

**Consultation Paper No.13/2013**



**Telecom Regulatory Authority of India**



**Consultation Paper**

**on**

**Reserve Price for Auction of Spectrum in the 800 MHz Band**

**30<sup>th</sup> December, 2013**

**Mahanagar Doorsanchar Bhawan  
Jawahar Lal Nehru Marg  
New Delhi- 110002**

**Written Comments on the Consultation Paper are invited from the stakeholders by 15<sup>th</sup> January, 2014 and counter-comments by 22<sup>nd</sup> January 2014. As the issue has to be decided urgently, no extension will be granted. Comments and counter-comments will be posted on TRAI's website [www.trai.gov.in](http://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 [traijams@gmail.com](mailto:traijams@gmail.com)**

**For any clarification/ information, Shri Arvind Kumar, Advisor (Networks, Spectrum and Licensing), TRAI, may be contacted at Telephone No. +91-11-23220209 Fax No. +91-11-23230056**

**Open House Discussion (OHD) on this consultation paper will be held on 27<sup>th</sup> January 2014 at New Delhi. This may be treated as an advance notice for the OHD.**

## CONTENTS

	<b>TITLE</b>	<b>PAGE NO.</b>
<b>CHAPTER-I</b>	<b>INTRODUCTION</b>	<b>1</b>
<b>CHAPTER-II</b>	<b>AVAILABILITY OF SPECTRUM IN THE 800 MHZ BAND AND THE ECO-SYSTEM</b>	<b>7</b>
<b>CHAPTER-III</b>	<b>THE VALUATION AND RESERVE PRICE OF THE SPECTRUM</b>	<b>19</b>
<b>CHAPTER-IV</b>	<b>ISSUES FOR CONSULTATION</b>	<b>35</b>

## **CHAPTER-I**

### **INTRODUCTION**

- 1.1 The Hon'ble Supreme Court of India in its Judgment dated 2<sup>nd</sup> 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 the 2G band in 22 Licence Service Areas (LSAs) 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".
- 1.2 In its recommendations on 'Auction of Spectrum' dated 23<sup>rd</sup> 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 delivering any services deploying any technology. The Authority arrived at the valuation of spectrum in the 1800 MHz band on the basis of the price realized in the auction for 3G spectrum (2100 MHz band) held in May 2010 after factoring in the relative efficiencies of 1800 MHz band vis-à-vis 2100 MHz band and adjustment for price escalation for 1 year. 80% of the resultant value was recommended as the reserve price for spectrum in the 1800 MHz band. The reserve price recommended was Rs. 3622 crore per MHz on a pan-India basis. 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.
- 1.3 Different latest technologies require different carrier sizes. e.g. Universal Mobile Telecommunications System (UMTS) technology can be deployed only with a carrier size of 5 MHz. Long Term Evolution (LTE) technology can be deployed in different carrier sizes viz. 1.4 MHz, 3 MHz, 5 MHz, 10 MHz and 20 MHz. However, better spectral efficiencies can be achieved

only with larger carrier sizes. Fragmented spectrum results in reduced efficiency, increased requirement of inter operator guard bands and availability of lesser amount of spectrum for productive use. In its recommendations on 'Auction of Spectrum' dated 23<sup>rd</sup> April 2012, the Authority observed that 5 MHz is the minimum amount of spectrum required to ensure that any technology can be deployed with the allocated spectrum. Further, in response to the Department of Telecommunications' (DoT's) back-reference, the Authority, in its recommendations dated 12<sup>th</sup> May 2012, stated that, in respect of 800 MHz, the amount of spectrum available for auction in some LSAs was 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.

- 1.4 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 (Rs. 2800 crore per 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 (Rs. 3640 crore per MHz).
- 1.5 Auctions for the spectrum in 1800 MHz and 800 MHz bands were held in November 2012. For 1800 MHz spectrum, there were five bidders and spectrum was sold in all the LSAs except in Delhi, Mumbai, Karnataka and Rajasthan. A total of 127.5 MHz of spectrum was sold out of total 295 MHz of spectrum that was put up for auction. However, there was no bidder for the 800 MHz band.
- 1.6 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<sup>1</sup> to Rs. 1820 crore per MHz from the previous reserve price of Rs 3,640 crore per MHz.

- 1.7 The auctions for spectrum in 800 MHz band for all 22 LSAs, 900 MHz band for the three metros (Delhi, Mumbai and Kolkata) and 1800 MHz for Delhi, Mumbai, Karnataka and Rajasthan LSA were conducted in March 2013 with reduced reserve prices (for 800 and 1800 MHz bands). There were no bidders for the spectrum in the 900 MHz and 1800 MHz bands. In 800 MHz band, M/s Sistema Shyam Tele-Services Limited (SSTL) was the sole applicant and it obtained spectrum 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: 1.1**  
**Reserve Price and Winning price of 800 MHz spectrum**  
(Rs Crore)

LSA	Reserve Price in November 2012 Auctions	Reserve price in March 2013 Auction	Winning Price in March 2013 Auctions
	Per 2x1.25 MHz	Per 2x1.25 MHz	Per 2x1.25 MHz
Delhi	900.98	450.49	450.49
Mumbai	881.99	441	No Bid
Kolkata	147.84	73.92	73.92
Karnataka	429.16	214.58	214.58
Rajasthan	87.2		
Andhra Pradesh	372.99	186.49	No Bid
Assam	11.27	5.63	No Bid
Bihar	55.26	27.63	No Bid
Gujarat	292.29	146.15	146.15
Haryana	60.47	30.24	No Bid
Himachal Pradesh	10.11	5.06	No Bid
Jammu & Kashmir	8.23	4.11	No Bid
Kerala	84.89	42.45	42.45
Madhya Pradesh	70.18	35.09	No Bid
Maharashtra	341.66	170.83	No Bid
North East	11.49	5.75	No Bid
Orissa	26.35	13.18	No Bid
Punjab	87.47	43.73	No Bid
Tamil Nadu	397.92	198.96	198.96
UP (E)	99.02	49.51	No Bid

<sup>1</sup> As per the press release on Union Cabinet's approval 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 issued on 17<sup>th</sup> Jan, 2013 available at pib.nic.in

UP (W)	139.63	69.82	69.82
West Bengal	33.59	16.79	16.79
<b>Total</b>	<b>4550</b>	<b>2231.41</b>	<b>1213.16</b>

- 1.8 The Government decided to conduct another round of auction in the 800 MHz, 900 MHz and 1800 MHz bands. The Empowered Group of Ministers (EGoM), in its meeting held on 26<sup>th</sup> June 2013, directed the DoT that before conduct of next round of auction of spectrum, recommendation of TRAI be obtained on reserve price. Accordingly, on 10<sup>th</sup> July 2013, the DoT sought TRAI's recommendations on reserve prices for auction of spectrum in the 800 MHz, 900 MHz and 1800 MHz bands. After carrying out a consultation process with the stakeholders, the Authority sent its recommendations on 'Valuation and Reserve price of Spectrum' on 9<sup>th</sup> September, 2013 to the DoT. On 11<sup>th</sup> October, 2013, the DoT sought clarification/ reconsideration on some of the recommendations. After considering the comments given by the DoT, the Authority furnished its response to the Government on 23<sup>rd</sup> October 2013.
- 1.9 On the auction of 800 MHz band, the Authority noted that the subscriber base of CDMA had diminished by around 30% over a period of three years. In contrast, the GSM subscriber base had increased by 65% over the same period. Moreover, in the auction held in November 2012, there was no participation in the bidding for the 800 MHz band. The reserve prices had been kept at 1.3 times those of the reserve price of 1800 MHz band (not 2 times as recommended by the Authority in April 2012). The spectrum in this band was again put up for auction in March 2013 after slashing the reserve price by 50%. Even then there was no participation by any existing licensee. Only one quashed licensee (SSTL) took part in the auction and acquired spectrum in eight LSAs despite the fact that earlier it was holding licences in 20 LSAs. The Authority was of the opinion that, considering the increasing demand for spectrum in sub 1-GHz band for data, it would be desirable to explore alternate usage in line with international practice. It would

simply not be prudent to allocate spectrum in the 800 MHz band at a far lower price than its true value for a technology whose eco-system is diminishing worldwide.

- 1.10 In view of the foregoing, the Authority recommended that the feasibility of adoption of E-GSM in this band should be explored and the auction in this band should not be held presently. Again in its response to the back-reference from the DoT, the Authority reiterated its recommendations and stated that the DoT should not summarily reject the recommendations on a cursory examination without first fully exploring the feasibility of adoption of E-GSM for efficient utilization of spectrum in the 800 MHz band.
- 1.11 On 12<sup>th</sup> November 2013, the DoT informed the Authority that *“These recommendations have been considered by the Government. With regard to E-GSM band, it has been viewed that apportioning spectrum in the 800 MHz band for E-GSM, 10 MHz of spectrum would remain unutilized. Besides, the E-GSM band requires vacation of spectrum by Defence services to ensure availability of adequate spectrum which is likely to take time and keeping spectrum in the 800 MHz band unsold would result in foregone revenues for Government. It would be appropriate to put the spectrum to auction and allow market forces to determine the appropriate technology solution using the liberalised spectrum. Therefore, it has been decided that 800 MHz band will be put to auction in the next round of auction of spectrum.”*
- 1.12 In view of the above, the DoT requested the Authority to provide its recommendations on the reserve price for all the service areas for the auction of spectrum in the 800 MHz band at the earliest. In response, the Authority informed the DoT that action on the original reference was over and done with. There can be no continuing reference to that earlier reference. It further stated that unless it was clarified that the present request for recommendation was indeed a fresh and new reference, then and then alone could TRAI initiate action in the matter.
- 1.13 Subsequently, through its letter dated 12<sup>th</sup> December 2013 (**Annexure-I**), the DoT has requested the Authority to furnish their recommendations on reserve price for 800 MHz band in all the service

areas in terms of clause 11(1)(a) of the TRAI Act 1997 as amended by TRAI Amendment Act 2000.

- 1.14 To prepare a comprehensive Consultation Paper on the subject, on 13<sup>th</sup> December 2013, the Authority, sought some information from the DoT which inter-alia include feasibility of shifting operations of defence from 925-935 MHz band to 834-844 MHz band, the rationale for putting a smaller quantum of spectrum on auction in last auction and details of the quantum of spectrum now proposed to be auctioned in all the LSAs. The DoT, in its reply dated 20<sup>th</sup> December 2013 (**Annexure II**) furnished the information. The DoT also informed the Authority that *“The consultation with the Ministry of Defence on the feasibility of shifting their existing frequency assignments from 925-935 MHz band to 834-844 MHz band was undertaken. Defence has intimated that due to their operational requirements, it is not feasible to migrate the equipment to other bands in a definite time frame.”*
- 1.15 In the said letter of 20<sup>th</sup> December 2013, the DoT also stated that *“the decision to auction spectrum in 800 MHz band is policy of the Government in terms of the Section 25 of the TRAI Act, 1997 as amended from time to time.”* However, the DoT, through letter dated 24<sup>th</sup> December 2013 has clarified that *“There is no intention of the Government to issue direction under Section 25 of TRAI Act. The recommendations for reserve price for auction of spectrum in 800 MHz band in all service areas has been sought under clause 11 (1) (a) as was mentioned in this Ministry’s letter of even No. dated 12<sup>th</sup> December 2013.”*
- 1.16 In view of the stated examination by the DoT on the feasibility of adoption of E-GSM in the 800 MHz band and the Government’s subsequent rejection of the Authority’s recommendations in this regard and its decision to auction this band as it is, the Authority has decided to go ahead with the exercise for determining the reserve price of spectrum in the 800 MHz band.

## CHAPTER-II

### AVAILABILITY OF SPECTRUM IN THE 800 MHZ BAND AND THE ECO-SYSTEM

#### AVAILABILITY OF SPECTRUM

- 2.1 In India, Telecom Service Providers (TSPs) holding spectrum in the 800 MHz band are using CDMA technology. Presently, there are 2-4 TSPs (including PSUs) in each LSA using this technology. In its letter of 20<sup>th</sup> December 2013, the DoT has intimated that “the quantum of spectrum in 800 MHz band to be put to auction will be decided by the Government after receipt of TRAI Recommendations on Reserve Price”. However, as per the information provided earlier by the DoT, the current availability of spectrum and its allocation amongst different TSPs is as given below<sup>2</sup>:

**TABLE 2.1** (in MHz)

Sl. No.	LSA	BSNL	HFCL	MTNL	SSTL	TTSL	RCL/RTL	Total spectrum holding
1	Delhi			2.5	3.75	5	5	16.25
2	Mumbai			2.5		5	5	12.5
3	Kolkata	2.5			3.75	3.75	5	15
4	Maharashtra	2.5				5	5	12.5
5	Gujarat	2.5			3.75	3.75	3.75	13.75
6	Andhra Pradesh	2.5				3.75	5	11.25
7	Karnataka	2.5			3.75	3.75	5	15
8	Tamilnadu	2.5			3.75	3.75	5	15
9	Kerala	3.75			3.75	3.75	5	16.25
10	Punjab	2.5	2.5			3.75	3.75	12.5
11	Haryana	2.5				3.75	3.75	10
12	UP (West)	2.5			3.75	3.75	5	15
13	UP (East)	2.5				3.75	5	11.25
14	Rajasthan	2.5			5	3.75	3.75	15
15	Madhya Pradesh	2.5				2.5	5	10
16	West Bengal	2.5			3.75	2.5	3.75	12.5
17	Himachal Pradesh	2.5				2.5	2.5	7.5
18	Bihar	2.5				3.75	5	11.25
19	Orissa	2.5				2.5	3.75	8.75
20	Assam	2.5					2.5	5
21	North East	2.5					2.5	5
22	J&K	2.5					2.5	5
	<b>Grand Total</b>	<b>51.25</b>	<b>2.5</b>	<b>5</b>	<b>35</b>	<b>70</b>	<b>92.5</b>	<b>256.25</b>

<sup>2</sup> Considering the carrier size as 2x1.25 MHz. Actual carrier size is 2x1.23 MHz

2.2 The 800 MHz band (824-844 MHz/869-889 MHz) is of 2x20 MHz in size, but because a guard band (typically 0.6 MHz) has to be provided between two TSPs to avoid interference, and also provision of a guard band at the start and end of the band, totaling to 0.98 MHz, out of 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). As per the information received from WPC, CDMA carrier assignments to various TSPs in the 800 MHz band are given in **Annexure -III** and are summarized in the table below:

**Table 2.2**  
**Spectrum Availability in the 800 MHz Band**

<b>Sl. No.</b>	<b>LSA</b>	<b>Total No. of Carriers</b>	<b>No. of Carriers assigned in March 2013 auctions</b>	<b>Total No. of Carriers assigned till date</b>	<b>No. of Carriers available currently</b>
1	Delhi	14	3	13	1
2	Mumbai	14		10	4
3	Kolkata	13	3	12	1
4	Maharashtra	14		10	4
5	Gujarat	14	3	11	3
6	A.P.	13		9	4
7	Karnataka	14	3	12	2
8	Tamilnadu	14	3	12	2
9	Kerala	14	3	13	1
10	Punjab	13		10	3
11	Haryana	14		8	6
12	UP (West)	14	3	12	2
13	UP (East)	14		9	5
14	Rajasthan	12		12	0
15	M.P.	13		8	5
16	West Bengal	14	3	10	4
17	H.P.	14		6	8
18	Bihar	14		9	5
19	Orissa	14		7	7
20	Assam	14		4	10
21	North East	14		4	10
22	J&K	14		4	10
	<b>Grand Total</b>	<b>302</b>	<b>24</b>	<b>205</b>	<b>97</b>

2.3 As shown in table 2.1, both PSUs (MTNL/BSNL) also hold spectrum in the 800 MHz band in all LSAs of the country. They are holding 2 carriers in each LSA except in Kerala where BSNL is holding 3 carriers.

As on September 2013, MTNL and BSNL are serving only 19,636 and 9,83,242 CDMA subscribers<sup>3</sup> respectively. Moreover, they are not providing full mobility service in this band.

**Table 2.3**  
**Subscriber Base of PSUs in 800 MHz Band<sup>4</sup>**

<b>QE</b>	<b>MTNL (HLR)</b>	<b>MTNL (Peak VLR)</b>	<b>BSNL (HLR)</b>	<b>BSNL (Peak VLR)</b>
Mar-11	279807	74293	5565437	NA
Jun-11	269421	65754	5298575	NA
Sep-11	261783	60971	4883770	NA
Dec-11	255763	NA	4334300	NA
Mar-12	247316	45972	4003914	NA
Jun-12	237502	42938	3489498	NA
Sep-12	185404	39138	3126587	NA
Dec-12	182739	33761	2829570	NA
Mar-13	179409	31015	2701813	NA
Jun-13	175947	26304	2578171	1113602
Sep-13	130046	19636	2385354	983242

**Table 2.4**  
**CDMA Subscriber base (Peak VLR data of Sep 2013)**

<b>Sl. No.</b>	<b>LSA</b>	<b>BSNL/MTNL Subscribers (Peak VLR)</b>	<b>Total Subscribers in the LSA (Peak VLR)</b>	<b>BSNL/MTNL subscriber base as a percentage of total CDMA subscriber base</b>
1	Andhra Pradesh	51400	3452394	1%
2	Assam	14916	14916	100%
3	Bihar	8742	3212643	0%
4	Delhi	2187	5478774	0%
5	Gujarat	75895	2004142	4%
6	Haryana	15833	795260	2%
7	Himachal Pradesh	27125	215340	13%
8	Jammu and Kashmir	24837	24873	100%
9	Karnataka	73526	3207094	2%

<sup>3</sup> Peak VLR data

<sup>4</sup> June 2013 Data

10	Kerala	213465	1735096	12%
11	Kolkata	7005	2088093	0%
12	Madhya Pradesh	58899	2760899	2%
13	Maharashtra	91942	3868591	2%
14	Mumbai	17449	3856393	0%
15	North East	53517	53517	100%
16	Orissa	35684	557520	6%
17	Punjab	14980	718422	2%
18	Rajasthan	50125	2712123	2%
19	Tamilnadu including Chennai	66477	2797704	2%
20	UP (East)	40685	3047660	1%
21	UP (West)	23703	2244386	1%
22	West Bengal	34486	2286512	2%
	<b>Total</b>	<b>1002878</b>	<b>47132352</b>	<b>2%</b>

2.4 Considering the fact that there has been (i) a continuous decline in the subscriber base of both the PSUs, and, (ii) the combined CDMA subscriber base of both the PSUs is only 2% of the total CDMA subscribers (Table 2.3 and 2.4), in its recommendations of 9<sup>th</sup> September 2013, the Authority expressed the view that BSNL may be allowed to retain a single carrier (of 1.25 MHz) in 800 MHz band so as to cater to its R-DEL subscribers. It may be asked to vacate other carrier(s) in all LSAs, whereas MTNL should vacate all the carriers of 800 MHz band assigned to it in both Delhi and Mumbai.

2.5 Additionally, an existing TSP holding spectrum in 800 MHz band (TTSL)<sup>5</sup> has offered to surrender spectrum holding beyond 3.75 MHz in Delhi and Mumbai and spectrum holding beyond 2.5 MHz in other LSAs. In case the offer of M/s TTSL materializes and is accepted by the DoT, and on the assumption that MTNL vacates the entire spectrum in 800 MHz band and BSNL retains only one CDMA carrier, LSA-wise

---

<sup>5</sup> As per press reports.

availability of the spectrum in the 800 MHz band shall be as given below:

**Table 2.5**

Sl. No.	LSA	Total No. of Carriers	No. of Carriers available currently	No. of carriers assigned to BSNL /MTNL	No. of carriers assigned to TTSL	No. of additional carriers that may be available <sup>6</sup>	Total No. of carriers likely to be available
1	Delhi	14	1	2	4	3	4
2	Mumbai	14	4	2	4	3	7
3	Kolkata	13	1	2	3	2	3
4	Maharashtra	14	4	2	4	3	7
5	Gujarat	14	3	2	3	2	5
6	Andhra Pradesh	13	4	2	3	2	6
7	Karnataka	14	2	2	3	2	4
8	Tamilnadu	14	2	2	3	2	4
9	Kerala	14	1	3	3	3	4
10	Punjab	13	3	2	3	2	5
11	Haryana	14	6	2	3	2	8
12	UP (West)	14	2	2	3	2	4
13	UP (East)	14	5	2	3	2	7
14	Rajasthan	12	0	2	3	2	2
15	Madhya Pradesh	13	5	2	2	1	6
16	West Bengal	14	4	2	2	1	5
17	Himachal Pradesh	14	8	2	2	1	9
18	Bihar	14	5	2	3	2	7
19	Orissa	14	7	2	2	1	8
20	Assam	14	10	2	0	0	10
21	North East	14	10	2	0	0	10
22	J&K	14	10	2	0	0	10
	<b>Grand Total</b>	<b>302</b>	<b>97</b>	<b>45</b>	<b>56</b>	<b>40</b>	<b>135</b>

## **SPECTRUM TO BE PUT UP FOR AUCTION**

2.6 The spectrum that was vacated as a result of the quashing of the licences, the amount of spectrum that was put up for auction, the quantum of spectrum that was sold in the auctions of November 2012 and March 2013 in the 800 MHz bands and the quantum of spectrum

<sup>6</sup> Considering BSNL retains only one carrier in each LSA, MTNL none and TTSL surrenders its holding beyond 3 carriers in Delhi/Mumbai and 2 carriers in other LSAs, except in AS/NE/J&K.

proposed to put up for auction (as mentioned by the DoT in its reference dated 10th July 2013) is as below<sup>7</sup>:

**Table 2.6**

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	Quantum of spectrum proposed to be put up for auction <sup>8</sup>
		MHz	MHz	MHz	MHz	MHz	MHz
1	Delhi	2.5	3.75	3.75	0	3.75	0.00
2	Mumbai	2.5	3.75	3.75	0		3.75
3	Kolkata	2.5	3.75	3.75	0	3.75	0.00
4	Maharashtra	2.5	3.75	3.75	0		3.75
5	Gujarat	2.5	5	5	0	3.75	0.00
6	AP	2.5	2.5	2.5	0		2.50
7	Karnataka	2.5	5	5	0	3.75	0.00
8	Tamil Nadu	2.5	5	5	0	3.75	0.00
9	Kerala	2.5	5	5	0	3.75	0.00
10	Punjab	2.5	2.5	2.5	0		2.50
11	Haryana	2.5	5	5	0		5.00
12	UP - West	2.5	5	5	0	3.75	0.00
13	UP - East	2.5	5	5	0		5.00
14	Rajasthan	0	0	0	0		0.00
15	M.P.	2.5	5	5	0		5.00
16	West Bengal	2.5	5	5	0	3.75	0.00
17	H.P.	2.5	5	5	0		5.00
18	Bihar	2.5	5	5	0		5.00
19	Orissa	2.5	5	5	0		5.00
20	Assam	5	5	5	0		5.00
21	North East	5	5	5	0		5.00
22	J&K	5	5	5	0		5.00
	<b>Total</b>	<b>60</b>	<b>95</b>	<b>95</b>	<b>0</b>	<b>30</b>	<b>57.50</b>

2.7 As discussed above, there are currently 97 carriers (each of 2x1.23 MHz) available in the 800 MHz band. In case the offer of M/s TTSL to surrender spectrum holding beyond 3.75 MHz in Delhi and Mumbai and spectrum holding beyond 2.5 MHz in other LSAs is accepted by the

<sup>7</sup> Considering the carrier size as 2x1.25 MHz. Actual carrier size is 2x1.23 MHz.

<sup>8</sup> As mentioned by the DoT in its reference dated 10th July 2013.

DoT, and if MTNL vacates the entire spectrum in 800 MHz band and BSNL retains only one CDMA carrier, there will be 40 additional carriers that will become available. In its reference dated 10th July 2013, the DoT proposed only 46 carriers to be put up for auction (as mentioned by the DoT in its reference) as shown in the table below.

**Table 2.7**

<b>Sl. No.</b>	<b>LSA</b>	<b>Total No. of Carriers</b>	<b>No. of Carriers available currently</b>	<b>Total No. of carriers likely to be available</b>	<b>No. of carriers proposed to be put up for auction<sup>9</sup></b>
1	Delhi	14	1	4	0
2	Mumbai	14	4	7	3
3	Kolkata	13	1	3	0
4	Maharashtra	14	4	7	3
5	Gujarat	14	3	5	0
6	A.P.	13	4	6	2
7	Karnataka	14	2	4	0
8	Tamilnadu	14	2	4	0
9	Kerala	14	1	4	0
10	Punjab	13	3	5	2
11	Haryana	14	6	8	4
12	UP (West)	14	2	4	0
13	UP (East)	14	5	7	4
14	Rajasthan	12	0	2	0
15	M.P.	13	5	6	4
16	West Bengal	14	4	5	0
17	H.P.	14	8	9	4
18	Bihar	14	5	7	4
19	Orissa	14	7	8	4
20	Assam	14	10	10	4
21	North East	14	10	10	4
22	J&K	14	10	10	4
	<b>Grand Total</b>	<b>302</b>	<b>97</b>	<b>135</b>	<b>46</b>

2.8 As can be seen from the table above, the DoT, in its reference dated 10<sup>th</sup> July 2013, proposed to auction the spectrum in the 800 MHz band only in those LSAs where there was no bidder in the March 2013 auctions. However, in its reference dated 12<sup>th</sup> December 2013, the DoT has requested TRAI to furnish their recommendations on reserve price for

<sup>9</sup> As per the DoT's reference dated 10<sup>th</sup> July 2013.

the 800 MHz band in all the service areas. The DoT, through its letter dated 20<sup>th</sup> December 2013, stated that the quantum of spectrum in 800 MHz band to be put to auction will be decided by the Government separately.

2.9 In view of the above discussion regarding availability of spectrum in the 800 MHz band, stakeholders are requested to comment on the following issue:

**Q.1. What should be the quantum of spectrum in the 800 MHz band that should be put up for auction?**

#### **ECO SYSTEM IN THE 800 MHz BAND**

2.10 In India, 824-844/869-889 MHz band is called as 800 MHz band, which is a part of IMT band no. 5 in the 3GPP<sup>10</sup> band table and is also referred to as the 850 MHz band<sup>11</sup>. 850 MHz band has been adopted by some countries in ITU Region 2 and 3 including US, Canada, Brazil, Australia and some Asian countries to provide cellular mobile services. In the ITU-R Region 1, there is no 850 MHz band. In this region, the GSM band is 880-915 MHz/925-960 MHz (i.e. 2x35 MHz) which is referred to as the E-GSM band, which overlaps with the 850 MHz band.

2.11 The eco-system of Universal Mobile Telecommunications System (UMTS) devices is mostly in the 900 and 2100 MHz bands. However, in some countries like USA, Canada, Australia, New Zealand, Philippines and Latin America there are some commercial UMTS850 networks. Currently, Telstra (the operator in Australia) offers dual mode LTE/HSPA+ mobile broadband devices for seamless operation across 1800 MHz and 850 MHz.

2.12 Compared to GSM and UMTS, LTE deployment is fragmented as there are many spectrum bands in which LTE networks are being deployed

---

<sup>10</sup> The 3rd Generation Partnership Project.

<sup>11</sup> IMT Band 5 is 824-849 MHz/864-894 MHz.

globally. There are 244 commercially launched LTE networks in 92 countries<sup>12</sup>. As per the GSA (Global mobile Suppliers Association) report, 1240 LTE user devices have been launched in the market by 120 suppliers, including 87 Category 4 devices<sup>13</sup>. The LTE devices ecosystems in different spectrum bands is given in the table below<sup>14</sup>:

**Table 2.8**

<b>Spectrum Bands</b>	<b>No. of Devices</b>
2600 MHz, band 7	448 devices
1800 MHz, band 3	412 devices
800 MHz, band 20	314 devices
2100 MHz, band 1	305 devices
700 MHz, bands 12, 17	289 devices
800/1800/2600 MHz tri-band	277 devices
AWS, band 4	279 devices
700 MHz, band 13	250 devices
<b>850 MHz, band 5</b>	<b>189 devices</b>
900 MHz, band 8	174 devices
1900 MHz, band 2	134 devices

2.13 It is to be noted that some devices are multiband and/or multimode (FDD and TDD). Further, the 850 MHz band is also among the prominent LTE bands with an impressive eco-system of 189 devices. However, as is evident from the chart 2.1, the number of countries where LTE850 networks have been commercially launched is very few. As discussed in subsequent paras, operators in South Korea have recently launched LTE in 850 MHz and 1800/2100 MHz band by deploying carrier aggregation technology. Carrier aggregation being a recent development, it is expected that in future more number of networks will be rolled out using a combination of carriers in 850/1800/2100 MHz spectrum bands.

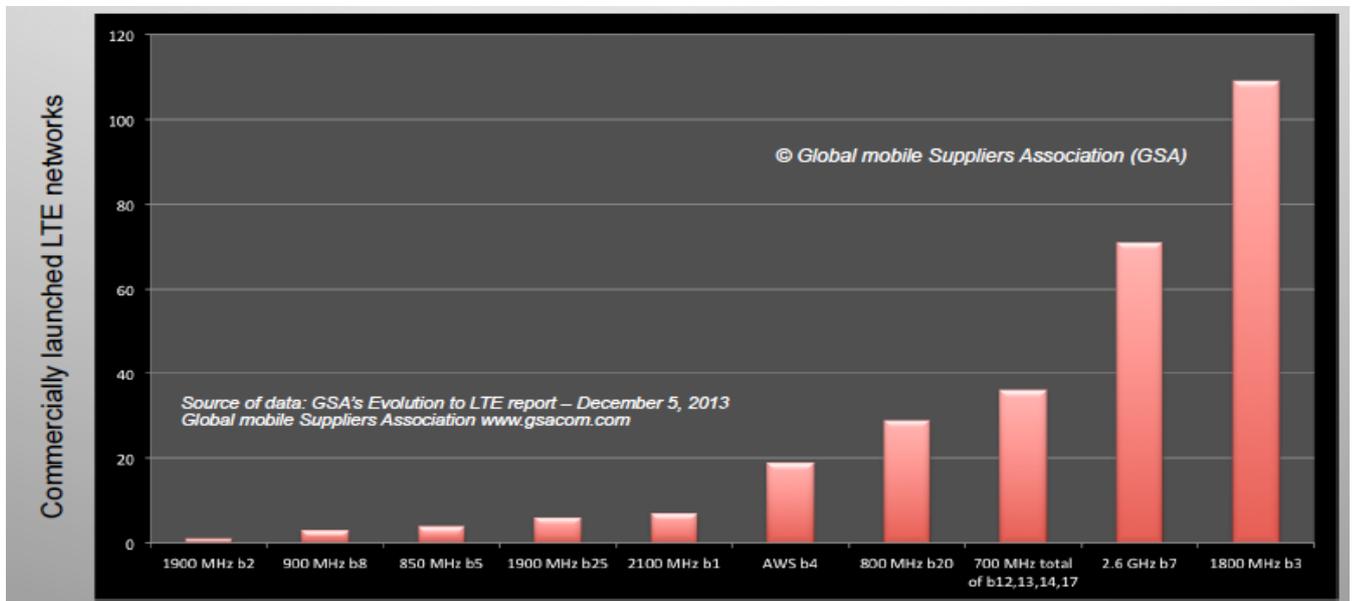
<sup>12</sup> GSA's "Evolution to LTE Report" - 5<sup>th</sup> December 2013 by GSA

<sup>13</sup> Category 4 (Cat 4) offers an enhanced user experience supporting a peak downlink data rate up to 150 Mbps and peak uplink up to 50 Mbps.

<sup>14</sup> GSA's Report "Status of the LTE Eco System" -7<sup>th</sup> November 2013

2.14 In South Korea, SK Telecom and LG U+ launched LTE service in July 2011. Both have launched their LTE services using 2x10 MHz spectrum in the 850 MHz band. A year later, both these operators have commercialized Multi-Carrier (MC) service for the first time in the world. Along with its carrier in 850 MHz band, SK Telecom used additional 2x10 MHz carrier in 1800 MHz band whereas LG U+ utilised a combination of carriers in the 850 MHz band and the 2100 MHz band for the MC Service.

**Chart: 2.1**



2.15 SK Telecom launched the world's first LTE-Advanced (LTE-A) service in June 2013. This LTE-A service, employing Carrier Aggregation (CA) technology that combines two carriers in different spectrum bands, was launched by using a category 4 device<sup>15</sup>. A month later, LG U+ launched the LTE-A service. SK Telecom has also announced its plans to launch quad-band LTE devices (850 MHz, 1800 MHz, 2.1 GHz and 2.6 GHz) in the near future.

<sup>15</sup> See Para 2.12 and Foot Note 13.

**Table 2.9**

<b>Operator</b>	<b>Spectrum Band</b>	<b>Bandwidth</b>	<b>Launched</b>	<b>Remark</b>
SK Telecom	850 MHz	2x10 MHz	July 2011	LTE
	1800 MHz	2x10 MHz	July 2012	LTE (Multiple carrier)
	850+1800 MHz	2x20 MHz	June 2013	LTE (Advanced) using Carrier Aggregation
LG U+	850 MHz	2x10 MHz	July 2011	LTE
	2100 MHz	2x10 MHz	July 2012	LTE (Multiple carrier)
	850+2100 MHz	2x20 MHz	July 2013	LTE (Advanced) using Carrier Aggregation

2.16 Philippines is another country where LTE services have been commercially launched in the 850 MHz band. Smart Communications commercially launched LTE service on August 25, 2012 in Metro Manila using 2.1 GHz. Subsequently, to extend coverage, commercial LTE service was launched using 1800 MHz and 850 MHz spectrum in September 2012.

2.17 In the USA, LTE deployments typically use 700 MHz (primarily band 13 or band 17) or AWS (band 4). However, it is quite likely that in future spectrum in other bands including 850 MHz band may be refarmed for newer technologies such as LTE/LTE-Advanced. KDDI Japan is using its 850 spectrum along with 2100 MHz spectrum for providing LTE services. ITC, a CDMA player in Ukraine, is considering deploying LTE in 850 MHz spectrum. In Brazil, Algar Telecom (CTBC) has conducted LTE trials in 850 MHz and 1800 MHz. Regulatory approval is needed for commercial services in these frequencies. The Malaysian regulator, MCMC, is also consulting on re-farming 850/900/1800 MHz. As per a recent study by RF Micro Devices (RFMD), almost all 4G device chipsets will support band 5 and out of 600+ million forecasted shipments in 2014, only less than 10 million may not support band 5.

2.18 In India, 800 MHz band is being used for CDMA technology. The TSPs have been assigned carriers of 2x1.23 MHz in the 800 MHz band. Lately, most CDMA operators have started reserving a major portion of

their allocation for deploying EVDO<sup>16</sup> technology for high speed wireless data services as EVDO is an evolution of CDMA technology and it also uses the same carrier size. As per the TRAI report on data usage for the month of August 2013, the total data usage using CDMA/EVDO technology was around 10,500 TB<sup>17</sup>, while the total data usage using 3G (WCDMA/HSPA) technology was around 15,500 TB.

2.19 As per a strategy report of one of the CDMA operators (SSTL)<sup>18</sup>, their non-voice revenue as a percentage of total revenue increased from 16.6% in 2010 to 36% in 2012 and the data card subscribers (dongles) increased by 75% between 2010 and 2012. As per the report, 850 MHz spectrum provides an opportunity for SSTL to migrate to LTE and provide users with a better experience than 3G.

2.20 As discussed above, CDMA and EVDO are not the only technologies which can be deployed in the 800 MHz band. The spectrum in this band can also be used for other technologies such as UMTS and LTE. However, these technologies require different carrier sizes as shown in the table below:

**Table 2.10**

<b>Technology</b>	<b>Carrier Size</b>
CDMA	1.25 MHz
WCDMA	5 MHz
LTE	1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 20 MHz

2.21 The stakeholders are requested to give their comments on the following issue:

**Q.2. What should be the block size in the 800 MHz band?**

---

<sup>16</sup> Evolution Data-Only

<sup>17</sup> 1 TB (Terabyte) =1000 Gigabytes.

<sup>18</sup> [http://www.sistema.com/media/439243/sstl\\_strategy\\_update.pdf](http://www.sistema.com/media/439243/sstl_strategy_update.pdf)

## **CHAPTER III**

### **THE VALUATION AND RESERVE PRICE OF THE SPECTRUM**

#### **VALUATION FOR 800 MHz**

##### **Technical efficiency**

- 3.1 One way of valuation of 800 MHz spectrum could be on the basis of the greater technical efficiency of the 800 MHz spectrum over the 1800 MHz spectrum. This approach was previously adopted in the case of the 900 MHz valuation in the recommendations on “Valuation and Reserve Price of Spectrum” dated 9<sup>th</sup> September 2013.
- 3.2 As per ITU, both 800 and 900 MHz have been identified as IMT bands. There is a growing interest 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.
- 3.3 The coverage in 900 MHz is roughly double that in 1800 MHz. The reduction in capital and operational expenditure could be as much as 40%. Operations in the 800 MHz band enjoy similar advantages. In TRAI's recommendations on 'Spectrum Management and Licensing Framework' dated 11<sup>th</sup> May 2010, the Authority recommended that the price of spectrum in the 900 MHz band be fixed at 1.5 times that of the 1800 MHz band. This could also be adopted as the basis of valuation of spectrum in the 800 MHz band.
- 3.4 Further, in the recommendations on the “Auction of Spectrum” dated 23<sup>rd</sup> April, 2012, it was discussed that the sub-1GHz (800/900 MHz) bands are far more efficient in terms of their propagation characteristics as compared to spectrum in 2100 MHz and other higher frequency bands. The Authority recommended that the reserve price in 800 and 900 MHz bands should be at least 2 times that of 1800 MHz band. This view was reiterated in the recommendations on 'Valuation and Reserve Price of Spectrum' dated 9<sup>th</sup> September, 2013.

3.5 In the current exercise, the value of 800 MHz spectrum can be derived from the value of 1800 MHz band, using a technical efficiency factor.

**Q.3. Should the value of 800 MHz spectrum be derived on the basis of the value of 1800 MHz spectrum using technical efficiency factors as discussed above?**

3.6 In the response to DoT dated 12<sup>th</sup> May, 2012 (on the back reference received on recommendations on “Auction of Spectrum” dated 23<sup>rd</sup> April, 2012), the Authority had observed that in case the amount of spectrum available for auction in the 800 MHz band is less than 5 MHz it will not be possible to offer all services that a truly liberalized spectrum can. Therefore, the Authority would be open to the Government fixing the reserve price of 800 MHz spectrum at 1.3 times (in place of 2 times) the 1800 MHz reserve price. In the auction held in November 2012, the Government decided to put up for sale a maximum of 3 blocks each of 1.25 MHz (3.75 MHz) of 800 MHz spectrum in 21 LSAs<sup>19</sup>. The reserve price was pegged at 1.3 times the reserve price of 1800 MHz spectrum. There were no bidders for 800 MHz spectrum in the November 2012 auction.

3.7 In the auction held in March 2013, a maximum of 3 blocks each of 1.25 MHz (3.75 MHz) of 800 MHz spectrum was put up for sale again in 21 LSAs, this time at a reserve price that was 50% of the reserve price in November 2012. 3 blocks (3.75 MHz) were purchased by a single bidder (SSTL) in 8 LSAs.

3.8 In its letter dated 20<sup>th</sup> December, 2013, the DoT has stated that the quantum of spectrum in the 800 MHz band to be put up for auction will be decided by the Government separately. Therefore, the quantum of spectrum which will be put up for auction in each LSA and the

---

<sup>19</sup> In some LSAs an additional block of 1.25 MHz of 800 MHz spectrum was on offer as “top-up” spectrum for a new entrant who was a provisional winning bidder to bring him to a total allocation of 2.5 MHz.

quantum of spectrum which a bidder will be permitted to acquire are not known to the Authority.

- 3.9 The question that arises is whether, while estimating the relative value of 800 MHz spectrum as compared to the value of 1800 MHz spectrum, a lower efficiency factor such as 1.3 instead of 2 times of 1800 MHz (as had been suggested by the Authority in the earlier exercise) can be employed, taking into consideration that the quantum of spectrum that will be available for sale has not been decided yet. However, in its reference of 12<sup>th</sup> December, 2013 the Government has requested the Authority to recommend reserve prices for 800 MHz spectrum for all 22 LSAs to enable auction.
- 3.10 One possibility is that the Government puts up for auction, spectrum of 5 MHz or more in LSAs where such spectrum is available. In that case, a participant in the auction can acquire 5 MHz and provide all the services that are possible on a truly liberalized spectrum.
- 3.11 On the other hand, the Government may also decide to put up less than 5 MHz; in some LSAs they may have no choice as the quantum of spectrum available may be less than 5 MHz. Even in that event, a possible anomaly may arise. In the auction held on March 2013, one bidder acquired 3 blocks of spectrum of 800 MHz in 8 LSAs. Now, if spectrum is put up for sale in the 8 LSAs in which one of the TSPs (SSTL) was successful in acquiring 3 blocks of spectrum in the March 2013 auction, and the same TSP is able to acquire even a single block of spectrum (1.25 MHz) in any one of these LSAs, it will have a total holding of 5 MHz of spectrum in that LSA enabling it to provide all the services possible on truly liberalized spectrum. It may be noted further that the same TSP (SSTL) that reaches a holding of 5 MHz in 8 LSAs in the forthcoming auction in the manner described above, would have acquired 3.75 MHz spectrum in the previous auction, at a price that was 50% of the recommended reserve price for a sub-5 MHz sale. Suitable ways may have to be devised to deal with this anomaly; for

example, restrictions may have to be placed on participation in the 8 LSAs where the spectrum was sold in the auction held in March 2013.

3.12 In view of the complexities discussed above, stakeholders are requested to give their views on the following issues.

**Q4. Is there any case for application of a lower efficiency factor (1.3) over the valuation of 1800 MHz spectrum, for determining the valuation of 800 MHz, as was done in the previous auction? If yes, give detailed reasons for the same.**

#### **CASE FOR INDEPENDENT VALUATION OF 800 MHz**

3.13 As discussed above, technically 800 MHz and 900 MHz are assumed to be equally efficient. However, for various reasons that are explained below, it may not be entirely appropriate to set the value of 800 MHz spectrum as exactly equal to that of 900 MHz spectrum; one argument could be that the valuation of 800 MHz spectrum should be undertaken as an independent and separate exercise.

3.14 In India, when the initial allocations of spectrum for mobile services were made from 1994 onwards, 800 MHz spectrum was set aside for CDMA technology while 900/1800 MHz spectrum was allocated for the deployment of GSM technology. TSPs deploying GSM technology were initially allocated spectrum in the 900 MHz band; subsequently, as the availability of 900 MHz spectrum was exhausted, allotments of spectrum for GSM technology were made in the 1800 MHz band. One way of viewing the valuation of 900 MHz spectrum in India (and this methodology had been adopted by the Authority in the recommendations of “Valuation and Reserve Price of Spectrum” dated 9<sup>th</sup> September 2013) is to consider it as a substitutable resource (carrying an economic premium due to better coverage capabilities) for 1800 MHz spectrum for the provision of mobile services using GSM technology. The substitutability of 800 MHz and 1800 MHz spectrum is possible only when 800 MHz is deployed for LTE. Since deployment of

LTE on 1800 MHz has not commenced in India, no empirical data is available as a basis for carrying out economic premium calculations as was done in the case of 900 MHz spectrum.

3.15 Secondly, the direction of evolution of services in the 800 MHz and 900 MHz bands has been somewhat different. In the Indian market, GSM technology grew faster than the CDMA technology and took control of the major market share in terms of revenue and subscribers, providing predominantly voice services. International experience also indicates that, in the initial stages of development of mobile telephony, GSM is a preferred band. Thus the eco-system for GSM technology is much better developed than that for CDMA technology. Information on CDMA services in India shows that there are not many takers for this technology. In fact, revenue from CDMA voice services has shown a declining trend over the last 3 years. However revenue from data services presents a different picture. It is interesting to note that against 5% share of non-data wireless revenue, CDMA holds approximately 25% share of wireless revenue from data services. In most LSAs, the data ARPU of CDMA services is higher than the data ARPU of GSM services. The reverse is true in respect of non-data ARPU. This indicates that the current business strategy of TSPs operating in the 800 MHz band is to use the spectrum for data services. As mentioned earlier, for one of the CDMA operators in India (SSTL), non-voice revenue as a percentage of total revenue has increased from 16.6% in 2010 to 36% in 2012 and data card subscribers increased by 75% between 2010 and 2012. There is also an opportunity for the operator (SSTL) to migrate to LTE technology on 850 MHz. Since 800 MHz will also be the band for deployment of LTE, there is a strong case for valuation of 800 MHz spectrum on the basis of expected revenues from data services.

## **VALUATION OF 800 MHz SPECTRUM BASED ON POTENTIAL GROWTH IN DATA SERVICES**

- 3.16 Use of a sub-GHz band is efficient for providing data services due to faster speed, better coverage and more capacity as compared to higher frequency bands.
- 3.17 In India, the 800 MHz is presently being used for deploying CDMA technology. As mentioned in a previous chapter of this Consultation Paper, these CDMA operators are reserving a major portion of their spectrum for deploying EVDO technology for high speed wireless data services. International data indicates that the 800 MHz band (also known as the 850 MHz band in the 3G PP band table) is a prominent LTE band with an impressive devices eco-system. Since LTE services in this band have been launched in some countries and utilization of commercial UMTS850 networks has also started in USA, Canada etc., it is clear that the 800 MHz band can be used for other technologies such as UMTS and LTE.
- 3.18 It is also a well-recognized that the future growth of telecommunications will center more on data than voice. In fact, the data revolution is likely to fuel the next phase of growth in telecommunications. While the telecom industry around the world obtains 35-50% of its revenues from non-voice services, in India the corresponding figure is currently<sup>20</sup> only around 17%, of which 8% is the share of data services, excluding revenue from non-voice messages and miscellaneous value added services such as caller-ring-back tones etc. There is thus a great potential for growth which can be realized through enabling policies and a developing eco system encompassing liberalisation of spectrum use, increased availability of spectrum, increased availability and use of smart phones and growth in value-added services and applications. The 800 MHz band, being a sub-GHz band, is an efficient spectrum band for providing data services. One

---

<sup>20</sup> Accounting Separation Reports for the year 2012-13 submitted by TSPs to TRAI

possible approach to its valuation could be on the basis of expected future revenue with focus on the revenues that can be earned from data services.

### **Basic assumptions**

3.19 The following assumptions could be made in arriving at the valuation of 800 MHz spectrum:

- a) Auction of 800 MHz spectrum will be for liberalized use (i.e. any technology, not just CDMA, can be deployed for providing mobile telephony services). TSPs operating in different bands will have an equal and analogous preference for 800 MHz spectrum. Demand for 800 MHz spectrum will not be confined to TSPs using 800 MHz for providing CDMA services.
- b) 800 MHz spectrum in the coming years will be primarily used for providing data services to customers. Since data services will also be provided on other spectrum bands, it is assumed that over the next 20 years, the share of the 800 MHz band in the total revenue from data services will be around 25% in each LSA.
- c) Share of the 800 MHz band in revenue from non-data (primarily voice) services in each LSA will be constant over the next 20 years.
- d) Data download per subscriber will grow, initially at a high rate of 10% in 2014-15 and subsequently at a tapering rate over the next 20 years. Minutes of voice usage per subscriber (MoU) will remain constant over 20 years. The number of subscribers will grow at a tapering rate, starting from 6% in 2014-15. Revenue per unit of usage from data services as well as non-data services remain the same over the next 20 years. Thus growth in revenue from non-data services effectively represents only growth in subscribers whereas growth in revenue from data services is the combined effect of subscriber growth and data download growth.

- e) Additional network operating and maintenance cost (including rental costs for infrastructure services) will be incurred for deploying the 800 MHz spectrum.

### **Methodology**

- 3.20 The amount of expected revenue from 800 MHz spectrum minus network operating and maintenance costs represents the potential net revenue earnings. The potential earnings can be calculated individually for each LSA based on LSA specific network operating cost percentage, share of data revenue, number of subscribers etc. The NPV of potential revenue earnings over 20 years discounted at 12.50% can be taken as one of the indicative values of 800 MHz spectrum that existing TSPs might be willing to pay in each LSA. For calculating the value per MHz, the NPV in each LSA can be divided by the total available (as of today) 800 MHz spectrum in that LSA.

- Q5. Should the value to be paid for 800 MHz spectrum be based upon the potential growth in data services? If yes, please state whether you agree with the assumptions made.**

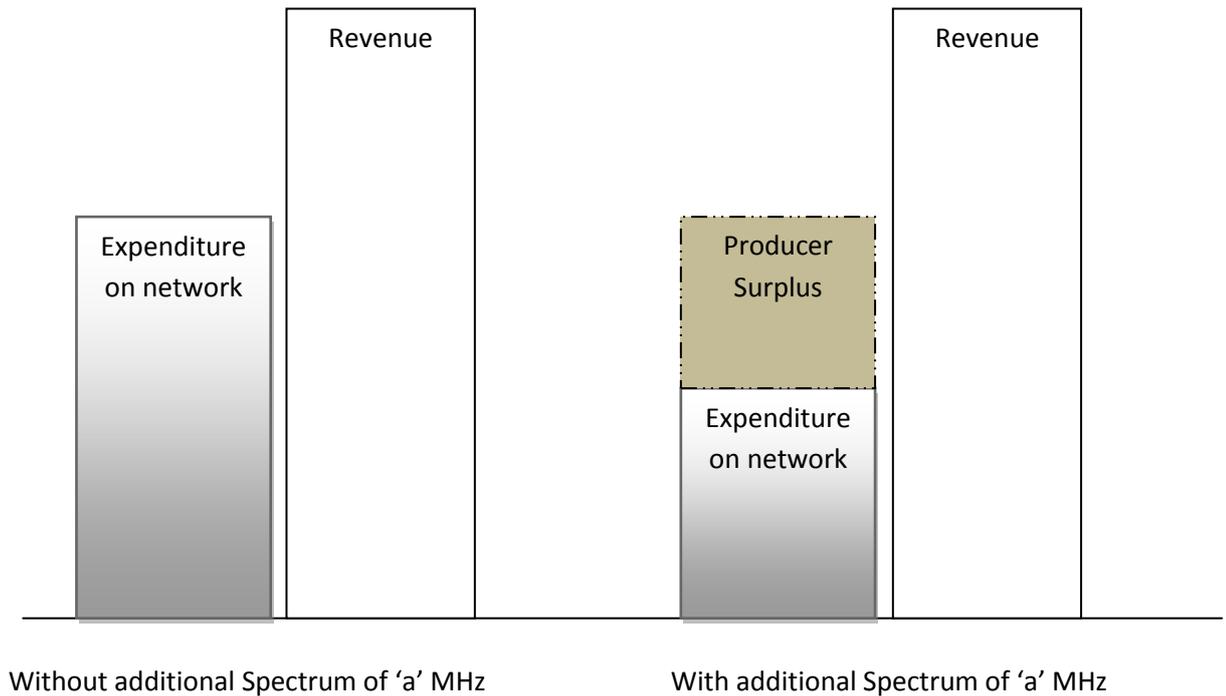
### **PRODUCER SURPLUS ON ACCOUNT OF ADDITIONAL SPECTRUM**

- 3.21 One of the methods used for valuation of spectrum in 1800 MHz was 'Producer Surplus' that arises when additional spectrum in 1800 MHz band is allocated to an existing GSM TSP. Using a similar method, the spectrum in 800 MHz band could also be valued.
- 3.22 As there is an inverse relationship between the quantum of spectrum allocated and the expenditure on the radio access network (RAN) required to serve a particular level of demand, the allocation of additional spectrum in the 800 MHz band to an existing TSP operating in the 800 MHz band will create a producer surplus in the form of costs saved on RAN.
- 3.23 Let us consider a TSP offering services having 'x' MHz of spectrum in 800 MHz band. 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 in 800 MHz band available to it. In order to fulfil 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 fulfil its projected demand.

- 3.24 If the TSP obtains an additional spectrum of 'a' MHz in 800 MHz band today, the capital expenditure on the network and operating expenditure to run the network in each year, required to fulfil 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 in 800 MHz band is approximately equal to the cost savings upon its acquisition.
- 3.25 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 in 800 MHz band and the other with spectrum of 'x+a' MHz in 800 MHz band 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:

### Producer Surplus on Account of Additional Spectrum in 800 MHz



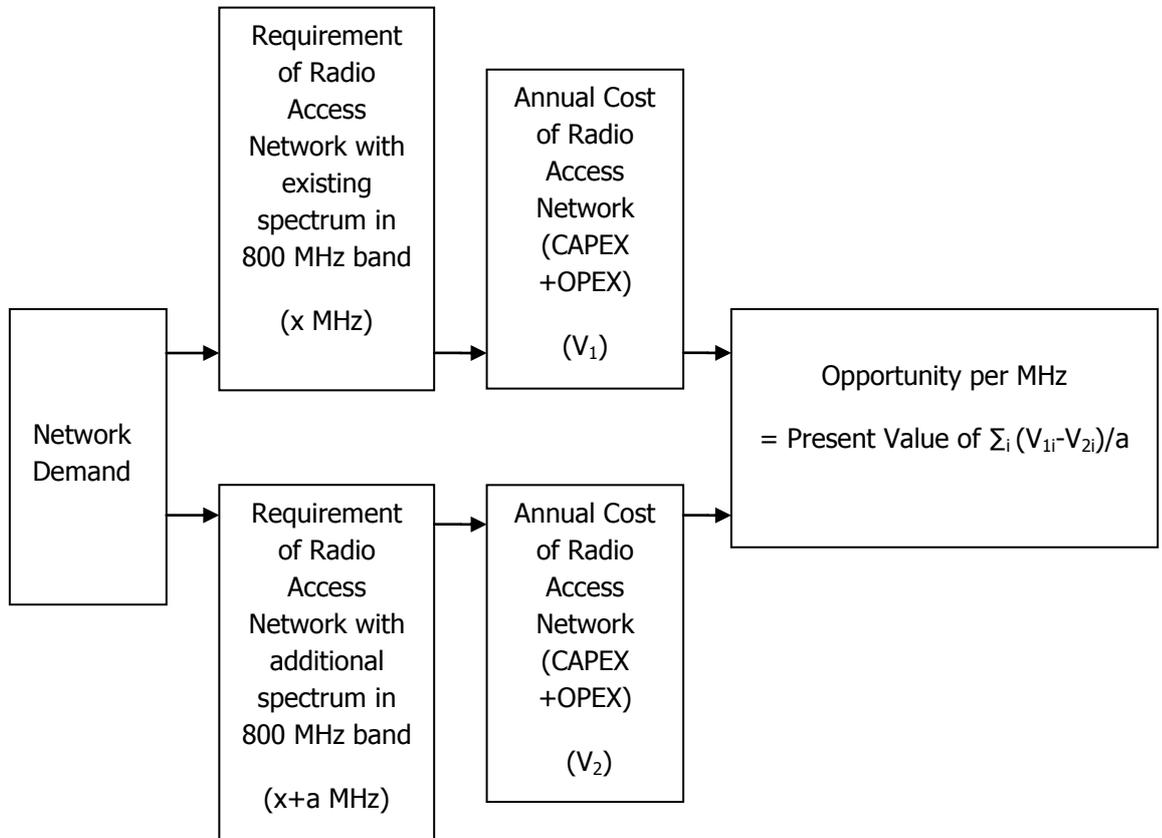
3.26 The producer surplus on account of additional spectrum of 'a' MHz in 800 MHz band may be estimated as below:

Producer surplus on account of additional spectrum of 'a' MHz in 800 MHz band

= 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 in 800 MHz

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

**Block Schematic of the Method for Estimating Producer Surplus  
in 800 MHz band**



3.28 The amount of producer surplus from deployment of additional 800 MHz spectrum can be estimated by using the industry data available with TRAI of the number of subscribers of TSPs operating their networks in the 800 MHz band, present usage by such subscribers, and overall growth patterns of voice, SMS and data for the telecom industry, as well as the CAPEX and OPEX cost of RAN in the 800 MHz band.

**Q6. Should the value of spectrum in the 800 MHz band be assessed on the basis of producer surplus on account of additional spectrum? If you are in the favour of this method, please furnish the detailed calculations and relevant data along with results.**

## **COMPARISON WITH INTERNATIONAL PRICES**

- 3.29 Unlike in the case of the valuation of 1800 MHz spectrum, in the current exercise of valuation of spectrum in the 800 MHz band, there is a lack of empirical data from previous auctions. In the March 2013 auction, spectrum was actually sold only in 8 LSAs. The number of data points are, therefore, inadequate for deriving any relationship based on regression analysis as was done during the last exercise for 1800 MHz spectrum (see the recommendations of 9<sup>th</sup> September, 2013).
- 3.30 Another way to estimate the value of 800 MHz spectrum in India could be to look at international prices realized in auctions of similar frequency (i.e. 700/800 MHz bands) held in other countries. Adopting international prices as benchmarks for the value of spectrum was discussed in the Authority's recommendations on "Valuation and Reserve Price of Spectrum" dated 9<sup>th</sup> September, 2013. It was concluded that international comparison could be adopted as a "sense check" on the value of spectrum on a pan-India basis rather than as a benchmark for its value.
- 3.31 In this context, it is observed that historical data on international prices realized in several countries in auctions of the 700/800 MHz frequency bands in the recent past is available. In the absence of historical data from within the country, the Authority in the current exercise of valuation has tried to explore the possibility of using international data as a value estimator for 800 MHz spectrum.
- 3.32 The international comparison is premised on the underlying principle that two goods or services of the same quality sold in a similar time-frame should inherently be valued at a similar price, given broad similarity in market and economic conditions.
- 3.33 The advantage of using this approach is that it is based on real market determined prices and, hence, assumptions made are restricted to a minimal set of standardizing parameters, rather than to the measure of

value itself. The data on international prices realized across 14 countries on the sale of 700-800 MHz in auctions held during the last 3 years is indicated below:

<b>Country</b>	<b>Year of Auction</b>	<b>Frequency/ band (MHz)</b>	<b>Licence duration (in years)</b>	<b>Realised price* per MHz (PPP adjusted Rs. in Crore)</b>
<b>Czech Republic</b>	2013	796 -862	15	<b>49.38</b>
<b>Finland</b>	2013	791-852	20	<b>8.10</b>
<b>New Zealand</b>	2013	700/800	20	<b>6.36</b>
<b>Germany</b>	2010	791-862	15	<b>420.86</b>
<b>Italy</b>	2011	700/800	18	<b>295.20</b>
<b>Portugal</b>	2011	791-862	15	<b>40.61</b>
<b>Spain</b>	2011	700/800	20	<b>130.37</b>
<b>France</b>	2011	700/800	15	<b>286.17</b>
<b>UK</b>	2013	791-837	20	<b>134.39</b>
<b>Sweden</b>	2011	791-862	25	<b>13.16</b>
<b>Croatia</b>	2012	792-862	12	<b>13.75</b>

\* Realised price per MHz has been prorated for 20 years license duration.

3.34 To ensure that the price data on the sale of 700/800 MHz is comparable, the following adjustments have been made:

- Adjustment for duration of the licence validity has been done as different countries have different licence durations e.g. in the case of countries where licence validity is for 15 years, the realized price has been prorated for 20 years to make it in line with licence validity duration in India.
- All the prices have been converted into common units i.e. Indian rupees (Rs) per MHz.
- PPP adjustments have been done to adjust for relative purchasing power in different countries.

3.35 One of the challenges in this exercise is to identify the factors that influence spectrum value and account for inter-country differences in price. These may range from measurable, quantitative factors such as income levels, size of population or subscriber base etc. to highly

qualitative, intangible features such as the state of governance, policy framework etc. While it may not be feasible to control for each and every factor, some major variables that may impact price and for which data is available are population, GDP, GDP per capita, tele-density, subscriber base and ARPU.

3.36 One approach could be to attempt a multiple variable regression using the empirical data available on prices of spectrum in the aforementioned cross-section of countries and variables such as population, GDP, GDP per capita, tele-density, subscribers and ARPU in these countries. The results from such regression can be analysed to find out if there is any significant relationship between the auction price (dependent variable) and the specified independent variables.

3.37 Regressions were run using two different combinations of independent variables with the dependent variable (spectrum price) being same in both the combinations:

(i) GDP per capita, PPP (constant 2005 Rs. in crore), tele-density (in %) and ARPU;

(ii) Population, wireless subscribers, GDP PPP (constant 2005 Rs. in crore), ARPU.

3.38 The coefficient estimates (both intercept as well slope) from the above regressions are not statistically significant. The standard errors for the coefficient estimates are also high, suggesting that the explanatory variables do not have a significant relationship with the prices (dependent variable). One reason could be that the variables used do not capture the totality of inherent inter-country differences that impact spectrum prices. However, since the number of data points is limited, explanatory variables to control for various country specific factors cannot be increased beyond a point. It will only result in reducing the degrees of freedom and render the regression results unstable.

3.39 An alternative approach could be mapping of LSAs to countries by comparing the values of the above stated variables in each LSA with the different countries. On the basis of values of some of these variables etc., many of our Metro /A category LSAs are comparable to countries like Germany, Italy and France. A similar exercise of mapping was also done by one of the stakeholders in their response to the consultation paper dated 23<sup>rd</sup> July, 2013 on 'Valuation and Reserve Price of Spectrum'.

**Q7. Should the value of spectrum in the LSAs in India for 800 MHz be determined by utilizing the data on international prices? What other variables do you suggest for arriving at robust value estimates using the multiple regression approach? Is there any alternate approach for valuation of spectrum in 800 MHz using the data on international auctions?**

**Q8. Apart from the approaches discussed above, is there any alternate approach for valuation of spectrum in 800 MHz that you would suggest? Please support your answer with detailed data and methodology.**

#### **RESERVE PRICE ESTIMATION**

3.40 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. 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.

3.41 The concept of auction efficiency, revenue maximization, reserve price in an auction and international practices were discussed in detail in the

Authority's Consultation Paper dated 23<sup>rd</sup> July 2013 on 'Valuation and Reserve Price of Spectrum'. Subsequent to that consultation, the Authority in its recommendations dated 9<sup>th</sup> September 2013 on 'Valuation and Reserve Price of Spectrum' decided on the general principle that the reserve prices should be fixed at 80% of the average valuation for a spectrum band. While giving recommendations on the reserve price for 1800 MHz spectrum, the Authority observed that in some LSAs, this method would result in reserve prices pegged higher than prices realized in the November 2012 auction / reserve prices in the March 2013 auction. The Authority was of the view, for the reasons stated in the recommendations of 9<sup>th</sup> September 2013, that reserve prices for 1800 MHz in different LSAs would therefore have to be tempered. The Authority recommended that reserve price for 1800 MHz should be the lower of (i) 80% of the average valuation or the price realized in November 2012 auction (in the 18 LSAs where spectrum was sold in November 2012 auction) and (ii) 80% of the average valuation or the reserve price in March 2013 (in the 4 LSAs where spectrum was not sold). The Authority also recommended that reserve price for 900 MHz in 3 Metro LSAs i.e. Delhi, Mumbai and Kolkata should be fixed at 80% of the average valuation of spectrum in each LSA.

3.42 However, during review of the Notice Inviting Applications for auction of spectrum issued by Government of India on 12<sup>th</sup> December 2013, it has been noted that, as against the reserve price recommended by the Authority, the Government has fixed the reserve price of 1800 MHz in Metro/A category LSAs equal to 100% of the average valuation of spectrum as worked out by the Authority. Similar is the position for 900 MHz in 3 Metro LSAs. Reserve prices for 1800 MHz in all other LSAs are as recommended by the Authority.

**Q9. What should be the ratio adopted between the reserve price for the auction and the valuation of the spectrum? Would it be optimal to fix reserve price equal to valuation of spectrum?**

## **CHAPTER-IV**

### **ISSUES FOR CONSULTATION**

- Q.1. What should be the quantum of spectrum in the 800 MHz band that should be put up for auction?**
- Q.2. What should be the block size in the 800 MHz band?**
- Q.3. Should the value of 800 MHz spectrum be derived on the basis of the value of 1800 MHz spectrum using technical efficiency factors?**
- Q.4. Is there any case for application of a lower efficiency factor (1.3) over the valuation of 1800 MHz spectrum, for determining the valuation of 800 MHz, as was done in the previous auction? If yes, give detailed reasons for the same.**
- Q.5. Should the value to be paid for 800 MHz spectrum be based upon the potential growth in data services? If yes, please state whether you agree with the assumptions made.**
- Q.6. Should the value of spectrum in the 800 MHz band be assessed on the basis of producer surplus on account of additional spectrum? If you are in the favour of this method, please furnish the detailed calculations and relevant data along with results.**
- Q.7. Should the value of spectrum in the LSAs in India for 800 MHz be determined by utilizing the data on international prices? What other variables do you suggest for arriving at robust value estimates using the multiple regression approach? Is there any alternate approach for valuation of spectrum in 800 MHz using the data on international auctions?**
- Q.8. Apart from the approaches discussed in the paper, is there any alternate approach for valuation of spectrum in 800 MHz that you would suggest? Please support your answer with detailed data and methodology.**

**Q.9. What should be the ratio adopted between the reserve price for the auction and the valuation of the spectrum? Would it be optimal to fix reserve price equal to valuation of spectrum?**

Government of India  
Ministry of Communications & IT  
Department of Telecommunications  
WPC Wing, Sanchar Bhavan, New Delhi 1

No.: L-14006/03/2013-NTG

Dated 12.12.2013

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 reserve price for 800 MHz band in all the service areas.**

Sir,

Undersigned is directed to state that it has been decided to conduct another round of auction of spectrum for 800 MHz band in all the service areas.

2. The EGoM in its meeting held on 22<sup>nd</sup> November, 2013, directed the Department to request the TRAI to recommend reserve price for 800 MHz band in all the service areas to enable auction.

3. TRAI is, therefore, requested to furnish their recommendations on reserve price for 800 MHz band in all the service areas in terms of clause 11(1)(a) of TRAI Act 1997 as amended by TRAI Amendment Act 2000.

Yours faithfully,



(R.B.Prasad)  
Joint Wireless Adviser

Government of India  
Ministry of Communications and IT  
Department of Telecommunications  
(WPC Wing)

No. L-14006/03/2013-NTG

Dated the 20<sup>th</sup> December, 2013

The Secretary,  
Telecom Regulatory Authority of India,  
Mahanagar Doorsanchar Bhawan,  
Jawahar Lal Nehru Marg,  
(Old Minto Road),  
New Delhi – 110 002

Sub: TRAI Recommendations on Reserve Price for auction of spectrum in 800 MHz band.

Sir,

I am directed to refer to your letter No. 103-9/2013-NSL-II dated 13<sup>th</sup> December, 2013 on the above subject. The information sought is as below, on issues raised in Para 8 of your above referred letter:

- (a) The consultation with the Ministry of Defence on the feasibility of shifting their existing frequency assignments from 925-935 MHz band to 834-844 MHz band was undertaken. Defence has intimated that due to their operational requirements, it is not feasible to migrate the equipment to other bands in a definite time frame.
- (b) It was decided in June 2012 by the Government to put to auction three (3) blocks each of 1.25 MHz (3.75 MHz) during November, 2012 and March, 2013 auction of 800 MHz band. In addition, it was also decided to make a provision for spectrum of one (1) block of 1.25 MHz, wherever available, for topping up the 3 blocks of spectrum put to auction, to meet the requirement of new entrants, if such an exigency arises. In the service areas of Punjab and Andhra Pradesh,

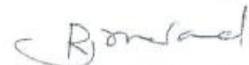
two (2) blocks of each of 1.25 MHz (2.50 MHz) was put to auction and no spectrum was put to auction in the service area of Rajasthan.

It has now been decided by the Government in November, 2013 to seek TRAI Recommendations for the reserve price in 800 MHz band in all service areas to enable auction. The quantum of spectrum in 800 MHz band to be put to auction will be decided by the Government separately.

- (b) Government in June, 2012 decided that in future all spectrum to be assigned shall be liberalised. In other words, spectrum in any band can be used for providing any service within the scope of the respective service licenses using any technology.

2. As far as confirmation sought vide para 7 of the above TRAI letter, it is confirmed that all the details mentioned in para 7 of TRAI letter were placed before the EGoM. Moreover, the decision to auction spectrum in 800 MHz band is policy of the Government in terms of the Section 25 of the TRAI Act, 1997, as amended from time to time. Further, it is worthwhile to mention that Cabinet has directed that the reserve price of spectrum in 800 MHz band be also finalised expeditiously.

Yours faithfully,



(R. B. Prasad)

Joint Wireless Adviser

**ANNEXURE-III**

**CDMA CARRIERS ASSIGNMENTS (EXISTING)**

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

### CDMA CARRIERS ASSIGNMENTS (EXISTING)

S. No	"B" Service Area	1				0.6	185				0.6	369				553		594	
		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23	1.23	1.23	1.23	1.23
		870.030	871.260	872.490	873.720	875.550 876.780 878.010 879.240				881.070 882.300 883.530 884.760				886.590	887.820				
1	HARYANA	AVAILABLE	BSNL	BSNL	AVAILABLE	RCL	RCL	RCL	AVAILABLE	TTL	TTL	TTL	AVAILABLE	AVAILABLE	AVAILABLE				
			42	83		185	226	267		369	410	451		553	594				
		870.03	871.26	872.49	873.72	875.55	876.78	878.01	879.24	881.07	882.30	883.53	884.76	886.59	887.82				
2	MP	AVAILABLE	Vacant	BSNL	BSNL	AVAILABLE	AVAILABLE	AVAILABLE	AVAILABLE	RCL	RCL	RCL	RCL	TTL	TTL				
				75	116					369	410	451	492	553	594				
		870.03		872.25	873.48		875.55	876.78	878.01	879.24	881.07	882.30	883.53	884.76	886.59	887.82			
3	PUNJAB	AVAILABLE	HFCL	HFCL	AVAILABLE	BSNL	BSNL	AVAILABLE	RCL	RCL	RCL	TTL	TTL	TTL					
			42	83	134	213	254	308	369	410	451	512	553	594					
		870.03	871.26	872.49	874.02	876.39	877.62	879.24	881.07	882.30	883.53	885.36	886.59	887.82					
4	RAJSATHAN	Vacant	BSNL	TTL	SSTL	SSTL	SSTL	SSTL	TTL	BSNL	RCL	RCL	RCL	TTL					
			37	98	160	201	242	283	337	398	451	492	533	594					
			871.11	872.49	874.80	876.03	877.26	878.49	880.11	881.94	883.53	884.76	885.99	887.82					
5	KERALA	BSNL	BSNL	BSNL	SSTL	AVAILABLE	TTL	TTL	TTL	RCL	RCL	RCL	RCL	SSTL	SSTL				
		1	42	83	134		226	267	308	369	410	451	492	553	594				
		870.03	871.26	872.49	874.02	875.55	876.78	878.01	879.24	881.07	882.30	883.53	884.76	886.59	887.82				
6	UP(E)	AVAILABLE	BSNL	BSNL	AVAILABLE	TTL	TTL	TTL	AVAILABLE	RCL	RCL	RCL	RCL	AVAILABLE	AVAILABLE				
			42	83		185	226	267		369	410	451	492						
		870.03	871.26	872.49	874.02	875.55	876.78	878.01	879.24	881.07	882.30	883.53	884.76	886.59	887.82				
7	UP(W)	AVAILABLE	BSNL	BSNL	SSTL	RCL	RCL	RCL	RCL	AVAILABLE	TTL	TTL	TTL	SSTL	SSTL				
			42	83	134	185	226	267	308		410	451	482	553	594				
		870.03	871.26	872.49	874.02	875.55	876.78	878.01	879.24	881.07	882.30	883.53	884.76	886.59	887.82				
8	WEST BENGAL	AVAILABLE	BSNL	BSNL	TTL	AVAILABLE	SSTL	AVAILABLE	TTL	SSTL	SSTL	RCL	RCL	RCL	AVAILABLE				
			42	83	144				308	359	400	451	492	533					
		870.03	871.26	872.49	874.32	875.55	876.78	878.01	879.24	880.77	882.00	883.53	884.76	885.99	887.82				

### CDMA CARRIERS ASSIGNMENTS (EXISTING)

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

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