage right is transferred to another party for a defined period of time but ownership, including the obligations this imposes, remains with the original rights holder.

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### Various mechanism of Spectrum Trade

1. There are various mechanisms also that can be used to facilitate the trade. These include:
* **Bilateral negotiation**: The seller and (prospective) buyer directly negotiate the terms of the sale and are not subject to any particular constraints set by the regulator.
* **Auctions**: Once a type of auction has been chosen and the rules have been decided primarily by the seller, prospective buyers have the opportunity to acquire the spectrum usage rights by bidding in the auction.
* **Brokerage**: Buyers and sellers employ a broker to negotiate, with their consent, the contractual terms under which the transfer of usage rights can take place.
* **Exchange**: This refers to the establishment of a trading platform, similar to a stock market, where transfers take place according to specific rules.

### Issues that needs to be addressed by the NRAs

1. The success of spectrum trading depends on appropriate institutional framework that precisely determines how rights of use of spectrum are transferred. There are some concerns that need to be addressed through appropriate measures while permitting the spectrum trading. Main regulatory concern is related to competitive issues. By spectrum trading, the spectrum may be concentrated in the hands of few players. Operators may resort to spectrum hoarding in order to restrict the entry of new players. By allowing companies to purchase more spectrum, trading could lead to the acquisition of market power both in the market for a particular type of spectrum, and in a related services. Anti-competitive market behaviour needs to be regulated for successful spectrum trading. Hence, there will be a need to define the conditions including safeguards to check monopolistic practices, duties. There may be other issues such as possibility of too much fragmented spectrum, high transactional cost or interference issues. Therefore, it is necessary to lay down rules of spectrum trading.
2. Spectrum trading needs to be designed to work within the constraints, that current and future international arrangements impose, regarding the harmonised use of spectrum, interference management particularly in the bordering areas and other international commitments.
3. In many countries, allocation of the spectrum is associated with certain obligations on the part of license. These obligations may be related to the roll out of network in the remote areas, primarily with the aim to ensure better coverage to the uncovered areas especially for rural population. In such case, issue for consideration would be whether licensees who have not fulfilled their roll out obligations be permitted spectrum trading. One view may be that unless a licensee transfers the entire spectrum assigned, the unmet roll-out obligations of the seller should continue to hold. Penalties, if any, liable to be paid by the seller prior to the date of the sale will remain payable by the seller. In case of sale of full spectrum holding no further penalties should be imposed on the seller after the date of the sale for unmet roll-out obligation.
4. Trading allows the users to transfer usage rights to other parties whereas Liberalisation provides users with increased flexibility to change technologies and alter their service provision. In the use of spectrum is not liberalised, new users would have to deploy the same type of services and technologies as their predecessors. The advantage is that it will not create any interference concerns for neighbouring users but on the flip side it shall limit their ability to exploit the spectrum. Both trading and liberalisation could potentially involve reconfiguration (redefinition) of existing usage rights, for example, by separating a single licence in two, or amalgamating two licences that are adjacent in terms of geography or frequency. Liberalisation of spectrum use, especially when combined with trading, creates other concerns – for example, harmful interference or possible fragmentation of spectrum allocations – but also offers potentially greater efficiency benefits over time.

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### INTERNATIONAL PRACTICES

1. Spectrum trading has been introduced in Australia, Canada, Guatemala, New Zealand, Norway, USA, UK etc In some other countries, individual spectrum trades have sometimes been allowed after regulatory review. However, the number of countries allowing spectrum licensees to trade spectrum on the secondary market has been steadily rising since 2005, showing that this is an area with great potential for further flexibility and liberalization. As of 2010, 25 of 156 countries responding to the ITU’s survey question[[7]](#footnote-7) on secondary spectrum trading indicated that secondary trading is permissible while six of these countries stated that there may be a change in spectrum use permitted on transfer.

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### EU[[8]](#footnote-8)

**EU Regulatory Framework 2002**

1. Article 9 of the 2002 EU Regulatory Framework, allows Member States to provide for the **transfe**r of spectrum rights subject to certain requirements about the process. Requirements inter-alia include that any transfer to be in accordance with the procedures laid down by the NRAs, transfers that have taken place must be made public, NRAs to ensure that competition is not distorted as a result of any such transaction and where radio frequency use has been harmonised, spectrum trading shall not result in change of use of that radio frequency. Since the introduction of the EC Framework Directive in 2002, most EU countries have subsequently introduced measures that allow full transfers of existing licences, subject to regulatory approval. However, some other regulators, such as Ofcom, have gone further than this, following in the footsteps of pioneer states outside Europe (such as Australia) by initiating mechanisms to permit more complex trades, including reconfiguration of existing licences.

**EU Regulatory Framework 2009**

1. New Article 9b of the Amended Framework Directive permitted to **lease** individual rights to use radio frequencies to other undertakings. Till then, only transfer of rights was permissible. The amendments require Member States to ensure that undertakings may transfer or lease right of use in bands which have been identified. Member States would only be required to “ensure that an undertaking’s intention to transfer rights to use radio frequencies, as well as effective transfer thereof is notified in accordance with national procedures to the competent national authority responsible for granting individual rights of use and is made public”.

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### **United Kingdom**[[9]](#footnote-9)**:**

1. It is possible to transfer all or part of licence rights and associated obligations to another party, referred to as ‘**transfer’**, provided that the licence is in a class covered Wireless Telegraphy (Spectrum Trading) Regulations 2004 as amended. The Trading Regulations set out (i) the licence classes for which spectrum trading is possible, (ii) the types of trading that may be undertaken and (iii) the procedure to be followed. The transfer of Public Wireless Network (PWN) licence rights and obligations is regulated separately by the Wireless Telegraphy (Mobile Spectrum Trading) Regulations 2011. These are broadly similar to the general Trading Regulations but include some provisions specific to PWN trades.
2. **Leasing** is governed by respective licence terms and conditions. A licence-holder may grant leases only if the licence contains the necessary terms and conditions. Leasing is a simpler process. Leaseholder is not granted its own licence but uses the spectrum by virtue of a lease contract with a licence-holder.
3. The trading framework, defined in the trading regulations, permits different types of transaction or ‘modes of trading’:
* **Outright total transfers** - all the rights and obligations under a licence are transferred to a third party;
* **Outright partial transfers** - only some of the rights or obligations are transferred to a third party and the rest remain with the original holder;
* **Concurrent total transfers** - all the licence rights and obligations are transferred to a third party while continuing at the same time to apply also to the original holder; and
* **Concurrent partial transfers** - some of the licence rights and obligations are transferred to a third party while continuing at the same time to apply also to the original holder and the rest of the rights and obligations remain with the original holder.
1. In partial transfers, the rights or obligations may be divided by frequency band, geographical coverage or time. Sub-division by time is not currently allowed under the present Trading Regulations.

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### Australia

1. Under the Radiocommunications Act 1992, there are three types of licences in Australia. **Spectrum licences,** which are initially auctioned, are fully tradable whereas **apparatus licences** which are site, service and technology specific, are transferable. While spectrum licences can be divided and aggregated, apparatus licences are transferred in whole, with no changes to terms and conditions. There are also a number of class licences, which sets out the conditions under which any person is permitted to operate on a shared, un-licensed basis. Class licences are not issued to individual users. As such, trading is not relevant to Class licences.
2. Spectrum licences may be combined or sub-divided to form new licences. However, there are certain technical restrictions specific to spectrum licence trades. A spectrum licence can be sold in whole or in part:  by geographic area and/or bandwidth although they may not be subdivided smaller than a standard trading unit (STU[[10]](#footnote-10)).  STUs are defined by geographical area and radio frequency bandwidth. This is intended to prevent fragmentation of the band. STUs can be stacked horizontally to enable greater coverage, or vertically to provide greater bandwidth. The geographical coverage is constant for all bands, while the frequency bandwidths of STUs vary in size depending on the spectrum band in which licences are issued. Spectrum licences are made up of one or more STUs. Further, each licence must have at least the Minimum Contiguous Bandwidth (MCB). Minimum bandwidths range from 1 MHz to 5 MHz depending on the frequency band.

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### New Zealand[[11]](#footnote-11):

1. New Zealand was the first country in the world to allow secondary trading of radio spectrum. The Radiocommunications Act of 1989 introduced a scheme of tradable spectrum rights. Since 1989, the Government has progressively transferred more frequencies to the market based framework by creating Management Rights for more frequency bands.
2. The Radiocommunications Act 1989 put in place a two-tier market-based mechanism for managing spectrum access:
* **Management Rights**, which are 20 year leases, giving the manager the exclusive right to manage a nationwide band of frequencies. The Government can either retain the Management Right of a particular band or allocate a tradable Management Right to a private entity. Within this band the manager can issue spectrum licences.
* **Spectrum Licences**, which assigns the holder the right to use spectrum within the band specified within a defined area. The range of uses to which spectrum can be put is unlimited, other than by interference constraints.
1. The Radiocommunications Amendment Act 2000 gave government the power to sell or auction management rights. It follows that spectrum management rights may be sold, assigned, leased, transferred and traded, initially by the Crown and subsequently by right holders in secondary markets. It is a matter for the spectrum managers concerned whether or not to trade their rights and, if so, on what basis. There are no restrictions on the activities of operators or on the number of entrants into the market, or specialised licensing requirements. Private management rights cover various spectrum areas including cellular telephone, broadcasting and fixed link services. Managers in these bands are free to issue licences according to their own policies.
2. Management rights are under the protection of limits on frequency emissions from adjacent bands that define the strength of out-of-band emissions. Spectrum licences have unwanted emission limits and maximum permitted interference limits. There are no sector-specific competition rules. Instead, such concerns within the industry are dealt with using general competition law. The New Zealand Register of Frequencies is available online.

****USA:****

1. The Federal Communications Commission (FCC) has been introducing measures to promote secondary markets and gradually moving away from a command and control approach in the direction of flexible use of spectrum, in conjunction with generally liberalized practices. Trades involving the transfer of a whole licence are permitted subject to individual FCC approval.
2. In 2003, FCC introduced new regulations authorising most wireless radio licensees with exclusive rights to their assigned spectrum to enter into spectrum-leasing arrangements. Licensees in the Wireless Radio Services covered may lease some or all of their spectrum usage rights to third parties, for any amount of spectrum and in any geographic area encompassed by the license, and for any period of time within the term of the license. These policies and rules affect both mobile and fixed services, including (but not limited to) cellular, personal communications services (PCS), specialised mobile radio (SMR), local multipoint distribution service (LMDS), fixed microwave, 24GHz and 39GHz. FCC provides parties to spectrum lease transactions through two different approaches based on the scope of the rights and responsibilities to be assumed by the lessee when leasing spectrum. These two approaches are give below:
3. ***“Spectrum manager” leasing****:* Under the “spectrum manager” leasing option, licensees and spectrum lessees may enter into spectrum leasing arrangements without the need for prior Commission approval, provided that licensees retain *de facto* control over the leased spectrum. Under this leasing option, the licensee acts as a “spectrum manager” with regard to the spectrum rights it chooses to lease. Under this option, where spectrum is leased to third parties, the original licensee is responsible for ensuring that interference limits are upheld. In addition, the licensee is responsible for ensuring that the lessee complies with the FCC’s safety guidelines relating to human exposure to radio frequency radiation.
4. ***“De facto transfer” leasing****:* Under this option, licensees and spectrum lessees may enter into spectrum leasing arrangements, in which *de facto* control of the leased spectrum is transferred to the spectrum lessee(s) for the duration of the lease. Policies and procedures under this option differ depending on whether the parties enter into “long-term” arrangements (leases longer than 360 days) or “short-term” arrangements (leases of 360 days or less).
5. Interference issues are dealt with by the FCC, which sets general emissions limits. Licensing information is available online, including maps showing licensee areas and service providers. The private sector provides most of this information: for example, Comsearch maintains a commercial spectrum database.

****Canada**:**

1. Access to the spectrum is gained through one of the four forms of authorization: apparatus licences, spectrum licences, broadcasting certificates and radio operator certificates. Radio operator certificates deal specifically with authorizing persons to operate radio transmitters, whereas broadcast certificates authorize spectrum use related to a broadcasting licence issued by the CRTC.
2. Apparatus Licences represent the traditional form of licensing which generally authorizes the operation of a transmitter or receiver at a particular location. There are 9 apparatus licence types listed in the Radio Regulations withthe licence specifying the category of service including: aeronautical, amateur radio, public information, developmental, fixed, inter-satellite, land mobile, maritime and radio determination. Such licences are issued with technical conditions to manage interference.
3. Spectrum Licences represent the more market-oriented form of licensing in the mixed market/administrative system. They authorize the operation of (non-specified) devices within a defined geography. The geography is be defined by bandwidth, geographic area, and time. Licensees are free to use any type of equipment for any purpose, although they are subject to licence conditions and technical frameworks designed to minimize the risk of interference with other spectrum users. Spectrum licences are transferable and can be divided and aggregated. They are issued for periods of up to 10 year and are generally renewable under certain circumstances.
4. **SPECTRUM SHARING**
5. Implementation of sharing of frequencies varies from relatively simple ways such as geographical separation between users of the same frequencies to very complex ways which are still evolving. Regulators are following diverse approaches to facilitate sharing of spectrum such as allowing in-band sharing/pooling of spectrum, permitting market based spectrum methods such as leasing/trading and promoting use of unlicensed spectrum combined with the use of low power radios and/or advanced radio technologies.
6. Shared networks can provide an answer for TSPs facing very diverse market conditions. For instance, coverage is the primary consideration for radio network deployment in remote or rural areas, and significant CAPEX savings are easily achievable for TSPs if they share the radio access network (RAN). Network roll-out and time-to-market also speed up, since only one set of new sites needs to be acquired and built. Restricted site availability is a big driver for TSPs in urban areas, where sharing sites can be the only feasible way to increase capacity. TSPs can remain competitors in other aspects of their businesses but generate major savings by sharing network resources. It may be difficult for rivals to work together effectively, so setting up a separate joint venture entity is often the favoured solution. Some joint venture partners go further and bring in a neutral third party to deploy and operate the shared network in a managed services deal.
7. Radio Access Network (RAN) and Core Network are the main components of any wireless network. Spectrum is the vital component of RAN. To avoid duplicity of the infrastructure elements, to reduce the cost and to ensure fast rollout of the network, many NRAs allow sharing of infrastructure elements. However, the depth of sharing may differ in different sharing models.
8. If sharing of spectrum is permitted, then both licensees can pool their spectrum and it shall be complete sharing of RAN. It shall result in the most optimal use of spectrum. However, there shall not be individual control of the licenses over the use of their radio resources.
9. There can be another model of sharing of spectrum based on roaming. One operator can ride over the network of another network to give its subscribers the mobile services in the areas where it has not rolled out its network. In such scenarios, it uses the complete network (RAN including spectrum and Core network) of other operator based on roaming agreement between the two.
10. Network sharing agreements may help operators to make the service available and leave operators to compete on more important parameters from a consumer perspective, such as brand, price and customer service. This applies in particular to rural and remote areas. On the flip side, MNOs could collaborate on network development and efficiency may also be lower with fewer networks able to provide high quality mobile broadband services. Regulatory authorities must assess the competitive situation and they may like to aim to ensure that all operators comply with the applicable regulatory obligations, including coverage. Authorities may also wish to distinguish between urban and rural areas when judging network sharing agreements. In particular, authorities that have anticompetitive concerns may choose to limit sharing for a period of time until operators have acquired a substantial customer base in rural areas in order to satisfy their business case. Subsequently, operators may be required to deploy their own network.

**CHAPTER-IV: SATRC COUNRIES PERSPECTIVE AND THE RECOMMENDATIONS**

1. **INDIA**
2. In India, at present spectrum bands shown in the table below are used for providing commercial mobile services. The spectrum in the 800 MHz band has been used for CDMA services whereas the spectrum in the 900 MHz and 1800 MHz band has been used for GSM band. However, spectrum assigned in these bands through auction is liberalised spectrum i.e. the operator may use technology in these bands. The spectrum in the 2100 MHz band is being used for providing 3G services (HSPA) services. The spectrum in the 2300 MHz band is being used for providing high speed wireless services using LTE-TDD technology.

**Table 4.1**

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Spectrum Band** | **Frequency Band (in MHz)** |
| **Uplink** | **Downlink** |
| 1. | 800 MHz Band | 824-844 MHz | 869-889 MHz |
| 2. | 900 MHz Band | 890-915 MHz | 935-960 MHz |
| 3. | 1800 MHz Band | 1710-1785 MHz | 1805-1880 MHz |
| 4. | 2100 MHz Band (‘3G Band’) | 1920-1980 MHz | 2110-2170 MHz |
| 5. | 2300 MHz Band (‘BWA’ band) | 2300-2400 MHz | TDD Duplexing Scheme |

1. The process for the award of Cellular Mobile Telecommunications Services (CMTS) was initiated by the Department of Telecommunications (DoT) for the time in March 1992, when it floated tenders for grant of GSM based cellular mobile telephone service license in four Metropolitan cities of India and as a result, eight (8) CMTS licenses in the four Metros were awarded to private companies in November, 1994 on beauty contest principle. In year 1995, after following competitive bidding process, 34 Cellular Mobile Telephone Service (CMTS) licences were awarded in 18 licence service area. It is worth mentioning here that the country is divided in to 22 licence service areas (LSAs) and separate licences are awarded for each of these LSAs.
2. The government companied (MTNL/BSNL) were given CMTS licence as the third CMTS operator. MTNL, which operates in Delhi and Mumbai, was given CMTS licence in 1997, whereas BSNL, which operates in rest of the country, was given CMTS licence in the year 2000. The fourth cellular operator was chosen through a multi-stage bidding in the year 2001 and licences were issued in 2001/2002. Afterwards, Universal Access Service Licences (UASL)[[12]](#footnote-12) were given in the years 2003, 2004, 2006, 2007 and 2008 following the principle of First Come First Served (FCFS). The Entry Fee discovered in the 2001 auction was applied for all the UAS licences. There was no separate fee for the assignment for the spectrum, which was bundled with the spectrum. Initially, 2x4.4 MHz of 900/1800 spectrum for GSM or 2x2.5 MHz of 800 MHz for CDMA service providers was allotted and subsequently additional spectrum was assigned based on the subscriber linked allocation criteria administratively.
3. The Hon’ble Supreme Court of India found the process of award of licences FCFS as arbitrary and flawed and through its order dated 2nd February 2012, cancelled 122 new licences, which were awarded in the year 2008. Hon’ble court ordered that auction, being the scare natural resource, must be assigned through the process of market based mechanism.

**Table 4.2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Year** | **Licenses** | **Type** | **Allocation Method** | **Remarks** |
| 1994 | 8 (4 Metros) | CMTS | Beauty Parade | 1st and 2nd CMTS operators in Metros |
| 1995-1998 | 34 (18 Non-metro Circles) | CMTS | Single stage auction | 1st and 2nd CMTS operators in non-metro circles. |
| 2001 | All circles | CMTS | Administrative allocation to Government Operators | 3rd CMTS Operator |
| 2001 | 4 (4 Metros) + 13 (Circles) | CMTS | Multi-stage auction | 4th CMTS operator |
| 2004-2007 | 73 | UAS | FCFS. Price determined in auction for 4th CMTS operator |  |
| 2008 | 122 | UAS | FCFS. Price determined in auction for 4th CMTS operator | Hon’ble Supreme Court cancelled these licences in 2012. |

1. In Feb 2012, the DoT announced[[13]](#footnote-13) that in future, the spectrum will not be bundled with the licence. The licence to be issued to telecom operators will be in the nature of a ‘unified licence’ and the licence holder will be free to offer any of the multifarious telecom services. In the event the licence holder would like to offer wireless services, it will have to obtain spectrum through a market-driven process. In future, there will be no concept of contracted spectrum and, therefore, no concept of initial or start-up spectrum. Spectrum will be made available only through a market-driven process**.**
2. Later on, the DoT has conducted auctions in November 2012, March 2013 and February 2014 for the award of spectrum in the 800MHz/900MHz and 1800 MHz. ‘3G Spectrum in 2100 MHz band’ and ‘BWA spectrum in 2300 MHz’ band was assigned through two separate e-Auctions in 2010.
3. The summary of the above discussion is that, in India, there would not be any assignment of spectrum for IMT services through administrative methods, but only market based mechanisms are being followed.

**Liberalised use of Spectrum**

1. In India, spectrum for mobile services has been assigned from different spectrum bands depending upon whether licensee is deploying CDMA or GSM technology. Therefore, the spectrum assigned in 800/900/1800 for 2G mobile services is bound with the technology chosen by the licensee, whereas ITU has assigned the spectrum in the 800, 900 and 1800 MHz bands for IMT applications. However, the spectrum that has been assigned through auctioned in the 900MHz/1800 MHz band is a liberalised spectrum. Also, there has been a provision that a TSP may convert its existing spectrum holding to liberalised form by paying market determined price pro-rated for the remaining licence validity period.

**Spectrum Trading**

1. TRAI in its recommendations on ‘Valuation and Reserve price of Spectrum’ dated 9th September 2013 had recommended that spectrum trading should be permitted in the country. In October 2013, the DoT conveyed its in-principle acceptance of Authority's recommendation to permit spectrum trading in the country. Subsequently, in January 2014, the Authority has finalized its recommendations on ‘Working Guidelines on Spectrum Trading’. The salient features of the recommendations are given below:
* Under spectrum trading, only outright transfer of spectrum is permitted, i.e. the ownership of the usage right is transferred to the buyer. Spectrum leasing is not permitted at this point of time.
* Spectrum trading will not alter the original validity period of spectrum assignment.
* For the present, Spectrum Trading shall be permitted only on a pan-LSA (Licensed Service Area) basis i.e. spectrum cannot be traded for a part of the LSA.
* The seller and the buyer shall be required to inform the Licensor regarding the spectrum trade, 6 weeks prior to the effective date of trade. However, no permission will be required from the Licensor/Government for Spectrum Trading.
* All spectrum bands earmarked for Access Services by the Licensor will be treated as tradable spectrum bands. Currently spectrum in 800MHz, 900MHz, 1800MHz, 2100MHz, 2300MHz and 2500MHz spectrum bands have been allocated for Access Services.
* Only CMTS/UASL/UL (AS)/UL licensees shall be eligible to participate in the spectrum trading. The entire spectrum held by the licensee in a particular spectrum band within an LSA should be tradable i.e. it has either been assigned through an auction in the year 2010 or afterwards, or on which the TSP has already paid the prescribed market value (as decided by the Government from time to time) to the Government.
* A TSP will not be permitted to trade any spectrum in the spectrum band in which it has acquired any spectrum through trading (or auction) for a period of 2 years from the effective date of transfer of spectrum (or effective date of assignment), i.e. TSP is required to hold spectrum for at least two years from the date it acquires the spectrum.
1. These recommendations are under examination of the DoT.

**Spectrum Sharing**

1. In February 2012, the Government had issued the following broad guidelines for the sharing of 2G spectrum (800/900/1800 MHz.
2. Spectrum sharing only within the same licence service area with the prior permission of the licensor. Permission for Spectrum sharing will be given initially for a period of 5 years. Government may renew the permission for a further one term of five years, on terms to be prescribed. Spectrum can be shared only between two spectrum holders both of which are holding spectrum either in 900/1800 MHz band or in 800 MHz band. Total quantum of spectrum, as a result of the spectrum sharing, shall not exceed the limit prescribed in case of mergers of licences. As per the existing guidelines of the merger of licences in a service area, the total spectrum held by the Resultant entity shall not exceed 25% of the spectrum assigned, by way of auction or otherwise, in the concerned service area in case of 900 and 1800 MHz bands. In respect of 800 MHz band, the ceiling will be 10 MHz.
3. In respect of spectrum obtained through auction, spectrum sharing will be permitted only if the auction conditions provide for the same. Parties sharing the spectrum will be deemed to be sharing their entire spectrum for the purpose of charging. Both the parties shall fulfill individually the roll out obligations as well as the QoS obligations prescribed under the licence.
4. Spectrum usage charges will be levied on both the operators individually but on the total spectrum held by both the operators together. In other words, if an operator ‘X’ having 4.4MHz of spectrum shares 4.4 MHz of spectrum of another operator ‘Y’, then both ‘X’ and ‘Y’ will be liable to pay spectrum usage charges applicable to 8.8 MHz of spectrum.
5. Spectrum sharing would involve both the service providers utilising the spectrum. Leasing of spectrum is not permitted. Decision on matters related to pricing of spectrum, post sharing, would be taken separately. Spectrum sharing will not be permitted among licensees having 3G spectrum.
6. In 2014, TRAI has formed a Steering Committee with representatives from the Industry and TRAI to frame the detailed guidelines for sharing of spectrum.

1. **BANGLADESH**
2. Bangladesh Telecommunication Regulatory Commission (BTRC)[[14]](#footnote-14) is the body responsible for the award of licence and the assignment of spectrum. It was established in 2001 under Bangladesh Telecommunication Act, 2001. **The applicant has to** submit **Application for Cellular Mobile Services Operator License to the commission. The Commission decides the eligibility of the** applicant **and also licensing procedure either auction or others. After awarding license, the licensee shall have to obtain separate Radio** **Communications Equipment license for spectrum use from the Commission. For obtaining the licence, the Licensee shall have to apply for frequency to BTRC, which is placed to the Spectrum Management Committee (SMC) for their opinion. The SMC recommends the proposal to the commission. Based on this, the commission takes the final decision. The commission reserves all the rights and sole responsibility of assigning spectrum to the licensee either auction or others.**
3. **As per the BTRC (Licensing Procedure) Regulations, 2004 (as amended from time to time), the new licences for the Cellular Mobile Phone shall be granted through competitive bidding (and/or auction) procedure and the number of such licensee shall be subjected to the availability of the scarce spectrum resource.**
4. ****Assignment of 2G licences**: Bangladesh has followed administrative methods for** the **assignment of 2G licences.** Pacific Bangladesh Telephone Limited (Citycell) got license **for** cellular services in 1989 for 20 years. However, service started commercially in the year 1993 under AMPS technology. Later it converted the technology to CDMA in the year 1999. Grameen Phone along with two other operators Roby Axatia and Banglalink got GSM licenses in the year 1996 for 15 years and started operations in 1997. GSM license to Teletalk (govt. owned company) and Warid were allotted in 2004 and 2005 respectively. At present five operators are providing this second generation mobile service by GSM technology and one operator using CDMA technology.

 **Table 4.3**

**Total Access Frequency Assigned to the Existing Mobile Operators**

| **SL No.** | **Operators** | **Assigned in****800MHz CDMA****Band (MHz)** | **Assigned in****900MHz GSM/****EGSM Band****(MHz)** | **Assigned in****1800MHz****GSM Band****(MHz)** | **Total****Assignment****(MHz)** |
| --- | --- | --- | --- | --- | --- |
| 1. | PBTL | 8.82 |  |  | 8.82 |
| 2. | GP |  | 7.4 | 14.6 | 22.0 |
| 3. | Roby AXIATA |  | 7.4 | 7.4 | 14.8 |
| 4. | OrascomBanglalink |  | 5 | 10 | 15 |
| 5. | Teletalk |  | 5.2 | 10 | 15.2 |
| 6. | Warid |  | 5 | 10 | 15 |

1. **BWA Spectrum (2300 MHz and 2500 MHz band):** BTRC issued Regulatory and licensing guidelines on Broadband Wireless Access (BWA) Services Operator Licenses on 06.08.2008. Total 3 (three) licenses were issued to provide **nationwide** BWA Services in 2.3 GHz and 2.5 GHz spectrum bands through auction. Each licensee was assigned 35 MHz of unpaired spectrum. These licensees were Banglalion Communication Limited and Augere Wireless Broadband (Bangladesh). An additional BWA license (fourth license) was issued to Bangladesh Telecommunications Company Limited (BTCL) in the same terms and conditions including the License Acquisition Fee (fixed by auction) were applicable to the other BWA licensees.
2. ****3G Cellular Mobile Phone Service** (2100 MHz band):** An auction for 3G frequency band 2100 MHz was held on 08 September 2013 and the licenses granted to four telecom companies namely Grameenphone, Robi Axiata, Banglalink and Airtel. Grameenphone purchased 10 megahertz **spectrum** and Banglalink, Robi Axiata, Airtel 5 megahertz each in the 3G auction and 15 MHz spectrum remained unsold.
3. **Infrastructure sharing[[15]](#footnote-15):** The guidelines for sharing of passive infrastructure are issued by BTRC in July 2011. The guidelines are emphasized on sharing of passive infrastructure like building, space, mast, earthing, air-conditioning, in-house wiring, local loop wire etc. The operator shall share its passive infrastructure with other operators on a non discriminatory ‘first come-first serve’ basis.
4. **PAKISTAN**
5. Mobile service in Pakistan was introduced by Paktel with 1st **Generation** technology in 1990 followed by Instaphone[[16]](#footnote-16). The evolution of technology, however, was fast as Mobilink entered the market carrying 2G technology in 1992. The 2G market got extended with the entry of other firms in the industry over the years. By 2005, a number of these companies upgraded their infrastructure to the so-called 2.5 G **that** contained internet connectivity through General Packet Radio Service (GPRS) on mobile phones.



1. Pakistan modernized its regulatory framework for telecommunications in 1996. Pakistan Telecom Authority (PTA) was established as the telecom sector regulator, **and** the Frequency Allocation Board (FAB)[[17]](#footnote-17) was constituted to manage the radio frequency spectrum. After 1996, further changes have occurred in the years 2000, when the Pakistan Telecommunication Rules and Polices came into force.
2. Spectrum was allocated administratively before 2004 and the licensing to mobile companies in Pakistan was free, i.e., no license fees were **charged** from cell companies. But after the telecom deregulation in 2004, it was decided that licenses for 2G services (where demand for spectrum is greater than **supply**) would be auctioned keeping in mind the most effective use of the spectrum as a whole. Hence, in 2004, licenses for 2G services were auctioned, and two new firms -Telenor and Warid – won these licenses at a price of US$ 291 million in 2004. These auctions were carried out by open outcry method[[18]](#footnote-18) and did not carry a base price. After an initial payment of 50 percent of bid price, the spectrum price had to be paid in equal annual installments. Later, the license of Mobilink was also renewed at the price of US$ 291 million in 2007.
3. Pakistan possess a very healthy competition in 2G telecom services with presence of five **telecom** service providers with Mobilink being the market leader has 32.20% market share, U-fone 18.70%, China Mobile Pak (previously known as Paktel) 12.10%, Telenor 24.90% and Warid 13.90%. Current allocation of 2G spectrum is summarized as below:

**Table 4.4**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Company Name** | **Assigned Frequencies/ BW in Pakistan** |
| 1 | China Mobile Pak Limited (Zong) (Also known previously as Paktel) | 882.5-890.1 MHz/927.5-935.1 MHz | (7.6 + 7.6) MHz |
| 1739.7-1745 MHz/1834-1840.7 MHz | (6 + 6) MHz |
| 2 | Pakistan Telecom Mobile Limited (PTML) (U Fone) | 894.9-902.5 MHz/939.9-947.5 MHz | (7.6 + 7.6) MHz |
| 1718.9-1724.9 MHz/1813.9-1819.9 MHz | (6 + 6) MHz |
| 3 | Pakistan Mobile Communication Limited (Mobilink) | 907.3-914.9 MHz/952.3-959.9 MHz | (7.6 + 7.6) MHz |
| 1733.7-1739.7 MHz /1828.7-1834.7 MHz | (6 + 6) MHz |
| 4 | Telenor Pakistan Limited | 902.5-907.3 MHz/947.5-952.3 MHz | (4.8 + 4.8) MHz |
| 1724.9-1733.7 MHz / 1819.9-1828.7 MHz | (8.8 + 8.8) MHz |
| 5 | Warid Telecom Limited | 890-894.8 MHz / 935-939.8 MHz  | (4.8 + 4.8) MHz |
| 1710 – 1718.8 MHz / 1805-1813.8 MHz | (8.8 + 8.8) MHz |

1. Continuing with the agenda of technological advancement, PTA wanted to move ahead with 3G auctions in 2007. However, at that time cellular companies strongly recommended delay in the licensing on the plea of almost nonexistent mobile internet demand, huge investments required for up-gradation of infrastructure and very high base price, which was set at US$ 107 **million**. Therefore, no progress could be made at **this** front. However, in 2011, Government of Pakistan again decided to move ahead with the **technology** neutral spectrum auctions both for enabling the country to reap gains from advancement of mobile technology as well as to fulfill its revenue generation requirements for financing fiscal deficit. According to schedule announced by PTA, the auction had to be held on March 29, 2012 **and** PTA also issued an Information Memorandum, in January 2012, outlining the basic rules and regulations for the auction as given below:
* The new spectrum license tenure will be for a period of 15 years.
* Government has decided to grant three technology neutral Mobile Cellular License/Spectrum through auction in 2100 MHz Band.
* Base Price for the Mobile Cellular license/Spectrum is US$ 210 Million.
* A bidder may bid for a maximum of two blocks.
* Infrastructure sharing shall be considered as a matter of first priority by the Mobile Cellular Operators at the time of roll out. The cellular mobile licensees are required to share infrastructure with other operators as per PTA’s directives.
* Spectrum for Mobile Cellular licenses is expected to be made available in blocks of 9.8 MHz given below. The winner of auction will have choice to select any block of 9.8+9.8 MHz from the available spectrum in 1900/2100MHz. Details of frequency bands expected to be put on auction is given below[[19]](#footnote-19):

**Table 4.5**

|  |  |  |
| --- | --- | --- |
| **Block** | **Frequency**  | **Block Size** |
| A | 1920-1929.8/ 2110-2119.8 MHz | (9.8 + 9.8 MHz) |
| B | 1929.8-1939.6/ 2119.8 -2129.6 MHz | (9.8 + 9.8 MHz) |
| C | 1939.6-1949.4/ 2129.6-2139.4 MHz | (9.8 + 9.8 MHz) |

The auction was, however, postponed later due to procedural changes in the auction exercise.[[20]](#footnote-20)

1. Currently, there is no provision of Spectrum Trading and Spectrum Sharing in Pakistan. However, all Licensees are encouraged to implement infrastructure sharing in accordance with the guidelines issued by PTA and FAB. **Infrastructure** sharing includes a requirement to lease facilities on a non-discriminatory basis, to such other service providers. The facilities provided may include space, electrical power, **air** conditioning, security, cable ducts, space on antenna masts or towers, rooms etc. Infrastructure sharing, including co-location and facility sharing, shall be provided based on the guidelines established by PTA/FAB on the principles of neutrality, non-discrimination, equal access and commercial arrangements.[[21]](#footnote-21)
2. **SRI LANKA**
3. Sri Lanka started reforming its telecommunications in 1980 with the bifurcation of posts and telecom departments of the government. The telecommunication sector in Sri Lanka was initially state-owned and run by the Department of Telecommunications. The first private operator entered the market in 1989, when Celltel (now Etisalat), a mobile operator, was licensed. The Office of the Director General of Telecommunications (ODGT) was established as the regulatory body with the enactment of the Sri Lanka Telecommunications Act No. 25 of 1991. T**hereafter**, the Department of Telecommunications was converted to a state-owned Corporation, the Sri Lanka Telecom Corporation. The liberalization of the telecommunication industry was an important step towards developing the infrastructure to provide the country with a solid platform for economic and social growth. System Operator licenses were also issued to several private operators to provide telecommunication facilities (such as data, mobile and payphone services), paving the way towards deregulation in Sri Lanka. In 1996, the regulator - the Office of the Director General of Telecommunications, became the present Telecommunications Regulatory Commission of Sri Lanka (TRCSL) under the Sri Lanka Telecommunications (Amendment) Act No 27 of 1996.

 **Mobile network operators launch timeline**

**Launch of Hutchinson Telecommunications Lanka**

**Launch of Celltell (now Etisalat)**

**First telecom license issued to Celltell**

**1988**

**1989**

**1993**

**1995**

**2004**

**2006**

**2009**

**2010**

**2013**

**Dialog launches first 4G network in Sri Lanka**

**Dialog launches first 3G network in Sri Lanka**

**Launch of Dialog Axlata**

**Launch of Bharti Airtel Lanka**

**Celltell rebranched from Tigo to Etisalat following acquisition by Etisalat in 2009**

**Launch of Mobitel**

Source: GSMA

1. The Telecommunications Regulatory Commission of Sri Lanka is the national regulatory agency. It regulates most aspects impacting on the sector including the allocation of spectrum (including broadcasting spectrum), tariffs, anti-competitive practices and quality of service. However, it does not have power to issue new licenses to start a telecom **services**. In Sri **Lanka**, this significant activity is done by the office of President.
2. Spectrum in Sri Lanka has generally been bundled with operating licenses and allocated on a first-come first-served basis. Typically, a new operator applies first for a systems license (e.g.in the data or voice categories), and **then** applies for spectrum allocations to the TRC. Telecom licenses in Sri Lanka are given for a period of ten years. Operators do not pay an upfront fee but instead pay an annual fee (generally set **according** to ITU guidelines) for use of the radio frequency. The one exception to this policy took place in April, 2003 when a closed auction was held among the four cellular players for additional spectrum in the 1800 MHz range. But only two operators participated in the bidding process. As a result, only these operators were awarded 7.5 MHz in the 1800 MHz band. The bidders paid only slightly above the minimum floor price set by the TRC.
3. As per the guidelines and procedures for issuing, renewal and modification of licenses under the Sri Lanka Telecommunications Act, No. 25 of 1991 as amended dated 10th March, 2006[[22]](#footnote-22), it was stated that the allocation and use of limited resources should be carried out in an objective, fairly, transparent and non-discriminatory manner. These guidelines require an auction to be conducted for all the applicants whose applications for license are successfully evaluated.
4. Telecommunications services in Sri Lanka are competitive, with eight operators in the country making retail offerings at the time of writing. Sri Lanka Telecom (SLT) is the partially privatized incumbent (government owns 52%, Global Telecommunications Holdings N.V of Netherlands owns 44.9% and the general public owns the rest), and the only firm with a copper access network to reach homes and businesses. Of the five mobile operators, four (Dialog Axiata, Etisalat, Airtel and Hutch) are private companies that are part of large international or regional telecom operators, and one (Mobitel) is a fully owned subsidiary of the incumbent SLT. Two other operators (Suntel and Lanka Bell) primarily provide CDMA based (fixed-wireless) telecommunications services. Dialog Axiata is the market leader having one-third market share in the market.
5. Details of the service providers and their spectrum holdings are given below:-

**Table 4.6**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Name of Telecom Service Provider** | **Technology** | **900 MHz**  | **1800 MHz** | **2100 MHz Band** |
| Sri Lanka Telecom (SLT) also known by the name (Mobitel) | GSM/ W-CDMA/ LTE | 7.5 MHz | LTE- 10 MHzGSM -10 MHz | 15 MHz; |
| Dialog Axiata | GSM/ WCDMA/ LTE | 7.5 MHz | LTE – 10 MHzGSM-15 MHz | 15 MHz |
| Hutchison | GSM/ WCDMA | 7.5 MHz | GSM-7.5 MHz | 10 MHz |
| Etisalat (previously known as Celltel) | GSM/ W-CDMA | 7.5 MHz | GSM-7.5 MHz | 10 MHz |
| Airtel | GSM/ W-CDMA | 5 MHz | GSM-7.5 MHz | 10 MHz |

Source: TRCSL, ITU (Strategies for the promotion of broadband services and infrastructure: a case study on Sri Lanka September 2012)

1. The Sri Lankan **regulator** was one of the first in the Asian region to make 3G spectrum available in 2100 MHz Band back in 2004 when it authorized its use for testing. By 2006, this spectrum was allocated administratively for **commercial** use to all operators at a charge of around USD 5 million. Not only was 3G spectrum made available at the time, but was thereafter available to any operator who paid the same price. This eliminated ―land-grab type behavior that would have been otherwise created by a one-off spectrum auction and enabled operators to enter the 3G market when it made most sense to them – based on their assessment of trade-offs between early entry vs. waiting for the right time in their capital investment cycle. Though the government arguably lost potential income through this allocation method, it did make spectrum available on a non-discriminatory basis to all operators, and at a relatively low price. Once the primary barrier to mobile broadband investment was removed (i.e. spectrum was made available), operators were quick to invest. Dialog launched South Asia’s first commercial 3G network in 2006 and other four Sri Lankan mobile operators followed the suit. This created a stiff competition among telecom service providers.
2. In 2010 mobile operators requested for the assignment of 700MHz frequency band for Long-Term Evolution (LTE) technology. However, this band was being used by TV broadcasters and could be made available only after TV broadcasting is digitalized. Instead of 700MHz band, a 20MHz slot was allocated in the 2.6 GHz band to each operator for trial LTE Networks. According to the operators, tests were successful and some operators are testing further in the 1800MHz band already allocated to them.
3. **NEPAL**
4. Nepal Telecommunications Authority (NTA) as an autonomous regulatory body was established on March 4, 1998 as stipulated within the framework of the Telecommunication Act 1997 and Telecommunication Regulation 1998 to regulate the telecom sector.[[23]](#footnote-23) There are two main acts that regulate radio frequency spectrum in Nepal. These are the Telecommunications Act 1997 and the Radio Act 1957. The current operating licences for telecommunication services are issued according to the Telecommunications Act 1997 as amended by the **Amendment** Act 2007 and the Telecommunications Amendment Act 2008. The licenses are allocated administratively and on the basis of recommendations made by NTA to the His Majesty’s government for a period of 10 years. The Radio Act, 1957 provides information regarding control and **regulation** of activities of holding, making and using “radio machines (radio equipments)” in Nepal, however this act does not provide deliberate information regarding spectrum allocation. The Telecommunication Act provides provisions for the creation of the Radio Frequency Policy Determination Committee. Its purpose is to determine policy relating to radio frequencies and spectrum allocation. [[24]](#footnote-24)
5. Until the partial deregulation of the telecommunications sector in the early 2000s, government-owned Nepal Telecom was the nation’s sole service provider. Subsequently, private operators were allowed in Mobile. Ssince 2010, a number of new participants have emerged in the mobile services market. Ncell, the nation’s largest GSM network operator, now provides 3G services using the 2100 MHz band to all main urban areas in Nepal. In addition, some there are some regional operators provide telephony in rural areas; they are Gramintel (STM), United Telecom Limited (UTL), Nepal Satellite Telecom Private Limited (NSTPL) and Smart Telecom Private Limited STSPL. Spectrum holdings of these operators along with technology details are given in following table:

**Table 4.7**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Licensee** | **CDMA 800** | **GSM 900** | **GSM 1800** | **CDMA 1900** | **3G 2100** | **Total MHz** |
| **Nepal Telecom** | 2x8 MHz | 2x7.2 MHz2x2.4 MHz | 2x8 MHz2x6 MHz | - | 2x10 MHz | 52.6 |
| **STSPL** | - | 2x2.4 MHz2x0.6 MHz | - | - | - | 3 |
| **UTL** | 2x3 MHz2x1.25 MHz | - | - | 2x1.25 MHz | - | 5.5 |
| **NSTPL** | - | 2x4.4 MHz | 2x9 MHz | - | - | 13.4 |
| **STM** | - | 2x2.4 MHz | - | - | - | 2.4 |
| **Ncell** | - | 2x6 MHz2x2 MHz | 2x9 MHz2x2 MHz | - | 2x10 MHz | 29 |

1. In 2012, the Radio Frequency Policy Determination Committee formulated and brought into force Radio Frequency (Assignment and Pricing) related Policy of Telecommunication Service. This policy has promised **very** **important** principles for overall spectrum management. Some of the important principles include-
* auction as a method for determining the spectrum prices and assignment in new bands including 3G,
* technology neutrality while assigning spectrum,
* prohibition on spectrum trading,
* adoption of spectrum refarming based on regional and international best practices to ensure economies of scale,
* spectrum hoarding discouraged by applying higher prices
* spectrum required for migration into unified licensing regime introduced through “basic telephone service” ensured ,
* provision of frequency for emergency telecommunications,
* digital dividend band to be allocated for mobile broadband based on international best practices,
* Spectrum refarming is one of the principles adopted in this policy. It has categorically declared that current 1900 MHz band used for CDMA will be freed to align with the international best practices so that more spectrum will be available in the GSM 1800 and WCDMA 2100 MHz bands. Similarly CDMA 800 MHz and GSM 900 MHz bands will be refarmed in such a way that E-GSM band now being occupied by CDMA 800 MHz band will be made available for GSM 900 MHz band. Similar spectrum refarming will also be done in the digital dividend 700 MHz band.
* spectrum capping introduced as given below:

**Table 4.8**

|  |  |  |
| --- | --- | --- |
| **SL. No.** | **Frequency Band/ Possible Technology** | **Maximum Bandwidth (MHz)** |
| 1 | 800 MHz/CDMA | 2 X 5 |
| 2 | 900 MHz/GSM | 2 X 9.6 |
| 3 | 1800 MHz/GSM | 2 X 15 |
| 4 | 2100 MHz/W-CDMA | 2 X 10 |
| 5 | 2300 MHz/BWA/IMT Advanced | 30 |
| The maximum spectrum limits for 700/ 2600/ 3300 MHz bands are yet to be fixed. |

1. In 2012, “unified service license” regime was introduced. It was brought out as a **measure** for migration of the current licensing regime into a **unified** licensing regime with the objective of creating a level playing field among the existing voice telephony operators licensed under different categories of licenses such as basic, mobile, rural etc.
2. **AFGHANISTAN**
3. Proper investment in telecom **sector** started when the **Interim** Government was established in 2001. In 2003, The Ministry of Communication (MoC) issued 2 GSM licences to two operators which were funded by various International Development **Agencies** and Govt. Of **Afghanistan** for $5 million each. One TSP operated under the brand name Roshan, a consortium led by Aga Khan Fund for Economic Development. The other TSP was Afghan Wireless Communication Company (AWCC), supported by Afghan Ministry of Communication. The MoC implemented a duopoly for GSM Mobile Services for a period of three years which means no other providers of GSM mobile telephony services would be allowed before 2006.[[25]](#footnote-25)
4. In 2005, as the infrastructure was improved several, companies shown interest in telecom sector of Afghanistan. So, MoC decided to auction its next 2 GSM licences. The auction was held in mid 2005 and five non-incumbent operators participated in that auction. Among the participants, four were international. The GSM licence winners were Areeba Afghanistan Limited and Etisalat at a price of $40.1 million. These two licences were issued for 15 years and can be extendable to another 10 years under some certain conditions.
5. The Telecom Regulatory Authority of Afghanistan (ATRA) within the framework of the Ministry of Communications and Information Technology (MCIT) was established according to the Telecommunication Law in 2006. After its establishment, the power of providing licences was given to ATRA instead of MoC.
6. One technology neutral **license** was issued in 2006 by Telecom Regulatory Authority of Afghanistan (ATRA) to Afghan Telecom, whose 100% stakeholder is with Govt. of Afghanistan. By this licence Afghan Telecom was encouraged to roll out wireless local loop (WLL) service.
7. Spectrum is provided bundled with the licence. But if that spectrum is not sufficient enough, the licensee can request to the concerned licensor for **additional** spectrum which can be granted or not depending on the licensor’s decision.[[26]](#footnote-26)
8. In 2011, ATRA invited an international competitive tender for a single nationwide license for the provision of broadband mobile services (3G - higher releases) in the 2100 MHz band, by auction (with a reserve price) for a 10 MHz duplex spectrum resource[[27]](#footnote-27). As the auction was not successful, ATRA **decided** to award 3G licences administratively. Three incumbent TSPs with GSM licences were awarded 3G licence at $25 million.

**Table 4.9**

**Mobile Cellular licence (GSM / CDMA):**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Licensee** | **Issuance of license** | **Technology specified in licence** | **Expiry of license** | **Spectrum band**  | **Uplink**[[28]](#footnote-28) **(MHz)** | **Downlink (MHz)** |
| AWCC | Awarded Administratively in 2003 at $5 million |  GSM | 2018 | P-GSM 900 | 829.2-898.0  | 935.2-943 |
| GSM 1800 | 1730.2-1736  | 1825.2-1831 |
| Administratively in 2012 at $25 million | 3G | NA | 2100 |  |  |
| Roshan | Awarded Administratively in 2003 at $5 million |  GSM | 2018 | P-GSM 900 | 898.4-906.2 | 934-951.2 |
| GSM 1800 | 1742.6-1748.4  | 1837.6-1843.4 |
| Administratively in 2012 at $25 million | 3G | NA | 2100 |  |  |
| MTN (Areeba)  | Awarded by auction in 2005 at $40.1 million |  GSM | 2020 | P-GSM 900 | 906.6-910.6 | 951.6-955.6 |
| GSM 1800 | 1710.2-1719.8 | 1805.2-1814.8 |
| Administratively in 2012 at $25 million | 3G | NA | 2100 |  |  |
| Etisalat | Awarded by auction in 2006 at $40.1 million |  GSM | 2021 | P-GSM 900 | 911-915  | 956-959.8 |
| E-GSM 900 | 880.2-884.2 | 925.2-929.2 |
| GSM 1800 | 1720-1729.8  | 1815.2-1824.8 |
| Afghan Telecom | Awarded Administratively in 2006 |  Technology neutral | 2021 | CDMA 800 |  |  |

1. **IRAN**
2. Historically, cellular mobile network in I.R. of IRAN was started by the only incumbent governmental company with no completion, using GSM technology in 900 MHz band one decade age. After the liberalization of telecom market, the second cell-phone operator introduced to the market in 2005 in 900 MHz and 1800 MHz frequency bands. To home new operator, the governmental operator was forced to release parts of 900 MHz band. Almost same time, the governmental operator sold out in the market and new Regulatory Authority came to existence. Thereafter, spectrum planning was done to enable some additional operators into the market in future.
3. Currently, almost all existing licenses issued for cell-phone and WiMAX networks tailored to certain level of technology in I.R. of IRAN. However, the Authority’s vision is to revise them to be technology-neutral and to issue new licenses with less dependence to technology or brand of technology. In new licensing regime, the spectrum-related restrictions would be limited to in-band and out-of-band emission conditions, just to reduce probability of harmful interference. However, other restrictions may still be retained, such as performance objectives, deliverable services, USO obligations, etc. The licensing regime approaches to be technology-neutral and opens two options for frequency assignments to the operators:
4. Allocate frequency blocks through a competitive procedure if the market has still potential for new comer(s); or
5. Distribute spectrum to the requesting operators, equally, conditioned to acceptance of some enhancements on the content of their owned license including improvement of financial, procedural and technical terms of references.
6. **MALDIVES**
7. In 1997, mobile services were introduced through Dhiraagu, whose major holder is Government of Maldives. Initially offered on AMPS (Advanced Mobile Phone System), GSM based mobile phone services were introduced in 1999. The announcement of **Telecom** Policy in 2001 facilitated the establishment of Telecom Authority of Maldives (TAM) in 2003. It was **authorized** to regulate the telecom sector through a decree, the Maldives Telecom Regulation of 2003.
8. The first and only competitor in the mobile sector entered in February 2005 with the issuance of a mobile license to Wataniya Telecom Maldives. Wataniya was selected administratively among 4 TSPs based on its **proposed** **investment** in new services and fast network rollout plans. Spectrum is allotted bundled with the licence.
9. **BHUTAN**
10. In Bhutan, the first mobile telephone service was launched in 2003 by operator Bhutan **Telecom** Ltd. (BTL). BTL came into existence on 1st July **2000** as a fully state-owned company, with the corporatization of the erstwhile Department of Telecommunications.
11. The first auction for second mobile licence was held in 2007 to introduce another operator in the market. Four companies participated in the auction and the **winner** of the 15 year licence was Tashi group. The licence was given by Bhutan Infocom media Authority (BICMA) which was formerly known as Bhutan Telecommunication Authority. Spectrum is allotted in Bhutan to the operators by BICMA as per request on first come first **serve** basis[[29]](#footnote-29).

# CONCLUSIONS

1. When the mobile services were introduced in the 90’s, there was not much demand of the spectrum. Nobody could have anticipated the phenomenal growth of the mobile all over the world. The value of spectrum is **associated** with its usage. Therefore, with the demand for mobile services, demand for spectrum and its value has also increased manifold. In this environment, administrative method of assignment may not be suitable in the countries where there is a competitive environment and there is sufficient number of Telecom Service Providers (TSPs). Many of the SATRC countries have already adopted the auction mechanism for the award of spectrum. However, there are few countries, where spectrum assignment is still being done through administratively because there are very few operators and there are no more willing companies to enter the market. In such cases, there is no other option but to continue with the existing administrative regime. Introduction of auctions may be considered at a later stage.
2. The auctions, not only provides a transparent means of assignment of spectrum which is scarce resource, but also permit market forces to find out its true valuation. However, it warrants suitable measures to be taken to safeguard market-concentration and to promote competition in the market. E.g. in India, assignment of spectrum is subject to the prescribed spectrum caps i.e. a TSP cannot have more than 50% of the spectrum in a particular band and 25% of the cumulative spectrum assigned to all the TSPs. TSPs have to adhere to the spectrum caps in all the LSAs separately. To promote competition, entry of a new operator may also be encouraged through the auction design.
3. Assignment of spectrum at the time of expiry of the licences may also be done through auction. However, it may put the continuance of services to the subscribers and the investment made by the operators at risk. In India, spectrum assigned to the licences awarded in 1994 was put up for auction in 2014 with no priority given to the incumbent operators. All the incumbent operators could get the spectrum back through auction.
4. When the spectrum is to be assigned through auctions, it is better to unlock the true potential and value of the spectrum. It can be done by attaching minimum possible strings with the use of spectrum and allowing its flexible use. Permitting spectrum trading and sharing will also create a win-win situation for both the Regulators and the operators. Regulators will get the maximum value at the time of auction and the operators will not be tied for the entire licence period and may get an exit opportunity. By this way, spectrum will always be in the hands who value it most. Spectrum sharing will result in the creation of capacities by pooling of spectrum by two or more operators.
5. Changing in the rights assigned with the spectrum may not be feasible mid-way during the currency of licence. Spectrum assignment through auction in new spectrum bands or at the time of renewal of licences could be a opportune time for the introduction of new spectrum policies such as permitting liberalised use of spectrum, spectrum trading and spectrum sharing.
6. There cannot be a solution for each and every country. Therefore, each country may define its own time frame to move forward to the following broad objectives:
* Adoption of auction as a means to assign new spectrum access rights.
* Spectrum trading and leasing as the means for spectrum access rights that are already assigned to change hands.
* Greater licence flexibility (‘liberalisation’) as a principle to enable change of use, wherever possible. This includes the liberalisation of mobile licensees which allowed the deployment of 3G and 4G technologies in all mobile bands and changes to business radio licensing.

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1. TRAI’ recommendations on ‘Auction of Spectrum’ dated 23rd April 2012 [↑](#footnote-ref-1)
2. **900 MHz and 1800 MHz band refarming case study : Denmark** <http://www.gsm.org/documents/Refarming_case_study_Denmark_20111124.pdf> [↑](#footnote-ref-2)
3. <http://en.itst.dk/spectrum-equipment/Auctions-and-calls-for-tenders/900-1800-mhz-auction> [↑](#footnote-ref-3)
4. 900 MHz band refarming case study 29th November 2011 <http://www.gsm.org/documents/Refarming_case_study_Sweden_900_MHz_20111129.pdf> [↑](#footnote-ref-4)
5. <http://www.pts.se/upload/Beslut/Radio/2009/08-12019-decision-900-mhz-march-2009.pdf> [↑](#footnote-ref-5)
6. *Study on conditions and options in introducing secondary trading of radio spectrum in the European Community* available at: <http://www.dotecon.com/publications/secontrad_final.pdf> [↑](#footnote-ref-6)
7. http://www.ictregulationtoolkit.org/en/Section.2094.html [↑](#footnote-ref-7)
8. OFCOM consultation on Simplifying Spectrum Trading ( Sept 2009) [↑](#footnote-ref-8)
9. OFCOM consultation on Simplifying Spectrum Trading ( Sept 2009) [↑](#footnote-ref-9)
10. Standard Trading Unit (STU) is the smallest unit of spectrum for which the ACMA will register a trade. [↑](#footnote-ref-10)
11. [www.rsm.govt.nz](http://www.rsm.govt.nz) [↑](#footnote-ref-11)
12. UASL permits a licensee to offer any access service viz. basic services, mobile services and internet services [↑](#footnote-ref-12)
13. These are in accordance with the TRAI’s recommendations on ‘Spectrum Management and Licensing Framework’ dated 11th May 2010 and 3rd November 2011/ [↑](#footnote-ref-13)
14. http://www.btrc.gov.bd/history-and-vision [↑](#footnote-ref-14)
15. http://www.btrc.gov.bd/sites/default/files/infrastructure\_sharing\_guidelines\_0.pdf [↑](#footnote-ref-15)
16. On January 4, 2008, Pakistan Telecommunication Authority (PTA) terminated the license of Instaphone due to the company’s failure to pay outstanding dues for the license renewal fee they agreed to in April 2005 ($291MM). [↑](#footnote-ref-16)
17. Frequency Allocation Board after receiving applications from PTA \ PEMRA \ Govt. assigns the Radio Frequencies with associated technical parameters for all wireless networks. [↑](#footnote-ref-17)
18. An English auction is a type of auction, whose most typical form is the "open outcry" auction. The auctioneer opens the auction by announcing a Suggested Opening Bid, a starting price or reserve for the item on sale and then accepts increasingly higher bids from the floor consisting of buyers with a possible interest in the item. Unlike sealed bid auctions, "open outcry" auctions are "open" or fully transparent as the identity of all bidders is disclosed to each other during the auction. The highest bidder at any given moment is considered to have the standing bid, which can only be displaced by a higher bid from a competing buyer. If no competing bidder challenges the standing bid within a given time frame, the standing bid becomes the winner, and the item is sold to the highest bidder at a price equal to his or her bid. [↑](#footnote-ref-18)
19. http://telecompk.net/wp-content/uploads/2012/01/Info-Memo-3G4GLTE-License.pdf [↑](#footnote-ref-19)
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21. http://www.itu.int/ITU-D/CDS/gq/Resolution9/pdf/Part-II/reponses/Pakistan.pdf [↑](#footnote-ref-21)
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25. Telecom and ICT policy document by Ministry of Communications, October 2003. [↑](#footnote-ref-25)
26. Licence agreement between ATRA and Etisalat [↑](#footnote-ref-26)
27. http://mcit.gov.af/Content/Post/Attachment/INVITATIONTOBID5102011102134231.pdf [↑](#footnote-ref-27)
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29. Spectrum Management, Bhutan Telecommunications and Broadband Policy 2013. [↑](#footnote-ref-29)