Telecom Regulatory Authority of India

Recommendations

on

Valuation and Reserve Price of Spectrum

9th September, 2013

Foreword

As the Authority commenced the exercise of spectrum pricing for auctions there was a discernible sense of déjà vu. After all, this task was not something new. The feeling of "been there, done it before" ought to have rendered the task easier. However, any sense of déjà vu quickly evaporated in the face of new challenges.

2. Why was the task so much harder this time around? For one, circumstances had radically changed both for the telecom sector and the economy in general. What is more, the atmospherics surrounding the decision-making process had also changed significantly. These exogenous and inexorable changes could not but influence the manner in which the Authority proceeded with the matter. Moreover, given that the Authority had made recommendations on spectrum prices in 2010, 2011 and 2012, it became necessary to reflect on and question the premises on which those conclusions were based. This is never an easy task for any institution. As Lord Keynes observed "*The difficulty lies not in the new ideas, but in escaping from the old ones which ramify.....into every corner of our minds*".

3. It is worthwhile to recall the circumstances in which the Authority made recommendations as well as how decisions on spectrum pricing were taken over the past few years. Since 2010 there has been a steady erosion of public confidence in executive decision-making. This has been a general phenomenon, not confined to the telecom sector and, that was the result of a highly charged atmosphere created by a coincidence of independent events that has radically altered the national mood. Graft in public life became both a topical and recurrent theme. Exaggerated accounts sensationalized by the media exacerbated the already vicious environment. The ability of persons holding public office to take fair decisions in public interest was questioned to the extent that the basic

tenet of presumption of innocence was turned on its head; the preponderant view beamed by segments of the electronic media was a presumption of guilt.

4. The telecom sector was in the eye of this public storm. Members of Parliament and senior officials found themselves behind bars, as did individuals working in the private sector. All this culminated in the February 2012 judgment of the Hon'ble Supreme Court which quashed licenses and called into question the manner in which licenses and spectrum were administratively allocated in 2008. The Authority could not be impervious to these developments.

5. In a sense, our country got carried away with its navel-gazing. The vicious atmosphere of the past two years has led to self-flagellation on a national scale. There is little doubt that this has contributed to despondency in the private sector and adversely impacted the mood of domestic and foreign investors. The processes and outcomes of decision-making became shrouded in doubt and subject to unusually intense scrutiny. The reluctance to grant the benefit of the doubt combined with the ease with which malafide could be attributed (or alleged), nurtured real (and rational) fears about the consequences of decision-making. It is not surprising, therefore, that the response manifested itself as indecision. The lament of industry over the past two years over "policy paralysis" and the lack of critical decision making is testimony of this despair. The Authority could not but be influenced by the prevailing atmosphere. It also had to bear in mind the Honourable Supreme Court's scathing observations on the administrative allocation of licenses and spectrum. In retrospect, the Authority's recommendations of May, 2012 need to be seen in this light.

6. What has changed over the last 16 months, since May 2012? It is important to answer this question to understand how to go forward with the current exercise.

7. First, there have been dramatic changes in India's economic situation and its prospects. In all of a year, fundamentals of the economy have deteriorated. Consumer inflation remains high and growth has stalled and has fallen each successive quarter over the last year. The country faces an unsustainable current account deficit combined with serious fiscal constraints. The rupee has depreciated and remains under pressure. Manufacturing growth has virtually come to a standstill and the possibility of interest rate reductions has abated. Prospects of an economic revival are at least one to two years away.

8. Second, there are sector-specific changes. The telecom sector has been going through financial duress over the past two years. Unrealistic pricing and indebtedness have taken a huge toll. Operating margins have fallen drastically. Some companies have negative operating margins; leave aside interest and taxation, they are not even able to cover depreciation and amortization charges. In this setting, the operators' willingness to pay for spectrum has been adversely impacted. Commercial banks' exposure to the sector has reached prudential limits precluding their ability (despite willingness) to further finance the sector. And, from a larger macroeconomic perspective, there is the serious prospect of non-performing assets in the sector if steps are not taken urgently to prevent this.

9. Third, spectrum prices have been tested in the market place, not once but twice. In the second auction, there was only one taker for a particular band of spectrum, (that too after a 50% price reduction) and no takers for <u>any</u> other band; this is evidence as good as any of the market's revealed preference. This is a reality that needs to be factored into the current exercise**.** Equally, the Authority is conscious of the need

to avert any possible collusive activity. That said, it also needs to be accepted that reluctance to bid in auction with a reserve price does not necessarily represent collusive intent; if the reserve price is set too high, it may dispel all bidders.

10. Fourth, the estimate of losses based on presumptions has, in some measure, contributed to the pernicious atmosphere leading to the decision standstill. While no one questions that there was indeed a loss, the egregious estimates of losses that were initially bandied about to sensationalize the issue no longer carry credence. Within the Government, the lurking fears that motives will be imputed for any decision have had its own fallout. And, all of this has entailed <u>real</u> economic losses.

11. As these changes affecting the sector and the economy have taken place, the national mood has also altered. The downturn for our economy has clearly dimmed prospects for employment and income growth at the household-level. The media has already articulated the growing resolve to put the train back on the rails. The driving concern is to snap out of the trance of immobilized indecision. The shift in mood is tangible and a clear signal "to get on with it": an urge to quick action and decision-making and a return to solving problems rather than being weighed down by them. The sense of national urgency for "getting back to business" has returned with a strong resolve to bring about the change.

12. The imperatives of today's times derive from: the telecom sector's performance over the past few years, the Indian economy's current predicament, (including, in particular, a virtual collapse of investment and a slowdown in consumption growth) and the evolution of the prevailing politico-economic climate. And, these imperatives are:

13. There is a compelling need for a successful auction. Economists view auctions as a means of realizing allocative efficiency viz. allocating spectrum to the individual who values it most. But, such success is vitally important to restore public confidence in executive decision-making. In the larger societal perspective, that will be the single largest gain from a successful auction. There are other palpable benefits. A successful auction will yield gains in efficiency. Moreover, a successful auction would augment overall spectrum availability, improve the quality of service, and enable Telecom Service Providers (TSPs) to plan for the future. There is another dimension to efficiency: If Government is unable to sell the spectrum on offer, it amounts to idling of a public resource. What public good is served by holding on to spectrum for which there is no other use? For a host of reasons, concluding a successful auction has become imperative.

14. Second, we must learn from history. As Santayana observed, "*Those who cannot remember the past are condemned to repeat it.*" The irrational exuberance surrounding the 2010 auction has abated. India's economic prospects have lost lustre and the market's mood has become far more somber. Times have changed as has the situation. The two recent auctions have revealed market information and preferences: while planning the third auction, one can ignore these facts only at one's own peril. Clearly these developments have a crucial bearing on how we proceed, especially to the extent that the assumptions and premises on which the pricing of spectrum was originally based have been invalidated. Analytical flaws and proof of failed hypotheses must be borne in mind when formulating any new approach. Ceteris paribus simply does not hold. As Lord Keynes is reported to have said: *"When the facts change, I change my opinion. What do you do, sir?"*

15. Third, the Authority is of the view that it is best to candidly accept that valuation of spectrum is difficult and not infallible. The value of spectrum changes over time, a product of both evolving economic circumstances and rapid technological change. The Authority is no soothsayer; it is impossible to predict what the value (price) of spectrum would be 5 or 10 years from now, much less 20 years hence, the terminal date for a spectrum license. In fact, valuations 5 to 10 years forward may be far higher than today's estimates. Trying to estimate a price, say a 2023 valuation, for spectrum, would be foolhardy. Worse yet, even if it could be done accurately, who would be willing to buy spectrum at estimated 2023 prices in today's auction? Now judging by the perfect vision of hindsight, in 2023, the 2013 estimated valuation may appear low compared to actual prices in 2023. Do we then presume that in selling spectrum on the basis of estimated value in 2013, we have incurred a presumptive loss? Such irrational and unfounded fears cannot be the basis if we are to move forward constructively and purposively. The Authority cannot allow itself to be bogged down by considerations of misplaced fears of prospective hypothetical 'losses' on this account.

16. Fourth, valuing spectrum and setting reserve prices is part science and part art. The Authority is clear that 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. Rather than count on one method, prudence suggests it would be better to rely on a number of such models to arrive at a final reasonable valuation and then to base a reserve price on such valuation. The valuation has to be based on clear and cogent reasoning, transparency, logic, and scientific method. This is what has guided the Authority in its endeavors. The driving consideration throughout this

paper has been Carveth Read's observation that: "I*t is better to be vaguely right rather than exactly wrong".*

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CHAPTER–I

INTRODUCTION

1.1 The Department of Telecommunications (DoT), through its reference dated 10th July 2013 **(Annexure-1.1)** sought TRAI's recommendations on the applicable reserve price for the auction of spectrum in the 800 MHz, 900 MHz and 1800 MHz bands. In this context, TRAI issued a Consultation Paper (CP) on 23rd July 2013, raising specific issues for consideration of stakeholders. The key issues raised in the CP were the quantum of spectrum to be auctioned, eligibility for participation, roll-out obligations, methods to be used for valuation and estimation of reserve price of spectrum, review of spectrum usage charges and spectrum trading.

1.2 In response to the CP, TRAI received 31 comments and 6 counter-comments from stakeholders. These were placed on TRAI's website www.trai.gov.in.

1.3 In another reference dated 22nd August 2013 **(Annexure – 1.2)** , the DoT sought TRAI's recommendations on permitting trading of spectrum obtained through auction and the attendant legal, regulatory and technical framework. In the CP TRAI had *suo motu* raised the issue of spectrum trading in the country and had requested comments/counter-comments from stakeholders on this issue. The majority of stakeholders had furnished their comments on the issue of spectrum trading. However, in the interest of transparency and full disclosure, the Authority decided to give further time up to 29th August 2013 to the stakeholders for giving any additional comments on issues pertaining to spectrum trading as referred by DoT in its letter of 22nd August 2013. Additional comments that were received from 14 stakeholders were also placed on TRAI's website.

1.4 An Open House Discussion (OHD) with stakeholders was organized on 26th July 2013. After analyzing the various issues involved and also considering the comments received from stakeholders in their written responses and during the OHD, and also additional comments on the issue pertaining to spectrum trading in the country, the Authority has finalised its recommendations.

1.5 Chapter-II discusses the availability of spectrum and deals with the policy framework for spectrum assignment in the 900 and 1800 MHz bands on issues such as block-size, eligibility conditions, roll-out obligations, contiguity and liberalization of spectrum. This Chapter also explores the feasibility of adoption of the Extended- GSM (E-GSM) band from the available 800 MHz band presently allocated for CDMA technology. Chapter-III identifies the major issues in valuation and discusses the methodologies adopted by the Authority for valuation of spectrum. Chapter- IV deals with the valuation and reserve price of spectrum in the 900 and 1800 MHz bands in different Licence Service Areas (LSAs). Chapter- V deals with the issue of Spectrum Usage Charge (SUC) and Chapter- VI discusses the legal, regulatory and technical framework for permitting spectrum trading in the country. The last Chapter summarises the recommendations.

CHAPTER-II

POLICY FRAMEWORK FOR SPECTRUM ASSIGNMENT

AVAILABILITY OF SPECTRUM

2.1 On the availability of spectrum in the 1800 MHz band, it was stated in the Consultation Paper (CP)[1], that the total spectrum available [2] in all the LSAs, after the auction of 127.5 MHz spectrum in November 2012 is 459.1 MHz. In its reference dated 10th July 2013, the DoT, had said that (a) 413.6 MHz spectrum was the quantum of spectrum that was released as a result of quashing of the licences, and; (b) 285 MHz of spectrum was the quantum proposed for the upcoming auction. The reasons cited by WPC in its communications to TRAI for restricting the auction to 285 MHz of spectrum are:

- Some of the quashed spectrum is lying in the Defence Band[3];
- Spectrum is available only partially in some LSAs viz. Gujarat, Maharashtra, Punjab, UP(E), UP(W), Haryana, West Bengal, Rajasthan, HP, Bihar, Assam, North East and Jammu & Kashmir, and;
- Some spectrum that has been vacated due to cancellation of licences is available in less than 1.25MHz block size.

2.2 On 15th February, 2013 the Hon'ble Supreme Court of India, inter-alia, issued the following directions in I.A. No. 11 of 2012, Writ Petition (Civil) No. 423 of 2010.

"The entire spectrum released as a result of quashing of the licences on 2.2.2012 should be auctioned without further delay".

[1] Table No. 2.9 of the consultation paper on Valuation and Reserve Price of Spectrum dated 23rd July 2013

[2] Counting the partially available spectrum in case it is available in at least 75% districts of the LSA including the state capital.

[3] In the 1800 MHz band, out of 2x75 MHz, 2x20 MHz has been earmarked as Defence Band.

2.3 The Authority examined spectrum availability in various LSAs. This included an examination of the spectrum that is only partially available in some LSAs. The Authority had examined the latter issue in its recommendations on 'Auction of Spectrum' dated 23rd April 2012 and was of the view that spectrum, being a scarce resource, should be utilised optimally. If the spectrum is available in the majority of the districts in an LSA including important cities and the state capital(s), it should be allocated for commercial use. Therefore, the Authority was of the opinion that if the spectrum is available for allocation in at least 75% of the number of districts in a LSA including the state capital(s), then that spectrum should be put to auction. However, the fact that this spectrum is currently available only in part of the LSA should be clearly informed to the bidders before the auction, along with the details of the districts where it is not available. The Authority also observed that, while giving the details, the WPC should endeavour to furnish the likely time period when the spectrum could be made available in such districts. The Authority is of the view that the same criteria can be adopted for determining the spectrum to be put up in the upcoming auction.

2.4 MTNL holds spectrum of 2x12.4 MHz in Delhi as well as in Mumbai in GSM band. The CP brought out that spectrum is not being put to efficient use by MTNL as the number of subscribers served per MHz of spectrum by private Telecom Service Providers (TSPs) is 6 to 8 times that of MTNL in Delhi and Mumbai. The CP articulated the Authority's view that the DoT should immediately take back at least 2x2.4 MHz of spectrum from MTNL in both Delhi and Mumbai and include it in the proposed auction. In its recommendations of April 2012 too, the Authority had recommended that excess spectrum of 2x2.4 MHz should be immediately taken back from MTNL. Therefore, while determining spectrum availability in the LSAs in the 1800 MHz band, 2x2.4 MHz spectrum has been counted as available both in Delhi and Mumbai.

2.5 Additionally, six CMTS licences (two in each of the three metros of Delhi, Mumbai and Kolkata), which were awarded in 1994 are due for renewal in 2014. These licensees have spectrum holding in 900 MHz and 1800 MHz bands, which shall become available on the expiry of their licences. The details of spectrum holding by such licensees in the 1800 MHz band is given in Table below:

TABLE 2.1
Spectrum Available on expiry of licences in 2014

S.No.	LSA	Total Spectrum available in 1800 MHz band on expiry of licences in 2014 (in MHz)
1	Delhi	4
2	Kolkata	3.8
3	Mumbai	4
	Total	**11.8**

2.6 As per the mutually agreed division of 1800 MHz band (75+75 MHz) between Ministry of Defence and Ministry of Communications & IT, 55+55 MHz is for commercial use and 20+20 MHz is earmarked as Defence Band. Therefore, while determining the availability of spectrum in an LSA, a cap of 55 MHz has been imposed. As informed by DoT, in certain LSAs, some of the spectrum held by the quashed licensees was part of the proposed Defence Band. Also in some LSAs, Defence has existing operations in the telecom band. This has resulted in reduced availability of spectrum for the auction.

2.7 In view of the foregoing, total spectrum available for assignment will be 366.1 MHz (in all the LSAs), whereas the DoT has proposed 285 MHz of spectrum for the auction. LSA-wise detail of the spectrum availability, spectrum proposed by the DoT for auction and spectrum required to be put up for auction to comply with the Hon'ble Supreme Court's order is tabulated below.

TABLE 2.2

Spectrum Availability in the 1800 MHz Band

S.No.	Circle	Spectrum available with cap of 55 MHz	Spectrum available excluding spectrum in the Defence Band*	Spectrum proposed for Auction	Spectrum required to be put up for auction to comply with the Court's order
		MHz	**MHz**	**MHz**	**MHz**
1	Delhi	16.0	22.4	15.00	4.4
2	Mumbai	18	22.4	15.00	13.2
3	Kolkata	27.4	31.4	13.75	12.6
4	Maharashtra	21.55	11.15	13.75	15.75
5	Gujarat	12	7.6	8.75	7.6
6	AP	22.8	22.8	17.50	17
7	Karnataka	27.8	27.8	22.50	22
8	Tamil Nadu	38.6	38.6	17.50	17
9	Kerala	28.75	28.75	17.50	16.35
10	Punjab	17.75	13.35	15.00	16.35
11	Haryana	18.9	8.7	11.25	14.5
12	UP - West	13.3	6.5	2.50	5.1
13	UP - East	6.35	4.55	7.50	6.35
14	Rajasthan	20.8	3.2	18.75	17.6
15	M.P.	20.7	20.7	11.25	10.1
16	West Bengal	12.85	9.05	10.00	8.85
17	H.P.	22.75	16.35	13.75	16.35
18	Bihar	8.25	4.45	5.00	8.25
19	Orissa	28.7	28.7	15.00	14.5
20	Assam	17.05	9.25	12.50	13.25
21	North East	21.5	20.7	15.00	14.5
22	J&K	20.9	7.3	6.25	14.5
	Total	**442.7**	**366.1**	**285**	**286.1**

* Only that partial spectrum has been considered which is available in at least 75% of the districts of the LSA including the State Capital(s).

2.8 Apart from six CMTS/UAS licences which will come for renewal in the year 2014, twenty nine licences in non-metro LSAs will also be expiring in 2015/16 as detailed below.

TABLE 2.3
Licence Expiring in 2015-2016

Sl. No.	LSA	TSP	Date of Expiry	Spectrum holding in 900 MHz band (MHz)	Spectrum holding in 1800 MHz band (MHz)
1	Andhra Pradesh	Bharti Airtel	11-12-15	7.8	2.2
		Idea	18-12-15	6.2	1.8
2	Assam	RTL	11-12-15	6.2	
3	Bihar	RTL	11-12-15	6.2	1.8
4	Gujarat	Idea	11-12-15	6.2	
		Vodafone	18-12-15	7.8	2
5	Haryana	Idea	11-12-15	6.2	
		Vodafone	11-12-15	6.2	
6	Himachal Pradesh	Bharti Airtel	11-12-15	6.2	
		RTL	11-12-15	6.2	
7	Karnataka	Bharti Airtel	14-02-16	7.8	2.2
		Idea	08-04-16	6.2	
8	Kerala	Idea	11-12-15	6.2	1.8
		Vodafone	11-12-15	6.2	
9	Madhya Pradesh	Idea	11-12-15	6.2	1.8
		RTL	11-12-15	6.2	
10	Maharashtra	Idea	11-12-15	7.8	2
		Vodafone	18-12-15	6.2	
11	North East	Bharti Airtel	11-12-15	4.4	1.8
		RTL	11-12-15	4.4	1.8
12	Orissa	RTL	11-12-15	6.2	
13	Punjab	Bharti Airtel	11-12-15	7.8	
		Idea	08-04-16	7.8	
14	Rajasthan	Bharti Airtel	21-04-16	6.2	2
		Vodafone	11-12-15	6.2	
15	Tamilnadu	Vodafone	11-12-15	6.2	1
16	Uttar Pradesh (East)	Vodafone	11-12-15	6.2	2
17	Uttar Pradesh (West)	Idea	11-12-15	6.2	1.8
18	West Bengal	RTL	11-12-15	4.4	1.8
	Grand Total	**29**		**184**	**27.8**

2.9 In the recommendations on 'Spectrum Management and Licencing Framework' dated 11th May 2010, the Authority recommended that spectrum in the 800 and 900 MHz bands should be refarmed at the time of renewal of the licences. In its response to the DoT dated 3rd November 2011, the Authority reiterated this view. Based on the above recommendations, through its press release dated 15th February 2012, the DoT announced the following decision:

"The need for refarming of spectrum is accepted in-principle. Further steps will be taken after receipt of TRAI's recommendations in this regard."

2.10 Subsequently, in its response dated 30th October, 2012 to DoT the Authority, after examining the amount of spectrum available in 1800 MHz band, concluded that in case *the Government decides to refarm partially and permit retention of 2.5MHz in 900MHz band then, as and when the auction of spectrum in 900MHz band is held, the following would need to be clearly announced:*

(i) Incumbent operators seeking to retain 2.5MHz could choose to bid or not bid for additional spectrum in the 900MHz band but in any event would pay the auction determined price for the 2.5MHz they wish to retain.

(ii) If incumbent operators bid, it should be made clear that in addition to the 2.5MHz which they retain, a maximum of 2.5MHz extra could be obtained through auction. This will permit them to garner up to 5MHz of spectrum which is the quantum required to provide high technology services."

2.11 In the NIA dated 30th January 2013, for the 'Auction of Spectrum in 1800MHz, 900MHz and 800MHz bands', instead of reserving spectrum in the 900 and 1800 MHz band for the licensees holding spectrum in the 900 MHz band in the 3 metros of Delhi, Mumbai and Kolkata, the DoT included a provision in the auction rules that the "Renewal Licensees" shall be ranked on priority for the retention of spectrum up to the

'Prescribed limits', while determining the provisional winning bidders in each round.

2.12 In the above context, the Authority sought the views of stakeholders on the method that should be adopted for refarming of 900 MHz band so that TSPs whose licences are expiring in 2014 onwards get adequate spectrum in 900/ 1800 MHz bands for continuity of services provided by them. Stakeholders were also asked to comment on reservation of spectrum for licences expiring in 2014 (metros) and licences expiring afterwards (LSAs other than metros).

2.13 One set of the TSPs are of the view that the issue of refarming of spectrum in 900 MHz band is well debated, thoroughly analyzed and has become part of the National Telecom Policy (NTP) announced in 2012. The NTP's objective is to make spectrum available for introduction of new technologies for telecom applications. Hence, this set of TSPs argues that the entire quantity of 900 MHz spectrum band should be made available for new technologies. These TSPs are also of the view that there is no need for reserving any spectrum; all spectrum in the two bands should be auctioned as soon as possible to ensure its most efficient utilization. In their view, with the introduction of Mobile Number Portability in India, the concerns related to *"Continuity of services"* are addressed in totality. A glimpse of this was visible when 2008 quashed licensees terminated operations in LSAs where they were unable to succeed in obtaining spectrum in the auctions of November 2012 and March 2013 and the customer base was successfully and seamlessly ported to other TSPs.

2.14 One of the stakeholders also submitted that reserving a certain amount of spectrum for operators renewing licenses reduces the amount of spectrum to be auctioned, thereby distorting the determination of the market price. The distortion is further accentuated by the fact that the cost of license renewals depends on the price discovered in the auction

and if an operator seeking renewal has assurance of a reservation, it would dampen auction bids. In the stakeholder's view, a more suitable approach would be to take back all spectrum from those whose licenses are expiring and invite them to bid in the auction. One TSP concurred with the Authority's view on refarming and submitted that each operator should be limited to a maximum of 5 MHz in sub-1 GHz band. This will also ensure equitable distribution amongst operators mandated with rural block level rollouts. The TSP added that priority in reservation should be restricted to licences expiring in 2014 (metros) and the licences expiring in 2015 or beyond have sufficient time to acquire spectrum through auction as per the timeline of their licence expiry. Another TSP stated that perpetuity of spectrum rights cannot be guaranteed in the name of continuity of service and, therefore, an open auction should be held for 900 MHz band and no 1800 MHz spectrum is required to be reserved for licences expiring in any year. Yet another TSP stated that the complete 900 MHz should be refarmed in the interest of a level playing field; the Authority should ensure that any TSP (irrespective of the date of expiry of its licence) can participate and obtain the desired quantum of spectrum necessary for its operations. Renewal licences should be granted priority for retention of 2.5 MHz in 900 MHz as envisaged in the NIA dated 30.01.2013, provided they participate and submit bids at the clock round price.

2.15 Another set of TSPs, who are holding spectrum in the 900 MHz band in the three metros, contended that their existing licences (bundled with spectrum) provide for their extension and, hence, their 900 MHz spectrum cannot be put to auction. Therefore, the issue of re-farming does not arise. These TSPs submitted that loss of 900 MHz spectrum could have serious implications for the quality of service that they are able to offer and the continuity of service for some customers particularly in semi-urban, rural and remote areas. These TSPs also made reference

to a report submitted by one of the consultants hired by them which concludes that refarming, as proposed by TRAI, will entail a substantial cost to industry, lead to an increase in retail tariff and cause significant inconvenience to customers. One such TSP stated that since licence coupled with spectrum is technology neutral, spectrum in both 800 MHz and 900 MHz bands can be used for any technology i.e. 2G, 3G, LTE etc. This will enable the GSM operators to migrate to 3G/ WCDMA in their 900 MHz band and the CDMA operators to provide 3G/ WCDMA or 4G/ LTE in their existing 800 MHz band. It was further submitted that auctioning 800 MHz band as E-GSM band will help in determining the value of 900 MHz band which then can be applied to the existing licensees at the time of extension of their licences along with allocated spectrum in 900 MHz band and this will obviate the need for the refarming or re-distribution of the spectrum. The TSP added that existing TSPs could be allowed to retain only 5 MHz of sub-1 GHz band at the time of extension and the balance spectrum could be put to auction along with E-GSM spectrum. For continuity of existing mobile services and for meeting the Quality of Service (QoS) required, spectrum deficiency created due to retention of only 5 MHz spectrum in 900 MHz band should be recouped through reservation of spectrum in 1800 MHz band.

2.16 Another TSP stated that there was a need for a comprehensive consultation process in case 900 MHz refarming is to be conducted. Both short-term as well as long-term planning, with a clear phased roadmap is a 'must-have' prerequisite for the telecom sector along with regulatory certainty as well as financial sustainability.

2.17 The Authority has noted that though comments of the stakeholders were sought on the 'method to be adopted for refarming of 900 MHz band' and 'need for reservation of spectrum in the 900/1800 MHz band', many of

the stakeholders sent comments on the very need and feasibility of refarming of 900 MHz band. In the recommendations dated 23rd April 2012, the Authority stated that refarming of spectrum in the 800 MHz and 900 MHz bands should be carried out progressively at an early date but not later than the date of renewal of licences. This stand was reiterated in its response to the Government dated 30.10.2012. Moreover, as mentioned earlier, the Government has also decided for refarming of 900 MHz band. Therefore, the Authority finds no reason to revisit this issue.

2.18 The Authority has analysed the views of stakeholders on the method of refarming 900 MHz spectrum band. It is an established fact that sub-1 GHz band has better propagation characteristics, leading to a fewer number of cells to provide the same coverage. Moreover, as per the present eco system, 900 MHz band is the most useful band on the technological front internationally. Therefore, this band should be used in a most efficient manner and should be given to operators for deploying spectrally-efficient latest state- of-the-art technologies.

2.19 On the issue of reservation of spectrum in the 900 MHz band or 1800 MHz band for TSPs, whose licenses are expiring in 2014, the Authority agrees with the view expressed that reserving a certain amount of spectrum in the 900 MHz or 1800 MHz band for operators renewing licenses reduces the amount of spectrum available for auction, and thereby distorts the determination of the market price. The distortion is further accentuated by the fact that the cost of license renewals depends on the price discovered in the auction and if an operator seeking renewal has assurance of a reservation, it would dampen auction bids. Moreover, incumbent TSPs are already in an advantageous position as they are having network and equipment in both these bands.

2.20 In the NIA dated 30th January 2013 for the 'Auction of spectrum in 1800MHz, 900MHz and 800MHz bands', a provision was made to give priority to the Renewal Licensees for the retention of spectrum up to the 'Prescribed limits'[4], while determining the provisional winning bidders in each round. The priority in ranking for retention in 900MHz band was limited to 2.5MHz only. The priority in ranking for the balance spectrum up to the prescribed limit was accorded in the 1800MHz band, provided the Renewal Licensee submitted the bid in this band at that price.

2.21 The Authority is not in favour of providing priority in retention in 900/1800 MHz band. The Authority is of the view that in the three metros, if such priority were to be given and if both the renewal licensees were amongst the highest provisional winners, then it would reduce the quantum of spectrum for other bidders in the 900 MHz band and, as far as 1800 MHz band is concerned, there would be hardly any spectrum left for the quashed licensees. This would be against the spirit of the Hon'ble Supreme Court's directions.

2.22 **In view of above, the Authority recommends that there should be no reservation of spectrum for the Renewal Licensees in 900 or 1800 MHz bands. The Authority also recommends that no priority should be accorded to these licensees in the bidding process and all bidders should be treated alike.**

2.23 As mentioned in the Table 2.3, 184 MHz of spectrum in the 900 MHz and 27.8 MHz of spectrum in 1800 MHz band shall be available for auction on the expiry of licences during 2015/2016. All these licensees have most of their spectrum holding in 900 MHz band and, in all cases, except two, the spectrum holding in 1800 MHz band is less than or equal to 2 MHz. The present availability of spectrum in the 1800 MHz band and the

[4] maximum of 10MHz spectrum or Current Holding in Metros

quantum proposed to be auctioned by the DoT are given in Table 2.2. The availability of additional spectrum in the 1800 MHz band in the short-term is not known to the Authority e.g. how much would Defence vacate.

2.24 **Therefore, the Authority recommends that, before the upcoming auction, the DoT should come out with a clear roadmap indicating the quantum of spectrum which will be available in future along with time-lines so that licensees whose licences are due for renewal in 2015/16 can take an informed decision about bidding for spectrum in the 1800 MHz band.**

BLOCK SIZE

2.25 In its recommendations on 'Auction of Spectrum' dated 23rd April 2012, the Authority observed that all spectrum to be auctioned in future will be liberalised and, therefore, the block size should be such as to satisfy the needs of any technology. 5 MHz is the minimum amount of spectrum required to ensure that any technology can be deployed with the allocated spectrum. Therefore, it was recommended that spectrum should be offered on auction in blocks of 1.25 MHz each. This recommendation was accepted by the Government and spectrum was auctioned in block sizes of 2x1.25 MHz in November 2012 and March 2013.

2.26 During the consultation process some of the TSPs submitted that a block size of 1.25 MHz had resulted in wastage of spectrum as this block size was not suitable for deployment in the majority of available technologies. They submitted that though 3G/ WCDMA are supported in 5 MHz, which is a multiple of 1.25 MHz, 4G/LTE supports block sizes of 1.4 MHz/3 MHz also and none of these are multiples of 1.25 MHz. Moreover, in the GSM technology the channel size is of 200 KHz, which is also not a factor

of 1.25 MHz. Therefore, according to them, the block size of 1.25 MHz is not suitable for GSM, 4G/ LTE and even for fractional 3G HSPA (3.8 MHz) and is likely to result in under utilization and wastage of some spectrum. These TSPs proposed a block size of 200 KHz or 1 MHz. One of the TSPs also suggested that a new entrant should be eligible for minimum 25 blocks of 200 KHz (paired) spectrum and existing licensees should be eligible for a minimum of 5 blocks of 200 MHz (paired). The TSP also suggested that while the GSM operators may be permitted to acquire a minimum of 1 MHz in 900 MHz/ 1800 MHz, however, the auction price of either 900 MHz/ 1800 MHz band should be deemed as the market determined price only when any operator acquires a minimum of 5 MHz.

2.27 There will be two categories of aspirants in the upcoming auction. There will be new entrants, who do not have any spectrum in a particular band in an LSA, and there shall be existing TSPs. The requirements of spectrum for new entrants and existing TSPs will be different. A new entrant may require a certain minimum amount of spectrum (say 5MHz) for establishing a network with good coverage and sufficient capacity at a reasonable price. On the other hand, existing TSPs may require spectrum for capacity enhancement. Therefore, their requirement might be far less compared to new entrants.

2.28 For deciding the block size, the various factors which should be kept in mind are (a) the spectrum that is being auctioned now is liberalised spectrum i.e. the spectrum can be used to deploy any technology; (b) the most prevalent technology that the spectrum is likely to be used for; (c) block size should be such that it is optimum to satisfy the requirement of both sets of bidders- new entrants as well as existing TSPs ;(d) facilitate the auction of the maximum available spectrum; and (e) it should not encourage frivolous bidding leading to artificial bid price escalation.

2.29 In the 900 and 1800 MHz bands, the most prevalent technology being used in India is GSM, although TSPs are at liberty to use other technologies such as LTE and UMTS, which are being used in a number of other countries in the 900/1800 MHz band. The spectrum holding of most existing TSPs is in multiples of 200 KHz i.e. 4.4 MHz, 6.2 MHz, 7.2 MHz etc. and in case they desire to deploy any technology e.g. GSM, HSPA or LTE, they would require additional spectrum in multiple of 200 KHz. Therefore, it is desirable that the block size is in multiples of 200 KHz.

2.30 While determining the total amount of spectrum available with the DoT and the quantum to be auctioned, WPC informed TRAI that there is some spectrum in 1800 MHz band which is available in smaller chunks of less than 1.25 MHz. However, since spectrum is to be auctioned in block sizes of 1.25 MHz, only that spectrum which is available in contiguous chunks of at least 1.25 MHz has been proposed for auction. In case the block size is reduced, the amount of spectrum that can be put up for auction can be increased. The Authority is of the view that since the present availability of spectrum with the TSPs is low, it would be desirable to have the maximum amount of spectrum put for auction so as to avoid idling of scarce resources.

2.31 Another factor in determination of the block size, as spelt out above, is that it should not encourage frivolous bidding leading to artificial bid price escalation. If the unit block is kept small to cater to the needs of all types of requirements, there is a need to prescribe a minimum number of blocks which a bidder is required to bid for, so that non-serious players do not participate in the bidding process. In its response, one of the stakeholders while suggesting a block size of 200 KHz has also opined that, in order to deter participants who are simply intent on driving up

the price of spectrum, a floor of 1 MHz should be imposed as minimum quantity which any bidder should be required to bid for.

2.32 Keeping in mind the foregoing objectives and the various pros and cons, the Authority is of the opinion that for auction of spectrum in 1800 MHz band, the block size should be of 200 KHz (paired) each and an existing licensee would have to bid for a minimum of 3 blocks. A new entrant will be required to bid for a minimum of 25 blocks of 200 KHz each. In case of 900 MHz spectrum, none of the participants will be holding any spectrum in the 900 MHz band. The Authority recommended refarming so that spectrum in the 900 MHz band should be utilised for more efficient IMT technologies. It is desirable that this spectrum is not sold in small pieces so that successful bidder has sufficient spectrum for deploying newer technologies and each successful bidder gets at least 5 MHz spectrum. Therefore, the Authority is of the view that spectrum in the 900 MHz band be auctioned in a block size of 1 MHz (paired) with the condition that each bidder will have to bid for a minimum of 5 blocks.

2.33 **The Authority recommends that for auction of spectrum in 1800 MHz band, the block size should be of 2 x 200 KHz each and the existing licensee will have to bid for a minimum of 3 blocks. A new entrant will be required to bid for a minimum of 25 blocks of 2 x 200 KHz each.**

2.34 **The Authority recommends that for auction of spectrum in 900 MHz band, the block size should be 2x1 MHz with the condition that each bidder will have to bid for a minimum of 5 blocks.**

ELIGIBILITY CONDITIONS

2.35 In the NIA dated 30th January 2013 for the auction of spectrum in 1800MHz, 900MHz and 800MHz bands, the following eligibility criteria to participate in the auctions was prescribed:

(i) Any licensee that holds a UAS/ CMTS/ UL(AS) licence; or
(ii) Any licensee that fulfils the eligibility for obtaining a UL(AS)/Unified Licence; or
(iii) Any entity that gives an undertaking to obtain a Unified Licence (Access Services)/ Unified Licence through a New Entrant Nominee as per the DoT guidelines/licence conditions before starting telecom operations

can bid for the Spectrum in 1800MHz, 900MHz and 800MHz band (subject to other provisions of the Notice).

2.36 The CP discussed that at present, there were 6-10 operators in each LSA, which has resulted in cut-throat competition and adversely affected the financial health of TSPs. The current state of the industry is not sustainable in the long-term and measures such as consolidation will be required to improve its financial health. In this context, stakeholders were requested to comment on eligibility for participation in the proposed auction.

2.37 Almost all stakeholders suggested that the auction should be 'open to all' and no restriction in the auction needs to be imposed for participation. They were of the view that eligibility criteria, as stipulated by the DoT in the auctions held in November 2012 and March 2013 should be adopted for the proposed auction. Some stakeholders additionally suggested that suitable modifications, taking into account the new FDI guidelines and the Unified Licensing Regime, may also be included in the eligibility criteria. The Authority agrees with the view that eligibility conditions

prescribed in the recently held auctions (November 2012 and March 2013) should be retained for the upcoming auction.

2.38 **The Authority recommends that eligibility conditions prescribed in the recently held auctions (November 2012 and March 2013) should be retained for the upcoming auction.**

ROLL-OUT OBLIGATIONS

2.39 As per the roll-out conditions prescribed in the CMTS/UAS Licence, at least 10% of the District Headquarters (DHQs) are to be covered in the first year and 50% of the District Headquarters within three years of effective date of allocation of spectrum. The licensees are permitted to cover any other town in a District in lieu of the District Headquarters. In case of the Metro Service Area licence, the licensees are required to provide in 90% of the service area streets as well as in-building coverage within one year of the effective date of allocation of spectrum.

2.40 As per the NIA dated 28th September 2012 and 30th January 2013, the 'New Entrant'[5] will have to fulfill roll-out obligations as provided in the existing UAS licence. In addition, the 'New Entrant' and the 'Existing Licensee'[6] acquiring spectrum in the auction will have to cover at least 10% of the Block Headquarters (BHQs) of the LSA by the end of three years from the effective date of licence or date of allotment of spectrum won in the auction process, whichever is later. Additional 10% of the BHQ of the LSA are to be covered in each of two subsequent years i.e. at least 20% and 30% coverage of the block headquarters of the LSA has to

[5] Licensees who do not hold UAS/ CMTS/ UL (AS) License were classified in the auction process as a 'New Entrant'.

[6] Existing UASL/CMTS/ UL (AS) licensees were classified as 'Existing Licensee' in those service areas for the frequency band(s) in which they already hold spectrum.

be achieved at the end of 4th and 5th year respectively, as part of roll-out obligations.

2.41 The companies/ licensees whose licenses have been quashed as per the direction of Supreme Court are also treated as 'New Entrants' and are required to re-offer the network to the TERM cells for testing of the compliance of roll-out obligations even if they had already completed their roll-out obligations. As per the NIA, the existing licensees are required to fulfil an additional three phases of roll-out obligations, if they have acquired even a single block of spectrum through this auction for their capacity augmentation. In this context, stakeholders were requested to comment on whether roll-out obligations for new/existing/renewal/quashed licences should be different. Stakeholders were also asked to give their opinion on whether there was a need to prescribe additional roll-out obligations for a TSP who acquires spectrum in the auction even if it had already fulfilled the prescribed roll-out obligations earlier.

2.42 In response, a number of stakeholders suggested that the same set of roll-out obligations should be applicable for all licensees. In their view, prescribing different roll-out obligations for operators who are operating under the same license, in the same service area would be discriminatory and would result in a non-level playing field. Some stakeholders advocated for retaining the same roll-out obligations that are prescribed in UASL, while others were in favour of continuing with the roll-out obligations mandated in the auctions of November 2012 and March 2013.

2.43 On the other hand, a few stakeholders were of the view that once roll-out obligations have been met by any licensee, then there should not be any fresh roll-out obligations mandated for them. One view expressed was

that existing TSPs should not be subject to any additional roll-out obligations upon acquiring incremental spectrum.

2.44 There was also a view aired that once spectrum is purchased from the market through auction, there should not be any roll-out obligations. One of the stakeholders holding this view commented that suitable methods like prescribing presumptive AGR may be included as a condition in the auction to prevent hoarding of the spectrum and to protect the genuine inflow of revenues to the Government. Some stakeholders suggested that since the Government has already created USO fund, TSPs should not be forced to roll-out their networks in rural and remote areas. On the other hand, a number of stakeholders were in favour of prescribing roll-out obligations to prevent spectrum hoarding and to ensure proper utilization of spectrum.

2.45 On the issue of quashed licensees being required to reoffer their network for testing for compliance of roll-out obligations, some stakeholders suggested that the quashed licensees, who have already completed their roll-out obligations, should not be required to offer their networks for retesting as they had been tested once and continuance of services had been maintained by them. Reoffering for testing would result in bureaucratic delay and additional costs to such TSPs and this should be avoided. One stakeholder expressed the contrary view that revised certifications may be stipulated in case of quashed licences since the earlier TERM certifications may have been in the name of a different entity or there may be significant reconfiguration of respective networks.

2.46 Some stakeholders said that existing licensees had been operating for a long period and might have fulfilled even the additional roll-out obligation at BHQ level. In their opinion, the existing licensees should not to be asked to offer their network for verification of roll-out obligations. Instead, self-certification should suffice.

2.47 A few stakeholders recommended that roll-out obligations should be generic and should not be linked to any particular service or technology as different spectrum bands will be used to provide the same service. It was suggested by some stakeholders that if the Government desires to provide service in remote areas, then the licensees should be suitably incentivized and any operator who rolls out the network in rural stretches and offers extensive coverage should be rewarded with incentives such as a reduction in the Spectrum Usage Charge (SUC) or a waiver of a proportion of the license fee.

2.48 In the auctions held in November 2012 and March 2013, roll-out obligations mandated were different from roll-out obligations prescribed in the CMTS/UAS licences. As a result of which, now, there are two different sets of roll-out obligations for TSPs providing access services. Existing CMTS/UAS licensee who have not acquired any spectrum in the auctions held in November 2012 and March 2013 are required to roll-out their network in at least 10% of the District Headquarters (DHQs) in the first year and 50% of the District Headquarters within three years of effective date of allocation of spectrum. On the other hand, the new entrants or existing licensees, who have acquired spectrum in the recently held auctions, will also have to additionally cover at least 10%, 20% and 30% of the Block Headquarters (BHQs) of the LSA by the end of 3rd, 4th and 5th years respectively from the effective date of licence or date of allotment of spectrum won in the auction process, whichever is later, as part of roll-out obligations. This has resulted in a non-level playing field between two licensees providing the same services in the same LSA but having two different sets of roll-out obligations. Moreover, spectrum has now been delinked from the licence and TSPs would be acquiring spectrum at different points of time and in different quantities with different periods of validity. Therefore, roll-out obligations should not be linked with each auction. The Authority is of the view that all

TSPs providing access service should have the same set of obligations. However, as some entities might acquire spectrum for providing access service in the up-coming auction, the time period for completion of roll-out obligations for such entities could be different from those who have been providing services for a long period.

2.49 **In view of the foregoing, the Authority recommends that all CMTS/UASL/UL(AS)/UL providing access service should have the same set of roll-out obligations and the DoT should amend the licence conditions to incorporate the same.**

2.50 What should be the roll-out obligations? As mentioned above, the present CMTS/UAS licence has one set of roll-out obligations which are limited to coverage of DHQs or any other town in lieu thereof while the NIAs of November 2012 and Match 2013 have obligations involving coverage of BHQs (30% of BHQ in 5 years). Earlier, the Authority had, in its recommendations of May 2010, observed that the present roll-out obligations are very lenient besides being urban centric. The result is that even 15 years after the introduction of mobile services in the country, the rural teledensity was below 25% (presently it is 40%). Spectrum being a scarce resource, service providers are expected to use it optimally and provide coverage and service in the entire LSA including the rural areas. The importance of telecommunications in the development of rural areas is well known.

2.51 There are about 5924 sub-districts/blocks in the country. Eighteen years after the introduction of the mobile services, putting an obligation of coverage of 30% of Block Head Quarters only in five years would not result in any significant increase in the mobile coverage in the country and would not help in the primary objective of increasing rural teledensity and reducing the urban-rural divide.

2.52 As per the Census of India 2001, there are about 593615 inhabited villages, of which around 99173 villages have a population above 5000 and around 129977 with a population between 2000 and 5000. The Authority is of the opinion that all TSPs providing access service should have coverage in all villages having population of more than 5000 within 5 years of acquiring spectrum for access services and should have coverage in all villages having more than 2000 within 7 years of their operations. Therefore, the Authority is of the view that the roll-out obligations should be suitably modified.

2.53 **Accordingly, the Authority recommends that in addition to the roll-out obligations already prescribed in the CMTS/UASL/UL (AS)/UL, the following roll-out obligations should also be incorporated for licensees having access spectrum (spectrum in 800/900/1800 MHz band).**

- **All villages having population of more than 5000 to be covered within 5 years of effective date of allocation of spectrum for access services and all villages having population of more than 2000 to be covered within 7 years of effective date of allocation of spectrum.**
- **These amendments should be made effective from 1st April 2014. However, in case of TSPs holding CMTS/UAS licences prior to the year 2008, the time period for completing these additional roll-out obligations shall be two years/four years from the effective date, while for TSPs acquiring licence post-2008 the time period shall be five years/seven years.**

2.54 An issue raised by a number of stakeholders pertains to the testing procedure for compliance of roll-out obligations. Stakeholders are generally of the view that this process should be simplified. As per the NIA dated 28th September 2012 and 30th January 2013, the

companies/licensees whose licenses were quashed, as per the direction of the Hon'ble Supreme Court, were required to re-offer the network to the TERM cells for testing of the compliance of roll-out obligations in case the network was already established. In the recently held auctions, some TSPs have re-acquired spectrum in the LSAs where their licences were quashed but they continued to provide services till the auction. It is quite likely that these licensees had already complied with the roll-out obligations and the testing by TERM cell might have been completed in some or all DHQs offered for test check, before the quashing of their licences. The Authority is of the view that in respect of such licensees, there is no need of re-offering their network for test check for the compliance of roll-out obligations. If the test check had been completed in some or all DHQs before cancellation of its licence, it should be taken into account.

2.55 In the year 2008, the quashed licensee were allocated spectrum in 1800 MHz band for providing access services using GSM technology. However, in the recent auctions, spectrum allocated to such licensees in the 1800 MHz band is liberalised. There might be a possibility that a quashed licensee who has re-acquired the spectrum in the auction, now decides to provide services using any alternate technology than that was used prior to the auctions. This will involve rearrangement of its existing network like shifting of BTS sites and also replacement of corresponding network equipments. Therefore, the Authority is of the opinion that in such cases, it would not be proper to take into account its earlier compliance of roll-out obligations and the TSP will have to offer its network for testing of roll-out obligations.

2.56 Similarly, a renewal licensee may be acquiring spectrum afresh through the upcoming auction. It is quite possible that their spectrum holding in 900 MHz and 1800 MHz band may change e.g. some licensee having its

spectrum holding mainly in 900 MHz band may get no/some spectrum in 900 MHz band and more spectrum in 1800 MHz band. It may require some readjustment of its network. However, the Authority is of the view that if the licensee continues to provide access services after the renewal of its licence, it should not be asked to re-offer its network for test check of roll-out obligations which were already met by it before the renewal of the licence.

2.57 **In view of the above, the Authority recommends that if a quashed licensee had already met its roll-out obligations in certain DHQs before its licence was quashed but it did not stop providing service in that LSA before re-acquiring spectrum in the auction, the roll out obligations already met by it before cancellation of its licence should be taken into account and the licensee should not be required to re-offer its that part of the network for the re-test. However, the TSP shall have to submit an undertaking to the concerned TERM cell, clearly indicating that it continues to provide the services using the same technology as was deployed earlier and the roll-out obligations complied earlier before quashing of licence remains valid. Similarly, a renewal licensee should not be asked to re-offer its network for test of roll-out obligations already met before the renewal of its licence, if the licensee continues to provide access services.**

2.58 As regard the compliance of additional roll-out obligations involving coverage of villages, the Authority is of the opinion that as the number of villages is large, it would not be practical for the TERM cell of the DoT to test each and every village for coverage. Therefore, to simplify the process, self-certification by the TSP can be considered as compliance subject to the condition that a certain percentage (20 percent) of the villages self-certified by the TSP will be sample checked by the TERM cell.

However, the sample test check by the TERM cell will be carried out within a time period of three months from the date of self-certification.

2.59 **Accordingly, the Authority recommends that regarding compliance of roll-out obligations involving coverage of villages, self-certifications by the TSPs should be taken as compliance subject to the condition that 20% of the villages self-certified by the TSP will be sample test checked by the TERM cell. The sample test check by the TERM cell will be carried out within a time period of three months from the date of self-certification.**

CONTIGUITY OF ALLOCATED SPECTRUM WITH EXISTING HOLDING

2.60 The need of having contiguous spectrum was discussed by the Authority in its recommendations on 'Auction of Spectrum' dated 23rd April 2012. It was noted by the Authority that in India, unlike other countries, spectrum was given to operators in tranches over a period of time. Moreover, as spectrum was being vacated by other agencies on a need basis, a number of operators were assigned spectrum in non-contiguous blocks. In the GSM technology, the channel width being 200 KHz, non-contiguity was not a major constraint in providing services. Now, spectrum is being liberalised and operators are allowed to use it for any technology and a number of IMT technologies require a channel width of a contiguous 5 MHz for efficient utilisation. Therefore, the necessity of having contiguous spectrum has become critical for its efficient utilisation. Accordingly, recognising the need for reconfiguration of frequencies assigned, the Authority recommended that *"Spectrum trading should be allowed between spectrum holders having obtained spectrum through auction or having paid the auction determined price for the spectrum held by them, only for the limited purpose of frequency configuration (arranging spectrum in a contiguous band)."*

2.61 As per the NIA dated 30th January 2013 for the 'Auction of spectrum in 1800 MHz, 900 MHz and 800 MHz', frequency re-configuration-rearrangement of spot frequencies in the same band- from within the assignments made to licensees, was permitted among the licensees with the authorization of WPC Wing. No charges were to be levied for re-arrangement of frequency spots. However, there was a condition that the entire spectrum held by the holder should be liberalized.

2.62 The main motive behind the above provision was to allow such licensees to rearrange their assigned frequencies so as to make them contiguous for use for newer technologies which require higher carrier sizes than the GSM, e.g. for UMTS, a contiguous block of 5 MHz is the minimum requirement. Frequency harmonisation will certainly provide more capacity by reducing the number of guard bands, providing larger blocks of spectrum and will also simplify frequency planning in future. But in the present setting, most spectrum held by TSPs is in un-liberalised form. More often than not, the frequency re-arrangement by TSPs having liberalised spectrum shall entail corresponding frequency re-arrangement for those TSPs who hold un-liberalised spectrum. Since such TSPs having unliberalised spectrum, are not allowed to participate in mutual re-arrangement, therefore, in effect re-configuration of frequencies would not be feasible in many cases, until all TSPs either liberalise their entire spectrum holding or are permitted to participate in such re-arrangement without liberalising the spectrum.

2.63 The Authority is of the opinion that since the sole motive for permitting such an arrangement is to facilitate that spectrum holding of TSPs becomes contiguous, the frequency rearrangement in the same band, from within the assignments made to the licensees, should be permitted, amongst all licensees irrespective of whether the spectrum is liberalised or not.

2.64 **Accordingly, the Authority recommends that the frequency rearrangement in the same band, from within the assignments made to the licensees, should be permitted, amongst all licensees irrespective of whether the spectrum is liberalised or not.**

LIBERALIZATION OF EXISTING SPECTRUM HOLDING

2.65 In India, spectrum in the 800/900/1800 MHz bands was assigned for 2G services and for a specific technology (either GSM or CDMA). It cannot be used for any other technology, until its use is liberalised. In its recommendations dated 23rd April 2012, the Authority opined that spectrum being limited in availability, the main aim of the frequency management administrator is to ensure allocative efficiency i.e. the spectrum must be allocated in such a way as to maximize the creation of community wealth, resulting from its use. The Authority was of the view that any restrictions would also mean sub-optimal utilisation of available spectrum and the effect of any stipulation restricting the use of spectrum to specific technologies will be felt for 20 years, which is the life span of the spectrum allocation being made through the proposed auction. Therefore, the Authority recommended that all spectrum to be assigned through the auction process in future shall be liberalised. In other words, spectrum in any band can be used for deploying any services in any technology.

2.66 The Government accepted TRAI's recommendations and NIA dated 30th January 2013 mentioned that there are no restrictions on the technology to be adopted for providing services within the scope of the service licence using spectrum blocks allotted through the auction. It also mentioned that the existing licensees will be allowed to use the additional spectrum block(s) allotted through the auction to deploy any technology by combining with their existing spectrum holding in the same band after converting their entire existing spectrum holding into liberalised

spectrum in the same band as per the terms and conditions to be specified. As per the provisions of NIA, existing CMTS/ UAS/ UL (AS) licensees can liberalise their existing spectrum holding in 1800MHz band after payment of the auction determined price.

2.67 The above provision of the NIA raises the issue regarding identification of the price which the TSP should pay for liberalising its entire spectrum holding. Already two rounds of auctions have been held and the Government is going to conduct the third auction soon. Considering the fact that many auction determined prices will now be available, it is not clear as to which market price shall be applicable for conversion to liberalised spectrum. Therefore, the stakeholders were asked to suggest the framework for conversion of existing spectrum holding into liberalised spectrum.

2.68 Many stakeholders agreed that there should be no restrictions on the use of spectrum and the technology to be adopted for providing telecom services within the scope of license. Referring to the NIA dated 30th January 2013 for the auction held in March, 2013, many stakeholders submitted that guidelines for migration of existing spectrum holding to liberalized spectrum holding had already been laid down by the Government.

2.69 A number of stakeholders made the point that TSPs should be granted the right to liberalize their spectrum based on the last auction determined prices prorated for the period remaining in the licence/spectrum. One suggestion was to apply the most recent auction-discovered price indexed against inflation and prorated for the balance licence validity period. Another stakeholder suggested that in case a market determined price is not available, then the base price in the last concluded auction should be provisionally charged and the balance

amount shall become payable once a market determined price is discovered.

2.70 Some stakeholders were of the view that the licences and spectrum are both technology neutral and liberalised. These stakeholders added that the policy of technology neutrality has been in place since 1999 and this has been repeatedly confirmed by both the DoT and the TRAI on several occasions. In their view, the licence does not restrict the usage of spectrum in 900/1800MHz bands to any specific technology or to any prescribed channel plan. These stakeholders further submitted that currently, millions of consumers are using GSM based mobile services, primarily for voice over 900/1800MHz network across the country, and it is not realistic or feasible to abandon or change the use of existing spectrum from the current GSM technology in favour of the futuristic UMTS/LTE technology. Therefore, there is no need to create a framework for liberalization of already 'liberalized' spectrum which, in any event, is unlikely to be used for UMTS/LTE technology in the near future.

2.71 One stakeholder submitted that the new technology deployment must be approved by WPC, considering interference aspects. It also mentioned that, from the interference point of view, it may not be desirable to allow both FDD and TDD technologies in the same band. Another stakeholder suggested that the Authority should first work to allocate a minimum of 5 MHz spectrum to all operators so that technically it is possible to use spectrum for advanced technologies. Accordingly, an allocation of a minimum of 0.6 MHz of GSM spectrum to operators holding 4.4 MHz GSM spectrum and 1.25/2.5 MHz of CDMA spectrum to operators holding 3.75/2.5 MHz of CDMA spectrum should be made. According to this stakeholder, the liberalization of spectrum at this stage will only benefit incumbent operators who have large spectrum holding and can run parallel operations of 2G as well as 3G/4G networks. It also

submitted that once a minimum 5 MHz spectrum has been allocated, TSPs may be allowed to use the additional spectrum block(s) allotted through auction to deploy any technology by combining their existing spectrum holding in the same band after converting their entire existing spectrum holding into liberalized spectrum in the same band.

2.72 The issue of liberalisation of spectrum was dealt by the Authority in its recommendations on 'Auction of Spectrum' dated 23rd April 2012. It was noted by the Authority that, for 2G mobile services, spectrum has been assigned in the 800/900/1800 MHz bands, depending upon whether the licensee is deploying CDMA or GSM technology. Hence, spectrum assigned for 2G services is for a specific technology; it cannot be used for any other technology, until its use is liberalised. This is why the Authority categorically rejected the argument of operators that the spectrum was already liberalized. The Authority's view has been accepted by the Government as is evident from the provisions of the NIA dated 28th September 2012 for auctions held in November 2012 and the NIA dated 30th January 2013 for the auction held in March 2013. The Authority, after examination of the comments of the stakeholders, finds no reason to alter its views on the issue.

2.73 On the issue of the payment required to be made by TSPs to liberalise their existing holdings in 800MHz, 900MHz and 1800 MHz bands, the Authority agrees with the views of some of the stakeholders that in case more than one set of market determined prices are available, the latest market determined prices available at the time when the TSP wants to liberalise its spectrum holding, should be applied. However, if the market determined prices are more than one year old, then these prices have to be suitably adjusted to reflect prevailing market conditions. One way of determining the prevailing market rates could

be by indexing the last auction prices at the rate of SBI PLR. Another way could be the market price as realised through spectrum trading.

2.74 Earlier, in April 2012, the Authority recommended that the TSPs be allowed to convert their existing 1800 MHz spectrum into liberalised spectrum on payment of the auction determined amount in which case they will be granted spectrum rights for a period of 20 years. They will be allowed to adjust the price paid by them for the existing spectrum on a pro-rata basis for the balance period of the existing licence. However, the Authority, after revisiting the issue, is of the opinion that the licensee should be permitted to liberalise its spectrum holding only for the balance validity period of the spectrum assignment.

2.75 As far as the use of liberalised spectrum is concerned, it would be governed by the licence held by the TSP. The technology to be used by the licensee should be based on standards approved by ITU/TEC or any other International Standards Organization/bodies/Industry. Also, if the use of spectrum is for any other technology than that already deployed in that spectrum band, then its use has to be first ratified by the WPC. In such cases, the licensee shall provide details of the technology proposed to be deployed for operation of its services to WPC. It is also to be ensured by the TSP that deployment of any new technology should not cause harmful interference to already operating technologies either in the same band or in adjacent bands.

2.76 **In view of above, the Authority recommends that:**

i. TSPs should be allowed to convert their existing 1800 MHz spectrum into liberalised spectrum only for the balance validity period of the spectrum assignment on payment of the auction determined amount. The auction determined amount

will be prorated for the balance validity period of spectrum assignment.

ii. **In case more than one set of market determined prices are available, the latest market determined prices available at the time when the TSP wants to liberalise its spectrum holding, should be applied.**

iii. **If the market determined prices are more than one year old, then these prices have to be suitably adjusted to reflect prevailing market conditions. One way of determining the prevailing market rates could be by indexing the last auction prices at the rate of SBI PLR. Another way could be the market price as realised through spectrum trading.**

iv. **The use of liberalised spectrum would be governed by the licence held by the TSP. The technology to be used by the licensee should be based on standards approved by ITU/TEC or any other International Standards Organization/bodies/ Industry. Also, if the use of spectrum is for any other technology than that already deployed in that spectrum band, its use has to be first ratified by the WPC. In such cases, the licensee shall provide details of the technology proposed to be deployed for operation of its services to WPC. It is also to be ensured by the TSP that deployment of any new technology should not cause harmful interference to already operating technologies either in the same band or in adjacent bands.**

E-GSM BAND

2.77 In India, TSPs holding spectrum in the 800 MHz band are using CDMA technology. Presently, there are 2-4 TSPs (including PSUs) in each LSA using this technology. The revenues, minutes of usage and the

subscribers' count of every CDMA operator are continuously declining over the last few years. In the auction held in November 2012, there was no bidder for spectrum in the 800 MHz band. Spectrum in this band was put up for auction again in March 2013, after slashing the reserve price by 50%. This time, only one TSP (SSTL), whose licences in 20 LSAs were cancelled by the Hon'ble Supreme Court, participated and won spectrum in eight LSAs whereas in other LSAs the spectrum remained unsold. Therefore, in the CP, the Authority explored the possibility of adopting the E-GSM band (880-890MHz/925-935MHz) by taking out 10 MHz from the existing CDMA 800 MHz band and clubbing it with the existing 900 MHz Band. Various possible issues in migrating to the E-GSM band were discussed in the CP and stakeholders were asked to comment on whether India should adopt E-GSM band, in view of the diminishing interest in the CDMA services. Stakeholders were also asked to comment on the amount of spectrum which should be retained for CDMA technology in case E-GSM band is adopted and the issues that need to be addressed in the process including the process that should be adopted for migration.

2.78 In response, some stakeholders, mainly the TSPs holding spectrum in the 800 MHz band, objected to the proposal of forming the E-GSM band. They argued that it would be wrong to conclude that the interest of the operators in the CDMA band is diminishing. CDMA technology is still supporting around 100 million customers and is used to provide robust internet service in many cities and towns of the country. These stakeholders further submitted that CDMA service providers have already made huge investment in network using 800 MHz band and also, there is no such growth path/alternate band for CDMA 800 MHz spectrum unlike for GSM where 1800 MHz band is available as expansion of GSM services in 900 MHz band. Therefore, in the opinion of these stakeholders, the proposal to form the E-GSM would not only wipe

out the credible competition to GSM services but would also result in wastage of billions of dollars of investment in the CDMA technology and would not be in the overall interest of the country.

2.79 Some stakeholders stated that CDMA spectrum in 800 MHz band has been allocated to licensees having validity till 2017-2024 and therefore it would be against the contract to withdraw carrier midway. One stakeholder commented that the lack of interest in the recent auction for CDMA spectrum was because of the high reserve price for CDMA spectrum. It also submitted that TRAI's proposal for E-GSM band is creating unnecessary uncertainty and may impact long term investment in the CDMA based data services in the country.

2.80 One stakeholder submitted that the E-GSM proposal is highly unfair and discriminatory towards CDMA operators as adoption of E-GSM band will restrict CDMA operations to only 10 MHz spectrum which would be sufficient for only 2 operators and therefore others would be forced to close their operations. It further submitted that the E-GSM proposal would require migration of complete network operation into new frequencies which is not an easy task and will also cost operators huge investment in terms of electronics, filters etc. This would impact quality of service for a long period of time. Another stakeholder stated that the E-GSM band 880-915 MHz/ 925-960 MHz is not a globally harmonized band. One stakeholder suggested that the 880-890 MHz band should not be made available for E-GSM services by the Authority till the time of licence renewal when the spectrum should be refarmed as is being done for 900 MHz.

2.81 A number of stakeholders commented in favour of adopting the E-GSM band. One of these stakeholders mentioned that the reducing market interest in CDMA reflected in the lower ARPU and the declining number of CDMA subscribers over the years has led to sub-optimal utilization as

well as lower equipment availability in the band. Therefore, it would be prudent to create the liberalized E-GSM band i.e. merge a portion of 800 MHz band with the GSM 900 MHz. Similarly, another stakeholder submitted that in view of declining numbers of CDMA users (28% year-on-year), the shrinking minutes of use (an average decline of 10% year-on-year over the past three years), the lack of interest in acquiring CDMA spectrum (nearly 70% unsold), the apparent desire by one CDMA operator to surrender spectrum, and the greater interest in 900 MHz, there is a strong case to reconfigure the 800 MHz band plan, auction the released spectrum as E-GSM, and harmonise India with the majority of Europe, the Middle East and Africa and the Asia Pacific region. One stakeholder commented that as compared to 800 MHz band, a greater number of operators could potentially acquire 900MHz spectrum. It also suggested that since all devices being sold in India cover E-GSM band, hence from the device perspective there would be no issue.

2.82 The Authority noted that the subscriber base of CDMA has diminished by around 30% over a period of three years. On the contrary, the GSM subscriber base has increased by 65% over the same period. For the QE March 2013, the average revenue per user per month (ARPU) of CDMA services was Rs. 95 as compared to Rs. 105 for GSM services. Similarly, the minutes of usage per subscriber per month (MoU) of CDMA services was 275 as compared to 383 for GSM services.

TABLE 2.4
Subscribers Base (in Millions)

	QE March 2010	**QE March 2011**	**QE March 2012**	**QE March 2013**
CDMA	105.64	113.22	105.11	73.78
GSM	478.68	698.37	814.06	794.03

2.83 In the auction held in November 2012, there was no participation in the bidding for 800 MHz band. The reserve prices were kept at 1.3 times those of the reserve price of 1800 MHz band (not 2 times as recommended by the Authority in April 2012) considering that the amount of spectrum available for auction in some LSAs was less than 5 MHz which was not sufficient to offer all services that a truly liberalised spectrum can. The spectrum in this band was again put up for auction in March 2013 after slashing the reserve price by 50%. Even then there was no participation by any existing licensee. Only one quashed licensee took part in the auction and acquired spectrum in eight LSAs despite the fact that earlier it was holding licences in 20 LSAs.

2.84 It is well-known that the propagation characteristics of 800 MHz band are comparable to the 900 MHz band. This was one of the primary reasons why the Authority had recommended the same reserve price for both the bands. However, as detailed above, there was not much interest evinced in the 800 MHz band in the recently held auctions despite significant lowering of the reserve price. In fact, an existing TSP has offered to surrender some of its spectrum in most LSAs. In view of this, the Authority is of the opinion that considering the increasing demand for spectrum in sub 1-GHz band for data, it would be desirable to explore alternate usage in line with international practice. It would simply not be prudent to allocate spectrum in the 800 MHz band at a far lower price than its true value for a technology whose eco system is diminishing worldwide.

2.85 As discussed in the CP, most WCDMA-HSPA mobile broadband networks operate in the 2100 MHz band, except in the Americas where HSPA systems typically operate in the 1900 and 850 MHz bands. However, UMTS900 is becoming standard for devices and gaining traction amongst operators and regulators of Europe, Middle-East and Africa (MEA) and

Asia-Pacific (APAC) markets. Several operators are now deploying HSPA in the 900 MHz band (UMTS900), typically as a complement to 2100 MHz systems, to extend voice, data and mobile broadband services coverage to rural areas. In UMTS900 there are 57 commercial UMTS networks in 39 countries and 22 more countries are considering UMTS900 deployments. According to The Global mobile Suppliers Association's (GSA) HSPA Devices Survey which was completed on 19th August 2012, there are a total of 978 UMTS900 user devices. Around 29% of all HSPA products announced to date can operate in the 900 MHz band, providing an excellent and full choice of terminals in all 'form factors' for users.

2.86 In India, at present the availability of spectrum in the 900 MHz band is limited to 18.6 MHz in most LSAs. A maximum of 22.2 MHz spectrum is available in the 900 MHz band in some LSAs. The entire available spectrum has been already assigned to TSPs. In the auction held in March 2013, only spectrum which would become available for assignment on the expiry of licences in 2014 was put to auction. The formation of the E-GSM band shall enhance the availability of spectrum in the precious 900 MHz band, for which an eco-system for GSM and UMTS technologies is already available.

2.87 For assessing the quantum of spectrum that can be made available for E-GSM band from the CDMA band, WPC was asked to provide details of the frequency assignment to different TSPs in the 800 MHz band. As per the information received from WPC, CDMA carrier assignments to various TSPs in the 800 MHz band are given in **Annexure – 2.1**. This has been summarized in the Table 2.5 below.

Table 2.5
CDMA Carriers Assigned

Sl. No.	LSA	BSNL	HFCL	MTNL	SSTL	TTSL/ TTML	RCL/ RTL	Total
1	Delhi	0	0	2	3	4	4	13
2	Mumbai	0	0	2	0	4	4	10
3	Kolkata	2	0	0	3	3	4	12
4	Maharashtra	2	0	0	0	4	4	10
5	Gujarat	2	0	0	3	3	3	11
6	Andhra Pradesh	2	0	0	0	3	4	9
7	Karnataka	2	0	0	3	3	4	12
8	Tamilnadu	2	0	0	3	3	4	12
9	Kerala	3	0	0	3	3	4	13
10	Punjab	2	2	0	0	3	3	10
11	Haryana	2	0	0	0	3	3	8
12	UP (West)	2	0	0	3	3	4	12
13	UP (East)	2	0	0	0	3	4	9
14	Rajasthan	2	0	0	4	3	3	12
15	Madhya Pradesh	2	0	0	0	2	4	8
16	West Bengal	2	0	0	3	2	3	10
17	Himachal Pradesh	2	0	0	0	2	2	6
18	Bihar	2	0	0	0	3	4	9
19	Orissa	2	0	0	0	2	3	7
20	Assam	2	0	0	0	0	2	4
21	North East	2	0	0	0	0	2	4
22	Jammu and Kashmir	2	0	0	0	0	2	4
	Grand Total	**41**	**2**	**4**	**28**	**56**	**74**	**205**

2.88 As discussed in the CP, apart from some private operators, both PSUs (MTNL/BSNL) also hold spectrum in the 800 MHz band in all LSAs of the country. However, they are not providing full mobility service in this band and there has been a continuous decline in the subscriber base of both the PSUs. As on June 2013, MTNL and BSNL are serving only 26,304 and 11,13,602 CDMA subscribers[7] respectively. The combined CDMA subscriber base of both the PSUs is **only 2%** of the total CDMA subscribers as shown in Tables 2.6 and 2.7 below.

[7] Peak VLR data

Table 2.6

Subscriber Base of PSUs in 800 MHz Band[8]

QE	MTNL (HLR)	MTNL (Peak VLR)	BSNL (HLR)	BSNL (Peak VLR)
Mar-11	279807	74293	5565437	NA
Jun-11	269421	65754	5298575	NA
Sep-11	261783	60971	4883770	NA
Dec-11	255763	NA	4334300	NA
Mar-12	247316	45972	4003914	NA
Jun-12	237502	42938	3489498	NA
Sep-12	185404	39138	3126587	NA
Dec-12	182739	33761	2829570	NA
Mar-13	179409	31015	2701813	NA
Jun-13	175947	26304	2578171	1113602

Table 2.7

CDMA Subscriber base (Peak VLR data of June 2013)

Sl. No.	Service Area	BSNL/MTNL Subscribers (Peak VLR)	Total Subscribers in the LSA (Peak VLR)	BSNL/MTNL subscriber base as a percentage of total subscriber base
1	Andhra Pradesh	55275	3587155	2%
2	Assam	15569	15569	100%
3	Bihar	110997	3450385	3%
4	Delhi	7248	5375030	0%
5	Gujarat	69633	2085690	3%
6	Haryana	16872	836672	2%
7	Himachal Pradesh	27816	219434	13%
8	Jammu and Kashmir	27418	27454	100%
9	Karnataka	75337	3314837	2%
10	Kerala	225800	1796843	13%
11	Kolkata	7700	2147333	0%

[8] June 2013 Data

12	Madhya Pradesh	64438	2950855	2%
13	Maharashtra	96571	4094103	2%
14	Mumbai	19056	3931770	0%
15	North East	31778	31778	100%
16	Orissa	38502	569798	7%
17	Punjab	16823	767606	2%
18	Rajasthan	59878	2763312	2%
19	Tamilnadu	73825	2825833	3%
20	UP (East)	40977	3165917	1%
21	UP (West)	24919	2408201	1%
22	West Bengal	33474	2353159	1%
	Total	**1139906**	**48718734**	**2%**

2.89 In response to the CP, as pointed out by some stakeholders, BSNL is providing R-DELs using CDMA spectrum. Therefore, if the entire CDMA spectrum is taken back from BSNL, it may affect connectivity in remote areas. The Authority is of the view that, BSNL may be allowed to retain a single carrier (of 1.25 MHz) in 800 MHz band so as to cater to its R-DEL subscribers. It may be asked to vacate other carrier(s) in all LSAs, whereas MTNL should vacate all the carriers of 800 MHz band assigned to it in both Delhi and Mumbai. On the assumption that MTNL vacates the entire spectrum in 800 MHz band and BSNL retains only one CDMA carrier, then, after carrying out frequency re-arrangement amongst TSPs, the amount of spectrum that can be utilized for clubbing with 900 MHz band to form E-GSM band is given in Table 2.8 below.

Table 2.8
Spectrum that can be carved out of CDMA band

Sl. No.	LSA	No. of Carriers Assigned	No. of Operators	Amount of spectrum assigned in CDMA (MHz)[9]	Spectrum left for liberalisation (MHz)
1	Delhi	11	3	15.11	4.89
2	Mumbai	8	2	11.12	8.88
3	Kolkata	11	4	15.41	4.59
4	Maharashtra	9	3	12.65	7.35
5	Gujarat	10	4	14.18	5.82
6	AP	8	3	11.42	8.58
7	Karnataka	11	4	15.41	4.59
8	Tamil Nadu	11	4	15.41	4.59
9	Kerala	11	4	15.41	4.59
10	Punjab	9	4	12.95	7.05
11	Haryana	7	3	10.19	9.81
12	UP - West	11	4	15.41	4.59
13	UP - East	8	3	11.42	8.58
14	Rajasthan	11	4	15.41	4.59
15	M.P.	7	3	10.19	9.81
16	West Bengal	9	4	12.95	7.05
17	H.P.	5	3	7.73	12.27
18	Bihar	8	3	11.42	8.58
19	Orissa	6	3	8.96	11.04
20	Assam	3	2	4.97	15.03
21	North East	3	2	4.97	15.03
22	J&K	3	2+defence	5.27	14.73

2.90 It can be seen from the above table that 10 MHz of spectrum can be made available for E-GSM in 5 LSAs, whereas at least 5 MHz can be made available in 15 LSAs. Additionally, an existing TSP holding spectrum in 800 MHz band (TTSL)[10] has offered to the DoT to surrender spectrum holding beyond 3.75 MHz in Delhi and Mumbai and spectrum holding beyond 2.5 MHz in other LSAs. In case, the offer of M/s TTSL

[9] Actual channel width is 1.23 MHz. Inter- operator guard band of 0.3 MHz has been considered. Provision of guard band has been kept at the start and end of the 800 MHz band, totaling to 0.98 MHz.
[10] As per press reports.

materializes and is accepted by the DoT, then the amount of spectrum in the 800 MHz band which can be deployed for E-GSM band is as given in Table 2.9.

Table 2.9
Spectrum that can be carved out of CDMA band considering surrender of some spectrum by TTSL

Sl. No.	LSA	No. of Carriers Assigned	No. of Operators	Amount of spectrum assigned in CDMA	Spectrum left for liberalisation
1	Delhi	10	3	13.88	6.12
2	Mumbai	7	2	9.89	10.11
3	Kolkata	10	4	14.18	5.82
4	Maharashtra	7	3	10.19	9.81
5	Gujarat	9	4	12.95	7.05
6	AP	7	3	10.19	9.81
7	Karnataka	10	4	14.18	5.82
8	Tamil Nadu	10	4	14.18	5.82
9	Kerala	10	4	14.18	5.82
10	Punjab	8	4	11.72	8.28
11	Haryana	6	3	8.96	11.04
12	UP - West	10	4	14.18	5.82
13	UP - East	7	3	10.19	9.81
14	Rajasthan	10	4	14.18	5.82
15	M.P.	7	3	10.19	9.81
16	West Bengal	9	4	12.95	7.05
17	H.P.	5	3	7.73	12.27
18	Bihar	7	3	10.19	9.81
19	Orissa	6	3	8.96	11.04
20	Assam	3	2	4.97	15.03
21	North East	3	2	4.97	15.03
22	J&K	3	2+defence	5.27	14.73

2.91 As shown above, it will be possible to allocate 10 MHz of spectrum in 7 LSAs and at least 5 MHz spectrum for the up-link of E-GSM band in all 22 LSAs. In the 900 MHz band, the amount of spectrum available in each

LSA is around 20 MHz (18.6 MHz to 22.2 MHz). In case it is possible to refarm even 5 MHz of spectrum in the 800 MHz band, then it means an addition of more than 25% of spectrum in the 900 MHz band.

2.92 In response to the CP, some stakeholders argued that spectrum in 800 MHz band had been allocated to them till 2017-2024 (validity period of their licence) and it would be against the contract to withdraw the carrier mid way. The Authority is not proposing to take back spectrum from any CDMA operators (except PSUs) in this band. It is only exploring the feasibility of the adoption of E-GSM band by re-arrangement of frequency assignments amongst existing TSPs. Hence, the contention of these TSPs is incorrect and misleading.

2.93 In the proposed E-GSM band (880-890 MHz/925-935MHz), the downlink i.e. 925-935 MHz is presently not allocated for any commercial use. As per NFAP-2011, it has been allocated to Fixed, Mobile and Broadcasting on co-primary basis. Certain spot frequencies in this band have been earmarked for Supervisory Control and Data Acquisition (SCADA). In addition, certain frequency spots in the frequency band 926-926.5 MHz may be considered for very low power cordless telephone systems. Requirement for micro cellular low power telecommunication systems may also be considered at specific locations for indigenously developed systems and technology.

2.94 As per information received from WPC, there are a total of 461 assignments made to various users i.e. Defence, State Electricity Boards, Bombay Municipal Corporation, BHEL, PSUs, ONGC, Railways etc. These assignments have been made for specific locations for captive usage. However, some assignments to Defence exist on an all-India basis spread over 7 MHz within this band.

2.95 For adoption of E-GSM band, it will be necessary to vacate the existing assignments by shifting them to an alternate media or different frequency band. As per discussion with WPC, most of these 461 assignments are quite old and there is a strong likelihood that a large number of these assignments may not be in actual use at present. However, refarming 7 MHz of spectrum presently being used by Defence will require time for discussion between Defence and WPC.

2.96 Further, the Authority has recommended that spectrum in 800 MHz band assigned to MTNL should be resumed back in full and spectrum assigned to BSNL may be taken back partly leaving one carrier of 1.25 MHz with it. As detailed in Table 2.7, both these PSUs have some subscribers in all the LSAs. These subscribers will have to be given advance notice and sufficient time to migrate to an alternate TSP.

2.97 Unlike the 1800 MHz band, where the Government is bound by the order of the Hon'ble Supreme Court to conduct another round of auction in order to ensure that the entire spectrum released as a result of quashing of the licences on 02.02.2012 is put for auction, no such compulsion exists in the case of spectrum in the 800 MHz band, as the directions of the Hon'ble Supreme Court have already been complied with. Therefore, in view of the foregoing, the Authority is of the opinion that the auction in the 800 MHz band should not be carried out now.

2.98 **Therefore, the Authority recommends that the feasibility of adoption of E-GSM should be explored in a time-bound manner. The Authority also recommends that the auction in the 800 MHz band should not be carried out now.**

CHAPTER-III
APPROACHES TO SPECTRUM VALUATION

FACTORS THAT INFLUENCE THE VALUATION OF SPECTRUM

3.1 Spectrum is a scarce natural resource: it is finite and limited by geographical range. Unlike other natural resources which are exhaustible, electromagnetic spectrum cannot be depleted: it is renewable unlike trees in a deforested area, or coal that has been mined.

3.2 Owing to its limited availability, the need for its efficient allocation is appreciated. Pricing of spectrum is important to avert any "tragedy of the commons" problem. If every individual (spectrum user) tries to reap the greatest benefit from a finite common resource, the demand for the resource will overwhelm supply. Every individual who consumes an additional unit directly imposes a cost on others who can no longer enjoy commensurate benefits. Allocation of spectrum through auction leads to efficiency as spectrum is sold to those who value it the most.

3.3 The consumption of spectrum is both rivalrous and excludable. Though it has the potential to be reused and reallocated, its consumption or use by one service provider entails a smaller amount of spectrum available for another to employ as it is scarce; hence, it is rival. To ensure interference-free operations by service providers, spectrum has perforce to be excludable. Several restrictions prevail on the supply side due to its attributes of overall scarcity and rivalry and excludability in consumption.

3.4 The supply of spectrum is also relatively inelastic as the Government controls when spectrum licenses will expire to make it available for re-auction and when new spectrum will be released and how much. Not all spectrum that can be utilized is auctioned. Much spectrum is also used by the Government for non-market purposes like defence. Developing

technologies that can function in new bands or function more effectively in existing bands can however alter the supply side dynamics of spectrum allocation.

3.5 The demand for spectrum as a natural resource is not a direct one like for most commodities. It is derived from the demand for final goods and services that are produced using spectrum as an input. There are many different users of spectrum supplying these final goods and services (e.g. telecom service providers (TSPs), broadcasters, aeronautical users, scientists, the military, etc.). In the case of TSPs, it is telecom consumers who, through their demand for telecommunication services, create a demand for spectrum. The greater the demand for telecom services, the greater will be the demand for spectrum by the TSPs. The demand for spectrum is a derived demand. Valuation of spectrum is determined to a large extent by its demand which, in turn, depends on the willingness and ability to pay of a large number of spectrum users or TSPs who use it as an input in the production of telecom services.

3.6 Telecom services have evolved significantly over the last 30 years, from simple first generation mobile voice telephony in the 1990s to complex 4G technology supporting voice and data transmissions. Over this period, consumers have increasingly demanded extended coverage, faster data transmission rates and more advanced, data-intensive mobile applications. In response, TSPs have deployed ubiquitous, high-capacity radio networks based on state-of-the-art technologies thereby increasing the demand for radio spectrum considerably.

3.7 In a broader sense, the demand for telecom services is influenced by variables like prevailing tele-density, GDP growth rate, unemployment rate, inflation rate, investment in infrastructure and technology, socio-economic characteristics of different age groups of the population etc. If the prevailing tele-density is low, then there is scope for increasing

service penetration. A higher GDP growth rate would invariably point to increased demand for these services; equally, high unemployment and inflation will push demand in the other direction. The usage of services can slow down if economic growth turns sluggish and the sense of personal well-being of the individual is reduced. If people feel poorer either due to a fall in income or a rise in prices, demand for telecommunications services can fall. The prospects of future growth also affect the volume of consumption of telecommunications services in an economy. Consumption levels can rise in a high growth economy as people anticipate higher future incomes. Actual economic conditions as well as potential for economic growth can have an impact on the valuation of spectrum. For example, in Bihar the tele-density is only 45.72%. This implies that more than half the population in the State does not have direct access to telecom services. But with the State witnessing a high GSDP growth rate and huge infrastructure investments, there is immense scope for increase in demand for tele-services in this region.

3.8 It is worthwhile to note that the demand for telecom services need not always get transformed into or get reflected in the demand for spectrum. Though metro cities like New Delhi and Mumbai have immense potential for enlarging the subscriber base due to the continuous inflow of population to these cities, spectrum allotted to these metro circles was left unsold in a recent auction. This is because though consumers create the demand for telecom services, the decision to buy spectrum and, hence, the demand for spectrum is actually made by the TSP. Though the potential market for tele-services might be large, if, say, the average revenue per user is unremunerative, the TSP will not find it profitable to increase operations in the LSA and will not demand the spectrum.

VALUATION OF SPECTRUM: PRICES FROM PAST AUCTIONS

3.9 Since there are no naturally competitive markets for spectrum, valuation of spectrum has to be undertaken through various alternative techniques. A market-based approach is a valuation technique where the value of an asset is calculated based on the prices of actual transactions for similar assets. This is one possible way to determine the value of assets that have no active market. In spectrum valuation, the use of past auction data for valuation is common for several reasons: (i) the items being sold are similar, if not identical (ii) the auction results are freely available; and (iii) these auctions generally are open to a wide variety of participants.

3.10 However, spectrum can be auctioned in a variety of different market sizes and areas. Auction prices for spectrum bands can vary substantially based on the type of spectrum, the geographic areas available, the spectrum holding of existing bidders (competition), the timing of the auction, attendant macro-economic conditions, the business environment and numerous other factors. It is important to understand the facts and circumstances surrounding an auction before drawing a conclusion from the results of an auction.

3G PRICES FROM 2010 AS THE BASE OR ANCHOR PRICE FOR THE AUCTION OF SPECTRUM IN THE 1800 MHZ BAND

3.11 In the recommendations made by TRAI in April, 2012 on "Auction of Spectrum", the prices realized in the 3G auction of 2010 were taken to be the base (or anchor price) on which valuation and reserve prices of spectrum in the 1800 MHz band were computed by the Authority. In the auctions of November 2012/ March 2013, even after application of discounts, spectrum could not be sold in some LSAs and could only partially be sold in a number of LSAs. The auction of November 2012 did not find any bidder for the 800 MHz band. For 1800 MHz band, spectrum

in LSAs of Delhi, Karnataka, Mumbai and Rajasthan failed to find any bidder. Other than Bihar, spectrum in all LSAs was sold at the reserve price. As a result, the Government decided to reduce the reserve price by 30 per cent for 1800 MHz spectrum in the four LSAs where no sale took place. The reserve price of 900 MHz was set at twice the price of 1800 MHz (i.e. either the reworked price or the price discovered through the auction) for those LSAs where spectrum was to be auctioned viz. Delhi, Mumbai and Kolkata. Further, the reserve price for 800 MHz band in all LSAs was reduced by 50 percent in January 2013. In the auction in March 2013, spectrum in this band was sold in only eight LSAs at the reserve price. Spectrum in the 900 MHz band found no bidders.

3.12 The failure (either partial or complete) of the auctions in Nov 2012 as well as March 2013 cannot be overlooked. The point for consideration is the viability of the approach of valuation and pricing of spectrum on the basis of the realized market prices in the 3G auction. In this connection the following question was raised in the CP :

Would it be appropriate to use prices obtained in the auction of 3G spectrum as the basis for the valuation in 2013? In case the prices obtained in the auction of 3G spectrum are to be used as the basis, what qualifications would be necessary?

3.13 Most stakeholders are of the view that prices obtained in the auction of 3G spectrum should <u>not</u> be used as the basis for valuation of spectrum in the forthcoming auction. Since 2010, when the 3G spectrum auction was held, the state of India's economy and that of the telecom sector has deteriorated.One stakeholder has stated that 3G prices were scarcity driven and operators were fearful of being left out of data service growth. Circumstances have changed significantly. Only a few stakeholders opined that 3G auction prices would be an appropriate basis for

valuation of spectrum which remained unsold in the auctions held in November 2012 and March 2013.

3.14 The Authority has considered the points raised by various stakeholders. The Authority is of the view that using past auction prices in determining current spectrum prices can be considered only as long as (a) the spectrum whose values are being compared are identical i.e. the comparison is apple to apple rather than apple to orange; (b) the auction has been conducted in the very recent past and the underlying demand, supply and market expectations in the sector and macroeconomic conditions in the economy have not changed materially over the period i.e. the apple of time period T_0 has the same value as the apple of time period T_1.

3.15 Do the auctions of spectrum in the 2100 MHz (3G) and the 1800 MHz band meet the first criterion? The point to note is that target markets for 3G services (provided on 2100 MHz spectrum) and 2G services (predominantly provided on 1800 MHz spectrum) are different. While 3G is seen as catering to the provision of data services such as video services and other data packet services, 2G provides primarily voice-dominated services with a different eco-system, growth profile and subscriber base. The two services being dissimilar, the spectrum underlying the provision of these services cannot be assumed as identical. For this reason, the Authority is of the view that 1800 MHz spectrum cannot, prima facie, have a relative value similar to the 2100 MHz band, as was assumed in the April 2012 recommendations.

3.16 Do the auctions of spectrum in the 2100 MHz (3G) and the 1800 MHz meet the second criterion? Overall market conditions (both economic and financial) have materially altered during the period in question viz. from May 2010 till today. These changes can be seen in (a) the deteriorating financial performance and overall financial position of the sector, (b) the

general slowdown in the economy and other macro-economic developments and (c) expectations of the future which have altered radically.

3.17 The falling trend of profitability- Earnings Before Interest Tax Depreciation and Amortization (EBITDA), Profit Before Interest and Tax (PBIT) and the rising trend of debt (long term) of telecom access service companies – as brought out in the CP point towards the overall weakening financial health of the TSPs. As per a statement of Deputy Governor RBI, the share of stressed assets in respect of loans to telecom companies on the books of the banks has increased from 1.3% in March 2011 to 15.64% in March 2013.[11]Moreover, the fall in the number of subscribers, minutes of usage per subscriber per month and the declining average revenue per user (ARPU) has adversely impacted the growth of revenue of TSPs.

3.18 In addition to the sector-based measures of growth, the overall economic slowdown has also impacted market conditions in 2013. The GDP growth rate has declined from 8.5% in 2010-11 to 4.8% at the end of 2012-2013, declining in each successive quarter since March 2011. In 2012-13, all quarters have seen falling economic growth hovering around 5%. Growth in the first quarter of 2013-14 clocked in at a meagre 4.4%. The economy's prospects in the near term are not encouraging. There has been a sharp fall in the growth of manufacturing and revival is not around the corner. High retail inflation continues to dog the economy for the fourth year in a row. The large and unsustainable Current Account Deficit (CAD) has prompted action to ensure a flow of foreign capital to finance the deficit. Nevertheless, the steady slide in the exchange value of the rupee continues. And, global economic prospects are not cheerful. In the US, economic recovery is slow; Europe's economy is expected to

[11] Mint Markets- August 22, 2013, Delhi

contract further this year. The other BRICS countries are having their own share of economic woes with growth decelerating, inflation worsening and exchange rate depreciating. These and other developments have further dampened immediate economic prospects for at least the next couple of years.

3.19 In this connection, also noteworthy are the huge variations in the prices achieved in the 3G auction across LSAs. There was aggressive bidding for some LSAs - Delhi and Mumbai- leading to price discovery at much higher levels than anticipated. On the contrary, some LSAs - category 'C' LSAs- were sold at relatively low prices. Part of the explanation is that Metro and category 'A' LSAs were "perceived" as more lucrative than category 'B' and 'C' LSAs from the point of view of providing niche 3G services. Another reason is that allocation of licences (and spectrum) to new entrants in 2008 had created a sense of scarcity of spectrum in the market resulting in a rush for additional spectrum especially in capacity constrained markets. From this perspective, after the quashing of licences on the orders of the Hon'ble Supreme Court, the situation is very different today.

3.20 Fluctuating market interest - aggressive demand and irrational exuberance on the part of bidders in some auctions for 3G spectrum followed by equally inexplicable bearish sentiments in other auctions for the same spectrum - has been observed in other countries. Paul Klemperer in his pioneering work[12] on 3G auctions in Europe in the years 2000 and 2001 clearly brings out the differences in the outcomes of the auctions in similarly placed nations of the European Union. In less than a period of two years, the market sentiment towards 3G auctions changed and resulted in revenues as varied as given in the Table below:

[12]"How (not) to run Auctions: the European 3G Telecom Auction" Paul Klemperer; www.paulklemperer.org Nov 2001 (later published in European Economic Review 2002)

TABLE 3.1

REVENUES FROM EUROPEAN 3G MOBILE SPECTRUM AUCTIONS

(Euros per capita)

Year 2000		**Year 2001**	
Austria	100	Belgium	45
Germany	615	Denmark	95
Italy	240	Greece	45
Netherlands	170		
Switzerland	20		
UK	650		

3.21 According to Klemperer, the initial enthusiasm waned as it became clear that the resultant revenues did not justify the large investments. According to him, "In part there were a number of negative shocks about both the development of the 3G technology itself, and the likely consumer interest in it."[12] Initially, "the values are highly leveraged since they reflect the difference between the (large) expected revenues and (also large) expected costs of developing the required network infrastructures."[12] The euphoria of the initial stage auction is replaced by reasoned bidding as bidders adjust their strategies. In the later auctions the valuations of the opponents become obvious to the bidders as they participate in auctions and it led to more learned bidding. Further, firms with higher financing costs are at a disadvantage as prices rise and difficulties in borrowings can also lead to change in market sentiment. The sum of Klemperer's arguments is that the exuberance of early auctions is replaced by more informed and realistic bidding in subsequent auctions. This brings out the inherent risk of failure if prices for subsequent auctions in India are benchmarked to prices realized in the 3G auctions.

3.22 **The Authority is of the view that conditions in the sector and in the overall economy have changed considerably between the time of the auction of 3G spectrum in the 2100 MHz band and the present, and a comparison of values between the 3G auction and the proposed auction of spectrum in the 1800 MHz band, is not appropriate. Further, there is a large body of evidence emanating from research that initial auctions can yield prices linked to irrational exuberance and subsequent auctions may not be able to match the market sentiment. Keeping all this in mind, the Authority is of the view that an independent assessment of the value and reserve price for 1800 MHz spectrum is the preferred way forward**.

INDEXATION OF ENTRY FEES PAID BY NEW ENTRANTS IN 2001

3.23 Another approach to the valuation of 1800 MHz spectrum in 2013 discussed in the CP is the indexation of the price (entry fee) paid by new entrants to the telecom sector in year 2001 for acquiring licences bundled with 1800 MHz spectrum. Different kinds of indices e.g. the cost inflation index as per the Income Tax Act, State Bank of India's prime lending rate and weighted average cost of capital have been used to estimate the present value of the entry fees received in 2001. The issue for consideration is how far such indexation captures changes in the economic and financial conditions of the telecom sector and of the economy as a whole. In this context, the following question was raised in the CP:

Is indexation of 2001 prices of 1800 MHz spectrum an appropriate method for valuing spectrum in 2013? If yes, what is the indexation factor to be used?

3.24 Most stakeholders are of the opinion that indexation of 2001 prices of 1800 MHz band is <u>not</u> an appropriate method for valuing spectrum in

2013 as huge economic and technological changes have taken place in the last decade. The changes over these two years are just too large to be factored in through mere indexation. One TSP favoured indexation of 2001 spectrum prices using the cost inflation index as per Income Tax Act, 1961, stating that this would be a fair reflection of inflation in the country. A couple of stakeholders said that indexation of 2001 spectrum prices can be used to determine reserve price and using SBI PLR would attract a large number of bidders.

3.25 The Authority notes that prices (entry fee) paid in 2001 reflect demand conditions and economic prospects at that point of time viz. about 12 years ago. The telecom sector and the economy have undergone major changes since then. Moreover, there have been significant advances in technology that have led to new ways of using spectrum and new services for which it can be used. The telecom industry has undergone radical change from the voice-centric usage paradigm to the data-driven and value added services model. The growing economy has set higher benchmarks and desire for services that has driven the growth of the telecom sector and also opened up new areas of expansion. These developments clearly indicate that merely indexing the prices of 2001 cannot capture the effect of all the changes that have occurred in the intervening period. Indexing may be good for measuring valuations over a shorter time period, but certainly not over the long haul.

3.26 **The Authority is of the view that indexation as a methodology for valuation of spectrum in 2013 from base data of 2001 is too simplistic and restrictive and does not encapsulate all the changes in expectations, the state of the market and overall economic conditions over the intervening period. Hence, it is not feasible to adopt this methodology for valuing spectrum in 2013.**

PAN–INDIA APPROACH VERSUS LSA LEVEL APPROACH TO VALUATION OF SPECTRUM

3.27 There can be two alternative approaches to fixing the valuation of spectrum and reserve price: 1) A pan-India or top-down approach, or 2) An LSA level or bottom-up approach.

3.28 With a top-down approach, the valuation of spectrum and reserve price are determined on the basis of over-all revenue expectations from the sale, given the general conditions in the market for telecom services. For example, in the recommendations on allocation and pricing of spectrum for 3G and broadband wireless access services dated 27th September 2006, the Authority, while determining the value and fixing the reserve price for 3G spectrum in the 2.1 GHz band, had adopted a top-down approach.

3.29 An alternative approach could be to fix the valuation of spectrum and the reserve prices in a bottom-up manner i.e. starting with the LSAs and arriving at a pan-India price through summation of the prices of individual LSAs. In this case, relative prices for different LSAs are not decided a priori on any pre-determined basis.

3.30 The issue for consideration is the choice between the two approaches. In the CP, the following question was posed:

Should the value of spectrum for individual LSAs be derived in a top-down manner starting with a pan-India valuation or should valuation of spectrum for each LSA be done individually?

3.31 Most stakeholders are of the opinion that value of spectrum should be assessed for individual LSAs using a bottom-up approach. Each LSA is unique in terms of demand/supply, income/expenditure pattern, economic growth, population, topography etc. Two stakeholders opined

that the value of spectrum should be done on a pan-India basis as every prospective bidder wants to be (or is likely to be) a pan-India operator (today or in the future) and would evaluate the business on a pan-India basis.

3.32 In India, at present, we have a service area-wise telecom licensing framework. For the purpose of telecom licensing, the country is divided into 22 LSAs. Since the licenses are granted by LSA, TSPs have the freedom to take license(s) for operation in one LSA, or more than one LSA, or for pan-India operations.

3.33 The Authority notes that each LSA is distinct from the point of view of telecom related parameters such as tele-density, level of competition amongst market players, cost structure of operations etc., all of which are likely to have an impact on the price of spectrum in the LSA. Further, LSAs differ in terms of population size, population density, economic growth, per capita income, average household expenditure, nature of terrain, climate and geographical location etc. Thus each LSA is unique in terms of characteristics and therefore each is likely to have a unique sale value. The valuation of spectrum and determination of the reserve price as an independent exercise for each LSA makes more sense than arriving at a pan-India value first and then working backwards to fix values across LSAs. By adding the individual valuations of all the 22 LSAs, one can always compute the pan-India value of spectrum.

3.34 **The Authority is of the opinion that the exercise for valuation of spectrum should capture the special characteristics of the market in each LSA. The Authority has, therefore, chosen to adopt an LSA-level approach rather than a top-down approach to the valuation of spectrum and determination of reserve price.**

TECHNICAL EFFICIENCY AND ECONOMIC EFFICIENCY OF SPECTRUM

3.35 Spectrum in different bands differs in respect of technical efficiency i.e. transmission or propagation characteristics. This factor has an important bearing on the value of different bands of spectrum. Ceteris paribus, the higher the frequency, the more the power required to provide a given amount of coverage and the less the ability of the radio signal to penetrate buildings and other tangible obstacles. A network built around lower frequency spectrum costs less to build than a network built around higher frequency spectrum, as the strength of the signal requires fewer cell sites to be built. With some exceptions therefore, the higher in frequency the spectrum band is, the lower is its value.

3.36 Cell sizes, or equivalently inter-BTS distances, are determined by the following two factors: i) The need to cover an area ii) The need to support a subscriber density with a specified traffic volume. Propagation characteristics determine the size of the cell in areas of low caller density and low traffic. These areas can be called `coverage limited areas.' Such areas are more likely rural areas rather than urban and semi-urban areas.

3.37 In valuing spectrum with better propagation characteristics, one approach could be to simply establish relative values using indexation factors based on relative technical efficiency. For example, if the number of base stations required for coverage of the same area in UMTS 1800 is 1.3 times less than the requirement in UMTS 2100, the value of 1800 MHz spectrum could be fixed as simply 1.3 times that of 2100 MHz spectrum. This approach has been adopted by TRAI in past exercises for the valuation of spectrum.

3.38 An alternate approach would be to derive relative valuations for different spectrum bands based on cost trade-offs when operations are switched

from a technically more efficient band to a technically less efficient band. This approach translates relative technical efficiency to cost savings in operations and postulates that these cost savings are approximately equal to the premium that an operator might be willing to pay for spectrum in the technically more efficient band as compared to spectrum in the technically less efficient band.

3.39 These ideas have been elaborated in the CP in the context of valuation of 900 MHz spectrum. The question raised, the stakeholder comments and analysis and recommendation of the Authority in this regard form a part of a subsequent chapter dealing with the valuation of 900 MHz spectrum.

LIBERALISATION OF SPECTRUM USE, WIDTH OF THE SPECTRUM BAND, AVAILABILITY OF SPECTRUM IN CONTIGUOUS BANDS AND EFFECTS ON VALUATION

3.40 While approaching the issue of valuation of spectrum, the impact on valuation of regulatory restrictions and availability of spectrum in optimum commercially exploitable tranches must be kept in mind. Restrictions on use can impact the value of spectrum. Spectrum bands with less regulatory restrictions and more flexibility in use would typically have greater value. Liberalisation of spectrum enhances the value of spectrum by removing technology restrictions so that the holder of the spectrum has the option of deploying alternative technologies on the same.

3.41 Within a number of spectrum bands, some spectrum is set aside for non-commercial use. Spectrum in such bands may command a lower value than similar spectrum without such reservations for specific non-commercial use.

3.42 The width of the spectrum band also impacts the value of the spectrum to a certain extent. For a cellular or broadband operator, the amount of

spectrum is important, as having too little spectrum in a market can negatively impact the network's performance, which is directly related to the consumption of the services by the end user. Larger bandwidth spectrum will generally have greater value.

3.43 The value of spectrum will also be a function of the extent of interference protection that spectrum holders will be offered/required to offer to/from services authorized in:

– adjacent frequency bands within the same country
– the same frequency band within the same country
– the same frequency band in adjacent countries

3.44 Also, there may be legacy issues which delay the availability of the spectrum band until incumbent services - including non-commercial holdings such as by defence authorities - in the band in the same country or other countries have been phased out. The non-availability of spectrum in contiguous bands in some LSAs in India could have important consequences on the valuation of spectrum, as will be seen later in our discussions (refer Chapter IV para 4.42).

3.45 Another factor that is increasingly likely to impinge upon the valuation of spectrum is the growing concern of populations around the world, unfounded or otherwise, regarding the potential hazards to public health from exposure to electromagnetic radiation from the proliferation of base stations. This has led to several constraining Court judgments, legislations and regulations to ensure protection of the public against electromagnetic fields. This naturally constrains development of networks in higher frequency bands, because creating new base station sites becomes difficult. Naturally, this would depress the value of such spectrum.

VALUATION OF SPECTRUM: SINGLE APPROACH VERSUS MULTIPLE APPROACHES

3.46 Valuation is undertaken to determine reserve prices in spectrum auctions. An attempt is made to replicate the kind of estimates bidders may be expected to make in designing their bidding strategies.

3.47 The economic valuation of spectrum depends on numerous variables. In functional form, one may posit that valuation of spectrum is a function of available market information I; technological factors T; macro and micro economic variables E. Or, more simply;

$$\mathbf{V= f (I, T, E)}$$

3.48 Spectrum valuation is also highly situational. It is important to note that there is no single value that applies for all situations. It varies over time, from market to market and from transaction to transaction. Quite simply, different users will value a particular band differently at different times. A deterministic approach to the valuation of spectrum is, therefore, more likely than not, to be off-the–mark. The best that can be done is to approach the matter from several different angles to arrive at a probabilistic "average" or overall basic valuation.

3.49 The market based valuation approach has already been discussed in a previous section. This is a valuation methodology in which the value of spectrum is calculated based on empirical data on the prices of actual transactions for the same or similar assets sold in the past. In combination with such comparative estimates, it is also possible to undertake direct valuation of spectrum. One approach is to use the concept of opportunity cost. In terms of spectrum, opportunity cost is relevant because of the array of costs and benefits associated with spectrum's role as an input to commercial services. It is the cost of the most economically rational alternative. In practical terms, if it becomes

cheaper or more profitable to pursue alternative methods of network expansion and decongestion, such as setting up of more Base Transceiver Stations (BTS) than to bid for spectrum, the rational actor will stop bidding and choose the more economical alternative. Opportunity cost assessments generally reflect the estimated price markets would place on spectrum at an auction. In this way, spectrum would be a "cost" like any other input into the production process and market players would make informed judgments about their use of spectrum and available alternatives. In the world of business, a decision to bid on spectrum would not only be based on costs, but also on a projection of future traffic or revenues, after analysing the efficiency and capability of technologies and the marketability of the resulting applications that the spectrum will support. Approaches to the valuation of spectrum could also factor in forecasts of potential traffic or revenues. Finally, there are numerous exogenous factors that apply differently in each country because of physical or demographic characteristics, historical, cultural or legal heritage or more pertinently, as a result of national government policies and regulations that are crucial to a real-world valuation of spectrum.

3.50 To assess the value of spectrum, various approaches have been adopted rather than selecting one particular methodology of valuation, as it is simply not possible to say deterministically that any one valuation is the 'right' valuation. Each model has certain strengths as well as limitations. Where some models better capture intrinsic technical features, others are more strongly grounded in economic and market realities. No one model completely captures every variable- technical, economic, sectoral, geographic and regulatory- that influences the valuation of spectrum. These recommendations, therefore, present a reasonable valuation obtained from an appraisal of the results of different models, which, to the best of the Authority's belief, has a high probability of realisation in

the actual world. The Authority believes it is better to be vaguely right rather than precisely wrong.

VALUATION AND RESERVE PRICES

3.51 A reserve price refers to the minimum amount that the owner of an item put up for auction will accept as the winning bid in the auction. The reserve price prevents the auction from being won at a price lower than the minimum the owner is ready to accept.

3.52 A reserve price is used primarily for two reasons a) to increase revenue from the auction b) to avoid collusion. These two objectives need to be balanced. A low reserve price may lead to a collusive outcome and loss of revenue. Paul Klemperer observes as follows, "Because an ascending auction effectively blocks the entry of weaker bidders it encourages stronger bidders to bid jointly or to collude."[13] Referring to the outcome of the disastrous Swiss 3G auction, he goes on to say, "Many of the disasters were greatly aggravated by the failure to set a proper reserve price. Inadequate reserves also increase the incentives for predation and may encourage collusion that would not otherwise have been in the bidders' interests. A stronger bidder in an ascending auction has its choice between either colluding to end the auction quickly at a lower price, or forcing the price up to drive out weaker bidders. The lower the reserve price, the more attractive the first option."[13] On the other hand, a high reserve price may result in spectrum remaining unsold. When spectrum is not sold, the revenue to Government is in any case zero. This is what happened in many LSAs in the Indian spectrum auctions of November 2012 and March 2013. It is important to keep this aspect in mind while arriving at an optimal reserve price.

[13] Auctions: Theory and Practice by Paul Klemperer, Princeton University Press, 2004.

3.53 The computation of an optimal reserve price requires two pieces of information:

- The range of possible valuations of the spectrum
- The probability of each valuation being realised.

3.54 The reserve price is clearly related with the valuation of spectrum. It is important to note however that it is not the eventual realized price in the auction. The reserve price is the starting point for an ascending price auction and bidding is a means to price discovery. A reserve price set lower than the a priori expected value of the object will enable price discovery and the final bid price is likely to be much higher than the reserve price. The reserve prices should not be too close to the estimates of valuation, and must be lower than these estimates, to enable competitive bidding and price discovery. A reserve price too close to estimations on valuations may discourage the bidders from participation in the auction. The issue for consideration relates to the setting of reserve price as ratio or percentage of the valuation of spectrum.

3.55 In this connection, the following question was raised in the consultation paper:

What should be the ratio adopted between the reserve price for the auction and the valuation of the spectrum?

3.56 Most stakeholders while agreeing that reserve price should be fixed as a percentage of spectrum value, have suggested percentages ranging from 25% to 100%. While some stakeholders have opined that the reserve price should be kept low to encourage participation and make the auction successful, other stakeholders are of the view that the reserve price should be kept high to prevent collusion. One stakeholder has suggested 0.46 times as the ratio for the 900 MHz band and 0.75 times

as the ratio for the 1800 MHz band. Another stakeholder has opined that the reserve price of all spectrum bands - 800 MHz/900 MHz/1800 MHz- should be kept uniform as the efficient band will attract higher auction value and will find its market value. One stakeholder is of the view that auction may be done without prescribing any reserve price with a condition that in case auction price is not satisfactory from the DoT's perspective, then the auction can be reconvened based on a reserve price recommended by TRAI.

3.57 The Authority has considered the matter. The Authority is of the view that the failure to sell spectrum in many LSAs in the last auctions of November 2012 and March 2013 has been a setback for both the Government and the industry as the value embodied in the unsold spectrum has not been realized. The primary task is, therefore, to ensure that spectrum is sold in the forthcoming auction and the impasse does not continue.

3.58 As stated earlier, the computation of an optimal reserve price requires information on the range of possible valuations of the spectrum and the probability of each valuation being realized. It is difficult, if not impossible, to calculate the complete range of all possible valuations. However, some estimates of valuation of spectrum can certainly be attempted. From some estimates of valuation, it is possible to work out an average valuation as the simple mean of the estimates at hand. As far as the reserve price for the auction is considered, the average valuation itself could be taken as the reserve price. The drawback of this method is that there is no way of knowing whether the theoretical optimum, i.e. the mid-point of a complete range of valuations has been achieved. The danger is that it may end up fixing the reserve price on the higher side. It is also observed that reserve prices in spectrum auctions around the world are around 45-55% of the final prices realized in the auction. The

Authority is conscious of the fact that the average valuation of spectrum is not, and can generally be expected to be lower than, the final auction price. Economists Michael Ostrovosky and Michael Schwarz have observed in the context of Internet Advertising auctions that "reserve prices actually observed in real world auctions are substantially lower than the theoretically optimal ones". [14] Brown and Morgan report the results of field experiments on auction of collectible coins conducted on Yahoo! and E-Bay. They find that "positive reserve prices set at a level of 70% of the purchase price of the coins from the dealer, lead to significantly higher revenues and lower number of bidders relative to zero reserve prices". [15] Taking all these factors into consideration, and in line with the approach adopted by the Authority in 2012, **the Authority has decided that the reserve price for the forthcoming auction should be fixed at 80% of the average valuation.**

3.59 While the reserve price can be derived from the valuation of spectrum, the Authority is of the view that setting a reserve price is a distinct exercise that would be influenced by several practical considerations as well. In the context of auction design, Paul Milgrom noted, '…designing real auctions raises important questions for which current theory currently offers no answer….. Because of such limits to our knowledge, auction design is a kind of engineering. It entails practical judgments guided by theory and all available evidence, but it also uses ad hoc methods to resolve issues about which theory is silent."[16]The Authority is of the view that this position applies as well to the setting of reserve

[14]Reserve Prices in internet Advertising Auctions: A Field Experiment by Michael Ostrovosky and Michael Schwarz (2009) Research Paper Series, Stanford Graduate School of Business.

[15]Jennifer Brown and John Morgan (2009), "How much is a dollar worth? Tipping versus equilibrium co-existence on competing online auction sites," Journal of Political Economy.

[16]Putting Auction Theory to Work:the Simultaneous Ascending Auction- Paul Milgrom (1999) Policy Research Working Paper Series, the World Bank

prices for auctions. There are limits to theoretical models. If the theoretical model sets a reserve price that is too high, this may deter bidders, bring down the level of competition and, at worst, cause the auction to fail. Regardless of the results of valuation of spectrum, if a certain reserve price has recently been rejected by the market, there is no point in setting a new reserve price equal to it or higher than it. Similarly, special circumstances, if any, attendant on any of the markets in which spectrum is being sold will need to be kept in mind while deciding the reserve price. These rationales have been kept in mind by the Authority in the approach to setting of reserve price for the different bands of spectrum described in the succeeding chapters.

SCOPE OF THE CURRENT VALUATION EXERCISE

3.60 During the two auction exercises held in November 2012 and March 2013 by the DoT, no bids were received for spectrum in 4 LSAs in 1800 MHz band (Delhi, Mumbai, Karnataka and Rajasthan).Where spectrum was sold in 1800 MHz, the price realized was the reserve price except in the case of Bihar, where the realised price (Rs 37.14 crore per MHz) was higher than the reserve price of Rs 34.01 crore per MHz.

3.61 The issue that arises is whether valuation and reserve prices need to be determined only for LSAs in which sale of spectrum did not take place in 1800 MHz during the last auctions held in November 2012 and March 2013, or for all LSAs. In the present exercise, one possible alternative is to determine the valuation of spectrum for only those LSAs in which spectrum was not sold in the auctions held in November 2012 and March 2013, on the ground that in respect of those LSAs in which spectrum was sold in November 2012/ March 2013, price discovery has already taken place as recently as 5-10 months ago and the market discovered price should be the basis for current valuation. An alternative is to determine the valuation in <u>all</u> LSAs, on the ground that purchases made

in November 2012/ March 2013 by TSPs whose licences were cancelled by the Supreme Court were in the nature of "distress purchases" and the prices paid cannot be construed as true price discovery.

3.62 In view of the above, the CP sought stakeholder comments on the following question:

Should the valuation of spectrum and fixing of reserve price in the current exercise be restricted to the unsold LSAs in the 1800 MHz band, or should it apply to all LSAs?

3.63 Some stakeholders are of the opinion that the current exercise should include valuation of 1800 MHz band in all LSAs including the 18 LSAs in which spectrum was sold in the November 2012 auction. They have argued that prices discovered in the 1800 MHz band for 18 LSAs in November 2012 were in the nature of "distress buying" by bidders and cannot be termed as market discovered prices. On the other hand, some stakeholders have opined that the current exercise should be limited to valuation of spectrum in 4 unsold LSAs only. One stakeholder has suggested that in addition to the 4 unsold LSAs, valuation may be relooked at for those LSAs in which spectrum was partially sold in the November 2012 auction.

3.64 The Authority has carefully considered the matter. Some TSPs who participated in the auctions held in November 2012 and March 2013 purchased spectrum because of cancellation of their licences by the Hon'ble Supreme Court's judgment dated 2nd February, 2012. The fact that spectrum was sold at the reserve price in all but one of the LSAs points to the fact that the free play of market forces could not quite take place in the November 2012/ March 2013 auction. However, the realised price of spectrum in LSAs where spectrum was successfully auctioned in November 2012/March 2013 can certainly be taken as one of the

indicators of the value of spectrum. **The Authority has decided to recommend fresh valuations and reserve prices for 1800 MHz spectrum in all LSAs.**

CHAPTER-IV
VALUATION AND RESERVE PRICES FOR DIFFERENT BANDS

1800 MHZ BAND

Valuation of 1800 MHz Spectrum: Alternative approaches

4.1 There are several alternative ways of determining the value of spectrum in the 1800 MHz band. To arrive at value estimates for the 1800 MHz band, the following approaches have been used.

MARKET DATA ANALYSIS

Estimation of value of spectrum in four unsold LSAs based on sale price in 18 LSAs

4.2 In the 1800 MHz band, spectrum in LSAs of Delhi, Karnataka, Mumbai and Rajasthan failed to find any bidder in the auction held in November 2012 and March 2013. The high reserve price was cited as a reason for failure of the auction by TSPs. Since these 4 LSAs did not find any bidder at the reserve price announced by the Government, the question at hand is how to re-assess the value of the spectrum in the 1800 MHz band in these 4 LSAs. A possible approach is to value spectrum based on market information revealed from the auction of November 2012 when spectrum in the 1800 MHz band was sold in 18 LSAs. The sale prices realised in these 18 LSAs can be correlated with other relevant variables to estimate values of spectrum in the 4 unsold LSAs. The exercise can be done using a single explanatory variable one at a time for representative LSAs or through multiple variable regression.

4.3 In this context, the following question was raised in the CP:

Should the value of spectrum in the areas where spectrum was not sold in the latest auctions of November 2012 and March 2013 be estimated by

correlating the sale prices achieved in similar LSAs with known relevant variables? Can multiple regression analysis be used for this purpose?

4.4 The multiple regression approach has been supported by some stakeholders. One of the TSPs argued that multiple regression analysis could be of some use but data from other countries should also be included. Some stakeholders expressed concern about the low number of observations available; this could lead to high goodness of fit while individual regression coefficients remain insignificant. One of the TSPs has tried to duplicate TRAI's regression analysis, getting similar results for the 4 unsold LSAs. Concerns about the negative coefficient for population as an explanatory variable in some of the combinations have been raised; it has been stated that this is not in line with a priori expectations. One stakeholder has argued that econometric analysis provides an objective way of controlling for market and economic factors, and therefore offers a more promising way forward than simply taking values from other auctions. Moreover, it does not rely on direct comparison of LSAs – instead, it uses estimated relationships between observed spectrum prices and explanatory variables (e.g. economic and demographic factors) to predict a value for an LSA based on the LSA's own economic and demographic circumstances.

4.5 Some stakeholders are not in favour of multiple regression, arguing that the basic assumption of the sample being representative of the population for multivariate regression analysis is not met; since prices for Delhi and Mumbai cannot be compared with other LSAs, the proposed multivariate regression model would not be a good fit to estimate spectrum valuation in Delhi/Mumbai. Also, simple correlations do not account for the effects of any other factors such as technological changes, market expectations etc. on the value of spectrum. Others are of the view that the November 2012 and March 2013 auctions do not reflect the true intrinsic value of the spectrum since bidders' licenses

were cancelled and they had no option but to pay these prices for business continuity (i.e. their purchases should be considered as 'distress purchases'). As no competitive bidding took place and there was no market discovered price, the stakeholders contend that it would be completely inappropriate to use any reference from these failed auctions.

4.6 Some stakeholders have opposed the methodology of correlating spectrum price with a single variable saying that the sale price in LSAs where spectrum was not sold in the last auction in November 2012 may not have any co-relation with the sale price in similar LSAs. Since every LSA has unique characteristics in terms of demography, population, per capita income, market dynamics, opportunity etc., the sale price of one LSA cannot be correlated with that of another. Also, simple correlations do not account for the effects of any other factors such as technological changes, market expectations etc. on the value per MHz as pointed out by the Authority.

4.7 One of the TSPs is of the view that the reserve prices for the 4 unsold LSAs were benchmarked to 3G auction results and therefore they are representative of true economic value of the spectrum; hence no revision is warranted. Any other basis of valuation such as correlating value to the sale price achieved in similar LSAs would be arbitrary and may lead to litigation. Further, according to them, some TSPs acted as a cartel in the recently held auctions which has caused huge loss to the exchequer as alleged by the Comptroller and Auditor General of India (CAG). Thus, any downward revision in prices should not be considered. While opposing the above contention, another TSP has argued that the absence of participation in the March 2013 auction was not evidence of a cartel, but it reveals that the reserve prices were set too high.

4.8 The Authority has examined the comments of the stakeholders. As far as the multiple regression model is concerned, there are practical difficulties

in adopting data from other countries in the sample in an LSA-wise bottom-up approach. Even in a top-down approach, it is difficult to accurately iron out inter-country differences with the help of standardising factors. It would, therefore, not be possible to compile meaningful inter-country data for the variables used in the regression analysis.

4.9 One of the concerns expressed is that the variable "population" has a negative coefficient in some of the regression results i.e. the model predicts that the greater the population, the lower the value of spectrum per MHz, which appears to be, prima facie, counter-intuitive. The results are partly justified by the nature of the sample data. The realised prices in LSAs with very high population, such as Bihar, UP (East), West Bengal etc. were comparatively low as compared to realised prices in LSAs with equal or smaller population, such as Andhra Pradesh, Tamilnadu and Gujarat. Nevertheless, taking into account stakeholder concerns, the multiple regressions have been re-run using alternative combinations including additional variables such as GDP per capita and AGR per population, which yield positive coefficients for population. These combinations yield robust results with R^2 above 0.77 and statistically significant coefficients.

4.10 There are limitations to methods using single variable correlations as well as multiple regressions for arriving at spectrum valuation. The effect of technological changes, market expectations and unique conditions in specific LSAs are not necessarily all captured. The sample data set (18 observations) is also not large. However, these methods have one important advantage: they make use of real market information that has been revealed in recent auctions and actual empirical data. The sale prices of the recent auctions are not directly being used as anchor or base prices. Correlating the sale prices realized in LSAs in which

spectrum was sold in November 2012 with relevant observable variables such as revenue (AGR), productivity(ARPU), potential (existing and residual tele-density) etc. yields a broad idea of the value of spectrum in the LSAs in which spectrum was not sold. **The Authority is, therefore, of the view that the method of estimating value of 1800 MHz spectrum in the 4 LSAs in which spectrum sales did not take place in the auctions of November 2012/March 2013 by correlating and establishing statistically significant relationships between the prices realised for spectrum in the LSAs where spectrum sales did take place and known observable and relevant variables can be used as a method for estimating the value of 1800 MHz spectrum.**

4.11 The data sources and variables used, the methodology followed and results obtained for these computations are at **Annexure 4.1.**

4.12 Some stakeholders averred that TSPs had formed a cartel to stay away from the auctions in November 2012 and March 2013, and that it was this 'fact', rather than a high reserve price that led to the failure of the auctions. The Authority noted that spectrum was sold in the auction, though some blocks in most LSAs and all blocks in 4 LSAs did not find any takers. The Authority further noted that one major existing TSP voluntarily purchased spectrum for 14 LSAs and another major existing TSP in one LSA in these two auctions, apart from TSPs whose licensees were cancelled by the Supreme Court. This empirical fact runs directly counter to the theory of collusive behavior through a cartel. In fact, the theory of collusive behaviour assumes that there is a high degree of co-ordination and commonality of interests, and a complete absence of rivalry amongst the TSPs; this proposition lacks credibility given market realities. In fact, some TSPs whose licenses were cancelled by the Supreme Court did not buy spectrum in some LSAs even though it meant closure of their business in these areas. This fact lends credence to the

theory that some reserve prices were just too high. The Authority is, therefore, of the view that there is little evidence to establish collusive cartel-like behavior in the context of the 1800 MHz auction and high prices played a contributory role in the failure (total or partial) of the auction.

Estimation of value of spectrum in 8 LSAs based on sale price in 14 LSAs

4.13 Some stakeholders said that realised prices in 1800 MHz in the November 2012 auction were prices paid for 'distress purchases' and hence these prices cannot be construed as valid market information on revealed value. The Authority notes that two kinds of bidders purchased 1800 MHz spectrum in the November 2012 auction: bidders whose licences had been cancelled by the order of the Hon'ble Supreme Court dated 2nd February 2012, and bidders who were existing TSPs adding to their spectrum holdings. While it could possibly be interpreted that bidders in the former category were compelled to buy spectrum to continue operations, the same interpretation does not hold good for the latter category whose purchases were clearly voluntary. Bidders in the latter category bought spectrum in 14 out of 18 LSAs where spectrum was sold. To remove the effect of any possible 'distress purchases' on the estimates of value, a modified multiple regression model can be fitted around the realised prices in the 14 LSAs where bidders in the latter category purchased spectrum and the results can then be used to estimate values in the remaining 8 LSAs. The results obtained from the foregoing exercise are also tabulated in **Annexure 4.1**. Although the number of data points is reduced in this model as compared to the model with prices for 18 LSAs, the results are significant-the p-value is less than 15% for all the variables and R^2 is 0.82. **In the Authority's view, these values should also be taken into consideration in arriving at an average valuation.**

OPPORTUNITY COST

Estimating the value of spectrum based on producer surplus on account of additional spectrum

4.14 Spectrum can also be valued on the basis of the producer surplus that arises when additional spectrum is allotted to an existing TSP. As there is an inverse relationship between the quantum of spectrum allocated and the expenditure on radio access network (RAN) required for serving a particular level of demand, the allocation of additional spectrum to an existing TSP will create a producer surplus. The model is a bottom-up approach to determine the opportunity of cost savings to an average TSP in the RAN upon getting additional spectrum (opportunity/MHz).

4.15 The following question was posed in the CP:

Should the value of spectrum be assessed on the basis of producer surplus on account of additional spectrum? Please support your response with justification. If you are in favour of this method, please furnish the calculation and relevant data along with the results.

4.16 One TSP, while supporting the method, has pointed out that the producer surplus approach to valuation (which is also called the avoided cost approach) has been used by a number of regulators to inform reserve prices.

4.17 The producer surplus approach hinges on the inverse relationship between the quantum of spectrum available with an operator and the costs incurred in servicing a subscriber base. Some stakeholders have opined that technical value alone is not sufficient to estimate spectrum valuation. It gives a limited view of the business dynamics and ignores the non-network related expenses as well as other factors like competition intensity, subscriber base, tele-density, and voice and data revenue; this is not realistic as the system planning of mobile networks is

dependent on a large number of factors. Some stakeholders said that the producer surplus approach does not include any revenue related impacts from having additional spectrum. Some opined that the method ignores green field/new operators. One argument was that the cost saving at the margin will not carry through to the entire block of spectrum. Also, some stakeholders have stated that the results are very sensitive to changes in the input assumptions, and several assumptions have to be made about the evolution of the mobile market and the timing of future spectrum releases in India over the next 20 years. M/s Vodafone has submitted a description of the producer surplus model, which they have developed for 5 LSAs- Delhi, Mumbai, Rajasthan, Karnataka and Orissa- for a typical operator. However, in the absence of source of input data and basis of assumptions used in the model, the veracity of the results obtained could not be ascertained.

4.18 Considering all of the above, it can be said that the method has not been strongly supported by stakeholders. However, the reasons adduced by them, namely that the model is only technical and does not capture ground level data in the markets in the different LSAs, appear to be based on a misunderstanding of the methodology. The model incorporates LSA-specific real world data relating to costs of operation, demand, subscriber growth, market concentration, and spectrum availability.

4.19 The producer surplus model focuses on the marginal savings resulting from acquisition of additional spectrum for an average TSP. These marginal savings could translate into the amount that a potential bidder may be willing to pay for additional spectrum. The Authority is aware of the fact that any valuation methodology has some limitations and no one method can exactly mimic the real world situation. The Authority is, therefore, of the view that valuation methodologies that are logically

consistent and yield viable results should be appraised with an open mind. Accordingly, **the Authority decided to run estimations of the value of 1800 MHz spectrum based on the producer surplus model using available data and industry benchmarks. The valuations obtained from this method will also be utilized in arriving at an average value for 1800 MHz spectrum.** The detailed methodology used in this model and the results obtained are at **Annexure 4.2.**

Estimating the value of spectrum using a production function approach

4.20 Spectrum valuation can also be derived by taking spectrum and BTS as two factor inputs to estimate a production function to produce mobile traffic or minutes of usage. The Cobb-Douglas production function is a commonly used functional form for estimating the relationship between inputs and output. The form of the production function is specified as:

$$X = Ay^{\alpha}z^{\beta}$$

4.21 The above specification is based on the assumption that the two inputs spectrum and BTS can be substituted for each other over a range of output. An optimal mix will be used by the TSPs to produce the required traffic and this optimal mix is determined by input prices. A higher charge for spectrum will induce TSPs to substitute spectrum for the less expensive BTS to produce the same number of minutes, and vice versa. One way of estimating the value of 1800 MHz spectrum is to take a panel data set of minutes of traffic, spectrum allocated and BTS in different LSAs over a past period and estimate the coefficients of the production function which can then be used to derive the value of spectrum across LSAs.

4.22 The following question was raised in the CP:

Should the value of spectrum in the 1800 MHz band be derived by estimating a production function on the assumption that spectrum and BTS

are substitutable resources? Please support your response with justification. If you are in favour of this method, please furnish the calculation and relevant data along with the results.

4.23 One stakeholder while supporting the above methodology has raised the concern that spectrum blocks are not homogenous units and so, there is a need to convert each block into effective spectrum i.e. the portion in excess of the 3 MHz required for "administrative purposes". Many stakeholders are of the opinion that the value of spectrum should not be estimated using a production function as BTS and spectrum are not completely substitutable and dynamically adjustable in a mobile network. The assumption that operators can continuously optimize their balance of base station and spectrum inputs is unrealistic. The relationship between spectrum and BTS as substitutable resources is not linear and depends heavily on the quantum of spectrum and the cost of BTS and associated infrastructure; further, the output elasticity of factor inputs is not constant. Some stakeholders' comments include the following: the Cobb-Douglas production function does not adequately account for change in technology, it overlooks the impact of revenues and other costs in providing mobile services, and it does not apply to green field valuations of spectrum.

4.24 Most stakeholders have not favoured this methodology. The method has its limitations: any economic modeling involves both assumptions and a degree of abstraction. Any such model cannot possibly precisely reflect the real world. The point at issue is whether it is able to capture key aspects, provide a reasonable approximation thereto, and thereby provide insights. The nature of the data used (panel data from the past years for existing TSPs) implies that the analysis is more suitable for mature operators as opposed to new entrants who are likely have a very different BTS-spectrum trade-off as they focus on customer acquisition and network coverage. For mature TSPs, equivalent cost savings are reckoned

for additional spectrum (or BTS) on the assumption that these operators are past the coverage stage and additional spectrum (or BTS) would be utilized to provide capacity.

4.25 However, like the producer surplus model, the production function approach captures the aspect of opportunity cost as a determinant of value. This method was also used in TRAI's Report of February 2011 on "The 2010 value of spectrum in the 1800 MHz band" for estimating the value of incremental spectrum. The base data required to develop this model is available with TRAI. As mentioned earlier, almost all methods of valuation of spectrum suffer from limitations arising from the nature of their focus and the underlying assumptions made. The approach of the Authority is to keep an open mind to all reasonable methodologies that yield valid results and to arrive at a range of possible valuations. **The Authority has, therefore, decided to use the results of the production function approach as well in the computation of an average value for 1800 MHz spectrum.**

4.26 The detailed methodology of this model and the results are at **Annexure 4.3**.

OTHER APPROACHES

4.27 Various approaches adopted by the Authority in estimating the value of spectrum are explained in the preceding paragraphs. To obtain insights into alternative approaches to the valuation of spectrum, the following question was raised in the CP:

Apart from the approaches discussed in the foregoing section, is there any alternate approach for valuation of spectrum that you would suggest? Please support your answer with detailed data and methodology.

Discounted Cash Flow

4.28 Some stakeholders have suggested that the Discounted Cash Flow (DCF) methodology should be used for the valuation of spectrum. They have stated that DCF analysis is widely used for all major investment decisions by TSPs in the telecom industry, including acquisition of spectrum. The net present value (NPV) arrived at using DCF methodology represents the maximum amount which the investor would like to pay for acquisition of an asset (in this case access to spectrum for a period of 20 years).

4.29 One stakeholder has calculated the value of the spectrum using the DCF methodology adopting a full industry value approach. The present value of the cash inflows of the total Indian mobile industry has been computed and this has been divided by the total quantum of available spectrum in 800 MHz, 900 MHz, and 1800 MHz bands to arrive at a per MHz value of spectrum. To compute LSA- wise spectrum value, a bottom-up approach has been used. It has, however, been acknowledged by the stakeholder that the DCF method suffers from inherent limitations arising from erroneous assumptions, and inaccurate and inadequate inputs.

4.30 The submission of the stakeholder using DCF methodology has been examined. The method relies on the estimated cash flows of the entire mobile sector. The sum of cash flows for all TSPs has been taken into account to get the full industry value. As these include negative and positive cash flows, it leads to biased estimations. In actual fact, the valuation of spectrum has to be undertaken from the perspective of the bidder who is likely to be an existing or potential TSP. In a particular LSA, every existing or potential TSP is likely to undertake the exercise and arrive at its own valuation based on its potential cost and revenue

projections derived from internal analysis as well as telecom industry factors.

4.31 Estimating such independent valuations for each operator is difficult. Further, such a model would be purely based on projections (rather than historical data) and would include assumptions regarding nearly every significant variable: subscribers; usage (both data & voice); ARPU; share of revenues of 800,900 and 1800 MHz etc. and the results would depend on these assumptions. Nonetheless, the Authority noted that a DCF valuation for "mature" operators had been attempted in TRAI's Report on the "2010 Value of Spectrum in the 1800 MHz band" dated 8th February 2011, in respect of spectrum holdings up to 6.2 MHz. In this method, the value of a block of spectrum of 6.2 MHz has been computed by determining the Net Present Value of cash flows that a mature operator would command over the licence period of 20 years by virtue of holding the corresponding block of spectrum. The values have been updated by indexing using the SBI PLR for a period of 3 years (2010-11 to 2012-13). In view of the stakeholder comments in favour of the DCF method as an alternate method for valuation, **the Authority has decided that the updated values contained in the Report of 8th February 2011 for spectrum up to 6.2 MHz can also be incorporated in the calculation of average value of 1800 MHz spectrum in the current exercise.**

Benchmarking with global prices

4.32 One stakeholder has suggested international comparison as an approach to check the value of spectrum in India. The advantages outlined by the stakeholder are that real market determined prices entail fewer assumptions and are restricted to a minimal set of standard parameters. The risks involved in such comparisons are that it is difficult to account for inter-country differences and variations over time. The stakeholder has suggested that in view of the risks involved, international

comparison should be taken as a "sense check" on the value of spectrum rather than a benchmark for its value.

4.33 Another stakeholder has provided data for international spectrum prices. The value per MHz per population is based on an Ofcom report. The report has indicated a range of figures, and the stakeholder has taken an average of the range. This figure has been adjusted for ARPU and PPP differences between the sample country and India data to arrive at a per MHz rate for India.

4.34 The Authority considered the international comparison provided by the stakeholders. The Authority noted that stakeholders were of the view that spectrum price in India cannot be derived directly from international prices, but can only be used as a "sense check" on the value of spectrum assessed by other approaches. The Authority further observed that factors (i.e. ARPU, population, economic development etc.) that could determine spectrum price in India are not comparable with sample countries covered by the stakeholders in their analysis. India is a low-ARPU high-subscriber market. The size of the market is large, yielding higher revenues even though ARPU is low. Most of the sample countries are developed nations and the revenue model is quite different from that of India. For instance, the share of revenue from data services is 2 to 4 times higher than in India.

4.35 In the light of the above, **the Authority is of the view that valuation of spectrum in India cannot be done on the basis of international prices.** However, in case a "sense check" is to be applied, it is observed that in a recent auction of 700 MHz in Australia (May 2013) in which 70% of the offered spectrum was sold, the reserve price was 1.36 AUD per MHz per population. This translates into a price of Rs.18.7 per MHz per population of 1800 MHz (factor of 0.25 of 700 MHz) at an exchange

rate of April 2013 (1 AUD=Rs 55). This compares favourably with the reserve price of 1800 MHz being recommended by the Authority.

ARRIVING AT AVERAGE VALUATION AND RESERVE PRICE OF 1800 MHZ SPECTRUM

4.36 The feedback received from the stakeholder consultation indicates that most stakeholders confined themselves to criticizing the various suggested approaches for valuing spectrum and few of them were able to give concrete, workable alternative models. In some cases, the valuations and reserve prices suggested by them are not even close to ball-park estimates: they have no basis in any rational, quantitative analysis. In other cases, reserve prices have been suggested without a link to any valuation of the spectrum. Wherever reasoned results have been presented by stakeholders, they have been taken cognizance of in the process of arriving at a valuation.

4.37 The current exercise aims at determining the appropriate value of spectrum in different bands. As discussed, the Authority has assessed the value of 1800 MHz spectrum using a number of alternative approaches (i.e. market based approaches such as correlating spectrum prices with single variables, multiple regression, and opportunity cost models such as the producer surplus and production function models). Also available with the Authority is the indexed (updated) price of spectrum worked out on DCF basis by TRAI in its Experts' Report of February 2011 for 1800 MHz spectrum. A Table containing the valuation of 1800 MHz spectrum using different approaches is at **Annexure 4.4.**

4.38 As explained, there are uncertainties and limitations in all the approaches. **The Authority is of the view that rather than follow a deterministic approach, it is best to work with a probabilistic average valuation that captures the range of possible valuations that have been attempted.** Any of these valuations could actually materialize

in the market place. A priori, there is no reason to pick one particular valuation as more likely than another. On this assumption of equal probability of occurrence, the Authority has arrived at an expected average valuation for 1800 MHz spectrum as the simple mean of the various valuations that have been attempted. In addition, the mean value of the estimates after removing the highest and the lowest values (outliers) and the median value have also been computed, in order to cross check the consistency of the average valuation obtained through the method of simple mean and the results are reported in **Annexure 4.4**. It can be seen that the values obtained through the latter two methods are close to (in fact, on pan-India basis, slightly lower than), the value obtained through the method of the simple mean. **The Authority has therefore decided to utilise the average expected valuation obtained through the method of simple mean.** The valuations of 1800 MHz spectrum are tabulated below:

TABLE 4.1

VALUE PER MHz IN 1800 MHz BAND

(Rs. in crore)

LSA	Category	Value per MHz of 1800 MHz
Delhi	Metro	**218.90**
Mumbai	Metro	**206.74**
Kolkata	Metro	**73.13**
Andhra Pradesh	A	**162.62**
Gujarat	A	**143.39**
Karnataka	A	**155.21**
Maharashtra	A	**172.91**
Tamilnadu	A	**207.89**
Haryana	B	**33.46**
Kerala	B	**72.22**
Madhya Pradesh	B	**81.52**

Punjab	B	**73.58**
Rajasthan	B	**76.63**
U. P. (East)	B	**123.67**
U.P. (West)	B	**77.71**
West Bengal	B	**40.50**
Assam	C	**11.32**
Bihar	C	**63.42**
Himachal Pradesh	C	**9.24**
Jammu & Kashmir	C	**16.43**
North East	C	**15.20**
Orissa	C	**24.20**
Pan India		**2059.89**

4.39 As discussed in Chapter III, the Authority has decided that the reserve price can be pegged at 80% of the average valuation of spectrum. However, 1800 MHz spectrum was sold in the November 2012 auction and a price was discovered in the market. Tabulated below are the figures for all LSAs of 80% of the average valuation of spectrum and the realized prices in the November 2012 auction:

TABLE 4.2

(Rs. in crore)

LSA	**Category**	**80% of average valuation per MHz of 1800 MHz spectrum**	**Realized price per MHz of 1800 MHz spectrum (November 2012)**
Kolkata	Metro	**58.50**	**90.98**
Andhra Pradesh	A	**130.10**	**229.53**
Gujarat	A	**114.71**	**179.87**
Maharashtra	A	**138.33**	**210.25**
Tamilnadu	A	**166.31**	**244.87**
Haryana	B	**26.77**	**37.21**

Kerala	B	**57.78**	**52.24**
Madhya Pradesh	B	**65.22**	**43.19**
Punjab	B	**58.86**	**53.82**
U. P. (East)	B	**98.94**	**60.94**
U.P. (West)	B	**62.17**	**85.93**
West Bengal	B	**32.40**	**20.67**
Assam	C	**9.06**	**6.93**
Bihar	C	**50.74**	**37.14**
Himachal Pradesh	C	**7.39**	**6.22**
Jammu & Kashmir	C	**13.14**	**5.06**
North East	C	**12.16**	**7.07**
Orissa	C	**19.36**	**16.22**

4.40 As can be seen, out of 18 LSAs, in 11 LSAs the figure of 80% of the average value of spectrum is higher than the price actually realized in the market. Now, the quantum of spectrum put up for auction in November 2012 was only partially sold in 17 LSAs (with Bihar as an exception). This suggests the realised price was not a market clearing price in the absence of sufficient demand. The realised price in a sense represents an upper bound; in the forthcoming auction, it is unlikely that spectrum can be sold at a price higher than this upper bound. On the contrary, it is highly likely that spectrum can potentially be sold at prices that are below this upper bound. If the principle of 80% of average valuation as reserve price is rigidly adhered to, the reserve price in 11 LSAs will be pegged higher than the prices realized in the last auction and it is possible that no further spectrum may be sold. The prime objective of the current exercise is to arrive at a reserve price at which spectrum will actually be sold. Therefore, a pragmatic approach is being adopted by the Authority. **The Authority recommends that the reserve price for 1800 MHz spectrum should be the lower of the two figures- 80% of the**

average valuation or the price realised in November 2012 auction- in each LSA.

4.41 Similar benchmarking for the reserve price can be done for the 4 LSAs in which spectrum was not sold in the November 2012/ March 2013 auction.

TABLE 4.3

(Rs. in crore)

LSA	Category	80% of average value per MHz of 1800 spectrum	Reserve price per MHz of 1800 spectrum (March 2013)
Delhi	Metro	**175.12**	**388.11**
Mumbai	Metro	**165.39**	**379.93**
Karnataka	A	**124.17**	**184.86**
Rajasthan	B	**61.30**	**37.56**

4.42 As can be seen above, in 3 out of 4 LSAs in which spectrum was not sold, 80% of the average of valuation spectrum as now worked out is lower than the earlier reserve price. **The Authority recommends that in Delhi, Mumbai and Karnataka LSAs the new reserve price for 1800 MHz spectrum can be pegged at 80% of the average valuation.** However, spectrum was not sold in Rajasthan LSA in November 2012 even at a reserve price of Rs 37.56 crore per MHz. Rajasthan is a special case of sorts. Complete spectrum is not available in the 1800 MHz band in 11 districts out of 33 in Rajasthan (including major urban centers such as Jaipur, Jodhpur and Bikaner), and this must have been a contributory factor for the lack of demand. **The Authority recommends that the reserve price for 1800 MHz spectrum in Rajasthan LSA be fixed at Rs.26.29 crore per MHz i.e. a discount of 30% on the earlier reserve price of Rs 37.56 crore per MHz.**

4.43 **Based on the above, the Authority recommends that the reserve prices for 1800 MHz spectrum for 22 LSAs should be as in column (4) of Table 4.4 below:**

TABLE 4.4

RESERVE PRICE PER MHz IN 1800 MHz BAND

(Rs. in crore)

(1)	(2)	(3)	(4)
LSA	**Category**	**Reserve Price (as calculated)**	**Recommended Reserve Price (Rounded off)***
Delhi	Metro	**175.12**	**175**
Mumbai	Metro	**165.39**	**165**
Kolkata	Metro	**58.50**	**59**
Andhra Pradesh	A	**130.10**	**130**
Gujarat	A	**114.71**	**115**
Karnataka	A	**124.17**	**124**
Maharashtra	A	**138.33**	**138**
Tamil Nadu	A	**166.31**	**166**
Haryana	B	**26.77**	**27**
Kerala	B	**52.24**	**52**
Madhya Pradesh	B	**43.19**	**43**
Punjab	B	**53.82**	**54**
Rajasthan	B	**26.29**	**26**
U. P. (East)	B	**60.94**	**61**
U.P. (West)	B	**62.17**	**62**
West Bengal	B	**20.67**	**21**
Assam	C	**6.93**	**7**
Bihar	C	**37.14**	**37**
Himachal Pradesh	C	**6.22**	**6**
Jammu & Kashmir	C	**5.06**	**5**
North East	C	**7.07**	**7**

Orissa	C	**16.22**	**16**
Pan India		**1497.36**	**1496**

*Recommended reserve prices have been rounded off to nearest Rs in crore

900 MHZ BAND

4.44 In contrast to the situation obtaining in the 1800 MHz band, there are no market determined/realised prices available for the 900 MHz band, on which basis the value of 900 MHz spectrum can be estimated. However, the value of 900 MHz spectrum can be derived from the value of 1800 MHz spectrum based on a comparison of (a) relative technical efficiency, or (b) relative economic efficiency of the 900 MHz band over the 1800 MHz band.

Technical efficiency

4.45 To value the 900 MHz band, one possible approach is to use the relative technical efficiency of the 900 MHz band over the1800 MHz band. The relative efficiency of the 900 MHz band over the 1800 MHz band/ 2100 MHz band was covered in paragraphs 3.70- 3.74 of the CP and is reported in the Tables below:

TABLE 4.5

IMPACT OF FREQUENCY ON BASE STATION DENSITIES

Base stations per km²	**UMTS 900**	**UMTS 1800**	**UMTS 2100**
Suburban	0.017	0.027	0.037
Remote/rural	0.008	0.013	0.018

TABLE 4.6

PERCENTAGE INCREASE IN COVERAGE AREA[17]

Frequency	Percentage increase in coverage area per Node-B (km^2)			
	Dense Urban	**Urban**	**Suburban**	**Rural**
900 vs 2100MHz	87%	44%	60%	119%

4.46 The CP also brought out that as per the report of consultant Vilicom Limited for ComReg, the Ireland Regulator, the cell sizes and range for various spectrum bands for UMTS systems based on link budgets and propagation models are as under:

TABLE 4.7

	Urban Cell range (km)	**Suburban cell range (km)**	**Rural cell Range (km)**
900 MHz	1.0329	1.697	16.198
1800 MHz	0.558	0.918	10.949
2100 MHz	0.470	0.772	9.753

4.47 As can be seen from the above Table, for urban and suburban areas, the cell range which can be achieved in case of 900 MHz band is around 1.9 times more than the cell range in 1800 MHz band, and in rural areas it is around 1.5 times.

4.48 The 900 MHz band spectrum thus intrinsically possesses a greater technical efficiency than 1800 MHz band in terms of cell range and coverage. This technical efficiency factor could lie anywhere between 1.5 times to 2 times; in TRAI's recommendations on spectrum dated May 2010, a factor of 1.5 for relative efficiency had been adopted. In TRAI's recommendations on 'Auction of Spectrum' dated April 2012 the Authority decided that the technical efficiency of 900 MHz spectrum was twice that of 1800 MHz spectrum. Working with technical efficiency, the

[17]http://www.gsmworld.com/documents/umts900_exec_sum.pdf

value of 900 MHz spectrum would be 1.5 times to 2 times of the average value worked out for 1800 MHz spectrum.

Economic efficiency

4.49 Technical efficiency of the 900 MHz spectrum leads to economic efficiency in comparison to 1800 MHz in the form of lesser CAPEX and OPEX requirements. Therefore, an alternate way of deriving a relative valuation for the 900 MHz band from the valuation worked out for the 1800 MHz band is by examining the trade-off in costs (CAPEX as well as OPEX) when spectrum in the technically more efficient 900 MHz band is substituted for spectrum in the technically less efficient 1800 MHz band. The additional cost per MHz to the TSP operating in the 1800 MHz band in a way represents the savings to TSP if its witches operations to the 900 MHz band. These savings can be looked on as the premium that the TSP would be willing to pay for acquiring spectrum in the 900 MHz band. Other things being equal, the price that a TSP may pay for a unit of 900 MHz spectrum would be less than or equal to the price of a unit of 1800 MHz spectrum plus the additional CAPEX and OPEX costs that the TSP saves by using 900 MHz spectrum instead of 1800 MHz spectrum, i.e.

$$\mathbf{V_{900MHz} \leq V_{1800\ MHz} + \Delta\ CAPEX + \Delta\ OPEX}$$

4.50 In this context, the following question had been raised in the CP:

Should the premium to be paid for the 900 MHz and liberalised 800 MHz spectrum be based upon the additional CAPEX and OPEX that would be incurred on a shift from these bands to the 1800 MHz band?

4.51 Most stakeholders are of the opinion that the 900 MHz band provides better coverage and quality of service than the 1800 MHz band; hence, a premium in the valuation of 900 MHz is justified. Stakeholders have also suggested different multiplication factors for the value of 900 MHz over

1800 MHz ranging from 1.2 times to 2 times. Some stakeholders have opined that valuation of 900 MHz spectrum or the premium on 900 MHz compared to 1800 MHz should be discovered by the market. Two stakeholders have commented that the premium on 900 MHz band should be computed on the economic efficiency factor and the migration cost (CAPEX and OPEX) is significantly high (more than 2 times). One stakeholder commented that no premium should be added to the valuation as the 900 MHz band is predominantly used for voice services and its efficiency over 1800 MHz is realized mainly in rural/remote areas where revenues are already low; any premium charged on the 900 MHz band would impact on roll-out in these areas.

4.52 The Authority has examined the opinions and comments of the stakeholders. The Authority is of the view that while the technical efficiency arguments have merit in that they are simple in construct, transparent and easily comprehensible, the economic efficiency approach takes into account ground level economic, geographic and demographic differences in different LSAs and provides a more nuanced valuation for the spectrum based on operational savings. On the other hand, the economic efficiency approach is based on certain assumptions and the results are sensitive to variations in these assumptions. The data sources, methodology followed, assumptions and the results obtained for premium to be paid for 900 MHz based on economic efficiency over and above the average value of 1800 MHz spectrum for the 3 LSAs for which recommendations for valuation and reserve price for 900 MHz spectrum have been sought by the Government, are at **Annexure 4.5**.

ARRIVING AT AVERAGE VALUATION AND RESERVE PRICE OF 900 MHZ SPECTRUM

4.53 As in the case of 1800 MHz spectrum, the different approaches to valuation of 900 MHz spectrum each have their own advantages and

limitations. It is very difficult to say which approach yields the "true" expected value of 900 MHz spectrum. **The Authority has decided, as in the case of 1800 MHz spectrum and adopting the same basic principle of equi-probability of occurrence of each valuation, to adopt an average valuation of 900 MHz spectrum as the simple mean of valuations obtained from technical as well as economic efficiency approaches.** The median value has also been computed and the results are close to (in fact slightly lower than), the value obtained through the method of the simple mean. A table containing the valuation, using different approaches, of 900 MHz spectrum for the 3 LSAs for which recommendations for valuation and reserve price for 900 MHz spectrum have been sought by the Government, is at **Annexure 4.6.** The average expected valuation of 900 MHz spectrum in each LSA is furnished below:

TABLE 4.8

VALUE PER MHz IN 900 MHz BAND

(Rs. in crore)

LSA	Category	Value per MHz of 900 MHz
Delhi	Metro	**359.65**
Mumbai	Metro	**327.50**
Kolkata	Metro	**125.27**

4.54 **The Authority recommends that reserve price for 900 MHz spectrum in Delhi, Mumbai and Kolkata LSA should be pegged at 80% of the average valuation of spectrum as listed in column (4) of Table 4.9 below:**

TABLE 4.9

RESERVE PRICE PER MHz IN 900 MHz BAND

(Rs. in crore)

LSA	Category	Reserve Price (as calculated)	Recommended Reserve Price (Rounded off)*
(1)	(2)	(3)	(4)
Delhi	Metro	**287.72**	**288**
Mumbai	Metro	**262.00**	**262**
Kolkata	Metro	**100.22**	**100**

*Recommended reserve prices have been rounded off to next Rs in crore

800 MHZ BAND

4.55 The Government has also requested the Authority to give its recommendation for valuation and reserve prices for 800 MHz spectrum.

4.56 In India, some TSPs are providing mobile cellular services employing CDMA technology in the 800 MHz band. At present, there are 2-4 TSPs (including public sector undertakings) in each LSA using this technology. All these TSPs except one are also providing mobile services using GSM technology. In view of the fact that the CDMA technology has been employed by comparatively few TSPs the world over, the eco-system as well as the market for CDMA has not developed as much as in the case of GSM. In India, over the last few years, the market share in terms of number of CDMA subscribers and revenue has continuously declined. In the auction of spectrum for the 800 MHz band in November 2012, there were no bidders for the spectrum. The spectrum in this band was put up for auction again after reducing the reserve price by 50%. This time, only one TSP (SSTL), whose licences in 20 LSAs were cancelled by the Hon'ble Supreme Court in February 2012, took part in the auction. SSTL

purchased 3.75 MHz of spectrum in eight LSAs; there were again no takers for spectrum in the remaining LSAs even at the reduced price.

4.57 In the context of dwindling or even non-existent demand for 800 MHz spectrum for CDMA services, the feasibility of deploying the available spectrum in the 800 MHz band for GSM/HSPA technologies, in line with the practice followed in a number of other countries, was raised. The stakeholder comments received, and the analysis and the decision of the Authority thereon, have been discussed in Chapter II of these recommendations.

VALUATION AND RESERVE PRICE FOR 800 MHZ:

4.58 In the backdrop of the discussion on adoption of the E-GSM band and the liberalisation of spectrum in the CP, stakeholder comments were sought on whether the valuation of liberalised 800 MHz spectrum could be treated at par with (liberalised) 900 MHz spectrum.

4.59 Some stakeholders are of the view that in the 800 MHz spectrum band, a 5 MHz block is not available and thus spectrum in this band can only be used for CDMA technology. The CDMA operators, in the absence of availability of sufficient spectrum will have to continue in the un-liberalized form for 2G services. As per the stakeholders, this fact has also been acknowledged by the Authority in its earlier recommendations dated 12th May, 2012. Accordingly, the Authority had recommended the fixing of reserve price of 800 MHz spectrum at 1.3 times the 1800 MHz reserve price where 5 MHz spectrum is not available in the 800 MHz band.

4.60 Some stakeholders are of the view that no premium is payable for 800 MHz over 1800 MHz spectrum band as valuation of the former is much lower due to a poor eco-system. Some stakeholders are of the view that

systems deployed in 800 MHz spectrum band cannot be deployed in the 1800 MHz spectrum band and, therefore, the basis of estimating the value of 800 MHz spectrum cannot be the same as the basis for 900 MHz spectrum. As per these stakeholders, the Government also "admits" that 800 MHz spectrum has lower value compared to 1800 MHz; this is evident from the reserve prices fixed for these two spectrum bands. (The pan- India reserve price for 5 MHz in the 800 MHz band was Rs 9100 crore whereas the pan-India reserve price for 5 MHz spectrum in the 1800 MHz band was Rs 11,893 crore). Some stakeholders suggested that in view of the typical characteristics of the 800 MHz band, TRAI should reduce the reserve price of 800 MHz spectrum to around 20% of the reserve price set in the March 2013 auction viz. one-fifth of the reserve price set in March 2013.

4.61 On the other hand, some stakeholders have suggested that 800 MHz band spectrum being sub 1GHz band like 900 MHz, it has an inherent advantage over 1800 MHz due to better propagation characteristics and consequently the advantage of lesser base station requirement etc. and hence the same formula for premium should be applied to 800 MHz band also. Another stakeholder is of the opinion that the valuation of liberalised spectrum in 900 and 800 MHz bands needs to be determined only through a transparent market driven process. When the E-GSM band is auctioned, the relative multiple of E-GSM/900MHz versus 1800MHz should be set conservatively (i.e., with reference to the marginal bidder) in all circles to ensure price discovery in the auction.

4.62 The Authority has considered the matter. The value of 800 MHz spectrum has to be determined in terms of its opportunity of use. The Authority has already recommended that the feasibility for adoption of the E-GSM band should be explored. The adoption of the E-GSM band would vastly enhance the opportunities for use of the spectrum, and

hence, its value. The E-GSM band being a sub 1 GHz band, its value would be much higher than that of 1800 MHz. Hence, any attempt to sell the 800 MHz spectrum at this stage (at prices well below the 1800 MHz band) without first exploring the possibility of adoption of the E-GSM band will be clearly sub-optimal.

4.63 It may be recalled that in the recommendations of 12th May 2012, the Authority had agreed to the fixing of reserve price of 800 MHz at 1.3 times the 1800 MHz reserve price only where 5 MHz spectrum was not being made available. This was done on the rationale that it is not possible to offer all services that a truly liberalized spectrum is capable of providing, with less than 5 MHz of spectrum. The reserve prices in the March 2013 auction were further discounted by 50%; these reserve prices for 800 MHz spectrum were even lower than the realized prices/reserve prices for 1800 MHz spectrum. Now, one stakeholder has suggested that the reserve prices for 800 MHz should be further reduced to 20% of the reserve prices in the March 2013 auction. If this were accepted, it would amount to offering the precious sub-1 GHz spectrum at a fraction of its potential economic value.

4.64 The auction in the 800 MHz band should, therefore, not be carried out now. The relevant frequencies should be auctioned as liberalized spectrum at a later date. The Authority is of the view that there is no need for determining a valuation or corresponding reserve price for 800 MHz spectrum at present. In any event, valuations and reserve prices for different LSAs for liberalized 800 MHz spectrum for E-GSM would be analogous to valuations and reserve prices for the 900 MHz band.

4.65 **Accordingly, the Authority recommends that there is no need for determining a valuation or corresponding reserve price for 800 MHz spectrum at present.**

MISCELLANEOUS ISSUES

Payment terms

4.66 Although this issue was not discussed in the CP, some stakeholders raised it during the consultation process. They have drawn the Authority's attention to the need for review of the deferred payment terms for the auction. The DoT had prescribed the following payment terms at the time of auctioning spectrum in November 2012 and March 2013: "*Full payment within 10 days of declaration of final price or pre-payment of one or more annual installments* ***Or*** *Deferred payment subject to the following conditions: An upfront payment of 33% in case of 1800 MHz band and 25% in case of 900 MHz and 800 MHz bands of the final bid amount within 10 days and the balance payment after a moratorium of two years in 10 equal (annual) installments."* The stakeholders have pointed out that since the last 2 auctions, the Rupee has depreciated and interest rates continue to be very high. Banks are reluctant to lend to Indian TSPs. The stakeholders have requested that the up-front payment to be made within 10 days should be only 15% in the case of the 1800 MHz band and 10% in the case of the 900 and 800 MHz bands and the balance payment should be after a moratorium of 2 years in 11 or 12 equal installments.

4.67 The Authority is of the view that the structuring of the payment terms is a matter that needs to be decided by the Government factoring in, amongst other things, the current budgetary requirements. The decision on the matter is solely the prerogative of the Government and the Authority would, therefore, not wish to make any specific recommendation in this regard. However, the Authority would like to draw the attention of the Government to this issue. It is a fact that the banking system is already heavily exposed to the telecom sector and there may be some reluctance on the part of the banks to advance

further loans to the TSPs for the forthcoming auction. Chapter 3, para 3.17 of these recommendations has highlighted the growing indebtedness of the telecom access service companies. In the circumstances, it is possible that some potential bidders may be forced to stay away from the auction for want of availability of credit. This would reduce participation and stand in the way of full price discovery. **The Authority recommends that payment terms should be structured by the Government to address these financing issues of the bidders in the proposed auction.**

CHAPTER-V

SPECTRUM USAGE CHARGE

5.1 The CP analysed the regime of Spectrum Usage Charges (SUC). SUC are levied as a percentage of the Adjusted Gross Revenue (AGR) earned by the spectrum holder and, at present, the rates vary from 3% of the AGR to 8% of the AGR depending on the quantum of spectrum held by a licensee.

5.2 The present regime is very complex and presents a bewildering array of rates giving different treatment to different technologies, which, in turn, invites charges of discriminatory treatment. The regime may be utterly incomprehensible to an outsider unfamiliar with its evolutionary history.

5.3 For instance, in the bands hitherto used for 2G technologies, the rates depend on the level of spectrum holding and also vary across different technologies. There are six slab rates for different quantum of holdings. The present applicable SUC slab rates for 2G spectrum are given in the table below:

TABLE 5.1

Spectrum slab		**Annual spectrum charges (as a percentage of AGR)**
GSM (900/1800 MHz)	**CDMA (800 MHz)**	
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

5.4 For other spectrum where different technologies are deployed, the SUC regime is different. There is a flat rate of 3% of AGR for standalone 3G spectrum (2100 MHz) and 1% of AGR for BWA spectrum (2300 MHz).

And, the 3G spectrum and the BWA spectrum are not added to the 2G spectrum for arriving at the total spectrum for application of a slab rate. What this implies is that for a standalone 3G TSP, spectrum is charged at 3% of AGR but in the hands of an existing 2G TSP who also owns 3G spectrum, the quantum of 3G spectrum is not added to the total quantum of 2G spectrum holding that determines the slab rate applicable to the TSP. However, in the case of BWA, the AGR itself is segregated from other revenues and SUC is charged at 1%.

5.5 In the case of CDMA, though similar slabs exist, the maximum applicable rate in actual fact is 3%. Why? For one, no TSP has more than 5 MHz in the 800 MHz band; most have less. Hence, a set of slab-rates for spectrum holdings up to 15 MHz is entirely theoretical. For CDMA spectrum holding, the effective rate is a flat 3%. Further, dual-spectrum holders are charged separately for their holdings of CDMA and GSM spectrum on the segregated AGR from the respective bands. And, since most such TSPs have no more than 6.2 MHz in the 900/1800 MHz band, (in fact many have less), the maximum applicable rate is 4% for their GSM holding. Thus, dual technology operators pay a maximum SUC of 3-4%.

5.6 Clearly, the SUC regime is not based on the total quantum of spectrum holding. For instance, a dual technology operator with 4.4 MHz in 900/ 1800 MHz band and 5 MHz in the 800 MHz band pays 3%. If a TSP who is a GSM operator holds an equivalent 9.4 MHz in 900/1800 MHz band, the applicable SUC rate is 6%. Consider yet another anomaly: a new entrant who acquires 5 MHz in the 900/1800 MHz band through auction is liable to pay 4%; in contrast, the dual technology holder (with the same holding as indicated above) would pay only 3%. And that too, when the new entrant has paid auction prices unlike the dual technology operator.

5.7 When one combines 2G and 3G spectrum holdings, the picture becomes even more complex. Take the case of 2 TSPs holding different quantities of 900/ 1800 MHz spectrum who acquire 3G spectrum. The SUC rate leviable on them varies according to their holding of 2G spectrum. Thus, the TSP holding the larger quantity of 2G spectrum, effectively pays a higher SUC on 3G revenues from 3G spectrum. It is baffling how the applicable SUC rate on 3G revenues can justifiably be linked to the quantum of 2G spectrum holding. When both TSPs acquired 3G spectrum through an auction, why should one TSP's SUC rate on 3G revenues be higher than that of the other?

5.8 It has also been contended that the rationale for the escalating slab rate is the non- linearity that arises from the quantum of spectrum holding. That is, a TSP with 10 MHz of spectrum can cater to more than twice the number of customers than a holder of 5 MHz; hence, the larger TSP should pay higher SUC. The point to note is that this rate escalation would be justified if the charge was levied on a per MHz basis viz. a higher charge per MHz for a higher holding. However, the SUC is levied on AGR and the non-linearity, in terms of ability to serve more customers, is already captured in the AGR. Hence, there is little justification for an escalating slab rate on the AGR.

5.9 Lastly, to a foreigner (read foreign investor), the regime appears especially peculiar. This is because in most countries charges for spectrum are recovered through up-front payment in auctions; there is no need for a supplementary charge. If at all there is such a charge, it is merely to cover the administrative cost of managing spectrum. And, typically that fee is either a fixed amount or a very small ad valorem charge.

5.10 In a sense, the bizarre SUC regime currently in force is a product of successive responses to developments in the telecom sector over the years. Historically, the WPC spectrum charge was a fixed charge paid in

advance annually on a calendar year basis. With the shift in the license fee regime to revenue-share based charges, the WPC charges were also migrated to a revenue-share based charge in 2001-2002. These charges were later termed as Spectrum Usage Charges. The charges were fixed at 2% of the AGR to be paid quarterly in advance.

5.11 Initially, the 2G spectrum was given bundled with the license of the TSPs. Additional spectrum assignment was made on subscriber-linked criteria. Such administrative assignments raised the possibility of hoarding of spectrum by the operators by exaggerating the subscriber figures in the LSAs. As a response to this, the slab rate system was devised to increase rates as the quantum of assignments to a particular TSP increased. This was expected to put pressure for efficient use of spectrum as the TSP had to pay a higher rate on its AGR i.e. there was no point in leaving spectrum idle. In actuality, the SUC rates combined the realization of administrative charges (cost of managing and regulating spectrum) with the realization of the value of spectrum.

5.12 Around mid-2007, dual technology licences were introduced where existing CDMA TSPs were permitted to obtain GSM spectrum (900/1800 MHz) and operate GSM based services (and vice versa) under a common Universal Access Service Licence (UASL). A separate entry fee was paid for adding the use of GSM technology to the UASL of CDMA. The UASL licence holder was allowed to segregate the AGR from the two technologies and its spectrum holdings were not clubbed for the purpose of determining the applicable slab rate. This decision established different categories for different technologies, creating separate rivalrous interest groups amongst the TSPs.

5.13 The regime next changed in 2010 when auctions for 3G and BWA spectrum were held. The regime was based on the concept of a common charge for collecting the cost of administration and management of

spectrum as well as the intrinsic value of spectrum. With auctions for a band of spectrum different from the 2G band, this basic premise came into focus. The question became how to determine the rate of SUC for the new bands viz. 3G (2100 MHz) and BWA (2300 MHz) which were being auctioned. The manner of its resolution has already been described in an earlier paragraph. And, some of the resultant incongruities have been brought out in para 5.7.

5.14 In sum, the policy changes to the SUC regime over the years have spawned numerous anomalies and distortions.

5.15 The SUC regime's other flaw lies in the fact that it disincentivises the acquisition of spectrum in the hitherto 2G bands. The CP clearly brought out how the slab rate structure acts as a disincentive for any merger or acquisition amongst the TSPs; an increase in spectrum holding due to a merger leads to the application of a higher slab rate on the combined revenue because of 'bracket creep' and the combined revenue attracts a higher SUC rate on the merged entity without any real increase in the AGR! The slab system is also a disincentive for spectrum trading as ownership of a larger quantity of spectrum attracts a higher SUC rate.

5.16 A review of the benchmark fee for 900, 1800 and 2100 MHz spectrum in European countries shows that most nations have either low annual spectrum fee charges, or no charge at all. This is the practice in countries where the value of spectrum is captured upfront in a single payment either through an auction or a "beauty parade" with a defined payment level. In the United States and Australia, annual fees are meant to cover the cost of management and regulation of the spectrum. In the United Kingdom, the Administrative Incentive Pricing is applied to spectrum that has not been auctioned or to licenses that have been re-assigned through auction after the expiry of the earlier license term. To sum up, it is now common to charge only administrative cost-based

spectrum usage charges in the case of spectrum sold through auctions. In most cases the spectrum fee is a charge of a fixed annual payment or a percentage of the turnover related to all revenues attributable to the use of relevant frequency bands. In this context, it is important to examine the structure of an annual SUC in those cases where spectrum is auctioned and intrinsic value is realized in the form of up–front charges.

5.17 The following questions were posed in the CP:

a) *Should annual spectrum usage charges be a percentage of AGR or is there a need to adopt some other method for levying spectrum usage charges? If another method is suggested than all details of its working may be furnished.*
b) *In case annual spectrum usage charges are levied on percentage of AGR, should annual spectrum charges escalate with the amount of spectrum holding as at present or should a fixed percentage of AGR be applicable?*
c) *If your response favours a flat percentage of AGR, what should that percentage be?*

5.18 Stakeholders are naturally divided on the method of application of SUC. Six stakeholders including the CDMA technology operators and AUSPI have suggested continuance of the present slab rate. Amongst others, the almost unanimous view is for a uniform rate of charge for spectrum usage either as a uniform fixed fee per MHz or as a uniform percent fee on AGR for all holding of spectrum. One stakeholder has also suggested slabs over a minimum of 5 MHz, another a variable rate on the basis of efficiency and a few have questioned the need for imposing an SUC on auctioned spectrum. Eleven stakeholders have suggested rates varying from 1% to 4% of the AGR with a uniform flat rate. Some have stated conditions like payment of one-time charge for shifting to a uniform fee or making it applicable to only the auctioned spectrum. COAI has

advocated only an administrative charge. SBI has suggested abolition of all fees and application of a uniform license fee to cover all charges. It has also been stated by some stakeholders that the rates have been a part of the NIA in previous auctions so its application has to continue on the spectrum to prevent any advantage to those that have valued the spectrum based on the SUC charges for the period of their license; therefore, applying uniform rates will be open to legal challenge.

5.19 Stakeholders who have advocated continuance of the present slab-based regime are the dual technology operators (or 800 MHz holders) and they are also the ones least impacted. They are the greatest beneficiaries of the present system as they effectively pay rates in the range of 3-4%. On the other hand, most of the stakeholders who have spoken for a flat rate or no charge are the GSM operators who have larger holdings of spectrum and are, therefore, adversely impacted by the escalating slab rates.

5.20 The Authority deliberated the issue of rationalizing the spectrum usage charge to a fixed ad valorem percentage of AGR.

5.21 In the opinion of the Authority, the argument of the stakeholder who has stated that the SUC rates cannot now be changed as they had formed a part of the NIA document issued prior to the auction for 2G spectrum in November 2012/ March 2013 is not correct, as the NIA clearly qualifies that the SUC rates will be as declared by the Government from time to time. Also, policy decisions are the exclusive preserve of the Government. And, no policy is ever intended or implemented in permanence. Policy change is inevitable: it may be noted how policy in spectrum allocation has changed radically from administrative assignment to auction.

5.22 Some stakeholders argued that the slab rates should continue because, as the size of spectrum holdings increase, the productivity of additional

spectrum is non- linear. However, this argument is not well founded, as brought out in a previous paragraph (see para 5.8).

5.23 The demand for rationalisation of charges has been a repeated plea of the telecom sector, which pays an 8% flat license fee and a slab rate charge of up to 8% in the form of SUC on AGR. The Authority is of the view that the present regime has created a plethora of rates for different categories and technologies resulting in numerous anomalies. Further, in an industry in need of consolidation, the SUC regime needs to change so as to stop disincentivising the acquisition of spectrum. This is a requirement of today's times and a policy change is needed.

5.24 First and foremost, it is necessary to delink the SUC from the quantum of spectrum held by a TSP. This will immediately simplify the SUC regime and make it more transparent. The arguments for adopting this method get strengthened as more and more spectrum is allocated on market determined prices.

5.25 One way of removing some of the anomalies is to amalgamate <u>all</u> spectrum and levy the SUC on the total quantum of spectrum held by a TSP. TRAI had recommended (in its recommendations of 28th August 2007) that, after a moratorium of one year from the date of assignment of spectrum for the second technology- the spectrum charges/fee would be governed by the combined total of spectrum allocated in different technology specific bands i.e. the slab of spectrum charge or fee would be determined by the combined total of spectrum. However, the Government did not implement this suggestion. While this would have resolved some anomalies, it would not have dented the regime's basic characteristic of penalizing the acquisition of any spectrum.

5.26 Second, howsoever strong the rationale may be for a fixed charge on the ground that spectrum is now auctioned, the reality is that this may not be acceptable since it delinks the SUC from the productivity of spectrum.

5.27 On the proposal that SUC could be linked to the highest bid amount in the auction, the Authority noted that this would give rise to a different rate after every auction as there is likely to be more than one auction for any band of spectrum. As a result, there would be different rates for spectrum sold at different auctions. Since each TSP could have holdings in different bands of spectrum purchased at different times, it could be paying SUC at various different rates on its spectrum holdings. This would make the regime multi-rate based and complex to administer.

5.28 However, the transition to a flat ad valorem rate is eminently feasible (and desirable) as it would address both the problems- the anomalies as well as the disincentives on acquiring spectrum. The application of a single ad valorem rate as a percentage of AGR for SUC would not only simplify and rationalize the levy structure, but would also remove the disincentives to mergers, acquisitions and spectrum sharing and trading which are inherent in the present regime. In addition, opportunities for arbitrage that exist between different bands and technologies would cease to exist. The TRAI recommendations of 23rd April and 12th May 2012 had also recommended the application of a uniform ad valorem rate of SUC for licenses acquiring spectrum through the mechanism of auction. The recommendation of the Authority in 2012 was to retain a levy of SUC at 3% of the AGR with conditions for ensuring transition of all TSPs to the new regime.

5.29 The Authority observed that a problematic issue is how to transition to a uniform flat rate regime in a situation in which TSPs hold different combinations of administratively assigned and auctioned spectrum. There are three kinds of 2G spectrum holders:

a) Licensees owning only auctioned spectrum.
b) Licensees that own administratively assigned spectrum and also have acquired auctioned spectrum
c) Licensees that have only administratively assigned spectrum.

Any move to uniform spectrum charges has to take into account the transition to a regime where majority of the spectrum is assigned through auction.

5.30 As discussed in para 5.11, spectrum was earlier allocated through an administrative process and that was the context in which the slab rate system was introduced. However, now that spectrum is being allocated through an auction process, the Authority finds no reason to continue with the slab rate system for spectrum allocated through auction. This is also in accordance with international practices as detailed in paragraph 5.16. This will also be in line with the treatment accorded to 3G and BWA spectrum auctioned in 2010 (Flat ad valorem rate of 3% for 3G spectrum and 1% for BWA spectrum).

5.31 **The Authority recommends that all spectrum allocated through auction should henceforth be charged at a flat rate. The Authority also recommends that spectrum acquired through auction or trading or on which a TSP has paid the prescribed market value to the Government should <u>not</u> be added to any existing spectrum holdings for determining the applicable slab rate. This will also apply to spectrum allocated in the auctions held in November 2012 and March 2013.**

5.32 The Authority deliberated the issue of what the new uniform rate of SUC should be. The Authority is of the opinion that since price discovery for spectrum will be through the market mechanism and as long as the SUC proposed to be levied are notified in advance, the market will factor this into the auction bids. Therefore, as in many other countries, the SUC

should be in the nature of administrative charges for management of spectrum being auctioned. Ideally, the Authority would have liked to keep the flat SUC charge at a nominal level, say, 1% of AGR. However, the Authority also noted that, at present, the lowest rate for SUC charges is 3% of AGR. Keeping this fact in view, the Authority is of the opinion that a flat rate of 3% of AGR of wireless services should be the uniform rate of SUC for all auctioned spectrum.

5.33 **The Authority recommends that SUC for all auctioned spectrum should be at a flat rate of 3% of AGR of wireless services. This will come into effect from 1st April, 2014.**

5.34 BWA spectrum, which was assigned through auction in 2010, was primarily for providing broadband services. Therefore, apart from the CMTS/UAS licensees, ISPs were also permitted to participate in the auction process. Applicable SUC in respect of BWA spectrum was fixed at 1% of the AGR from services using this spectrum. In the new Unified Licensing regime, spectrum is delinked from licence and the licensee is permitted to provide any service under the umbrella of the Unified License. With the technological development, it has now become possible to offer other services including voice using this spectrum. Therefore, using BWA spectrum, a TSP can offer all services as provided in the Unified License on a mobile platform and as it will not be possible to segregate the subscribers and consequent AGR, it will pay less in the form of SUC as compared to other TSPs. This might open up the possibility for arbitrage. The Authority would like to avoid this possible arbitrage and therefore, is of the opinion that there should be a single uniform rate of SUC for all spectrum including the BWA spectrum (2300 MHz and 2500 MHz).

5.35 **The Authority therefore recommends that the SUC rate for BWA spectrum should also be fixed at 3% where services are provided under CMTS/UASL/UL (AS)/UL.**

5.36 As can be seen in Table 5.1, the present slab rates of SUC range from 3% to 8% of AGR. The Authority is of the opinion that as the SUC is levied on AGR and the non-linearity, in terms of the ability to serve more customers because of additional spectrum holding, is already captured in AGR, there is hardly any justification for an escalating slab rate of SUC. Ideally, the escalating slab rate system should be changed to a flat rate across the board for all TSPs. However, the Authority observed that there are a number of TSPs who hold a mix of administratively assigned and auctioned spectrum, or only administratively assigned spectrum. While the first two licenses given in 1994-95 in most LSAs, will come up for renewal from end 2014 to early-2016, there will be a number of licenses in which the licensee is holding administratively assigned spectrum (in whole or part), that will continue up to 2024. Since the flat rate regime cannot be fully implemented because of this legacy issue, the Authority is of the view that, in the interim, the highest slab rate may be brought down to 5% with effect from 1st April, 2014.

5.37 **Accordingly, the Authority recommends that the highest slab rate of SUC may be brought down to 5% of AGR with effect from 1st April, 2014.**

CHAPTER-VI

SPECTRUM TRADING

6.1. Spectrum trading is a mechanism whereby rights and any associated obligations to use spectrum are transferred from one party to another through a market-based exchange for a certain price. In a spectrum trade, the right to use spectrum is transferred voluntarily by the present user either in full or in part of its total holding, in exchange for a monetary consideration.

TYPES OF TRADES AND TRADING MECHANISM

6.2. '**Spectrum transfer**' is one form of spectrum trading, where 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'**, where the right to usage is transferred to another party for a defined period of time but ownership, including the obligations this imposes, remains with the original rights holder.

6.3. Various mechanisms can be used to facilitate a trade. These include bilateral negotiation, auctions, brokerage or establishment of a trading platform. In bilateral negotiation, the seller and prospective buyer directly negotiate the terms of the sale. The seller can also choose to go for an auction to give prospective buyers the opportunity to acquire the spectrum usage rights by bidding. Alternatively, buyers and sellers may employ a broker to negotiate, with their consent, the contractual terms under which the transfer of usage rights can take place. There is also the possibility of establishment of a trading platform, similar to a stock market, where transfers take place according to specific rules.

6.4. The current licensing framework in India does not provide for spectrum trading. Spectrum is allocated for a particular use by the Wireless and Planning Commission (WPC) wing of the DoT. The rights to use of frequencies within these allocated bands are assigned to various licensees for use as authorized in their respective licenses.

PRESENT STATUS

6.5. The issue of permitting spectrum trading was considered by the Authority earlier. In its recommendations on 'Spectrum management and Licensing Framework' dated 11th May 2010, the Authority cited the following reasons for not recommending spectrum trading at that point of time:

- In India, till date the 2G spectrum has been either given along with the licence or given based on Subscriber Linked Criteria, without any additional charges for the spectrum. These licensees have not competed in the open market to buy spectrum.

- Regarding spectrum for 3G and BWA services, the amount of spectrum available is limited and there is a restriction in the NIA that no licensee can acquire more than one block of spectrum either in auction or subsequently through M&A.

- Allowing spectrum trading at this juncture might result in anti-competitive conduct through consolidation/hoarding of spectrum by an incumbent trying to preclude newcomers from providing service by buying out the spectrum necessary for such services.

- Spectrum – a national asset with sovereign right over it by the Government - has only been assigned on a "right to use" basis for a fixed period to the service provider. A licensee has no ownership right to enable it to 'trade' in it.

6.6. In its recommendations on 'Auction of Spectrum' dated 23rd April 2012, the Authority again examined the issue of spectrum trading and observed that although from now on, all spectrum should be allocated through auction process, but this would be the first time that the spectrum in 800/900 and 1800 MHz bands was being put to auction in recent years and a substantial portion of these bands had already been administratively allocated. Therefore, the Authority concluded that it was pre-mature to allow spectrum trading and this issue may be may be taken up at a later date. However, the Authority recommended allowing spectrum trading between spectrum holders having obtained spectrum through auction or having paid an auction determined price for the spectrum held by them, only for the limited purpose of frequency configuration (arranging spectrum in a contiguous band). As explained in Para 2.62, this has been a non-starter, which has prompted the Authority to make its recommendations given in Para 2.64.

WHY THE ISSUE NEEDS RECONSIDERATION?

6.7. As discussed in the CP:

"Earlier spectrum trading was not allowed primarily on the ground that TSPs had obtained spectrum through administrative process without paying its market price. The Government has now decided that all TSPs will have to pay one time charge at market determined price for their existing spectrum holding beyond 4.4 MHz/2.5MHz for GSM/CDMA for the remaining validity period of Licenses.

As discussed earlier, the average spectrum holdings of TSPs in India is low in comparison with international standards. There is an urgent need for consolidation of spectrum holdings. The Authority has already given its recommendations to the Government in November 2011 on guidelines for Mergers and Acquisitions (M&A) in the industry. Another way of facilitating

consolidation of spectrum holdings is by allowing market forces to operate i.e. by permitting spectrum trading as it allows much more specific and targeted reallocations of spectrum than what can be achieved through M&A activity. A TSP holding spectrum that is paid for but in excess of its current requirements would then be able to directly trade these holdings with another TSP which requires additional spectrum for its operations. This would help to ensure optimal allocative efficiency of this limited natural resource, making the sector as a whole better off in the bargain. Clarity on the policy framework with regard to spectrum trading will help to unlock full potential value of spectrum that is proposed to be auctioned."

6.8. Secondly, in its press release of February 2012, the DoT had announced that '*spectrum trading will not be allowed in India, at this stage. This will be re-examined in a later date'*. However, in view of recent developments in the sector, the DoT has decided to revisit the issue. In a reference of 22nd August 2013 **(Annexure – 1.2)**, the DoT has sought TRAI's recommendations on permitting trading of spectrum obtained through auction and the attendant legal, regulatory and technical framework.

6.9. Thirdly, the Authority had given its recommendations on Mergers and Acquisitions (M&A) in November 2011. However, the DoT has not yet announced the final guidelines. As such, presently no mechanism exists for a telecom company to exit the sector after selling its spectrum holding. Thus, companies (investors) who entered the industry are locked-in: there is no way out (surrendering spectrum to the Government without receiving any refund is a commercial non-option). Hence, stakeholders were requested to comment on whether it is the right time to permit spectrum trading in India.

6.10. Most stakeholders were in favour of permitting spectrum trading in India. However, one stakeholder in favour of allowing spectrum trading, requested the Authority to carry out a separate consultation process on

the issue as, in its opinion, a detailed deliberation is required for finalizing the legal, regulatory and technical framework for spectrum trading.

6.11. Most stakeholders in support of permitting spectrum trading in the country were of the view that in a country with sub-optimal and fragmented spectrum holdings, spectrum trading would enhance national productivity; would help in evolving optimal spectrum utilization practices because allowing spectrum trading will increase flexibility and will enable TSPs to refine the alignment of their spectrum holdings with their business needs; spectrum trading between operators facilitates the efficient use of spectrum because it ensures that spectrum is put into the hands of those that can use it most productively. One justification given in favour of allowing spectrum trading in the country was that the absence of trading has meant that large amounts of spectrum in India are underutilized and it would result in better utilisation of spectrum if operators could aggregate their holdings into contiguous lots. A few stakeholders suggested that since spectrum has been delinked from the license, spectrum trading should be permitted in the country. These stakeholders were of the view that spectrum trading can unleash the potential of the mobile and facilitate technology upgrades.

6.12. One stakeholder commented that given the tough financial condition of the telecom sector, it has become difficult for some TSPs to rollout their network in 3G or BWA spectrum band even after holding spectrum for almost 3 years. These TSPs can neither sell their 3G/BWA spectrum nor surrender spectrum back to the government without forfeiting the auction price. The stakeholder further added that the present M&A policy does not allow these TSPs to selectively demerge spectrum in a particular band and then sell it to some other TSP.

6.13. Some stakeholders were not in favour of allowing spectrum trading. According to one stakeholder, only when sufficient quantity of spectrum is auctioned and liberalised spectrum is available in the country, can spectrum trading be brought in. Another stakeholder, who opposed the idea, suggested that since we have a mix of allocated and auction purchased spectrum, spectrum trading will only lead to "speculation and distortion" in distribution of the spectrum; further since operators don't hold comparable spectrum, trading will aggravate the situation of a non-level playing field. One suggestion received was that spectrum trading should be limited to return of unwanted spectrum bought at market prices to DoT or sold on a bilateral negotiated basis to a prospective buyer. As per the stakeholder, free trading should be brought in only when market forces have been well established and all operators are competing on a more comparable footing. One stakeholder commented that NTP-2012 has envisaged the introduction of spectrum trading later i.e. after the introduction of spectrum sharing, which is also not permitted at the moment.

6.14. As mentioned above, the majority of stakeholders were in favour of permitting spectrum trading in India. The Authority is of the opinion that since a market system allocates scarce resources to entities that value them the most, it is important in the interest of allocative efficiency to introduce a market-price based trading system for spectrum, in the most flexible manner. The old system of centralized spectrum management can be modernized by a supplementary spectrum trading system. This will impart the necessary flexibility through market-based realignments of spectrum holding. This means that entities (corporate or others) who have property rights should be allowed to decide about the use they intend to make of their spectrum, as long as they have paid for it.

6.15. Spectrum trading can facilitate efficient utilization of spectrum. It is possible that a company which purchased spectrum through an auction may not be interested in carrying on with business and may be seeking an exit. Similarly, it is also possible that a company has more spectrum than it actually requires, whereas others may need to buy spectrum either as a new entrant or to supplement existing holding. Spectrum trading will provide flexibility in managing the spectrum requirement and would facilitate optimal use of spectrum by way of consolidation of spectrum holdings.

6.16. As the number of TSPs in each LSA is quite large, the average spectrum holding per operator is very small. Also, spectrum holding in India is highly fragmented owing to the fact that the spectrum allocated to the TSPs was assigned in different quantums at different points of time. Moreover, in most LSAs the current assignments of spectrum to TSPs is less than optimal and there are uncertainties over the availability of further spectrum. Spectral efficiency is suffering and, therefore, permitting spectrum trading can allow operators to find efficiency of scale. Spectrum trading allows much more specific and targeted reallocations of spectrum than can be achieved through Sharing / M&A activity. Consolidation in the telecom sector has become economically inevitable. Hence, another reason for permitting spectrum trading. This will enable average spectrum holding per operator to increase. With the delinking of spectrum from the licence, this is the opportune time to allow spectrum trading in the country.

6.17. Moreover, as discussed in the CP, the financial performance of the telecom companies has been on the wane for the last few years. With tariffs in India amongst the lowest in the world and the constant requirement of capital investment, particularly to cater to data services, many companies are in the red. Industry-wide consolidation in the sector

is the need of the hour. Apart from Mergers and Acquisitions (M&A), spectrum trading is another way to realise consolidation in the sector: it provides a means for market-driven realignment of spectrum holdings as also an easier path for companies wanting to exit.

6.18. Spectrum auctions help to realise an initial economically efficient allocation of spectrum. Spectrum trading helps to ensure that operators are constantly encouraged to optimally use spectrum because the incentive for selling unused (or inefficiently used) spectrum always exists. As such, trading is likely to result in more efficient use of spectrum. It can also help by introducing new players, thereby promoting competition in the market.

6.19. Secondary trading in spectrum can overcome any inefficiencies that arise after 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 competition, provide incentives for 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.

6.20. As mentioned earlier, spectrum trading can take two forms: either the outright transfer of usage rights of spectrum to another party (spectrum transfer) or the usage right is transferred to another party for a defined period of time but ownership (including the obligations) of usage rights remains with the original rights holder (spectrum leasing). The Authority is of the opinion that, initially, only outright transfer of ownership should

be permitted under the framework of spectrum trading. Leasing of spectrum will be examined at a later date.

6.21. **In view of the foregoing, the Authority recommends that spectrum trading should be permitted in the country. Initially, only outright transfer of spectrum should be permitted.**

6.22. The stakeholders were also requested to send their comments on the legal, regulatory and technical framework required for trading. Various comments received from the stakeholders on the issues such as eligibility to trade, safeguards to prevent spectrum hoarding, roll-out obligations, transfer fee, trade of administratively assigned spectrum, setting up of a trading platform etc are discussed below.

ELIGIBILITY TO PARTICIPATE IN THE SPECTRUM TRADING

6.23. On the eligibility criteria to trade spectrum, some stakeholders have suggested that only licensed players should be permitted to trade spectrum. Any entity having a plain vanilla UAS license can be permitted to carry out acquisition of spectrum through trading. Some stakeholders commented that eligibility conditions for spectrum trading and participation in spectrum auction should be the same, which, in their view, will ensure that only existing TSPs or serious new entrants can trade spectrum. One stakeholder suggested that all licensees, government as well as lenders (to whom spectrum has been mortgaged) should be eligible participants. Some stakeholders said that any licensee/entity holding spectrum in any band should be permitted to trade the same.

6.24. Since spectrum trading will provide flexibility in managing spectrum requirements and will facilitate optimal use of spectrum by way of consolidation, the Authority is of the view that only those entities be permitted to buy spectrum through trading who intend to deploy the

spectrum for providing telecom services. Trading should not be used for purposes of speculation and hoarding. As there is no difference between acquiring spectrum either through the primary market (through participation in auction process) or buying from the secondary market (through trading), there should be no difference in eligibility conditions to participate in the two processes.

6.25. **Accordingly, the Authority recommends that the eligibility conditions for spectrum trading and participation in spectrum auctions should be the same.**

TRADABLE SPECTRUM

6.26. On the issue of tradable spectrum, the Authority is of the view that only spectrum that has been allocated for providing access services should be permitted to be traded. Other spectrum like spectrum given for backhaul or for any other purpose should not be permitted for trading. Secondly, the spectrum given through administrative process should be traded only after the TSP holding the spectrum converts the same as tradable by paying the prescribed market value of the spectrum to the Government.

6.27. In case, the spectrum being traded by the TSP was assigned to it administratively, the prescribed market value shall be payable to the Government after adjusting the entry fee paid by the TSP for acquiring the spectrum (bundled with licence) prorated for the remaining validity. This is applicable only for the first time when the administratively assigned spectrum is traded. After the first trade, the spectrum shall be at par with the spectrum acquired through auction.

6.28. Apart from the spectrum in 800/900/1800 MHz bands, access spectrum has been assigned in 2100 and 2300 MHz bands also. Some stakeholders pointed out that as per the NIA conditions for 3G/BWA auctions, a TSP cannot acquire more than one block of 3G/BWA

spectrum, even through Merger & Acquisition. One stakeholder submitted that the TSPs acquired 3G and BWA spectrum at exorbitant prices as the market uptake for these services was perceived to be very high; however, given the tough financial condition of the telecom sector, it has become difficult for some TSPs to rollout their network in 3G or BWA spectrum band even after acquiring spectrum for almost 3 years. These TSPs can neither sell their 3G/BWA spectrum nor surrender spectrum back to the Government without forfeiting the auction price. Another stakeholder commented that, in the interest of market consolidation, TRAI may like to recommend the holding of up to two blocks of 3G/BWA spectrum in case of M&A by amending the conditions laid down in the NIA for the auction of 3G and BWA spectrum.

6.29. For providing high speed data services, only one block of 2x5 MHz in 2100 MHz band may not be sufficient and a TSP may wish to have another block of spectrum, when its subscriber base increases. Moreover, there could be a TSP, who may wish to exit the 3G or BWA market due to financial conditions. As on date, only one TSP has rolled out its BWA network in a few LSAs. If an exit route is facilitated through spectrum trading, it will help in ensuring optimal and efficient use of spectrum and would also help the TSP, exiting the sector to recoup some of its investment. Therefore, the Authority is of the opinion that spectrum trading should also be permitted in 3G and BWA spectrum. The uniform cap on the spectrum holding, discussed subsequently, should be applicable for 2100 and 2300 MHz bands also. The condition in NIA relating to holding of maximum one block of 3G/BWA spectrum should be amended accordingly.

6.30. **Accordingly, the Authority recommends that only that spectrum should be allowed to be traded which has either been obtained through auction or on which the TSP has paid the prescribed market**

value to the Government. This will also include the spectrum in 2100 MHz and 2300 MHz bands. In case, the spectrum being traded by the TSP was assigned to it administratively, the prescribed market value shall be payable to the Government after adjusting the entry fee paid by the TSP for acquiring the spectrum (bundled with licence) prorated for the remaining validity of the spectrum. After the first trade, the spectrum shall be at par with the spectrum acquired through auction. Through trading, the validity period of spectrum will not change.

6.31. **The Authority also recommends that the seller and the purchaser shall be required to inform the Licensor about the spectrum trade. However, no permission shall be required from the Licensor/ Government. The information of the prospective trade is for the purpose of updating the spectrum register. The register should be updated within a maximum time of eight weeks. On expiry of the time limit, the spectrum trade will be treated as effective.**

SPECTRUM CAP

6.32. Emphasizing the fact that appropriate competition norms must be stipulated and enforced to prevent dominance or market abuse, many stakeholders have suggested placing a limit on the permissible spectrum holding by a TSP. It has been suggested that the amount of spectrum to be traded can be governed by the limits set out in the M & A guidelines. One suggestion was that the Government should first consider capping total spectrum holding in each band. Similarly, another suggestion was that the Authority should frame rules for trading in a manner which prevents speculation and spectrum hoarding. A few stakeholders suggested that there should be a uniform cap for spectrum holding per LSA in case of trading, spectrum auction and Merger & Acquisition; there

should be no distinction between spectrum transferred through an M&A transaction or traded directly in the market.

6.33. One submission made was that trading transactions should be subject to a spectrum cap of 50% in any band and 25% of the total commercial spectrum assigned in an LSA, irrespective of technology mix and/or spectrum band deployed.

6.34. The Authority agrees with the view expressed by a number of stakeholders that there should be a uniform cap for spectrum holding per LSA irrespective of whether the spectrum is obtained by trading, spectrum auction or Merger & Acquisition. There should be no distinction between spectrum transferred through an M&A transaction or traded directly in the market.

6.35. **Accordingly, the Authority recommends that trading transactions should be subject to the spectrum cap of 50% of the spectrum in a band and 25% of the total commercial spectrum assigned in an LSA.**

ROLL-OUT OBLIGATIONS

6.36. A few stakeholders suggested that in order to ensure that only serious service providers participate in trading, spectrum blocks can be sold or leased (for both short term as well as long term) only after full compliance of the roll-out obligations and meeting of Quality of Service (QoS) norms. The other point of view was that the Government should not link spectrum trading with fulfillment of the related roll-out obligations or with any other condition. According to one of these stakeholders, in case spectrum trading takes place before the fulfillment of roll-out obligations, then the buyer should be responsible for fulfilling the roll-out obligations, however, if spectrum trading takes place after the mandatory roll-out obligation period, but without fulfilling it, then

the seller company should be responsible for the consequences, before trading is permitted.

6.37. Spectrum being a scarce resource, the purpose of imposing roll-out obligations is to ensure that the holder of the spectrum uses it efficiently and in a time-bound manner to provide services to the people. Presently, the roll-out obligations are linked with the CMTS/UASL. However, in the new dispensation, with the de-linking of license from spectrum, the Authority has recommended (Para 2.49) that roll-out obligations should be incorporated in the CMTS/UASL/UL/UL(AS) for licensees having access spectrum (spectrum in 800/900/1800 MHz bands).

6.38. Providing an opportunity for telecom companies to exit from the sector is one of the reasons cited by the Authority for permitting spectrum trading. However, the Authority has no intention to dilute its resolve in ensuring speedy penetration of telecom services in the country, especially in the rural areas. Therefore, in case any TSP desires to exit from the market, it should either complete its roll-out obligations or transfer its obligations to the transferee.

6.39. **The Authority recommends that in case a TSP wishes to sell its spectrum through spectrum trading, after completion of the roll-out obligations, the TSP will be permitted to sell the access spectrum in parts, subject to the minimum quantum of spectrum permitted for trading. However, in case the TSP has not fulfilled its roll-out obligations, then it will have to sell its entire holding of access spectrum and the roll-out obligations will also be transferred to the transferee.**

TRANSFER FEE

6.40. Some comments were received on the issue of transfer fee payable to the Government on spectrum trading. A number of stakeholders favoured

the idea of imposing a spectrum transfer fee to ensure that Government gets its due share from the trading of this valuable national resource. However, they were of the view that the levy should not be so high as to make such transactions infeasible. They suggested that the transfer fees imposed for such trades be kept at a reasonable level that actually encourages, rather than deters, market based re-allocations. There were another set of operators who were not in favour of levying any charge on the transfer of spectrum through spectrum trade. According to them, there should not be any spectrum trading charges for the auctioned spectrum as the Government had already collected the market value of spectrum.

6.41. On the issue of permitting trading for administratively assigned spectrum, a few stakeholders commented that a transfer fee should be imposed on the trades of such spectrum as otherwise it will result in windfall gains for TSP but this should be charged only the first time that administratively allocated spectrum is traded in the market and only when a potential gain is possible on the trade. Subsequent trades should not attract any transfer fees.

6.42. The Authority agrees with the views that a transfer fee for trading should not be high so as to discourage trading. However, as any transaction through trading will require some additional work like book keeping, transfer/issue of new Wireless License etc, it would be desirable to impose an administrative charge on such transaction. To ensure that the Government gets a minimum revenue, the administrative charge should be a percentage of the transactional amount or the prescribed market price whichever is higher.

6.43. **Accordingly, the Authority recommends that a transfer fee of one percent (1%) of the transactional amount or the prescribed market price, whichever is higher should be imposed on all spectrum trade**

transactions. The transfer fee should be paid by the transferee to the Government.

OTHER ISSUES

6.44. One stakeholder suggested that the technology to be adopted by the buyer of the spectrum should be ratified by WPC to ensure that the traded channel plans do not interfere with the adjacent existing spectrum which is already in use. Another suggestion was to develop a suitable IT platform to ensure a transparent bidding process in the exchange and to recover administrative charges from the participants in this context. The suggestion received from one stakeholder was that normal taxation issues such as capital gains as well as loss on sale of assets should be factored in trading like any other asset and companies allowed to mark-to-market the spectrum asset value in their respective Balance Sheets.

6.45. **The Authority recommends that if, after a trade, spectrum is intended to be used for any purpose other than its present use, then the details of the technology have to be submitted to the WPC, so as to ensure that the intended use does not create any interference with other users.**

6.46. In addition to the above issues, some stakeholders have suggested that a separate and detailed consultation process should be carried out to work out the detailed guidelines for spectrum trading framework in the country.

6.47. The Authority agrees with this suggestion of the stakeholders. For the present, the Authority has limited itself to these recommendations. However, in order to work out the detailed framework of spectrum trading including the implementation issues, the Authority would like to have further deliberations with the stakeholders.

6.48. **Accordingly, the Authority recommends that the Government may first accept the above recommendations relating to spectrum trading. After the acceptance of the recommendations is conveyed TRAI, the Authority shall constitute a Steering Committee consisting of TSPs and Industry Associations to work out the details of the implementation issues.**

6.49. In the CP, it was mentioned that clarity on the policy framework with regard to spectrum trading will help in unlocking the full potential value of spectrum that is proposed to be auctioned. **Accordingly, the Authority recommends that before the proposed auction, the Government should take the decision on the recommendations pertaining to spectrum trading and incorporate the same in the NIA for the proposed auction. This will help participants in the auction to take an informed decision.**

SHARING OF SPECTRUM

6.50. In its recommendations on 'Spectrum Management and Licensing Framework' dated 11th May 2010 and subsequently in its response dated 3rd November 2011 to the DoT's reference, the Authority had considered the issue of sharing of spectrum and had recommended that spectrum sharing would be permitted only between two spectrum holders in the same LSA with the prior permission of the licensor. However, leasing of spectrum was not permitted. The Authority recommended that permission for spectrum sharing would initially be for a period of 5 years, which may be renewed for a further term of five years, at the discretion of the Government on terms to be prescribed. The Authority also recommended that the total quantum of spectrum, as a result of the spectrum sharing, shall not be exceed the limit prescribed in case of mergers of licences.

6.51. The Authority recommended that parties sharing spectrum would be deemed to be sharing their entire spectrum for the purpose of charging and shall fulfil individually the roll out obligations and the QOS obligations prescribed under the licence. Both would be liable to pay to the Government the prorated current price for spectrum beyond 6.2/5 MHz (GSM/CDMA), in the ratio of the spectrum held by them individually. Spectrum usage charges would be levied on both the operators individually but on the total spectrum held by both the operators together. In respect of spectrum obtained through auction, the Authority recommended that, spectrum sharing will be permitted only if the auction conditions provide for the same.

6.52. Through a Press Statement dated 15th February 2012, the DoT announced the broad guidelines for sharing of 2G spectrum (800/900/1800 MHz bands).

6.53. As per the NIA dated 28th September 2012 for 'Auction of Spectrum in 1800MHz and 800MHz Bands', 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. It was also mentioned in the NIA that detailed guidelines regarding sharing of spectrum and one-time charges for liberalising spectrum currently held would be issued in due course.

6.54. Till date, the Government has not issued the detailed guidelines regarding sharing of spectrum. The Authority is of the opinion that the true value of spectrum shall be revealed in the auction if the entire information is made available to participants. Therefore, the Government should announce the detailed guidelines on the subject of sharing of spectrum before the initiation of the auction process.

6.55. **The Authority recommends that the Government should announce the detailed guidelines on the subject of sharing of spectrum before the initiation of the auction process.**

SPECTRUM AS COLLATERAL

6.56. As discussed in the CP, the telecom sector has been going through financial duress over the past two years. Due to unrealistic pricing and resultant heavy debt, a number of companies have negative operating margins. In this environment, the TSP's ability to pay for spectrum in the auction has been adversely affected. Commercial banks' exposure to the sector is at a very high level and they have become apprehensive of their loans turning bad. Therefore, these banks are no longer willing to further finance the sector in the absence of any matching collateral.

6.57. In this context, one of the nationalized banks has, in its response to the CP, pointed out that since spectrum is classified as an intangible asset, when banks provide funds for roll-out of business plan or for meeting entry fee/ BG requirement, the loans to that extent have to be treated as unsecured loans, even though the licenses are assigned in favour of the lenders. Holding unsecured assets on the banks' books have, in turn, several implications in terms of lower ratings, higher provisioning, etc. In case spectrum to be auctioned in future is priced at high levels, as in the case of 3G spectrum (approx. Rs 67,000 Crs) , then lenders may not be in a position to fund these business plans considering the unsecured nature of the lending. Hence, the bank suggested that TRAI may initiate a consultation process with RBI for treating spectrum as a tangible asset which can be mortgaged for the purpose of lending by banks. In case of default by operators, lenders can recover their dues by selling the spectrum on a 'trading platform' or through any other method as prescribed by the regulator. The valuation of spectrum can be expected to increase if spectrum is made mortgageable. The spectrum holders on

the other hand shall need to mark the value of spectrum to the market value as is happening in case of its other assets.

6.58. In the UAS Licence Agreement, the format of the Tripartite Agreement is prescribed, which needs to be executed amongst the Licensor, Licensee and Lenders to fulfill one of the conditions for transfer or assignment of the licence. Now, spectrum has been delinked from the licence. Therefore, the Authority is of the view that there is a need to include 'Spectrum' in the Tripartite Agreement to facilitate raising of capital by the licensee. Accordingly, in its recommendations on "Terms and Conditions of Unified License (Access Services') dated 2nd January 2013, the Authority had recommended that the format of Tripartite Agreement, to be executed amongst the Licensor, Licensee and Lenders, should be modified after including 'Spectrum' and should be prescribed in the WOL (Wireless Operating Licence).

6.59. **In view of the foregoing, the Authority recommends that the DoT should take up the matter with RBI before the proposed auction so as to ensure that commercial banks and other lending institutions are in a position to provide loans to the telecom companies for participation in the auction.**

CHAPTER-VII

SUMMARY OF RECOMMENDATIONS

7.1. The Authority recommends that there should be no reservation of spectrum for the Renewal Licensees in 900 or 1800 MHz bands. The Authority also recommends that no priority should be accorded to these licensees in the bidding process and all bidders should be treated alike.

7.2. The Authority recommends that, before the upcoming auction, the DoT should come out with a clear roadmap indicating the quantum of spectrum which will be available in future along with time-lines so that licensees whose licences are due for renewal in 2015/16 can take an informed decision about bidding for spectrum in the 1800 MHz band.

7.3. The Authority recommends that for auction of spectrum in 1800 MHz band, the block size should be of 2 x 200 KHz each and the existing licensee will have to bid for a minimum of 3 blocks. A new entrant will be required to bid for a minimum of 25 blocks of 2 x 200 KHz each.

7.4. The Authority recommends that for auction of spectrum in 900 MHz band, the block size should be 2x1 MHz with the condition that each bidder will have to bid for a minimum of 5 blocks.

7.5. The Authority recommends that eligibility conditions prescribed in the recently held auctions (November 2012 and March 2013) should be retained for the upcoming auction.

7.6. The Authority recommends that all CMTS/UASL/UL(AS)/UL providing access service should have the same set of roll-out

obligations and the DoT should amend the licence conditions to incorporate the same.

7.7. The Authority recommends that in addition to the roll-out obligations already prescribed in the CMTS/UASL/UL (AS)/UL, the following roll-out obligations should also be incorporated for licensees having access spectrum (spectrum in 800/900/1800 MHz band).

- **All villages having population of more than 5000 to be covered within 5 years of effective date of allocation of spectrum for access services and all villages having population of more than 2000 to be covered within 7 years of effective date of allocation of spectrum.**
- **These amendments should be made effective from 1st April 2014. However, in case of TSPs holding CMTS/UAS licences prior to the year 2008, the time period for completing these additional roll-out obligations shall be two years/four years from the effective date, while for TSPs acquiring licence post-2008 the time period shall be five years/seven years.**

7.8. The Authority recommends that if a quashed licensee had already met its roll-out obligations in certain DHQs before its licence was quashed but it did not stop providing service in that LSA before re-acquiring spectrum in the auction, the roll out obligations already met by it before cancellation of its licence should be taken into account and the licensee should not be required to re-offer its that part of the network for the re-test. Similarly, a renewal licensee should not be asked to re-offer its network for test of roll-out obligations already met before the renewal of its licence, if the licensee continues to provide access services.

7.9. The Authority recommends that regarding compliance of roll-out obligations involving coverage of villages, self-certifications by the TSPs should be taken as compliance subject to the condition that 20% of the villages self-certified by the TSP will be sample test checked by the TERM cell. The sample test check by the TERM cell will be carried out within a time period of three months from the date of self-certification.

7.10. The Authority recommends that the frequency rearrangement in the same band, from within the assignments made to the licensees, should be permitted, amongst all licensees irrespective of whether the spectrum is liberalised or not.

7.11. The Authority recommends that:

i. TSPs should be allowed to convert their existing 1800 MHz spectrum into liberalised spectrum only for the balance validity period of the spectrum assignment on payment of the auction determined amount. The auction determined amount will be prorated for the balance validity period of spectrum assignment.

ii. In case more than one set of market determined prices are available, the latest market determined prices available at the time when the TSP wants to liberalise its spectrum holding, should be applied.

iii. If the market determined prices are more than one year old, then these prices have to be suitably adjusted to reflect prevailing market conditions. One way of determining the prevailing market rates could be by indexing the last auction prices at the rate of SBI PLR. Another way could be the market price as realised through spectrum trading.

iv. **The use of liberalised spectrum would be governed by the licence held by the TSP. The technology to be used by the licensee should be based on standards approved by ITU/TEC or any other International Standards Organization/bodies/ Industry. Also, if the use of spectrum is for any other technology than that already deployed in that spectrum band, its use has to be first ratified by the WPC. In such cases, the licensee shall provide details of the technology proposed to be deployed for operation of its services to WPC. It is also to be ensured by the TSP that deployment of any new technology should not cause harmful interference to already operating technologies either in the same band or in adjacent bands.**

7.12. The Authority recommends that the feasibility of adoption of E-GSM should be explored in a time-bound manner. The Authority also recommends that the auction in the 800 MHz band should not be carried out now.

7.13. The Authority recommends that the reserve prices for 1800 MHz spectrum for 22 LSAs should be as in the table below:

LSA	Reserve Price per MHz (Rs. in crore)
Delhi	175
Mumbai	165
Kolkata	59
Andhra Pradesh	130
Gujarat	115
Karnataka	124
Maharashtra	138
Tamil Nadu	166
Haryana	27

Kerala	**52**
Madhya Pradesh	**43**
Punjab	**54**
Rajasthan	**26**
U. P. (East)	**61**
U.P. (West)	**62**
West Bengal	**21**
Assam	**7**
Bihar	**37**
Himachal Pradesh	**6**
Jammu & Kashmir	**5**
North East	**7**
Orissa	**16**
Pan India	**1496**

7.14. The Authority recommends that the reserve prices for 900 MHz spectrum for Delhi, Mumbai and Kolkata LSAs should be as in the table below:

LSA	Reserve Price per MHz (Rs. in crore)
Delhi	**288**
Mumbai	**262**
Kolkata	**100**

7.15. The Authority recommends that there is no need for determining a valuation or corresponding reserve price for 800 MHz spectrum at present.

7.16. The Authority recommends that payment terms should be structured by the Government to address financing issues of the bidders in the proposed auction.

7.17. The Authority recommends that all spectrum allocated through auction should henceforth be charged at a flat rate. The Authority also recommends that spectrum acquired on through auction or trading or on which TSP has paid the prescribed market value to the Government should not be added to any existing spectrum holdings for determining the applicable slab rate. This will also apply to spectrum allocated in the auctions held in November 2012 and March 2013.

7.18. The Authority recommends that SUC for all auctioned spectrum should be at a flat rate of 3% of AGR of wireless services. This will come into effect from 1st April, 2014.

7.19. The Authority recommends that the SUC rate for BWA spectrum should also be fixed at 3% where services are provided under CMTS/UASL/UL (AS)/UL.

7.20. The Authority recommends that the highest slab rate of SUC may be brought down to 5% of AGR with effect from 1st April, 2014.

7.21. The Authority recommends that spectrum trading should be permitted in the country. Initially, only outright transfer of spectrum should be permitted.

7.22. The Authority recommends that the eligibility conditions for spectrum trading and participation in spectrum auctions should be the same.

7.23. The Authority recommends that only that spectrum should be allowed to be traded which has either been obtained through auction

or on which the TSP has paid the prescribed market value to the Government. This will also include the spectrum in 2100 MHz and 2300 MHz bands. In case, the spectrum being traded by the TSP was assigned to it administratively, the prescribed market value shall be payable to the Government after adjusting the entry fee paid by the TSP for acquiring the spectrum (bundled with licence) prorated for the remaining validity of the spectrum. After the first trade, the spectrum shall be at par with the spectrum acquired through auction. Through trading, the validity period of spectrum will not change.

7.24. The Authority also recommends that the seller and the purchaser shall be required to inform the Licensor about the spectrum trade. However, no permission shall be required from the Licensor/ Government. The information of the prospective trade is for the purpose of updating the spectrum register. The register should be updated within a maximum time of eight weeks. On expiry of the time limit, the spectrum trade will be treated as effective.

7.25. The Authority recommends that trading transactions should be subject to the spectrum cap of 50% of the spectrum in a band and 25% of the total commercial spectrum assigned in an LSA.

7.26. The Authority recommends that in case a TSP wishes to sell its spectrum through spectrum trading, after completion of the roll-out obligations, the TSP will be permitted to sell the access spectrum in parts, subject to the minimum quantum of spectrum permitted for trading. However, in case the TSP has not fulfilled its roll-out obligations, then it will have to sell its entire holding of access spectrum and the roll-out obligations will also be transferred to the transferee.

7.27. The Authority recommends that a transfer fee of one percent (1%) of the transactional amount or the prescribed market price, whichever is higher should be imposed on all spectrum trade transactions. The transfer fee should be paid by the transferee to the Government.

7.28. The Authority recommends that if, after a trade, spectrum is intended to be used for any purpose other than its present use, then the details of the technology have to be submitted to the WPC, so as to ensure that the intended use does not create any interference with other users.

7.29. The Authority recommends that the Government may first accept the above recommendations relating to spectrum trading. After the acceptance of the recommendations is conveyed TRAI, the Authority shall constitute a Steering Committee consisting of TSPs and Industry Associations to work out the details of the implementation issues.

7.30. The Authority recommends that before the proposed auction, the Government should take the decision on the recommendations pertaining to spectrum trading and incorporate the same in the NIA for the proposed auction. This will help participants in the auction to take an informed decision.

7.31. The Authority recommends that the Government should announce the detailed guidelines on the subject of sharing of spectrum before the initiation of the auction process.

7.32. The Authority recommends that the DoT should take up the matter with RBI before the proposed auction so as to ensure that commercial banks and other lending institutions are in a position to provide loans to the telecom companies for participation in the auction.

ABBREVIATION

S.No.	Abbreviation	Expansion
1.	2G	Second Generation
2.	3G	Third Generation
3.	4G	Fourth Generation
4.	AGR	Adjusted Gross Revenue
5.	APAC	Asia-Pacific
6.	ARPU	Average Revenue per User
7.	BHQ	Block Headquarter
8.	BSNL	Bharat Sanchar Nigam Limited
9.	BTS	Base Transceiver Station
10.	BWA	Broadband Wireless Access
11.	CAD	Current Account Deficit
12.	CAPEX	Capital Expenditure
13.	CDMA	Code Division Multiple Access
14.	CMTS	Cellular Mobile Telephone Service
15.	CP	Consultation Paper
16.	DCF	Discounted Cash Flow
17.	DHQ	District Headquarter
18.	DoT	Department of Telecommunications
19.	EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
20.	E-GSM	Extended Global System for Mobile
21.	FDD	Frequency Division Duplex
22.	FDI	Foreign Direct Investment
23.	GDP	Gross Domestic Product
24.	GSA	Global mobile Supplier Associations
25.	GSM	Global System for Mobile Communication

ABBREVIATION

S.No.	Abbreviation	Expansion
26.	HSPA	High Speed Packet Access
27.	IMT	International Mobile Telecommunications
28.	ITU	International Telecommunication Union
29.	LSA	Licensed Service Area
30.	LTE	Long Term Evolution
31.	MEA	Middle-East and Africa
32.	M&A	Merger and Acquisitions
33.	MOU	Minutes of Usage
34.	MTNL	Mahanagar Telephone Nigam Limited
35.	NFAP	National Frequency Allocation Plan
36.	NIA	Notice Inviting Application
37.	NPV	Net Present Value
38.	NTP	National Telecom Policy
39.	OPEX	Operating Expenditure
40.	PBIT	Profit before Interest and Taxes
41.	PLR	Prime Lending Rate
42.	PPP	Purchasing Power Parity
43.	QoS	Quality of Service
44.	RAN	Radio Access Network
45.	RBI	Reserve Bank of India
46.	R-DEL	Rural Direct Exchange Line
47.	SCADA	Supervisory Control and Data Acquisition
48.	SUC	Spectrum Usage Charges
49.	TDD	Time Division Duplex
50.	TEC	Telecom Engineering Centre
51.	TERM	Telecom Enforcement, Resource and

ABBREVIATION

S.No.	Abbreviation	Expansion
		Monitoring
52.	TRAI	Telecom Regulatory Authority of India
53.	TSP	Telecom Service Provider
54.	UASL	Unified Access Service License
55.	UL	Unified License
56.	UL(AS)	Unified License (Access Service)
57.	UMTS	Universal Mobile Telecommunication System
58.	USO	Universal Service Obligation
59.	WCDMA	Wideband Code Division Multiple Access
60.	WPC	Wireless Planning & Coordination Wing

ANNEXURE-1.1

Government of India
Ministry of Communications & IT
Department of Telecommunications
WPC Wing

Sanchar Bhawan
New Delhi-110001

No. L-14006/03/2013-NTG

Dated: 10.07.2013

To

The Secretary,
Telecom Regulatory Authority of India,
Mahanagar, Doorsanchar Bhawan,
Jawahar Lal Nehru Marg, (Old Minto Road)
New Delhi –110002.

Subject: TRAI Recommendations on the reserve price for auction of spectrum in 1800 MHz, 800 MHz and 900 MHz bands – reg.

Sir,

Undersigned is directed to state that Hon'ble Supreme Court, in its order dated 15.2.2013, has issued, among others, the following direction:

> *"(i) The entire spectrum released as a result of quashing of the licences on 2.2.2012 should be auctioned without further delay.*
>
> -------"

2. Accordingly, it has, now been decided to conduct another round of auction of spectrum in 1800 MHz, 900 MHz and 800 MHz bands.

3. In this context, it is mentioned that TRAI, in its recommendations on 'Auction of Spectrum' of April and May, 2012, had recommended, among others, the reserve price for auction of spectrum in different bands, including for 1800 MHz, 800 MHz and 900 MHz bands. The Government, having considered the above TRAI recommendations on reserve price and also taking into account related issues decided the reserve price for 1800 MHz, 800 MHz and 900 MHz bands and conducted two rounds of auction of spectrum, one in November, 2012 and another in March, 2013.

3.1 While in November, 2012 auction, about 52% of spectrum on offer was sold; in March, 2013 auction in 1800 MHz and 900 MHz bands, there was no participation. There was only a single participant for 800 MHz band who took 30% of the spectrum on offer in that band. The reserve price decided by the Government for different bands for November, 2012 and March, 2013 are given in Annex-I. The spectrum sold during the November 2012 and March 2013 in 1800 MHz and 800 MHz bands as well as the spectrum proposed for auction now is at Annex-IIA and Annex-IIB respectively. Spectrum in 900 MHz band is also proposed for auction in 3 Telecom Service Areas (i.e. Delhi, Mumbai and Kolkata) as in March, 2013.

4. The EGoM, in its meeting held on 26th June, 2013, directed that before conduct of next round of auction of spectrum, recommendation of TRAI be obtained on the reserve price.

5. Therefore, TRAI is requested to kindly provide recommendations on applicable reserve price for auction of spectrum in 800 MHz, 900 MHz and 1800 MHz bands. In light of SC directive, TRAI may also consider an expedited process in this matter.

Yours faithfully,

(R.B. Prasad)
Joint Wireless Adviser

Annexure I

Service Area	Reserve Price (in Rs. crore) per block of 1.25 MHz				
	Nov-2012		Mar-2013		
Spectrum Band (in MHz)	1800	800	1800	800	900
Andhra Pradesh	286.91	372.99		186.49	
Assam	8.67	11.27		5.63	
Bihar	42.51	55.26		27.63	
Delhi	693.06	900.98	485.14	450.49	970.29
Gujarat	224.84	292.29		146.15	
Haryana	46.52	60.47		30.24	
Himachal Pradesh	7.78	10.11		5.06	
Jammu & Kashmir	6.33	8.23		4.11	
Karnataka	330.12	429.16	231.09	214.58	
Kerala	65.30	84.89		42.45	
Kolkata	113.72	147.84		73.92	227.44
Madhya Pradesh	53.99	70.19		35.09	
Maharashtra	262.81	341.65		170.83	
Mumbai	678.45	881.99	474.92	440.99	949.83
North East	8.84	11.49		5.75	
Orissa	20.27	26.35		13.18	
Punjab	67.28	87.47		43.73	
Rajasthan	67.08	87.20	46.95		
Tamil Nadu	306.09	397.92		198.96	
Uttar Pradesh (East)	76.17	99.02		49.51	
Uttar Pradesh (West)	107.41	139.63		69.82	
West Bengal	25.84	33.59		16.79	
Total	**3500.00**	**4549.99**			

*Spectrum in all service areas was sold at reserve price except in case of Bihar in respect of 1800 MHz where auction price was Rs. 46.43 crores per 1.25 MHz.

Annexure-II A.

Quantum of spectrum to be put for auction in 1800 MHz band

S. No.	Service Area	Quantum of Quashed Spectrum	Spectrum sold in November 2012	Spectrum put for auction in March 2013*	Quantum of spectrum proposed to be put for auction
(a)	(b)	(c)	(d)	(e)	(f)
1	Delhi	4.40	0.00	15.00	15.00
2	Mumbai	13.20	0.00	15.00	15.00
3	Kolkata	17.6	5.00	0.00	13.75
4	Maharashtra	22.0	6.25	0.00	13.75
5	Gujarat	17.6	10.00	0.00	8.75
6	Andhra Pradesh	22.0	5.00	0.00	17.50
7	Karnataka	22.0	0.00	13.75	22.50
8	Tamil Nadu	22.0	5.00	0.00	17.50
9	Kerala	17.6	1.25	0.00	17.50
10	Punjab	17.6	1.25	0.00	15.00
11	Haryana	22.0	7.50	0.00	11.25
12	UP (W)	17.6	12.50	0.00	2.50
13	UP (E)	17.6	11.25	0.00	7.50
14	Rajasthan	17.6	0.00	13.75	18.75
15	MP	17.6	7.50	0.00	11.25
16	West Bengal	17.6	8.75	0.00	10.00
17	HP	17.6	1.25	0.00	13.75
18	Bihar	22.0	13.75	0.00	5.00
19	Orissa	22.0	7.50	0.00	15.00
20	Assam	22.0	8.75	0.00	12.50
21	North East	22.0	7.50	0.00	15.00
22	J & K	22.0	7.50	0.00	6.25
		413.6	127.5	57.5	285.00

* For spectrum put for auction in March 2013, no bid received.

Note: Spectrum shall be auctioned in Block Size of 1.25 MHz.

Annexure-II B

Quantum of spectrum proposed to be put for auction in 800 MHz band

S. No.	Service Area	Quantum of Quashed Spectrum	Spectrum sold in November 2012	Spectrum put for auction in March 2013	Quantum of spectrum sold during March 2013	Quantum of spectrum proposed to be put for auction
(a)	(b)	(c)	(d)	(e)	(f)	(g)
1	Delhi	2.5	0.00	3.75	3.75	
2	Mumbai	2.5	0.00	3.75	0.00	3.75
3	Kolkata	2.5	0.00	3.75	3.75	
4	Maharashtra	2.5	0.00	3.75	0.00	3.75
5	Gujarat	2.5	0.00	5.00	3.75	
6	Andhra Pradesh	2.5	0.00	2.50	0.00	2.50
7	Karnataka	2.5	0.00	5.00	3.75	
8	Tamil Nadu	2.5	0.00	5.00	3.75	
9	Kerala	2.5	0.00	5.00	3.75	
10	Punjab	2.5	0.00	2.50	0.00	2.50
11	Haryana	2.5	0.00	5.00	0.00	5.00
12	UP (W)	2.5	0.00	5.00	3.75	
13	UP (E)	2.5	0.00	5.00	0.00	5.00
14	Rajasthan	0.0	0.00	0.00	0.00	
15	MP	2.5	0.00	5.00	0.00	5.00
16	West Bengal	2.5	0.00	5.00	3.75	
17	HP	2.5	0.00	5.00	0.00	5.00
18	Bihar	2.5	0.00	5.00	0.00	5.00
19	Orissa	2.5	0.00	5.00	0.00	5.00
20	Assam	5.0	0.00	5.00	0.00	5.00
21	North East	5.0	0.00	5.00	0.00	5.00
22	J & K	5.0	0.00	5.00	0.00	5.00
		60.0	0.00	95.00	30.00	57.50

Note: spectrum shall be auctioned in block size of 1.25 MHz.

ANNEXURE-1.2

Government of India
Ministry of communications & IT
Department of telecommunications
(WPC Wing)

No. L-14040/06/2013-NTG Dated 22nd August, 2013

The Secretary,
Telecom Regulatory Authority of India,
Mahanagar,Doordarshan Bhawan,
Jawaharlal Lal Nehru Marg, (Old Minto Road)
New Delhi-110002

Subject: Trading of spectrum

Sir,

Undersigned is directed to refer to TRAI's recommendations of May 2010 and recommendations of April 2012 wherein TRAI had made certain recommendations on spectrum trading. In April, 2012, TRAI had recommended, among others, that spectrum trading should be allowed between spectrum holders having obtained spectrum through auction or having paid auction determined price for the spectrum held by them, only for the limited purpose of frequency reconfiguration (arranging spectrum in a contiguous band). (Para 3.186).

2. It has now been decided that spectrum will be made available only through market related process. Also spectrum allotted through auction process is now liberalised.

3. TRAI is requested to provide their recommendations in terms of clause 11 (1) (a) of TRAI Act 1997, as amended by TRAI Amendment Act, 2000, on trading of spectrum which inter- alia may include conditions & timing for permitting trading of spectrum obtained through auction, quantity of spectrum for trading by an operator, revenue payable apart from legal, regulatory & technical frame work. TRAI may also consider any other item on the subject .

Yours faithfully,

(R. B. Prasad)
Joint Wireless Adviser

ANNEXURE 2.1

CDMA CARRIERS ASSIGNMENTS (EXISTING)

S. No.	Metro Circles	1	42	83	124	0.6	185	226	267	308	0.6	369	410	451	492	0.6	553	594
		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
1	Delhi	MTNL	AVAILABLE	MTNL	SSTL		RCL	RCL	RCL	RCL		TTL	TTL	TTL	TTL		SSTL	SSTL
		1		84			185	226	267	308		369	410	451	492		553	594
		870.03	871.26	872.52	874.02		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
2	Mumbai	TTML	TTML	TTML	TTML		MTNL	MTNL	AVAILABLE	AVAILABLE		AVAILABLE	AVAILABLE		RCL	RCL	RCL	RCL
		1	42	83	124		185	226				369	410		471	512	553	594
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3		884.13	885.36	886.59	887.82
3	Kolkata	AVAILABLE	BSNL	BSNL		TTL	TTL	SSTL	TTL		SSTL	SSTL		RCL	RCL	RCL	RCL	
			42	83		144	185		288		339	380		451	492	533	574	
		870.03	871.26	872.49		874.32	875.55	877.08	878.64		880.17	881.4		883.53	884.76	885.99	887.22	
	A' Service Areas																	
1	AP	AVAILABLE	Vacant	BSNL	BSNL		AVAILABLE	TTL	TTL	TTL		RCL	RCL	RCL	RCL		AVAILABLE	AVAILABLE
				78	119			226	267	308		369	410	451	492			
		870.03		872.34	873.57		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
2	Gujarat	TTL	TTL	SSTL	SSTL		AVAILABLE	TTL	BSNL	BSNL		SSTL	AVAILABLE	AVAILABLE		RCL	RCL	RCL
		1	42	93	134			226	279	320						512	553	594
		870.03	871.26	872.79	874.02		875.55	876.78	878.37	879.6		881.07	882.3	883.53		885.36	886.59	887.82
3	Maharashtra	TTML	TTML	TTML	TTML		AVAILABLE	AVAILABLE	AVAILABLE	Vacant		BSNL	BSNL	AVAILABLE		RCL	RCL	RCL	RCL
		1	42	83	124							347	388			471	512	553	594
		870.03	871.26	872.49	873.72		875.25	876.48	878.01			880.41	881.64			884.13	885.36	886.59	887.82
4	Karnataka	AVAILABLE	BSNL	BSNL	SSTL		TTL	TTL	TTL	AVAILABLE		RCL	RCL	RCL	RCL		SSTL	SSTL
			42	83			185	226	267			369	410	451	492		553	594
		870.03	871.26	872.49	874.02		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
5	Tamil Nadu	AVAILABLE	BSNL	BSNL	SSTL		TTL (only Chennai)	TTL	TTL	AVAILABLE		RCL	RCL	RCL	RCL		SSTL	SSTL
			42	83				226	267			369	410	451	492		553	594
		870.03	871.26	872.49	874.02		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82

CDMA CARRIERS ASSIGNMENTS (EXISTING)

		1	42	83	124		185	226	267	308		369	410	451	492		553	594
		1.23	1.23	1.23	1.23	0.6	1.23	1.23	1.23	1.23	0.6	1.23	1.23	1.23	1.23	0.6	1.23	1.23
		870.030	871.260	872.490	873.720		875.550	876.780	878.010	879.240		881.070	882.300	883.530	884.760		886.590	887.820
S. No	"B" Service Area																	
1	HARYANA	AVAILABLE	BSNL	BSNL	AVAILABLE		RCL	RCL	RCL	AVAILABLE		TTL	TTL	TTL	AVAILABLE		AVAILABLE	AVAILABLE
			42	83			185	226	267			369	410	451			553	594
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.78		886.59	887.82
2	MP	AVAILABLE	Vacant	BSNL	BSNL		AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE		RCL	RCL	RCL	RCL		TTL	TTL
				75	116							369	410	451	492		553	594
		870.03		872.25	873.48		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
3	PUNJAB	AVAILABLE	HFCL	HFCL	AVAILABLE		BSNL	BSNL		AVAILABLE		RCL	RCL	RCL		TTL	TTL	TTL
			42	83	134		213	254		308		369	410	451		512	553	594
		870.03	871.26	872.49	874.02		876.39	877.62		879.24		881.07	882.3	883.53		885.36	886.59	887.82
4	RAJSATHAN	Vacant	BSNL		TTL		SSTL	SSTL	SSTL	SSTL		TTL	BSNL		RCL	RCL	RCL		TTL
			37		98		160	201	242	283		337	398		451	492	533		594
			871.11		872.49		874.80	876.03	877.26	878.49		880.11	881.94		883.53	884.76	885.99		887.82
5	KERALA	BSNL	BSNL	BSNL		SSTL	AVAILABLE	TTL	TTL	TTL		RCL	RCL	RCL	RCL		SSTL	SSTL
		1	42	83		134		226	267	308		369	410	451	492		553	594
		870.03	871.26	872.49		874.02	875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
6	UP(E)	AVAILABLE	BSNL	BSNL		AVAILABLE	TTL	TTL	TTL	AVAILABLE		RCL	RCL	RCL	RCL		AVAILABLE	AVAILABLE
			42	83			185	226	267			369	410	451	492			
		870.03	871.26	872.49		874.02	875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
7	UP(W)	AVAILABLE	BSNL	BSNL		SSTL	RCL	RCL	RCL	RCL		AVAILABLE	TTL	TTL	TTL		SSTL	SSTL
			42	83		134	185	226	267	308			410	451	482		553	594
		870.03	871.26	872.49		874.02	875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
8	WEST BENGAL	AVAILABLE	BSNL	BSNL		TTL	AVAILABLE	SSTL	AVAILABLE	TTL		SSTL	SSTL		RCL	RCL	RCL		AVAILABLE
			42	83		144				308		359	400		451	492	533		
		870.03	871.26	872.49		874.32	875.55	876.78	878.01	879.24		880.77	882.00		883.53	884.76	885.99		887.82

CDMA CARRIERS ASSIGNMENTS (EXISTING)

		1	42	83	124	0.6	185	226	267	308	0.6	369	410	451	492	0.6	553	594
		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23
		870.030	871.260	872.490	873.720		875.550	876.780	878.010	879.240		881.070	882.300	883.530	884.760		886.590	887.820
S. No.	"C" Service Area																	
1	ASSAM	AVAILABLE	BSNL 42	BSNL 83	AVAILABLE		AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE		RTL 369	RTL 410	AVAILABLE	AVAILABLE		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
2	BIHAR	AVAILABLE	BSNL 42	BSNL 83	AVAILABLE		TTL 185	TTL 226	TTL 267	AVAILABLE		RCL 369	RCL 410	RCL 451	RCL 492		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.30	883.53	884.76		886.59	887.82
3	HP	AVAILABLE	BSNL 42	BSNL 83	AVAILABLE		AVAILABLE	TTL 226	TTL 267	AVAILABLE		AVAILABLE	RCL 410	RCL 451	AVAILABLE		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.30	883.53	884.76		886.59	887.82
4	J&K	AVAILABLE	BSNL 42	BSNL 83	AVAILABLE		AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE		AVAILABLE	RCL 410	RCL 451	AVAILABLE		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.30	883.53	884.76		886.59	887.82
5	NE	AVAILABLE	BSNL 42	BSNL 83	AVAILABLE		AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE		RTL 369	RTL 410	AVAILABLE	AVAILABLE		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
6	ORRISSA	AVAILABLE	BSNL 42	BSNL 83	AVAILABLE		AVAILABLE	TTL 226	TTL 267	AVAILABLE		RCL 369	RCL 410	RCL 451	AVAILABLE		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.30	883.53	884.76		886.59	887.82

Legends:	BSNL	Bharat Sanchar Nigam Ltd.	RCL	Reliance Communications Ltd.	TTL	Tata Teleservice Ltd.
	MTNL	Mahanagar Telephone Nigam Ltd.	RTL	Reliance Telecom Ltd.	SSTL	Shyam Telelink Ltd.
	HFCL	Himachal Futuristic Comm. Ltd.			TTML	Tata Teleservice (Mah.) Ltd.

ANNEXURE 2.2

CDMA CARRIERS ASSIGNMENTS (AFTER SURRENDER OF SPECTRUM BY PSUs AND TTSL)

S. No.	Metro Circles	1	42	83	124	0.6	185	226	267	308	0.6	369	410	451	492	0.6	553	594
		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
1	Delhi	AVAILABLE	AVAILABLE	AVAILABLE	SSTL		RCL	RCL	RCL	RCL		TTL	TTL	TTL	AVAILABLE		SSTL	SSTL
		870.03	871.26	872.52	874.02		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
2	Mumbai	TTML	TTML	TTML	AVAILABLE		AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE		AVAILABLE	AVAILABLE		RCL	RCL	RCL	RCL
		1	42	83								369	410		471	512	553	594
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3		884.13	885.36	886.59	887.82
3	Kolkata	AVAILABLE	BSNL	AVAILABLE	TTL	TTL	SSTL		AVAILABLE		SSTL	SSTL			RCL	RCL	RCL	RCL
			42		144	185					339	380			451	492	533	574
		870.03	871.26	872.49	874.32	875.55	877.08		878.64		880.17	881.4			883.53	884.76	885.99	887.22
A' Service Areas																		
1	AP	AVAILABLE	Vacant	BSNL	AVAILABLE		AVAILABLE	TTL	TTL	AVAILABLE		RCL	RCL	RCL	RCL		AVAILABLE	AVAILABLE
		870.03		78	873.57		875.55	226	267	879.24		369	410	451	492		886.59	887.82
				872.34				876.78	878.01			881.07	882.3	883.53	884.76			
2	Gujarat	TTL	TTL	SSTL	SSTL		AVAILABLE	AVAILABLE	BSNL	AVAILABLE		SSTL	AVAILABLE	AVAILABLE			RCL	RCL	RCL
		1	42	93	134				279								512	553	594
		870.03	871.26	872.79	874.02		875.55	876.78	878.37	879.6		881.07	882.3	883.53			885.36	886.59	887.82
3	Maharashtra	TTML	TTML	AVAILABLE	AVAILABLE		AVAILABLE	AVAILABLE	AVAILABLE	Vacant	BSNL	AVAILABLE	AVAILABLE		RCL	RCL	RCL	RCL
		1	42								347				471	512	553	594
		870.03	871.26	872.49	873.72		875.25	876.48	878.01		880.41	881.64			884.13	885.36	886.59	887.82
4	Karnataka	AVAILABLE	BSNL	AVAILABLE	SSTL		TTL	TTL	AVAILABLE	AVAILABLE		RCL	RCL	RCL	RCL		SSTL	SSTL
			42				185	226				369	410	451	492		553	594
		870.03	871.26	872.49	874.02		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
5	Tamil Nadu	AVAILABLE	BSNL	AVAILABLE	SSTL		AVAILABLE	TTL	TTL	AVAILABLE		RCL	RCL	RCL	RCL		SSTL	SSTL
			42					226	267			369	410	451	492		553	594
		870.03	871.26	872.49	874.02		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82

CDMA CARRIERS ASSIGNMENTS (AFTER SURRENDER OF SPECTRUM BY PSUs AND TTSL)

		1	42	83	124		185	226	267	308		369	410	451	492		553	594
		1.23	1.23	1.23	1.23	0.6	1.23	1.23	1.23	1.23	0.6	1.23	1.23	1.23	1.23	0.6	1.23	1.23
		870.030	871.260	872.490	873.720		875.550	876.780	878.010	879.240		881.070	882.300	883.530	884.760		886.590	887.820
S. No	"B" Service Area																	
1	HARYANA	AVAILABLE	BSNL 42	AVAILABLE	AVAILABLE		RCL 185	RCL 226	RCL 267	AVAILABLE		TTL 369	TTL 410	AVAILABLE	AVAILABLE		AVAILABLE 553	AVAILABLE 594
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.78		886.59	887.82
2	MP	AVAILABLE	Vacant	BSNL 75	AVAILABLE		AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE		RCL 369	RCL 410	RCL 451	RCL 492		TTL 553	TTL 594
		870.03		872.25	873.48		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
3	PUNJAB	AVAILABLE	HFCL 42	HFCL 83	AVAILABLE 134		BSNL 213	AVAILABLE		AVAILABLE 308		RCL 369	RCL 410	RCL 451			TTL 512	TTL 553	AVAILABLE
		870.03	871.26	872.49	874.02		876.39	877.62		879.24		881.07	882.3	883.53			885.36	886.59	887.82
4	RAJSATHAN	Vacant	BSNL 37		TTL 98		SSTL 160	SSTL 201	SSTL 242	SSTL 283		TTL 337		AVAILABLE			RCL 451	RCL 492	RCL 533	AVAILABLE
			871.11		872.49		874.80	876.03	877.26	878.49		880.11		881.94			883.53	884.76	885.99	887.82
5	KERALA	BSNL 1	AVAILABLE	AVAILABLE		SSTL 134	AVAILABLE	TTL 226	TTL 267	AVAILABLE		RCL 369	RCL 410	RCL 451	RCL 492		SSTL 553	SSTL 594	
		870.03	871.26	872.49		874.02	875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82	
6	UP(E)	AVAILABLE	BSNL 42	AVAILABLE	AVAILABLE		TTL 185	TTL 226	AVAILABLE	AVAILABLE		RCL 369	RCL 410	RCL 451	RCL 492		AVAILABLE	AVAILABLE	
		870.03	871.26	872.49	874.02		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82	
7	UP(W)	AVAILABLE	BSNL 42	AVAILABLE	SSTL 134		RCL 185	RCL 226	RCL 267	RCL 308		AVAILABLE	TTL 410	TTL 451	AVAILABLE		SSTL 553	SSTL 594	
		870.03	871.26	872.49	874.02		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82	
8	WEST BENGAL	AVAILABLE	BSNL 42	AVAILABLE		TTL 144	AVAILABLE	SSTL	AVAILABLE	TTL 308		SSTL 359	SSTL 400		RCL 451	RCL 492	RCL 533		AVAILABLE
		870.03	871.26	872.49		874.32	875.55	876.78	878.01	879.24		880.77	882.00		883.53	884.76	885.99		887.82

CDMA CARRIERS ASSIGNMENTS (AFTER SURRENDER OF SPECTRUM BY PSUs AND TTSL)

		1	42	83	124	0.6	185	226	267	308	0.6	369	410	451	492	0.6	553	594
		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23
		870.030	871.260	872.490	873.720		875.550	876.780	878.010	879.240		881.070	882.300	883.530	884.760		886.590	887.820
S. No.	"C" Service Area																	
1	ASSAM	AVAILABLE	BSNL 42	AVAILABLE	AVAILABLE		AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE		RTL 369	RTL 410	AVAILABLE	AVAILABLE		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
2	BIHAR	AVAILABLE	BSNL 42	AVAILABLE	AVAILABLE		TTL 185	TTL 226	AVAILABLE	AVAILABLE		RCL 369	RCL 410	RCL 451	RCL 492		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.30	883.53	884.76		886.59	887.82
3	HP	AVAILABLE	BSNL 42	AVAILABLE	AVAILABLE		AVAILABLE	TTL 226	TTL 267	AVAILABLE		AVAILABLE	RCL 410	RCL 451	AVAILABLE		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.30	883.53	884.76		886.59	887.82
4	J&K	AVAILABLE	BSNL 42	AVAILABLE	AVAILABLE		AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE		AVAILABLE	RCL 410	RCL 451	AVAILABLE		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.30	883.53	884.76		886.59	887.82
5	NE	AVAILABLE	BSNL 42	AVAILABLE	AVAILABLE		AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE		RTL 369	RTL 410	AVAILABLE	AVAILABLE		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		886.59	887.82
6	ORRISSA	AVAILABLE	BSNL 42	AVAILABLE	AVAILABLE		AVAILABLE	TTL 226	TTL 267	AVAILABLE		RCL 369	RCL 410	RCL 451	AVAILABLE		AVAILABLE	AVAILABLE
		870.03	871.26	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.30	883.53	884.76		886.59	887.82

Legends:	BSNL	Bharat Sanchar Nigam Ltd.	RCL	Reliance Communications Ltd.	TTL	Tata Teleservice Ltd.
	MTNL	Mahanagar Telephone Nigam Ltd.	RTL	Reliance Telecom Ltd.	SSTL	Shyam Telelink Ltd.
	HFCL	Himachal Futuristic Comm. Ltd.			TTML	Tata Teleservice (Mah.) Ltd.

ANNEXURE 4.1

VALUATION OF 1800 MHZ SPECTRUM: MARKET DATA ANALYSIS

Data Sources and Variables for correlation with Single Variables or through Multiple Regression

1. Data on realised prices (per MHz, 1800 band) for 18 circles on November 2012 has been used for this analysis. The data on relevant variables used in estimating the value of spectrum has been gathered from various sources. Variables which could have an impact on the value of spectrum are listed below:

- AGR (Wireless)[18]: It can be taken as variable since the price of spectrum in a particular LSA is likely to depend on revenue earning potential of that LSA.
- Subscribers (Wireless)[18]: It represents the part of the population having mobile connections.
- Existing Tele-density[18]: It indicates the percentage of population having mobile telecom connectivity. Existing Tele-density = Number of mobile cellular subscribers per 100 persons.
- Residual Tele-density[18]: It is the difference between an assumed maximum tele-density and the existing tele-density. It is an indicator of the potential mobile subscribership in the LSA. Maximum tele-density can be assumed as Metro circles (200%), Circle A (150%), Circle B (125%) and Circle C (100%).
- Minutes of Usage[18]: It indicates the volume of traffic in the market.
- Population[19]: Population across circles in the year 2012-2013 indicates the potential for growth for the industry as a whole conditional on the standard of living of the set of individuals.

[18] Reported by TSPs to TRAI

- GSDP per capita[20]: A measure of the total output of a particular state that takes the gross state domestic product (GDP) and divides it by the number of people in that state (i.e. population state-wise). It is sometimes used as an indicator of standard of living, with higher per capita GDP being interpreted as having a higher standard of living.

Estimating the value of spectrum by correlating the sale prices achieved in similar LSAs with known relevant variables:

2. The value of spectrum in the 4 LSAs where spectrum remained unsold can be estimated by establishing a correlation between the sale price realised in similar LSAs in the same category and some other relevant variable e.g. Adjusted Gross Revenue (AGR). The ratio established can then be used to estimate the value of spectrum in the LSA where sale of spectrum did not take place. Of the LSAs in which sale of spectrum did not take place, 3 (Delhi, Mumbai and Karnataka) are Metro/Category A LSAs, and 1 (Rajasthan) is a Category B LSA. LSAs in the same category are expected to bear a closer resemblance to each other in terms of AGR, ARPU, Revenue per Minute (RPM) and other economic indicators, than to LSAs in other categories. Therefore, valuation of spectrum in Delhi, Mumbai and Karnataka LSAs could be done on the basis of a comparison with other Metro/Category A LSAs and valuation of spectrum for Rajasthan could be done on the basis of comparison with Category B LSAs. Sample estimated valuations that emerge using AGR and ARPU in separate iterations are as below. The reserve prices fixed for these LSAs in the March 2013 auction are indicated alongside for comparison:

[19]Population for year 2013 as projected by office of the Registrar General and Census Commissioner, India. Delhi's population adjusted for national capital region (NCR) as the subscribers reported by TSPs are for NCR. 50% of population of Faridabad, Gurgaon, Ghaziabad and Gautam Budh Nagar added to Delhi. Uttar Pradesh population divided between UP (West) LSA and UP (East) LSA in the proportion of subscribers.
[20]Data from Planning Commission

TABLE A

VALUE OF 1800 MHz BAND

(Rs. in crore)

LSA	Category	AGR	ARPU	Reserve Price per MHz (March 2013)
Delhi	Metro	**177.51**	**244.78**	**388.11**
Mumbai	Metro	**154.62**	**265.02**	**379.93**
Karnataka	A	**190.99**	**200.99**	**184.86**
Rajasthan	B	**58.17**	**51.89**	**37.56**

Estimating the value of spectrum using multiple regression analysis

3. Linear regression establishes a relationship between a scalar dependent variable denoted as Y and one or more explanatory variables denoted as X. If only one explanatory variable is used, it is called simple linear regression; for more than one explanatory variable, it is called multiple linear regression.

4. If the goal is prediction or forecasting, linear regression can be used to fit a predictive model to an observed data set of Y and X values. After developing such a model, if an additional value of X is then given without its accompanying value of Y, the estimated model can be used to make a prediction of the value of Y. Multiple regression can therefore be adopted to estimate the value of spectrum (per MHz) for the 4 unsold LSAs (Delhi, Mumbai, Karnataka and Rajasthan) using the data available for the realized prices for spectrum in November 2012 for the LSAs where the operators participated in the auction. The underlying model is as follows:

$$\mathbf{Yi = \alpha + \beta 1\ X1i + \beta 2\ X2i + \ldots\ldots + \beta 3\ Xki + \varepsilon i}$$

Where,

Yi = Value of 1800 MHz spectrum per MHz for i = 1, 2,....18 circles;

X1, X2,.....,Xk = the possible independent variables (as explained earlier);

α= the intercept term;

β1, β2..... βk= partial regression coefficients for the explanatory variables X1, X2,.....,Xk respectively;

and, εi is the error term.

5. A multiple regression model can be fitted using the observed data set of Y [the achieved prices of spectrum (1800 MHz band) across 18 LSAs] and values of X (explanatory variables). Then, the value of spectrum in the 4 LSAs where spectrum remained unsold can be computed from the estimated values for the coefficients of the explanatory variables (X) for those LSAs.

Results and Interpretation:

6. Using cross-sectional data for 2012-2013, a few sample valuations of spectrum that emerge for 4 LSAs (Delhi, Mumbai, Karnataka and Rajasthan) from the regression model taking different combinations of variables, are tabulated below:

TABLE B

VALUE OF 1800 MHZ BAND

(Rs. in crore)

LSA	Category	Variables: GSDP per capita, Population, Residual Tele-density, AGR per population	Variables: GSDP per capita, Residual Tele-density, MoU	Variables AGR, Existing Tele-density
Delhi	**Metro**	**284.10**	**197.83**	**211.22**
Mumbai	**Metro**	**330.05**	**180.78**	**189.74**
Karnataka	**A**	**131.81**	**138.32**	**153.35**
Rajasthan	**B**	**50.97**	**55.28**	**88.49**
Model R^2		**0.7731**	**0.8577**	**0.8155**

7. The goodness of fit of estimation is given by 'R squared' which is the variation in the value of spectrum that is explained by the variation in the above specified combination of variables e.g. AGR, Residual Tele-density and Population. The R-squared in the estimations is over 0.75 in

each combination of variables. In addition, the coefficient estimates in the regression are statistically significant (at 15% level of significance). It appears, therefore, that the explanatory variables used have a significant relationship with the value of spectrum.

Estimating the value of spectrum using multiple regression analysis based on spectrum prices in 14 LSAs

TABLE C

VALUE OF 1800 MHz BAND

(Rs. in crore)

LSA	Category	Variables: (GSDP per capita, Residual Tele-density, Population, AGR per population)*
Delhi	**Metro**	**210.69**
Mumbai	**Metro**	**243.23**
Kolkata	**Metro**	**114.06**
Andhra Pradesh	**A**	**125.13**
Gujarat	**A**	**123.61**
Karnataka	**A**	**103.47**
Tamil Nadu	**A**	**129.17**
Rajasthan	**B**	**43.12**
Model R^2		**0.8157**

*Multiple regression is based on data for 14 LSAs where existing operators (whose licences had not been cancelled by the orders of the Court) purchased spectrum in the November 2012 auction.

ANNEXURE 4.2

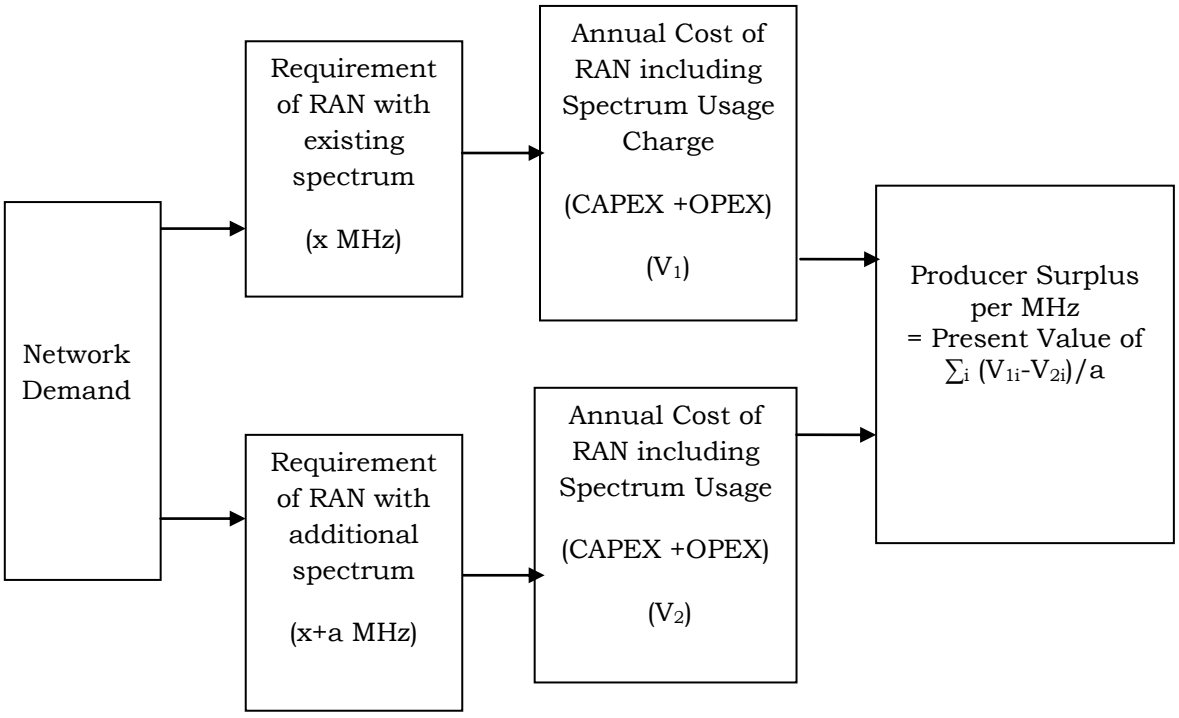
VALUATION OF SPECTRUM IN 1800 MHz BAND
PRODUCER SURPLUS MODEL

Introduction

1. This model is a bottom-up approach to determine the opportunity of net savings to an average telecom service provider (TSP) upon expenditure in the radio access network (RAN) and spectrum usage charge (SUC) during the next 20 years upon getting additional spectrum. The opportunity of the net savings in expenditure made by the TSP has been termed as 'Producer Surplus'. A block schematic of the model is given below:

FIGURE A

BLOCK SCHEMATIC OF THE PRODUCER SURPLUS MODEL



2. For the purpose of estimation of value of spectrum in 1800 MHz, only the expenditure upon RAN (more specifically, upon Base Transceiver Stations (BTSs)) in urban areas is relevant for the following reasons:

(i) There is an inverse relationship between the quantum of spectrum allocated and the expenditure on RAN required to serve a particular level of demand. In case, additional spectrum is allocated to a TSP, he would be able to save upon the expenditure of RAN. On the other hand, additional spectrum would have no impact on the cost of core network.

(ii) RAN consists of Base Transceiver Stations (BTSs), Base Station Controllers (BSCs) and transmission media to connect them. A Base Station Transceiver (BTS) operating in a particular spectrum band is characterized by the following two parameters -

(a) Maximum traffic carrying capacity
(b) Maximum coverage (i.e. adequately covered area)

(iii) An existing TSP would install a new BTS to cater to either or both -

(a) Capacity constraint i.e. the existing cluster of BTSs in an area is not able to cater to the increased traffic in the cluster.
(b) Coverage constraint i.e. the existing cluster of BTSs is not able to cover the populated area adequately.

(iv) As the urban and rural areas have different population density, capacity constraints owing to increased traffic would arise mainly in urban areas. On the other hand, situations of coverage constraints would arise mainly in rural areas which remain uncovered/ under-covered by the existing clusters of BTSs. Thus urban areas are generally capacity constrained while rural areas are generally coverage constrained. Thus A TSP would, generally, install a new BTS in order to meet:

(a) New capacity requirements in urban areas

(b) New coverage requirements in rural areas

(v) The GSM operators in India have already been allotted spectrum in 900 MHz and 1800 MHz spectrum bands. Thus an existing GSM operator would get no additional benefit of coverage in case he gets additional spectrum in 1800 MHz band. However, owing to an inverse relationship between the quantum of spectrum available and number of BTSs required to meet a particular level of demand, the TSP would need to install fewer additional BTSs in future in capacity constrained areas (i.e. urban areas) in case he gets additional spectrum in 1800 MHz band. Thus, it is clear that additional spectrum in 1800 MHz band would help the existing TSPs in reducing their expenditure on the BTSs in urban areas only.

3. Accordingly, requirement of the BTSs in urban areas in the two scenarios i.e. with 'x' MHz of spectrum and with 'x+a' MHz of spectrum has been estimated in order to arrive at the savings in the expenditure upon BTSs.

4. As per the existing regime for spectrum usage charge (SUC), the SUC levied on a TSP varies with the value of spectrum held by him in an LSA. Accordingly, the SUC in the two scenarios i.e. with 'x' MHz of spectrum and 'x+a' MHz of spectrum has also been estimated.

5. Clearly, the value of producer surplus would vary with the TSPs depending upon his projected demand (i.e. subscriber base and minutes of usage per subscriber), cost of operation of BTSs (OPEX and CAPEX), spectrum holdings and profile of its subscribers in various LSAs. Therefore, the average of the values of producer surplus for various TSPs would best capture the expected value of producer surplus upon acquiring additional spectrum in 1800 MHz band. Accordingly, in order to arrive at the expected value of producer surplus, an average TSP having an average level of projected demand (i.e. subscriber base and

minutes of usage per subscriber), average cost of operation of BTSs (CAPEX and OPEX), average spectrum holdings and average profile of subscribers in each LSA has been considered. Data has either been provided by the TSPs or industry benchmarks have been adopted.

6. In the model, the present values (PVs) of the expenditures (CAPEX + OPEX) on BTSs in urban area and SUC to be incurred during the next 20 years for the two cases described above i.e. with 'x' MHz of spectrum and 'x+a' MHz of spectrum have been estimated for an average TSP. The difference of the PVs in the two cases is the producer surplus:

Producer Surplus
= Present Value of (expenditure on BTSs in urban area and SUC during the next 20 years without additional spectrum of 'a' MHz ***minus*** *expenditure on BTSs and SUC during the next 20 years with additional spectrum of 'a' MHz in 1800 MHz band)*

Methodology

7. The following steps have been used for estimation of producer surplus in case the TSP acquired '*a*' MHz of spectrum in 1800 MHz band:

(i) Estimation of Network Demand in urban areas of an average TSP
(ii) Estimation of No. of BTS in urban areas in the two scenarios
  (a) With average spectrum holding
  (b) With average spectrum holding + ('*a*' MHz of 1800 MHz)
(iii) Estimation of Annual Cost of BTSs in urban areas and SUC in the two scenarios
(iv) Estimation of producer surplus per MHz

Estimation of Network Demand in Urban areas of an Average TSP

8. The demand for network in urban areas of each LSA has been estimated on the basis of no. of urban subscribers and usage per subscriber per month as below:

Busy hour demand of the network

*= No. of urban subscribers * No. of MOU per subscriber per month * No. of Busy Hour Erlangs per MOU per month*

9. **Determination of Urban Subscriber Base of the average TSP**: The urban subscriber base of the average TSP in an LSA as on 31.03.2013 has been estimated using the Herfindahl-Hirschman Index (HHI) as below:

The urban subscriber base of average TSP as on 31.03.2013 in an LSA

*=Total number of urban Subscribers (GSM) in the LSA * HHI of the GSM segment in the LSA/ 10000*

10. **Determination of MOU**: The minutes of usage (MOU) per subscriber per month in an LSA has been determined as below:

Total MOU

= Voice MOU + SMS converted to MOU + Data download converted to MOU

11. The voice MOU and SMS per subscriber per month have been projected on the basis of the information received in TRAI for the quarter ending March 2013. The data download per subscriber per month has been projected on the basis of the information for the month of April 2013. The following growth rates have been considered for the number of subscribers, number of voice MOU, number of SMS, amount of data download:

TABLE A

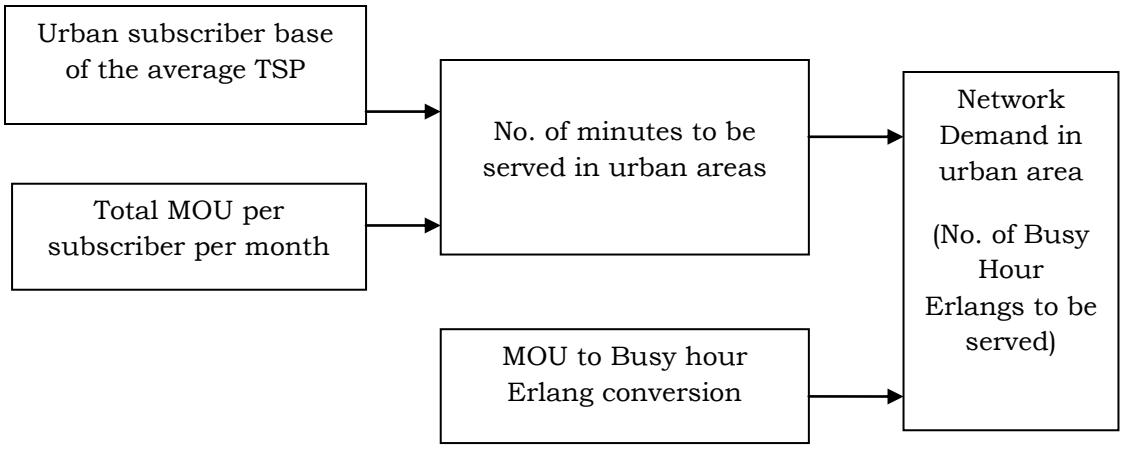
(PROJECTED GROWTH RATES)

Year	Growth of subscribers	Growth of Voice MOU	Growth of SMS	Growth of Data Download
2013	Base Year	Base Year	Base Year	Base Year
2014	6%	0%	0%	10%
2015	6%	0%	0%	10%
2016	5%	0%	0%	10%
2017	4%	0%	0%	8%
2018	4%	0%	0%	8%
2019	3%	0%	0%	8%
2020	2%	0%	0%	8%
2021	2%	0%	0%	8%
2022	2%	0%	0%	6%
2023	1%	0%	0%	6%
2024	1%	0%	0%	6%
2025	1%	0%	0%	6%
2026	1%	0%	0%	6%
2027	1%	0%	0%	4%
2028	0.5%	0%	0%	4%
2029	0.5%	0%	0%	4%
2030	0.5%	0%	0%	4%
2031	0.5%	0%	0%	4%
2032	0.5%	0%	0%	4%
2033	0.5%	0%	0%	2%

12. The following schematic diagram depicts the method of estimating network demand in each LSA separately.

FIGURE B

BLOCK SCHEMATIC FOR ESTIMATION OF RAN DEMAND



Estimation of Number of BTSs in Urban Areas in the two Scenarios

13. In order to determine the number of BTSs in urban areas required by the average TSP in each LSA in the two scenarios (with and without additional spectrum) it has been considered that the average TSP has average spectrum holding in each LSA.

14. **Determination of Spectrum Available to the Average TSP:** The spectrum available to the average TSP in each LSA has been estimated as below:

Spectrum available to the average TSP in an LSA

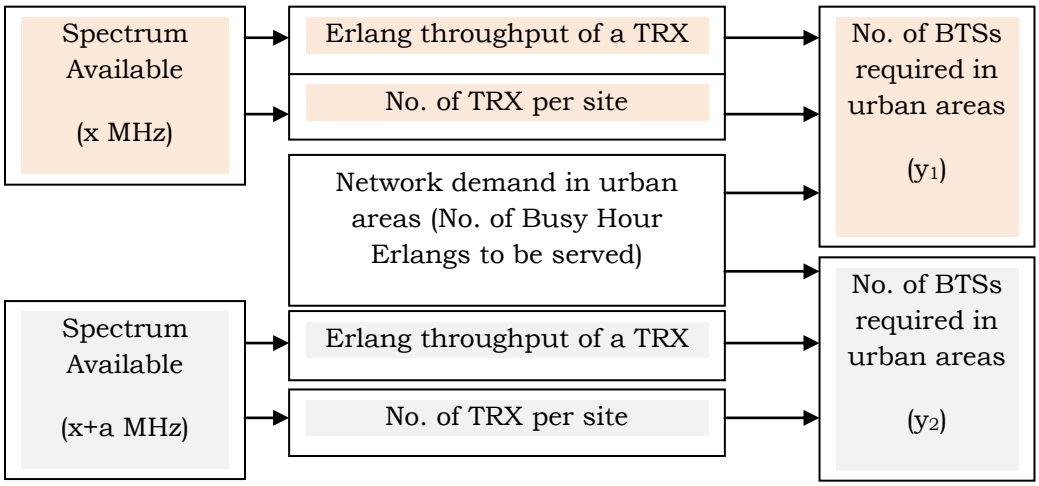
= *Total GSM spectrum held by the TSPs in the LSA/No. of GSM TSPs in the LSA*

Based on the spectrum available to the average TSP, number of transceivers (TRXs) in a BTS site has been estimated in both the scenarios (with and without additional spectrum).

15. **Determination of no. of BTSs in urban areas**: A block schematic showing the method to determine the no. of BTS in urban areas of the average TSP in each LSA is as follows:

FIGURE C

BLOCK SCHEMATIC FOR DETERMINATION OF NO. OF BTS



Estimation of Annual Cost of BTSs in Urban Areas and SUC in the two scenarios

16. In order to estimate the annual cost (OPEX and CAPEX costs) on the BTSs in urban areas of each LSA, the following steps have been taken:

(i) The Capital Cost (Gross Block) as on 31.03.2012 and Annual Operating cost of Radio Access Network (RAN) for the F.Y. 2011-12 for three major pan-India GSM operators have been taken from the Accounting Separation Report (ASR) for F.Y. 2011-12.

(ii) Assuming that BTSs (and their associated transmission media) constitute 90% of the cost of the RAN, the Capital Cost (Gross Block) and Operating cost per BTS for an LSA has been estimated as below:

Capital Cost (Gross Block) per BTS as on 31.03.2012 for an LSA

*= 0.9*Capital Cost (Gross Block) of RAN/ Number of BTSs*

Annual Operating Cost per BTS for F.Y. 2011-12 for an LSA

*= 0.9*Annual Operating Cost of RAN/ Number of BTSs*

17. Further, the capital cost per BTS has been assumed to be reducing by 5% and operating cost per BTS has been assumed to be increasing by 1% on Y-o-Y basis for the next 20 years.

18. **Useful Life of BTS Equipment** has been taken as 10 years.

19. **Determination of Annualized CAPEX Costs of the BTSs in urban areas:** Based on the number of BTSs required in urban areas to cater to the projected demand and capital cost (Gross Block) per BTS, the capital cost of the BTSs in urban areas has been calculated.

20. Further, straight line depreciation @10% and prevalent cost of capital @15% have been applied to obtain annualized CAPEX cost of the BTSs in urban areas for the average TSP in each LSA.

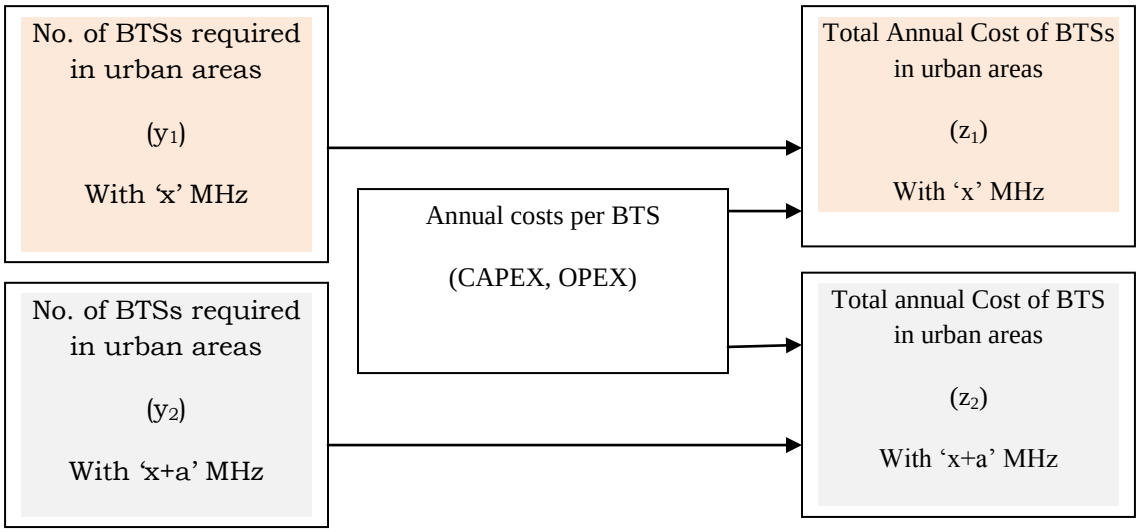
21. **Determination of Annual OPEX Costs of the BTSs:** Based on the number of BTSs required in urban areas to cater to the network demand and annual operating cost per BTS, the annual OPEX cost of BTSs in urban areas has been determined for the typical operator in each LSA.

22. **Determination of Total Annual Cost on BTSs in Urban Areas:** The total annual cost on the BTSs in urban areas in each LSA has been estimated by summing up the annualized CAPEX cost and annual OPEX cost as below:

The Total annual cost on BTSs in urban areas in an LSA
= Annualized CAPEX cost on BTSs in urban areas + Annual OPEX cost on BTSs in urban areas

23. The annual costs for BTS for average TSP in the two scenarios have been estimated as per the following schematic diagram.

FIGURE D
SCHEMATIC DIAGRAM FOR ESTIMATION OF TOTAL COST OF BTSS IN THE TWO SCENARIOS



24. **Estimation of SUC in two scenarios:** The spectrum usage charge (SUC) levied on a TSP varies with the value of spectrum held by him in an LSA. Accordingly, the SUC in the two scenarios i.e. with 'x' MHz of spectrum and 'x+a' MHz of spectrum has been estimated for the next 20 years assuming no change in average revenue per user (ARPU) from the present levels.

Estimation of Producer Surplus per MHz

25. The producer surplus upon getting an additional spectrum of 'a' MHz has been estimated as below:

Producer Surplus upon getting an additional spectrum of 'a' MHz in an LSA = Present Value of (expenditure on BTSs in urban area and SUC during the next 20 years without additional spectrum of 'a' MHz ***minus*** *expenditure on BTSs in urban area and SUC during the next 20 years with additional spectrum of 'a' MHz in 1800 MHz band)*

26. In order to arrive at the present value, a discounting rate of 12.5% has been used.

Results

27. The following table presents the producer surplus per MHz.

TABLE B

PRODUCER SURPLUS PER MHz

S. No.	Name of LSA	Category	Producer Surplus per MHz (Rs. in Crore)
1	Delhi	Metro	**170.92**
2	Mumbai	Metro	**109.51**
3	Kolkata	Metro	**47.88**
4	Andhra Pradesh	A	**101.59**
5	Gujarat	A	**91.07**
6	Karnataka	A	**157.97**
7	Maharashtra	A	**170.74**
8	Tamilnadu	A	**276.74**
9	Haryana	B	**42.95**
10	Kerala	B	**71.59**
11	Madhya Pradesh	B	**74.66**
12	Punjab	B	**87.12**
13	Rajasthan	B	**118.90**
14	U. P. (East)	B	**125.92**
15	U.P. (West)	B	**71.75**
16	West Bengal	B	**21.34**
17	Assam	C	**12.25**
18	Bihar	C	**88.59**

19	Himachal Pradesh	C	**7.33**
20	Jammu & Kashmir	C	**41.62**
21	North East	C	**27.14**
22	Orissa	C	**19.57**
Pan India			**1937.15**

ANNEXURE 4.3

VALUATION OF SPECTRUM IN 1800 MHz BAND
PRODUCTION FUNCTION OR SUBSTITUTION APPROACH

1. This method is also based on the opportunity cost principle. It is assumed that spectrum and BTS are the two essential inputs for the supply of mobile services. These two factor inputs are the independent variables in the estimation of a production function to 'produce' mobile traffic or minutes of use (MoU).

2. The production function has been specified as a Cobb-Douglas functional form which is widely used to estimate the statistical relationship between inputs & output. The required specification is:

$$X = Ay^{\alpha} z^{\beta} \qquad (1)$$

In the above equation, the dependent variable (X) is the minutes of usage. The independent or explanatory variables are: i) allocated amount of spectrum (y) and ii) Number of BTSs deployed by a service provider (z). The parameters α and β reflect the percentage change in minutes of usage for a unit change in spectrum and BTS respectively.

3. The above specification is based on the assumption that the two inputs spectrum and BTS can be substituted for each other over a given range of output. An optimal mix of both will be used by service providers to produce the required traffic and that optimal mix is determined by input prices. (Though it may seem impossible to achieve an optimal mix in a real scenario, it could be benchmarked as an ideal situation to get the required estimates). A higher charge for spectrum will induce service providers to substitute the less expensive BTS for spectrum over the relevant range to get the same minutes of usage and vice versa.

4. To estimate the above production function (equation 1) we can linearize it by taking logs on both the sides as follows:

$$\ln X = \ln A + \alpha \ln y + \beta \ln z \qquad (2)$$

α and β measure the responsiveness of output (MoU) to changes in levels of spectrum and BTS respectively keeping the other input constant. A panel data set for minutes of usage, BTS and amount of spectrum held by established private TSPs (having pan-India presence) across the different categories of circles (16 LSAs) over the period 2007-2012 (yearly data) is utilised to get the estimated coefficients.

5. These estimated parameters are eventually used to derive value of the spectrum in 1800 MHz band relying on the substitutability between BTS and Spectrum. For example, if the service provider were to give up 1 unit of spectrum, he would need additional BTS to be able to produce the same mobile traffic. Since the price of BTS is known, the value of the 2G spectrum can be derived as an opportunity cost i.e. the savings in cost in terms of BTS conserved by deploying an additional unit of spectrum.

6. The optimum condition so as to reach the optimal input mix of both spectrum and BTS is given by:

$$\frac{MPy}{Py} = \frac{MPz}{Pz} \qquad (3)$$

Where, MPy = marginal productivity of spectrum

and, MPz = marginal productivity of BTS

The above equation indicates that at the optimum a service provider will allocate expenditure between the two inputs in such a manner that they yield the same marginal productivity per rupee spent.

7. MPy and MPz can be calculated by differentiating the above specified production function (equation 1) as follows:

$$\mathbf{MPy} = \frac{\alpha A y^{\alpha} z^{\beta}}{y} \qquad \mathbf{(4)}$$

$$\mathbf{MPz} = \frac{\beta A y^{\alpha} z^{\beta}}{z} \qquad \mathbf{(5)}$$

8. Now, with the optimality condition and MPy and MPz calculated above (i.e. using 3, 4 and 5) the value of spectrum, denoted by **Py** is derived as follows:

$$\mathbf{Py} = \frac{\alpha z}{\beta y} \mathbf{Pz} \qquad \mathbf{(6)}$$

Where, Py = value of spectrum (unknown), Pz = known price of a BTS (i.e. NPV of CAPEX and OPEX on BTS), z is the number of BTSs deployed and y is the amount of spectrum allocated and α and β are the estimated coefficients of the production function.

9. Using a panel data set of minutes of usage, spectrum allocated and BTS set up in various LSAs (16 LSAs) for different TSPs over the period 2007-2012, the required estimated coefficients can be estimated and then used in the above equation to get the value of spectrum i.e. Py (value per MHz) across LSAs.

10. Separate regressions have been run for Metros (Delhi & Mumbai), Kolkata, category A and category B. Category C LSAs have been omitted as their growth has principally been concentrated in cities, and historical data will misrepresent their future which will be in habitations with lower density. The calculation for Category C Circles is elaborated below -

Category C circles share some similarities in terms of terrain and ability to pay with Category B circle. We next find that taken as a whole, incremental 2G spectrum in Category B circles is priced at 0.99 times 3G

spectrum in Category B circles. Finally we find the price of incremental 2G spectrum in a Category C circle by multiplying the 3G price in that circle with the multiplicative factor for incremental 2G spectrum (estimated through regression) with respect to 3G spectrum in Category B circles as a whole.

11. Further, value of spectrum in 1800 MHz band for 20 years has been calculated for which the CAPEX and OPEX on BTS is calculated for 20 years, as the license period is 20 years. The steps involved in calculation are as follows:

- Minutes of usage and number of BTS for the year 2012-2013 is available.
- Minutes of usage have been projected for 20 years.
- Number of BTS (year-wise) has been projected for 20 years based on projected MoUs in the following manner: Suppose, the number of BTS for "X" MoUs is 100, the number of BTS required for "(X+ΔX)" MoUs can be calculated by using the following equation:

$$\mathbf{BTS_n = \left(\frac{MoUn}{MoUn-1}\right)^{\beta} * BTS_{n-1}}$$

Where, 'β' is the output elasticity of BTS (also called trunking efficiency factor) as computed above and 'n' is the year for which number of BTS is projected (i.e. n = 2014,2015,.....,2033)

- A life of 10 years for BTS has been assumed. After 10 years, fresh investment in BTS will be required. CAPEX per BTS is taken at Rs. 5 lakh.
- Since a number of operators are working on an outsourced model for towers, additional towers would be taken on rent. OPEX on additional BTS includes rental for towers and other costs such as fuel, electricity etc. associated with running a BTS. OPEX per BTS in

Metro LSAs (assuming total area urban) has been taken at Rs.6 lakhs per year and for A, B and C LSA at Rs. 4.32 lakhs per year.

- Cash flows have been discounted over 20 years using a rate of 12.50%.
- Using equation 6 as explained above the value of spectrum for 20 years is computed. This is the weighted average of value of 900 MHz band and 1800 MHz band. The value of 1800 MHz spectrum has been calculated assuming 900 MHz = 1.5 * 1800 MHz.
- The Table below give the results of the above exercise:

TABLE A

VALUE OF 1800 MHZ (PER MHZ) USING THE SUBSTITUTION APPROACH

(Rs. in crore)

LSA	Category	Value of 1800 MHz (per MHz)
Delhi	Metro	**251.85**
Mumbai	Metro	**238.42**
Kolkata	Metro	**39.67**
Andhra Pradesh	A	**129.75**
Gujarat	A	**101.07**
Karnataka	A	**118.90**
Maharashtra	A	**137.64**
Tamilnadu	A	**111.95**
Haryana	B	**32.27**
Kerala	B	**55.80**
Madhya Pradesh	B	**78.69**
Punjab	B	**45.77**
Rajasthan	B	**66.29**
U. P. (East)	B	**83.70**
U.P. (West)	B	**64.40**
West Bengal	B	**53.84**
Assam	C	**10.73**

Bihar	C	**52.59**
Himachal Pradesh	C	**9.63**
Jammu & Kashmir	C	**7.83**
North East	C	**10.93**
Orissa	C	**25.07**
Pan India		**1726.79**

ANNEXURE 4.4

VALUATION (PER MHz) USING DIFFERENT APPROACHES - 1800 MHz

(Rs. in crore)

Circle	1800 MHz	Correlating with a single variable		Multiple regression				Opportunity cost		Experts price 2011 indexed for 3 yrs (upto 6.2 MHz)	Mean	Mean after removing highest & lowest	Median
	Reserve Price/ Achieved Price (2G) - November 2012 & March 2013	AGR	ARPU	(GSDP per capita, Population, Residual Tele-density, AGR per Population)	(AGR, Existing Tele-density)	GSDP per Capita, Residual Tele-density, MOU)	(GSDP per Capita, Population, Residual Tele-density, AGR per Population) based on 14 data points*	Producer Surplus	Production function				
Delhi	388.11	177.51	244.78	284.10	211.22	197.83	210.69	170.92	251.85	221.20	**218.90**	216.44	211.22
Mumbai	379.93	154.62	265.02	330.05	189.74	180.78	243.23	109.51	238.42	149.33	**206.74**	203.02	189.74
Kolkata	90.98	_	_	_	_	_	114.06	47.88	39.67	73.08	**73.13**	70.65	73.08
Andhra Pradesh	229.53	_	_	_	_	_	125.13	101.59	129.75	227.10	**162.62**	160.66	129.75
Gujarat	179.87	_	_	_	_	_	123.61	91.07	101.07	221.34	**143.39**	134.85	123.61
Karnataka	184.86	190.99	200.99	131.81	153.35	138.32	103.47	157.97	118.90	201.09	**155.21**	156.05	153.35
Maharashtra	210.25	_	_	_	_	_	_	170.74	137.64	173.00	**172.91**	171.87	171.87
Tamilnadu	244.87	_	_	_	_	_	129.17	276.74	111.95	276.73	**207.89**	216.92	244.87
Haryana	37.21	_	_	_	_	_	_	42.95	32.27	21.41	**33.46**	34.74	34.74

Kerala	52.24	_	_	_	_	_	_	71.59	55.80	109.26	**72.22**	63.70	63.70
Madhya Pradesh	43.19	_	_	_	_	_	_	74.66	78.69	129.54	**81.52**	76.68	76.68
Punjab	53.82	_	_	_	_	_	_	87.12	45.77	107.60	**73.58**	70.47	70.47
Rajasthan	37.56	58.17	51.89	50.97	88.49	55.28	43.12	118.90	66.29	156.59	**76.63**	70.00	58.17
U. P. (East)	60.94	_	_	_	_	_	_	125.92	83.70	224.13	**123.67**	104.81	104.81
U.P. (West)	85.93	_	_	_	_	_	_	71.75	64.40	88.77	**77.71**	78.84	78.84
West Bengal	20.67	_	_	_	_	_	_	21.34	53.84	66.15	**40.50**	37.59	37.59
Assam	6.93	_	_	_	_	_	_	12.25	10.73	15.36	**11.32**	11.49	11.49
Bihar	37.14	_	_	_	_	_	_	88.59	52.59	75.38	**63.42**	63.99	63.99
Himachal Pradesh	6.22	_	_	_	_	_	_	7.33	9.63	13.79	**9.24**	8.48	8.48
Jammu & Kashmir	5.06	_	_	_	_	_	_	41.62	7.83	11.22	**16.43**	9.53	9.53
North East	7.07	_	_	_	_	_	_	27.14	10.93	15.67	**15.20**	13.30	13.30
Orissa	16.22	_	_	_	_	_	_	19.57	25.07	35.93	**24.20**	22.32	22.32
PAN INDIA	2378.60	_	_	_	_	_		1937.15	1726.79	2613.67	**2059.89**	1996.40	1951.60

Note: Realised prices in LSAs in which spectrum was sold in November 2012 auction have been included in calculation of average valuation

* Multiple regression is based on data for 14 LSAs where Vodafone took spectrum in auction. Other 3 multiple regression were based on data for 18 sold LSAs in auction.

ANNEXURE 4.5

VALUATION OF SPECTRUM IN 900 MHz BAND
PREMIUM BASED ON ECONOMIC EFFICIENCY

1. In its recommendations dated 23rd April 2012 and in the CP dated 23rd July 2013, the Authority noted that additional CAPEX and OPEX is required for operating in the 1800 MHz band, as compared to 900 MHz band. Therefore, the 900 MHz band commands a premium over the 1800 MHz band that would correspond to the additional cost (CAPEX and OPEX) per MHz required in 1800 MHz.

2. The approximate additional cost per MHz while operating in the 1800 MHz band as compared to the 900 MHz has been worked out for 3 Metro LSAs using actual data on BTS and spectrum allocations, based on following assumptions:

- Since disaggregated information on BTS is not available, in Metro LSAs, all BTS are considered to be in the urban area.
- Since TSPs hold a mix of 900 and 1800 MHz spectrum, in Metro LSAs, 75% of BTS are considered to be in 900 MHz.
- While operating in 1800 MHz as compared to 900 MHz in urban areas, requirement of additional BTS would be lower in 900 MHz as there is concentration of population and BTS have already been installed at comparatively close distances to cater to traffic loads. Thus in urban area number of BTS in 900 MHz band would have to be increased by 25%.
- A life of 10 years for BTS has been assumed. After 10 years, fresh investment in BTS will be required. CAPEX per additional BTS taken

at Rs.5 lakh. CAPEX for replacing the existing BTS in 900 MHz band is taken at Rs.2 lakh as only TRX would need replacement on shift to 1800 MHz from 900 MHz band.

- Since a number of operators are working on an outsourced model for towers, it is assumed additional towers would be taken on rent. OPEX on additional BTS includes rental for towers and other costs such as fuel, electricity etc. associated with running a BTS. OPEX per BTS in Metro LSA has been taken at Rs.6 lakh per year.
- Cash flows (CAPEX and OPEX) have been discounted over 20 years using rate of 12.50%.

3. Based on the above assumptions, the additional cost per MHz operating on 1800 MHz as compared to 900 MHz (premium on 900 MHz) has been estimated for 3 Metro LSAs as follows:

Table A

(Rs. in crore)

LSA	Category	Approximate additional cost per MHz in 1800 MHz as compared to 900 MHz
Delhi	Metro	**93.91**
Mumbai	Metro	**52.17**
Kolkata	Metro	**46.71**

4. Since the intrinsic value of the 900 MHz band as compared to the 1800 MHz band lies in its better propagation characteristics and lower requirement of BTS for coverage, its economic benefits are most evident in areas where coverage requirements are paramount i.e. where the density of population is lower and the spread of population to be covered is relatively wider.

ANNEXURE 4.6

VALUATION (PER MHz) USING DIFFERENT APPROACHES - 900 MHz

(Rs. in crore)

LSA	1.5 times of average valuation of 1800 MHz band	2 times of average valuation of 1800 MHz band	Economic premium over 1800 MHz plus average valuation of 1800 MHz band	Mean	Median
Delhi	328.35	437.80	312.81	**359.65**	328.35
Mumbai	310.11	413.48	258.91	**327.50**	310.11
Kolkata	109.70	146.26	119.84	**125.27**	119.84