Telecom Regulatory Authority of India

Recommendations

on

Valuation and Reserve Price of Spectrum: Licences Expiring in 2015-16

15th October, 2014

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CHAPTER–I: INTRODUCTION

The Reference from Department of Telecommunications (DoT)

1.1 The DoT, through its letter dated 17th April 2014 **(Annexure 1.1),** communicated that some of the Access Service licences are due to expire during December 2015 and early 2016. It also provided the list of Access (CMTS/UAS) licences due to expire during 2015-16 and their spectrum holdings in 900 and 1800 MHz band and stated that the spectrum held by such licensees is to be put to auction at least 18 months in advance of expiry of licences. The DoT sought TRAI's recommendations on the applicable reserve price for all the service areas for auction of spectrum in 900 MHz and 1800 MHz bands. The Authority has finalised these recommendations in response to DoT's said reference.

1.2 In these recommendations, the Authority has highlighted that the upcoming auction is critical for the Telecom Service Providers (TSPs) whose licences are due to expire in 2015-16. In the 900 MHz band, only the spectrum held by them is available for the auction. These licensees will have to win back this spectrum to ensure business continuity in a Licence Service Area (LSA); if they don't, it places the large investment made in the LSAs in jeopardy. The continuity of services to millions of customers is also at stake. Some of these licensees have already acquired spectrum in the 1800 MHz band in the recently held auctions that can be used as a fallback option, in case they fail to win back spectrum in the 900 MHz band. But, that option cannot be said to be a preferable path. Moreover, in the coming auction, even that fallback option may not be available because the amount of spectrum in the 1800 MHz is insignificant in most LSAs. In this backdrop, the Authority has emphasized the need to make available additional spectrum before conducting the auction.

Background

1.3 The Hon'ble Supreme Court of India through its judgment dated 2nd February 2012 quashed the licences granted on or after 10th January 2008 and ordered the issue of fresh licences by auctions. This decision of the Hon'ble Supreme Court had a significant impact on the process of the award of spectrum, the assignment of which was hitherto done administratively.

1.4 In compliance of the order of the Hon'ble Supreme Court of India, auctions for spectrum in the 1800 MHz and 800 MHz bands were held in November 2012. There was no bidder for the spectrum in the 800 MHz band. In 1800 MHz, except in the LSAs of Delhi, Mumbai, Karnataka and Rajasthan, some spectrum was sold in all the other LSAs.

1.5 The licences awarded in the metros of Delhi, Mumbai and Kolkata in 1994, were due to expire in 2014[1]. The majority of the spectrum held by these licences was in the 900 MHz band. It was put to auction in March 2013 along with 1800 MHz band spectrum in the four LSAs viz Delhi, Mumbai, Karnataka and Rajasthan, where spectrum could not be sold in the previous auctions. There was no bidder for the spectrum in both the 900 MHz and 1800 MHz bands. In addition, spectrum in the 800 MHz band was also put to auction. M/s Sistema Shyam Tele-Services Limited (SSTL) was the sole applicant and obtained 800 MHz spectrum in eight LSAs.

1.6 Auctions were again held in February 2014. In the 900 MHz band, spectrum was again put to auction only in Delhi, Mumbai and Kolkata LSAs. However, in the 1800 MHz band, since the DoT had spectrum available, it was put to auction in all the LSAs. The entire spectrum in the 900 MHz band was sold. In the 1800 MHz band, 307 MHz of spectrum of the total 385 MHz put to auction was sold.

[1] Licences awards for Chennai LSA in 1994 were merged with the licences given for Tamilnadu LSA. Therefore, their validity period got extended.

1.7 The spectrum that would become available as a result of licences expiring in 2014 has already been auctioned. Next in line are the licences awarded in 1995/1996; these licences are due to expire in December 2015 and early 2016. These licensees hold spectrum in the 900 MHz and 1800 MHz bands. It is in this context that the DoT has sent the present reference to the Authority.

1.8 In the 900 MHz band, spectrum becoming available because of 'expiry licences'[2] is the only spectrum that can be put to auction. 184 MHz of spectrum is the amount of spectrum held by these licensees in the 900 MHz band.

1.9 The 'expiry licences' also have a small amount of spectrum (34.2 MHz[3]) in the 1800 MHz band. Some part of this spectrum (8.2 MHz) is lying in the Defence Band (1765 MHz-1785 MHz/1860 MHz-1880 MHz) band); hence, the DoT does not intend to reassign it to the TSPs. In addition, there is some unsold spectrum of the last auction. But altogether, barring a few LSAs, there is a very small amount of spectrum in the 1800 MHz band.

1.10 Apart from limited availability, the non-availability of spectrum in contiguous form is also a major concern for the deployment of new technologies. As per the information provided by the Wireless Planning and Coordination Wing (WPC), 135 MHz of the total 184 MHz spectrum in the 900 MHz band is available in contiguous blocks of 5 MHz while the remaining 49 MHz spectrum is non-contiguous. In the 1800 MHz band, only 35 MHz spectrum of total 104 MHz is available in contiguous form. The rest 69 MHz is available in very small tranches.

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[2] Licences due to expire in 2015-16

[3] The licences, which are expiring in 2015 and 2016, have 27.8 MHz of spectrum in the 1800 MHz band. In some of the LSAs (AP, GUJ and UP (E)), these licensees were awarded different frequencies in different districts depending upon the availability of spectrum after its vacation by the Defence. Now the spectrum, which was selectively available in some of the districts, is available in entire LSA. Therefore, 34.2 MHz of spectrum has been reported by the WPC as the spectrum that is becoming available because of expiry of these licences.

1.11 To prepare a comprehensive Consultation Paper (CP) on the subject, the Authority sought certain information from DoT regarding the availability of spectrum in contiguous and non-contiguous form and the quantum of spectrum that will be put to auction. The DoT, through its letter dated 04th July 2014, provided the LSA-wise details of the available spectrum. However, it informed that the quantum of spectrum to be put to auction and the auction of spectrum in Tamilnadu LSA (excluding Chennai) will be decided by the Government separately. The DoT furnished the details of frequencies assigned in 900/1800 MHz bands through its letter of 12th September 2014.

1.12 The CP was issued on 7th August 2014. In response to the CP, TRAI received 19 comments and 7 counter-comments from stakeholders. These were placed on TRAI"s website www.trai.gov.in.

1.13 An Open House Discussion (OHD) was held on 22nd September 2014. After considering the written comments and counter-comments received from stakeholders, views expressed during the OHD and their written submissions after the OHD, and after carrying out its own analysis, the Authority has finalised these recommendations.

1.14 The recommendations are presented in five chapters. The introductory chapter discusses a brief background to the subject. The second chapter discusses the availability of spectrum in the 900 MHz and 1800 MHz bands and the preferable block-size for auction. The third chapter deals with the valuation and reserve price of spectrum. The fourth chapter discusses about the imperative of decision-making for overcoming spectrum shortage. The fifth chapter contains a summary of the recommendations.

CHAPTER- II: AVAILABILITY OF SPECTRUM

Presently Available Spectrum

2.1 There are 29 licences in 18 LSAs which expire in 2015-16. These 'expiry licences' hold 184 MHz spectrum in the 900 MHz band. In addition, the licensees have a small spectrum holding (34.2 MHz) in the 1800 MHz band. The LSA-wise spectrum held by these licensees is given in Table 2.1 below.

Table 2.1
Licences Expiring in 2015-16

Sl. No.	LSA	TSP	Date of Expiry	Spectrum holding in	
				900 MHz band (MHz)	1800 MHz band (MHz)
1.	Maharashtra (MH)	Idea	11-12-15	7.8	2
		Vodafone	18-12-15	6.2	Nil
2.	Gujarat (GUJ)	Idea	11-12-15	6.2	Nil
		Vodafone	18-12-15	7.8	2
3.	Andhra Pradesh (AP)	Bharti Airtel	11-12-15	7.8	2.2
		Idea	18-12-15	6.2	1.8
4.	Karnataka (KTK)	Bharti Airtel	14-02-16	7.8	2.2
		Idea	08-04-16	6.2	Nil
5.	Tamil Nadu (TN)	Vodafone	11-12-15	6.2	1
6.	Kerala (KL)	Idea	11-12-15	6.2	1.8
		Vodafone	11-12-15	6.2	Nil
7.	Punjab (PB)	Bharti Airtel	11-12-15	7.8	Nil
		Idea	08-04-16	7.8	Nil
8.	Haryana (HR)	Idea	11-12-15	6.2	Nil
		Vodafone	11-12-15	6.2	Nil
9.	UP West (UP (W))	Idea	11-12-15	6.2	1.8
10.	UP East (UP (E))	Vodafone	11-12-15	6.2	2
11.	Rajasthan (RAJ)	Vodafone	11-12-15	6.2	Nil
		Bharti Airtel	21-04-16	6.2	2
12.	Madhya Pradesh (MP)	Idea	11-12-15	6.2	1.8
		RTL	11-12-15	6.2	Nil
13.	West Bengal (WB)	RTL	11-12-15	4.4	1.8
14.	Himachal Pradesh (HP)	Bharti Airtel	11-12-15	6.2	Nil
		RTL	11-12-15	6.2	Nil
15.	Bihar (BH)	RTL	11-12-15	6.2	1.8

Sl. No.	LSA	TSP	Date of Expiry	Spectrum holding in	
				900 MHz band (MHz)	1800 MHz band (MHz)
16.	Orissa (OR)	RTL	11-12-15	6.2	Nil
17.	Assam (AS)	RTL	11-12-15	6.2	Nil
18.	North East (NE)	Bharti Airtel	11-12-15	4.4	1.8
		RTL	11-12-15	4.4	1.8
	Grand Total	**29**		**184.0**	**27.8**[4]

2.2 In the 900 MHz band, the spectrum becoming available due to expiry of licences is the only spectrum that can be put to auction as currently the DoT does not have any unassigned spectrum in this band. Its quantum varies from 4.4 MHz to 15.6 MHz in different LSAs.

2.3 In the 1800 MHz band, 104 MHz spectrum is proposed to be put to auction. Now, 34.2 MHz of spectrum will be available because of expiry of licences and 78 MHz of spectrum is unsold from the last auction held in February, 2014. This adds up to 112.2 MHz. However, as 8.2 MHz is lying in the Defence band, therefore, the DoT does not intend to reassign it to TSPs. The LSA-wise availability of spectrum in 900 and 1800 MHz bands is given in Table 2.2.

2.4 Table 2.2 shows that spectrum availability in the 1800 MHz band is very small. Moreover, all of it is not available in the entire LSA. Of the total 104 MHz spectrum, only 71.6 MHz spectrum is available in the entire LSA; the remaining 32.4 MHz spectrum is available only in part of the LSAs. The details of the geographical areas in each LSA where spectrum is available in given in **Annexure 2.2.** The LSA-wise

[4] The licences, which are expiring in 2015 and 2016, have 27.8 MHz of spectrum in the 1800 MHz band. In some of the LSAs (AP, GUJ and UP (E)), these licence were awarded different frequencies in different districtsdepending upon the availability of spectrum after its vacation by the Defence. Now the spectrum, which was selectively available in some of the districts, is available in entire LSA. Therefore, 34.2 MHz of spectrum has been reported by the WPC as the spectrum that is becoming available because of expiry of these licences.

quantum of spectrum in the 1800 MHz band that is available partially is given in Table 2.3.

Table 2.2
Spectrum Availability in 900 MHz and 1800 MHz Band

Sl. No.	LSA	900 MHz Band	1800 MHz Band			
			Quantum of spectrum unsold in Feb 2014 auction	Quantum of Spectrum available due to expiry of licences	Out of spectrum being released, quantum of spectrum in defence band	Quantum of total available spectrum
		MHz	MHz	MHz	MHz	MHz
1	Delhi (DEL)	0	0	0	0	0
2	Mumbai (MUM)	0	0	0	0	0
3	Kolkata (KOL)	0	7	0	0	7
4	MH	14	0	2	0	2
5	GUJ	14	0	5	1.6	3.4
6	AP	14	0	5.6	1.8	3.8
7	KTK	14	0.8	2.2	1.2	1.8
8	TN	6.2	19	1	0	20
9	KL	12.4	1	1.8	1.8	1
10	PB	15.6	1.6	0	0	1.6
11	HR	12.4	8	0	0	8
12	UP (W)	6.2	0.4	1.8	0	2.2
13	UP (E)	6.2	0.4	3.8	0	4.2
14	RAJ	12.4	8.4	2	0	10.4
15	MP	12.4	0	1.8	1.8	0
16	WB	4.4	0	1.8	0	1.8
17	HP	12.4	10.2	0	0	10.2
18	BH	6.2	0.2	1.8	0	2
19	OR	6.2	16.2	0	0	16.2
20	AS	6.2	0	0	0	0
21	NE	8.8	4.8	3.6	0	8.4
22	J&K	0	0	0	0	0
	TOTAL	**184**	**78**	**34.2**	**8.2**	**104**

Table 2.3
Spectrum Availability in 1800 MHz Band

Sl.No.	LSA	Quantum of total available spectrum	Quantum of partial spectrum	Quantum of spectrum available in entire service area
1	DEL	0.0	0.0	0.0
2	MUM	0.0	0.0	0.0
3	KOL	7.0	0.0	7.0
4	MH	2.0	2.0	0.0
5	GUJ	3.4	2.0	1.4
6	AP	3.8	0.0	3.8
7	KTK	1.8	0.0	1.8
8	TN	20.0	0.0	20.0
9	KL	1.0	0.0	1.0
10	PB	1.6	0.0	1.6
11	HR	8.0	0.0	8.0
12	UP (W)	2.2	1.8	0.4
13	UP (E)	4.2	4.2	0.0
14	RAJ	10.4	10.4	0.0
15	MP	0.0	0.0	0.0
16	WB	1.8	1.8	0.0
17	HP	10.2	4.0	6.2
18	BH	2.0	1.8	0.2
19	OR	16.2	0.0	16.2
20	AS	0.0	0.0	0.0
21	NE	8.4	4.4	4.0
22	J&K	0.0	0.0	0.0
	TOTAL	**104.0**	**32.4**	**71.6**

What is different about this auction?

2.5 The context of the current auction was clearly brought out in CP. To recapitulate, licences are expiring in 18 LSAs and, effectively, the only spectrum on offer is that which is becoming available as a consequence of the expiry of licenses. This is certainly true of the 900 MHz band; in the 1800 MHz band a small quantity of additional

spectrum is available (that remaining unsold from the previous auction). In sum, the two crucial facts are:

(i) The supply of spectrum is constrained; and

(ii) The auction is unusual in that licences are expiring and this knowledge is *a priori* known to all TSPs, enabling strategic decision-making on the latter's part.

2.6 This has important consequences. First, in any situation of short supply, market prices will rise. If any new entrant or another existing licensee enters the fray, one outcome is certain; there will be frenzied bidding viz. a race to the top. A similar escalation of prices was witnessed in the May 2010 auction when 3G spectrum was auctioned; the short supply of 3G spectrum led to a massive increase over the reserve price. But, as pointed out above, in the upcoming auction, the short supply of spectrum is but one dimension of the problem. The other is that incumbent operators would be willing to pay huge sums to retain their spectrum so as to protect their investments made in the LSA and ensure continuity of business. And, all industrial rivals know this; which is why even a non-serious bidder is potentially in a position to push up the final auction price.

2.7 Second, there are only two possible outcomes of such an auction: (a) the incumbents win back the 900 MHz spectrum albeit at significantly high prices; or, (b) one or both incumbent operators lose the 900 MHz spectrum which is won by two or more other bidders. If an incumbent operator wins back the 900 MHz spectrum but at a very high price, it will seriously limit its ability to invest viz. given the indebtedness of most TSPs and the availability of just a limited amount of resources, whatever extra is paid for spectrum, in effect, reduces the amount available for investment in the LSA. The second possibility is that the incumbent loses the spectrum. The

implications here are even graver. There will be immediate discontinuation of service in the LSA. And, a huge loss in terms of the value of investment already made in that LSA[5].

2.8 Once services are discontinued, and a new entrant(s) come into the LSA, they will need time to roll-out services. This will obviously pose problems for consumers. Moreover, if existing consumers port out under Mobile Number Portability (MNP) to another TSP in the same LSA, then, in effect, the auction would have led to a consolidation of market power (dominance) of that TSP. (Leave aside the fact that it effectively deprives consumers of choice of service provider)

2.9 What is more, there are potential spillover effects to other sectors. Given the larger indebtedness of many TSPs to public sector banks (and private sector banks), an exit from an LSA raises the prospect that some part of that TSP's debt could become a Non-Performing Asset (NPA). So, what the Government gains in terms of higher prices of spectrum because of short-supply, may also lead to large NPAs of public sector banks which will ultimately require Government budgetary support viz., the socialization of public costs.

2.10 To sum up; there is a very real risk that bidding could lead to an escalation of auction prices far beyond any reasonable value. Further, even if the incumbents win back the spectrum, there will be serious limit to the investment ability of incumbents. And, if an incumbent operator loses out to a new entrant (or, another licensee), the discontinuation of services would pose problems for consumers leave aside the losses on capital investment made by the incumbent TSP in the LSA.

[5] Once the spectrum is lost, then the RAN cannot be sold at anything close to its economic value because any prospective buyer will be in a commanding position, if at all there is a buyer for the RAN.

Requirement of additional spectrum for auction

2.11 From the above discussion, it is clear that spectrum availability is far from adequate. In the 900 MHz band, there is no additional spectrum; the only spectrum available is as a result of expiry of licences. In the 1800 MHz band, spectrum that can be put to auction is even lesser. Moreover, in case 'expiry licences' fail to acquire spectrum in 900 MHz band, availability of 1800 MHz spectrum does not provide any practical and credible backup arrangement for incumbent licensees, whose licences are expiring.

2.12 In view of the non-availability of adequate quantum of spectrum in the 900 and 1800 MHz bands, stakeholders were requested to comment on the issue of making available additional spectrum in contiguous form in both these bands.

2.13 A number of stakeholders, mainly TSPs whose licences are due to expire, submitted that as per the terms of the License Agreement, there is a provision for extension for 10 years at one time on mutually agreed terms. Hence, in the opinion of these stakeholders, their licences should be extended along with the associated spectrum at a fair market price. They contend that the whole basis of seeking a reserve price for an auction is flawed.

2.14 One stakeholder stated that although the Government did not extend telecom licences along with spectrum in Delhi, Mumbai and Kolkata and put the spectrum to auction, but in that auction, additional spectrum in 1800 MHz was also put to auction, which enabled them to ensure business continuity on 1800 MHz if they failed to acquire their earlier 900 MHz spectrum holding. However, in the upcoming auction no fallback option is available due to the limited availability of spectrum in the 1800 MHz band. Therefore, in the opinion of the stakeholder, it is essential that the approach recommended by the Authority and adopted by the Government

should be such as to ensure continuity of service as well as maintain fairness amongst all licensees.

2.15 Some stakeholders submitted that as the spectrum put to auction is entirely that held by the existing licensees, it may lead to predatory and irrational bidding. In such skewed auction scenarios, new entrants can always artificially raise bids in excess of any fair value with the intent to force existing operators to buy spectrum at unrealistic prices.

2.16 One stakeholder suggested that in the 900 MHz band, up to 4.8 MHz is assigned to Government agencies and used sparingly in very select locations. Therefore, these frequencies may be reused for commercial purposes in the remaining service areas. A few stakeholders also suggested that BSNL is holding 6.2 MHz in the 900 MHz band but in a very fragmented form. If it can be converted to 5 MHz of contiguous spectrum and some part of the spectrum assigned to Government agencies can be assigned to BSNL for its use in only those locations where it is not used by the Government agencies, it will facilitate the availability of another block of 5 MHz (partially available) in the 900 MHz band. Another stakeholder suggested that BSNL should be asked to retain only a maximum of 8 MHz of administered spectrum, consisting of one block of 900 MHz (whatever the determined block size) and the balance in 1800 MHz as their traffic does not require spectrum beyond 8 MHz. A few stakeholders suggested coordinating with Defence to make available additional spectrum in the 1800 MHz and 2100 MHz bands.

2.17 Some stakeholders submitted that it is critical to make available additional spectrum not only in the 900 MHz and 1800 MHz bands but also in the 2100 MHz and 800 MHz bands. These stakeholders also suggested that the auction of spectrum in all bands i.e. 800 MHz, 900 MHz, 1800 MHz and 2100 MHz, should be conducted simultaneously which will ensure that existing operators are at least able to retain previous holdings or procure alternate spectrum in

other bands to ensure continuity of services while newer operators would be able to procure spectrum for future needs.

2.18 Some stakeholders suggested that a roadmap for future availability of spectrum (band wise and year wise) is required to be provided by the DoT. This will enable TSPs to plan for the future. A few stakeholders submitted that the guidelines on spectrum trading and spectrum sharing are critical and will have a lasting impact on operators in the years to come. Therefore, they suggested that these may be released by DoT prior to the upcoming auction.

2.19 A stakeholder pointed out that as there is not enough spectrum in some LSAs, the process needs to be managed carefully if investment is to continue and disruption to services avoided. The stakeholder pointed out that some markets (foreign) have used other methods, such as an 'administrative procedure' for licence renewal, primarily because markets have been seen to be competitive and the economic value of continuity of service has been seen by the Governments to outweigh any potential benefit of using auctions to determine the economic value of spectrum.

2.20 One stakeholder was of the view that, although equal opportunity will be available for a prospective new entrant to acquire spectrum, however their chances of winning will be minimal since "expiry" licensees will do their utmost to retain their spectrum holding in the 900 MHz band to avoid disruption in services. The stakeholder also commented that, in the 1800 MHz band, only 35 MHz is in contiguous full blocks and the balance is in small chunks of fragmented spectrum. This fragmented spectrum is not useful for launch of any data centric network. Spectrum for new service providers in the 1800 band is only available in Kolkata, Orissa and Tamilnadu. Therefore, the possibilities of acquiring spectrum by prospective new entrants are significantly low. Hence, the Government should strive to ensure availability of adequate amount of spectrum for this auction.

Analysis

2.21 The context of the upcoming auction has been discussed in Para 2.5 to 2.10. There is no additional spectrum in the 900 MHz band available with the DoT for assignment. The only spectrum available is because of expiry of licences. The 900 MHz spectrum is a premium spectrum because of its propagation characteristics which results in better in-house coverage and the requirement of fewer number of BTSs to cover a large area. There is a well-developed device ecosystem of HSPA/HSPA+ technology in this band. 80 operators in 53 countries have already deployed HSPA/HSPA+ networks using 900 MHz spectrum[6] and this number is steadily growing. The requirement of 900 MHz is accentuated by the fact that there is no pan-India 3G service provider in the country and the future availability of spectrum in 2100 MHz band is uncertain. Considering all these facts, there is every possibility that most TSPs will try to obtain spectrum in the 900 MHz band. This creates a very difficult situation for 'expiry' licensees.

2.22 Some 'expiry licensees' have acquired spectrum in the 1800 MHz band in the auctions held in February 2014 (Table 2.4). The existing licensees are presently providing mainly voice services using spectrum in the 900 MHz band, which can also be provided using spectrum in the 1800 MHz band. Therefore, to some extent, these licensees have a backup arrangement. Nevertheless, there are some TSPs, whose continuance of services will depend on the outcome of the upcoming auction (Table 2.5). Some of such licensees have 3G spectrum, but it is not a perfect substitute.

2.23 Unlike the February 2014 auctions, spectrum in the 1800 MHz band is now not available in sufficient quantum. Out of 18 LSAs where licences are due to expire, there are only 4 LSAs (Tamilnadu,

[6] Global mobile Suppliers Association's (GSA) report on 'GSM/3G Market/Technology Update' dated 13th February 2014

Haryana, Himachal Pradesh and Orissa) where spectrum availability is 5 MHz or more. The implication is that in case an 'expiry licensee' fails to regain spectrum in 900 MHz, the option of acquiring 1800 MHz is simply not available to it in most LSAs. Moreover, even if these TSPs acquire spectrum in the 1800 MHz band, shifting their entire subscriber base to the 1800 MHz band may not be interruption-free and a smooth process and as there is a considerable difference between the penetration capabilities of 1800 MHz band as compared to 900 MHz band; it may also require considerable re-planning of network and increasing the number of BTSs.

Table 2.4
Spectrum acquired by the 'expiry licensees' in 1800 MHz band in the recent auctions

Sl. No.	LSA	TSP	Spectrum holding in		Spectrum acquired in the 1800 MHz band in 2014 auctions (MHz)	Spectrum acquired in the 1800 MHz band in 2012 (MHz)	Total spectrum acquired in recent auctions (MHz)
			900 MHz band (MHz)	1800 MHz band (MHz)			
		Idea	7.8	2	9	Nil	9
1	MH	Vodafone	6.2		Nil	1.25	1.25
		Idea	6.2		1.6	Nil	1.6
2	GUJ	Vodafone	7.8	5	4.4	Nil	4.4
		Bharti Airtel	7.8	2.2	8.8	Nil	8.8
3	AP	Idea	6.2	3.4	6	Nil	6
		Bharti Airtel	7.8	2.2	8.8	Nil	8.8
4	KTK	Idea	6.2		5	Nil	5
5	TN	Vodafone	6.2	1	Nil	Nil	Nil
		Idea	6.2	1.8	10	Nil	10
6	KL	Vodafone	6.2		7	1.25	8.25
		Bharti Airtel	7.8		8.2	Nil	8.2
7	PB	Idea	7.8		8	Nil	8
		Idea	6.2		6	Nil	6
8	HR	Vodafone	6.2		2.4	2.5	4.9
9	UP (W)	Idea	6.2	3.8	Nil	Nil	Nil
10	UP (E)	Vodafone	6.2	2	4	1.25	5.25
		Bharti Airtel	6.2	2	8.2	Nil	8.2
11	RAJ	Vodafone	6.2		0.8	Nil	0.8
		Idea	6.2	1.8	7	Nil	7
12	MP	RTL	6.2		Nil	Nil	Nil

13	WB	RTL	4.4	1.8	Nil	Nil	Nil
		Bharti Airtel	6.2		10.2	Nil	10.2
14	HP	RTL	6.2		Nil	Nil	Nil
15	BH	RTL	6.2	1.8	Nil	Nil	Nil
16	OR	RTL	6.2		Nil	Nil	Nil
17	AS	RTL	6.2		Nil	Nil	Nil
		Bharti Airtel	4.4	1.8	7	Nil	7
18	NE	RTL	4.4	1.8	Nil	Nil	Nil

Table 2.5
LSAs where licensee need to win spectrum to ensure continuity of services

Name of the licensee	No. of 'expiry licensee'	No. of LSAs where the licensee has already acquired spectrum.	No. of LSAs, where licensee need to win spectrum to ensure continuity of services	Name of such LSAs where Licensee need to win spectrum to ensure continuity of services[7]
Idea	9	7	2	UP(W), GUJ
Vodafone	7	4	3	MH, RAJ, TN
RTL	7	0	7	AS, BH, HP, MP, NE, OR, WB
Airtel	6	6	0	
Total	29	17	12	

Augmenting the Supply of Spectrum

2.24 In view of the above, the Authority is of the considered opinion that there is an obvious and compelling need to make available additional spectrum for the conduct of a fair and equitable auction. Apart from 900 and 1800 MHz bands, new technologies can also be deployed in other bands. For instance, there is deployment of LTE in the 700 MHz bands and 3G in 2100 MHz band in a number of countries. Therefore, if the spectrum can be made available in these bands, it will reduce the dependence of the TSPs only on 900/1800 MHz bands. Therefore, the subsequent paras attempt to examine the

[7] Some of these licensees has already acquired some spectrum in recent auctions. E.g. Idea - 1.6 MHz in Gujarat, Vodafone - 1.25 MHz in Maharashtra and 0.8 MHz in Rajasthan. However, this much quantum of spectrum is not enough for the continuance of services in 1800 MHz band.

feasibility of augmenting the quantum of spectrum in 900 MHz, 1800 MHz, 700 MHz and 2100 MHz bands.

900 MHz band

2.25 BSNL has 6.2 MHz in the 900 MHz band in all 18 LSAs, where licences are due to expire in 2015-16 (Table 2.6). If 1.2 MHz is taken back from BSNL, it will still be left with 5 MHz spectrum in the 900 MHz band. Therefore, it would not impact its ability to offer HSPA/HSPA+ services in the 900 MHz band, if it wishes to do so after converting its spectrum holding into liberalised form. BSNL has 3.8 MHz is 1800 MHz band in all the LSAs except Gujarat, Punjab, Rajasthan and West Bengal.

2.26 The Authority is of the view that 1.2 MHz spectrum in 900 MHz band should be taken back from BSNL and, in lieu, assign 1.2 MHz in the 1800 MHz band only in those LSAs where its spectrum holding in that band is less than 3.8 MHz. There are 3 LSAs, wherein BSNL's spectrum holding in 1800 MHz band is less than 3.8 MHz. Therefore, as per this proposal, an additional 1.2 MHz in 900 MHz band can be obtained in all LSAs and 1.2 MHz in 1800 MHz band can be assigned to BSNL in Gujarat, Rajasthan and West Bengal. In Punjab LSA, no spectrum in the 900 MHz band will be taken as BSNL does not hold any spectrum in the 1800 MHz band. Moreover, in Punjab, 15.6 MHz will become available due to expiry of licences which is comparatively more than other LSAs.

Table 2.6
Spectrum Holding of BSNL in 900 and 1800 MHz band

LSA	900 MHz Band (in MHz)	1800 MHz Band (in
MH	6.2	3.8
GUJ	6.2	1.2
AP	6.2	3.8
KTK	6.2	3.8
TN	6.2	3.8
KL	6.2	3.8
PB	6.2	NIL
HR	6.2	3.8

UP (W)	6.2	3.8
UP (E)	6.2	3.8
RAJ	6.2	1.8
MP	6.2	3.8
WB	6.2	1.8
HP	6.2	3.8
BH	6.2	3.8
OR	6.2	3.8
AS	6.2	3.8
NE	6.2	3.8
Total	**111.6**	**58.0**

2.27 After adding 1.2 MHz spectrum in the 900 MHz band, proposed to be taken back from BSNL, spectrum availability in the 900 MHz band shall be as given in Table 2.7:

Table 2.7

Sl. No.	**LSA**	**No. of 'expiry licences'**	**Spectrum currently available for auction**	**Total No. of 5 MHz blocks possible out of currently available spectrum**	**Spectrum in 900 MHz band that can be taken back from BSNL**	**Spectrum available in 900 MHz band after considering the spectrum that can be taken back from BSNL**	**Total No. of 5 MHz blocks possible after considering the spectrum that can be taken back from BSNL**
		No.	**MHz**	**No.**	**MHz**	**MHz**	**No.**
1	MH	2	14	2	1.2	15.2	3
2	GUJ	2	14	2	1.2	15.2	3
3	AP	2	14	2	1.2	15.2	3
4	KTK	2	14	2	1.2	15.2	3
5	TN	1	6.2	1	1.2	7.4	1
6	KL	2	12.4	2	1.2	13.6	2
7	PB	2	15.6	3	NIL	15.6	3
8	HR	2	12.4	2	1.2	13.6	2
9	UP (W)	1	6.2	1	1.2	7.4	1
10	UP (E)	1	6.2	1	1.2	7.4	1
11	RAJ	2	12.4	2	1.2	13.6	2
12	MP	2	12.4	2	1.2	13.6	2
13	WB	1	4.4	0	1.2	5.6	1
14	HP	2	12.4	2	1.2	13.6	2
15	BH	1	6.2	1	1.2	7.4	1

16	OR	1	6.2	1	1.2	7.4	1
17	AS	1	6.2	1	1.2	7.4	1
18	NE	2	8.8	1	1.2	10	2
	Total	**29**	**184**	**28**	**20.4**	**204.4**	**34**

2.28 This will lead to availability of an additional block of 5 MHz (contiguous and/or non-contiguous) in 6 LSAs (Maharashtra, Gujarat, Andhra Pradesh, Karnataka, North East and West Bengal). It will also augment spectrum availability in other LSAs which is vital in the present context. In view of foregoing, **the Authority recommends that 1.2 MHz spectrum in 900 MHz band should be taken back from BSNL from all the LSAs where licences expire in 2015-16 except in Punjab. In lieu, BSNL should be assigned 1.2 MHz in the 1800 MHz band only in those LSAs where its spectrum holding in that band is less than 3.8 MHz in this band i.e. in Gujarat, Rajasthan and West Bengal.**

The E-GSM band solution

2.29 In its recommendations of 9th September 2013, the Authority recommended that the feasibility of adoption of E-GSM should be explored in a time-bound manner. On 11th October, 2013, the DoT sought clarification/reconsideration on some of the recommendations. In its response dated 23rd October 2013, 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 the adoption of E-GSM for efficient utilization of spectrum in the 800 MHz band.

2.30 On 12th 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."

2.31 The Department of Telecommunications (DoT), through its letter dated 12th December 2013, sent a fresh reference seeking TRAI's recommendations on reserve price for 800 MHz band in all the service areas. Accordingly, the Authority sent its recommendations on 'Reserve Price for Auction of Spectrum in the 800 MHz Band" dated 22nd February 2014.

2.32 From the above discussion, it can be seen that almost eight months have passed. The DoT has neither taken any decision on the Authority's recommendations of February 2014 nor has it taken any initiative to get the spectrum **vacated** from Defence and licensees for implementation of E-GSM band. Implementation of E-GSM band could have resulted in an additional supply of 900 MHz equivalent spectrum and hence, removed the constraint in the supply of spectrum in the 900 MHz band. What is more it would have given all those clamouring for 900 MHz a fair chance of obtaining 900 MHz equivalent spectrum. The Authority is of the considered view that the DoT should take a fresh look at the implementation of E-GSM band. Accordingly, **the Authority recommends that the DoT should take a completely fresh look at the implementation of E-GSM band.**

1800 MHz band

2.33 Of a total 2x75 MHz of spectrum in the 1800 MHz band, 55 MHz (1710 -1765 MHz/1805-1860 MHz) is earmarked for commercial use while the DoT has decided to assign remaining 20 MHz (1765 -1785 MHz/1860-1880 MHz) to Defence. As per the information provided

by the WPC, the current assignment for Defence and commercial use differ from the above arrangement as given in Table 2.8. WPC has not provided the information that if any TSP is assigned any spectrum partially, then who is the user for rest of the LSA. Therefore, the actual assignment to Defence may be more than what is shown in Table 2.8.

Table 2.8

LSA	Assignment to Defence in commercial band	Assignment to Defence in Defence band	Total assignment to Defence	Assignment to commercial users in Defence band	Vacant /Un-assigned spectrum /guard band in Defence band
	MHz	MHz	MHz	MHz	MHz
A	B	C	D=B+C	E	F=20-(C+E)
DEL	15.4	14.8	30.2	3.4	1.8
MUM	12.8	0.0	12.8	16.4	3.6
KOL	6.2	0.0	6.2	9.4	10.6
GUJ	17.8	5.2	23.0	10.4	4.4
MH	8.2	5.4	13.6	8.4	6.2
AP	0.0	0.0	0.0	10.6	9.4
KTK	9.2	0.0	9.2	13.0	7.0
TN	0.0	0.0	0.0	12.2	7.8
KL	0.0	0.0	0.0	10.0	10.0
PB	7.6	14.4	22.0	5.6	0.0
HR	11.2	10.4	21.6	9.6	0.0
UP(W)	7.8	7.8	15.6	12.2	0.0
UP(E)	3.8	8.2	12.0	9.4	2.4
RAJ	5.0	15.4	20.4	4.4	0.2
MP	0.0	0.0	0.0	8.0	12.0
WB	9.8	9.6	19.4	8.2	2.2
HP	16.0	11.2	27.2	8.8	0.0
BH	2.4	0.0	2.4	15.6	4.4
OR	0.0	1.2	1.2	10.6	8.2
AS	17.2	2.0	19.2	10.0	8.0
NE	9.2	10.0	19.2	6.2	3.8
J&K	43.8	13	56.8	4.4	2.6
Total	**203.4**	**128.6**	**332**	**206.8**	**104.6**

2.34 It can be seen from Table 2.8 that Defence is holding significant quantity of spectrum in the commercial band i.e. in 1710-1765 MHz /1805-1860 MHz range. The DoT has decided that spectrum to be vacated by licences expiring but lying in the Defence band will not be

put to auction. This will result in spectrum lying unused till such time as Defence vacates spectrum in the commercial band and migrates to its assigned band. For instance, in Gujarat, Defence has assignment of 23 MHz in 1800 MHz band. If the DoT decides not to auction vacant spectrum in Defence band, 4.4 MHz will remain idle till the time Defence migrates from commercial band to Defence band. To the best of our understanding, the DoT has taken this decision without any commitment from Defence regarding its migration plan from commercial band to Defence band.

2.35 **The Authority is of the view that, in the absence of any time frame for shifting of Defence from commercial band to its designated band, unused spectrum in the Defence band should not be kept idle.** Keeping spectrum unused not only creates artificial scarcity but also amounts to commercial loss to the Government. The DoT in coordination with Defence should fix a time frame for such shifting. If because of any reasons, this is not possible then only that much spectrum should be kept reserved for Defence in the Defence band which would make its total spectrum holding 20 MHz in the 1800 MHz band. The rest of the vacant spectrum in the Defence band should be put to auction. Refer to Table 2.9 for implications.

2.36 It can also be seen from the Table 2.8 that there is nil or negligible spectrum assignment to Defence in a number of LSAs viz. Andhra Pradesh (nil), Tamilnadu (nil), Kerala (nil), Madhya Pradesh (nil), Bihar (2.4 MHz) and Orissa (1.2 MHz). The Authority is of the view that if Defence can managed its communications requirements till date with no or a negligible amount of spectrum in these LSAs, there seems little justification for assigning 20 MHz to it, especially when it is idle. Perhaps, only 5 MHz can be kept reserved for them in these 6 LSAs for any future requirement.

2.37 Considering the spectrum that will become available as suggested in the above paras, the net availability of spectrum in 1800 MHz band will be as given in Table 2.9.

Table 2.9

Sl. No.	LSA	Quantum of total available spectrum	Quantum of partial spectrum	Quantum of spectrum available in entire service area	Additional spectrum that can be made available in 1800 MHz band[8]	Total[9]
		MHz	MHz	MHz	MHz	MHz
		A	B	C	D	E=A+D
1	DEL	0	0	0	1.8	1.8
2	MUM	0	0	0	0	0
3	KOL	7	0	7	0	7
4	MH	2	2	0	0	2
5	GUJ	3.4	2	1.4	4.4	7.8
6	AP	3.8	0	3.8	4.4	8.2
7	KTK	1.8	0	1.8	0	1.8
8	TN	20	0	20	2.8	22.8
9	KL	1	0	1	5	6
10	PB	1.6	0	1.6	0	1.6
11	HR	8	0	8	0	8
12	UP (W)	2.2	1.8	0.4	0	2.2
13	UP (E)	4.2	4.2	0	0	4.2
14	RAJ	10.4	10.4	0	0.2	10.6
15	MP	0	0	0	7	7
16	WB	1.8	1.8	0	1.6	3.4
17	HP	10.2	4	6.2	0	10.2
18	BH	2	1.8	0.2	1.8	3.8
19	OR	16.2	0	16.2	4.4	20.6
20	AS	0	0	0	7.2	7.2
21	NE	8.4	4.4	4	3	11.4
22	J&K	0	0	0	2.6	2.6
	TOTAL	**104**	**32.4**	**71.6**	**46.2**	**150.2**

2.38 In view of above, **the Authority recommends that unused spectrum in the Defence band should not be kept idle. The DoT in coordination with Defence should fix a time frame for migration of Defence from commercial band to Defence band. If**

[8] In 6 LSAs viz. Andhra Pradesh, Tamilnadu, Kerala, Madhya Pradesh, Bihar and Orissa, 5 MHz has been kept reserved for Defence. In other LSAs a provision of 20 MHz has been kept wherever the assignment to Defence is less than 20 MHz. The remaining spectrum in the Defence band has been shown as additional spectrum.

[9] Spectrum assignment of 1.2 MHz in 1800 MHz band to BSNL in GUJ, RAJ and WB in lieu of 900 MHz spectrum ,as recommended earlier, has not been taken into account in this table.

because of any reasons, this is not possible then only that much spectrum should be kept reserved for Defence in the Defence band which would make its total spectrum holding 20 MHz in the 1800 MHz band. In some LSAs viz. Andhra Pradesh, Tamilnadu, Kerala, Madhya Pradesh, Bihar and Orissa, where there is nil or negligible spectrum assignment to Defence in both commercial and Defence band, only 5 MHz can be kept reserved for them for any future requirement. The rest of the vacant spectrum in the Defence band should be put to auction.

2.39 In some LSAs, such as Delhi, Gujarat, Himachal Pradesh etc, the spectrum held by Defence is more than 20 MHz. The Authority is of the view that DoT should coordinate with Defence for the vacation of spectrum held by Defence in excess of 20 MHz. Accordingly, **the Authority recommends that in the LSAs, where spectrum assigned to Defence in the 1800 MHz band is more than 20 MHz, DoT should coordinate with Defence for the vacation of spectrum held by Defence in excess of 20 MHz.**

2100 MHz band

2.40 2100 MHz band is one of the most internationally harmonized spectrum bands. This band is being used for 3G services (HSPA/HSPA+) which are the leading mobile broadband technologies globally. There are 547 HSPA networks in 205 countries and 363 HSPA+ networks in 157 countries which have been commercially launched[10]. Most of these networks use the 2100 MHz band.

2.41 In India, out of 2x60 MHz available in the 2100 MHz band, only 2x25 MHz spectrum is available for 3G services. 4 blocks of 2x5 MHz (total 2x20 MHz) has been assigned in all the LSAs while the 5th block has been assigned in five LSAs (Punjab, Bihar, West Bengal, Jammu & Kashmir and Himachal Pradesh) and is available with DoT

[10] Global mobile Suppliers Association's (GSA) report on 'GSM/3G Market/Technology Update' dated 13th February 2014

for assignment in the remaining 17 LSAs. Keeping spectrum unassigned to any TSP amounts to commercial loss to the Government both upfront as well recurring charges in form of licence fee and spectrum usage charges. Moreover, there is not a single TSP which has 3G spectrum in all the LSAs. Also, as per the licence terms and conditions, the TSPs can offer subscription of their 3G services in only those LSAs where they have 3G spectrum. However, this issue is under litigation in the Hon'ble Supreme Court on an appeal by the DoT against TDSAT judgment.

2.42 Pending resolution of the above issue, a number of TSPs have requested the Authority to facilitate the release of additional spectrum in the 2100 MHz band so that they can have pan-India 3G spectrum (apart from an add-on to their existing spectrum holdings). In the absence of spectrum in the 2100 MHz band, these TSPs would have no choice but to bid for the 900 MHz band spectrum. Though it cannot be inferred that if the 2100 MHz band spectrum is made available, then these TSPs would not like to have 900 MHz band spectrum; but, surely, their dependence on 900 MHz would not be that much. In view of above, it is critical to make additional spectrum available in the 2100 MHz band.

2.43 The only possible way to further augment availability of spectrum in the 2100 MHz band is through vacation by Defence. The DoT and Defence have agreed to share 300 MHz bandwidth in the 1700-2000 MHz band with each retaining 150 MHz. The DoT's share consists of 2x55 MHz (i.e. 110 MHz) in 1800 MHz band (1710-1765 MHz/1805-1860 MHz). It also includes 15 MHz (1900-1907.5 MHz/1980-1987.5 MHz) of spectrum in the 1900 MHz band[11]. The remaining 25 MHz spectrum of the total 150 MHz to be earmarked for commercial use is in the lower portion of the 3G spectrum band (1920-1980 MHz / 2110-2170 MHz). The issue that is relevant here is that if only 150 MHz of spectrum is to be earmarked for commercial usage, then

[11] 1900 MHz band refers to 1900-1910/1980-1990 MHz range.

which particular spectrum band should be chosen for it. Should it be 2x7.5 MHz spectrum in the 1900 MHz band or 15 MHz of spectrum in the 1920-1980 MHz band?

2.44 In its earlier recommendations, the Authority had consistently recommended that spectrum of 800 MHz band should be refarmed at the time of renewal of respective licences and should be replaced by an equal amount of spectrum in the 1900 MHz band after carrying out the interference study in the 1900 MHz band vis-a-vis its adjoining bands, particularly the 3G band. However, now spectrum has been delinked from the licence and licensees have to obtain the spectrum through the market process. Therefore, the Authority is now of the view that its earlier recommendations for reserving the 1900 MHz band for the refarming of 800 MHz band spectrum are no longer relevant. Moreover, there is a steady decline in the number of CDMA subscribers in the 800 MHz band. In comparison, as discussed above, the 2100 MHz band is a globally harmonized band with a mature device eco-system. Therefore, the Authority is of the opinion that the entire 2x60 MHz in the 2100 MHz band should be made available for commercial use. If required, Defence may be assigned spectrum in the 1900 MHz band (1910-1920/1980-1990 MHz). This matter is of utmost importance, therefore it must be taken up at the highest levels and the vacant 3G slots should be put to auction along with the auctions of the 900 and 1800 MHz band.

2.45 Accordingly, **the Authority recommends that the entire 2x60 MHz in the 2100 MHz band should be made available for commercial use. If required, Defence may be assigned spectrum in the 1900 MHz band (1910-1920/1980-1990 MHz). The Authority also recommends that auctions in this band should be carried out along with the auctions in 900/1800 MHz band.**

700 MHz Band

2.46 The 700 MHz (698-806 MHz) band is an excellent frequency band for wide area coverage and for penetrating homes and buildings. It is being adopted as a prime band for Long Term Evolution (LTE) technology by a number of countries. There has been growing consensus in the APAC and Latin America region on the band plan, also known as APT700 band (FDD option) or band 28, for the use of this band. This band along with the adoption of a uniform band plan represents a major opportunity for spectrum harmonization for LTE deployments covering a large part of the world which may create vast economies of scale for devices.

2.47 Spectrum in the 700 MHz band has been allocated in Australia, Chile, Ecuador, Fiji, Japan, New Zealand, Papua New Guinea, South Korea, and Taiwan. Several LTE networks using APT700 band (FDD option) are commercially launched as can be seen from Table below:

Table 2.10

APT700 Network	Country	Launch date
Digicel	Papua New Guinea	26th March 2014
FarEas Tone	Taiwan	3rd June 2014
Taiwan Mobile	Taiwan	4th June 2014
Vodafone	New Zealand	18th July 2014
Optus	Australia	23rd July 2014
Telstra	Australia	25th July 2014
Spark	New Zealand	28th August 2014

2.48 Global mobile Suppliers Association (GSA) recently confirmed that 33 APT700-capable devices have been announced by 11 manufacturers. The eco-system is likely to grow as more networks are commercially launched in different countries.

2.49 In its report of 23rd April 2012 on 'Auction of Spectrum' dated 16th April 2012, the Authority recommended that the auction of spectrum in the 700 MHz band should be carried out in the first half of financial year 2014-15. Further, in its recommendations on "IMT –

Advanced Mobile Wireless Broadband Services" dated 20th February 2013, the Authority recommended that *"APT700 band plan should be adopted for the 700 MHz spectrum band (698-806 MHz) with FDD based 2x45 MHz frequency arrangement."* It has been almost 20 months since then, and the DoT has not taken a decision on it. Without finalising the band plan, auctions cannot be conducted. It will also give fillip to the development of device eco-system.

2.50 In January 2013, the WPC intimated that out of 2x45 MHz available in the 700 MHz band, 2x30 MHz will be assigned for commercial use while the remaining 2x15 MHz is for Defence.

2.51 Spectrum in the 700 MHz band is vital for proliferation of broadband in the country. Therefore, the Authority is of the view that the Government should immediately announce the roadmap for the auction of spectrum in 700 MHz band. This should be done before the conduction of upcoming auctions in 900/1800 MHz band, so that the TSPs can take informed decision regarding their participation in the auction.

2.52 In view of the above discussion, **the Authority recommends that**

- **The Government should immediately take action on the Authority's recommendations of February 2013 on the adoption of APT700 in the country.**
- **The Government should also announce the roadmap for the auction of spectrum in 700 MHz band. This should be done before the conduct of the upcoming auctions in 900/1800 MHz band.**

Fragmented Spectrum

2.53 The new technologies like 3G require a minimum 2x5 MHz contiguous block of spectrum. While LTE can be deployed at lower bandwidths, but the minimum quantum for efficient commercial use

is 2x5 MHz in FDD or 10 MHz in TDD mode. It is generally accepted that 2x5MHz contiguous block of spectrum is the minimum required for a data centric network. In the 900 MHz band, 135 MHz of spectrum is available in the form of contiguous blocks of 2x5 MHz. The remaining spectrum is in smaller than 5 MHz blocks. LSA-wise details of frequencies in the 900 MHz band to be put to auction are given in **Annexure 2.1** and a summary is provided in Table 2.11.

Table 2.11

Sl. No.	**LSA**	**Spectrum in 900 MHz band that can be taken back from BSNL**	**Spectrum available in 900 MHz band counting spectrum suggested to be taken back from BSNL**		
			In form of contiguous 5 MHz blocks	**Remaining**	**Total**
			MHz	MHz	MHz
1	MH	1.2	10	5.2	15.2
2	GUJ	1.2	10	5.2	15.2
3	AP	1.2	10	5.2	15.2
4	KTK	1.2	10	5.2	15.2
5	TN	1.2	5	2.4	7.4
6	KL	1.2	10	3.6	13.6
7	PB	NIL	10	5.6	15.6
8	HR	1.2	10	3.6	13.6
9	UP (W)	1.2	5	2.4	7.4
10	UP (E)	1.2	5	2.4	7.4
11	RAJ	1.2	10	3.6	13.6
12	MP	1.2	10	3.6	13.6
13	WB	1.2	0	5.6	5.6
14	HP	1.2	10	3.6	13.6
15	BH	1.2	5	2.4	7.4
16	OR	1.2	5	2.4	7.4
17	AS	1.2	5	2.4	7.4
18	NE	1.2	5	5.0	10.0
	Total	**20.4**	**135**	**69.4**	**204.4**[12]

2.54 The quantity of spectrum available in the 1800 MHz band is not only small but terribly fragmented. Contiguous blocks of 2x5 MHz

[12] Spectrum held in the 900 MHz band by expiring licensees is 184 MHz. Adding to it 20.4 MHz spectrum suggested to be taken back BSNL, total available spectrum becomes 204.4 MHz.

spectrum are available only in four LSAs viz. Kolkata (1 block), Orissa (3 blocks), Rajasthan (1 block but available only in part of LSA) and Tamilnadu (2 blocks). The rest of the spectrum is available in very small tranches (See Table 2.12). In some cases, spectrum is available in tranches of only 2x200 KHz as can be seen from details given in **Annexure 2.2.**

Table 2.12

Availability of spectrum in the 1800 MHz band

Name of LSA	Availability of spectrum in the form of contiguous blocks of 5MHz (MHz)	Availability of spectrum in form of smaller than 5 MHz contiguous blocks		Total available spectrum (MHz)	Total available spectrum excluding partially available spectrum (MHz)
		Quantum of Spectrum (MHz)	Number of small tranches		
DEL	0	0	0	0	0
MUM	0	0	0	0	0
KOL	5	2	1	7	7
MH	0	2	1	2	0
GUJ	0	3.4	3	3.4	1.4
AP	0	3.8	1	3.8	3.8
KTK	0	1.8	3	1.8	1.8
TN	10	10	4	20	20
KL	0	1	1	1	1
PB	0	1.6	1	1.6	1.6
HR	0	8	4	8	8
UP (W)	0	2.2	2	2.2	0.4
UP (E)	0	4.2	2	4.2	0
RAJ	5	5.4	2	10.4	0
MP	0	0	0	0	0
WB	0	1.8	1	1.8	0
HP	0	10.2	5	10.2	6.2
BH	0	2	2	2	0.2
OR	15	1.2	1	16.2	16.2
AS	0	0	0	0	0
NE	0	8.4	7	8.4	4
J&K	0	0	0	0	0
Total	**35**	**69**	**41**	**104**	**71.6**

2.55 As not all spectrum is available in contiguous form, stakeholders were requested to comment whether only contiguous blocks of minimum 5 MHz spectrum should be put to auction. In response, a number of stakeholders suggested that all efforts should be made to make available as much as spectrum as possible in contiguous form.

2.56 One stakeholder commented that contiguity, whilst desirable, may not be easily achievable in a short time frame given the fragmented and sub-optimal supply of spectrum. Therefore, according to the stakeholder, contiguity can be separately and subsequently facilitated by the Government including through discussion and agreement amongst operators. The stakeholder was of the view that, at present, it is important for the Government to maximize the supply of spectrum on offer.

2.57 Another stakeholder said that by making sufficient contiguous spectrum available, the operators would benefit from access to newer technology-ready spectrum. Therefore, a sincere attempt is required to increase availability of contiguous spectrum. However, according to the stakeholder, the proposed spectrum auction will primarily be for 'expiry licensees' wherein concerns over business continuity would take centre stage. Any limitation such as putting up only contiguous blocks of 5 MHz for sale will limit overall availability of spectrum from the currently available 184 MHz of spectrum to 135 MHz in the 900 MHz band and from 104 MHz of spectrum to 40 MHz in the 1800 MHz band. The reduction in the quantum of spectrum will have a direct bearing on the spectrum that the licensee with an expiring term would be able to win, which could conceivably have a significant negative impact on the continuity of services to millions of subscribers. Therefore, in the opinion of the stakeholder, it is in the interest of consumers, industry and the national exchequer that the entire available spectrum is put to auction with a sincere attempt to make available as much contiguous spectrum as possible.

2.58 One stakeholder was of the view that re-assigning spectrum away from the existing users could also potentially result in operators facing additional costs associated with re-planning and implementing charges and potential disruption to service. Another stakeholder suggested that the Government should allow such re-arrangements between TSPs on mutual agreements amongst them. The stakeholder also suggested that the rearrangement of spectrum should be permitted irrespective of the type of spectrum holding with the administrative spectrum holder being mandated to continue with their original services only.

Analysis

2.59 Now that spectrum allocated through auction is liberalised and operators are allowed to use it for any technology, it is essential that the maximum amount of spectrum should be made available in contiguous form. Therefore, making available contiguous spectrum is of great importance. For 3G technology (HSPA/HSPA+), 5MHz is the carrier size. Although, LTE can be offered even with 1.4 MHz and 3 MHz carrier size, but the spectral gains start only with larger spectrum blocks. Therefore, the Authority agrees with the opinion expressed by most stakeholders that all efforts should be made to put spectrum on auction in contiguous form.

2.60 Since various TSPs will acquire spectrum in different quantities, there will always a need for realignment of frequencies assigned to make them contiguous. This can be achieved by mutual cooperation amongst TSPs. To encourage TSPs to make their spectrum holding contiguous, the NIA dated 30th January 2013 for the "Auction of spectrum in 1800 MHz, 900 MHz and 800 MHz", permitted frequency re-configuration- rearrangement of spot frequencies in the same band- from within the assignments made to licensees with the authorization of WPC Wing. No charges were to be levied for re-arrangement of frequency spots. However, there was a condition that the entire spectrum held by the holder should be liberalized.

2.61 The need for having contiguous spectrum was discussed by the Authority in its recommendations on 'Valuation and Reserve Price of Spectrum' dated 9th September 2013, wherein the Authority said that:

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

Accordingly, the Authority recommended that frequency rearrangement in the same band, from within the assignments made to licensees, should be permitted amongst all licensees irrespective of whether the spectrum is liberalised or not. However, the Government, till date, has not accepted/acted on this recommendation.

2.62 The Authority is unable to understand the necessity for placing a restriction on permitting reconfiguration of frequencies only amongst those licensees who have liberalised their entire spectrum holding. In the opinion of the Authority, the condition of liberalizing spectrum is not relevant, as the primary purpose of spectrum continuity is to increase spectral efficiency. Even if a licensee having administratively assigned spectrum or a combination of both administratively assigned and market acquired spectrum makes its spectrum holding contiguous, it would not be permitted to use it for

liberalised use, until its entire spectrum holding in that band is liberalized (Because of the licence condition). This restriction makes it virtually impossible in most cases to swap frequencies to make the spectrum holding contiguous. Moreover, when the licensees have paid the market price to acquire the liberalised spectrum, they should be facilitated to convert their fragmented spectrum holding into a contiguous form.

2.63 The Authority would like to reemphasize the need for having contiguous spectrum blocks. There is no denying the fact that a contiguous block results in a better and more efficient use of spectrum. It can be used for the deployment of new technologies such as 3G, LTE etc. which ensures enhanced spectral efficiencies. Optimal use of spectrum is beneficial not only for the industry but for Government also, because it will result in more revenues in terms of its licence fee and spectrum usage charges. Hence, denying the opportunity to swap frequencies also amounts to commercial loss to the Government. Therefore, **the Authority reiterates its recommendation that the frequency rearrangement in the same band, from within the assignments made to the licensees, should be permitted amongst all licensees irrespective of whether the spectrum is liberalised or not. However, the use of spectrum shall be liberalised only if the entire spectrum holding of a licensee in a particular band is liberalised.**

Can the fragmented spectrum be converted into contiguous form?

2.64 Apart from permitting and encouraging TSPs to realign their spectrum holding to make it contiguous, the Government can itself reassign spectrum frequencies amongst TSPs and Government Users so as to make it contiguous. The Authority has carried out an exercise to examine the feasibility of re-aligning spectrum so that available spectrum in the 900 MHz band and 1800 MHz bands

becomes contiguous. The exercise has been carried out in all such LSAs where the spectrum availability in non-contiguous form is at least 5 MHz. As can be seen from Table 2.11, availability of spectrum in non-contiguous form in 7 LSAs (MH, GUJ, AP, KTK, PB, WB and NE) is 5 MHz or more. The possible ways to make a contiguous block of 5 MHz in respect of these 7 LSAs are provided in Table 2.13.

Table 2.13 (A): Punjab

Vacant Slots		**Possible ways**	**Remark**
902.2-902.4 MHz	2.4 MHz	3.2 MHz spectrum assigned to BSNL and Government Agencies (902.6-905.6) may be swapped with the vacant slots of 0.8, 0.8 and 1.6 MHz.	Affected Users: 2, Affected Assignments: 5. Because in this block of 3.2 MHz, BSNL has 2.8 MHz (in 3 trenches) and Government Agencies has 0.4 MHz (in two trenches).
906.6-907.2 MHz	0.8 MHz		
909.6-910.2 MHz	0.8 MHz		
910.6-912 MHz	1.6 MHz		
Total	5.6 MHz		

Table 2.13 (B): Maharashtra/AP/Karnataka/Gujarat

Vacant Slots		**Possible ways**	**Remark**
900.2-902.4	2.4 MHz	Vacant slot (910.6-912) should be swapped with following assignments: BSNL-902.6-902.8 (0.4 MHz) Govt. User-903-903 (0.2 MHz) Govt. User-904.4-904.4(0.2 MHz) BSNL- 904.6-905.2 (0.8 MHz)	Affected Users: 2, Affected Assignments: 4.
903.2-904.2 (Proposed to be surrendered by BSNL)	1.2 MHz		
910.6-912	1.6 MHz		
Total	5.2 MHz		

Table 2.13 (C): North East

Vacant Slots		**Possible ways**	**Remark**
899.6-902.4	3 MHz	Vacant slot (907.8-908.4) should be swapped with following assignments: BSNL-902.6-902.8 (0.4 MHz) Govt. User-903-903 (0.2 MHz) Govt. User-904.4-904.4 (0.2 MHz)	Affected Users: 2, Affected Assignments: 3
903.2-904.2 (Proposed to be surrendered by BSNL)	1.2 MHz		
907.8-908.4	0.8MHz		
Total	5 MHz		

Table 2.14 (D): West Bengal

Vacant Slots		Possible ways	Remark
898.2-902.4	4.4 MHz	Part of slot to be vacated by BSNL(903.8-903.8 i.e. 0.2 MHz) should be swapped with assignment made to Govt. User-903-903 (0.2 MHz)	Affected Users: 2, Affected Assignments: 2
902.6-902.8 (Proposed to be Surrendered by BSNL)	0.4 MHz		
903.2-903.8 (Proposed to be Surrendered by BSNL)	0.8 MHz		
Total	5.6 MHz		

2.65 A similar exercise has been carried out for the 1800 MHz band. As can be seen from Table 2.12, there are 3 LSAs viz TN, HR and HP, where spectrum availability is 5 MHz or more but in non-contiguous form. The possible ways to make a contiguous block of 5 MHz in respect of these LSAs is given in Table 2.14.

Table 2.14 (A): Himachal Pradesh

Vacant Slots		Possible ways	Remark
1714-1714 MHz	0.2 MHz	Option 1: Vacant Slot of 1761-1763.6 (2.8 MHz) is swapped with 1741-1743.6 MHz of BSNL.	1. BSNL has contiguous block of 3.8 MHz (1740-1743.6 MHz). It will be fragmented. 2. 1741-1743.6 MHz is assigned to BSNL only for Solan. Therefore, its availability for rest of the LSA is not known.
1716.8-1716.8 MHz	0.2 MHz	Option 2: Vacant slot of 1763-1763.6 (0.8 MHz) is swapped with 1716-1716.6 assigned to Airtel.	4 MHz (1717-1720.8) is partially available in the LSA. It is not available in Chamba, Kangra, Kinnaur, Shimla, Sirmour and Solan.
1717-1720.8 MHz	4 MHz	Option 3: 1758.8-1760.8 (2.2 MHz) assigned to Vodafone is swapped with any vacant slot.	It will fragment the contiguous spectrum holding of 5.9 MHz assigned to Vodafone. (Part of it is administratively assigned)
1743.8-1746.6 MHz	3 MHz	Option 4: 1746.8-1748.6(2 MHz) assigned to Defence is vacated/swapped with any vacant slot.	
1761-1763.6 MHz	2.8 MHz		
Total	10.2 MHz		

Table 2.14 (B) -Tamil Nadu

Vacant Slots		**Possible ways**	**Remark**
1715-1715.8 MHz	1 MHz	Vacant Slot of 1715-1715.8 (1 MHz) should be swapped with 1730-1730.8 MHz assigned to Vodafone in Chennai. **It will make one contiguous block of 5 MHz.**	It can only be done if 1730-1730.8 assigned to Vodafone in Chennai is vacant in rest of the LSA.
1725.6-1729.8 MHz	4.4 MHz	Vacant slot of 1743.8-1746 (2.2 MHz) should be swapped with 1749.2-1750.2 (1.1 MHz) assigned to Reliance Jio and 1750.4-1751.4 (1.1 MHz) MHz assigned to BSNL. **It will make available 15 MHz contiguous spectrum.**	
1743.8-1749 MHz	5.4 MHz		
1751.6-1761 MHz	9.6 MHz		
Total	20.4		

Table 2.14 (C): Haryana

Vacant Slots		**Possible ways**	**Remark**
1718.4-1719 MHz	0.8 MHz	**Option 1**: Airtel has total assignment of 6.2 MHz in this band. It is spread over partial assignments of 3 MHz, 3.2 MHz, 4.4 MHz and 1.8 MHz. If the partial assignment can be clubbed to make LSA wise assignments, then 6.2 MHz can be made available for fresh assignment. Some of it can be clubbed with vacant slots to make contiguous clots of 5 MHz available. e.g. 1743.4-1745 (1.8 MHz) of vacant slot may be combined with 1745.2-1749.4 (4.4 MHz)	It can also be done provided that the spectrum that was assigned partially to Airtel is now available for commercial use throughout the LSA.
1733.2-1736.6 MHz	3.6 MHz	**Option 2**: Vacant slot of 1733.2-1736.6 (3.6 MHz) can be clubbed with 1736.8-1738 MHz, which is currently assigned to Government Agency.	
1743.4-1745 MHz	1.8 MHz		
1763-1764.6 MHz	1.8 MHz		
Total	8 MHz		

2.66 The Authority is in agreement with stakeholders that although it is most desirable to make available contiguous blocks for auction to the extent possible, the entire available spectrum should be put to auction. Putting up spectrum only in contiguous blocks will limit the amount of spectrum available for the auction and exacerbate the shortage. For the present, the priority is to put the entire spectrum available with DoT up for auction. Moreover, not all licensees may have immediate plans for 3G or other new technologies which require a minimum of 5 MHz contiguous spectrum. In future, TSPs can themselves or through DoT's intervention realign spectrum holdings. Spectrum trading may also facilitate the realignment of spectrum frequencies.

2.67 In view of above discussion, **the Authority recommends that all efforts should be made to make available spectrum in contiguous form. Nevertheless, the entire available spectrum should be put to auction.**

Block Size and Minimum Quantum of Spectrum to be bid for

2.68 In the auction held in February 2014, the block size was kept as 1 MHz (paired) in the 900 MHz Band and 200 KHz (paired) in the 1800 MHz band. The bidder was required to bid for a minimum of 5 blocks (i.e. 5 MHz) in the 900 MHz band. In the 1800 MHz band, a new entrant[13] was required to bid for a minimum of 25 Blocks (i.e. 5 MHz), while an existing licensee was required to bid for a minimum of 3 blocks (i.e. 0.6 MHz). In the upcoming auctions, the quantum of spectrum is very small in some LSAs e.g. in West-Bengal, spectrum availability in 900 MHz band is only 4.4 MHz. Similarly, in North East LSA, there would be only one successful winner, whereas there are two licences expiring in the 900 MHz band. In the 1800 MHz

[13] Licensees who do not hold UAS/ CMTS/ UL (AS) Licence could participate in the auction process as a 'New Entrant'. Existing UASL/CMTS/ UL (AS) licensees were treated as 'New Entrant' for the frequency bands in which they do not hold spectrum. For the limited purpose of this provision, 900MHz band and 1800MHz band were treated as the same band.

band, there are only 7 LSAs (Kolkata, Tamilnadu, Haryana, Himachal Pradesh, Orissa, North-East and Rajasthan) where spectrum availability is 5 MHz or more. In this context, stakeholders were requested to comment on: (i) what should be the block size to auction spectrum in the 900 MHz and 1800 MHz bands; and, (ii) what should be the minimum quantum of spectrum that a new entrant and an existing licensee should be required to bid for.

2.69 On the issue of block-size, most stakeholders were of the view that a block size of 200 KHz is suitable for all kind of operators and will offer them the flexibility to deploy any kind of technology; a larger block size, such as 1 MHz or 5 MHz, may lead to a situation where it will not be possible to auction all the spectrum becoming available on the expiry of licenses.

2.70 One stakeholder suggested that the minimum quantum of spectrum in the 900 MHz be kept at 4 MHz for new entrants, extension ('expiry') licensees and existing licensees not holding any spectrum in the 900 MHz band because this will meet the twin objectives of business continuity and attracting a third operator in the 900 MHz band. According to the stakeholder, keeping the minimum spectrum at 5 MHz may plausibly force the holder of an expiring licence to abandon its 900 MHz holding without having a fallback option in the 1800 MHz band and therefore force it to shut down operations. Moreover, the option to buy 5 MHz or more in an auction is also available.

2.71 One stakeholder suggested that a new entrant, an extension ('expiry') licensee and an existing licensee who do not have any spectrum in the 900 MHz band should be mandated to bid for 4 MHz in the 900 MHz band. However, for the existing licensee already having spectrum in the 900 MHz band, this may be kept at 0.6 MHz. The stakeholder further submitted that, for new entrants, minimum spectrum required to bid for should be kept at 5 MHz.

2.72 One stakeholder submitted that only a new operator would require a minimum of 5 MHz spectrum to launch services; however, an existing operator can be better off with top-up spectrum in sub-units of 5 MHz. Therefore, restricting the minimum block size to 5 MHz in 900 MHz band will discourage participation of existing operators and would provide an undue advantage to other operators under the logic of continuation of services.

2.73 Another stakeholder submitted that block size in both bands should be kept as 200 KHz (paired); however, a new operator should be mandated to bid for minimum 25 blocks whereas an existing operator should be permitted to bid for minimum of 3 blocks. Also, there should be no priority linkage and a fair market driven auction should take place.

2.74 In the current scenario, where even fallback spectrum in 1800 MHz is largely absent, one stakeholder proposed that the minimum spectrum in 900 MHz be set such that it allows for entry of new operators without affecting continuity of services offered by extension licensees, and that the quantum procured be large enough to ensure the operation of standalone networks.

2.75 One stakeholder suggested that a renewal operator should be offered the flexibility of acquiring 5 MHz i.e. 25 blocks individually in either of the bands i.e. 900 MHz, 1800 MHz or in combination of 900 MHz and 1800 MHz. As per the stakeholder, the on ground availability of spectrum in circles like West Bengal (wherein the availability of spectrum is only 4.4 MHz and 1.8 MHz in 900 MHz and 1800 MHz respectively) also necessitates provisioning of this kind of flexibility to these operators.

2.76 One stakeholder was of the view that the minimum quantum of spectrum for the purpose of bidding should be kept as that of the February 2014 auction. In case of 900 MHz band, the stakeholder suggested that the minimum number of blocks can be kept at 1 (i.e.

1 MHz). It also suggested that the bid for 5 MHz should get the highest priority for assignment of contiguous blocks, wherever available.

Analysis:

2.77 The Authority agrees with the views expressed by most stakeholders that, in the present context, it is preferable to keep block size as 200 KHz. If a larger block size is kept, some spectrum may remain unsold e.g. a block size of 1 MHz would mean spectrum ranging from 0.2 MHz to 0.8 MHz cannot be sold.

2.78 On the issue of specifying a minimum quantity of spectrum that a bidder is required to bid for in 900 and 1800 MHz band, stakeholders have suggested various quantums. In the auctions held in February 2014, minimum requirement to bid was kept as 2x5 MHz in the 900 MHz band for the new entrants and the 'expiry licensees' were treated at par with new entrant. Ideally, the Authority would like to retain the minimum spectrum holding as 2x5 MHz as it provides the flexibility to the TSPs to launch any mobile technology. However, keeping in view the limited availability of spectrum and the context of spectrum as discussed in paras 2.5 to 2.10, the Authority would like to revisit the issue.

2.79 If a requirement of acquiring 2x5 MHz is retained in the 900 MHz band, then only in 5 LSAs[14], the number of successful bidders can be one more than the number of 'expiry licensees'; in the remaining 13 LSAs, successful bidders can at the most be equal to 'expiry licensees'. Certainly, this would put the 'expiry licensees' in a risky situation and also reduce the chances of the entry of a new entrant. This situation surely cannot be a desirable one. At present, all the 'expiry licenses' are providing 2G services using the spectrum in 900/1800 MHz band. There are millions of voice-customers being catered to by them. Although the spectrum that is being put to auction is liberalized spectrum, it is quite likely that the incumbent

[14] Refer Table 2.7

TSPs will continue voice services in the near future. Therefore, even if their spectrum holding is less than 5 MHz, continuity of 2G services can be ensured. Moreover, it is just the minimum quantity of spectrum that bidders need to bid for. There is no restriction on the quantum of spectrum that they wish to acquire[15]. Therefore, the Authority is of the view that for the upcoming auctions, the minimum quantity that a bidder is required to bid for should be kept as 2x3.6 MHz in the LSAs where spectrum availability is 10 MHz or more (taking into account 1.2 MHz of BSNL as recommended by the Authority) in the 900 MHz band. In the remaining LSAs, minimum quantity may be kept as 2x2.4 MHz; and this would be uniformly applicable for 'expiry licensee' as well as new entrants.

2.80 Keeping the minimum quantity as 2 x 3.6 MHz, 2 x 2.4 MHz will facilitate entry of one more TSP than the number of expiry licenses in each LSA except West Bengal. For example in Kerala LSA (Refer Table 2.7), where the available spectrum in the 900 MHz band is 2 x 13.6 MHz, two TSPs can get one block each of 2 x 5 MHz and the third TSP can get 2 x 3.6 MHz for providing voice services. Similarly in UP (West) LSA, where the amount of spectrum available is only 2 x 7.4 MHz, one TSP can get one block of 2 x 5 MHz and another one can get 2 x 2.4 MHz of 900 MHz spectrum.

2.81 In the 1800 MHz band, minimum quantity required to bid in February 2014 auctions was specified as 5 MHz and 0.6 MHz for the new entrants and existing licensees respectively. However, the 'expiry licensees' were treated as new entrant. It is quite possible that even if 'expiry licensees' are successful in regaining their entire or a part of their spectrum holding in 900 MHz band, they may require to have a small spectrum holding in 1800 MHz band also for augmentation of their overall capacity of networks. The 'expiry licensees' currently also have a small spectrum holding in 1800 MHz band. Therefore, it would not be fair to force them to buy minimum

[15] Restricted to the prescribed spectrum cap of 50% in a band on 25% of total spectrum in all bands.

5 MHz in 1800 MHz band, particularly when in most LSAs, spectrum availability is less than 5 MHz. Therefore, the Authority is of the view that the 'expiry licensees' should be treated at par with the existing licensees for the sole purpose of defining the minimum spectrum required to bid for in 1800 MHz band. The Authority is also of the view that the minimum quantity required to bid in 1800 MHz band should be retained at 0.6 MHz.

2.82 In view of above, **the Authority recommends that**

- **Spectrum should be put to auction in a block size of 2x200 KHz in both the 900 and 1800 MHz bands.**
- **In the 900 MHz band, the bidders should be required to bid for a minimum of 2x3.6 MHz in those LSAs where spectrum being put to auction is 10 MHz or more and 2x2.4 MHz in the remaining LSAs.**
- **In the 1800 MHz band, the bidders would be required to bid for a minimum of 2x0.6 MHz spectrum.**

CHAPTER-III: THE VALUATION AND RESERVE PRICE OF SPECTRUM

BACKGROUND

3.1 The DoT's letter of 17th April 2014 requested the Authority to provide recommendations on the applicable reserve price (RP) for all the service areas for auction of spectrum in the 900 MHz and 1800 MHz bands. The Authority's most recent Recommendations on the valuation and RP of spectrum in these bands were made in September 2013 (henceforth, the September 2013 Recommendations) for 3 Metro LSAs in the case of 900 MHz band and for all 22 LSAs in the case of 1800 MHz band.

3.2 The auction conducted by DoT in February 2014 based on the September 2013 Recommendations is widely perceived to have been successful. The entire spectrum in the 900 MHz band put to auction was sold and about 80% of the spectrum in the 1800 MHz band on offer was sold.

3.3 The Consultation Paper (CP) floated to elicit stakeholder responses noted that the need for fresh valuation and estimating RP of the 1800 MHz band at this stage, soon after the September 2013 recommendations resulted in a successful auction, remains a moot question. In the CP, the Authority also adverted to the clauses of previous auction NIAs of February 2010, September 2012, January 2013 and February 2014 (as well as its May 2010 Recommendations) to detail the context and conditions surrounding the determination of RP for spectrum auctions specifically with regard to auctions taking place within one year of a previous auction (see paragraphs 3.11 and 3.12). The primary purpose of setting RPs is to enable discovery of market prices. Further, it is clear that any determination of market prices, including in the case of spectrum, is a function of a host of context-specific factors such as demand and supply, as well as macroeconomic conditions. Reserve prices represent the starting point of an auction; the eventual realized prices are determined by the

bidding process in which a host of factors – the supply and demand situation amongst others – are taken into account by bidders. It is necessary, therefore, to appreciate the overall context of the auctions proposed to be conducted for spectrum being held by TSPs whose licences are due to expire in 2015-2016.

THE CONTEXT

3.4 The context of the forthcoming auction has been explained in detail in Chapter II. DoT's reference provides the details of the spectrum proposed to be put to auction. The majority of the spectrum is in the 900 MHz band (184 MHz across all LSAs) and a small portion in the 1800 MHz band (27.8 MHz)[16]. In the CP, important supply-side issues were highlighted: (1) Non-availability of additional spectrum for commercial use in the 900 MHz band; (2) The wide variation in spectrum availability in the 900 MHz band across LSAs; (3) The fragmented and non-contiguous nature of the 900 MHz spectrum assignments; (4) The availability of only some 1800 MHz spectrum that remained unsold in the February 2014 auction (henceforth, the 2014 auction); (5) The partial availability of the 1800 MHz band spectrum in some LSAs and the limited supply of contiguous blocks; etc. The supply of spectrum that arises from the expiry of licences in the forthcoming auction poses a very real problem for incumbent TSPs. They are obliged to win back the spectrum so as to maintain continuity of service in the LSA. The CP noted that some incumbent TSPs had bought spectrum in the 1800 MHz band in some LSAs in the 2014 auction, giving them a fallback option, in case they are unable to win back spectrum in the 900 MHz band. Nevertheless, there would be huge pressure on TSPs to win back the 'flagship' 900 MHz band spectrum.

3.5 That a bidder's response may differ based on the business case of these TSPs and perceived competition can also be discerned from the

[16] Table 2.1 of the CP

pattern of bidding in the 2014 auction as compared to the previous auctions (November 2012/March 2013). In some LSAs, the prices realised in the 2014 auction were higher than prices realised in previous auctions. Moreover in these LSAs (except Bihar), spectrum remained unsold in previous auctions.

3.6 The supply-side issues highlighted above pose a regulatory challenge for arriving at the RP for the forthcoming spectrum auction. As discussed in paragraphs 2.5 to 2.10 in Chapter II, limited supply of spectrum may force TSPs to bid unrealistically high prices in order to continue operations. While the winner's curse is best avoided in an ideal world, the legacy of the evolution of the telecom sector licensing in India (that saw the allocation of licences and spectrum to TSPs under differing conditions at different points of time) weakens the argument against allowing the market to determine the value placed on spectrum in the present context. As was further indicated in Chapter II, the short-term benefit arising from high bids likely to be generated if the supply constraint is allowed to fester in the forthcoming auction ought to be viewed in a larger context. The TSPs who fail to win spectrum are likely to be left with idle investments in the LSA; and these may well become substantial non-performing assets of the banking sector. Banks and financial institutions may bear the initial costs of such myopic fiscal imperatives, but in the end these costs may devolve on the Government and the economy.

3.7 Before concluding the discussion regarding the context of the forthcoming auction, it is necessary to briefly advert to the options available in arriving at a RP. There has been an important change in the dynamics of the telecom sector over the course of the last year viz., since September 2013. The significant increase in the growth of data usage simply cannot be ignored. In fact, data usage has been much higher than projected in the previous valuation exercises. There is the expectation that taken together, these factors may mark the beginning of a turnaround in the sector's financial performance, as also

evidenced from a quick check of recent performance indicators put out by the Authority. Coupled with the emerging recognition that the 1800 MHz band is the key to the rollout of LTE networks around the world (see paragraph 3.26 of the CP), and the band's increased attractiveness for data carriage, the increase in data usage may indeed support the case for a fresh valuation of the 1800 MHz band for the forthcoming auction.

VALUATION OF 1800 MHz BAND

NEED FOR FRESH EXERCISE OF VALUATION VERSUS USE OF FEBRUARY 2014 AUCTION DETERMINED PRICES

3.8 One approach to valuation of the 1800 MHz spectrum discussed in the CP is the adoption of auction determined prices in the February 2014 auction as the value of the 1800 MHz spectrum and appropriately index this for the time gap between the auction held in February 2014 and forthcoming auction. In this context, the following questions were raised in the CP:

Q: Should the valuation exercise for 1800 MHz spectrum be undertaken afresh for all the 22 LSAs?

Q: Should the prices revealed in the February 2014 auction for 1800 MHz spectrum auction be taken as the value of 1800 MHz spectrum for the forthcoming auction in the respective LSA? Would the response be different depending on whether the forthcoming auction is conducted within one year of completion of last round of auction of February 2014 or later?

Q: If the prices revealed in the February 2014 auction for 1800 MHz spectrum are taken as the value of 1800 MHz for the forthcoming auction, would it be appropriate to index it for the time gap (even if this is less than one year) between the auction held in February 2014 and forthcoming auction? If yes, what rate should be adopted for the indexation?

3.9 Most stakeholders are of the opinion that there is no need for a fresh valuation exercise for 1800 MHz spectrum. Why? Because only a year has elapsed since the previous valuation exercise (September 2013) and there are no significant changes in economic factors or financial fundamentals to warrant a fresh exercise. Two stakeholders have favoured fresh valuation of 1800 MHz spectrum for those LSAs where market clearing price was not achieved in the 2014 auction (i.e., where demand for spectrum was less than supply). Some stakeholders have endorsed the view that prices revealed in the 2014 auction should be taken as the value of the 1800 MHz spectrum.

3.10 The comments of the stakeholders have been examined. In general, there appears to be consensus amongst the stakeholders that there is no need for fresh valuation of 1800 MHz spectrum. However, the uptick in data usage in the composition of revenue in the GSM segment cannot be ignored: the share of revenue from data services in total revenue rose from 9% in the quarter ending (QE) in June 2013 to 14.3% in QE March 2014.

3.11 The circumstances in which the forthcoming auction will be held are altogether different from those obtaining at the time of the 2014 auction. The forthcoming auction will be conducted in a supply-constrained context. On the one hand, stakeholders have drawn attention to the supply-demand mismatch; at the same time, they have chosen not to comment in any detail on how this might affect the valuation of spectrum for the forthcoming auction. Further, as has been brought out already, the responses do not appear to have factored in the growth in data usage; the projected values of data usage in the estimation approaches used in the September 2013 Recommendations would need to be updated based on the step-up witnessed in 2013-14 and this would consequently entail reappraisal of spectrum valuations.

3.12 On the question of indexation of the 2014 auction prices for 1800 MHz spectrum, the majority of stakeholders are of the opinion that there is

no need for any indexation as the time period is less than a year. Only one stakeholder favoured indexation (using bank rate) to reflect fair value.

3.13 The absence of uniform NIA conditions with regard to the applicability of auction determined prices for arriving at the RP for subsequent rounds of auction is another factor which has a bearing on the need for fresh valuation. Indexation of previous auction determined prices may prove more useful for subsequent spectrum allocations where such allocations are done administratively rather than for situations, as in the present case, where the objective is to conduct a fresh round of auctions. Therefore, **the Authority is of the view that adoption of 2014 auction prices (duly indexed) as value of 1800 MHz spectrum is not an appropriate valuation approach in the current exercise.**

3.14 In the February 2014 auction for 1800 MHz spectrum, spectrum was sold in all the LSAs either partially or fully as can be seen from Table 3.2 of the CP. In 12 LSAs the entire spectrum on offer was sold[17]. Therefore, one view that could be taken is that the auction determined price (P_{ADP}) in these 12 LSAs was a market clearing price (P_{MCP}) since demand exceeded supply. In the remaining 10 LSAs (where demand<supply), the P_{ADP} may not be considered as P_{MCP} as there were not enough buyers for 1800 MHz spectrum in these 10 LSAs. On the other hand, it could also be argued that since spectrum was sold in these LSAs as recently as February 2014, a market determined price already exists for these LSAs that can serve as a basis for any forthcoming auction, especially since in most cases, the bulk of the spectrum was sold. In this context, the following question was raised in the CP (In addition, three additional questions (Q10, Q11 and Q12) were also raised on the topic):

[17] In UP (East), UP (West) and Bihar, the quantity left unsold was below the minimum quantity of bid (0.6 MHz). Therefore, these 3 LSAs have been treated at par with those 9 LSAs where demand was greater than or equal to supply. Further, in Karnataka and Kerala, 97% and 96% of the spectrum put to auction was sold.

Q: What should be the criteria for defining a 'market clearing price'? Can the auction determined price be considered as market clearing price, when (i) the demand for spectrum is greater than the supply and when (ii) the demand is greater than or equal to the supply? Can the auction determined price be considered as the market discovered price?

3.15 Some stakeholders have argued that auction determined price (including in LSAs where partial sale of spectrum took place) should qualify as the market clearing price in the respective LSA. A few stakeholders are of the view that market clearing price can be said to be achieved if the price of spectrum has moved beyond/ breached the RP or demand was greater than or equal to supply.

3.16 In economic theory, market clearing price (P_{MCP}) is the price at which the demand curve for a product/ service intersects the supply curve. In other words, the price at which all the offered quantity of a product/service is sold can be considered as market clearing price. Thus, market clearing price for 1800 MHz spectrum was achieved in 12 LSAs (where demand ≥ supply) and in the remaining 10 LSAs (where demand<supply), the P_{ADP} cannot be considered as P_{MCP} as there were not enough buyers for 1800 MHz spectrum in these 10 LSAs. Nevertheless, the prices discovered in the 2014 auction for 1800 MHz band (and 900 MHz band) remain the best available and most recent indicators of the value placed on spectrum by the TSPs. Further, these prices could be utilised for conducting a 'sense check' if a fresh valuation exercise is attempted. As noted in paragraph 3.11 above, the growth in data usage differs from the projected values in the estimation approaches used in September 2013 and would need to be updated. In these circumstances, the discussion on the distinction between P_{MCP} and P_{ADP} is somewhat academic by virtue of the particular circumstances of the forthcoming auction as discussed above. Given the thinness of stakeholder responses on these issues and significant differences in the supply-demand situation between

the February 2014 auction and the forthcoming auction, it would be pedantic to stress upon the differences between P_{MCP} and P_{ADP}.

3.17 Taking all these factors into consideration, **the Authority is of the view that a fresh valuation of 1800 MHz spectrum for all 22 LSAs is the preferred way to initiate the process of determining valuation and reserve price of 1800 MHz spectrum for the forthcoming auction.**

APPROACH TO VALUATION OF SPECTRUM AND RESERVE PRICE DETERMINATION IN THE EARLIER EXERCISE IN 2013

3.18 In its September 2013 Recommendations, the Authority had acknowledged that there are different ways to estimate the value of the spectrum, all of which have some merits as well as demerits. Any of these valuations could actually materialize in the market place. Thus, the Authority took the holistic view that rather than following a deterministic approach, it had arrived at an expected average valuation for 1800 MHz spectrum as the simple mean of the various valuations arrived at using different valuation methodologies.

3.19 Table 3.1 of CP indicates the valuation and RP of 1800 MHz spectrum recommended by the Authority in September 2013 Recommendations, RP as fixed by the Government and auction determined/ realised price of 1800 MHz spectrum in the 2014 auction. It can be seen that the auction determined price is higher than the Reserve Price (RP) set by DoT in 11 LSAs. In the remaining 11 LSAs the auction determined price is equal to the RP set by DoT.

SCOPE OF THE CURRENT VALUATION EXERCISE FOR 1800 MHz SPECTRUM: ALTERNATIVE APPROACHES

MARKET DATA ANALYSIS

3.20 The issue for consideration is whether the auction determined prices in the LSAs can be taken as a representative value of 1800 MHz spectrum. An attempt could be made to revisit the valuation of 1800 MHz spectrum for those LSAs (where D<S) either by correlating it with

the prices realized in similar LSAs (where D≥S) using a single explanatory variable[18] one at a time or through multiple variable regression. These valuation approaches were adopted in the September 2013 Recommendations[19].

3.21 In this context, the following questions were raised in the CP:

Q: Should the value of spectrum in the LSAs where market clearing price was not achieved be estimated by correlating the sale prices achieved in similar LSAs where market clearing price was achieved with known relevant variables (Para 3.19)? If yes, please suggest which single variable is best suited for this purpose?

Q: Can multiple regression analysis be gainfully employed for this purpose given the limited number of sample data points?

3.22 One stakeholder responded that all the variables listed in CP (Para 3.19) are important for the valuation exercise and any approach based on a single variable will not be logical and scientifically correct. Some stakeholders did not favour this methodology. One stakeholder argued that multiple regression models are statistical correlation models based on past observations. Most stakeholders did not comment on the use of this methodology as they were of the view that any fresh valuation exercise may not yield significantly different results (as compared to September 2013 Recommendations).

3.23 The Authority has considered the comments of the stakeholders. In the present valuation exercise, the Authority is aware that the sample size of market revealed information (i.e. LSAs where D≥S:12 LSAs) available is quite limited and almost the same as the number of LSAs for which estimation is required (sample size of 12 to predict for 10). The availability of data points is further constrained if intra-category comparison is required to be attempted. As the number of data points is limited, it would render the regression results unstable and may fail

[18] Variables listed in Para 3.19 of Consultation Paper on Valuation and Reserve Price of Spectrum: Licences expiring in 2015-16 dated 7th August 2014.
[19] see Annexure 4.1 of the September 2013 Recommendations for details

to yield a useful prediction. Therefore**, the Authority is of the view that the use of single variable correlation and multiple regression approaches would not be suitable for the current exercise of estimating the value of 1800 MHz spectrum.**

DISCOUNTED CASH FLOW

3.24 This method of valuation is based on the expected future earnings (net of expenses) from the business operations. Valuation of spectrum (for "mature" operators) using DCF had been attempted in TRAI's Report[20] (prepared by a group of Experts) on the "2010 Value of Spectrum in the 1800 MHz band" of 8th February 2011 in respect of spectrum holdings up to 6.2 MHz. In this context, the following question was raised in the CP:

Q: Should the values contained in the Report of 8th February 2011 for spectrum up to 6.2 MHz be incorporated after indexation in the calculation of the average value of the 1800 MHz spectrum in the current exercise?

3.25 One stakeholder is of the view that the report was prepared by the group of experts having detailed and in-depth knowledge of the telecom industry and thus this method may give more realistic results. Another stakeholder, while favoring DCF as a method of valuation, has stated that it is based on reasonable and fair assumptions. However, no stakeholder has given any comments on the assumptions and methodology followed.

3.26 The Authority is acutely conscious of the many changes in the spectrum allocation regime since the group of experts came up with the estimates of value. These changes include the delinking of spectrum from licences, the move from an administrative allocation of spectrum to market-based models, liberalization of spectrum, etc. The distinction between spectrum holding up to 6.2 MHz and beyond 6.2

[20]http://www.trai.gov.in/WriteReadData/Recommendation/Documents/reportmndive9feb11.pdf

MHz was a legacy of the previous licensing regime in the sense that this amount was to be taken as the 'contracted' quantum of spectrum to be made available to TSPs[21]. The changes in the licencing architecture and the march of technology have rendered the utility of the above distinction doubtful. Further, as discussed in a following section, the Revenue Surplus approach (that incorporates elements of the DCF approach used in the experts' model) would also be used in the estimation exercise for valuing the 1800 MHz spectrum. As such, **the Authority is of the view that the value of 1800 MHz spectrum contained in the Report of 8th February 2011 (for spectrum up to 6.2 MHz) should not be incorporated in the current estimation exercise.**

USE OF FEBRUARY 2014 AUCTION DETERMINED PRICES

3.27 As can be seen from Table 3.1 of CP, the 1800 MHz spectrum was sold at RP in some LSAs and at higher than RP in the remaining LSAs. The auction determined price of February 2014 as such represents the bidders' preferred price for spectrum put on auction in the respective LSA. In this connection, the following question was raised in the CP:

Q: Should the prices revealed in the February 2014 auction for 1800 MHz spectrum auction be used as one of the values of 1800 MHZ spectrum?

3.28 Some stakeholders have commented that market determined price of 1800 MHz spectrum in February 2014 auction should be considered as the value of spectrum whereas some have argued for the adoption of the September 2013 valuation for 1800 MHz spectrum. One stakeholder has suggested that a fresh valuation exercise should be restricted to those LSAs where demand in the February 2014 auction was less than the spectrum offered for sale.

3.29 The Authority has examined the comments of the stakeholders. It is a fact that spectrum in February 2014 auction was sold at a price higher than RP in 12 LSAs and around 80% of the total spectrum

[21] The quantum of 'contracted' spectrum has been a subject of dispute.

offered (in all LSAs) in the 1800 MHz band was sold. This is a sure indicator of the demand for spectrum at the achieved price. Further, any argument that prices revealed in the most recent auction can be ignored does serious disservice to the very idea of moving away from the administrative allocation of spectrum to a market-based model. As already discussed, the February 2014 auction prices are the best available and most recent indicators of the value placed on spectrum by TSPs; they could also act as a 'sense check' for fresh valuation. Therefore, the Authority is of the view that 2014 auction realized price can be taken as one of the indicative values of 1800 MHz spectrum. Thus **the Authority has decided that the auction determined price of 1800 MHz spectrum in February 2014 auction can be taken as one of possible values of the 1800 MHz spectrum in the current exercise.**

OPPORTUNITY COST MODELS

3.30 The two opportunity cost models discussed in the CP were based on the cost saving derived from the relationships between spectrum and Base Transceiver Stations (BTS). These two approaches were adopted in the Recommendations of September 2013[22] for valuation of 1800 MHz spectrum. In this context, besides questions on admissibility of these two models, the following question was also raised in the CP:

Q: Is there any need for a change/revision of any of the assumptions adopted by the Authority in producer surplus model in the Recommendations of September 2013? Justify with reasons.

3.31 Most respondents have commented that estimating the value of spectrum with the help of the producer surplus approach and production function approach again in the present exercise is not necessary as the Authority has only recently conducted such an exercise and any fresh valuation may not yield significantly different

[22] See Annexure 4.2 for the Producer Surplus Model and Annexure 4.3 for the Production Function Model.

results. Some stakeholders have contended that both the models are based on the technical value of spectrum without taking into consideration the commercial value of spectrum. These comments were also raised by stakeholders in the consultation process for September 2013 Recommendations. None of the stakeholders have commented on the assumptions regarding growth rate of inputs (data usage, subscribers etc.)

3.32 The Authority has examined the comments of the stakeholders and is of the view that both these models are able to capture key aspects (BTS Spectrum trade-off) and provide a reasonable approximation to equivalent cost savings on BTS conserved by deploying an additional unit of spectrum. Therefore, these two models provide a reasonable estimation of the opportunity to save costs upon acquisition of an additional MHz of spectrum**. The Authority has, therefore, decided to use the results of the producer surplus model and production function approach as possible valuations of 1800 MHz spectrum.** The detailed methodology and assumption used in the producer surplus model and the results obtained are at **Annexure 3.1**. The results obtained using the production function approach are at **Annexure 3.2**.

REVENUE SURPLUS MODEL

3.33 Under the Revenue Surplus approach, the valuation of spectrum is based on the perspective of an access service provider willing to invest in spectrum to realize the net revenue potential/revenue surplus from the GSM segment (since 1800 MHz spectrum is used as a GSM band) over the licence period of 20 years for acquiring spectrum. The approach is premised on the assumption that the NPV of the projected revenue surplus over 20 years (net of all expenses/costs) could potentially represent the maximum amount which a buyer would be willing to pay for acquiring spectrum. The business model adopted by different service providers would influence the respective valuations if firm-level calculations were to be adopted. Hence, a full industry

approach using aggregate data of the GSM segment has been used in the valuation exercise using this approach.

3.34 The following question was raised in the CP in this background:

Q: Should the revenue surplus approach be used to arrive at the value of 1800 MHz spectrum? Do you agree with the assumptions made?

3.35 Most stakeholders have not commented on this methodology (and assumptions taken) for estimating value of 1800 MHz spectrum. The responses once again reflect the view that any fresh valuation exercise may not yield significantly different results (as compared to September 2013 Recommendations). However, one stakeholder has stated that the cost of network deployment is not in exact proportion to the quantum of spectrum for which the network is being deployed; therefore this approach is not a correct approach.

3.36 The Authority has considered the comments of stakeholders. Like any other economic model (involving assumptions and a degree of abstraction), this approach too has its limitations. However, the fact remains that the proposed revenue surplus approach is a feasible alternative approach to the estimate the value of 1800 MHz spectrum from the perspective of a TSP willing to invest in the expectation of a targeted/projected revenue and profitability. The model's utility as an alternative approach is enhanced in the backdrop of the Authority's decision not to adopt the expert price as one of the valuation approaches, since the Revenue Surplus model incorporates elements of the DCF approach used in the experts' model. **The Authority has, therefore, decided to use the results of the revenue surplus model as one of the possible valuations of 1800 MHz spectrum.** The detailed methodology and assumptions used in this model and the results obtained are at **Annexure 3.3**.

OTHER APPROACHES

3.37 Various approaches adopted by the Authority in estimating the value of spectrum are laid out in the preceding paragraphs. To obtain views

on alternative approaches to the valuation of spectrum, the following question was raised in the CP:

Q: Apart from the approaches discussed as above, is there any other approach for valuation of spectrum that you would suggest? Please support your answer with detailed data and methodology.

3.38 None of the stakeholders suggested any practical, robust alternative approach that could be used for valuing 1800 MHz spectrum.

VALUATION OF SPECTRUM: SINGLE APPROACH *VERSUS* MULTIPLE APPROACHES

3.39 As discussed above, the Authority has assessed the value of 1800 MHz using a number of alternative approaches. Each approach of valuing 1800 MHz spectrum has its merits and drawbacks. Any of these valuations could actually materialize in the market place. In this context, the following question was raised in the consultation paper-

Q: Would it be appropriate to value 1800 MHz spectrum as the simple mean of the values thrown up in all the approaches? If no, please suggest with justification that which single approach should be adopted to value 1800 MHz spectrum.

3.40 Two stakeholders have suggested that in case of a fresh exercise of spectrum valuation, an estimated expected valuation be obtained through the method of simple mean as was done in Recommendations of September 2013. One stakeholder stated that taking the mean when there is large variation could lead to distortions. Once again, the responses of most stakeholders proceed on the basis that a fresh valuation may not yield results different from the last valuation exercise. Thus, according to these stakeholders, there is no need for any fresh valuation.

3.41 The Authority has carefully considered the comments of stakeholders. For reasons discussed earlier, the Authority decided to initiate a fresh valuation of 1800 MHz spectrum. The Authority is of the view that it is

simply not possible to say deterministically that any one valuation is the 'right' valuation. Each model has certain strengths as well as limitations. Therefore, on the assumption of equal probability of occurrence of each valuation (as was done in the Recommendations[23] of September 2013), **the Authority has decided to use the average expected valuation of 1800 MHz spectrum obtained through the method of the simple mean of various valuation approaches that have been adopted.**

ARRIVING AT AVERAGE VALUATION OF 1800 MHZ SPECTRUM

3.42 In view of discussion above, the Authority has arrived at an expected average valuation for 1800 MHz spectrum as the simple mean of the various valuations that have been adopted. A Table containing the average valuation of 1800 MHz spectrum using different approaches is at **Annexure 3.4.** As can also be seen that there are variations – both higher and lower – when the average valuation is compared with the 2014 auction revealed price.

3.43 The Authority recognizes that there was demand for 1800 MHz spectrum in 2014 auction in every LSA. Therefore, the 2014 auction price can be treated as the bidders' revealed preference price for spectrum in the respective LSA. In the context of the spectrum that was sold at 2014 auction, the Authority is of the view that any estimation of the value of spectrum at this stage should be tempered by revealed preferences (realized prices) of the market. The 2014 auction revealed price can thus serve as a benchmark price representing a lower bound while estimating the valuation of 1800 MHz spectrum. Therefore, **the Authority recommends that the average expected valuation of 1800 MHz spectrum should be the higher of the two figures – average expected valuation based on simple mean or the price realized in February 2014 auction in each LSA.**

In other words, in LSA **i**,

[23] See paragraphs 3.46 to 3.50 and paragraph 4.38.

If $\mathbf{A_i^{1800}}$ is the average valuation per MHz of the 1800 MHz spectrum derived based on the simple mean as above

and $\mathbf{P_i^{1800}}$ is the price realized per MHz for the 1800 MHz spectrum in the February 2014 auction,

Then,

The recommended valuation, $\mathbf{V_i^{1800} = Max\ (A_i^{1800}, P_i^{1800})}$

3.44 Accordingly, the recommended average expected value of 1800 MHz spectrum for each LSA is tabulated below:

TABLE 3.1
RECOMMENDED AVERAGE VALUE PER MHz (1800 MHz BAND)
(Rs. in crore)

LSA	Category	Average Value per MHz of 1800 MHz
Delhi*	Metro	364.00
Mumbai*	Metro	272.00
Kolkata	Metro	73.00
Andhra Pradesh	A	169.32
Gujarat	A	237.80
Karnataka	A	184.75
Maharashtra	A	290.35
Tamilnadu	A	225.41
Haryana	B	39.84
Kerala	B	93.86
Madhya Pradesh*	B	86.03
Punjab	B	88.38
Rajasthan	B	107.36
U. P. (East)	B	121.66
U.P. (West)	B	94.95
West Bengal	B	43.90
Assam*	C	36.10
Bihar	C	76.89
Himachal Pradesh	C	11.86
Jammu & Kashmir*	C	30.78
North East	C	26.33

Orissa	C	29.22
Pan India		**2703.78**

* 1800 MHz spectrum is not available in Delhi, Mumbai, MP, Assam and J&K. However, average valuations of these LSAs have been included in the table since there is some likelihood of spectrum becoming available as discussed in Chapter II.

VALUATION OF THE 900 MHZ BAND

3.45 In contrast to the situation obtaining in the 1800 MHz band, there are no market determined/ realised prices available for the 900 MHz band (except for 3 metro LSAs), on which basis the value of 900 MHz spectrum can be estimated. It is generally accepted that a network built around lower frequency spectrum costs less to build than a network built around higher frequency spectrum, as the strength of the signal requires fewer cell sites to be built. Thus, the value of 900 MHz spectrum can be derived from the value of 1800 MHz spectrum based on a comparison of (a) relative technical efficiency or (b) relative economic efficiency of the 900 MHz band over the 1800 MHz band. No stakeholder has suggested any alternative approach for valuing 900 MHz spectrum other than those discussed in the CP.

TECHNICAL EFFICIENCY

3.46 A detailed discussion of the relative efficiencies between 900 MHz spectrum and 1800 MHz spectrum is available at paragraphs 4.45 - 4.47 of the September 2013 Recommendations. This technical efficiency factor could lie anywhere between 1.5 times to 2 times. In this context, the following question was raised in the CP:

Q: Should the value of 900 MHz spectrum be derived on the basis of the value of 1800 MHz spectrum using technical efficiency factors (1.5 times and 2 times) as discussed above?

3.47 Stakeholders have suggested different multiplication factors for the value of the 900 MHz spectrum over the 1800 MHz spectrum, ranging from 1.2 times to 2 times. Another set of stakeholders has suggested

that the valuation/ RP of 900 MHz spectrum should be equal to the value/ RP of the 800 MHz spectrum in the respective LSAs.

3.48 The Authority has considered the comments of the stakeholders. While the propagation characteristics/technical efficiency of 900 MHz and 800 MHz bands may be similar, the final value of 900 MHz spectrum and 800 MHZ spectrum cannot be taken to be equal. This has been discussed in detail in paragraphs 3.38 to 3.40 of the Recommendations dated 22nd February 2014 on 'Reserve Price for Auction of Spectrum in the 800 MHz Band'. The 900 MHz spectrum intrinsically possesses a greater technical efficiency than the 1800 MHz band. Staying consistent with its earlier estimation exercise, **the Authority recommends that valuations of the 900 MHz spectrum may be worked out using both 1.5 times and 2 times of the average valuation of 1800 MHz spectrum in the current estimation exercise.**

ECONOMIC EFFICIENCY

3.49 An alternative valuation approach would be to derive relative valuations for 900 MHz spectrum based on cost trade-offs (CAPEX as well as OPEX) when operations are switched from the 900 MHz spectrum to the 1800 MHz spectrum (a technically less efficient band). This approach was explained in detail in the September 2013 Recommendations[24].

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

Q: Should the economic efficiency approach as discussed above be used to calculate the premium for the 900 MHz spectrum, based on the additional CAPEX and OPEX that would be incurred on a shift from this band to the 1800 MHz band?

3.51 Stakeholders' comments on this approach are very thin and other than suggesting the inclusion of other economic factors like ARPU,

[24] See paragraph 4.49 and Annexure 4.5 of the September 2013 Recommendations.

customers' purchasing power etc., no specific comments have been given on the economic efficiency approach and assumptions.

3.52 As explained in the earlier Recommendations of September 2013 (see paragraph 4.52), 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. Therefore, **the Authority decided that the value of 900 MHz spectrum emerging from the economic efficiency approach be used as one possible value of the 900 MHz spectrum in the current valuation exercise.** The data sources, methodology followed, assumptions and the results obtained using economic efficiency approach are at **Annexure 3.5**.

AVERAGE VALUATION OF 900 MHz SPECTRUM

3.53 As in the case of the 1800 MHz spectrum valuation, the Authority has arrived at the value of the 900 MHz spectrum using different approaches. Consistent with its earlier methodology, **the Authority has decided, as in the case of 1800 MHz spectrum and adopting the same basic principle of equi-probability of occurrence of each valuation, to adopt an average valuation of 900 MHz spectrum as the simple mean of valuations obtained from technical as well as economic efficiency approaches.** A Table containing the mean value (average valuation) of 900 MHz spectrum using different approaches is at **Annexure 3.6.**

3.54 The Authority is also conscious of the technical literature available on the relationship between the 900 MHz spectrum and the 1800 MHz spectrum. The economic efficiency approach discussed above takes into account the operational benefits (in the form of cost savings) enjoyed by the 900 MHz band spectrum over the 1800 MHz band. If the market conditions are held constant, the techno-economic appraisal of the relative benefits of the two bands would indicate that the value of the 900 MHz spectrum would not exceed two times the value of the 1800 MHz spectrum.

3.55 **Annexure 3.7** indicates the average valuation of 1800 MHz spectrum and the average value of the 900 MHz spectrum. **The Authority recommends that the value of 900 MHz spectrum in each LSA should be the lower of the two figures - average valuation of 900 MHz or twice the value of 1800 MHz spectrum.**

In other words, in LSA **i**,

If $\mathbf{A_i^{900}}$ is the average valuation per MHz of the 900 MHz spectrum derived based on the simple mean as above

and $\mathbf{V_i^{1800}}$ is the recommended valuation per MHz of spectrum in the 1800 MHz band,

Then,

The recommended valuation per MHz of the 900 MHz spectrum,

$$\mathbf{V_i^{900} = Min\ [A_i^{900}, (2^* V_i^{1800})]}$$

3.56 Accordingly, **Table 3.2** contains the recommended value of 900 MHz spectrum for each LSA:

TABLE 3.2

RECOMMENDED VALUATION OF 900 MHz SPECTRUM (PER MHz)

(Rs. in crore)

LSA	Category	Value per MHz of 900 MHz
Andhra Pradesh	A	338.64
Gujarat	A	423.83
Karnataka	A	357.15
Maharashtra	A	524.57
Tamil Nadu	A	422.74
Haryana	B	79.67
Kerala	B	187.71
Madhya Pradesh	B	172.07
Punjab	B	176.76
Rajasthan	B	214.72
U. P. (East)	B	243.31
U.P. (West)	B	189.90
West Bengal	B	87.80
Assam	C	72.20

Bihar	C	153.78
Himachal Pradesh	C	23.71
North East	C	52.66
Orissa	C	58.43

Note: 900 MHz spectrum is not available/ not likely to be available in Delhi, Mumbai. Kolkata and J&K LSAs. Hence, the valuation has not been given.

RESERVE PRICE ESTIMATION

3.57 A reserve price refers to the minimum amount that the owner of an item will accept as the winning bid in an auction. It is the starting point for an ascending price auction and bidding is a means to price discovery. The concept of auction efficiency, revenue maximization, the RP in an auction and various international practices were discussed in detail in the Consultation Paper dated 23rd July 2013 on 'Valuation and Reserve Price of Spectrum'. In the September 2013 Recommendations it was decided that the reserve prices should be fixed at 80% of the average valuation for a spectrum band. While giving Recommendations in September 2013 on the reserve price for 1800 MHz spectrum, the Authority observed that in some LSAs, this method would result in an RP pegged at a level higher than prices realized in the November 2012 auction / RP in the March 2013 auction. The Authority was of the view that the RP for the 1800 MHz spectrum in different LSAs would, therefore, have to be tempered accordingly[25] instead of following the general principle of fixing it uniformly at 80% of the average valuation. However, contending arguments are possible on the need for setting the RP when auction determined prices of a recent vintage are available.

In this connection the following questions were raised in the CP:

Q: *Should the reserve price of 1800 MHz spectrum in the forthcoming auction be fixed equal to the realized price of 1800 MHz spectrum in the February 2014 auction? If not, what should be the ratio between the reserve price for the auction and the valuation of the spectrum?*

[25] See paragraph 4.40 of the September 2013 Recommendations.

Q: If the realized prices in the February 2014 auction for 1800 MHz spectrum is taken as the reserve price of 1800 MHz for forthcoming auction, would it be appropriate to index it for the time gap (even if less than one year) between the auction held in February 2014 and forthcoming auction? If yes, what rate should be adopted for the indexation?

3.58 Some stakeholders favoured setting the RP of 1800 MHz spectrum equal to the reserve price recommended by the Authority in September 2013. Another group of stakeholders suggested that the RP of 1800 MHz should be linked to the auction determined price of 2014 auction. They have given a range of 50% to 80% of the auction determined price of 2014 auction as the RP for the forthcoming auction. One stakeholder suggested that the RP of 1800 MHz spectrum should be fixed equal to the auction determined price of the 2014 auction, duly indexed for time value of money. Some stakeholders have stated that in LSAs where market clearing price was not achieved, RP should be fixed at a discount to the RP fixed in the 2014 auction. On 900 MHz spectrum, some stakeholders have suggested that RP should be fixed at multiple (ranging 1.5 to 2) of RP of 1800 MHz spectrum. Another set of stakeholders have suggested that RP of 900 MHz spectrum should be equal to the RP of 800 MHz spectrum.

3.59 The Authority has carefully considered the comments of the stakeholders. The Authority has been of the consistent view that RP should not be fixed too close to the estimate of valuation, so as to encourage participation, enable competitive bidding and lead to price discovery. In consistency with its earlier Recommendations, the Authority is of the view that the reserve price for the forthcoming auction of 1800 MHz spectrum and 900 MHz spectrum be fixed at 80% of the respective average valuation, subject to qualifications discussed below.

RESERVE PRICE OF THE 1800 MHZ BAND

3.60 At the same time, the significance of auction determined prices of 1800 MHz spectrum in the 2014 auction cannot be ignored. The Authority notes that 80% of average valuation is above the 2014 auction revealed price in the case of some LSAs and below that in others. The dissimilarity is on account of LSA-specific factors and inputs that have gone into the estimation exercise. In 12 LSAs, 80% of average valuation is higher than the February 2014 auction determined prices whereas in the remaining 10 LSAs, 80% of the average valuation is lower (**Annexure 3.8)**.

3.61 Once again, the Authority is conscious of the need to factor in the most recent auction determined prices in arriving at the RP. Given that TSPs have bought spectrum at the prices revealed in the 2014 auction (some at RP and others at levels above RP), it would only be fair to expect that the level at which the spectrum in the forthcoming auction should be alienated to bidders cannot be lower than the 2014 auction determined prices. There was a demand for 1800 MHz spectrum in each LSA. Even in the 10 LSAs where market clearing price was not achieved (Demand < Supply) in 2014 auction, 5 LSAs showed demand more than 70% of offered spectrum and in another 3 LSAs, more than 50% was sold. As such, the 2014 auction revealed price can serve as a benchmark price representing a lower bound while fixing RP for the forthcoming auction. This approach of fixing RP is somewhat different from the Recommendations of September 2013 where benchmarking was done treating auction determined price of November 2012 as an upper bound. The deviation from the approach adopted in September 2013 Recommendations is on account of changed context as well as circumstances surrounding the forthcoming auction as explained earlier in detail in paragraphs 3.4 to 3.7 as well as the scale of demand in the majority of LSAs in the successful auction of February 2014 that was conducted after the September 2013 Recommendations. Taking into consideration all the

above, **the Authority recommends that the reserve price for 1800 MHz spectrum should be higher of the two figures – 80% of the average valuation or the price realized in February 2014 auction in each LSA.**

In other words, using the same notation as at paragraph 3.43 above,

The Reserve Price $\mathbf{RP_i^{1800} = Max\ [P_i^{1800}, (0.8^* V_i^{1800})]}$

3.62 The RP calculated using this principle is given in **Annexure 3.9.**

3.63 Further as can be seen from Table 2.4 of the CP, in four LSAs (Maharashtra, UP (E), Rajasthan and West Bengal) 1800 MHz spectrum is available only partially (i.e., not covering entire LSA). The number of districts in which the spectrum is available in each of these LSAs according to the information available is indicated in **Table 3.3**.

TABLE 3.3

PARTIAL SPECTRUM AVAILABILITY

LSA	Total number of districts	Number of districts in which spectrum is available
Maharashtra	35	1
UP (East)	48	45
Rajasthan	33	22
West Bengal	26	5

3.64 The partial availability of spectrum in these LSAs will affect the bidders' demand for spectrum. In fact, spectrum availability in Maharashtra and West Bengal is so limited that there does not exist a case for going in for auction at this stage. In the case of Rajasthan, there may be a need to set the RP for these LSAs at a discount, as was done in the September 2013 Recommendations to encourage bidding and wider participation. Only in the case of UP (East), the availability of spectrum can be considered adequate. In view of different numbers of the districts where 1800 MHz spectrum is available in these LSAs, **the Authority recommends that (1) auctions should not be held in Maharashtra and West Bengal for 1800 MHz spectrum at this stage; (2) due to availability of partial spectrum, the reserve price**

for 1800 MHz spectrum in Rajasthan LSA should be fixed at a discount of 30% on the reserve price as given in Annexure 3.9 in case spectrum is available only partially (as was done in the February 2014 auction); and (3) for UP (East) LSA, the RP should be fixed as in the case of the remaining LSAs.

3.65 Apart from the above cases of partial availability of spectrum, the Authority is conscious of the need to give a fillip to penetration of telecom services in the North East for improving the economic well-being of the region, given its peculiar geography, needs and particular circumstances[26]. To accelerate the pace of investment in telecom infrastructure in the LSA, the Authority is of the view that the reserve price for spectrum in the North East LSA should be kept at 50% of the reserve price indicated in **Annexure 3.9**. **The Authority accordingly recommends that the reserve price for North East LSA may be fixed at a discount of 50% on the reserve price given in Annexure 3.9**.

3.66 **Accordingly, the Authority recommends that the reserve prices for 1800 MHz spectrum for 20 LSAs should be as in column (4) of Table 3.4 below:**

TABLE 3.4

RECOMMENDED RESERVE PRICE PER MHz IN 1800 MHz BAND

(Rs. in crore)

(1)	(2)	(3)	(4)
LSA	**Category**	**Reserve Price (as calculated)**	**Recommended Reserve Price (Rounded off)***
Delhi*	Metro	364.00	364
Mumbai*	Metro	272.00	272
Kolkata	Metro	73.00	73
Andhra Pradesh	A	163.00	163
Gujarat	A	237.80	238

[26] See the Authority's Recommendations of 26th September 2013 on Improving Telecom Services in the North-Eastern States: An Investment Plan.

Karnataka	A	155.00	155
Tamil Nadu	A	208.00	208
Haryana	B	31.87	32
Kerala	B	75.09	75
Madhya Pradesh*	B	68.83	69
Punjab	B	70.70	71
Rajasthan	B	60.12	60
U. P. (East)	B	97.32	97
U.P. (West)	B	94.95	95
Assam*	C	36.10	36
Bihar	C	61.51	62
Himachal Pradesh	C	9.48	9
Jammu & Kashmir*	C	24.63	25
North East	C	10.53	11
Orissa	C	23.37	23

* 1800 MHz spectrum is not available in Delhi, Mumbai, MP, Assam and J&K. However, reserve prices of these LSAs have been included in the table since there is some likelihood of spectrum becoming available as discussed in Chapter II. No reserve price has been recommended for Maharashtra and West Bengal LSAs (see recommendation at paragraph 3.64 above).

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

RESERVE PRICE OF THE 900 MHZ BAND

3.67 Like 1800 MHz spectrum, RP for the forthcoming auction of 900 MHz spectrum is fixed at 80% of its average valuation. Also in line with the approach adopted by the Authority in its previous recommendations, **the Authority recommends that the reserve price for 900 MHz spectrum should be fixed at 80% of the recommended average valuation.**

In other words, using the same notation as at paragraph 3.55 above,

The Reserve Price $\mathbf{RP_i^{900} = (0.8*V_i^{900})}$

Further, as recommended in the case of 1800 MHz spectrum, the Authority recommends that a discount of 50% on the reserve price is given for North East LSA.

3.68 **Accordingly, the recommended reserve price of 900 MHz spectrum for each LSA be as in column (4) of Table 3.5 below**:

TABLE 3.5

RECOMMENDED RESERVE PRICE PER MHz OF 900 MHz BAND

(Rs. in crore)

(1)	(2)	(3)	(4)
LSA	**Category**	**Reserve Price (as calculated)**	**Recommended Reserve Price (Rounded off)***
Andhra Pradesh	A	270.91	271
Gujarat	A	339.06	339
Karnataka	A	285.72	286
Maharashtra	A	419.65	420
Tamilnadu	A	338.19	338
Haryana	B	63.74	64
Kerala	B	150.17	150
Madhya Pradesh	B	137.65	138
Punjab	B	141.41	141
Rajasthan	B	171.77	172
U. P. (East)	B	194.65	195
U.P. (West)	B	151.92	152
West Bengal	B	70.24	70
Assam	C	57.76	58
Bihar	C	123.02	123
Himachal Pradesh	C	18.97	19
North East	C	21.06	21
Orissa	C	46.75	47

Note: 900 MHz spectrum is not available/ not likely to be available in Delhi, Mumbai. Kolkata and J&K LSAs. Hence, the reserve price has not been given.

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

CHAPTER IV: DECISION-MAKING: THE POLITICAL IMPERATIVE

4.1 The preceding chapters have discussed the availability, block sizes and the valuation and reserve price of spectrum. As elaborated in Chapter II, the context of the current auction brings into sharp focus the supply constraints and the distinct possibility of strategic decision-making on the part of bidders given that the licences of some TSPs are due for expiry. Both the possibilities – (a) that incumbents win back the 900 MHz spectrum at significantly high prices; or, (b) that one or both incumbent operators lose the 900 MHz spectrum (which is won by two or more other bidders) – have grave implications for investments in the telecom sector and the larger economy.

4.2 It is in this context that the Authority has made several recommendations to increase the availability of spectrum: (1) augmenting spectrum in the 900 MHz band by taking back 1.2 MHz of 900 MHz spectrum from BSNL; (2) increasing the availability of 900 MHz equivalent spectrum by implementing the E-GSM band solution; (3) utilizing idle 1800 MHz spectrum in the Defence band[27] and vacating spectrum held in excess of 20 MHz by Defence in the 1800 MHz band; (4) announcing the roadmap for the auction of spectrum in the 700 MHz band; (5) making the entire 2 x 60 MHz spectrum in the 2100 MHz band available for commercial use; and (6) simultaneously auctioning spectrum in other bands (i.e., 800 MHz and 2100 MHz) to ease the overall supply constraint. In addition, the Authority has also recommended measures to augment spectrum availability in the 2100 MHz band.

4.3 In response to the DoT's reference of 17th April 2014, the Authority has recommended the Reserve Price for auction of spectrum only for 900 MHz and 1800 MHz bands (see Chapter III above). The Authority's Recommendations for Reserve Price for the 800 MHz

[27] The DoT does not intend to reassign the spectrum lying in the Defence band.

band were sent to DoT on 22nd February 2014; however, no auction has yet been conducted for the 800 MHz band even after eight months of the Recommendations.

4.4 The Authority is acutely conscious of the deleterious fallout, not only for the telecom sector but for the economy as a whole, of conducting the auction while leaving the supply constraints unresolved. Notwithstanding the clearly-stated objectives of national telecom policies and the various recommendations made by the Authority over the past decade for improving the supply of spectrum availability for commercial use, DoT/ WPC have so far not been able to take effective steps to lay out a roadmap for increasing the supply of spectrum to ensure orderly growth of the telecom sector. It is clear that these issues cannot be resolved by discussions at the official level. Some issues, such as the Authority's Recommendation to take back 1.2 MHz spectrum in the 900 MHz band from BSNL could well be taken at the level of DoT; the rest of them require the involvement of other Ministries and Departments. Therefore, the complex nature of many of the problems may make it difficult for DoT to find a solution by itself, without extensive consultation with, and the active involvement of, other Departments and Ministries of the Government. If left unresolved, supply side issues will affect not only the proposed auction of spectrum arising from expiry of licences in 2015-2016, but will also continue to have a negative impact on all subsequent auctions for spectrum becoming available from impending expiry of licences at different points in the near future (2017-2021). In these circumstances, the Authority would advise caution in going ahead with the forthcoming auction without resolving the spectrum constraints.

4.5 As such, the Authority is of the view that headway in resolving the spectrum supply constraints can only be made through an effective dialogue at the highest level between DoT and the Ministry of Defence (MoD) and the Ministry of Finance (MoF). The MoF needs to

be involved since the auction process has a direct impact on fiscal matters given the huge revenue potential. There always exists the temptation to succumb to short-term benefits at the cost of longer-term viability of the sector; MoF will, no doubt, be sensitive to the economic costs of continuing spectrum shortages. The Authority is aware that some discussions have indeed taken place at the official level between the DoT and MoD and this dialogue has gone on for years. However, there is little light at the end of the tunnel viz. official level dialogue has just not yielded tangible results by way of vacating additional spectrum for commercial use by Defence. Therefore, the Authority is of the considered opinion that the issues involved need resolution at the level of the Ministers concerned. Accordingly, **the Authority recommends that a dialogue needs to be held at the level of the Finance Minister, the Minister of Communications and IT and the Defence Minister to ensure the availability of additional spectrum for commercial use. The Authority is also of the view that the auction should be carried out only after a clear roadmap is available for vacating spectrum in 2100 MHz band from Defence and in 900 MHz band from BSNL.**

4.6 What could be a potential agenda for the Ministers to discuss? As detailed in the earlier chapters and in previous recommendations, the issues for decision would include: (1) Vacating spectrum held by Defence to implement the E-GSM Band solution; (2) Vacating spectrum held by Defence in excess of 20 MHz in the 1800 MHz band; (3) Shifting Defence usage from the commercial band in 1800 MHz; (4) Making available the entire quantum of 2 x 60 MHz in the 2100 MHz band for commercial use; and (5) Making available the entire 2 x 45 MHz in the 700 MHz band for IMT use and roadmap for its auction.

4.7 The Authority is aware that discussion at the level of Ministers may require some time, given the complexity of the issues involved. At the

same time, the Authority is also aware that (a) neither has the auction for 800 MHz spectrum been conducted so far even after 8 months of the Authority's Recommendations; and (b) nor has the spectrum that was bought in the February 2014 auction been made available to successful bidders. Under the circumstances, the Authority would urge prudence before going ahead with the auction. The Authority is of the view that the forthcoming auction should be scheduled only after the above issues are resolved and supply constraints are removed. As adverted to above, short-term fiscal imperatives should not be the primary motivating factor in scheduling the spectrum auctions. It should be ensured that auction in the bands of 800 MHz, 900 MHz, 1800 MHz and 2100 MHz are conducted simultaneously. As such, **the Authority recommends that the forthcoming auction should be scheduled after the above issues are resolved and auction in the 800 MHz, 900 MHz, 1800 MHz and 2100 MHz band be conducted simultaneously.**

CHAPTER–V: SUMMARY OF RECOMMENDATIONS

5.1 The Authority recommends that 1.2 MHz spectrum in 900 MHz band should be taken back from BSNL from all the LSAs where licences expire in 2015-16 except in Punjab. In lieu, BSNL should be assigned 1.2 MHz in the 1800 MHz band only in those LSAs where its spectrum holding in that band is less than 3.8 MHz in this band i.e. in Gujarat, Rajasthan and West Bengal. (Para 2.28)

5.2 The Authority recommends that the DoT should take a completely fresh look at the implementation of E-GSM band. (Para 2.32)

5.3 The Authority recommends that unused spectrum in the Defence band should not be kept idle. The DoT in coordination with Defence should fix a time frame for migration of Defence from commercial band to Defence band. If because of any reasons, this is not possible then only that much spectrum should be kept reserved for Defence in the Defence band which would make its total spectrum holding 20 MHz in the 1800 MHz band. In some LSAs viz. Andhra Pradesh, Tamilnadu, Kerala, Madhya Pradesh, Bihar and Orissa, where there is nil or negligible spectrum assignment to Defence in both commercial and Defence band, only 5 MHz can be kept reserved for them for any future requirement. The rest of the vacant spectrum in the Defence band should be put to auction. (Para 2.38)

5.4 The Authority recommends that in the LSAs, where spectrum assigned to Defence in the 1800 MHz band is more than 20 MHz, DoT should coordinate with Defence for the vacation of spectrum held by Defence in excess of 20 MHz. (Para 2.39)

5.5 The Authority recommends that the entire 2x60 MHz in the 2100 MHz band should be made available for commercial use. If

required, Defence may be assigned spectrum in the 1900 MHz band (1910-1920/1980-1990 MHz). The Authority also recommends that auctions in this band should be carried out along with the auctions in 900/1800 MHz band. (Para 2.45)

5.6 The Authority recommends that:

- **The Government should immediately take action on the Authority's recommendations of February 2013 on the adoption of APT700 in the country.**
- **The Government should also announce the roadmap for the auction of spectrum in 700 MHz band. This should be done before the conduct of the upcoming auctions in 900/1800 MHz band. (Para 2.52)**

5.7 The Authority reiterates its recommendation that the frequency rearrangement in the same band, from within the assignments made to the licensees, should be permitted amongst all licensees irrespective of whether the spectrum is liberalised or not. However, the use of spectrum shall be liberalised only if the entire spectrum holding of a licensee in a particular band is liberalised. (Para 2.63)

5.8 The Authority recommends that all efforts should be made to make available spectrum in contiguous form. Nevertheless, the entire available spectrum should be put to auction. (Para 2.67)

5.9 The Authority recommends that

- **Spectrum should be put to auction in a block size of 2x200 KHz in both the 900 and 1800 MHz bands.**
- **In the 900 MHz band, the bidders should be required to bid for a minimum of 2x3.6 MHz in those LSAs where spectrum being put to auction is 10 MHz or more and 2x2.4 MHz in the remaining LSAs.**

- **In the 1800 MHz band, the bidders would be required to bid for a minimum of 2x0.6 MHz spectrum.**

(Para 2.82)

5.10 The Authority is of the view that a fresh valuation of 1800 MHz spectrum for all 22 LSAs is the preferred way to initiate the process of determining valuation and reserve price of 1800 MHz spectrum for the forthcoming auction. (Para 3.17)

5.11 The Authority recommends that the reserve prices for 1800 MHz spectrum for 22 LSAs should be as in the table below: (Para 3.66)

LSA	Category	Recommended Reserve Price per 1800 MHz (Rs. in crore)
Delhi*	Metro	364
Mumbai*	Metro	272
Kolkata	Metro	73
Andhra Pradesh	A	163
Gujarat	A	238
Karnataka	A	155
Tamil Nadu	A	208
Haryana	B	32
Kerala	B	75
Madhya Pradesh*	B	69
Punjab	B	71
Rajasthan	B	60
U. P. (East)	B	97
U.P. (West)	B	95
Assam*	C	36
Bihar	C	62
Himachal Pradesh	C	9
Jammu & Kashmir*	C	25
North East	C	11
Orissa	C	23

5.12 The Authority recommends that the reserve price of 900 MHz spectrum for each LSA should be as in the table below: (Para 3.68)

LSA	Category	Recommended Reserve Price per 900 MHz (Rs. in crore)
Andhra Pradesh	A	271
Gujarat	A	339
Karnataka	A	286
Maharashtra	A	420
Tamilnadu	A	338
Haryana	B	64
Kerala	B	150
Madhya Pradesh	B	138
Punjab	B	141
Rajasthan	B	172
U. P. (East)	B	195
U.P. (West)	B	152
West Bengal	B	70
Assam	C	58
Bihar	C	123
Himachal Pradesh	C	19
North East	C	21
Orissa	C	47

5.13 The Authority recommends that a dialogue needs to be held at the level of the Finance Minister, the Minister of Communications and IT and the Defence Minister to ensure the availability of additional spectrum for commercial use. The Authority is also of the view that the auction should be carried out only after a clear roadmap is available for vacating spectrum in 2100 MHz band from Defence and in 900 MHz band from BSNL. (Para 4.5)

5.14 The Authority recommends that the forthcoming auction should be scheduled after the above issues are resolved and auction in the 800 MHz, 900 MHz, 1800 MHz and 2100 MHz band be conducted simultaneously. (Para 4.7)

ABBREVIATION

S.No.	Abbreviation	Expansion
1.	3G	Third Generation
2.	ADP	Auction Determined Price
3.	APAC	Asia Pacific
4.	APT	Asia-Pacific Telecommunity
5.	ARPU	Average Revenue per User
6.	BSNL	Bharat Sanchar Nigam Limited
7.	BTS	Base Transceiver Station
8.	CAPEX	Capital Expenditure
9.	CDMA	Code Division Multiple Access
10.	CMTS	Cellular Mobile Telephone Service
11.	CP	Consultation Paper
12.	DCF	Discounted Cash Flow
13.	DoT	Department of Telecommunications
14.	EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
15.	E-GSM	Extended GSM
16.	FDD	Frequency Division Duplexing
17.	GSA	Global mobile Suppliers Association
18.	GSM	Global System for Mobile Communication
19.	HSPA	High Speed Packet Access
20.	HSPA+	Evolved HSPA
21.	IMT	International Mobile Telecommunications
22.	LSA	Licence Service Area
23.	LTE	Long Term Evolution
24.	MCP	Market Clearing Price
25.	MNP	Mobile Number Portability

ABBREVIATION

S.No.	Abbreviation	Expansion
26.	MoU	Minutes of Usage
27.	NIA	Notice Inviting Application
28.	NPA	Non-Performing Asset
29.	NPV	Net Present Value
30.	OHD	Open House Discussion
31.	OPEX	Operating Expenditure
32.	RAN	Radio Access Network
33.	RP	Reserve Price
34.	SUC	Spectrum Usage Charge
35.	TDD	Time Division Duplexing
36.	TDSAT	Telecom Disputes Settlement & Appellate Tribunal
37.	TRAI	Telecom Regulatory Authority of India
38.	TSP	Telecom Service Provider
39.	UAS	Unified Access Service
40.	UL(AS)	Unified Licence Access Service
41.	UMTS	Universal Mobile Telecommunication System
42.	WPC	Wireless Planning and Coordination Wing

Annexure 1.1

Government of India
Ministry of Communications & IT
WPC Wing, Sanchar Bhawan
New Delhi-110001

No.L-14010/02/2014-NTG Dated:17.04.2014

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 900 MHz and 1800 MHz Bands – Reg.

Sir,

The undersigned is directed to state that some of the Access Service licenses are due to expire during December, 2015 and early 2016. The Telecom Service Providers whose licenses are expiring in 2015 - 2016 are holding spectrum in 900 MHz and 1800 MHz Bands. The spectrum held by such licensees are to be put to auction atleast 18 months in advance of expiry of licenses. The list of Access (CMTS/ UAS) licences due to expire during 2015-2016 and the spectrum holding by these licensees are at Annexure.

2. Accordingly, TRAI is requested to kindly provide recommendations on applicable reserve price for all the service areas for auction of spectrum in 900 MHz and 1800 MHz Bands.

Yours faithfully,

17-04-2014

(R.B.Prasad)
Joint Wireless Adviser

Annexure

Detail of the Spectrum in 900/1800 MHz bands of the CMTS/UASL licenses expiring during 2015-16

S.No.	Name of the licensee company	Service area	Type of license	Effective date of license	Spectrum Holding		Total spectrum holding
					900 MHz band	1800 MHz band	
1	Bharti Airtel Limited	Andhra Pradesh	UAS	12 Dec., 1995	7.8	2.2	10.0
2	Bharti Airtel Limited	Himachal Pradesh	UAS	12 Dec., 1995	6.2	-	6.2
3	Bharti Airtel Limited	Punjab	UAS	12 Dec., 1995	7.8	-	7.8
4.	Bharti Hexacom Ltd.	North East	CMTS	12 Dec., 1995	4.4	1.8	6.2
5.	Idea Cellular Ltd.	Gujarat	CMTS	12 Dec., 1995	6.2	-	6.2
6	Idea Cellular Ltd.	Haryana	CMTS	12 Dec., 1995	6.2	-	6.2
7	Idea Cellular Ltd.	Kerala	CMTS	12 Dec., 1995	6.2	1.8	8.0
8	Idea Cellular Ltd.	Madhya Pradesh	CMTS	12 Dec., 1995	6.2	1.8	8.0
9	Idea Cellular Ltd.	Maharashtra	CMTS	12 Dec., 1995	7.8	2.0	9.8
10	Idea Cellular Ltd.	Uttar Pradesh (West)	CMTS	12 Dec., 1995	6.2	1.8	8.0
11	Reliance Telecom Ltd.	Assam	UAS	12 Dec., 1995	6.2	-	6.2
12	Reliance Telecom Ltd.	Bihar	UAS	12 Dec., 1995	6.2	1.8	8.0
13	Reliance Telecom Ltd.	Himachal Pradesh	UAS	12 Dec., 1995	6.2	-	6.2
14	Reliance Telecom Ltd.	Madhya Pradesh	UAS	12 Dec., 1995	6.2	-	6.2
15	Reliance Telecom Ltd.	North East	UAS	12 Dec., 1995	4.4	1.8	6.2
16	Reliance Telecom Ltd.	Orissa	UAS	12 Dec., 1995	6.2	-	6.2
17	Reliance Telecom Ltd.	West Bengal	UAS	12 Dec., 1995	4.4	1.8	6.2
18	Vodafone Essar Cellular Ltd.	Kerala	UAS	12 Dec., 1995	6.2	-	6.2
19	Vodafone Essar Cellular Ltd.	Tamil Nadu (excluding Chennai Service Area)	UAS	12 Dec., 1995	6.2	1.0	7.2
20	Vodafone Essar Digilink Ltd.	Haryana	UAS	12 Dec., 1995	6.2	-	6.2
21	Vodafone Essar Digilink Ltd.	Rajasthan	UAS	12 Dec., 1995	6.2	-	6.2
22	Vodafone Essar Digilink Ltd.	Uttar Pradesh (East)	UAS	12 Dec., 1995	6.2	2.0	8.2
23.	Idea Cellular Ltd.	Andhra Pradesh	CMTS	19 Dec. 1995	6.2	1.8	8.0
24	Vodafone Essar Cellular Ltd.	Maharasthra	UAS	19 Dec. 1995	6.2	-	6.2
25	Vodafone Essar Cellular Ltd.	Gujarat	UAS	19 Dec. 1995	7.8	2.0	9.8
26	Bharti Airtel Limited	Karnataka	UAS	15 Feb., 1996	7.8	2.2	10.0
27	Spice Communications Ltd.	Karnataka	UAS	9 April 1996	6.2	-	6.2
28	Spice Communications Ltd.	Punjab	UAS	9 April 1996	7.8	-	7.8
29	Bharti Hexacom Ltd.	Rajasthan	UAS	22 April 1996	6.2	2.0	8.2

Annexure 2.1

Details of Expiry of Spectrum in 900 MHz up to 2016								
Sl. No.	**LSA**	**Block details**	**Uplink**		**Downlink**		**Total**	Remark
1	**MH**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	Except GMRT Area
		5 MHz (2)	895.2	900.0	940.2	945.0	5.0	Except GMRT Area (1 MHz partial)
		Non-Contiguous	900.2	902.4	945.2	947.4	2.4	
		Non-Contiguous	910.6	912.0	955.6	957.0	1.6	
		Total					**14.0**	
2	**GUJ**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		5 MHz (2)	895.2	900.0	940.2	945.0	5.0	
		Non-Contiguous	900.2	902.4	945.2	947.4	2.4	
		Non-Contiguous	910.6	912.0	955.6	957.0	1.6	
		Total					**14.0**	
3	**AP**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		5 MHz (2)	895.2	900.0	940.2	945.0	5.0	
		Non-Contiguous	900.2	902.4	945.2	947.4	2.4	
		Non-Contiguous	910.6	912.0	955.6	957.0	1.6	
		Total					**14.0**	
4	**KTK**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		5 MHz (2)	895.2	900.0	940.2	945.0	5.0	
		Non-Contiguous	900.2	902.4	945.2	947.4	2.4	
		Non-Contiguous	910.6	912.0	955.6	957.0	1.6	
		Total					**14.0**	
5	**TN**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		Non-Contiguous	895.2	896.2	940.2	941.2	1.2	
		Total					**6.2**	
6	**KL**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		5 MHz (2)	895.2	900.0	940.2	945.0	5.0	
		Non-Contiguous	900.2	902.4	945.2	947.4	2.4	
		Total					**12.4**	
7	**PB**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		5 MHz (2)	895.2	900.0	940.2	945.0	5.0	
		Non-Contiguous	900.2	902.4	945.2	947.4	2.4	
		Non-Contiguous	906.6	907.2	951.6	952.2	0.8	
		Non-Contiguous	909.6	910.2	954.6	955.2	0.8	
		Non-Contiguous	910.6	912.0	955.6	957.0	1.6	
		Total					**15.6**	
8	**HR**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		5 MHz (2)	895.2	900.0	940.2	945.0	5.0	
		Non-Contiguous	900.2	902.4	945.2	947.4	2.4	
		Total					**12.4**	
9	**UP(W)**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	

		Non-Contiguous	895.2	896.2	940.2	941.2	1.2	
		Total					**6.2**	
10	**UP(E)**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		Non-Contiguous	895.2	896.2	940.2	941.2	1.2	
		Total					**6.2**	
11	**RAJ**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		5 MHz (2)	895.2	900.0	940.2	945.0	5.0	
		Non-Contiguous	900.2	902.4	945.2	947.4	2.4	
		Total					**12.4**	
12	**MP**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		5 MHz (2)	895.2	900.0	940.2	945.0	5.0	
		Non-Contiguous	900.2	902.4	945.2	947.4	2.4	
		Total					**12.4**	
13	**WB**	Non-Contiguous	898.2	902.4	943.2	947.4	4.4	
		Total					**4.4**	
14	**HP**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		5 MHz (2)	895.2	900.0	940.2	945.0	5.0	
		Non-Contiguous	900.2	902.4	945.2	947.4	2.4	
		Total					**12.4**	
15	**BH**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		Non-Contiguous	895.2	896.2	940.2	941.2	1.2	
		Total					**6.2**	
16	**OR**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		Non-Contiguous	895.2	896.2	940.2	941.2	1.2	
		Total					**6.2**	
17	**AS**	5 MHz (1)	890.2	895.0	935.2	940.0	5.0	
		Non-Contiguous	895.2	896.2	940.2	941.2	1.2	
		Total					**6.2**	
18	**NE**	5 MHz (1)	894.6	899.4	939.6	944.4	5.0	
		Non-Contiguous	899.6	902.4	944.6	947.4	3.0	
		Non-Contiguous	907.8	908.4	952.8	953.4	0.8	
		Total					**8.8**	

Annexure 2.2

1800 MHz band					
Delhi					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
Total				0.0	
Mumbai					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
Total				0.0	
Kolkata					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1741.2	1746.0	1836.2	1841.0	5.0	Entire service area
1760.6	1762.4	1855.6	1857.4	2.0	Entire service area
Total				7.0	
Maharashtra					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1733.4	1735.2	1828.4	1830.2	2.0	Pune City
Total				2.0	
Gujarat					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1721.2	1722.0	1816.2	1817.0	1.0	Entire service area
1733.0	1734.8	1828.0	1829.8	2.0	Entire Gujarat except Ahmedabad, Jamnagar, Vadodara
1764.6	1764.8	1859.6	1859.8	0.4	Entire service area
Total				3.4	
Andhra Pradesh					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1745.4	1749.0	1840.4	1844.0	3.8	Entire service area
Total				3.8	
Karnataka					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1714.6	1715.0	1809.6	1810.0	0.6	Entire service area
1722.6	1723.2	1817.6	1818.2	0.8	Entire service area
1743.6	1743.8	1838.6	1838.8	0.4	Entire service area
Total				1.8	
Tamil Nadu					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		

1715.0	1715.8	1810.0	1810.8	1.0	Entire service area
1725.6	1729.8	1820.6	1824.8	4.4	Entire service area
1743.6	1748.4	1838.6	1843.4	5.0	Entire service area
1748.8	1749.0	1843.8	1844.0	0.4	Entire service area
1751.8	1756.6	1846.8	1851.6	5.0	Entire service area
1757.0	1761.0	1852.0	1856.0	4.2	Entire service area
Total				20.0	
Kerala					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1746.4	1747.2	1841.4	1842.2	1.0	Entire service area
Total				1.0	
Punjab					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1749.2	1750.6	1817.2	1819.2	1.6	Entire servie area
Total				1.6	
Haryana					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1718.4	1719.0	1813.4	1814.0	0.8	Entire service area
1733.2	1736.6	1828.2	1831.6	3.6	Entire service area
1743.4	1745.0	1838.4	1840.0	1.8	Entire service area
1763.0	1764.6	1858.0	1859.6	1.8	Entire service area
Total				8.0	
Uttar Pradesh (West)					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1712.0	1713.6	1807.0	1808.6	1.8	Meerut, Sahranpur, Muzaffarnagar, Biznore and Firozabad
1763.4	1763.6	1858.4	1858.6	0.4	Entire service area
Total				2.2	
Uttar Pradesh (East)					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1720.6	1720.8	1815.6	1815.8	0.4	Entire service area except Allahabad, Gorakhpur and Jhansi
1714.6	1718.2	1809.6	1813.2	3.8	Entire service area except Allahabad, Gorakhpur and Jhansi
Total				4.2	
Rajasthan					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1732.8	1736.0	1817.2	1819.2	3.4	Entire service area except Bikaner,

1744.0	1748.8	1839.0	1843.8	5.0	Barmer, Bharatpur, Dausa, Ganganagar, Hanumangarh, Jodhpur, Jaipur, Jaisalmaer, Jalore & Sirohi
1752.2	1754.0	1847.2	1849.0	2.0	
Total				10.4	
Madhya Pradesh					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
Total				0.0	
West Bengal					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1732.6	1734.2	1827.6	1829.2	1.8	Darjeeling, Kooch Bihar, Uttar Dinajpur, Dakshin Dinajpur, Maldah
Total				1.8	
Himachal Pradesh					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1714.0	1714.0	1809.0	1809.0	0.2	Entire service area
1716.8	1716.8	1811.8	1811.8	0.2	Entire service area
1717.0	1720.8	1812.0	1815.8	4.0	Entire service area except Chamba, Kangra, Kinnaur, Shimla, Sirmour, Solan
1743.8	1746.6	1838.8	1841.6	3.0	Entire service area
1761.0	1763.6	1856.0	1858.6	2.8	Entire service area
Total				10.2	
Bihar					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1718.2	1719.8	1813.2	1814.8	1.8	Motihari, Gopalganj, Madhubani, Raxaul, Betiah, Sheohar, Sitamarhi
1749.0	1749.0	1844.0	1844.0	0.2	Entire service area
Total				2.0	
Odisha					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
1736.8	1741.6	1817.2	1819.2	5.0	Entire service area
1741.8	1751.6	1836.8	1846.6	10.0	Entire service area
1753.8	1754.8	1817.2	1819.2	1.2	Entire service area
Total				16.2	
Assam					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
Total				0.0	
North East					
UPLINK		**DOWNLINK**		**Total**	**Remarks**

From	To	From	To	Spectrum	
1726.0	1726.0	1817.2	1819.2	0.2	Entire service area
1728.2	1729.8	1823.2	1824.8	1.8	Entire service area
1730.0	1731.6	1825.0	1826.6	1.8	Meghalaya only
1748.6	1749.2	1817.2	1819.2	0.8	Entire service area
1751.2	1751.8	1828.4	1830.2	0.8	Entire service area
1756.6	1756.8	1828.4	1830.2	0.4	Entire service area
1762.4	1764.8	1828.4	1830.2	2.6	Entire service area except East Khasi Hill & Tawang
Total				8.4	
Jammu & Kashmir					
UPLINK		**DOWNLINK**		**Total Spectrum**	**Remarks**
From	**To**	**From**	**To**		
Total				0.0	

Annexure 3.1

VALUATION OF SPECTRUM IN 1800 MHz BAND
PRODUCER SURPLUS MODEL

1. The methodology for estimation of value of spectrum has been described in the Annexure 4.2 to the Authority's Recommendations on Valuation and Reserve Price of Spectrum dated 09.09.2014. As indicated in the afore-mentioned Annexure,

   Producer Surplus

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

2. For estimation of producer Surplus, the information on MOUs, cost of BTSs and spectrum-in-use have been updated with the latest information available with the Authority. Further, the assumptions regarding growth in subscriber base, data usage and average revenue per user (ARPU) have been modified to better capture the reality. The following Table presents the growth rates used in the model:

TABLE A

PROJECTED GROWTH RATES

Year	Growth of subscribers	Growth of Voice MOU per subscriber per month	Growth of SMS per subscriber per month	Growth of Data Download per subscriber per month	Growth of ARPU per month
2015	4.0%	0%	0%	20%	5%
2016	4.0%	0%	0%	20%	5%
2017	3.5%	0%	0%	16%	4.5%
2018	3.0%	0%	0%	16%	4.5%
2019	2.5%	0%	0%	12%	4.5%
2020	2%	0%	0%	12%	4%
2021	2%	0%	0%	10%	4%

2022	1.5%	0%	0%	10%	4%
2023	1%	0%	0%	10%	4%
2024	1%	0%	0%	8%	3%
2025	1%	0%	0%	8%	3%
2026	1%	0%	0%	8%	3%
2027	1%	0%	0%	6%	3%
2028	0.5%	0%	0%	6%	3%
2029	0.5%	0%	0%	6%	3%
2030	0.5%	0%	0%	4%	3%
2031	0.5%	0%	0%	4%	2%
2032	0.5%	0%	0%	4%	2%
2033	0.5%	0%	0%	2%	2%
2034	0.5%	0%	0%	2%	2%
2035	0.5%	0%	0%	2%	2%

3. The following table indicates the estimated values of spectrum using Producer Surplus model:

TABLE B

Value of 1800 MHz (Per MHz)
using Producer Surplus Model

(Rs. in crore)

LSA	Category	Value of 1800 MHz (per MHz)
Delhi*	Metro	247.61
Mumbai*	Metro	217.08
Kolkata	Metro	74.22
Andhra Pradesh	A	123.38
Gujarat	A	154.46
Karnataka	A	213.10
Maharashtra	A	305.07
Tamilnadu	A	247.30
Haryana	B	56.53

Kerala	B	92.15
Madhya Pradesh*	B	117.07
Punjab	B	145.66
Rajasthan	B	203.59
U. P. (East)	B	194.56
U.P. (West)	B	122.09
West Bengal	B	39.45
Assam*	C	17.42
Bihar	C	103.76
Himachal Pradesh	C	11.51
Jammu & Kashmir*	C	53.81
North East	C	43.80
Orissa	C	26.29
Pan India		**2809.91**

* 1800 MHz spectrum is not available in Delhi, Mumbai, MP, Assam and J&K. However, value of these LSAs have been included in the table since there is some likelihood of spectrum becoming available as discussed in Chapter II.

Annexure 3.2

VALUE OF 1800 MHZ (PER MHZ)
USING PRODUCTION FUNCTION APPROACH

(Rs. in crore)

LSA	Category	Value of 1800 MHz (per MHz)
Delhi*	Metro	349.34
Mumbai*	Metro	338.02
Kolkata	Metro	62.13
Andhra Pradesh	A	164.12
Gujarat	A	133.75
Karnataka	A	161.15
Maharashtra	A	182.33
Tamilnadu	A	185.59
Haryana	B	33.13
Kerala	B	60.40
Madhya Pradesh*	B	81.62
Punjab	B	51.34
Rajasthan	B	74.51
U. P. (East)	B	84.90
U.P. (West)	B	62.70
West Bengal	B	53.81
Assam*	C	12.85
Bihar	C	62.97
Himachal Pradesh	C	11.53
Jammu & Kashmir*	C	9.38
North East	C	13.09
Orissa	C	30.02
Pan India		**2218.70**

* 1800 MHz spectrum is not available in Delhi, Mumbai, MP, Assam and J&K. However, value of these LSAs have been included in the table since there is some likelihood of spectrum becoming available as discussed in Chapter II.

Annexure 3.3

VALUATION OF SPECTRUM IN 1800 MHz BAND
REVENUE SURPLUS MODEL

1. The following assumptions are made in arriving at the valuation of 1800 MHz spectrum using this approach:

   a) A bottom-up approach to be adopted with separate revenue surplus projections done for each LSA.
   b) The growth of subscribers and ARPU is assumed to be the same as in the producer surplus model (one other approach of spectrum valuation).
   c) The revenue is calculated as the product of Average Revenue per User (ARPU) and average number of subscribers. The figures given by service providers to TRAI for the year 2013-14 have been used as the base figures in this exercise.
   d) The EBITDA margin (%) varies across LSAs as well as TSPs. A uniform EBITDA margin of 30% of revenue has been taken in the calculation to ensure that the incentive to invest is incorporated into the calculation.
   e) Per line Investment (Capex) has been taken Rs.1500 per subscriber. However, the investment per subscriber does not include spectrum auction fee and one time licence fee.
   f) Capital investment for the first year (2015-16) would be equal to the number of subscribers multiplied by the investment required per subscriber. For subsequent years, additional capital investment is calculated on the basis of the number of incremental subscribers. Capital investment per year can be projected for a period of 20 years in the following manner:

$$\text{Capital investment (year 2015-16)} = N_{S\,(2015\text{-}16)} \times I_S$$

$$\text{Capital Investment}_n \text{ (subsequent year)} = [N_{S(n)} - N_{S\,(n\text{-}1)}] \times I_S$$

Where n = (year 2016-17, 2017-18,..., 2034-35)

g) Useful life for the capital investments is assumed to be 10 years.

h) Return on capital investment is allowed @ 15%.

i) Revenue surplus (i.e. revenue net of costs and return on capital investment) is calculated for 20 years.

j) The NPV of revenue surplus for 20 years is computed using a discounting factor of 12.5 %.

k) The NPV of revenue surplus represent the blended present value of surplus from the GSM bands of 1800 MHz, 900 MHz and 2100 MHz. To work out the valuation of the 1800 MHz, spectrum allocated in 900 MHz and 2100 MHz has been converted to 1800 MHz using factors of 1.5 and 0.83 respectively based on technical parameters and propagation characteristics of 900 MHz and 2100 MHz bands.

2. To calculate the value per MHz of the 1800 MHz spectrum, the NPV of revenue surplus of each LSA is divided by the total available 1800 MHz spectrum in that LSA prior to the February 2014 auction (i.e. 1800 MHz spectrum + equivalent spectrum in 900 MHz and 2100 MHz spectrum.

3. Based on the above assumptions the value of 1800 MHz spectrum (per MHz) using revenue surplus approach are as follows:

TABLE A

Value of 1800 MHz (Per MHz)

(Rs. in crore)

LSA	Category	Value of 1800 MHz (per MHz)
Delhi*	Metro	213.03
Mumbai*	Metro	139.86
Kolkata	Metro	51.51
Andhra Pradesh	A	226.78
Gujarat	A	132.25
Karnataka	A	209.76

Maharashtra	A	221.79
Tamilnadu	A	260.74
Haryana	B	42.68
Kerala	B	170.88
Madhya Pradesh*	B	95.05
Punjab	B	102.52
Rajasthan	B	125.33
U. P. (East)	B	143.16
U.P. (West)	B	93.42
West Bengal	B	57.75
Assam*	C	64.13
Bihar	C	97.72
Himachal Pradesh	C	18.39
Jammu & Kashmir*	C	53.85
North East	C	41.43
Orissa	C	44.55
Pan India		**2606.56**

* 1800 MHz spectrum is not available in Delhi, Mumbai, MP, Assam and J&K. However, value of these LSAs have been included in the table since there is some likelihood of spectrum becoming available as discussed in Chapter II.

Annexure 3.4

VALUATION (PER MHz) USING DIFFERENT APPROACHES – 1800 MHz SPECTRUM

(Rs. in crore)

LSA	Achieved Price - February 2014 auction	Producer Surplus	Production function	Revenue Surplus	Average (mean) Value
Delhi*	364.00	247.61	349.34	213.03	293.49
Mumbai*	272.00	217.08	338.02	139.86	241.74
Kolkata	73.00	74.22	62.13	51.51	65.21
Andhra Pradesh	163.00	123.38	164.12	226.78	169.32
Gujarat	237.80	154.46	133.75	132.25	164.57
Karnataka	155.00	213.10	161.15	209.76	184.75
Maharashtra	290.35	305.07	182.33	221.79	249.89
Tamilnadu	208.00	247.30	185.59	260.74	225.41
Haryana	27.00	56.53	33.13	42.68	39.84
Kerala	52.00	92.15	60.40	170.88	93.86
Madhya Pradesh*	50.40	117.07	81.62	95.05	86.03
Punjab	54.00	145.66	51.34	102.52	88.38
Rajasthan	26.00	203.59	74.51	125.33	107.36
U. P. (East)	64.00	194.56	84.90	143.16	121.66
U.P. (West)	94.95	122.09	62.70	93.42	93.29
West Bengal	24.60	39.45	53.81	57.75	43.90
Assam*	36.10	17.42	12.85	64.13	32.62
Bihar	43.10	103.76	62.97	97.72	76.89
Himachal Pradesh	6.00	11.51	11.53	18.39	11.86
Jammu & Kashmir*	6.10	53.81	9.38	53.85	30.78
North East	7.00	43.80	13.09	41.43	26.33
Orissa	16.00	26.29	30.02	44.55	29.22
PAN INDIA	**2270.40**	**2809.91**	**2218.70**	**2606.56**	**2476.39**

* 1800 MHz spectrum is not available in Delhi, Mumbai, MP, Assam and J&K. However, average valuations of these LSAs have been included in the table since there is some likelihood of spectrum becoming available as discussed in Chapter II.

Annexure 3.5

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

1. In CP dated 7th August 2014, the Authority noted that additional CAPEX and OPEX is required for operating in the 1800 MHz band, as compared to 900 MHz band. Therefore, the 900 MHz band commands a premium over the 1800 MHz band that would correspond to the additional cost (CAPEX and OPEX) per MHz required in 1800 MHz.

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

   i) Since disaggregated information on BTS is not available, in category 'A' LSAs 70% and in category 'B' and 'C' 60% of BTSs are considered to be in urban area.

   ii) Since TSPs hold a mix of 900 and 1800 MHz spectrum, in urban area of category 'A', 'B' and 'C', 60% of BTS are considered to be in 900 MHz and in rural areas 90% of BTS are considered in 900 MHz.

   iii) While operating in 1800 MHz as compared to 900 MHz in urban areas, requirement of additional BTS would be lower in 900 MHz as there is concentration of population and BTS have already been installed at comparatively close distances to cater to traffic loads. Thus after shifting from 900 MHz to 1800 MHz spectrum, number of BTS in 900 MHz band would have to be replaced by 1800 MHz BTS with an increase of 25% in urban area and of 100% in rural areas.

   iv) A life of 10 years for BTS has been assumed. After 10 years, fresh investment in BTS will be required. CAPEX per additional BTS taken at Rs.5 lakh. CAPEX for replacing the

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

v) Since a number of operators are working on an outsourced model for towers, it is assumed additional towers would be taken on rent. OPEX on additional BTS includes rental for towers and other costs such as fuel, electricity etc. associated with running a BTS. OPEX per BTS has been taken at Rs.4.32 lakh per year for category A, B and C LSAs.

vi) Cash flows (CAPEX and OPEX) have been discounted over 20 years using rate of 12.50%.

3. Based on the above assumptions, the additional cost per MHz operating on 1800 MHz as compared to 900 MHz (premium on 900 MHz) has been estimated for 18 LSAs as given in following table. The table also contains the value of 900 MHz spectrum after taking into account economic premium over 1800 MHz spectrum.

TABLE A

VALUATION OF 900 PER MHz SPECTRUM USING ECONOMIC EFFICIENCY APPROACH

(Rs. in crore)

LSA	Average value of 1800 per MHz spectrum (A)	Economic premium over 1800 per MHz (B)	Value of 900 per MHz spectrum (A+B)
Andhra Pradesh	169.32	273.61	442.93
Gujarat	237.80	201.39	439.19
Karnataka	184.75	240.08	424.83
Maharashtra	290.35	267.12	557.47
Tamil Nadu	225.41	253.89	479.29
Haryana	39.84	105.41	145.24
Kerala	93.86	207.94	301.80
Madhya Pradesh	86.03	270.32	356.35
Punjab	88.38	169.64	258.02

Rajasthan	107.36	253.94	361.30
UP (East)	121.66	305.96	427.61
UP (West)	94.95	208.99	303.94
West Bengal	43.90	217.25	261.15
Assam	36.10	114.08	150.18
Bihar	76.89	207.52	284.41
Himachal Pradesh	11.86	49.77	61.62
North East	26.33	95.65	121.98
Orissa	29.22	119.02	148.24

Note: 900 MHz spectrum is not available/ not likely to be available in Delhi, Mumbai, Kolkata and J&K LSAs. Hence, the value has not been given.

Annexure 3.6

VALUATION (PER MHz) USING DIFFERENT APPROACHES - 900 MHz

(Rs. in crore)

LSA	1.5 times of average valuation of 1800 MHz band	2 times of average valuation of 1800 MHz band	Economic premium over 1800 MHz plus average valuation of 1800 MHz band	Average of different approaches (Average valuation of 900 MHz)
Andhra Pradesh	253.98	338.64	442.93	345.19
Gujarat	356.70	475.60	439.19	423.83
Karnataka	277.13	369.50	424.83	357.15
Maharashtra	435.53	580.70	557.47	524.57
Tamil Nadu	338.11	450.82	479.29	422.74
Haryana	59.75	79.67	145.24	94.89
Kerala	140.79	187.71	301.80	210.10
Madhya Pradesh	129.05	172.07	356.35	219.16
Punjab	132.57	176.76	258.02	189.12
Rajasthan	161.04	214.72	361.30	245.68
UP (East)	182.48	243.31	427.61	284.47
UP (W)	142.43	189.90	303.94	212.09
West Bengal	65.85	87.80	261.15	138.27
Assam	54.15	72.20	150.18	92.18
Bihar	115.33	153.78	284.41	184.51
Himachal Pradesh	17.78	23.71	61.62	34.37
North East	39.50	52.66	121.98	71.38
Orissa	43.82	58.43	148.24	83.50

Note: 900 MHz spectrum is not available/ not likely to be available in Delhi, Mumbai, Kolkata and J&K LSAs. Hence, the reserve price has not been given.

Annexure 3.7

AVERAGE AND RECOMMENDED VALUATION (PER MHz) OF 900 MHz BAND

(Rs. in crore)

LSA	Category	Average value per MHz of 1800 MHz (A)	Average value per MHz of 900 MHz (B)	Twice of Average value per MHz of 1800 MHz (C = 2 * A)	Recommended Value per MHz of 900 MHz (Lower of C OR B) (D)
Andhra Pradesh	A	169.32	345.19	338.64	338.64
Gujarat	A	237.80	423.83	475.60	423.83
Karnataka	A	184.75	357.15	369.50	357.15
Maharashtra	A	290.35	524.57	580.70	524.57
Tamilnadu	A	225.41	422.74	450.82	422.74
Haryana	B	39.84	94.89	79.67	79.67
Kerala	B	93.86	210.10	187.71	187.71
Madhya Pradesh	B	86.03	219.16	172.07	172.07
Punjab	B	88.38	189.12	176.76	176.76
Rajasthan	B	107.36	245.68	214.72	214.72
U. P. (East)	B	121.66	284.47	243.31	243.31
U.P. (West)	B	94.95	212.09	189.90	189.90
West Bengal	B	43.90	138.27	87.80	87.80
Assam	C	36.10	92.18	72.20	72.20
Bihar	C	76.89	184.51	153.78	153.78
Himachal Pradesh	C	11.86	34.37	23.71	23.71
North East	C	26.33	71.38	52.66	52.66
Orissa	C	29.22	83.50	58.43	58.43

Note: 900 MHz spectrum is not available/ not likely to be available in Delhi, Mumbai. Kolkata and J&K LSAs. Hence, the valuations has not been given.

Annexure 3.8

COMPARISON OF 80% OF AVERAGE VALUATION PER MHZ OF 1800 MHZ SPECTRUM AND FEBRUARY 2014 AUCTION REVEALED PRICE

(Rs. in crore)

LSA	Category	80% of average valuation per MHz of 1800 MHz spectrum	February 2014 Auction revealed price per MHz of 1800 MHz spectrum
Delhi*	Metro	291.20	364.00
Mumbai*	Metro	217.60	272.00
Kolkata	Metro	58.40	73.00
Andhra Pradesh	A	135.46	163.00
Gujarat	A	190.24	237.80
Karnataka	A	147.80	155.00
Maharashtra	A	232.28	290.35
Tamil Nadu	A	180.33	208.00
Haryana	B	31.87	27.00
Kerala	B	75.09	52.00
Madhya Pradesh*	B	68.83	50.40
Punjab	B	70.70	54.00
Rajasthan	B	85.89	26.00
U. P. (East)	B	97.32	64.00
U.P. (West)	B	75.96	94.95
West Bengal	B	35.12	24.60
Assam*	C	28.88	36.10
Bihar	C	61.51	43.10
Himachal Pradesh	C	9.48	6.00
Jammu & Kashmir*	C	24.63	6.10
North East	C	21.06	7.00
Orissa	C	23.37	16.00
Pan India		**2163.02**	**2270.40**

* 1800 MHz spectrum is not available in Delhi, Mumbai, MP, Assam and J&K. However, value of these LSAs have been included in the table since there is some likelihood of spectrum becoming available as discussed in Chapter II.

Annexure 3.9

RESERVE PRICE : HIGHER OF 80% OF AVERAGE VALUATION OF 1800 MHZ BAND OR FEBRUARY 2014 AUCTION REVEALED PRICE

(Rs. in crore)

LSA	Category	Reserve Price per MHz of 1800 MHz spectrum
Delhi*	Metro	364.00
Mumbai*	Metro	272.00
Kolkata	Metro	73.00
Andhra Pradesh	A	163.00
Gujarat	A	237.80
Karnataka	A	155.00
Maharashtra	A	290.35
Tamil Nadu	A	208.00
Haryana	B	31.87
Kerala	B	75.09
Madhya Pradesh*	B	68.83
Punjab	B	70.70
Rajasthan	B	85.89
U. P. (East)	B	97.32
U.P. (West)	B	94.95
West Bengal	B	35.12
Assam*	C	36.10
Bihar	C	61.51
Himachal Pradesh	C	9.48
Jammu & Kashmir*	C	24.63
North East	C	21.06
Orissa	C	23.37
Pan India		**2499.08**

* 1800 MHz spectrum is not available in Delhi, Mumbai, MP, Assam and J&K. However, reserve price of these LSAs have been included in the table since there is some likelihood of spectrum becoming available as discussed in Chapter II.