Consultation Paper No. 06/2013

Telecom Regulatory Authority of India

Consultation Paper

on

Valuation and Reserve Price of Spectrum

23rd July, 2013

Written Comments on the Consultation Paper are invited from the stakeholders by 14th August, 2013 and counter-comments by 21st August, 2013. As the issue has to be decided urgently, no further extension will be granted. Comments and counter-comments will be posted on TRAI's website www.trai.gov.in. The comments and counter-comments may be sent, preferably in electronic form, to Shri Arvind Kumar, Advisor (Networks, Spectrum and Licensing), TRAI on the email ID trai.jams@gmail.com

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Open House Discussion (OHD) on this consultation paper will be held on 26th August 2013 at New Delhi. This may be treated as an advance notice for the OHD.

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CHAPTER–I

INTRODUCTION

1.1 The Department of Telecommunications (DoT), through its letter No. L-14006/03/2013-NTG dated 10th July 2013 (Annexure-A) has sought the Authority's recommendations on the applicable reserve price for the auction of spectrum in the 800 MHz, 900 MHz and 1800 MHz bands.

1.2 This consultation paper is being issued so as to discuss the various issues involved in fixing reserve prices for auction of spectrum and other related topics. The paper is divided into four chapters. This chapter gives a brief background to the subject and includes a summary of auctions/biddings for licenses/spectrum that have taken place in India till date. The second chapter dwells on the current status of the telecom industry, availability of spectrum in India and roll-out obligations linked with spectrum to be auctioned. The third chapter discusses the methodology that has been followed while determining the reserve price in the past and raises various related issues. The fourth chapter gives a theoretical perspective on estimation of the reserve price. It also discusses other related issues such as spectrum usage charges, economic value of spectrum etc.

1.3 At the outset, it is pertinent to recall the recent history of the allocation of spectrum in India.

Award of Cellular Licences in 1994-95

1.4 In terms of National Telecom Policy-1994 (NTP-1994), the first phase of liberalisation in mobile telephony began with the award of eight Cellular Mobile Telephone Service (CMTS) licences in four Metros (Bombay, Delhi, Calcutta, Madras) in 1994. These were awarded on the basis of a 'beauty contest'. For metro licences, the financial bids were evaluated on the

rental to be charged to the customers for the first three years (the airtime tariffs were fixed by the DoT). The licence fees were a flat amount for the first three years, and then were linked to the number of subscribers subject to a minimum amount. Subsequently, 34 CMTS licences were awarded in 18 Licence Service Areas (LSAs) through a single-stage competitive bidding process in November 1995, two each in all LSAs except West Bengal and Assam, where only one licence was awarded. No bids were received for Jammu and Kashmir and the then Andaman and Nicobar LSA. The licence had a validity of 10 years extendable by a period of five years at a time. The rental was the same as that for the metros and the bidders were evaluated on the annual licence fee for the duration of the licence, converted to its net present value at a specified discount rate.

1.5 This cellular licence was bundled with a certain amount of committed spectrum. The technology at that point of time was specified as GSM and the licences had provision for 4.4+4.4 MHz spectrum in the 900 MHz band. In addition to the annual licence fee, the licensee was also to pay royalty charge for the spectrum. The amount of royalty charge was as per a prescribed formula which was based on the number of radio frequency channels of 200 KHz each held by the licensee. It was required to pay an annual wireless licence fee of Rs. 100 per fixed base station and mobile subscriber station. The licence fee for various service areas was as follows:

TABLE 1.1
CMTS Licence Fee (For Metros) **(Rs. in Crore)**

Service area	1st year	2nd year	3rd year	4th to 6th year (each year)	7th year onwards (each year)	Total of 10 years
Bombay	3	6	12	18	24	171
Delhi	2	4	8	12	16	114
Calcutta	1.5	3	6	9	12	85.5
Madras	1	2	4	6	8	57

4th year onwards @ Rs. 5 Lakh per 100 subscribers or part thereof; subject to the minimum shown in table above

TABLE 1.2

CMTS Licence Fee (For LSAs) **(Rs. in Crore)**

Service Area	Licence Fee to be paid during 10 years	Service Area	Licence Fee to be paid during 10 years
AP	1001.00	MH	1657.70
Assam	1.32	NE	1.90
Bihar	136.53	Orissa	89.22
Gujarat	1794.10	Punjab	1266.00
Haryana	240.00	Rajasthan	382.00
HP	14.96	TN	836.00
Karnataka	1393.00	UP (East)	210.89
Kerala	517.00	UP (West)	406.21
MP	51.00	West Bengal	42.00

The total amount bid by the licensees was **Rs.10040 crore** to be paid over a period of 10 years.

1.6 In 1997, the Government granted the third mobile licence to Mahanagar Telephone Nigam Limited (MTNL), for Delhi and Mumbai Metros. In 2000, BSNL was licenced as the third CMTS operator, in all the LSAs except Delhi and Mumbai.

Bidding for Cellular Licences in 2001

1.7 In 1999, the Government noted that the result of the NTP-94 was not satisfactory and the operators and the sector were facing problems with financing. It, therefore, brought in a fresh policy-the New Telecom Policy 1999 (NTP-99). The policy allowed the licensees to migrate from a Fixed Licence Fee Regime to a Revenue Share arrangement with effect from 1st August, 1999. On migration to the revenue sharing model, the Government initially fixed 15% of the gross revenue of the licensee as the provisional licence fee and referred the matter to TRAI for its recommendations. Subsequently, after getting the recommendations from TRAI, the DoT fixed the annual licence fee as 15% of the Adjusted Gross Revenue (AGR). In addition, it also levied the spectrum usage charge at 2% of AGR covering royalty payment for the use of cellular

spectrum of 4.4 MHz + 4.4 MHz and Licence fee for Cellular Mobile handsets and Cellular Mobile Base Stations and also for possession of wireless telegraphy equipment as per the details prescribed by Wireless Planning & Coordination Wing (WPC). Any additional bandwidth, if allotted, subject to availability and justification, would attract additional licence fee as revenue share (typically 1% additional revenue share if bandwidth allocated was up to 6.2 MHz + 6.2 MHz in place of 4.4 MHz + 4.4 MHz).

1.8 NTP-99 mentioned that licences would be awarded for an initial period of 20 years and would be extendable by additional periods of ten years thereafter.

1.9 Pursuant to NTP-99, the Government sought TRAI's recommendations on the appropriate level of entry fee, the percentage of revenue to be shared with the licensor, the definition of revenue for the purpose, and the basis for selection of new operators and any other issue considered relevant. On 23rd June 2000, TRAI recommended that all new operators should be selected through a competitive process, by a multistage bidding process (multistage informed ascending bid).

1.10 The Government accepted TRAI's recommendation and issued a Tender Document in March 2001 for awarding CMTS licences to prospective 4th operators in the LSAs. The bidding process had a pre-qualification criterion which was to be applied for the purpose of short-listing bidders whose first financial bids for entry fee were to be opened. The highest offer emanating from the first financial bid was to be treated as the 'Reserve Price' for the subsequent round.

1.11 The auction was held for 21 LSAs; however the entry fee was discovered only in 17 LSAs. No bid was received in West Bengal, Bihar, Orissa and

Andaman & Nicobar Telecom LSAs[1]. The entry fees discovered for various LSAs in the 2001 auctions are tabulated below:

TABLE 1.3

Entry Fee (Rs. In Crores)							
Sl.	**Service Area**	**Category**	**Entry fee 2001**	**Sl.**	**Service Area**	**Category**	**Entry fee 2001**
1	Delhi	Metro	170.7	10	Kerala	B	40.54
2	Mumbai	Metro	203.66	11	Punjab	B	151.75
3	Chennai	Metro	154	12	Haryana	B	21.46
4	Kolkata	Metro	78.01	13	Uttar Pradesh (West)	B	30.55
5	Maharastra	A	189	14	Uttar Pradesh (East)	B	45.25
6	Gujarat	A	109.01	15	Rajasthan	B	32.25
7	Andhra Pradesh	A	103.01	16	Madhya Pradesh	B	17.4501
8	Karnataka	A	206.83	17	Himachal Pradesh	C	1.1
9	Tamilnadu	A	79		**Total**		**1633.57**

1.12 Spectrum was bundled with these licences also, but the spectrum assigned was in the 1800 MHz band and the contracted spectrum was 6.2+6.2 MHz. The relevant extract from the 2001 CMTS licence is given below:-

> *"……. A cumulative maximum of upto 4.4 MHz + 4.4 MHz will be permitted. Based on usage, justification and availability, additional spectrum upto 1.8 MHz + 1.8 MHz making a total of 6.2 MHz +6.2 MHz, may be considered for assignment, on case by case basis, on payment of additional Licence fee. The bandwidth upto maximum as indicated i.e. 4.4 MHz & 6.2 MHz as the case may be, will be allocated based on the Technology requirements. (e.g. CDMA @ 1.25 MHz, GSM @ 200 KHz etc.). …"* (**Clause 24.7)**

1.13 All licences granted post-2001 till 2010 were given by the DoT (licensor) through an administrative process. In all these licences, spectrum was tied to the licence and the entry fee remained constant in respect of each service area, totaling to Rs.1659 crore for the entire country.

3G and BWA Auction

1.14 On 22nd May 2006, the DoT sought TRAI's recommendations on the methodology for allotment of spectrum for 3G services and its pricing

[1] As no bids were received in four service areas, for the Cellular Mobile Telephone Services (CMTS) licenses, DoT awarded Unified Access Service (UAS) licenses in these service areas in 2004. The licences were given on the entry fee paid by the Basic service operators in these service areas.

aspects. TRAI submitted its recommendations on 'Allocation and pricing of spectrum for 3G and broadband wireless access services' on 27th September 2006. In addition to recommendations on allotment and pricing of 3G spectrum, TRAI also gave its recommendations on spectrum allocation and pricing for broadband wireless access (BWA) technologies to boost broadband penetration in the country, especially in the rural areas. In the recommendations TRAI, inter-alia recommended:

a. Allocation of 3G spectrum through simultaneous ascending e-auction as per the defined auction process.
b. 3G Spectrum to be auctioned in blocks of 2x5 MHz.
c. BWA spectrum to be auctioned through one-stage sealed bid auction.
d. Specific roll-out obligations for 3G and BWA services were also prescribed.

1.15 As the eco system for 3G services was not evolved till that time and its growth potential was totally unknown, unlike that for 2G services, TRAI used international spectrum prices as an indicator of the possible value of spectrum. TRAI noted that many European and some Asian countries had allocated their 3G spectrum before 2002. However, some of the early spectrum allocations in Europe were at very high prices, clearly suggestive of overbidding. This was attributed to a 'now or never' syndrome that made operators bid excessively viz. far higher than their valuations to assure a supply of spectrum. To steer clear of the distortions on account of excessive prices in Europe, and to reflect more recent trends, TRAI based its recommendations on international allocations that were made since 2002.

1.16 The average price for international allocations since 2002 was worked out to be Rs. 68 per Hz. Unlike other countries, where the licences are generally for the whole country, licences in India are on a regional basis. However, as the size of a number of countries can be equated to the size of the majority of India's telecom LSAs in population, taking the average

international price of Rs. 68 per Hz, the price at a national level in India, if all the LSAs were put at the same level, worked out to approximately Rs.1500 crore for 2x5 MHz of spectrum. This was also in line with the total entry fee for the 4th CMTS licence, which was around Rs. 1659 crore. Therefore, a pan-India reserve price in the range of Rs.1050-1100 crore for 2x5 MHz of spectrum for 3G services was considered fair and just by TRAI at that time.

1.17 Since the international price of spectrum reflects nation-wide allocations, and not regional allocations, as are made in India, TRAI was of the view that the service areas with relatively higher earning potential should fetch a higher price for the spectrum than those with relatively lower earning potential. The ratio of average percent of subscribers of Metros (barring Chennai and Kolkata) and Category A vis-à-vis Category B LSAs including Chennai and Kolkata, and C LSAs was about 15: 8: 3 at that point of time. Given that the total reserve price across the country was pegged at approximately Rs. 1100 crore, TRAI arrived at the reserve prices for one block of 2 x 5 MHz for a period of 20 years in the 2.1 GHz band as follows:

TABLE 1.4

Categories of LSAs	**Reserve price in Rs. Crore for 2 x 5 MHz in 2.1GHz**
Delhi, Chennai, Mumbai, and Kolkata & Category 'A'	80
Category 'B'	40
Category 'C'	15

1.18 On 1st July 2008, the Government referred back to TRAI, some of the recommendations on 3G services including the amount of reserve price, the auction process and the amount of spectrum to be allocated. In its reference the DoT proposed that, based on the experience of successful 3G auctions in certain countries, the reserve price for a block of 2x5 MHz in the 2.1 GHz band should be 0.5% of GDP, which, in the case of India,

would come to US$ 0.5 billion or about Rs 2100 crore[2]; this was twice the amount recommended by TRAI. On 12th July 2008, TRAI accepted the proposals of DoT with some minor modifications.

1.19 In another reference dated 1st July 2008, the DoT referred back some of the recommendations on BWA services which including eligibility criteria, amount of spectrum to be allocated, reserve price and performance bank guarantee, auction process and duration of the BWA spectrum licence. The DoT proposed that the reserve price for each 10 MHz block of BWA spectrum for a period of 15 years should be 25% of the reserve price of 3G spectrum. Thus, the reserve price and Performance Bank Guarantee (PBG) as proposed by DoT was :

TABLE 1.5

LSA	Reserve Price Rs(Cr)	PBG Rs(Cr)
Metro & 'A'	40	20
'B'	20	10
'C'	7.5	3.75

1.20 On the auction methodology for BWA spectrum, the DoT proposed a controlled simultaneous e-auction similar to that in the case of 3G spectrum and that all successful bidders should be asked to match the highest bid i.e. H1. TRAI agreed with this proposal of DoT.

1.21 The auction of 3G and BWA spectrum was conducted in April-May 2010. As per the Notice Inviting Application (NIA) of 25th February 2010, it can be seen that the DoT further revised the reserve prices for 3G & BWA spectrum upwards from what it proposed in its communication of 1st July 2008 (as was agreed to by TRAI). A Simultaneous Ascending e-auction was conducted over the internet. The details of the reserve price specified for

[2] Taking 0.5% of GDP as a reserve price, the amount was coming to Rs. 21,415 crore. Therefore, the correct figure would be 0.05%.

3G and BWA spectrum and the prices discovered through the auction are given below :

TABLE 1.6

3G and BWA Auction 2010 - Reserve Price & Auction determined Price

Type	LSA	Reserve Price for 3G spectrum for 2x5MHz (FDD) (Rs Cr)	3G Price discovered in auction (2x5MHz) (Rs Cr)	No of times the Auction determined price was more than Reserve Price for 3G	Reserve Price for BWA spectrum for 20MHz (TDD) (Rs Cr)	BWA Price discovered in auction 20MHz (Rs Cr)	No of times the Auction determined price was more than Reserve Price for BWA
Metro	Delhi	320	3,316.93	10.37	160.00	2241.02	14.01
Metro	Mumbai	320	3,247.07	10.15	160.00	2,292.95	14.33
A	Maharashtra	320	1,257.82	3.93	160.00	915.64	5.72
A	Gujarat	320	1,076.06	3.36	160.00	613.85	3.84
A	AP	320	1,373.14	4.29	160.00	1,059.12	6.62
A	Karnataka	320	1,579.91	4.94	160.00	1,543.25	9.65
A	Tamil Nadu	320	1,464.94	4.58	160.00	2,069.45	12.93
Metro	Kolkata	120	544.26	4.54	60.00	523.2	8.72
B	Kerala	120	312.48	2.60	60	258.67	4.31
B	Punjab	120	322.01	2.68	60	332.27	5.54
B	Haryana	120	222.58	1.85	60	119.9	2.00
B	UP (E)	120	364.57	3.04	60	142.5	2.38
B	UP (W)	120	514.04	4.28	60	183.87	3.06
B	Rajasthan	120	321.03	2.68	60	97.32	1.62
B	MP	120	258.36	2.15	60	124.66	2.08
B	West Bengal	120	123.63	1.03	60	70.97	1.18
C	HP	30	37.23	1.24	15	20.66	1.38
C	Bihar	30	203.46	6.78	15	99.28	6.62
C	Orissa	30	96.98	3.23	15	63.63	4.24
C	Assam	30	41.48	1.38	15	33.02	2.20
C	North East	30	42.3	1.41	15	21.27	1.42
C	J & K	30	30.3	1.01	15	21.27	1.42
Total		**3500**	**16,750.58**	**4.79**	**1,750.00**	**12,847.77**	**7.34**

1.22 It can be seen from the above table, the auctioned determined price for 3G as well as BWA spectrum was many times more than the reserve price of the respective spectrum band. The pan-India auction determined price of

3G spectrum was around 4.79 times the reserve price and that of BWA spectrum was around 7.34 times the reserve price.

Recommendations on "Spectrum Management and Licensing Framework" dated 11th May 2010

1.23 In its recommendations on 'Spectrum Management and Licensing Framework' dated 11th May 2010, the Authority examined the future possibility of allocating the spectrum in the 800/900 and 1800 MHz bands through auction. However, in view of the reasons given in Para 3.44 and 3.45 of the recommendations, the Authority concluded that it was not feasible to auction spectrum in these bands due to the non-availability of enough spectrum and the creation of a non-level playing field. But, it recommended that spectrum in the 800 and 900 MHz bands shall be subject to auction as and when the spectrum in these bands is refarmed.

1.24 In view of the Authority's conclusion that it was not feasible to auction spectrum and that the price of the spectrum discovered in the 2001 bidding was no longer relevant due to drastic changes in market conditions, TRAI attempted to estimate the 'Current Price' (valuation) of spectrum in the 1800MHz band taking into consideration the present value of 4th CMTS operator's entry fee based on the time value of money. However, the Authority noted that these methods merely yielded a derived figure. While these recommendations were under deliberation, the auction for 3G spectrum was already under way. Therefore, the Authority also examined the issue whether the 3G auction price could be reckoned as the 'Current price' of 2G spectrum in the 1800MHz band. As mentioned in Paras 3.80 and 3.81 of the recommendations, there were conflicting views in the matter and the Authority could not arrive at a definitive conclusion on the subject. Therefore, the Authority recommended that "*the 3G prices be adopted as the 'Current price' of*

spectrum in the 1800 MHz band. At the same time, Authority is separately initiating an exercise to further study this subject and would apprise the Government of its findings".

1.25 To determine the current prices of 800 MHz and 900 MHz spectrum on the basis of the price of 1800 MHz spectrum, the Authority analysed the comparative performance of spectrum in different bands. It observed that coverage in 900 MHz is roughly double than that in 1800 MHz in dense urban settings. This increased coverage leads to lower capital requirement as fewer towers are needed for the coverage for the same transmitted power. Because of the higher coverage, the capital and operational expenditure in 900 MHz is about 60% of that in 1800 MHz. In view of this, the Authority recommended that the valuation of spectrum in the 900 MHz band be fixed at 1.5 times that of the 1800 MHz band. It also recommended that for fixing the price of spectrum in the 800 MHz band, the same multiplying factor of 1.5 may be employed.

TRAI's recommendations on the 2010 Value of Spectrum in the 1800 MHz Band dated 8th Feb, 2011

1.26 As the Authority could not arrive at a definitive conclusion on the issue of determining the valuation of spectrum in the 1800 MHz band, it appointed a committee of experts to estimate the 2010 value of 1800 MHz spectrum. The following Table gives the price of spectrum arrived at by them.

TABLE-1.7

Sl. No.	LSA	Category	Entry Fee (in 2001) per MHz (Rs. Cr)	Estimated Price of 1800 MHz spectrum (in 2010) per MHz (Rs. Cr)	
				Up to 6.2 MHz	Beyond 6.2 MHz
1	Delhi	Metro	27.53	149.78	249.73
2	Mumbai	Metro	32.85	101.11	157.34

3	Kolkata	Metro	12.58	49.48	47.60
4	Maharashtra	A	30.48	117.14	374.47
5	Gujarat	A	17.58	149.87	355.37
6	Andhra Pradesh	A	16.61	153.77	431.95
7	Karnataka	A	33.36	136.16	345.92
8	Tamil Nadu	A	37.58	187.38	426.05
9	Kerala	B	6.54	73.98	232.16
10	Punjab	B	24.48	72.86	180.56
11	Haryana	B	3.46	14.50	107.90
12	UP- East	B	7.30	151.76	318.76
13	UP-West	B	4.93	60.11	252.55
14	Rajasthan	B	5.20	106.03	278.84
15	Madhya Pradesh	B	2.81	87.71	254.45
16	West Bengal	B	0.16	44.79	216.96
17	Himachal Pradesh	C	0.18	9.34	28.12
18	Bihar	C	1.61	51.04	153.69
19	Orissa	C	0.81	24.33	73.26
20	Assam	C	0.81	10.40	31.33
	All India		**267.51**	**1769.75**	**4571.87**

1.27 Based on the 2010 value of spectrum in 1800 MHz arrived at by the experts, in February, 2011 the Authority recommended that the price given by the experts be adopted as the best available figures. However, in November, 2010 the Authority had also recommended to the DoT for cancellation of a number of licenses given in 2008, on account of non-fulfillment of rollout obligations. Therefore, the Authority also recommended that the charging of spectrum in the 1800 MHz band beyond 6.2 MHz, on the basis of these estimated figures, should be unambiguously subject to the condition that the final price could be suitably modified if any surplus spectrum, which would become available after cancellation of licences as recommended by the Authority, is auctioned. These prices were to be made applicable from 1st April 2010, pro-rated for the remaining validity of the respective licences while charging for excess spectrum. It also recommended that the price of spectrum upto 6.2 MHz will also be relevant for renewal of existing

licences subject to the condition that these figures will be duly adjusted for inflation.

TRAI's recommendations on "Auction of Spectrum" dated 23rd April 2012

1.28 The Hon'ble Supreme Court of India in its Judgment dated 2nd February 2012 in the Writ Petitions no 423/2010 and 10/2011, directed TRAI to make fresh recommendations for the grant of licence and allocation of spectrum in 2G band in 22 Service Areas by auction. In its order, it also directed that "keeping in view the decision taken by the Central Government in 2011, TRAI shall make fresh recommendations for grant of license and allocation of spectrum in 2G band in 22 service areas by auction, as was done for allocation of spectrum in 3G band".

1.29 In view of the above, the Authority requested the Government to communicate the decisions taken in the year 2011. In reply, the DoT communicated the decisions announced by the Government regarding TRAI's recommendations on "Spectrum Management and Licensing Framework" and policy for spectrum management and pricing. The reply of the DoT contained (a) the text of the Press Statement dated 29th January 2011 of the Minister of Communications and IT on the policy for spectrum assignment and pricing, and, (b) the Press Statement dated 15th February 2012 of the Minister of Communications and IT indicating the decisions taken by the DoT on the recommendations of TRAI.

1.30 Some of the important decisions communicated by the DoT are as follows.

- In future, the spectrum will not be bundled with the licence. The licence to be issued to telecom operators will be in the nature of a 'unified licence' and the licence holder will be free to offer any of the multifarious telecom services. In the event the licence holder would like to offer wireless services, it will have to obtain spectrum through a market-driven process. In future, there will be

no concept of contracted spectrum and, therefore, no concept of initial or start-up spectrum. **Spectrum will be made available only through a market-driven process.** *(Emphasis added)*

- The need for refarming of spectrum is accepted in-principle. Further steps will be taken after receipt of TRAI's recommendations in this regard.
- The prescribed limit on spectrum assigned to a service provider will be 2x8 MHz/2x5 MHz for GSM/CDMA technologies for all service areas other than in Delhi and Mumbai where it will be 2x10MHz/2x6.25MHz. However, the licensee can acquire additional spectrum beyond prescribed limits, in the open market, should there be an auction of spectrum subject to the limits prescribed for merger of licences.
- In respect of spectrum obtained through auction, spectrum sharing will be permitted only if the auction conditions provide for the same.
- Spectrum trading will not be allowed in India, at this stage. This will be re-examined at a later date.

1.31 In its recommendations on 'Auction of Spectrum' dated 23rd April 2012, 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. Further, for arriving at the valuation of spectrum in the 1800 MHz band, the Authority took the price realized in the auction for 3G spectrum (2100 MHz band), held in May 2010 as the base price and after considering the relative efficiency of 1800 MHz and 2100 MHz spectrum, applied a factor of 1.2 to it. The reserve price was fixed at 80% of the resultant value. The reserve price for spectrum in 800/900 MHz bands

was fixed at twice this value keeping in view their relative efficiencies and international experience.

1.32 In response to Authority's recommendations, the DoT suggested that 3G auction price must be indexed for a period of two years, instead of one year, to determine the present value of spectrum. Accordingly, the DoT suggested a 17% increase in the reserve price for 2G spectrum over the price proposed by the Authority i.e. the reserve price in the 1800 MHz band was proposed to be revised to Rs 4,245 crore per MHz (on a pan-India basis), instead of Rs 3,622 crore per MHz recommended by the Authority.

1.33 In response to the DoT's suggestions, in its recommendations dated 12th May 2012, the Authority mentioned that in respect of 800 MHz, the amount of spectrum available for auction in some LSAs is less than 5 MHz. As such, it was not possible, to offer all services with this spectrum that a truly liberalised spectrum is capable of (i.e.<5MHz). Therefore, TRAI would be open to the Government fixing the reserve price of 800 MHz spectrum at 1.3 times the 1800 MHz reserve price, only where 5 MHz spectrum is not being made available.

Key Government decisions after TRAI's recommendations on "Auction of Spectrum" dated 23rd April 2012 and before Nov 2012 Auctions

1.34 In July 2012, the Empowered Group of Ministers (EGoM) recommended two options to the Cabinet - a minimum price of either Rs 14,000 crore or Rs 15,000 crore - for 5MHz spectrum in 1800 MHz band. In August 2012, the Cabinet approved the reserve price of Rs.14,000 crore for 2x5 MHz pan-India spectrum in the 1800 MHz band. The Cabinet also approved the recommendation of EGoM for a reserve price in 800 MHz band at 1.3 times that of 1800 MHz band[3].

[3] As per the press release on Union Cabinet's approval on **Pricing of Spectrum** issued on 3rd Aug, 2012; available at pib.nic.in

Auction of Spectrum held in November 2012

1.35 Auctions for the spectrum in 1800 MHz and 800 MHz bands were held in November 2012. There was no bidder for the 800 MHz band. For 1800 MHz spectrum, there were five bidders. Spectrum in LSAs of Delhi, Mumbai, Karnataka and Rajasthan in 1800 MHz remained unsold. Except in Bihar, spectrum in all other LSAs was sold at the reserve price. LSA wise details of reserve price and auction discovered price are given at Table 1.8.

Key Government decisions between November 2012 and March 2013 Auctions

1.36 Subsequently in December 2012, based on the recommendations of the EGoM, the Cabinet approved that the reserve price for 1800 MHz band in the service areas of Delhi, Mumbai, Karnataka and Rajasthan be reduced by 30 percent from the previous reserve price and the reserve price for 900 MHz spectrum in Delhi and Mumbai be twice such revised reserve price for the 1800 MHz band. It also approved that the reserve price for 900 MHz spectrum in Kolkata be twice the price obtained for the 1800 MHz band spectrum for this LSA in the auction held in November, 2012[4].

1.37 In January 2013, after considering the recommendations of the EGoM, the Cabinet approved that the reserve price for 800 MHz band spectrum in all LSAs be reduced by 50 percent from the previous reserve price of Rs 3,640 crore per MHz[5] (Rs.4550 crore per 1.25 MHz).

Auction of Spectrum held in March, 2013

1.38 The auctions for spectrum in 1800 MHz and 800 MHz bands were conducted in March 2013 with reduced reserve prices. M/s Sistema

[4] Please see the press release on Union Cabinet's approval on Finalisation of Reserve Price for the Auction of Spectrum in 1800 MHz band for service areas where no bids were received during auctions held in November, 2012 and 900 MHz band in metro service areas and TRAI's recommendations on "Spectrum Management and Licensing Framework" issued on 13th Dec, 2012 available at pib.nic.in

[5] As per the press release on Union Cabinet's approval on finalization of Revised Reserve Price for the Auction of Spectrum in 800 MHz band (CDMA) and Pricing of Spectrum for current spectrum holding in 800 MHz band(CDMA) by existing operators in the 800 MHz issued on 17th Jan, 2013 available at pib.nic.in

Shyam Tele-Services Limited (SSTL) was the sole applicant and it obtained spectrum in 800 MHz band in eight (8) LSAs, all at the reserve price. LSA wise details of reserve prices and auction discovered prices are shown in table below.

Table 1.8

Reserve Price per 1.25 MHz and Winning price of 800/900/1800 MHz spectrum for auctions held in November 2012 & March 2013 **(Rs. Crore)**

	November 2012 Auction Reserve prices)		**March 13 Auction Reserve prices**			**Winning Price per 1.25 MHz block**	
LSA	**800 MHz**	**1800 MHz**	**800 MHz**	**900 MHz**	**1800 MHz**	**800 MHz (Mar'13)**	**1800 MHz (Nov'12)**
Delhi	900.98	693.06	450.49	970.3	485.15	450.49	
Mumbai	881.99	678.45	441	949.84	474.92		
Kolkata	147.84	113.72	73.92	227.44		73.92	113.72
Karnataka	429.16	330.12	214.58		231.08	214.58	
Rajasthan	87.2	67.08			46.96		
Andhra Pradesh	372.99	286.91	186.49				286.91
Assam	11.27	8.67	5.63				8.67
Bihar	55.26	42.51	27.63				46.43
Gujarat	292.29	224.84	146.15			146.15	224.84
Haryana	60.47	46.52	30.24				46.52
Himachal Pradesh	10.11	7.78	5.06				7.78
Jammu & Kashmir	8.23	6.33	4.11				6.33
Kerala	84.89	65.3	42.45			42.45	65.3
Madhya Pradesh	70.18	53.99	35.09				53.99
Maharashtra	341.66	262.81	170.83				262.81
North East	11.49	8.84	5.75				8.84
Orissa	26.35	20.27	13.18				20.27
Punjab	87.47	67.28	43.73				67.28
Tamil Nadu	397.92	306.09	198.96			198.96	306.09
Uttar Pradesh (E)	99.02	76.17	49.51				76.17
Uttar Pradesh (W)	139.63	107.41	69.82			69.82	107.41
West Bengal	33.59	25.84	16.79			16.79	25.84
Total	**4550**	**3500**	**2231.41**	**2147.58**	**1238.11**	**1213.16**	**1735.2**

CHAPTER-II

AVAILABILITY OF SPECTRUM

Telecom Industry Status

2.1 As on 30th April 2013, there are 897.02 million telephone subscribers in India. Of these, 867.02 million are wireless subscribers and 29.99 million are wireline subscribers. The share of urban subscribers is 60.7% whereas share of rural subscribers is 39.3%. The overall teledensity in India is 73.2% whereas wireless teledensity is 70.7%.

2.2 Presently, there are 6-10 telecom services providers (TSPs) in different LSAs operating in 800/900/1800 MHz band. The band-wise details of the number of TSPs in each of the LSAs are tabulated below:

TABLE 2.1

LSA	Total No. of Telecom Service Providers operating in		
	800 MHz Band	900/1800 MHz Band	800/900/1800 MHz Band*
Andhra Pradesh	3	8	8
Assam	2	6	6
Bihar	3	9	9
Chennai		2	2
Delhi	4	6	8
Gujarat	4	9	10
Haryana	3	8	8
Himachal Pradesh	3	7	7
Jammu & Kashmir	2	6	6
Karnataka	4	7	8
Kerala	4	7	8
Kolkata	4	7	8
Madhya Pradesh	3	8	8
Maharashtra	3	8	8
Mumbai	3	8	8

North East	2	6	6
Orissa	3	7	8
Punjab	4	8	8
Rajasthan	4	8	8
Tamilnadu (excluding Chennai)		2	2
Tamilnadu (including Chennai)	4	5	6
Uttar Pradesh (East)	3	9	9
Uttar Pradesh (West)	4	9	10
West Bengal	4	7	8
Grand Total	**72**	**167**	**177**

* Dual Technology Operators have been counted as one.

2.3 Regarding the area of presence of these operators, there are six TSPs having a pan-India presence, whereas four TSPs have regional presence in 6-19 LSAs and two TSPs have operation in only one LSA each.

TABLE 2.2

Sl. No.	**Name of Telecom Service Provider**	**Presence in following LSAs**
1	Aircel	Pan India Presence (22 LSAs)
2	Bharti Airtel	Pan India Presence (22 LSAs)
3	BSNL/MTNL (PSUs)	Pan India Presence (22 LSAs)
4	HFCL	Punjab (1 LSA)
5	Idea	Pan India Presence (22 LSAs)
6	Loop	Mumbai (1 LSA)
7	Reliance (RCL/RTL)	Pan India Presence (22 LSAs)
8	Sistema Shyam	Rajasthan, Delhi, Gujarat, Karnataka, Kerala, Kolkata, Tamilnadu, West Bengal and UP(W) (9 LSAs)
9	Tata Teleservices	All Service Areas except J&K, Assam and North East (19 LSAs)
10	Telewings	AP, Bihar, Gujarat, Maharashtra, UP(E) and UP(W) (6 LSAs)
11	Videocon	Bihar, Gujarat, Haryana, MP, UP(E) and UP(W) (6 LSAs)
12	Vodafone	Pan India Presence (22 LSAs)

Spectrum Available With Various TSPs

2.4 The total spectrum available with the TSPs in each of the LSAs in 900 MHz, 1800 MHz and 800 MHz bands is tabulated below:

TABLE 2.3

LSA	Total Spectrum available with Telecom Service Providers (in MHz)			Average quantum of spectrum per TSP in 900/1800 MHz Bands (in MHz)	Average quantum of spectrum per TSP in 800 MHz Band (in MHz)
	900 MHz Band	1800 MHz Band	800 MHz Band		
Andhra Pradesh	20.2	32.2	13.75	6.6	4.6
Assam	18.6	23.15	5	7.0	2.5
Bihar	18.6	39.95	11.25	6.5	3.8
Chennai	18.6	14.6	0	5.5	0.0
Delhi	22.2	27	17.5	8.2	4.4
Gujarat	20.2	32.6	13.75	5.9	3.4
Haryana	18.6	30.7	11.25	6.2	3.8
Himachal Pradesh	18.6	22.65	7.5	5.9	2.5
Jammu & Kashmir	18.6	16.3	5	5.8	2.5
Karnataka	20.2	27.2	15	6.8	3.8
Kerala	18.6	26.25	16.25	6.4	4.1
Kolkata	20.2	27.6	15	6.8	3.8
Madhya Pradesh	18.6	34.3	10	6.6	3.3
Maharashtra	20.2	33.45	12.5	6.7	4.2
Mumbai	22.2	37	12.5	7.4	4.2
North East	19.4	19.3	5	6.5	2.5
Orissa	18.6	26.3	8.75	6.4	2.9
Punjab	21.8	25.05	12.5	5.9	3.1
Rajasthan	18.6	27.6	15	5.8	3.8
Tamilnadu (excluding Chennai)	20.2	11	0	6.7	0.0
Tamilnadu (including Chennai)	0	16.4	15	5.7	3.8
Uttar Pradesh (East)	18.6	37.45	11.25	6.2	3.8
Uttar Pradesh (West)	18.6	37.5	15	6.2	3.8
West Bengal	19.4	24.75	12.5	6.3	3.1
Total	**449.4**	**650.3**	**261.25**	**6.6**	**3.6**

TSP wise spectrum availability in the 800 MHz, 900 MHz and 1800 MHz band in different LSAs is shown in Annexure – B.

Amount of Spectrum to be put to Auction

2.5 The first issue which needs deliberation is the amount of spectrum to be put up for auction. In its Judgment dated 2nd February 2012 in Writ Petitions no. 423/2010 and 10/2011, the Hon'ble Supreme Court of India has directed as follows:

"The licenses granted to the private respondents on or after 10.1.2008 pursuant to two press releases issued on 10.1.2008 and subsequent allocation of spectrum to the licensees are declared illegal and are quashed."

2.6 A total of 122 licences were granted pursuant to the press releases dated 10th January 2008 and the **total spectrum allotted in various LSAs, in respect of these 122 licences was 413.6 MHz in the 1800 MHz band and 60 MHz in the 800 MHz band**. However, in the auctions held in November 2012, 295 MHz of spectrum in the 1800 MHz band and 95 MHz in the 800 MHz band was put to auction.

2.7 On 28th September 2012, I.A. No.11/2012 was filed on behalf of the Vodafone Essar South Limited and others for issue of a direction to the DoT to put the whole spectrum to auction pleading that the Government is duty bound to auction the entire spectrum which became available as a result of the quashing. On 15th February, 2013 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".

2.8 The spectrum that was vacated as a result of the quashing of the licences, the amount of spectrum that was put up for auction and the quantum of spectrum that was sold in the auctions in 1800 MHz and 800 MHz bands are as below:

TABLE 2.4

1800 MHz Band

(in MHz)

Sl. No.	LSA	Spectrum vacated due to cancellation of licences	Spectrum put up for auction in November 2012	Spectrum put up for auction in March 2013	Spectrum sold in November 2012	Spectrum sold in March 2013	Difference between spectrum vacated due to cancellation of licences and spectrum put up for auction in November 2012	Difference between spectrum vacated due to cancellation of licences and spectrum sold in November 2012
1	Delhi	4.4	10	15		NIL	-5.6	4.4
2	Mumbai	13.2	10	15		NIL	3.2	13.2
3	Kolkata	17.6	13.75		5		3.85	12.6
4	Maharashtra	22	13.75		6.25		8.25	15.75
5	Gujarat	17.6	13.75		10		3.85	7.6
6	AP	22	13.75		5		8.25	17
7	Karnataka	22	13.75	13.75		NIL	8.25	22
8	Tamilnadu	22	13.75		5		8.25	17
9	Kerala	17.6	13.75		1.25		3.85	16.35
10	Punjab	17.6	13.75		1.25		3.85	16.35
11	Haryana	22	13.75		7.5		8.25	14.5
12	UP - West	17.6	13.75		12.5		3.85	5.1
13	UP - East	17.6	13.75		11.25		3.85	6.35
14	Rajasthan*	17.6	13.75	13.75		NIL	3.85	17.6
15	M.P.	17.6	13.75		7.5		3.85	10.1
16	West Bengal	17.6	13.75		8.75		3.85	8.85
17	H.P.	17.6	13.75		1.25		3.85	16.35
18	Bihar	22	13.75		13.75		8.25	8.25
19	Orissa	22	13.75		7.5		8.25	14.5
20	Assam	22	13.75		8.75		8.25	13.25
21	North East	22	13.75		7.5		8.25	14.5
22	J&K	22	13.75		7.5		8.25	14.5
	Total	**413.6**	**295**	**57.5**	**127.5**	**NIL**	**118.6**	**286.1**

*Spectrum not available in 11 Districts.

TABLE 2.5

800 MHz Band **(in MHz)**

Sl. No.	LSA	Spectrum vacated due to cancellation of licences	Spectrum put up for auction in November 2012	Spectrum put up for auction in March 2013	Spectrum sold in November 2012	Spectrum sold in March 2013
1	Delhi	2.5	3.75	3.75	0	3.75
2	Mumbai	2.5	3.75	3.75	0	
3	Kolkata	2.5	3.75	3.75	0	3.75
4	Maharashtra	2.5	3.75	3.75	0	
5	Gujarat	2.5	5	5	0	3.75
6	AP	2.5	2.5	2.5	0	
7	Karnataka	2.5	5	5	0	3.75
8	Tamil Nadu	2.5	5	5	0	3.75
9	Kerala	2.5	5	5	0	3.75
10	Punjab	2.5	2.5	2.5	0	
11	Haryana	2.5	5	5	0	
12	UP - West	2.5	5	5	0	3.75
13	UP - East	2.5	5	5	0	
14	Rajasthan	0	0	0	0	
15	M.P.	2.5	5	5	0	
16	West Bengal	2.5	5	5	0	3.75
17	H.P.	2.5	5	5	0	
18	Bihar	2.5	5	5	0	
19	Orissa	2.5	5	5	0	
20	Assam	5	5	5	0	
21	North East	5	5	5	0	
22	J&K	5	5	5	0	
	Total	**60**	**95**	**95**	**0**	**30**

2.9 In view of the direction of Hon'ble Supreme Court dated 15th February 2013, the DoT has decided to conduct another round of auction in 1800 MHz, 900 MHz and 800 MHz bands. It is in this context that DoT has requested TRAI through a letter dated 10th July 2013 to provide recommendations on applicable reserve price for auction of spectrum in these bands. In its reference, the DoT has also conveyed to TRAI the

amount of spectrum in 1800 MHz and 800 MHz bands, which it proposes to be put up for auction.

TABLE 2.6

Quantum of Spectrum proposed to be put up for Auction in 1800 MHz Band

Sl. No.	LSA	Quantum of quashed spectrum (in MHz)	Spectrum sold in November 2012 (in MHz)	Spectrum put up for auction in March 2013 (in MHz)	Quantum of spectrum proposed to be put up for auction (in MHz)
(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	17.60	5.00	0.00	13.75
4	Maharashtra	22.00	6.25	0.00	13.75
5	Gujarat	17.60	10.00	0.00	8.75
6	AP	22.00	5.00	0.00	17.50
7	Karnataka	22.00	0.00	13.75	22.50
8	Tamilnadu	22.00	5.00	0.00	17.50
9	Kerala	17.60	1.25	0.00	17.50
10	Punjab	17.60	1.25	0.00	15.00
11	Haryana	22.00	7.50	0.00	11.25
12	UP - West	17.60	12.50	0.00	2.50
13	UP - East	17.60	11.25	0.00	7.50
14	Rajasthan*	17.60	0.00	13.75	18.75
15	M.P.	17.60	7.50	0.00	11.25
16	West Bengal	17.60	8.75	0.00	10.00
17	H.P.	17.60	1.25	0.00	13.75
18	Bihar	22.00	13.75	0.00	5.00
19	Orissa	22.00	7.50	0.00	15.00
20	Assam	22.00	8.75	0.00	12.50
21	North East	22.00	7.50	0.00	15.00
22	J&K	22.00	7.50	0.00	6.25
	Total	**413.60**	**127.50**	**57.50**	**285.00**

TABLE 2.7

Quantum of Spectrum proposed to be put up for Auction in 800 MHz Band

Sl. No.	LSA	Quantum of quashed spectrum (in MHz)	Spectrum sold in November 2012 (in MHz)	Spectrum put up for auction in March 2013 (in MHz)	Spectrum sold in March 2013 (in MHz)	Quantum of spectrum proposed to be put up for auction (in MHz)
(a)	(b)	(C)	(d)	(e)	(f)	(g)
1	Delhi	2.50	0.00	3.75	3.75	0.00
2	Mumbai	2.50	0.00	3.75	0.00	3.75
3	Kolkata	2.50	0.00	3.75	3.75	0.00
4	Maharashtra	2.50	0.00	3.75	0.00	3.75
5	Gujarat	2.50	0.00	5.00	3.75	0.00
6	AP	2.50	0.00	2.50	0.00	2.50
7	Karnataka	2.50	0.00	5.00	3.75	0.00
8	Tamil Nadu	2.50	0.00	5.00	3.75	0.00
9	Kerala	2.50	0.00	5.00	3.75	0.00
10	Punjab	2.50	0.00	2.50	0.00	2.50
11	Haryana	2.50	0.00	5.00	0.00	5.00
12	UP - West	2.50	0.00	5.00	3.75	0.00
13	UP - East	2.50	0.00	5.00	0.00	5.00
14	Rajasthan	0.00	0.00	0.00	0.00	0.00
15	M.P.	2.50	0.00	5.00	0.00	5.00
16	West Bengal	2.50	0.00	5.00	3.75	0.00
17	H.P.	2.50	0.00	5.00	0.00	5.00
18	Bihar	2.50	0.00	5.00	0.00	5.00
19	Orissa	2.50	0.00	5.00	0.00	5.00
20	Assam	5.00	0.00	5.00	0.00	5.00
21	North East	5.00	0.00	5.00	0.00	5.00
22	J&K	5.00	0.00	5.00	0.00	5.00
	Total	**60.00**	**0.00**	**95.00**	**30.00**	**57.50**

2.10 As can be seen from the above tables, in the 1800 MHz band, the spectrum put up for auction in November 2012 and March 2013 was less than the spectrum vacated due to cancellation of licences. However, as far as 800 MHz band is concerned, the spectrum put up

for auction was more than the spectrum which got vacated due to the cancellation of the licences. Therefore, in the 800 MHz band, the directions of the Hon'ble Supreme Court have already been complied with.

Spectrum Availability in different LSAs

2.11 What is the amount of spectrum in these bands which can be made available for allocation through auction? As per the information provided by the DoT, the availability of spectrum in different LSAs in the 800 MHz, and 1800 MHz bands is given below:

800 MHz Band

TABLE 2.8

Spectrum Availability in the 800 MHz Band

S.No.	LSA	Total available spectrum after cancellation of licences (in MHz)	Spectrum Assigned in March 2013 (in MHz)	Spectrum Available (in MHz)
1	Delhi	3.75	3.75	0
2	Mumbai	3.75		3.75
3	Kolkata	5	3.75	1.25
4	Maharashtra	3.75		3.75
5	Gujarat	7.5	3.75	3.75
6	AP	2.5		2.5
7	Karnataka	6.25	3.75	2.5
8	Tamil Nadu	5	3.75	1.25
9	Kerala	5	3.75	1.25
10	Punjab	3.75		3.75
11	Haryana	6.25		6.25
12	UP - West	6.25	3.75	2.5
13	UP - East	5		5
14	Rajasthan	0		0
15	M.P.	6.25		6.25
16	West Bengal	7.5	3.75	3.75
17	H.P.	10		10

18	Bihar	6.25		6.25
19	Orissa	8.75		8.75
20	Assam	12.5		12.5
21	North East	12.5		12.5
22	J&K	10		10
	Total	**137.5**	**30**	**107.5**

1800 MHz

TABLE 2.9

Spectrum Availability in the 1800 MHz Band[6] **(in MHz)**

S.No.	LSA	Total Spectrum available after cancellation of licences	Spectrum sold in Nov 2012	Available Spectrum
1	Delhi	18.4		18.40
2	Mumbai	20.6		20.60
3	Kolkata	40.6	5	35.60
4	Maharashtra	28.0	6.25	21.75
5	Gujarat	22.0	10	12.00
6	AP	37.0	5	32.00
7	Karnataka	33.8		33.80
8	Tamil Nadu	47.4	5	42.40
9	Kerala	45.6	1.25	44.35
10	Punjab	19.0	1.25	17.75
11	Haryana	26.4	7.5	18.90
12	UP - West	21.4	12.5	8.90
13	UP - East	17.6	11.25	6.35
14	Rajasthan	3.2		3.20
15	M.P.	35.6	7.5	28.10
16	West Bengal	21.6	8.75	12.85
17	H.P.	19.6	1.25	18.35
18	Bihar	18.8	13.75	5.05
19	Orissa	40.0	7.5	32.50
20	Assam	25.8	8.75	17.05
21	North East	29.0	7.5	21.50
22	J&K	15.2	7.5	7.70
	Total	**586.6**	**127.5**	**459.1**

[6] In Gujarat, Punjab, Haryana, West Bengal, Assam and North East some quantum of spectrum is available partially. Spectrum, which is available in at least 75% of districts of the LSA including State Capital, is considered in the available spectrum. 2.4 MHz of excess spectrum held by MTNL in Delhi and Mumbai LSAs has been considered in the available spectrum.

Spectrum held by MTNL in 900/1800 MHz Band

2.12 On the issue of availability of spectrum and the need to ensure its efficient utilisation, the Authority in its recommendations of May, 2010 also examined the quantum of spectrum held by the two PSUs. In its recommendations, the Authority observed that in the metros of Delhi and Mumbai, MTNL is holding 12.4 MHz which is being underutilized and the Authority would like the Government to withdraw spectrum in the amount of 2x2.4 MHz from MTNL to maintain a level-playing field between the private and public service providers. This was reiterated in its recommendations of April 2012, where the Authority stated that "…excess Spectrum of 2x2.4 MHz should be immediately taken back from MTNL." As per the information available with the Authority, the DoT has not yet taken any action on this recommendation of the Authority.

2.13 The spectrum held by MTNL, includes spectrum holding of 6.2 MHz in 900 MHz band in both the LSAs. The total subscribers being served by MTNL vis-â-vis rest of the operators in Delhi and Mumbai are compared in table 2.10.

2.14 It is obvious that spectrum is not being put to efficient use by MTNL. A measure of usage-efficiency is the number of subscribers being served per MHz of spectrum. As can be seen from the table 2.10, the number of subscribers served per MHz of spectrum by private TSPs is 6 to 8 times that of MTNL in Delhi and Mumbai. In fact, as per the earlier subscriber-based criteria for allotment of GSM spectrum[7], the amount of spectrum assigned to MTNL should have been only 6.2 MHz both in Delhi and Mumbai.

[7] WPC letter no. J-14025/200(17)/2004-NT dated 17th January 2008

TABLE 2.10

MTNL Spectrum Holding and Subscribers Served vis-s-vis Private Operators[8]

Service Area	Service providers	Spectrum Held (900/1800 MHz bands) in MHz	No. of GSM Subscribers (Peak VLR)	No. of GSM Subscribers (in millions)	No. of Subscribers per MHz	No of GSM Subscribers per MHz (in milions)
Delhi	Bharti	10	6959402	6.96	695940	0.70
	Vodafone	10	7884077	7.88	788408	0.79
	MTNL	12.4	1171735	1.17	94495	0.09
	Idea	8	4578807	4.58	572351	0.57
	Aircel	4.4	1766498	1.77	401477	0.40
	RCL	4.4	4304138	4.30	978213	0.98
	Total	**49.2**	**26664657**	**26.66**	**541965**	**0.54**
Mumbai	Loop	10	1272608	1.27	127261	0.13
	Vodafone	10	5480462	5.48	548046	0.55
	MTNL	12.4	781548	0.78	63028	0.06
	Bharti	9.2	3289509	3.29	357555	0.36
	Idea	4.4	2506063	2.51	569560	0.57
	RCL	4.4	2637351	2.64	599398	0.60
	Aircel	4.4	867794	0.87	197226	0.20
	Tata	4.4	1364702	1.36	310160	0.31
	Total	**59.2**	**18200037**	**18.20**	**307433**	**0.31**

2.15 In view of the foregoing, and also keeping in view the larger objective of ensuring efficient utilisation of spectrum, the Authority is of the opinion 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. Therefore, in this consultation paper, 2.4 MHz of spectrum held by MTNL has been included in all the calculations of spectrum availability in the 1800 MHz band.

2.16 Another issue which has a direct bearing on the availability of spectrum in the 1800 MHz band for allocation is the need for refarming of spectrum in the 900 MHz band. As per the information given by DoT,

[8] May 2013

presently, no spectrum is available in the 900 MHz band. However, licences of operators having spectrum in the 900 MHz band will be expiring progressively from the year 2014 to 2024. In the year 2014, the following spectrum shall be available because of the expiry of licences given in the year 1994.

TABLE 2.11

Availability of Spectrum in the 900 MHz Band on expiry of licences in 2014

Sl. No.	LSA	Amount of Spectrum (in MHz)
1.	Delhi	16
2.	Mumbai	16
3.	Kolkata	14
4.	Chennai*	6.2

*Chennai is now part of Tamilnadu LSA.

2.17 The issue of refarming of 800/900 MHz bands had been examined by the Authority in paras 1.62 to 1.72 of its recommendations on 'Spectrum Management and Licensing Framework" dated 11th May 2010. The Authority noted that both 800 and 900 MHz have been identified as IMT bands and there is a growing interest world over in deploying UMTS in the 800 and 900 MHz frequency bands in order to reduce the cost of coverage for mobile communications services, especially in rural areas. Being sub-1GHz bands, these have better propagation characteristics and signals travel farther and pass through walls and other obstacles much better than existing cell phone networks do, leading to a less number of cells to provide the same coverage. Therefore, less capital expenditure is required for roll-out of services.

2.18 The Authority noted that the spectrum in the 900 MHz band given to the early licence holders, who obtained licences before the year 2001,

was far more efficient and more valuable than the spectrum given to licensees from 2001 onwards which was in the 1800 MHz band. Three private operators (Bharti Airtel, Vodafone and Idea) besides BSNL/MTNL hold nearly 85% of the spectrum in 900 MHz band and therefore have a strong competitive edge over others. After analysing the issue, the Authority proposed that spectrum in the 800 and 900 MHz bands should be refarmed at the time of renewal of the licences. The Authority recommended that:

"Spectrum in 800 and 900 MHz bands should be refarmed at the time of renewal of the licenses. For holders of spectrum in 900 MHz band, substitute spectrum should only be assigned in 1800 MHz band and for licence holders of 800 MHz band, spectrum should be assigned in 450 / 1900 MHz bands."

2.19 However, in view of the various issues involved in refarming of spectrum, the Authority recommended that it would carry out a separate consultation process on the issues involved in the refarming of 800/900 MHz spectrum and endeavour to give its recommendations before the licences come up for renewal. 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."

2.20 In its recommendations dated 23rd April 2012, the Authority examined the different alternatives for carrying out refarming of spectrum in these bands and concluded that the entire spectrum in the 800/900 MHz band should be refarmed. The Authority recommended that:

a. The 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 due date of renewal of the licences.

b. The spectrum available with the service providers in the 800/900 MHz band should be replaced by spectrum in the 1900/1800 MHz band, which should be charged at the price prevalent at the time of refarming.

c. In areas where the amount of spectrum in the 1800 MHz band is insufficient for fully carrying out refarming, immediate steps must be taken to get Government agencies to vacate 1800 MHz spectrum so that the entire 900 MHz spectrum could be refarmed.

2.21 In its response dated 30th October, 2012 to DoT's letter No. L-14001/18/2012-NTG dated 25th October 2012 seeking clarifications on its recommendations on 'Auction of Spectrum', the Authority again examined the issue of refarming in Paras 5.9 to 5.23 and concluded that:

"The Authority sees no reason to alter its recommendations on sequencing of auctions. However, should the Government decide to refarm partially and permit retention of 2.5MHz in 900MHz band then, as and when the auction of spectrum in 900MHs 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."

2.22 However, instead of reserving spectrum in the 900 and 1800 MHz band for the licensees holding spectrum in 900 MHz band in the 3 metros of Delhi, Mumbai and Kolkata, as recommended by the Authority, the DoT in the NIA dated 30th January 2013 for the auction of spectrum in

1800MHz, 900MHz and 800MHz bands, 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. The related clauses are reproduced below:

"5.4.5 Ranking of Bidders and Provisional Winning Bidders

……. The Provisional Winning Bidders would be ranked at the end of each Clock Round using the following criteria:

- *A bidder, who is categorized as a "Renewal Licensee", will be ranked on priority for the spectrum up to which the bidder is entitled for retaining;*
    - *A Renewal Licensee has an entitlement for retaining up to a maximum of 10MHz spectrum or Current Holding (Prescribed Limit), whichever is less. For this purpose, 1800MHz and 900MHz band will be considered as a Single band. This entitlement has been incorporated in the ranking rule and to be exercised by Renewal Licensees in Service Areas of Delhi and Mumbai solely by participation and bidding. The priority in ranking for retention in 900MHz band is limited to 2.5MHz only. The priority in ranking for the balance spectrum up to the prescribed limit will be accorded in the 1800MHz band, if the Renewal Licensee submits the bid in this band at that price.*
    ……"

2.23 As explained in the para 2.16, licences of the TSPs in the LSAs other than metros having spectrum in the 900 MHz band will be expiring progressively from 2015 to 2024. In case spectrum in 1800 MHz is required to be reserved for refarming of the 900 MHz spectrum available with such TSPs, it will have a direct bearing on the availability of spectrum in the 1800 MHz band for auction. In view of the foregoing, stakeholders are requested to comment on the following issues:

Q.1. What method should be adopted for refarming of the 900 MHz band so that the TSPs whose licences are expiring in 2014 onwards get adequate spectrum in 900/1800 MHz band for continuity of services provided by them?

Q.2. In case spectrum is to be "reserved" for such TSPs, should it be restricted to licences expiring in 2014 (metros) or include licences expiring afterwards (LSAs other than metros)?

Eligibility Criteria

2.24 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).

2.25 In the NIA, there was a categorization of the prospective bidders as given below:

* **'New Entrant'**: Licensees who do not hold UAS/ CMTS/ UL (AS) Licence could participate in the auction process as a 'New Entrant'. Also, the companies/ licensees whose licences were slated to be quashed as per the direction of Supreme Court would be treated as 'New Entrants' and would be required to fulfil the conditions stipulated both for bidding and for obtaining a Unified Licence (Access Service)/ Unified Licence as per the DoT guidelines. Existing UASL/CMTS/ UL (AS) licensees would be treated as 'New Entrant' in those service area(s) for the frequency bands in which they do not hold spectrum at present. In other words, UAS/CMTS/ UL (AS) licensees who hold either spectrum in

1800MHz/900MHz only or 800 MHz band only in a particular Service Area were also allowed to participate in the auction as 'New Entrant' in that service area for the frequency band in which they did not hold spectrum at present. Their eligibility to bid for spectrum blocks in that particular service area will be that of a new entrant.

* **'Existing Licensee'**: Existing UASL/CMTS/ UL (AS) licensees would be treated as 'Existing Licensee' in those service areas for the frequency band(s) in which they already held spectrum. Their eligibility to bid for spectrum blocks would be that of an existing operator. For the limited purpose of this provision, 900MHz band and 1800MHz band were treated as the same band.

* **"Renewal Licensee"**: Licensees, whose licenses are due for renewal in 2014, will be categorized as "Renewal Licensee" for the respective LSAs in the 1800MHz and 900MHz band.

2.26 Presently, there are 6-10 operators in each service area. However, because of a large number of operators in each LSA, there is cut-throat competition which has adversely affected the financial health of operators and the industry. Due to unsustainable pricing and slow revenue growth, their EBIDTA is under pressure. The current state of industry is not sustainable in the long term and measures like consolidation etc might be required to improve its financial health.

2.27 Additionally, as can be seen from Annexure-B, the average spectrum holding of telecom service providers in India in 900 MHz and 1800 MHz band ranges from 4.4 MHz to 10MHz which is far below most of their counter-parts in other countries. Spectrum that is held by leading telecom service providers in some countries in 900 MHz and 1800 MHz is placed at Annexure-C. A research study on spectrum holding relative to population coverage for the 170 service providers carried out

by Tolaga Research[9] indicates that the average allocation across the European region is in the order of 71.6 MHz FDD (across the 800, 900, 1800, 2100 and 2600 MHz ranges). On a band-specific basis, the aggregate spectrum bandwidth allocations to service providers across Europe are around 20.5 MHz in 900 MHz band and 30.6 MHz in 1800 MHz band. In view of the aforesaid, there is a need to ensure availability of adequate amount of spectrum for TSPs in India so as to ensure provision of affordable quality services.

2.28 In view of the above discussion, stakeholders are requested to comment on the following:

Q.3. Is any restriction required to be imposed on the eligibility for participation in the proposed auction?

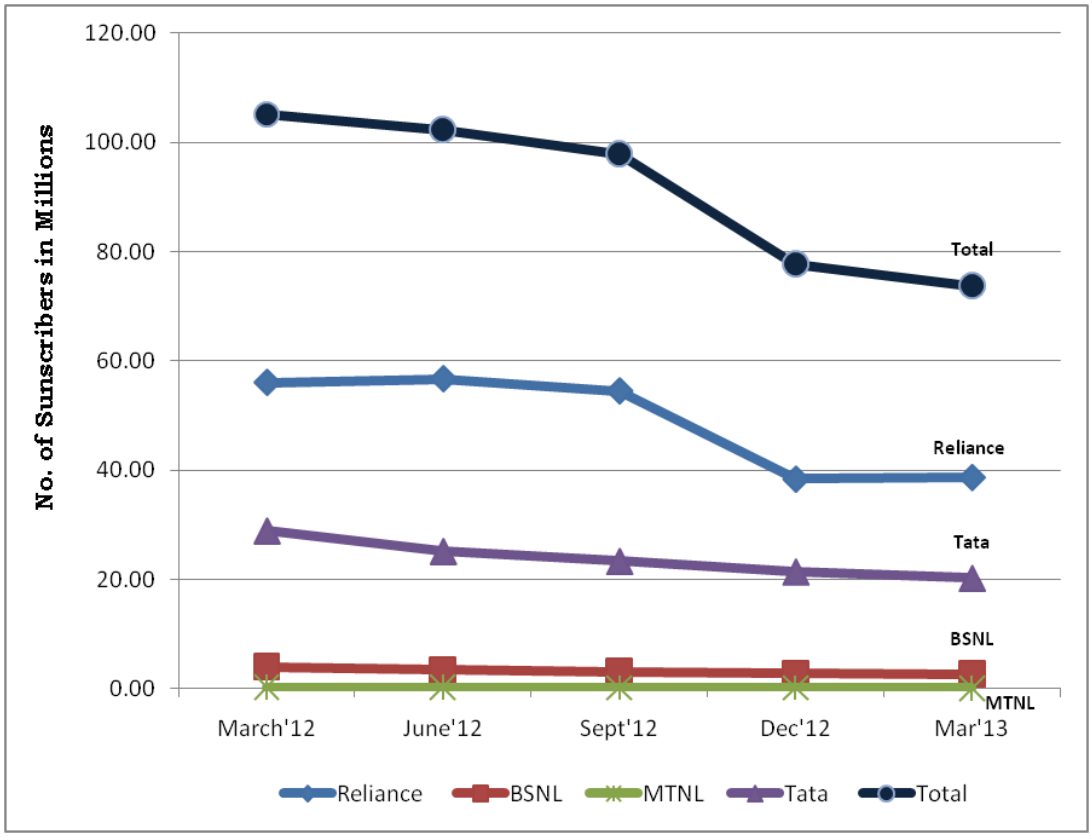
800 MHz Band

2.29 In India, some of the operators are providing mobile cellular services using CDMA technology using the 800 MHz band. Presently, there are 2-4 TSPs (including PSUs) in each LSA using this technology. Out of these TSPs, all 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 very few operators the world over, the eco-system of CDMA has not developed as much as GSM technology. In India too, it is seen that over the last few years, the number of CDMA subscribers is declining. Total CDMA subscribers has fallen from 105.11 million as on March 2012 to 73.78 million as on March 2013 i.e. there is shrinkage in total CDMA subscriber base by around 30% in 2013. Revenues, minutes of usage and the subscribers' count of each operator are continuously decreasing. In the recently held auctions held in November 2012, spectrum in the 1800 MHz and 800 MHz bands were put to auction. Quashed licensees in the 800 MHz band did

[9] http://www.tolaga.com/pdfReports/TolagaInsightEuropeSpec0910.pdf

not participate in the auctions. In fact, there was no bidder for the spectrum in the 800 MHz band. The spectrum in this band was again put up for auction 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's verdict, took part in the auction. SSTL won 3.75 MHz spectrum in each of the eight LSAs where it participated in the bidding process.

CHART 2.1
Number of CDMA subscribers during 2012-2013



Possibility of Adoption of Extended GSM (E-GSM) Band

2.30 In the above context, it is useful to examine the feasibility of deploying available spectrum in 800 MHz band for GSM/HSPA technology in line with its usage in a number of other countries. In India, as well as most

of the other ITU-R Region 3 countries, the GSM band is from 890-915 MHz/935-960 MHz (i.e. 2x25 MHz). In the ITU-R Region 1, the GSM band is 880-915 MHz/925-960 MHz (i.e. 2x35 MHz) which is referred to as the E-GSM band. The E-GSM band overlaps with the 824-844/869-889 MHz band, which is known as the 800 MHz band in India and the 850 MHz band in many other countries. Therefore, countries which have adopted E-GSM band, do not have the 850 MHz band.

2.31 Before examining the technical feasibility for migrating to the E-GSM band, it is important to discuss the eco-systems of UMTS in 900 spectrum band vis-a-vis 850 MHz band. 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. There are some commercial UMTS850 networks in Australia, New Zealand, Philippines and Latin America also. A robust UMTS850 ecosystem exists today which includes several hundred HSPA devices. 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. Deploying HSPA in lower bands (below 1 GHz) gives a much larger coverage area and a significant reduction in cell sites needed, compared with 1900/2100 MHz, saving OPEX and CAPEX.

2.32 There are 482 commercial HSPA networks launched in 186 countries. UMTS900 is main-stream with 57 commercial UMTS networks in 39 countries and 22 more countries are considering UMTS900 deployments. According to GSA's 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.

2.33 The migration to E-GSM band will necessitate the vacation of the frequency range 880-890 MHz or part thereof which implies lateral frequency adjustment amongst the CDMA operators. If the complete range of 880-890 MHz is vacated, then CDMA band will be restricted to 824-834 MHz/869-879 MHz i.e. 2x10 MHz. Therefore, it can serve only 2 operators.

2.34 Presently, both the PSUs (MTNL/BSNL) are also holding spectrum in 800 MHz. However, they are not providing full mobility service in this band and their number of subscribers by these PSUs is very small. Therefore, these two PSUs could be asked to vacate spectrum in the 800 MHz band.

2.35 In case spectrum is vacated by the PSUs in the 800 MHz band, the present availability of spectrum and its allocation between different TSPs in terms of quantum of spectrum and number of channels (each channel of 1.23 MHz) will be as given below:

TABLE 2.12 **(in MHz)**

Sl. No.	LSA	BSNL	HFCL	MTNL	SSTL	TTSL	RCL/ RTL	Total spectrum holding	Spectrum holding except PSUs
1	Delhi			3.75	3.75	5	5	17.5	13.75
2	Mumbai			2.5		5	5	12.5	10
3	Kolkata	2.5			3.75	3.75	5	15	12.5
4	Maharashtra	2.5				5	5	12.5	10
5	Gujarat	2.5			3.75	3.75	3.75	13.75	11.25
6	Andhra Pradesh	3.75				5	5	13.75	10
7	Karnataka	2.5			3.75	3.75	5	15	12.5
8	Tamilnadu	2.5			3.75	3.75	5	15	12.5
9	Kerala	3.75			3.75	3.75	5	16.25	12.5
10	Punjab	2.5	2.5			3.75	3.75	12.5	10
11	Haryana	2.5				5	3.75	11.25	8.75
12	UP (West)	2.5			3.75	3.75	5	15	12.5

13	UP (East)	2.5				3.75	5	11.25	8.75
14	Rajasthan	2.5			5	3.75	3.75	15	12.5
15	Madhya Pradesh	2.5				2.5	5	10	7.5
16	West Bengal	2.5			3.75	2.5	3.75	12.5	10
17	Himachal Pradesh	2.5				2.5	2.5	7.5	5
18	Bihar	2.5				3.75	5	11.25	8.75
19	Orissa	2.5				2.5	3.75	8.75	6.25
20	Assam	2.5					2.5	5	2.5
21	North East	2.5					2.5	5	2.5
22	J&K	2.5					2.5	5	2.5
	Grand Total	**52.5**	**2.5**	**6.25**	**35**	**72.5**	**92.5**	**261.25**	**202.5**

2.36 In CDMA technology, theoretically the channel width is said to be 1.25 MHz. However, the actual channel width is 1.23 MHz with a guard band of 0.6 MHz between two TSPs to avoid interference. Also, guard band has been kept at the start and end of the 800 MHz band, totaling to 0.98 MHz band. Therefore, though there are 16 carriers of 1.25 MHz in 20 MHz of spectrum, practically, only 13-14 carriers are available to be used, depending on the number of TSPs assigned the spectrum. Considering all these, the total spectrum assigned in this band and the quantum of spectrum that can be considered for vacation is given in the table 2.13.

TABLE 2.13 **(in MHz)**

Sl. No.	LSA	No. of Carriers Assigned*	No. of Operators except PSUs	Amount of spectrum assigned in CDMA	Spectrum left for liberalisation
1	Delhi	11	3	15.71	4.29
2	Mumbai	8	2	11.42	8.58
3	Kolkata	10	3	14.48	5.52
4	Maharashtra	8	2	11.42	8.58
5	Gujarat	9	3	13.25	6.75
6	AP	7	2	10.19	9.81
7	Karnataka	10	3	14.48	5.52
8	Tamil Nadu	9	3	13.25	6.75
9	Kerala	10	3	14.48	5.52
10	Punjab	8	3	12.02	7.98

11	Haryana	6	2	8.96	11.04
12	UP - West	10	3	14.48	5.52
13	UP - East	7	2	10.19	9.81
14	Rajasthan	10	3	14.48	5.52
15	M.P.	6	2	8.96	11.04
16	West Bengal	8	3	12.02	7.98
17	H.P.	4	2	6.5	13.5
18	Bihar	7	2	10.19	9.81
19	Orissa	5	2	7.73	12.27
20	Assam	4	2	6.5	13.5
21	North East	4	2	6.5	13.5
22	J&K	4	2+ Defence	7.1	12.9

* Excluding BSNL/MTNL
Remark: It shall require reconfiguration of the frequencies assigned to the incumbent CDMA operators to make contiguous spectrum available for liberalisation.

2.37 As can be seen from table 2.13, after vacation by PSU operators, at least 10 MHz of spectrum in the E-GSM band can be available for auction in 7 LSAs. In the other LSAs (except Delhi), 2x5 MHz of spectrum can be auctioned for use in the E-GSM band. However, the following issues will need to be resolved before deciding to liberalize the spectrum in this band for E-GSM band:

- It shall require reconfiguration of the frequencies assigned to the incumbent CDMA operators to make contiguous spectrum available for liberalisation.
- Whether the present equipment installed for GSM networks including the handsets can work in E-GSM band needs to be assessed.
- In the E-GSM downlink (925-935 MHz), as per the report of WPC, there are 448 assignments to different users for captive use.
- Additionally, in the E-GSM downlink (925-935 MHz), as per the report of WPC, around 7 MHz is being used by defence. Its vacation needs to be examined.

Q.4. Should India adopt E-GSM band, in view of the diminishing interest in the CDMA services? If yes,

a) How much spectrum in the 800 MHz band should be retained for CDMA technology?

b) What are the issues that need to be addressed in the process?

c) What process should be adopted for migration considering the various issues involved?

Roll Out Obligations

2.38 In the NIA of 30th January 2013, the roll-out obligations for coverage in respect of Metro Service Areas was prescribed as the same as given in the Unified Access Service License (UASL) for Metro Service Areas. However, in LSAs other than the Metros, a five phase roll-out obligation has been stipulated for spectrum in 900/1800 MHz and 800 MHz band, as detailed below:

TABLE 2.14

Roll-Out Obligations as per NIA of 30th January 2013 for Auction of Spectrum in 1800MHz, 900MHz and 800MHz Bands

Phases of the Roll out	Roll Out Requirement	Time Period*
Phase 1	Coverage of 10% DHQs/ Towns	by the end of One years
Phase 2	Coverage of 50% DHQs/ Towns	by the end of Three years
Phase 3	Coverage of 10% BHQs	by the end of Three years
Phase 4	Coverage of additional 10% BHQs (Cumulative 20% BHQs).	by the end of Four years
Phase 5	Coverage of additional 10% BHQs (Cumulative 30% BHQs).	by the end of Five years

* From the effective date of Licences or date of allotment of spectrum won in the auction process, whichever is later.

2.39 The first two phases of the roll-out obligations are the same as provided in the existing UAS license. For a 'New Entrant', there would be five phases of rollout obligations; for an 'Existing Licensee' acquiring spectrum in the auction, there would be three additional phases of roll-out obligations. In case of Existing Licensees/ Renewal Licensees

having spectrum in both the bands (i.e. 900/1800MHz Band and 800MHz Band), the roll-out obligation shall be applicable with respect to the network deployed using the spectrum acquired through auction. For this purpose, 900MHz band and 1800MHz band would be treated as the same band. The companies/licensees whose licenses were to be quashed as per the directions of the Hon'ble Supreme Court (New Entrant) would need to re-offer the network to the TERM cells for testing compliance of roll-out obligations in case the network has been already established.

2.40 These provisions in the NIA raise the following issues:

i) In the category of 'New Entrant', there will be TSPs whose licenses were quashed but are successful in acquiring spectrum again. These TSPs will have to re-offer their network to TERM cell for compliance of roll-out obligations even if such TSPs had met the compliance conditions before their licenses were quashed. As these TSPs did not stop providing service in the LSAs where they opted to bid for spectrum and had already fulfilled the roll-out obligations, requiring them to go back to TERM cells to recheck for compliance will only result in bureaucratic delay and additional costs to such TSP.

ii) In the category of 'Existing Licensees' are those TSPs who are operating since pre-2006. These TSPs have already fulfilled their roll-out obligations as prescribed in the License agreement and are holding spectrum ranging from 4.4MHz to 10 MHz, which was assigned to them administratively without any additional roll-out obligations. Of these TSPs, some might acquire additional spectrum (say 1 or 2 blocks) primarily for capacity enhancement. Therefore, would the imposition of additional roll-out obligations only on such TSPs pass the test of maintaining a level-playing field?

2.41 In its recommendations of May 2010, the Authority had examined the issue of coverage of the rural areas and had recommended revised roll-out criteria for **all** the TSPs.

2.42 In this context, the stakeholders are requested to comment on the following questions:

Q.5. Should roll-out obligations for new/existing/renewal/quashed licenses be different? Please give justification in support of your answer.

Q.6. Is there a need to prescribe additional roll-out obligations for a TSP who acquires spectrum in the auction even if it has already fulfilled the prescribed roll-out obligations earlier?

Liberalised Spectrum

2.43 In its recommendations of 'Auction of Spectrum' dated 23rd April 2012, the Authority opined that technology is evolving constantly and the pace of technological progress is such that artificial restrictions may not prove effective in the long run. Restrictions would also mean sub-optimal utilisation of available spectrum leading to lower productivity and higher costs to society. Accordingly, 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.

2.44 The Government accepted TRAI's recommendations and provisions were incorporated in the NIA dated 30th January 2013 for "Auction of Spectrum in 1800MHz, 900MHz and 800MHz Bands". As per NIA, there are no restrictions on the technology to be adopted for providing services within the scope of the service license using spectrum blocks allotted through this auction. It is also mentioned in the NIA that existing Licensees will be allowed to use the additional spectrum

block(s) allotted through this 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. Existing CMTS/ UAS/ UL (AS) licensees can liberalise their existing spectrum holding in 1800MHz band after payment of auction determined price.

2.45 An existing TSP who acquires spectrum in the 900/1800 MHz bands in the auction will have both liberalised and un-liberalised spectrum. However, it can use the spectrum in the liberalised form only if it pays the market determined price for its entire holding of un-liberalised spectrum. Moreover, clarity is needed on which auction determined price i.e. November 2012 auction price or up-coming auction price will be considered the market determined price for converting the existing spectrum holdings into liberalised spectrum.

2.46 Accordingly, Stakeholders are requested to comment on the following:

Q.7. What should be the framework for conversion of existing spectrum holdings into liberalised spectrum?

Spectrum Trading

2.47 Another issue which will have a bearing on the valuation of spectrum in the proposed auction is whether the spectrum won in the auction would be allowed to be traded in future. Spectrum trading is a mechanism whereby rights and any associated obligations to use spectrum can be transferred by one party to another by way of a market-based exchange for a certain price.

2.48 On the issue of spectrum trading, the Authority in its recommendations of May 2010, had observed that "*In countries where spectrum trading is permitted, the spectrum is normally assigned through market*

mechanism, i.e. auction. However, in India, the 2G spectrum till date 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. Now, to allow them to trade the scarce spectrum at a premium would not be proper. Regarding spectrum for 3G and BWA services, though the spectrum will be given through the auction process, but presently, the amount of spectrum available is limited and there is a restriction that no licensee can acquire more than one block of spectrum either in auction or subsequently through M&A. As such allowing trading in these bands will be premature and may not be of any benefit to the industry."

2.49 In 2012, the Central Government in 2012 decided that "Spectrum trading will not be allowed in India, at this stage. This will be re-examined at a later date. (Press statement dated 15.2.2012)."

2.50 In its recommendations of April 2012, the Authority revisited this issue and observed that "the *Authority is conscious of the fact that from now on all the spectrum should be given through auction process. Therefore, the reservation expressed earlier that as the licensees have not competed in the open market to buy the spectrum, to allow them to trade the scarce spectrum would not be proper, would no longer hold good. This will be the first time that the spectrum in 800/900 and 1800 MHz bands is being put to auction in recent years and a substantial portion of these bands has been already allocated through administrative process, therefore, the Authority is of the opinion that it is still pre-mature to allow spectrum trading and this issue may be may be taken up at a later date."*

2.51 However, for the limited purpose of frequency configuration (arranging spectrum in a contiguous band), the Authority recommended allowing Spectrum trading between spectrum holders having obtained spectrum

through auction or having paid the auction determined price for the spectrum held by them.

2.52 Accordingly, the NIA of March 2013 auction had a provision that "Frequency reconfiguration i.e. rearrangement of spot frequencies in the same band, from within the assignments made to the licensees, may be carried out, with the authorization of WPC Wing, among the licensees, only when the entire spectrum held by them is liberalized. No charges will be levied for rearrangement of frequency spots".

2.53 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.

2.54 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.

2.55 In view of the forgoing, stakeholders are requested to comment on the following:

Q.8. Is it right time to permit spectrum trading in India? If yes, what should be the legal, regulatory and technical framework required for trading?

CHAPTER-III

THE VALUATION OF SPECTRUM

3.1 With growth in telecommunication services, spectrum has become an increasingly valuable natural resource. Developing naturally competitive markets for spectrum allocation is not feasible owing to its limited availability and also its possession by a single entity, the Government. Pricing of spectrum through auctions leads to efficiency in allocation, as spectrum is sold to those who value it the most.

3.2 The factors that determine the market valuation and price of spectrum are discussed below.

On the Demand Side

3.3 The demand for spectrum is not a direct one like for most commodities. It is telecom consumers who, through their demand for telecommunication services, create a demand for spectrum. Hence, the demand for spectrum is a derived demand. The derived demand for a good or a service is the demand for it due to its use in the production of another good for which a market exists. In this case the demand for spectrum arises from its use in the telecommunications sector for producing telecom services and measuring the demand for telecom services is possible using tangible market variables and macroeconomic conditions in the country. The greater the demand for telecom services, the greater will be the demand for spectrum from the TSPs.

3.4 The demand for telecom services is influenced by variables like prevailing tele-density, GDP growth rate, unemployment rate, inflation rate, investments in infrastructure, 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 economic 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 the 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 an increase in demand for tele-services in this region.

3.5 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 always 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 the previous 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 falling, the TSP will not find it profitable to increase operations in the LSA and will not demand the spectrum. The TSPs' willingness and ability to pay are important determinants of demand for spectrum.

On the Supply Side

3.6 Spectrum is a limited natural resource. 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 lesser 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.

3.7 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.

Reaching an equilibrium

3.8 Conditions of high demand coupled with the inelastic supply of spectrum lead to market situations where high spectrum prices become inevitable. The demand side dynamics are largely market determined and vary with changing macroeconomic conditions in the country; in short, these are autonomously and exogenously determined. However the supply of spectrum is controlled and that too exclusively by the Government (i.e. the Licensor). Clearly, increasing the amount of spectrum for auction can alter equilibrium price to a great extent.

Approach to Valuation of Spectrum and Reserve Price Determination in Earlier Exercise in 2012

3.9 In the recommendations on auction of spectrum dated 23rd April, 2012, the Authority used the prices discovered in the 3G auction as the anchor price to determine the reserve price for spectrum in the liberalised 1800 MHz band. This was based on the argument that the 1800 MHz band was being used to provide Long Term Evolution (LTE) services in a number of countries and therefore, the valuation of the liberalised 1800 MHz spectrum should be close to that of spectrum auctioned for LTE deployment in 2010.

3.10 The auction for 3G spectrum was held in 2010. It was mentioned in the NIA document for auction of 3G and BWA spectrum released on 25th February, 2010 that if a further round of auction of 3G or BWA spectrum takes place within 12 months of the date of completion of the current round, the reserve price in such an auction would be the same as the successful bid amount in the current round of auction for the respective service area. In May 2012, therefore, the 3G prices were around two years old. The 3G auction prices per MHz for different service areas were therefore indexed for one year using State Bank of India (SBI) average Prime Lending Rate (PLR) rate of 12.63%.

3.11 The spectrum which was auctioned in 2010 was in the 2100 MHz band. While determining the valuation and reserve price of 1800 MHz band on the basis of the price realized in the 2100 MHz band, the relative efficiency of the 1800 MHz band vis-à-vis the 2100 MHz band was considered. It was taken into account that the number of base stations required for coverage of the same area is 1.3 times less in the UMTS 1800 as compared to UMTS 2100. The data on cell sizes and range for various spectrum bands for UMTS system was obtained from a report prepared by the Consultant Vilicom Limited for ComReg, the Ireland operator. As per this data the cell range in suburban areas that can be

achieved in the case of 1800 MHz band is around 1.2 times more than the cell range in the 2100 MHz band and the cost of deployment of UMTS 1800 network is about 88.5% of the cost of deploying UMTS 2100 network. On this basis, it was held that the 1800 MHz band could be taken as 1.2 times more efficient than the 2100 MHz band.

3.12 As regards the setting of the reserve or the minimum price vis-à-vis the market valuation, based on a report of Economic Consultant DotEcon for ComReg, the Authority took the view that it would be appropriate to set minimum prices reflecting market value, subject, of course, to the level of uncertainty about the estimate of market value itself. If the risk of exceeding market value is perceived as low, the closer the chosen reserve price is to market value, the less incentives bidders have to act strategically within the auction. A study of various auctions held globally in the last 3-4 years revealed that reserve prices were generally about 0.5 times the final price. However, in the context of the Indian telecom sector where the demand for spectrum was expected to be considerably higher, the Authority decided to use a scale factor of 0.8 while arriving at the reserve price based on the market valuation.

3.13 To sum up, the recommended reserve price for 1800 MHz spectrum (say 'A') was set as equal to the realised price per MHz for 2100 MHz spectrum 'B' indexed for 1 year using SBI average PLR rate of 12.63% multiplied by the scale of efficiency between 1800 MHz vs 2100 MHz spectrum i.e.1.2 multiplied by the scale factor of reserve price with reference to the value of spectrum i.e. 0.8 or,

A= B*(1+0.1263)*1.2*0.8

3.14 The pan-India realized price per MHz for 2100 MHz spectrum was Rs. 3350 crore. Using the above formula, the pan-India reserve price per MHz for 1800 MHz spectrum band was worked out as below:

Pan-India reserve price per MHz for 1800 MHz spectrum band

= Rs. 3350 crore *(1+0.1263)*1.2*0.8

= Rs. 3622.2 crore

3.15 The Authority also recognized that the auction mechanism throws up different prices for different regions. Since the reserve prices were based on the prices realized for 3G spectrum in 2010 and these prices ranged from Rs.6.06 crores per MHz in J&K to Rs.663.39 crores in Delhi, the reserve price for the 1800 MHz spectrum also suitably reflected inter-regional variation, although the total added up to a pan- India price per MHz of Rs 3622 crores.

3.16 The Authority also discussed the setting of reserve price for spectrum in the sub-1 GHz band. Spectrum in the sub-1GHz band is more efficient in terms of propagation characteristics as compared to spectrum in the 2100 MHz and higher frequency bands. In terms of impact of frequency on base station density, it was noted that the number of base stations required for coverage of the same area is approximately 2.1 times less in UMTS 900 as compared to UMTS 2100. Similarly, relative CAPEX for network infrastructure investment in 2100 MHz spectrum band is approximately 2 times more when compared to the sub- 1 GHz band.

3.17 Reports of technical consultants put the cost of deployment of a UMTS 900 network, variously at between 60-65% of the cost of deploying a UMTS 2100 network, and the relative value of spectrum of 1800 MHz as compared to and sub 1 GHz, in the range of 45-60%. The Authority on this basis concluded that the reserve price (RP) in 800 and 900 MHz bands (liberalised) should at least be 2 times that of the 1800 MHz band (liberalised) i.e.

$RP_{900/800} = 2 * RP_{1800}$

Using 3G prices as the base for valuation

3.18 As discussed earlier, the prices realised in the 3G auction of 2010 were taken to be the base on which valuation and reserve prices of spectrum in the 1800 MHz band had been worked out by the Authority in the recommendations of April 2012. 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 auctions for spectrum in November 2012 did not find any bidder for the 800 MHz band. (This was in spite of the fact that the reserve price of the 800 MHz band (unliberalised) was revised to 1.3 times the reserve price for 1800 MHz spectrum). For 1800 MHz band, spectrum in service areas of Delhi, Karnataka, Mumbai and Rajasthan failed to find any bidder. Other than the LSA of Bihar, spectrum in all service areas was sold at the reserve price. As a result, the Government decided to reduce the reserve price for 1800 MHz in the four LSAs where no sale of spectrum took place by 30 percent. In all cases the reserve price of 900 MHz was to be twice the price of 1800 MHz, either reworked or discovered through the auction. Further, the reserve price for 800 MHz band in all service areas was reduced by 50 percent in January 2013. In the ensuing auction, spectrum in this band was sold in eight LSAs at the reserve price.

3.19 The issue for consideration is whether we should persist with the approach of valuing spectrum and calculating reserve prices on the basis of prices realised in the 3G auction. Using past auction prices in fixing 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 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.

3.20 The 3G spectrum sold in the auction of 2010 was seen as catering to the provision of data services such as video services and other data packet services. This was significantly different from the voice-dominated services provided on 900, 1800 or 800 MHz spectrum. 3G services have a different eco-system, growth profile and even subscriber base as compared to 2G services. From this point of view, even assuming similar market conditions in 2012-13 as compared to 2010, the 900, 1800 or 800 MHz spectrum could not, prima facie, have had a relative value *in 2012-13*, similar to the 3G band. In 2012-13, therefore, comparing the 3G band and 900, 1800 or 800 MHz was akin to comparing apples and oranges. Of course, the liberalisation of use could have helped to realize the potential value in the 900, 1800 or 800 MHz bands, if market expectations had been positive. However, this did not happen.

3.21 There were a large number of applicants when licences were issued in 2008. This suggested that there were enough new operators ready to enter the market at the 2001 spectrum prices. The trend of aggressive demand continued in the 3G spectrum auction of 2010 leading to price discovery at much higher levels than anticipated. The allocation of licences to new entrants in 2008 may also have created a sense of scarcity and resulted in a rush for the additional spectrum. Instances of irrational exuberance on the part of the bidders are not unknown in spectrum auctions around the world. In any auction, there is the possibility of the "winner's curse" afflicting the successful bidder who ends up paying "too much". In the Czech Republic, a recent auction in the 800 MHz, 1800 MHz and 2600 MHz band (March 2013) had to be cancelled midway by the regulator when the bids became economically unrealistic on all models of feasibility.

3.22 The situation in India, however, changed markedly in the auctions held in November 2012 and March 2013; spectrum was not at all sold in some

LSAs and only partially sold in a number of LSAs. The reduced demand for spectrum has to be seen in at least two contexts namely, (a) the deteriorating financial performance and overall financial position of the sector, and, (b) the general slowdown in the economy over the last few years.

3.23 The profitability- Earnings Before Interest Tax Depreciation and Amortization (EBITDA) & Profit Before Interest and Tax (PBIT) -and debt position (long term & short term) of telecom access service companies for the period 2007-08 and 2011-12 based on their annual financial reports are as under:

TABLE 3.1

(Rs. in cr.)	2007-08	2008-09	2009-10	2010-11	2011-12
EBITDA	43030	39328	28264	22192	15217
PBIT	20886	17036	1754	-6926	-17499
Total Loans	74737	112210	110940	173095	182938
Long Term Loan	39419	67390	63667	87985	124843
Short Term Loan	35318	44820	47273	85110	58095

3.24 The following charts plot the clearly deteriorating trends in these parameters:

CHART 3.1

Trends in PBIT and EBITDA

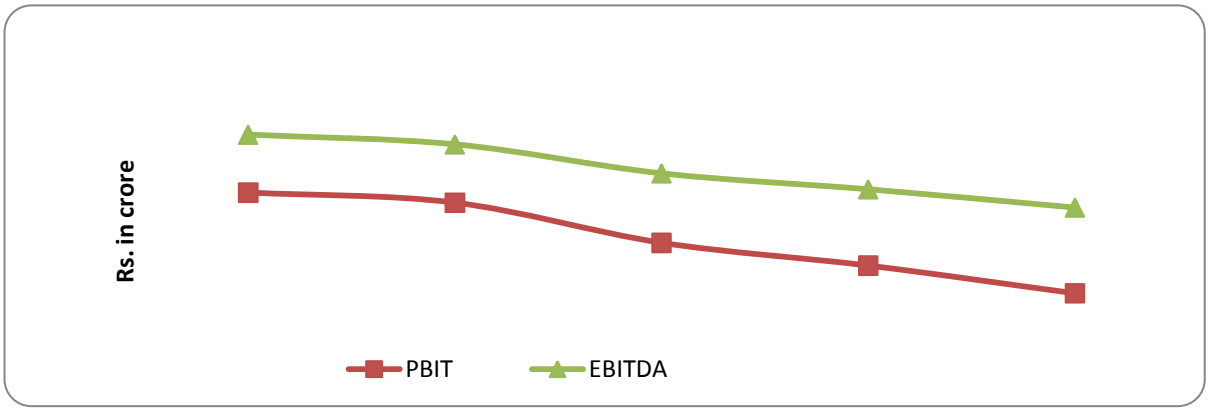
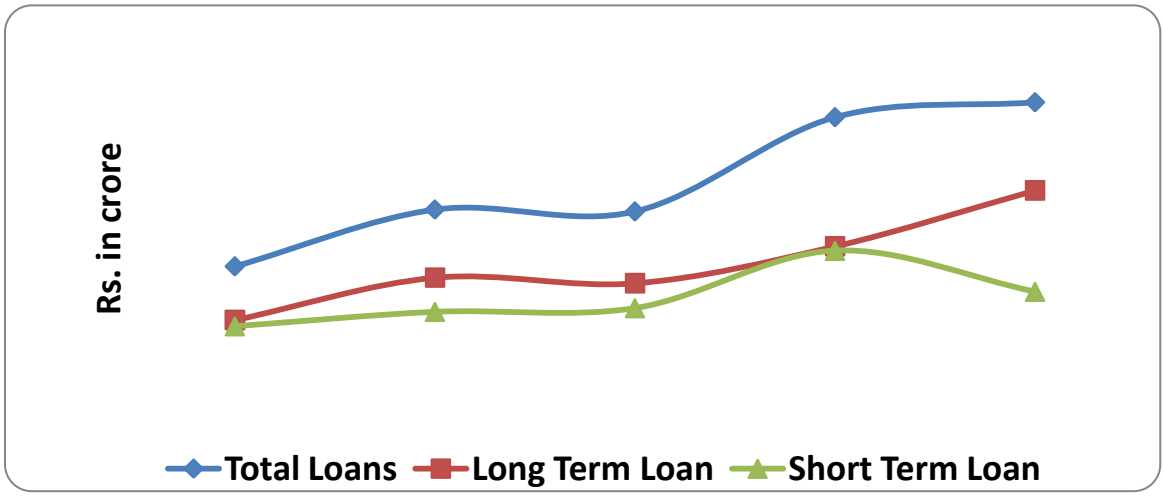


CHART 3.2

Debt Position



3.25 What is the position with regard to growth in the telecom sector in terms of subscribers, revenue and usage of network? The number of subscribers has increased substantially since 2010, from 584.32 million in Quarter Ending (QE) March 2010 to a peak of 934.09 million in QE June 2012 and then declining to 864.72 million in QE December 2012. The declining trend has continued into the first four months of 2013.

3.26 The Minutes of Usage (MOU)[10] per subscriber per month, another important variable for measuring growth of usage of network, has declined overall from 410 in QE March 2010 to 331 in QE September 2011 and then increased to 359 in QE December 2012. However it has decreased by more than 12% in the period in the GSM network. There is an even more pronounced decrease in the case of CDMA where MOU has fallen from 307 in QE March 2010 to 230 in QE December 2012.

3.27 The Average Revenue per User (ARPU)[11] per month has declined from Rs.131 in QE March 2010 to Rs. 98 in QE December 2012 for GSM. This

[10] MOU per subscriber per month = Total Minutes of Usage in a month /Total subscribers

[11] ARPU per month = Total Revenue in a month/ Total Subscribers

decline of 25% in the ARPU over three years has had an arresting impact on the rate of growth of revenue of the TSPs.

3.28 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%[12]. Sectors like trade, hotels, transport and communication in particular saw a slump in growth rate from 11.6 % in the fourth quarter of 2010-11 to 7% for the same period in 2011-12[13]. 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 rupee has depreciated 7-10% in just 8 weeks. And, global economic prospects are not cheerful. In the US, economic recovery is slow; Europe's economy is expected to 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.

3.29 The valuation of spectrum and determination of reserve price ought to reflect the demand for spectrum in the industry. The demand for spectrum as discussed earlier, is a derived demand. Therefore, all variables that impact the demand for spectrum including growth in the

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Note: The MOU and ARPU are inversely related to total subscribers, other things i.e. Total Minutes of Usage in a month and Total Revenue in a month remaining the same.

[12] Source: CSO

[13] Source: http://www.ibtimes.co.in/articles/347226/20120532/india-q4-economic-growth-disappointing-nine-low.htm

telecommunications services and general economic conditions must be factored into the calculations. From that point of view, substantial qualification would be required before the prices of spectrum from the 3G auction held in 2010 could be used as a base for valuation of spectrum in the current exercise.

Q.9. 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?

LSA-wise approach versus Pan-India approach

3.30 With a pan–India approach or a top-down approach, the valuation of spectrum and the 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[14]. 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. On the basis of a minimum expected realization from the sale of 3G spectrum, a pan-India reserve price for 2x5 MHz of spectrum in the 2.1 GHz band of Rs 1000-1100 crores was determined and then, based on the number of mobile subscribers in the different categories of LSAs –Metro/ Category A, Category B and Category C- reserve prices of Rs 80 crores for Mumbai, Delhi and Category A LSAs, Rs 40 crores for Chennai, Kolkata and Category B LSAs and Rs 15 crores for Category C LSAs were recommended.

[14] The value of spectrum on pan-India basis ($P^{\wedge}$) = Sum of the values of spectrum for each LSA i.e. $P^{\wedge} = P_1+P_2+\ldots.P_{22}$

3.31 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[15] In this case, relative prices for different LSAs are not decided a priori on any pre-determined 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 service areas. These circles are further categorized into four groups: Metro (3 LSAs), A (5 LSAs), B (8 LSAs) and C (6 LSAs). The hierarchy is ordered in terms of "profitability" or "revenue potential" i.e. a priori, a 'Metro' LSA has a much higher revenue potential, than a 'C' category LSA. Moreover, 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. The financial results for each LSA are separately compiled by TRAI and show wide diversity in terms of profitability. Sample figures of Adjusted Gross Revenue (AGR), ARPU, Average Cost Per User(ACPU) and EBITDA margin of each LSA for the year 2011-12 are given below by way of illustration:

TABLE 3.2
Wireless Service
(ASR 2011-12)

LSA Name	LSA Category	AGR (Rs. crore)	ARPU (Rs)	ACPU (Rs)	EBITDA Margin (%)
Delhi	Metro	5789.80	116.54	128.03	17.62%
Kolkata	Metro	2208.75	79.68	108.36	-6.01%
Mumbai	Metro	5281.60	132.17	186.48	-7.45%

[15] The sum of the values of spectrum for each LSA i.e. (P_1+P_2+….P_{22}) = The value of spectrum on pan-India basis (P*)

AP	A	8355.08	106.14	106.53	21.38%
Gujarat	A	5392.45	85.59	101.18	5.40%
Karnataka	A	6575.49	100.91	119.13	8.70%
MH	A	7764.16	93.23	100.06	16.91%
TN	A	8809.95	97.89	110.94	14.60%
Haryana	B	1776.44	70.49	94.85	-9.46%
Kerala	B	4380.08	112.66	115.80	16.30%
MP	B	4492.18	72.13	88.17	0.34%
Punjab	B	3429.05	93.08	103.82	11.96%
Raj	B	4787.33	81.58	88.40	12.22%
UP(E)	B	6579.80	73.70	81.02	8.98%
UP(W)	B	4431.50	72.41	94.37	-4.99%
WB	B	3369.84	64.26	81.48	-3.17%
Assam	C	1915.69	111.64	127.09	7.59%
Bihar	C	5060.86	68.13	85.43	-2.46%
HP	C	642.85	71.43	85.56	8.50%
J&K	C	1089.21	137.53	171.33	3.34%
NE	C	1157.29	109.59	116.08	16.65%
Orissa	C	2133.65	69.45	94.27	-8.55%

ARPU: Average revenue per subscriber per month
ACPU : Average total cost per subscriber per month
EBITDA Margin: EBITDA/Revenue

3.33 The data above show that each LSA represents a unique business case. Attempting to work out a pan-India approach to spectrum valuation would therefore be both difficult and fraught with the risk of error. An LSA-level approach to valuation of spectrum can factor in special characteristics of the market in each LSA.

3.34 The sale of spectrum is done LSA-wise. In addition, since the licenses are granted by LSA, TSPs have the freedom to take license(s) for operation in one LSA, or operation in more than one LSA, or for pan-India operations.

3.35 For the above reasons, the valuation of spectrum and the reserve price could be undertaken as an independent exercise for each LSA. Not only would the values be different, the approach to valuation as well as the fixing of reserve prices may differ. This may be more appropriate than arriving at a pan-India value first and then working backwards to fix values across LSAs. And, in any case, by adding the individual valuations of all the 22 LSAs, one can always compute the pan-India value of spectrum.

Q.10. Should the value of spectrum for individual LSA be derived in a top-down manner starting with pan-India valuation or should valuation of spectrum for each LSA be done individually?

Alternative Approaches to the Valuation of Spectrum in the 1800 MHz band

3.36 There can be several alternative ways of determining the value of spectrum in the 1800 MHz band. To arrive at such estimates for the 1800 MHz band, the following approaches can be used:

1. Prices from past auctions appropriately indexed

3.37 The latest spectrum auctions in 1800 MHz took place in November 2012 for all 22 LSAs and in March 2013 for four LSAs (i.e. Delhi, Mumbai, Karnataka and Rajasthan). For these four areas, no bids were received either in November 2012 or in March 2013. For the remaining LSAs, bids were received in the November 2012 auction.

Indexation of year 2001 price

3.38 Prior to the November 2012 and March 2013 auctions, the last available market determined price in the 1800 MHz band is from the spectrum allocation that took place in 2001. The entry fee received by DoT in 2001

for 6.2 MHz[16] of 1800 MHz spectrum for a pan-India licence was Rs.1658.5 crore. To estimate the present value of the entry fee received in 2001, the latter can be indexed using the Income Tax Cost Inflation Index, the Average SBI PLR, or the Weighted Average Cost of Capital.

Indexation based on Cost Inflation Index as per Income Tax Act

3.39 The Cost Inflation Index (CII) is a measure of inflation that finds application in tax law, when computing long-term capital gains on the sale of assets. Section 48 of the Income-Tax Act defines the CII. The CII is notified by the Government every year. The CII can also be used to compute the indexed present value of assets purchased in the past. The year-wise CII can be applied to compute the present indexed value of the entry fee received by DoT in 2001 for different LSAs.

Indexation based on Prime Lending Rate (PLR)

3.40 The Prime Lending Rate (PLR) is a term used in many countries for a reference interest rate used by banks. PLR is used as a guide for computing interest rates for most of other categories of borrowers which are offered at discount or premium to PLR. The State Bank of India (SBI) annual PLR over a period of 11 years (2002-03 to 2012-13 - weighted average PLR for the years in which PLR varied over the course of the year) can be applied to calculate the present indexed value of the entry fee received in 2001 for different LSAs.

Indexation based on Weighted Average Cost of Capital

3.41 The Weighted Average Cost of Capital (WACC) indicates the rate of return that an entity needs to earn to reward its investors. The Authority has also used WACC (pre-tax) of 15% as return on capital employed for tariff fixation in other regulatory exercises. A 15% return on capital employed

[16] Assumed in line with the Recommendations of TRAI on "Spectrum Management and licensing Framework" issued on 11th May, 2010

can also be applied to compute the present indexed value of entry fee received by DoT in 2001 for different LSAs.

3.42 Based on the above three methods, the price per MHz realised in 2001 has been indexed for the year 2013 and tabulated below. The sale price of spectrum in November 2012 in 18 licence service areas is also indicated for comparison. As can be seen, the sale price in 2012 is has been higher in all the cases than the indexed price of 2001, barring the sole instance of Punjab. In four LSAs, as stated earlier, spectrum was not sold either in November 2012 or in March 2013.

TABLE 3.3 (Rs. in crore)

		2001 Price		**Valuation per MHz after Indexation based on 2001 spectrum price**			**Sale Price per MHz Nov 2012**	**% change over 2001 price of Sale Price per MHz Nov 2012***
	Name of Circle	**Entry fee 2001 for 6.2 MHz**	**Entry fee 2001 per MHz**	**Cost Inflation Index**	**SBI PLR**	**WACC**		
1	AP	102.98	16.61	33.22	57.69	77.28	229.53	1282%
2	Assam	5.02	0.81	1.62	2.81	3.77	6.93	756%
3	Bihar	9.98	1.61	3.22	5.59	7.49	37.14	2207%
4	Delhi	170.69	27.53	55.06	95.61	128.08	-	-
5	Gujarat	109.00	17.58	35.16	61.05	81.79	179.87	923%
6	Haryana	21.45	3.46	6.92	12.02	16.10	37.21	975%
7	HP	1.12	0.18	0.36	0.63	0.84	6.22	3356%
8	J & K	1.98	0.32	0.64	1.11	1.49	5.06	1481%
9	Karnataka	206.83	33.36	66.72	115.86	155.20	-	-
10	Kerala	40.55	6.54	13.08	22.71	30.43	52.24	699%
11	Kolkata	78.00	12.58	25.16	43.69	58.53	90.98	623%
12	MP	17.42	2.81	5.62	9.76	13.07	43.19	1437%
13	Maharashtra	188.98	30.48	60.96	105.86	141.80	210.25	590%
14	Mumbai	203.67	32.85	65.70	114.09	152.83	-	-
15	North East	1.98	0.32	0.64	1.11	1.49	7.07	2109%

16	Orissa	5.02	0.81	1.62	2.81	3.77	16.22	1902%
17	Punjab	151.78	24.48	48.96	85.02	113.89	53.82	120%
18	Rajasthan	32.24	5.20	10.40	18.06	24.19	-	-
19	TN (incl. Chennai)	233.00	37.58	75.16	130.51	174.84	244.87	552%
20	UP (East)	45.26	7.30	14.60	25.35	33.96	60.94	735%
21	UP (West)	30.57	4.93	9.86	17.12	22.94	85.93	1643%
22	West Bengal	0.99	0.16	0.32	0.56	0.74	20.67	12819%
	Total	**1658.50**	**267.50**	**535.00**	**929.01**	**1244.51**	**-**	**-**

** as against % change in Cost inflation Index over 2001 prices of100%, in SBI PLR of 247% and in WACC of 365%*

3.43 It is necessary, however, to sound a note of caution. Prices in 2001 would be reflective of demand conditions and economic prospects at that point of time viz. about 12 years ago. The telecom sector as well as the economy has undergone major changes since then. In a world of rapid economic change, a decade is a very long time. 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. All in all, these various developments raise the question whether merely indexing the prices of 2001 is really reflective of all the changes that have occurred in the intervening period. Indexing may be good for measuring valuations over a shorter time period, not over a long-haul.

Q.11. Is indexation of 2001 prices of 1800 MHz spectrum an appropriate method for valuing spectrum in 2013? If yes, what is the indexation factor that should be used?

2. Estimation of Valuation in four unsold areas based on sale price in 18 areas

3.44 For the 4 LSAs (Delhi, Mumbai, Karnataka and Rajasthan) in which spectrum could not be sold in the auction held in November 2012/March 2013, one reason for failure of the auction cited by TSPs was the high reserve price. An attempt can be made to estimate the value (per MHz) of spectrum in the 1800 MHz band in the four LSAs (Delhi, Mumbai, Karnataka and Rajasthan) for which no bids were received in the auction held in November 2012 and March 2013, by correlating the sale prices realised in the remaining 18 LSAs with other relevant variables. The exercise can be done using a single explanatory variable for representative LSAs or through multiple variable regression.

Data Source and Variables

3.45 Data on achieved prices (per MHz, 1800 band) for 18 circles on Nov 2012 can be used for this analysis. The data on relevant variables used in estimating the value of spectrum can be gathered from various sources. Variables which could have an impact on the price of spectrum are listed below:

- AGR (Wireless): 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.
- Mobile subscribers: It represents the part of the population having mobile connections.
- Existing Tele-density: It indicates the percentage of population having mobile telecom connectivity. Existing Tele-density = Number of mobile cellular subscribers per 100 persons.
- Residual Tele-density: It is the difference between an assumed maximum tele-density and the existing tele-density and 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%).

- Potential subscribers: It can be taken as an indicator of the potential mobile traffic in that circle, calculated by multiplying residual tele-density by the population.
- Minutes of usage: It indicates the volume of traffic in the market.
- Herfindahl Hirschman Index (HHI index): It is a measure of concentration calculated on market share in terms of (i) Adjusted Gross Revenue (AGR) and (ii) total Minutes of Usage (MoU). These are indicators of competition in the market.
- Existing Allocation of Spectrum: It indicates the existing allocation of spectrum in various bands (800/900/1800/2100).
- Population (in crore): 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.
- Urban population or percentage of urban population: It indicates the level of growth or development.
- Growth rate of Gross Domestic Product across LSAs for the year 2012-2013: It is the rate at which a particular LSA is growing in terms of GDP which again is an indicator of the potential for growth of the industry.
- Per capita income (at constant prices 2004-05): A higher per capita income is an indication of a higher propensity to spend and a better standard of living.

2(a) Estimating the value of spectrum by correlating the sale prices achieved in similar LSAs with known relevant variables

3.46 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 class and some other relevant

variable e.g. 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 different variables- AGR, ARPU, RPM, existing tele-density and residual tele-density - in separate iterations are as below. The reserve prices fixed for these circles in the March 2013 auction are indicated alongside for comparison:

TABLE 3.4

(Rs. in crore)

LSA	Cat.	Value per MHz based on					Reserve Price per MHz (March 2013)
		AGR	ARPU	RPM	Existing Tele-density	Residual Tele-density	
Delhi	Metro	181.8	250.7	219.7	321.9	106.4	388.1
Mumbai	Metro	182.0	311.9	292.9	320.8	108.2	379.9
Karnataka	A	191.1	201.1	186.4	169.5	194.5	184.9
Rajasthan	B	56.67	51.3	53.7	48.0	50.1	37.6

2(b) Estimating the value of spectrum using multiple regression analysis

3.47 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.

3.48 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 realised prices for spectrum in November 2012 for the LSAs where the operators participated in the auction.

3.49 The underlying model is as follows:

$$\mathbf{Yi = \alpha + \beta 1\ X_{1i} + \beta 2\ X_{2i} + ...+ \beta 3\ X_{ki} + \varepsilon_i}$$

Where,

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

X_1, X_2,.....,Xk = the possible independent variables (as explained earlier);

α= the intercept term;

β1, β_2..... βk= coefficients for the explanatory variables X_1, X_2,....., X_k;

and, εi is the error term.

3.50 We can fit a multiple regression model 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:

3.51 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 3.5

Cat.	LSA	Value per MHz (Rs. in crore)					
		Variables AGR, Population, Residual Tele-density	Variables AGR, Potential subscribers, Population, GDP growth rate	Variables MoU, Residual Tele-density, Population and GDP growth rate	Variables MoU, Residual Tele-density, Population	Variables AGR per MHz, Residual Tele-density, Population	Variables AGR, Existing, Tele-density
M	Delhi	193	221	224	186	166	214
M	Mumbai	203	224	158	131	197	214
A	Karnataka	180	157	172	192	143	153
B	Rajasthan	100	103	105	89	134	93

3.52 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 80% in each combination of variables. In addition, the coefficient estimates in the regression are statistically significant (at 10% level of significance). It appears, therefore, that the explanatory variables used have a significant relationship with the value of spectrum.

3.53 The results of the analyses in 2(a) and 2(b) above give a broad idea of how the value of spectrum could be estimated from empirical data that has emerged from the auctions of 2012-13. However, the approach has its limitations. It does not capture the effect of technological changes,

market expectations, unique characteristics of specific LSAs e.g. non-availability of continuous spectrum as in Rajasthan LSA etc., all of which could affect the valuation.

Q.12. 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?

3. Estimating The Value Of Spectrum By Assessing Producer Surplus On Account of Additional Spectrum

3.54 Spectrum may also be valued on the basis of 'Producer Surplus' that arises when additional spectrum is allocated to an existing TSP. As there is an inverse relationship between the quantum of spectrum allocated and the expenditure on the 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.

3.55 Let us consider a TSP offering GSM service having 'x' MHz of spectrum. The TSP has drawn its long term demand model and thereby it has made projections of (i) geographical coverage requirements and (ii) network capacity requirements in each year with 'x' MHz of spectrum available to it. In order to fulfill its requirements of coverage and capacity, the TSP has to make capital expenditure on the network apart from incurring operating expenditure to run the network every year. Accordingly, the TSP has estimated the total expenditure on the network to be incurred in each year during the next 'y' years, which shall be required to fulfill its projected demand.

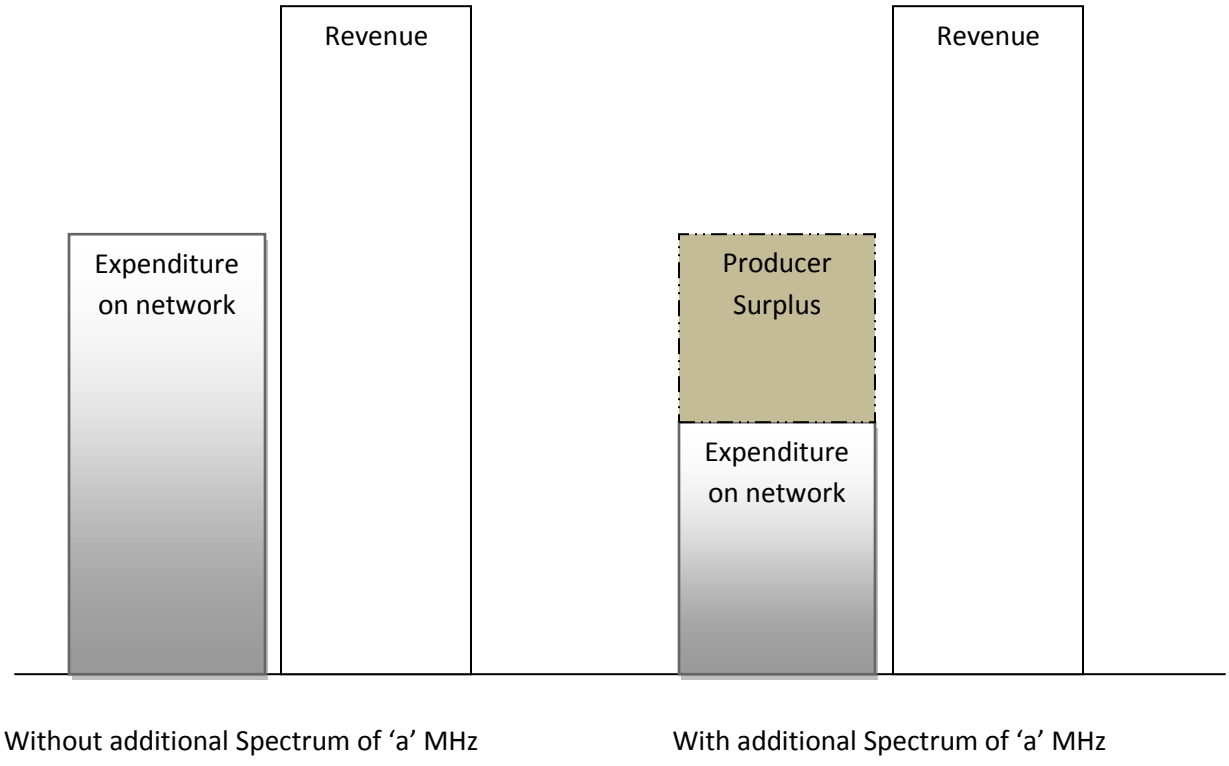
3.56 If the TSP obtains an additional spectrum of 'a' MHz today, the capital expenditure on the network and operating expenditure to run the

network in each year, required to fulfill the same demand, will be lower owing to the inverse relationship between the spectrum available and the expenditure on the network. A working hypothesis could be that the value that the TSP places on the additional spectrum is approximately equal to the cost savings upon its acquisition.

3.57 It would be necessary to estimate the expenditures to be incurred during the next 'y' years for the two cases described above i.e. one with the available spectrum of 'x' MHz and the other with spectrum of 'x+a' MHz on the basis of demand and network expenditures and compute the present value (PV) of the estimated expenditures. The following Figure indicates how the producer surplus would arise:

Figure 3.1

Producer Surplus on Account of Additional Spectrum

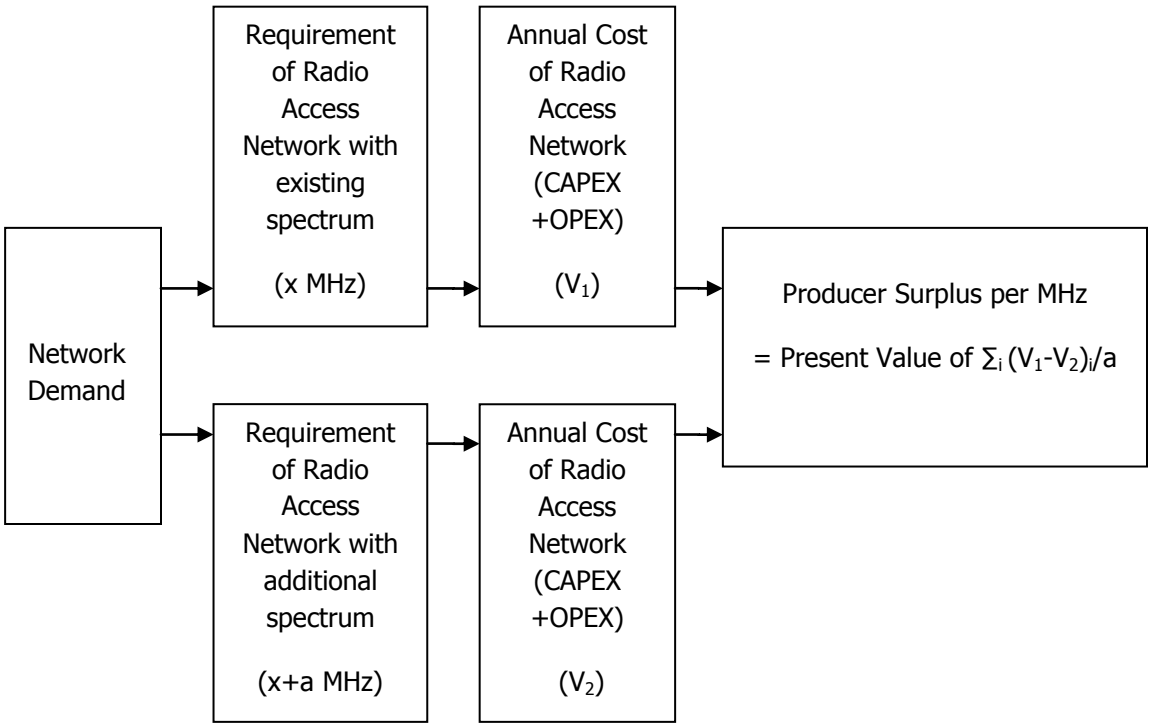


3.58 The producer surplus on account of additional spectrum of 'a' MHz may be estimated as below:

Producer surplus on account of additional spectrum of 'a' MHz
= Present value of the expenditure on the network during the next 'y' years without additional spectrum of 'a' MHz *minus* Present value of the expenditure on the network during the next 'y' years with additional spectrum of 'a' MHz

3.59 A block schematic of the method to estimate producer surplus model is given below:

Figure 3.2
Block Schematic of the Method for Estimating Producer Surplus



3.60 The amount of producer surplus can be estimated by using the industry data of number of subscribers, usage and cost of radio access network available with TRAI.

Q.13. 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 results.

4. Valuation of Spectrum using a Production Function Approach

3.61 An attempt can also be made to derive the value of spectrum (reserve price per MHz for 1800 band) across LSAs by taking spectrum and Base Transceiver Stations (BTS) as two factor inputs to estimate a production function to 'produce' mobile traffic or minutes of usage. This approach was adopted in TRAI's Report of February 2011 on 'The 2010 value of spectrum in the 1800 MHZ band'. (In that Report, subscriber numbers were used as a proxy for minutes of usage).

3.62 The Cobb-Douglas function is a widely used functional form to estimate a production function by estimating the relationship between inputs and output. The production function is specified as follows:

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

3.63 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) No. of BTSs deployed by a service provider (z). The parameters α and β reflect the percentage change in minutes of usage for a percentage change in spectrum and BTS respectively.

3.64 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. 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 and vice versa.

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

$$\mathbf{\ln X = \ln A + \alpha \ln y + \beta \ln z} \quad (2)$$

3.66 A panel dataset for minutes, BTS and amount of spectrum held by established operators across the different categories of circles over the period 2007-2012 can be utilised.

3.67 The condition so as to realise the optimal input mix of both spectrum and BTS is given by:

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

Where, MPy = Marginal Productivity of spectrum

MPz = Marginal Productivity of BTS

Py= the Price of spectrum

Pz = the Price of BTS

3.68 Equation (3) states that, at the optimum, a TSP will allocate expenditure between the two inputs in such a manner that they yield the same marginal productivity per rupee spent.

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

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

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

Now, by making use of the above calculated MPy and MPz the value of spectrum, denoted by Py is derived as follows:

$$Py = \frac{\alpha z}{\beta y} Pz \quad \text{(using 3, 4, 5)}$$

Where, z is the number of BTSs deployed and y is the amount of spectrum allocated. α and β are the estimated coefficients of the production function.

3.69 Thus, using a panel data set of minutes of usage, spectrum allocated and BTS set up in various circles for different operators over the period 2007-2012 (data available with TRAI) the required estimated coefficients can be obtained and then used in the above equation to derive the prices of spectrum i.e. Py (price per MHz) across LSAs.

Q.14. 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 results.

Q.15. 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.

Deriving valuations for 900 MHz and 800 MHz from the valuations for 1800 MHz

Technical efficiency

3.70 The valuation of 800 MHz and 900 MHz spectrum can be determined on the basis of the value of 1800 MHz spectrum, based on greater technical efficiency of the 900 MHz band vis-a-vis the 1800 and 2100 MHz bands. The relative efficiencies of these bands are indicated in the tables below[17]:

TABLE 3.6

Impact of Frequency on base station densities

Base stations per km^2	UMTS 900	UMTS 1800	UMTS 2100
Suburban	0.017	0.027	0.037
Remote/rural	0.008	0.013	0.018

TABLE 3.7

Percentage increase in coverage area[18]

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

3.71 The coverage in 900 MHz is roughly double that in 1800 MHz in a dense urban setting. Thus the reduction in capital and operational expenditure could be as much as 40%. Operations in the 800 MHz band enjoy similar advantages. In the TRAI recommendations of April 2012, the number of base stations required for the coverage of the same area is taken as 1.3 times less in UMTS 1800 as compared to UMTS 2100 and approximately 2.1 times less in UMTS 900 as compared to UMTS 2100. It was also noted that[19] the relative CAPEX required for network

[17] http://www.analysysmason.com/PageFiles/14182/GSM_refarming.pdf
[18] http://www.gsmworld.com/documents/umts900_exec_sum.pdf
[19] http://www.itu.int/ITU-D/tech/events/2011/Broadcasting_Hanoi_May11/Presentations/Hanoi_May11_Session7_Qualcomm.pdf

infrastructure investment in 2100 MHz spectrum band is approximately 2 times more as compared to the sub- 1GHz bands.

3.72 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 follows –

TABLE 3.8

	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

As per the above table, for the suburban areas, the cell range which can be achieved in case of 1800 MHz band is around 1.2 times more than the cell range in 2100 MHz band.

3.73 Ovum in its report "Market Study for UMTS 900- A report to GSMA" has analysed the network cost of a UMTS 900 network v/s that of a UMTS 2100 network for markets in Western Europe, Asia Pacific, Middle East and sub-Saharan Africa. The study found that the cumulative CAPEX cost over a five year period for a UMTS 900 operator would be around 60% that of a UMTS 2.1GHz operator. On the relative value of 1800 MHZ and sub-1GHz spectrum, DotEcon in its report[20] has mentioned that based on the auction data and substantiating with technical studies, the relative value of 1800 MHz and sub-1GHz should range between 45%-60%.

3.74 The conclusion in 2012 was therefore, that the efficiency of the 1800 MHz band can be taken as 1.2 times that of the 2100 MHz band and the efficiency of the 800 and 900 MHz bands as 2 times that of the 1800 MHz band.

[20] A report for ComReg: Award of 800MHz, 900 MHz and 1800 MHz- Fifth Benchmarking Report, March 2012.

Economic Efficiency

3.75 An alternate way of deriving a relative valuation for the 900/ 800 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/ 800 MHz band is substituted for spectrum in the technically less efficient 1800 MHz band. In essence the argument is that the premium a TSP would be willing to pay for a unit of say 900 MHz spectrum, cannot not be greater than the additional CAPEX and OPEX costs that the TSP saves by using that spectrum instead of 1800 MHz spectrum, i.e.

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

3.76 The Authority has already acknowledged in its recommendations dated 23rd April 2012 (Para 3.87 to 3.88) that additional CAPEX is required for operating in the 1800 MHz band, as compared to 900 MHz band, considering the operational efficiency 900 MHz over the 1800 MHz band. The additional costs in the form of infrastructure (CAPEX) and associated operating cost (OPEX) that arise when operations are switched from the 900 MHz band to the 1800 MHz band can be assessed for different LSAs. The actual position of spectrum holding in the 900 and 1800 MHz band varies by LSA and service provider. The following assumptions could be made:

a) Where the service provider holds spectrum only in 900 MHz, all the BTS installed would need to be replaced consequent on a shift to 1800 MHz. Where the service provider holds a mix of spectrum in 900 MHz as well as in 1800 MHz, a proportion of the BTSs would need to be replaced as some BTSs are exclusively for 1800 MHz and some are compatible for both the frequencies.

b) On shift to 1800 MHz from 900 MHz, the number of BTS in rural areas would have to be doubled. In urban areas, requirement of additional BTS would be lower as there is concentration of

population and BTS have already been installed at comparatively close distances to cater to traffic loads.

c) A life of 10 years for BTS can be assumed. After 10 years, fresh investment in BTS will be required.

d) 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. Cash flows have been discounted over 20 years.

3.77 Based on these assumptions, the additional cost per MHz on a shift from 900 MHZ to 1800 MHz for a period of 20 years for representative Metro, A, B, C Category LSAs can be estimated:

TABLE 3.9

(Rs. in crore)

LSA	Category	Approximate additional cost per MHz in 1800 MHz as compared to 900 MHz
Delhi	M	125
Karnataka	A	360
MP*	B	390
Assam	C	170

* includes Chhattisgarh

3.78 The data given above is illustrative and provides an approximate estimation of the premiums the TSPs might be willing to pay for 900 MHz spectrum, over and above the price for 1800 MHz spectrum. It is worth noting that, the relative value is not fixed across the board using a single multiplication factor for all LSAs as in the technical efficiency model. It is individually computed for each LSA. 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. The percentage of rural population in an LSA and the rural area to be covered would therefore have a direct correlation to the premium a TSP might be willing to pay for 900 MHz spectrum. As a corollary, the premium on 900 MHz in Metros is lower as compared to other categories of LSAs.

3.79 At present, the eco-system for the 800 MHz band supports the provision of CDMA based services only. CDMA services however, never really took off in the Indian telecom sector and are characterized by low subscriber base, low revenue and poor ARPUs. These services have been left behind by other emerging technologies, and today, the CDMA technology can be considered to be on the wane in Indian telecom. If however, the 800 MHz spectrum is offered as a liberalised band for E-GSM as discussed in an earlier chapter, the economic principle applied above for 900 MHz band can also be applied for the 800 MHz band.

Q.16. 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?

Scope of the current valuation exercise

3.80 In the auctions for spectrum conducted by DOT in November 2012 and March 2013, the following results were obtained:

TABLE 3.10

Result of 1800 MHz Auction held in November 2012							
Cat	LSA	Reserve Price (1.25 MHz) Rs cr	Reserve Price (per MHz) Rs cr	Blocks put up for sale	Total Blocks sold	Spectrum sold(MHz) = Total Blocks *1.25	Unsold Spectrum (MHz)
M	Delhi	693.06	554.45	8			10.00

M	Mumbai	678.45	542.76	8			10.00
M	Kolkata	113.72	90.98	11	4	5.00	8.75
A	Maharashtra	262.81	210.25	11	5	6.25	7.50
A	Gujarat	224.84	179.87	11	8	10.00	3.75
A	Andhra Pradesh	286.91	229.53	11	4	5.00	8.75
A	Karnataka	330.12	264.09	11			13.75
A	Tamil Nadu	306.09	244.88	11	4	5.00	8.75
B	Kerala	65.30	52.24	11	1	1.25	12.50
B	Punjab	67.28	53.83	11	1	1.25	12.50
B	Haryana	46.52	37.21	11	6	7.50	6.25
B	Uttar Pradesh (W)	107.41	85.93	11	10	12.50	1.25
B	Uttar Pradesh (E)	76.17	60.94	11	9	11.25	2.50
B	Rajasthan	67.08	53.66	11			13.75
B	Madhya Pradesh	53.99	43.19	11	6	7.50	6.25
B	West Bengal	25.84	20.67	11	7	8.75	5.00
C	Himachal Pradesh	7.78	6.22	11	1	1.25	12.50
C	Bihar	42.51	34.01	11	11	13.75	0.00
C	Orissa	20.27	16.22	11	6	7.50	6.25
C	Assam	8.67	6.93	11	7	8.75	5.00
C	North East	8.84	7.07	11	6	7.50	6.25
C	Jammu & Kashmir	6.33	5.06	11	6	7.50	6.25
Total		3500	2800	236	102	127.5	167.5

Result of 800 MHz Auction held in March 2013							
Cat	LSA	Reserve Price of 1.25 MHz (Rs. cr)	Reserve Price per MHz (Rs. cr)	Blocks put up for sale (MHZ)	No. of Blocks sold	Sold spectrum (MHz) = Blocks *1.25	Unsold spectrum (MHz)
M	Delhi	450.49	360.39	3	3	3.75	0.00
M	Mumbai	441.00	352.80	3			3.75
M	Kolkata	73.92	59.14	3	3	3.75	0.00
A	Maharashtra	170.83	136.66	3			3.75
A	Gujarat	146.15	116.92	3	3	3.75	0.00
A	Andhra Pradesh	186.49	149.19	2			2.50

A	Karnataka	214.58	171.66	3	3	3.75	0.00
A	Tamil Nadu	198.96	159.17	3	3	3.75	0.00
B	Kerala	42.45	33.96	3	3	3.75	0.00
B	Punjab	43.73	34.98	3			3.75
B	Haryana	30.24	24.19	2			2.50
B	Uttar Pradesh (W)	69.82	55.86	3	3	3.75	0.00
B	Uttar Pradesh (E)	49.51	39.61	3			3.75
B	Rajasthan		0.00	0			0.00
B	Madhya Pradesh	35.09	28.07	3			3.75
B	West Bengal	16.79	13.43	3	3	3.75	0.00
C	Himachal Pradesh	5.06	4.05	3			3.75
C	Bihar	27.63	22.10	3			3.75
C	Orissa	13.18	10.54	3			3.75
C	Assam	5.63	4.50	3			3.75
C	North East	5.75	4.60	3			3.75
C	Jammu & Kashmir	4.11	3.29	3			3.75
Total		2231	1785.13	61	24	30.00	46.25

Results of 1800 MHz Auction held in March 2013

	Circle	Reserve Price per Block (Rs. cr)	Reserve Price per MHz (Rs. cr)	Blocks put up for sale (MHz)	No. of Blocks sold	Sold spectrum (MHz) = Blocks *1.25	Unsold spectrum (MHz)
M	Delhi	485.14	388.11	12			15.00
M	Mumbai	474.92	379.93	12			15.00
A	Karnataka	231.08	184.86	8			10.00
B	Rajasthan	46.95	37.56	8			10.00

Results of 900 MHz Auction held in March 2013

Cat	Circle	Reserve Price for 1.25 MHz (Rs. cr)	Reserve Price per MHz (Rs. cr)	Blocks put up for sale (MHz)	No. of Blocks sold	Sold spectrum (MHz) = Blocks *1.25	Unsold spectrum (MHz)
M	Delhi	970.29	776.23	12			15.00
M	Mumbai	949.83	759.87	12			15.00
M	Kolkata	227.44	181.95	10			12.50

Note: Spectrum sold at reserve price in all cases except in the case of Bihar LSA (Nov'12) where achieved price was Rs. 37.14 crore per MHz as against reserve price of Rs. 22.10 crore.

3.81 As can be seen, during these two auction exercises held in November 2012 and March 2013 by the DoT, no bids were received for 1800 MHz for Delhi, Mumbai, Karnataka and Rajasthan LSAs and for 900 MHz for Delhi, Mumbai and Kolkata LSAs. Similarly, for 800 MHZ, bids were received for only 8 out of 22 LSAs. In those cases where spectrum was sold, the price achieved was the reserve price except in the case of 1800 MHz in Bihar circle, where the realised price (Rs 37.14 cr per MHz) was higher than the reserve price of Rs 34.01 cr per MHz.

3.82 Table 3.11 presents the status of sale of spectrum in various bands in the auctions held in November 2012 and March 2013.

3.83 The issue that now arises is whether valuation and reserve prices need to be determined only for LSAs in which sale of spectrum did not take place 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 reserve price of the spectrum in each LSA for all the bands mentioned in the above table. On the other hand, one may contend that the reserve price should be determined for only those spectrum bands in each LSA which could not be sold in the auctions held in November 2012 and March 2013.

Table 3.11
Status of Sale of Spectrum in Various Bands in the Auctions held in November 2012 and March 2013

Item	Spectrum Bands		
	800 MHz	**900 MHz**	**1800 MHz**
Total no. of LSAs in which spectrum was put for sale	22	22	22
No. of LSAs in which the spectrum could be sold	8	0	18
No. of LSAs in which the spectrum could NOT be sold	14	22	4

3.84 The issue that now arises is whether valuation and reserve prices need to be determined only for LSAs in which sale of spectrum did not take place 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 reserve price of the spectrum in each LSA for all the bands mentioned in the above table. On the other hand, one may contend that the reserve price should be determined for only those spectrum bands in each LSA which could not be sold in the auctions held in November 2012 and March 2013.

3.85 One view could be that in respect of those circles in which spectrum was sold in November 2012/ March 2013, price discovery has already taken place as recently as 5-10 months ago, and therefore a "market determined" price already exists that can serve as a basis for estimating current valuation. In that case, the valuation needs to be done only for the remaining LSAs in which spectrum was not sold.

3.86 A counterview could be that the purchases of spectrum in the auctions of November 2012 and March 2013 were made by service providers whose licences had been cancelled by the Court. Since, these service providers had already sunk in substantial investments in network rollout that were irrecoverable in the event of cessation of operations, they had no option but to buy spectrum in the auction to survive in the telecom market. Therefore, the prices paid by these service providers could be considered as prices for "distress purchases" rather than genuine price discovery. If such a view is held, there is a case for determination of valuation for all LSAs, de novo.

3.87 However, in case the de novo reserve price for the forthcoming auction is determined at a level lower than the auction determined price of 2012/ 2013, this may give rise to protests and subsequent litigation by TSPs who participated in the auctions held in November 2012 and March 2013

and purchased spectrum because they were compelled to bid for spectrum at the higher reserve price on account of cancellation of their licences by the Supreme Court's judgment dated 2nd February, 2012. The action of fixing reserve price for the forthcoming auction at a level lower than the auction determined price of 2012/ 2013, could also be construed as a violation of the principle of natural justice because the service providers who had purchased spectrum in November 2012 and March 2013 would have to face a comparative disadvantage vis a vis service providers who did not participate in the earlier auctions and could possibly now purchase the spectrum at a lower price.

Q.17. 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?

Spectrum Usage Charges (SUC)

3.88 The successful bidders in the auction will also be required to pay SUC (over and above the spectrum auction price and the applicable licence fee) as a percentage of the AGR as per rules notified by the Government. At present, annual SUC varies from 3% of AGR to 8% of AGR depending upon the quantum of spectrum held by the licensee. The following table describes the present rates of SUC:

Table 3.12

Slab-wise Spectrum Usage Charges

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

3.89 For 3G services, the rules prescribe that the amount of 3G spectrum will not be counted for calculating the slab of total spectrum holding for determining the rate of applicable SUC. However, the AGR earned from 3G services will be taken together with AGR of 2G services for calculation of the amount of SUC. For a standalone 3G operator, the SUC has been prescribed as 3% of AGR.

3.90 Licensees using BWA spectrum need to pay 1% of AGR from services using this spectrum as SUC, irrespective of the type of licence held by them.

3.91 According to the NIA for auction held in November 2012 and March 2013, spectrum allocated through these auctions, would be added for determining the slab for SUC. Moreover, for the purpose of calculation of SUC, there shall be a minimum AGR which shall be not less than 5% of the bid amount and the calculation of SUC shall be on the basis of minimum AGR or the actual AGR whichever is higher.

3.92 It is evident that varied approaches to levy of SUC would be applicable to spectrum acquired through various auctions. This leads to anomalous results in the levy of SUC on different operators. From time to time, stakeholders have submitted to TRAI that the current SUC regime creates a non-level playing field between existing operators who have both 3G and 2G spectrum and new entrants who hold only 3G spectrum. An existing TSP has to pay higher SUC on the revenue generated through 3G services compared to a new entrant. However 2G spectrum obtained in the auctions of November 2012/ March 2013, has to be added to arrive at the slab rate; therefore, an existing operator is obliged to pay a higher SUC, as the SUC would be applicable at a higher slab on the entire revenue. Clearly this creates a non-level playing field vis-à-vis new operators. Some TSPs have also expressed the opinion that an escalating fee structure approach penalises larger operators who are utilising

spectrum more efficiently and generating high revenue, as they have to pay a higher rate on the higher revenue that accrues from the deployment of incremental spectrum. The escalating slab rate system of charging SUC is also a disincentive for mergers as any merged entity will have to move to a higher slab rate as a result of the increased holding of spectrum. The government's revenue from SUC are higher from the merged entity than from the two separate entities. Assuming entity A pays SUC_1, entity B pays SUC_2 and merged entity (A+B) would pay SUC_3. After the creation of merged entity, the payable SUC can be shown by the following equation:

$$\mathbf{SUC_3 > SUC_1 + SUC_2}$$

3.93 The process of obtaining spectrum in various bands will continue in the future also. It may be very difficult for TSPs to segregate the revenue obtained from the various services using different spectrum bands. The present slab-based SUC mechanism was evolved to discourage operators acquiring new spectrum unless it is absolutely required, so that operators would efficiently use spectrum and not hoard spectrum. Some of the TSPs also submitted during earlier consultations that the industry is already facing the problem of declining profit margin, lower ARPU and high operating cost, and, therefore, the high burden of regulatory charges, which accounts for 19% to 28% of their revenue, should be reduced. One way is to keep the SUC at a level that covers only the cost of management of spectrum viz. administrative charges.

3.94 This would also bring the regulatory regime in India in line with practice in other countries. In the US, the Federal Communications Commission (FCC)'s regulatory fees for spectrum users are applied toward the agency's broad range of enforcement, policy, rulemaking and international activities. By statute, the total fees collected are assessed annually and must cover (but cannot exceed) the level of funding

appropriated by the U.S. Congress for these activities. In the UK, Administered Incentive Pricing (AIP)- another name for spectrum fees- is potentially applied by Ofcom to wireless licences that have not been auctioned, or where appropriate, to licences that have been auctioned, on renewal after the expiry of their licence term. The Australian telecommunications regulator ACMA allocates spectrum licences using a spectrum auction; under its enabling legislation, ACMA is permitted to recover its costs and therefore ACMA recovers some of the overhead costs of maintaining the spectrum through an annual spectrum licence tax. A publication brought out by the Irish telecommunication regulator ComReg on "Liberalisation of Spectrum in the 900 MHz and 1800 MHz bands" in Dec. 2009, brings out that for 900 MHz spectrum, most countries have either low or no annual spectrum usage fees. In such countries the value of spectrum is captured by the award process, be it an auction or a "beauty parade", upfront and in a single payment.

3.95 Some suggestions have also been received from stakeholders on a uniform fixed price per MHz as spectrum usage charges.

3.96 In its recommendations on 'Auction of Spectrum' of 23rd April, 2012, the Authority recommended that a rate of 1% (later revised to 3%) of AGR should be applicable to those licensees who have acquired spectrum only through auction. Licensees who have a mix of spectrum assigned administratively and acquired through auction should be required to pay SUC at the rate applicable on the administratively assigned spectrum and on the entire AGR till it pays the current auction determined price for the spectrum administratively assigned. Thereafter, it would be required to pay SUC at the rate of 1% (3%) of AGR.

3.97 The Authority in its earlier recommendations has already recommended de-linking of spectrum allocation from the licence. Auctions of spectrum have also been carried out to get the market value of the spectrum before

allocating to various service providers. One of the important aspects a participant in the auction would keep in consideration is the applicable SUC. Therefore, there is evidently a need to evolve a framework for SUC which is equitable and simple, negates possible accounting manipulations and offers easy ways for estimation.

3.98 One way could be to fix spectrum usage charges as a percentage of AGR without any escalating slabs. Alternately, there could be a way in which SUC is linked with to highest bid amount which reflects the market price of spectrum. Stakeholders may like to provide their opinions considering all limitations like segregation of revenue for various services, non-level playing field between existing and new operators, and a fair revenue share to the Government.

Q.18.

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, all details may be furnished.**

b) **In case annual spectrum usage charges are levied as a 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?**

CHAPTER IV

RESERVE PRICE ESTIMATION

What is a Reserve Price?

4.1 A reserve price refers to the minimum amount that the owner of an item 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.

4.2 Reserve prices are designed to protect the owner of an auctioned item from an unfavourable outcome. However, auction bidders dislike reserve prices because they reduce the possibility of winning the auction at a bargain price, and because they create uncertainty over the minimum price that must be paid to win the auction.

Efficiency, Revenue and Reserve Price in an Auction

4.3 Efficiency in a single object auction requires the object to be allocated to the bidder with the highest value which ensures allocative efficiency. Different kinds of auctions have an equilibrium in which the highest bidder wins the object, and hence, efficiency is achieved. The equilibrium condition in an ascending price auction is that, irrespective of what other bidders bid, a bidder's best strategy is to express interest until the price reaches his valuation of the object. The equilibrium in the first-price sealed-bid auction and the Dutch auction requires bidders to bid optimally given their beliefs on what other bidders are doing, and hence, their optimal bidding maximizes their expected payoff. The auction compels bidders to disclose their true valuations through the bid price.

4.4 The other important objective in auction design is revenue. When we say revenue maximization, we mean expected revenue maximization. The reason for this is that the seller does not know the valuations of the

bidders. If valuations are known, then an auction is unnecessary; the seller could simply allocate the good to the potential buyer with the highest valuation and charge this buyer‘s valuation. It is standard in the theory to assume that the seller has beliefs about the possible valuations of the bidders. Once bidder valuations are realized and bidders make their bids, the seller obtains revenue. However, since the realizations are unobservable to the seller, the revenue to be obtained by the seller is a random variable in the language of probability theory. The best that the seller can hope to achieve is to maximize the mean (or expectation) of this random variable.

4.5 An important observation is that the objectives of efficiency and revenue may be incompatible. Suppose there is a single bidder whose value is not known to the seller but the seller knows that it is distributed uniformly between 0 and 100. In this setting, efficiency will require that the seller always allocates the object to the bidder.

4.6 But the bidder must pay zero in this case. (i) He must pay zero when his value is zero otherwise he will make negative profit (this is called the individual rationality or voluntary participation constraint) and (ii) if his value is any other number, he will strategically say that his value is zero and settle for zero payment. Hence, efficiency in this example leads to zero revenue. Can we increase revenue in this example? It is possible to do so using a reserve price. A reserve price indicates the minimum amount a bidder must pay to win the object. In this example, if the seller sets a reserve price of 40, then the bidder will take the object if his value is above 40 and pay an amount equal to 40 whenever he takes the object. So, suppose the bidder sets a reserve price r. The bidder, whenever he takes the object, pays an amount equal to r. We have already seen that setting r equal to zero achieves efficiency but gives revenue of zero. Now if r is set at 100, then the object will never be sold and the revenue from the auction is again zero. What is the optimal value

of r? We need to compute the expected revenue from setting a reserve price. The seller earns zero revenue if the value of the bidder is less than r and earns a revenue r if the value of the bidder is more than r. The probability that the bidder has a value more than r is (1-r/100). Hence, the expected revenue from this reserve price auction is r (1-r/100). This expression can be maximized by setting r=50.

4.7 There are four observations worth making. First, the selection of an optimal reserve price increases revenue; the optimal reserve price depends on the distribution of values of bidders.

4.8 The second observation is that it is not generally optimal for the seller to choose the highest possible valuation that the seller believes that a buyer may have. In the example above, setting r=100 would be disastrous from the point of view of revenue. The reserve price should not be so high as to discourage the participation of bidders and leave the spectrum unsold and it should neither be so low as to be ineffective in warding off the adverse impact of collusion. An intermediate reserve price may be best, balancing the goals of a high probability of sale with a high price when the sale takes place.

4.9 The third observation is that the optimal reserve price increases with the number of bidders if bidder valuations are not correlated (i.e., if value for the object for a bidder does not depend on private information of other bidders). This is so because the likelihood of the presence of a high valuation bidder increases as the number of bidders increases. If there are a large number of bidders, the reserve price can be statistically pegged at a higher level. However, in the real world, the numbers of bidders are not many and their valuations may be correlated.

4.10 Finally, setting reserve prices deters collusion. For instance, consider the Japanese (clock) auction for a single object. Suppose there is no reserve price. The price will then start at zero. Suppose there are only two

bidders. If these two bidders reach a private agreement, only one bidder can express demand at price zero. The auction stops at price zero and the resulting revenue is zero. Setting a reserve price thus helps in mitigating the effect of collusion on revenue.

Setting of the Reserve Price

4.11 Traditional auction theory advocates the use of reserve price for two reasons: (a) increase in revenue (b) avoidance of collusion. The objective of the current auction is to achieve efficiency (i.e., high valued bidders should win spectrum). Setting a high reserve price may result in a scenario where the spectrum is unsold, resulting in inefficiency. On the other hand, low reserve prices may lead to a collusive outcome and loss of revenue. An optimal reserve price must balance these two objectives. However, computing an optimal reserve price is not a trivial exercise and requires knowledge about the distribution of valuations of the bidders.

4.12 Spectrum for each service area in the auction can be regarded as a separate object for auction. These service areas have different characteristics - (a) the set of bidders interested in different service areas are different (b) the values of a bidder for different service areas are different. This implies that the service areas are heterogeneous in nature. Hence, it is reasonable to fix different reserve prices for different service areas.

4.13 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.

Reserve prices and valuation of spectrum

4.14 In the previous chapter, we have dealt with the estimation of the value of spectrum, i.e. attempting to answer the question - what price would the market eventually be willing to pay for spectrum? Typically a reserve price 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 on valuations, and must be lower than these estimates, to enable competitive bidding and price discovery.

4.15 It still needs to be assessed what are probabilities attached to the range of estimated valuations. It is difficult, if not impossible, to calculate such probabilities. If it is assumed that each valuation is equally likely to occur, the theory says that the optimal reserve price would be at the mid-point of the distribution of valuations (see para 4.6 above).

4.16 Data from international auctions can also be utilized to establish the general relationship between the final price and reserve price for spectrum. Table 4.1 indicates the Reserve Price and Auction Price per MHz of international auctions conducted in the recent past. International estimates of ratio of reserve price to final price of different auctions can be considered as reasonable estimates for adoption in India. This would align the methodology followed to international best practices.

4.17 Table 4.2 indicates the mean and median of Reserve Price to Final Price ratio for all international spectrum auctions, all 800 MHz, all 1800 MHz and 900 MHz auctions

TABLE 4.1
RESERVE PRICE AND FINAL PRICE OF INTERNATIONAL AUCTIONS

Serial No.	Country	Year	Spectrum	Reserve Price per MHz (Million USD)	Auction Price per MHz (Million USD)	Reserve Price/Auction Price (per MHz)
1	Austria	2010	2600	0.052	0.27	0.1926
2	Denmark	2010	900	0.142	0.13	1.0923
		2010	1800	0.035	0.03	1.1667
		2010	2600	0.018	0.89	0.0202
3	Germany	2010	800	0.325	78	0.0042
		2010	1800	0.325	2.73	0.1191
		2010	2000	0.325	7.64	0.0425
		2010	2600	0.325	2.36	0.1377
4	Netherlands	2010	2600	0.013	0.03	0.4333
5	Finland	2009	2600	0.02	0.03	0.6667
6	Sweden	2011	800	2.25	5.14	0.4377
		2008	2600	0.041	1.66	0.0247
7	Norway	2007	2600	0.017	0.2	0.085
8	Greece	2011	900/1800	2.308	4.5	0.5129
9	Hong Kong	2012	2300	0.6	0.67	0.8955
		2011	850/900	0.4	12.58	0.0318
		2009	2600	0.6	2.2	0.2727
10	Singapore	2011	1800	0.03	0.86	0.0349
		2010	2100	1.59	1.59	1
11	France	2011	2600	7.8	8.69	0.8975
		2011	800	39	57.2	0.6818
12	Spain	2011	800	22.1	28.8	0.7674
		2011	900	2.1	21.97	0.0956
		2011	2600	0.4	1.18	0.3390
13	Italy	2011	800	0.4	66.38	0.006
		2011	1800	0.4	21.38	0.0187
		2011	2600	0.4	4.84	0.0826
14	Portugal	2011	800	5.85	5.87	0.9966

		2011	900	3.9	3.91	0.9974
		2011	1800	0.52	0.51	1.0196
		2011	2600	0.39	0.39	1
		2011	2600	0.16	0.16	1
15	USA	2008	700	161.29	386.44	0.4173
16	Mexico	2010	1900	8.3	14.65	0.5665
		2010	1700	8.3	8.79	0.9442
17	Brazil	2010	3G	16	18	0.8889
18	S. Korea	2011	1800	21.2	47.38	0.4474
19	Indonesia	2009	WiMax	0.17	1.5	0.1133
		2009	WiMax	0.1	0.76	0.1358

Note: Some spectrum was sold at a price equal or less than the reserve price.

TABLE 4.2

Mean and Median of Reserve Price/Final Price Ratio

Spectrum Band	Reserve Price to Final Price Ratio Mean	Reserve Price to Final Price Ratio Median
All	0.4502	0.4173
800 MHz	0.4822	0.5997
1800 MHz	0.458	0.4801
900 MHz	0.546	0.513

Q.19. What should be the ratio adopted between the reserve price for the auction and the valuation of the spectrum?

CHAPTER-V

ISSUES FOR CONSIDERATION

Q.1. What method should be adopted for refarming of the 900 MHz band so that the TSPs whose licences are expiring in 2014 onwards get adequate spectrum in 900/1800 MHz band for continuity of services provided by them?

Q.2. In case spectrum is to be "reserved" for such TSPs, should it be restricted to licences expiring in 2014 (metros) or include licences expiring afterwards (LSAs other than metros)?

Q.3. Is any restriction required to be imposed on the eligibility for participation in the proposed auction?

Q.4. Should India adopt E-GSM band, in view of the diminishing interest in the CDMA services? If yes,

a) How much spectrum in the 800 MHz band should be retained for CDMA technology?

b) What are the issues that need to be addressed in the process?

c) What process should be adopted for migration considering the various issues involved?

Q.5. Should roll out obligations for new/existing/renewal/quashed licenses be different? Please give justification in support of your answer.

Q.6. Is there a need to prescribe additional roll-out obligations for a TSP who acquires spectrum in the auction even if it has already fulfilled the prescribed roll-out obligations earlier?

Q.7. What should be the framework for conversion of existing spectrum holdings into liberalised spectrum?

Q.8. Is it right time to permit spectrum trading in India? If yes, what should be the legal, regulatory and technical framework required for trading?

Q.9. 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?

Q.10. Should the value of spectrum for individual LSA be derived in a top-down manner starting with pan-India valuation or should valuation of spectrum for each LSA be done individually?

Q.11. Is indexation of 2001 prices of 1800 MHz spectrum an appropriate method for valuing spectrum in 2013? If yes, what is the indexation factor that should be used?

Q.12. 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?

Q.13. 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 results.

Q.14. 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 results.

Q.15. 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.

Q.16. Should the premium to be paid for the 900 MHz and liberalised 800 MHZ spectrum be based on the additional CAPEX and OPEX that would be incurred on a shift from these bands to the 1800 MHz band?

Q.17. 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?

Q.18.

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, all details may be furnished.**

b) **In case annual spectrum usage charges are levied as a 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?**

Q.19. What should be the ratio adopted between the reserve price for the auction and the valuation of the spectrum?

Abbreviation		
S.No.	**Abbreviation**	**Expansion**
1.	**2G**	**Second Generation**
2.	**3G**	**Third Generation**
3.	**ACMA**	**Australian Communications and Media Authority**
4.	**ACPU**	**Average total cost per subscriber per month**
5.	**AGR**	**Adjusted Gross Revenue**
6.	**AIP**	**Administered Incentive Pricing**
7.	**APAC**	**Asia-Pacific**
8.	**ARPU**	**Average Revenue per User**
9.	**BSNL**	**Bharat Sanchar Nigam Limited**
10.	**BTS**	**Base Transceiver Station**
11.	**BWA**	**Broadband Wireless Access**
12.	**CAPEX**	**Capital Expenditure**
13.	**CDMA**	**Code Division Multiple Access**
14.	**CII**	**Cost Inflation Index**
15.	**CMTS**	**Cellular Mobile Telephone Service**
16.	**DoT**	**Department of Telecommunications**
17.	**EBITDA**	**Earnings Before Interest, Taxes, Depreciation and Amortization**
18.	**EGoM**	**Empowered Group of Ministers**
19.	**E-GSM**	**Extended Global System for Mobile**
20.	**FDD**	**Frequency Division Duplexing**
21.	**GDP**	**Gross Domestic Product**
22.	**GSM**	**Global System for Mobile Communication**
23.	**HHI**	**Herfindahl Hirschman Index**
24.	**HSPA**	**High Speed Packet Access**
25.	**LSA**	**Licensed Service Area**
26.	**LTE**	**Long Term Evolution**
27.	**MEA**	**Middle-East and Africa**
28.	**MOU**	**Minutes of Usage**
29.	**MTNL**	**Mahanagar Telephone Nigam Limited**
30.	**NIA**	**Notice Inviting Application**
31.	**NPV**	**Net Present Value**

32.	**NTP 1994**	**National Telecom Policy 1994**
33.	**NTP 1999**	**New Telecom Policy 1999**
34.	**Ofcom**	**Regulator for UK**
35.	**OPEX**	**Operating Expenditure**
36.	**PBG**	**Performance Bank Guarantee**
37.	**PBIT**	**Profit before Interest and Taxes**
38.	**PLR**	**Prime Lending Rate**
39.	**PSU**	**Public Sector Undertaking**
40.	**QE**	**Quarter Ending**
41.	**RPM**	**Revenue per minute**
42.	**SUC**	**Spectrum Usage Charges**
43.	**TDD**	**Time Division Duplexing**
44.	**TRAI**	**Telecom Regulatory Authority of India**
45.	**TSPs**	**Telecom Service Providers**
46.	**UAS**	**Unified Access Service**
47.	**UASL**	**Unified Access Service License**
48.	**UL(AS)**	**Unified License Access Service**
49.	**UMTS**	**Universal Mobile Telecommunication System**
50.	**WACC**	**Weighted Average Cost of Capital**
51.	**WCDMA**	**Wideband Code Division Multiple Access**
52.	**WPC**	**Wireless Planning & Coordination Wing**

ANNEXURE-A

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-B

	Aircel			Bharti Airtel			BSNL			HFCL			Idea			Loop			MTNL		
LSA	**900**	**1800**	**800**	**900**	**1800**	**800**	**900**	**1800.0**	**800**	**900**	**1800**	**800**	**900**	**1800**	**800**	**900**	**1800**	**800**	**900**	**1800**	**800**
Andhra Pradesh		4.4		7.8	2.2		6.2	3.8	3.75				6.2	1.8							
Assam	4.4	1.8		1.8	5.65		6.2	3.8	2.5					5							
Bihar		4.4		6.2	3		6.2	3.8	2.5					5.65							
Chennai	6.2	2.4		6.2	2.4		6.2	1.8													
Delhi		4.4		8	2									8					6.2	6.2	3.75
Gujarat		4.4			6.2		6.2	1.2	2.5				6.2								
Haryana		4.4			6.2		6.2	3.8	2.5				6.2								
Himachal Pradesh		4.4		6.2			6.2	3.8	2.5					4.4							
Jammu & Kashmir	4.4			6.2			8		2.5					5							
Karnataka		4.4		7.8	2.2		6.2	3.8	2.5				6.2								
Kerala		4.4			6.2		6.2	3.8	3.75				6.2	1.8							
Kolkata		4.4		6.2	1.8		6.2	3.8	2.5					5							
Madhya Pradesh		4.4			8		6.2	3.8	2.5				6.2	1.8							
Maharashtra		4.4			8.2		6.2	3.8	2.5				7.8	2							
Mumbai		4.4			9.2									4.4		8	2		6.2	6.2	2.5
North East	4.4			4.4	1.8		6.2	3.8	2.5					5							
Orissa		4.4		6.2	1.8		6.2	3.8	2.5					5							
Punjab		4.4		7.8			6.2		2.5		4.4	2.5	7.8								
Rajasthan		4.4		6.2	2		6.2	1.8	2.5					6.2							
Tamilnadu (excluding Chennai)	7.8	2		0	6.2		6.2	1.8													
Tamilnadu (including Chennai)					0.6			2.0	2.5					5							
Uttar Pradesh (East)		4.4		6.2	1		6.2	3.8	2.5					6.2							
Uttar Pradesh (West)		4.4			6.2		6.2	3.8	2.5				6.2	1.8							
West Bengal		4.4		4.4	1.8		6.2	1.8	2.5					6.25							
Grand Total	**27.2**	**85.4**	**0**	**91.6**	**84.65**	**0**	**132**	**63.6**	**52.5**	**0**	**4.4**	**2.5**	**59**	**80.3**	**0**	**8**	**2**	**0**	**12.4**	**12.4**	**6.25**

ANNEXURE – B (Contd.)

	Sistema Shyam			Tata Teleservices			Telewings			Videocon			Vodafone			RCL/RTL			Total		
LSA	900	1800	800	900	1800	800	900	1800	800	900	1800	800	900	1800	800	900	1800	800	900	1800	800
Andhra Pradesh					4.4	5		5						6.2			4.4	5	20.2	32.2	13.75
Assam														6.9		6.2		2.5	18.6	23.15	5
Bihar					4.4	3.75		5			5			6.9		6.2	1.8	5	18.6	39.95	11.25
Chennai														8					18.6	14.6	0
Delhi			3.75			5							8	2			4.4	5	22.2	27	17.5
Gujarat			3.75		4.4	3.75		5			5		7.8	2			4.4	3.75	20.2	32.6	13.75
Haryana					4.4	5					5		6.2	2.5			4.4	3.75	18.6	30.7	11.25
Himachal Pradesh					4.4	2.5								5.65		6.2		2.5	18.6	22.65	7.5
Jammu & Kashmir														6.9			4.4	2.5	18.6	16.3	5
Karnataka			3.75		4.4	3.75								8			4.4	5	20.2	27.2	15
Kerala			3.75		4.4	3.75							6.2	1.25			4.4	5	18.6	26.25	16.25
Kolkata			3.75		4.4	3.75							7.8	2			6.2	5	20.2	27.6	15
Madhya Pradesh					4.4	2.5					5			6.9		6.2		5	18.6	34.3	10
Maharashtra					4.4	5		5					6.2	1.25			4.4	5	20.2	33.45	12.5
Mumbai					4.4	5							8	2			4.4	5	22.2	37	12.5
North East														6.9		4.4	1.8	2.5	19.4	19.3	5
Orissa					4.4	2.5								6.9		6.2		3.75	18.6	26.3	8.75
Punjab					4.4	3.75								7.45			4.4	3.75	21.8	25.05	12.5
Rajasthan		4.4	5		4.4	3.75							6.2				4.4	3.75	18.6	27.6	15
Tamilnadu (excluding Chennai)													6.2	1					20.2	11	0
Tamilnadu (including Chennai)			3.75		4.4	3.75											4.4	5	0	16.4	15
Uttar Pradesh (East)					4.4	3.75		5			5		6.2	3.25			4.4	5	18.6	37.45	11.25
Uttar Pradesh (West)			3.75		4.4	3.75		5			5		6.2	2.5			4.4	5	18.6	37.5	15
West Bengal			3.75		4.4	2.5							4.4	4.3		4.4	1.8	3.75	19.4	24.75	12.5
Grand Total	**0**	**4.4**	**35**	**0**	**79.2**	**72.5**	**0**	**30**	**0**	**0**	**30**	**0**	**79.4**	**100.75**	**0**	**39.8**	**73.2**	**92.5**	**449.4**	**650.3**	**261.25**

ANNEXURE- C

Spectrum Holdings (in MHz) of Operators in Some Countries

Country	Operator	900 MHz Band	1800 MHz Band
Netherlands	KPN	10	20
Germany	T-Mobile	12.4	20
Italy	TIM	9.8	15
Spain	Movistar	9.8	20
Ireland	Vodafone	10	25
Sweden	Tele2	7.5	3
	TeliaSonera	10	3
	Telenor	7.5	3
	Swefour	5	
	Hi3G	5	
France	Bouygues Telecom	9.8	26.6
	Orange France	10	23.8
	SFR	10	23.8
	Free Mobile	5	
Denmark	Telia	11.8	23.6
	TDC Mobil	9	17.2
	Telenor	9	20.2
	Hi3G	5	10
Romania	Orange	12.4	12.4
	Vodafone	12.4	12.4
	Cosmote	10	12.6
	RCS & RDS		