



Telecom Regulatory Authority of India



Consultation Paper

on

**Valuation and Reserve Price of Spectrum in 700, 800, 900, 1800, 2100,
2300 and 2500 MHz Bands**

26th November, 2015

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Written Comments on the Consultation Paper are invited from the stakeholders by 21st December 2015 and counter-comments by 28th December 2015. As the issue has to be decided urgently, no further extension of time will be granted. Comments and counter-comments will be posted on TRAI's website www.trai.gov.in. The comments and counter-comments may be sent, preferably in electronic form, to Shri Sanjeev Banzal, Advisor (Networks, Spectrum and Licensing), TRAI on the email ID advmn@trai.gov.in with a copy to trai.jams@gmail.com

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CHAPTER-I: INTRODUCTION

- 1.1 The Department of Telecommunications (DoT), through its letter dated 9th July 2015 (**Annexure-1.1**), communicated that the Government is planning for auction of right to use of spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz in the forthcoming auction. DoT has requested the Authority to provide recommendations on applicable reserve price for auction of spectrum in these bands for all service areas under the terms of clause 11(1)(a) of TRAI Act 1997 as amended. DoT also referred to its earlier reference dated 16th October 2014 (**Annexure 1.2**) and requested the Authority to expedite the recommendations on applicable reserve price for 2300 MHz and 2500 MHz bands for all the service areas.
- 1.2 Further, DoT vide its letter dated 06th November 2015¹, has sent another reference (**Annexure 1.3**) wherein it has stated that the Government has already made provisions for liberalisation of administratively allotted spectrum holding in 800 MHz and 1800 MHz bands. At present there is no provision for liberalization of administratively allotted spectrum holding in 900 MHz band. Therefore, DoT has sought the recommendations of the Authority on the liberalization of administratively allotted spectrum in the 900 MHz band.
- 1.3 As the information given in its reference dated 9th July 2015 was not sufficient, the Authority vide its letter dated 24th July 2015 had sought additional information on some of the issues from DoT. In its reply dated 16th October 2015, DoT supplied some of the information. As the information provided by DoT was incomplete, the Authority sought further clarification on 16th November 2015. However, to save time, the Authority has decided to issue the consultation paper based on the available information.

¹ It seems that DoT has inadvertently mentioned the date of letter as 6th October 2015.

- 1.4 Background information on each of these bands is given in the subsequent paras.

BACKGROUND

700 MHz band

- 1.5 The 700 MHz (698-806 MHz) band is being adopted as a prime band for Long Term Evolution (LTE) technology by a number of countries in the Asia-Pacific (APAC), Middle East, Europe, America and Latin American region. Most of the countries in APAC region and Latin America region are adopting APT-700 band plan (FDD option), designated as band B28. Spectrum in the 700 MHz band is vital for proliferation of broadband in the country. Due to its adoption by large number of countries, harmonisation can be achieved resulting in lower price of devices in this band due to economy of scale and quick penetration of services.
- 1.6 In its recommendations dated 23rd April 2012 on ‘Auction of Spectrum’, 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.”* In its recommendations dated 15th October 2014 on ‘Valuation and Reserve Price of Spectrum: Licences Expiring in 2015-16’, the Authority recommended 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.”*

- 1.7 In the recommendations dated 17th April,2015, on ‘Delivering Broadband Quickly: What do we need to do?’, the Authority emphasised that *“The use of 700 MHz band has to be decided within 3 months so that auction of the spectrum can be planned accordingly.”*
- 1.8 In the present reference dated 9th July 2015, DoT has intimated that out of 2x45 MHz available in the 700 MHz band, 2x35 MHz will be assigned for commercial use. Through its letter dated 24th July 2015, the Authority asked DoT to confirm that the assignment through proposed auction in 700 MHz band will be as per APT700 band plan. In response, DoT submitted that while recommending the price of spectrum in 700 MHz band, if felt appropriate, TRAI may deliberate once again the issue of adopting APT700 band plan for 700 MHz band and provide its recommendations on this subject after taking into consideration current status of eco system. The Authority would like to emphasize that the Adoption of the APT700 MHz band plan (FDD option) by 40+ countries across the APAC and Latin America regions represents a major opportunity for wide scale spectrum harmonization for LTE deployments, paving the way for ensuring the economies of scale for devices and for roaming. Details about and the countries which have adopted APT700 band plan and the device eco-system in this band is annexed at **Annexure 1.4**. The Authority is of the firm view APT700 band plan should be adopted for the 700 MHz spectrum band (698-806 MHz) with FDD based 2x45 MHz frequency arrangement. Accordingly, through its letter dated 16th November 2015, the Authority has informed DoT that it is proceeding with the consultation process on the presumption that the the assignment through proposed auction in 700 MHz band will be as per APT700 band plan only. The Authority has also requested DoT that if it has any other understanding, the same may be communicated.

800/900/1800 MHz Bands

- 1.9 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 to issue fresh licences by auctions. This decision of the Hon'ble Supreme Court had a major bearing on the process of the award of spectrum, the assignment of which was hitherto done administratively. Since then four auctions have been held.
- 1.10 Post judgment, first auction was held for the spectrum in the 1800 MHz and 800 MHz bands in November 2012. There were no bidders 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.
- 1.11 The second auction was held in March 2013. The licences, which were awarded in the metros of Delhi, Mumbai and Kolkata in 1994, were due for expiry in 2014². As these licensees were holding spectrum in both 900 and 1800 MHz bands and the Government had decided to reform the spectrum in the 900 MHz band, therefore, in March 2013, spectrum in the 900 MHz assigned to these licensees was put to auction. The 1800 MHz band spectrum in the four LSAs viz Delhi, Mumbai, Karnataka and Rajasthan, where spectrum could not be sold in November 2012 auctions, was also put up for bidding. However, 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 it obtained spectrum in 800 MHz band in eight LSAs.
- 1.12 Auctions were again held in February 2014. In the 900 MHz band, spectrum was put up for auction only in those LSAs where the licences were due for expiry in 2014 i.e. Delhi, Mumbai and Kolkata

² Licences awarded for Chennai LSA in 1994 were merged with the licences given for Tamilnadu LSA. Therefore, their validity period got extended.

LSAs. However, in the 1800 MHz band, since DoT had spectrum available, it was put up for auction in all the LSAs. The entire available spectrum (46 MHz) in the 900 MHz band was sold. In the 1800 MHz band, 307 MHz of spectrum was sold out of total 385 MHz which was placed on auction.

1.13 Latest auctions were held in March 2015. In these auctions, the spectrum linked to licences expiring in 2015-16 was put to auction along with the unassigned spectrum that was available with DoT in the 800, 900 and 1800 MHz bands. One slot of 2x5 MHz of 2100 MHz band in 17 LSAs was also put to auction. Out of 108.75 MHz spectrum in 800 MHz, 86.25 MHz spectrum was sold. In the 900 MHz band, 168 MHz of spectrum was sold out of 177.8 MHz of spectrum that was put to auction. 93.8 MHz in 1800 MHz band was sold out of 99.2 MHz that was put to auction.

1.14 As discussed above, the spectrum becoming available as a result of licences expiring in 2014-2016 has already been auctioned. Now, the two CMTS licences given to MTNL and the six Basic service licences given in 1997-98, which were subsequently migrated to UASL, are due to expire during May 2016 to March 2018. These licensees hold spectrum in the 800 MHz, 900 MHz and 1800 MHz bands. In addition, there is some spectrum available in these bands that remained unsold in the last auction, held in March 2015.

2100 MHz Band

1.15 First auction in the 2100 MHz band was held in 2010. The Government put to auction three blocks (each block of 2x5 MHz) in 17 LSAs and four blocks in the remaining 5 LSAs. In addition, the Government allocated one block of 2x5MHz spectrum in Delhi and Mumbai to MTNL and in the remaining service areas to BSNL at the winning price achieved in the respective LSAs.

- 1.16 Second auctions in 2100 MHz band were held in March 2015 along with other spectrum bands. While the Authority recommended that in addition to the one block of 5 MHz spectrum available with DoT, 15 MHz of spectrum in the 2100 MHz spectrum being vacated by Ministry of Defence, in lieu of spectrum in the 1900 MHz spectrum, should also be auctioned in view of the in-principle agreement reached with MoD. However, only one block was put to auction in the 17 LSAs. The spectrum remained unsold in 3 LSAs viz Delhi, Mumbai and Andhra Pradesh.
- 1.17 Now, DoT, through its present reference dated 9th July 2015, has stated that since Defence has agreed, in principle, for swapping of 15 MHz spectrum in 2100 MHz band with 1900 MHz band in all service areas, a total of 345 MHz³ of spectrum, including the spectrum unsold in March 2015 auctions, is available for auction in the 2100 MHz band.

2300/2500 MHz band

- 1.18 The only auction held for the spectrum in the 2300 MHz band was in 2010. The Government put to auction two blocks (each block of 20 MHz unpaired) in each of the 22 LSAs. In addition, the Government allocated one block of 20 MHz spectrum in 2500 MHz band in Delhi and Mumbai to MTNL and in the remaining service areas to BSNL at the winning price achieved in respect of 2300 MHz band. There was no auction for the spectrum in the 2500 MHz band.
- 1.19 DoT, through its reference dated 16th October 2014, had requested the Authority to give its recommendations on the reserve price for auction of right to use of spectrum in the 2100 MHz, 2300 MHz and 2500 MHz bands. Subsequently, DoT through its letter of 27th November 2014, requested the Authority to expedite the process for its recommendations on the reserve price of 2100 MHz band so that the auction of spectrum being released by Defence could be conducted

³ 15 MHz x 22 LSAs + 15 MHz unsold in the last auction.

along with the auction of spectrum in the 800/900/1800 MHz bands scheduled in February 2015. Accordingly, the Authority had given its recommendations 'Valuation and Reserve Price of Spectrum: 2100 MHz band' on 31st December 2014 and decided that it will separately take up other matters referred by DoT in its reference dated 16th October 2014.

- 1.20 Now, through its reference dated 9th July 2015, DoT has requested the Authority to provide its recommendations on applicable reserve price for auction of spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz and 2100 MHz bands for all service areas. DoT has also requested the Authority to expedite its recommendations on applicable reserve price for 2300 MHz and 2500 MHz bands for all the service areas.
- 1.21 In addition, through its reference dated 6th November 2015, DoT has sought the recommendations of the Authority on the liberalization of administratively allotted spectrum in the 900 MHz band.

STRUCTURE OF THE CONSULTATION PAPER

- 1.22 The paper is divided into four Chapters. This Chapter provides background to the subject. Chapter-II discusses the availability of spectrum in the 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands. It also deals with policy issues such as roll-out obligations, spectrum cap, preferable block-size for auction etc. Chapter-III discusses the different alternative approaches to valuation of spectrum in the 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands and fixation of reserve price. The issues for consultation have been listed in Chapter-IV. International practices have been included at the relevant paras.

CHAPTER-II: AUCTION RELATED ISSUES

A. SPECTRUM AVAILABILITY

2.1 Availability of spectrum in the various spectrum bands viz. 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands has been discussed below.

700 MHz

2.2 As per the APT700 band plan (698-806 MHz), 2x45 MHz spectrum (FDD) can be utilised in this band. However, as per the information provided by DoT, 35 MHz (paired) spectrum is available for commercial purpose in each of the 22 LSAs in this band. DoT has not provided the carrier details and stated that it will be decided in consultation with Defence.

800 MHz Band (824-844 MHz/869-889 MHz):

2.3 As can be seen from Table below, there are 3 to 4 TSPs in each LSA having spectrum in the 800 MHz band.

Table 2.1
Spectrum Assigned in 800 MHz Band (MHz)

LSA	No. of TSPs	Total spectrum assigned
DEL	3	15
MUM	3	17.5
KOL	4	15
MH	3	15
GUJ	4	16.25
AP	3	13.75
KTK	4	15
TN	4	15
KL	4	15
PB	4	13.75
HR	4	16.25
UP (W)	4	16.25

UP (E)	4	15
RAJ	4	12.5
MP	4	15
WB	4	13.75
HP	4	15
BH	4	16.25
OR	4	15
AS	3	12.5
NE	3	12.5
J&K	3	12.5

2.4 Two CMTS licences given to MTNL and the six Basic service licences given in 1997-98, which were subsequently migrated to UASL, are due to expire during May 2016 to March 2018. As per the information provided by DoT, the quantum of spectrum being held by these licensees in 800, 900 and 1800 MHz bands, which was assigned administratively, is as given in Table 2.2 below:

Table 2.2
Licences Expiring in 2016-2018

Sl. No.	LSA	TSP	Date of Expiry of Licence	Spectrum Holding (MHz)		
				900 MHz Band	1800 MHz Band	800 MHz Band ⁴
1	Delhi	MTNL	09-Oct-17	6.2	2.2	
2	Mumbai	MTNL	09-Oct-17	6.2	2.2	
3	Mumbai	TTML	29-Sep-17		4.4	5
4	Maharashtra	TTML	29-Sep-17		4.4	5
5	Gujarat	RCL	29-Sep-17		4.4	3.75
6	Andhra Pradesh	TTL	29-Sep-17		4.4	3.75
7	Punjab	HFCL	29-Sep-17		4.4	2.5
8	Rajasthan	SSTL	03-Mar-18		4.4	2.5
	Total	8 TSPs		12.4	30.8	22.5

2.5 In the auctions held in March 2015, a total of 108.75 MHz spectrum was put to auction in the 800 MHz band, out of that 22.5 MHz spectrum remained unsold. As intimated by DoT, the unsold spectrum

⁴ This includes the spectrum which was surrendered by TTSL but could not be auctioned as the matter is sub-judice.

together with the spectrum becoming available due to expiry of licences during May 2016 to March 2018 will constitute the total available spectrum as given in the Table below:

Table 2.3
Spectrum availability in 800 MHz Band (MHz)

LSA	Total spectrum put in March 2015 auction	Spectrum that remained unsold	Spectrum becoming available due to expiry of licences during May 2016 to March 2018	Additional spectrum that is available with DoT	Total spectrum available for auction
	(A)	(B)	(C)	(D)	(E)=(B+C+D)
	MHz	MHz	MHz	MHz	MHz
DEL	3.75	2.5	0	0	2.5
MUM	7.5	0	5	0	5
KOL	1.25	0	0	1.25	1.25
MH	3.75	1.25	5	2.5	8.75
GUJ	2.5	0	3.75	1.25	5
AP	6.25	2.5	3.75	1.25	7.5
KTK	1.25	1.25	0	1.25	2.5
TN	1.25	1.25	0	1.25	2.5
KL		0	0	2.5	2.5
PB	3.75	1.25	2.5	1.25	5
HR	7.5	0	0	1.25	1.25
UP (W)	1.25	0	0	1.25	1.25
UP (E)	3.75	0	0	2.5	2.5
RAJ		0	2.5	2.5	5
MP	6.25	1.25	0	0	1.25
WB	1.25	0	0	3.75	3.75
HP	8.75	1.25	0	1.25	2.5
BH	5	0	0	1.25	1.25
OR	7.5	1.25	0	1.25	2.5
AS	13.75	3.75	0	1.25	5
NE	13.75	3.75	0	1.25	5
J&K	8.75	1.25	0	1.25	2.5
Total	108.75	22.5	22.5	31.25	76.25

2.6 However, DoT has indicated that either due to non-availability of inter-operator guard band or Government's own requirement, the following quantum of spectrum will be put to auction.

Table 2.4
Spectrum in 800 MHz Band (MHz) that may be put to auction

LSA	Total spectrum available with DoT	Total spectrum that can be put to auction as per DoT	Remark
DEL	2.5	0	Unsalable due to non-availability of inter-operator Guard band
MUM	5	5	
KOL	1.25	0	Unsalable due to non-availability of inter-operator Guard band
MH	8.75	7.5	Out of total 7 carriers, 1 carrier is unsalable due to non-availability of inter-operator Guard band
GUJ	5	3.75	Out of total 4 carriers, 1 carrier is unsalable due to non-availability of inter-operator Guard band
AP	7.5	6.25	1 unsalable due to non-availability of inter-operator Guard band
KTK	2.5	1.25	Out of total 2 carriers, 1 carrier is unsalable due to non-availability of inter-operator Guard band
TN	2.5	1.25	Out of total 2 carriers, 1 carrier is unsalable due to non-availability of inter-operator Guard band
KL	2.5	0	Both the carriers unsalable due to non-availability of inter-operator guard band
PB	5	5	
HR	1.25	0	Unsalable due to non-availability of inter-operator Guard band
UP (W)	1.25	0	The carrier is unsalable due to non-availability of inter-operator guard band
UP (E)	2.5	1.25	Out of total 2 carriers, 1 carrier is unsalable due to non-availability of inter-operator guard band
RAJ	5	5	
MP	1.25	1.25	
WB	3.75	0	All three carriers unsalable due to non-availability of inter-operator guard band
HP	2.5	0	Both the carriers unsalable due to non-availability of inter-operator guard band
BH	1.25	0	Unsalable due to non-availability of inter-operator Guard band
OR	2.5	0	Both the carriers unsalable due to non-availability of inter-operator guard band
AS	5	0	Government requirement of 4 carriers is under consideration
NE	5	0	Government requirement of 4 carriers is under consideration
J&K	2.5	0	Government requirement of 2 carriers is under consideration
Total	76.25	37.5	

- 2.7 LSA-wise available carrier details in the 800 MHz band can be seen at **Annexure-2.1**. As can be seen from the above table, DoT proposes to auction only 37.5 MHz⁵ out of total 76.25 MHz available spectrum. This will lead to keeping a large part of the valuable spectrum idle. How best the spectrum can be put to optimal use is surely an issue that needs careful examination. Requirement of inter-operator guard band needs to be reviewed considering the fact that now the spectrum is a liberalized spectrum and it is not bound to be used only for CDMA technology. Moreover, as the spectrum sharing and trading guidelines have already been approved, carrier assignment cannot be seen as a static event. Moreover, DoT has the option of reshuffling the carrier assignment amongst the TSPs to reduce the inter-operator guard band.
- 2.8 The Authority in its recommendations of 9th September 2013 and 22nd February 2014, emphasized that spectrum assigned to PSUs in the 800 MHz band was grossly unutilized and there was a continuous decline in the number of subscribers being served by them and their combined CDMA subscriber base was only 2% of the total CDMA subscribers, while they held nearly 24% of the total spectrum assigned in the 800 MHz band. Therefore, the Authority recommended that *“The DoT should take back from MTNL its entire spectrum holding in the 800 MHz band. BSNL should be allowed to retain only one CDMA carrier in all the LSAs except in Jammu and Kashmir, Assam and North-East LSAs, where it can retain both the carriers. The DoT should take back other carriers assigned to BSNL in the 800 MHz band.”*
- 2.9 DoT has partially accepted the above recommendations and put to auction entire spectrum held by MTNL in Delhi and Mumbai and one carrier of BSNL in 10 LSAs viz. AP, Bihar, Gujarat, Haryana, Himachal Pradesh, Punjab, UP (East), UP (West), Orissa and Kolkata. The reasons for non-acceptance of these recommendations in the remaining 7 LSAs are not clear.

⁵ Carrier size is 2x1.23 MHz instead of 2x1.25 MHz.

2.10 In April 2013, TTSL has surrendered the CDMA spectrum held by them beyond 2.5+2.5 MHz in all circles except in Delhi and Mumbai where it retained 3.75+3.75 MHz spectrum. However, the spectrum has not been put to auction by DoT perhaps because the matter is sub-judice.

2.11 Considering the spectrum that should be taken back from the BSNL and the spectrum surrendered by TTSL, additional spectrum in 800 MHz band that can be considered to putting to auction will be as given in table below:

Table 2.5
Spectrum availability in 800 MHz Band (MHz)

LSA	Spectrum surrendered by TTSL	Additional Spectrum that can be taken back from BSNL	Total Additional spectrum that may be available
	MHz	MHz	MHz
DEL	1.25	0	1.25
MUM	0	0	0
KOL	1.25	0	1.25
MH	0	1.25	1.25
GUJ	1.25	0	1.25
AP	0	0	0
KTK	1.25	1.25	2.5
TN	0	1.25	1.25
KL	1.25	2.5	3.75
PB	1.25	0	1.25
HR	1.25	0	1.25
UP (W)	1.25	0	1.25
UP (E)	1.25	0	1.25
RAJ	1.25	1.25	2.5
MP	0	1.25	1.25
WB	0	1.25	1.25
HP	0	0	0
BH	1.25	0	1.25
OR	0	0	0
AS	0	0	0
NE	0	0	0
J&K	0	0	0
Total	13.75	10	23.75

2.12 In view of the foregoing, the issue for consultation will be whether the entire spectrum available with DoT in 800MHz band including that surrendered by TTSL and spectrum that can be taken back from BSNL should be put to auction?

Q1. Whether the entire spectrum available with DoT in the 800 MHz band be put for auction? Justify your answer.

Q2. How can the spectrum in the 800 MHz band, which is not proposed to be auctioned due to non-availability of inter-operator guard band, be utilised?

Spectrum availability in 900 MHz Band

2.13 There are 3 TSPs in most LSAs having spectrum in the 900 MHz band. Only exceptions are (i) Bihar, where there are only 2 TSPs and (ii) Delhi, where there are 4 TSPs in this band, as can be seen from Table below:

**Table 2.6
Spectrum Assigned in 900 MHz Band (MHz)**

LSA	No. of TSPs	Total spectrum assigned
DEL	4	22.2
MUM	3	22.2
KOL	3	20.2
MH	3	20.2
GUJ	3	17.2
AP	3	20.2
KTK	3	20
TN	3	14
KL	3	18.6
PB	3	21.8
HR	3	18.4
UP (W)	3	17.4
UP (E)	3	18
RAJ	3	18.6

MP	3	18.6
WB	3	19.4
HP	3	18.6
BH	2	14
OR	3	18.6
AS	3	18.6
NE	3	19.4
J&K	3	18.6

2.14 In the auctions held in March 2015, a total of 177.8 MHz spectrum in the 900 MHz band was put to auction, out of that 168 MHz spectrum was sold and only 9.8 MHz spectrum remained unsold.

2.15 MTNL's licences in both Mumbai and Delhi are due to expire during May 2016 to March 2018 (See Table 2.2). MTNL holds 6.2 MHz of 900 MHz band spectrum in both these LSAs. DoT has informed that decision on not putting these spectrum chunks allotted to MTNL in auction is under consideration and therefore it has been excluded from the spectrum availability. Apart from MTNL, there is no other licence due to expire during 2016-18 having spectrum in the 900 MHz band. Therefore, unsold spectrum in 2015 auctions is the only spectrum that is available with DoT to put to auction. (Table 2.7)

Table 2.7
Spectrum availability in 900 MHz Band (MHz)

LSA	Total spectrum put to auction in March 2015	Balance spectrum left
DEL	0	0
MUM	0	0
KOL	0	0
MH	14	0
GUJ	14	3
AP	14	0
KTK	14	0.2
TN	0	0
KL	12.4	0
PB	15.6	0

HR	12.4	0.2
UP (W)	6.2	1.2
UP (E)	6.2	0.6
RAJ	12.4	0
MP	12.4	0
WB	4.4	0
HP	12.4	0
BH	6.2	4.6
OR	6.2	0
AS	6.2	0
NE	8.8	0
J&K		0
Total	177.8	9.8

Spectrum availability in 1800 MHz

2.16 As can be seen from the Table below, there are 7 to 10 TSPs in each LSA having spectrum in the 1800 MHz band. Only exception is Jammu & Kashmir, where there are only 5 licensees in this band.

Table 2.8
Spectrum Assigned in 1800 MHz Band (MHz)

LSA	No. of TSPs	Total spectrum assigned
DEL	7	40
MUM	8	52.4
KOL	8	48.8
MH	9	45.45
GUJ	10	46
AP	9	54.6
KTK	8	50.4
TN	8	44.6
KL	8	52.45
PB	7	43.45
HR	9	47.1
UP (W)	9	39.9
UP (E)	10	47.25
RAJ	9	46.2
MP	8	51.7
WB	7	34.15

HP	7	43.05
BH	8	40.35
OR	8	52.5
AS	7	34.55
NE	7	43.5
J&K	5	20.7

2.17 In the auctions held in March 2015, a total of 99.2 MHz spectrum in the 1800 MHz band was put to auction. Out of that 5.4 MHz spectrum remained unsold. The TSPs, whose licences are due for expiry during May 2016 to March 2018, hold 30.8 MHz spectrum in the 1800 MHz band. MTNL's licences in both Mumbai and Delhi are due for expiry during May 2016 to March 2018 (See Table 2.2). MTNL holds 2.2 MHz of 1800 MHz band spectrum in both these LSAs. As mentioned earlier, DoT has informed that decision on not putting these spectrum chunks allotted to MTNL in auction is under consideration and therefore it has been excluded from the spectrum availability. Further, a part of spectrum (8.8 MHz) becoming available due to expiry of licences lies in the designated Defence Band (1765 MHz-1785 MHz/1860 MHz-1880 MHz). Therefore only 17.6 MHz out of total 30.8 MHz becoming available due to expiry of licences along with 5.4 MHz of unsold spectrum can be reassigned for commercial use as detailed in Table 2.9.

Table 2.9
Spectrum availability in 1800 MHz Band (MHz)

LSA	Total spectrum put to auction in March 2015 (A)	Balance spectrum left after auction (B)	Spectrum becoming available due to expiry of licences during May 2016 to March 2018 (C)	Spectrum that cannot be reassigned being in the Defence Band (D)	Total spectrum available (E)=(B)+(C)-(D)
DEL	0	0	0		0
MUM	0	0	4.4	4.4	0
KOL	7	0	0		0
MH	0	0	4.4	4.4	0
GUJ	3.4	0	4.4		4.4
AP	3.8	0	4.4		4.4
KTK	1.8	0.2	0		0.2
TN	19	2	0		0 ⁶
KL	1	0	0		0
PB	1.6	0	4.4		4.4
HR	8	0	0		0
UP (W)	2.2	0	0		0
UP (E)	4.2	0	0		0
RAJ	10.4	0.4	4.4		4.8
MP	0	0	0		0
WB	0	0	0		0
HP	10.2	0	0		0
BH	2	2	0		2
OR	16.2	0	0		0
AS	0	0	0		0
NE	8.4	0.8	0		0.8
J&K	0	0	0		0
Total	99.2	5.4	26.4	8.8	21

2.18 The available spectrum is not only meager but fragmented. Moreover, some of this spectrum is available in only some part of the LSA. Fragmentation particulars and the LSA-wise details of the areas in which it is available is given in Table 2.10 below:

⁶ DoT has excluded the unsold spectrum in Tamilnadu from the availability.

Table 2.10**Details of availability of partial spectrum in 1800 MHz Band**

Sl. No.	LSA	Quantum of partial spectrum (MHz)	Places in the service area, where available
1.	Andhra Pradesh	4.4	Entire Service Area
2.	Gujarat	4.4	Entire Service Area
3.	Karnataka	0.2	Entire Service Area
4.	Punjab	4.4	Entire Service Area
5.	Bihar	1.8	Available in Motihari, Gopal Ganj, Madhubani, Raxaul, Betiah, Sheohar and Sitamarhi
		0.2	Available in entire LSA except Patna, Purnea, Chapra, Jahanabad and Ara.
6.	North East	0.8	Meghalaya only
7.	Rajasthan	3.4	Entire LSA except Bikaner, Barmer, Bharatpur, Dausa, Ganganagar, Hanumangarh, Jodhpur, Jaipur, Jaisalmer, Jalore and Sirohi
		0.4	Entire LSA except Bikaner, Barmer, Bharatpur, Dausa, Ganganagar, Hanumangarh, Jodhpur, Jaipur, Jaisalmer, Jalore, Sirohi
		0.2	Entire Service Area
		0.8	Entire Service Area

Spectrum availability in 2100 MHz Band

2.19 This is internationally one of the most harmonized bands. In 2010, 4 blocks of 2x5 MHz (total 2x20 MHz) were assigned in all the LSAs while a 5th block was assigned in five LSAs (Punjab, Bihar, West Bengal, Jammu & Kashmir and Himachal Pradesh).

2.20 In the auctions held in March 2015, an additional block of 2x5 was put to auction in 17 LSAs. The 5 LSAs, where additional spectrum was not put to auction, were those LSAs where 5th block was assigned in 2010 auctions itself i.e. Punjab, Bihar, West Bengal, Jammu & Kashmir and Himachal Pradesh. A total of 85 MHz spectrum in the

2100 MHz band was put to auction, out of that 70 MHz spectrum was sold and 15 MHz spectrum remained unsold.

2.21 STEL acquired the 2100 MHz spectrum in three service areas viz. Bihar, Orissa and Himachal Pradesh in 2010. However, spectrum was taken back from STEL following its cancellation of licence after 2G verdict dated 2nd February 2012 of Hon'ble Supreme Court. Currently, there are 4-5 licensees in each LSA having 5 MHz spectrum in the 2100 MHz band. The details of spectrum holding in each LSA is as shown in Table below:

Table 2.11
Spectrum Assigned in 2100 MHz Band (MHz)

LSA	Spectrum assigned in 2010 auction	Spectrum assigned to PSUs	Spectrum assigned in 2015 auction	Spectrum taken back from STel	Net spectrum holding
	A	B	C	D	E=A+B+C-D
DEL	15	5	0		20
MUM	15	5	0		20
KOL	15	5	5		25
MH	15	5	5		25
GUJ	15	5	5		25
AP	15	5	0		20
KTK	15	5	5		25
TN	15	5	5		25
KL	15	5	5		25
PB	20	5	0		25
HR	15	5	5		25
UP (W)	15	5	5		25
UP (E)	15	5	5		25
RAJ	15	5	5		25
MP	15	5	5		25
WB	20	5	0		25
HP	20	5	0	5	20
BH	20	5	0	5	20
OR	15	5	5	5	20
AS	15	5	5		25
NE	15	5	5		25
J&K	20	5	0		25
Grand Total	355	110	70	15	520

2.22 As intimated by DoT, 3 additional blocks of 2x5 MHz spectrum is becoming available in the 2100 MHz band in all LSAs. The unsold spectrum together with the additional spectrum becoming available due to vacation by Defence will constitute the total available spectrum as given in Table below:

Table 2.12
Spectrum availability in 2100 MHz Band (MHz)

LSA	Total spectrum put to 2015 auction	Balance spectrum left	Additional Spectrum likely to become available	Total spectrum available
DEL	5	5	15	20
MUM	5	5	15	20
KOL	5	0	15	15
MH	5	0	15	15
GUJ	5	0	15	15
AP	5	5	15	20
KTK	5	0	15	15
TN	5	0	15	15
KL	5	0	15	15
PB	0	0	15	15
HR	5	0	15	15
UP (W)	5	0	15	15
UP (E)	5	0	15	15
RAJ	5	0	15	15
MP	5	0	15	15
WB	0	0	15	15
HP	0	0	15	15
BH	0	0	15	15
OR	5	0	15	15
AS	5	0	15	15
NE	5	0	15	15
J&K		0	15	15
Total	85	15	330	345

2.23 In its recommendations on 'Valuation and Reserve Price of Spectrum: 2100 MHz Band' dated 31st December 2014, the Authority recommended that "the DoT should take all measures to ensure that the 2100 MHz spectrum which was earlier assigned to STEL in three

service areas viz. Bihar, Orissa and Himachal Pradesh is also put to auction.” However, DoT neither included this in the last auctions held in March 2015 nor in the quantum of spectrum that it intends to put in the next auction. The matter was sub-judice. Now, TDSAT, in its Judgment dated 06th July 2015, ordered DoT to refund the money that STEL paid for allocation of 3G spectrum. As the matter has been decided by TDSAT, spectrum assigned to STEL in Bihar, Orissa and Himachal Pradesh LSA can also be considered for putting in the next auction.

2.24 There is an additional factor that may influence the availability of spectrum in the 2100 MHz band. After the 2100 MHz auction in 2010, the carrier frequencies assigned for the uplink were 1959-1964 MHz, 1964-1969 MHz, 1969-1974 MHz and 1974-1979 MHz in most LSAs. Interference is continuously being reported by the TSPs who were assigned spectrum in the 2100 MHz band in parts of Punjab, Gujarat, J&K and Haryana LSA and, as brought out by one TSP, interference in the Jammu region is so high that it has not been able to launch services in that region. According to the affected TSPs, the interference has severely impacted the quality of services in these LSAs leading to extreme customer dissatisfaction.

2.25 In its recommendations on ‘Valuation and Reserve Price of Spectrum: 2100 MHz Band’ dated 31st December, 2014, the Authority had examined this issue and recommended that *“The issue of interference, reported in the 2100 MHz band in some LSAs, needs to be resolved before putting fresh spectrum blocks to auction in these LSAs. Further, it is imperative to ensure that spectrum blocks being put to auction are interference-free.”*

2.26 Affected TSPs moved the TDSAT for the resolution of the above issue. A committee comprising of representatives of DoT, Defence and TSPs was formed by TDSAT to examine the issue. Assignment of alternate slots has been recommended by the committee in some of the LSAs to

the TSPs facing interference problem. However, till date, the issue remains unresolved.

Spectrum availability in 2300 MHz

2.27 Spectrum in 2300 MHz band was put to auction only in the auctions held in 2010. In that auction, 2 blocks of 20 MHz (unpaired) spectrum were put to auction in all LSAs and all of it was sold. Now, DoT has intimated about the availability of one more block of 20 MHz in 16 LSAs as given in the Table below:

Table 2.13
Spectrum assigned and available in 2300 MHz Band (MHz)

LSA	Spectrum assigned in 2010	Additional spectrum likely to become available
DEL	40	20
MUM	40	20
KOL	40	20
MH	40	20
GUJ	40	20
AP	40	20
KTK	40	20
TN	40	20
KL	40	20
PB	40	0
HR	40	0
UP (W)	40	0
UP (E)	40	0
RAJ	40	0
MP	40	20
WB	40	20
HP	40	20
BH	40	20
OR	40	20
AS	40	20
NE	40	20
J&K	40	0
Total	880	320

Spectrum availability in 2500 MHz

2.28 Presently, in India, out of the 190 MHz of spectrum in this band, 150 MHz is assigned to Department of Space (DoS) for Satellite Networks. Only 40 MHz (unpaired) are available for terrestrial applications in frequency slots of 2535-2555 MHz and 2635-2655 MHz. One slot of 20 MHz (unpaired) in this band was assigned to MTNL/BSNL in all the LSAs at the auctioned determined prices of 2300 MHz band in 2010. Later on, MTNL has surrendered its spectrum in this band in both Mumbai and Delhi while BSNL surrendered it in 6 LSAs viz. Kolkata, Maharashtra, Gujarat, Andhra Pradesh, Tamilnadu and Karnataka. Following table gives the assignment and availability status of spectrum for commercial telecommunications purpose in the 2500 MHz band.

Table 2.14
Spectrum assigned and available in 2500 MHz Band (MHz)

LSA	Spectrum assigned in 2010 to BSNL /MTNL	Spectrum surrendered by BSNL / MTNL	Additional spectrum likely to become available	Total spectrum available
DEL	20	20	20	40
MUM	20	20	20	40
KOL	20	20	20	40
MH	20	20	20	40
GUJ	20	20	20	40
AP	20	20	20	40
KTK	20	20	20	40
TN	20	20	20	40
KL	20	0	20	20
PB	20	0	20	20
HR	20	0	20	20
UP (W)	20	0	20	20
UP (E)	20	0	20	20
RAJ	20	0	20	20
MP	20	0	20	20
WB	20	0	20	20
HP	20	0	20	20
BH	20	0	20	20

OR	20	0	20	20
AS	20	0	20	20
NE	20	0	20	20
J&K	20	0	20	20
Total	440	160	440	600

B. BLOCK SIZE

2.29 An issue that needs consideration is the block size in which spectrum in various bands should be put to auction. Where practicable, spectrum is now typically awarded in blocks of 5MHz (paired) in the case of Frequency Division Duplex (FDD). This is widely considered as the minimum quantity for 3G or 4G deployment. Awarding spectrum in block sizes smaller than 5 MHz may lead to reduced efficiency. Band-wise discussion on the issue is given below:

700 MHz band

2.30 The spectrum being put to auction is liberalised spectrum i.e. it can be used for the deployment of any technology. Since 700 MHz band will be put to auction for the very first time and sufficient spectrum is available in this band, it is desirable that this spectrum is not sold in small pieces. To offer all services that a liberalised spectrum is capable of, it is essential to have minimum 5 MHz of spectrum. Therefore, one option is to put the 700 MHz band spectrum in the block size of 5 MHz so that each successful bidder gets at least 5 MHz spectrum. With the use of carrier-aggregation, one can use 2 or more carriers for delivering more throughputs with better spectral efficiency.

800 MHz band

2.31 In the auctions held in March 2015, the block size in the 800 MHz Band was kept as 1.25 MHz⁷ (paired). An existing licensee holding

⁷ Infact, carrier size was 2x1.23 MHz. Same is likely to be the case for the next auction.

spectrum in 800 MHz band was required to bid for a minimum of 1 block (i.e. 1.25 MHz) in this band. A new entrant was required to bid for (a) a minimum of 2 blocks, if the spectrum put to auction was 2 blocks, (b) a minimum of 3 blocks if the spectrum put to auction was 3 blocks and (c) a minimum of 4 blocks, if the spectrum put to auction was 4 blocks or more.

900 MHz and 1800 MHz band

2.32 In the auction held in February 2014, the block size was kept as 1 MHz in the 900 MHz Band and 200 KHz 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 was required to bid for a minimum of 25 Blocks (i.e. 5 MHz), while an existing licensee⁸ was required to bid for a minimum of 3 blocks (i.e. 0.6 MHz).

2.33 Considering the fact that the amount of spectrum to be put to auction in March 2015 auctions was very less in some LSAs, the Authority, in its recommendations 'Valuation and Reserve Price of Spectrum: Licences Expiring in 2015-16' dated 15th October 2014, recommended 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."*

2.34 In the auctions of March 2015, the block size in the 900 MHz Band was kept as 200 KHz (paired). The existing licensees, whose licenses were not expiring in 2015-16 and holding spectrum in 900 MHz band in a service area, were required to bid for a minimum of 3 blocks (i.e.

⁸ UASL/CMTS/UL (AS)/UL licensee having spectrum either in 900 or 1800 MHz band.

0.6 MHz) in this band. All other categories of bidders⁹ were required to bid for a minimum of 5 MHz of spectrum in the 900 MHz band, except in West Bengal service area, where such bidders were required to bid for a minimum of 4.4 MHz as only 4.4 MHz spectrum was available in the 900 MHz band.

2.35 Similarly, in the 1800 MHz Band, block size was kept as 200 KHz (paired). An existing licensee¹⁰ was required to bid for a minimum of 3 blocks (i.e. 0.6 MHz) in this band. In those LSAs where at least one chunk of contiguous 5 MHz (paired) was available in the 1800 MHz band, a new entrant and the licensees, whose licenses were expiring in 2015-16 and do not hold any spectrum in 1800 MHz band won through Auctions in November 2012 and February 2014, were required to bid for a minimum of 25 Blocks (i.e. 5 MHz), otherwise such entities/licensees were also required to bid for a minimum of 3 blocks (i.e. 0.6 MHz) in this band.

2100 MHz band

2.36 In the auctions held in 2010 as well as 2015, the block size in the 2100 MHz Band was kept as 5 MHz. The most developed device ecosystem in this band is in HSPA which requires carrier size of 5 MHz. Apparently spectrum should be auctioned in the block size of 5 MHz.

2300 MHz band

2.37 In the auctions held in May 2010, the block size in the 2300 MHz band was kept as 20 MHz (unpaired). Additional 20 MHz spectrum is available with DoT for assignment for commercial purpose. One obvious choice is to auction it in the block size of 20 MHz as was done in 2010 auctions.

⁹ New entrants, licensees whose licenses are expiring in 2015-16 and existing licensees whose licenses are not expiring in 2015-16 & holding spectrum only in 1800 MHz band.

¹⁰ Existing UASL/CMTS/UL (AS)/UL licensees were treated as 'New Entrant' for the frequency bands in which they do not hold spectrum. For the limited purpose of this provision, 900 MHz band and 1800 MHz band were treated as the same band.

2500 MHz band

2.38 MTNL/BSNL was awarded one block of 20 MHz (unpaired) in the 2500 MHz band. They paid the auction determined price of spectrum in the 2300 MHz band in 2010 auctions. This is for the first time that auction is being conducted in this band. Putting it in the auction in the block size of 20 MHz (unpaired) can be one alternative.

2.39 The stakeholders are requested to comment on:

Q3. What should be the block size in the 700 MHz band?

Q4. Whether there is any requirement to change the provisions of the latest NIA with respect to block size and minimum quantum of spectrum that a new entrant/existing licenses/expiry licensee is required to bid for in 800, 900, 1800 and 2100 MHz bands. Please give justification for the same.

Q5. What should be the block size in the 2300 MHz and 2500 bands?

C. Spectrum Cap

2.40 Spectrum-acquisition caps are typically designed and enforced to prevent excessive spectrum concentration in one or two operators' hand. As per the NIA provisions of the recent auctions, the overall spectrum cap for each of the service areas is calculated as 50% of the total spectrum assigned for telecom services in a particular band and 25% of the total spectrum assigned for telecom services in 800/900/1800/2100/2300 and 2500 MHz bands put together. While calculating spectrum caps, the spectrum being put to in the auction was also taken into account.

2.41 On 29th May 2015, DoT sought the Authority's views on the issues relating to spectrum cap and minimum spectrum holding by TSPs as follow up of Hon'ble S.C. interim order dated 14th May 2015 in the

Transfer Case (Civil) Nos. 43/2015 and other similar matters. In its response dated 2nd July 2015, the Authority, inter-alia, stated that :

“The Authority is of the opinion that at present there is no need to modify the existing spectrum cap (50% of the spectrum assigned in each of the 800/900/1800/2100/2300/2500 MHz and 25% of the total spectrum assigned in all these bands put together in each service area).

On the methodology of calculating the spectrum cap, the Authority is of the opinion that all spectrum assigned to the TSPs including any spectrum which was put to an auction but remain unsold, spectrum which was assigned but subsequently surrendered by the TSP or taken back by the Licensor and spectrum put to auction should be counted. However, any spectrum out of the above will not be taken into calculation, if the Government assigns it for any other non-commercial purpose e.g. assignment to Defence.”

.....
The Authority is also of the view that telecom being an evolving sector, review of such policy decisions such as spectrum cap is a continuous process. The Authority may review it at appropriate time like introduction of new spectrum bands, additional spectrum released for commercial purpose, any other major development etc.”

2.42 The above definition does not include 700 MHz band. Now, since the spectrum in 700 MHz band is also proposed to be auctioned, above provision of spectrum cap needs to be reviewed. One obvious alternative is to extend NIA provisions of the recent auctions to the 700 MHz band also. As 2x35 MHz is available in all the LSAs and if spectrum is put to auction in the block size of 2x5 MHz, 50% spectrum limit in a band may allow a single bidder to acquire up to 2x15 MHz. In such a scenario, minimum 3 TSPs will get spectrum in this band.

2.43 700 MHz band is a premium band suitable for LTE technology in which device eco-system for LTE technology is developing fast. Being a lower frequency band, it has better propagation characteristics. If it is to be ensured that more TSPs get access to 700 MHz band, one option could be to impose separate spectrum caps on the quantum of spectrum that a single TSP can acquire in this band. If this cap is kept at say 10 MHz, this would ensure that at least 4 TSPs can acquire spectrum in this band.

- 2.44 Instead of putting a separate cap only on the 700 MHz band spectrum, another approach could be clubbing together of all sub-1 GHz spectrum bands i.e. 700 MHz, 800 MHz and 900 MHz bands and impose a limit on spectrum that one TSP can acquire in these bands. As all these bands are lower frequency bands, all of them have better propagation characteristics and, hence, can be treated alike for formulating any spectrum cap for the lower frequency spectrum.
- 2.45 The current provision of spectrum cap put a cap on each band. The spectrum being assigned through auction is a liberalised spectrum. TSP is free to choose any technology to deploy in any band within the provisions of the NIA. Therefore, as an alternative approach, instead of having band-specific cap, there could be cap on only the total spectrum that a TSP can acquire in all the bands taken together. Additionally, there can be a cap on sub-1 GHz band spectrum as discussed in para 2.44 above. As an illustration to above proposition, there can be a cap on overall spectrum holding of a TSP which can be as per existing provision of 25% of spectrum assigned in all the bands put together with an additional cap on the spectrum holding in sub-1 GHz spectrum bands which can be 50% of spectrum assigned in all the sub-1 GHz bands. There will be no band specific cap.
- 2.46 If 50% spectrum cap in each band is retained then the existing TSPs in 2300 MHz and 2500 MHz bands will not be able to acquire additional spectrum block in these bands as they will be crossing 50% spectrum cap in this band. As the eco-system in this band is still not fully developed, it is less likely that any new entrant will come in this band. Doing away with spectrum cap in each band barring a sub 1 GHz band and an overall spectrum cap will help in more competition in these bands. Another option to overcome this challenge is to treat 2300 MHz and 2500 MHz as one band for the purpose of spectrum cap.

2.47 In view of the foregoing paras, the stakeholders are requested to comment on:

- Q6. Considering the fact that one more sub-1 GHz band (i.e. 700 MHz band) is being put to auction, is there a need to modify the provisions of spectrum cap within a band?**
- Q7. Is there any need to specify a separate spectrum cap exclusively for the spectrum in 700 MHz band?**
- Q8. Should a cap on the spectrum holding within all bands in sub-1 GHz frequencies be specified? And in such a case, should the existing provision of band specific cap (50% of total spectrum assigned in a band) be done away with?**
- Q9. Should 2300 MHz and 2500 MHz bands be treated as same band for the purpose of imposing intra-band Spectrum Cap?**

Please support your suggestions with detailed justifications.

D. Roll-out Obligations

Roll-out Obligations in 700 MHz

2.48 In case of 700 MHz band, this is for the first time that the spectrum in this band would be put to auction in India. Therefore, unlike other bands, there is no instance of roll-out obligations prescribed earlier for this band. Roll-out obligations which were mandated for other spectrum band in previous auctions are discussed in the subsequent section.

2.49 Mobile networks are a viable way to offer affordable broadband services in rural areas. As rural roll-outs are mostly commercially unviable, regulatory initiatives are needed to ensure roll-out to remote areas. Recognising this challenge, regulators have adopted various approaches in setting coverage obligations for mobile licences as a

means of ensuring availability of mobile broadband service in remote areas.

- 2.50 In Germany a multi-band auction was conducted in 2010, through which a total of 360 MHz of spectrum in 800 MHz band, 1800 MHz band and 2600 MHz band was put to auction. Licence conditions on coverage and roll-out were imposed on the 800 MHz band. These licensees were obliged to roll out the network in rural areas first, before rolling out to urban areas. To prevent, duplication of infrastructure, operators were permitted to fulfil the obligations in a shared manner and it was up to individual operators to co-ordinate with regard to rolling out in particular areas. Areas with higher populations couldn't be served until 90% of target population was served.
- 2.51 In Sweden, a different approach was used, when spectrum in 800 MHz band was put to auction in 2009. An obligation was placed upon only one spectrum lot of 2x5 MHz in the 800 MHz auction to provide service of at least 1Mbit/s or better to a list of stated addresses (identified as being broadband 'not spots', lacking any other forms of broadband connection). These spots were identified by the regulator. The cost of achieving this coverage obligation in Sweden was reflected in the price paid for licences in that auction.
- 2.52 In both the German and the Swedish cases, obligations reflect the fact that the high cost of infrastructure roll-out in rural areas means that, whilst competition is desirable, network duplication is undesirable in those areas.
- 2.53 OFCOM carried out auction of spectrum in the 800 MHz band along with 2600 MHz band in 2013. A total of 250 MHz of spectrum was auctioned in these two bands. OFCOM attached a coverage obligation to one of the 800 MHz lots of spectrum. The winner of this lot was obliged to provide a mobile broadband service for indoor reception to at least 98% of the UK population and at least 95% of the population

of each of the UK nations – England, Northern Ireland, Scotland and Wales - by the end of 2017 at the latest. This represents a different approach to the German and Swedish cases, since it does not explicitly require operators to cover specific areas where availability of other means of broadband service is limited.

2.54 In India, the roll-out obligations mandated for the mobile operators have been largely urban centric. In India, still there are around 50,000 villages which do not have mobile connectivity. The rural tele-density is around 48.66% against the total tele-density of around 81¹¹. Therefore, there is an urgent need to take regulatory measures to enhance the rural penetration of mobile network. As discussed earlier, being a lower frequency band, 700 MHz band has the ability to support wider coverage using fewer base stations/sites. This band may play an important part in improving broadband coverage in the remote areas and could be a cost-effective means to achieve the NTP 2012 broadband target **‘broadband for all’**. To effectively utilise the 700 MHz band for enhancing mobile services in the villages, one option could be mandating operators to roll-out their networks in the villages/rural areas first followed by urban areas as part of roll-out obligations.

Roll-out Obligations in 800 MHz, 900 MHz and 1800 MHz Band

2.55 In the NIA of 9th January 2015, the roll-out obligations in respect of non-Metro Service Areas for the spectrum in the 800 MHz, 900 MHz and 1800 MHz bands mandates a new entrant to provide a five phase roll-out obligation as detailed in Table 2.15. In case of Metro category Service Areas, street-level coverage of 90% of the service area was mandated within one year of the date of allotment of spectrum as part of the roll-out obligations.

¹¹ As on 30th September 2015.

Table 2.15

Roll-Out Obligations as per NIA of 9th January 2015 for Spectrum in 1800MHz, 900MHz and 800MHz Bands

Phases of the Roll out	Roll Out Requirement	Time Period*
Phase 1	Coverage of 10% DHQs/ Towns	by the end of one year
Phase 2	Coverage of 50% DHQs/ Towns	by the end of three years
Phase 3	Coverage of 10% BHQs	by the end of three years
Phase 4	Coverage of additional 10% BHQs (Cumulative 20% BHQs).	by the end of four years
Phase 5	Coverage of additional 10% BHQs (Cumulative 30% BHQs).	by the end of five years

* From the date of allotment of spectrum won in the auction process.

2.56 In case of Existing Licensees¹² having spectrum in 900 MHz and 1800 MHz bands, the roll-out already achieved in these bands would be counted. For this purpose, 900 MHz band and 1800 MHz band would be treated as the same band.

2.57 As discussed earlier, the roll-out obligations mandated for the mobile operators In India have been largely urban centric. It has also been pointed out that there is an urgent need to enhance the mobile penetration in the villages. To ensure better mobile coverage in the villages, the Authority In its recommendations on 'Valuation and Reserve Price of Spectrum' dated 9th September 2013 had recommended that:

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

- *All villages having population of more than 5000 to be covered within 5 years of effective date of allocation of spectrum for access services and all villages having population of more than 2000 to be covered within 7 years of effective date of allocation of spectrum.*

¹² Existing UASL/CMTS/ UL (AS) licensees were classified as 'Existing Licensee' in those service areas for the frequency band(s) in which they already hold spectrum.

- *These amendments should be made effective from 1st April 2014. However, in case of TSPs holding CMTS/UAS licences prior to the year 2008, the time period for completing these additional roll-out obligations shall be two years/four years from the effective date, while for TSPs acquiring licence post-2008 the time period shall be five years/seven years.”*

2.58 If operators are mandated to cover villages as part of roll-out obligations, it is quite possible that the villages which are nearby to towns/cities and have better access may be covered by many operators. On the other hand, remote villages may still be left unconnected. To ensure that villages in large numbers are connected through mobile services, there can be two approaches. Either the operators decide themselves to ensure that a village is not covered by more than 2-3 operators as part of roll-out obligations. Second approach could be that the Licensor/DoT itself decides which villages are to be covered as part of roll-out obligations by individual operator.

Roll-out Obligations in 2100 MHz Band

2.59 Specific roll-out obligations were mandated for the licensee to whom spectrum was assigned in the 2010 auction. In the Metro category Service Areas, the licensee was required to provide street-level coverage in at least 90% of the Service Area within five years of the effective date¹³. In Category A, B and C Service Areas, the licensee had to ensure that, within five years of the effective date, at least 50% of the District Headquarters (DHQ) in the service area would be covered, of which at least 15% of the DHQs should be rural Short Distance Charging Areas (SDCA). The licensee was permitted to cover any other town in a District in lieu of the DHQ and coverage of a DHQ/town would mean that at least 90% of the area bounded by the municipal/ local body limits should get the required street-level coverage.

¹³ The Effective Date is the later of the date when the right to use awarded spectrum commercially commences and the date when the UAS licence, if applicable, is granted to the operator.

- 2.60 If a licensee did not complete its roll-out obligations, it would be allowed a further period of one year to do so by making a payment of 2.5% of the successful bid amount (i.e. spectrum acquisition price) per quarter or part thereof as liquidated damages. If the operator did not complete its roll-out obligations even within the extended period of one year, the spectrum assignment would be withdrawn.
- 2.61 In the NIA dated 9th January 2015, roll-out obligations for the spectrum in 2100 MHz band were modified on two-counts. Firstly, time period permitted to provide coverage in at least 50% of the District Headquarters (DHQ)¹⁴ was reduced from five to three years. Secondly, additional two phases of roll-out obligations were specified. The licensee was required to provide additional 10% of District Headquarters (DHQs) in the LSA within fourth and fifth year each from the date of allotment of spectrum.
- 2.62 In case existing licensee¹⁵ acquire additional block of 5 MHz in the 2100 MHz band, they were required to provide additional 10% of District Headquarters (DHQs) in the LSA within first and second year each from the date of allotment of spectrum, over and above their existing roll-out obligations in this band.

Roll-out Obligations in 2300 MHz Band

- 2.63 Roll-out obligations were mandated for the successful licensees who obtained the spectrum in the 2300 MHz band in 2010 auction. In case of Metro Service Area, the licensees were required to provide required street level coverage using the 2300 MHz band spectrum in at least 90% of the service area within five years of the Effective Date. In Category A, B and C LSAs, the licensee has to ensure that at least 50% of the rural SDCAs are covered within five years of the Effective Date using the 2300 MHz band spectrum. Coverage of a rural SDCA would

¹⁴ of which at least 15% of the DHQs should be rural Short Distance Charging Areas (SDCA)

¹⁵ Existing licensees refer to those licensees who have acquired 5 MHz in 2100 MHz band through 2010 auctions.

mean that at least 90% of the area bounded by the municipal/ local body limits should get the required street level coverage.

2.64 Same roll out obligation is mandated for 2500 MHz band.

Need for roll out obligation

2.65 Roll out condition is mandated in a licence so that the service providers roll out their networks in their licence service areas. It has two effects (i) the services are rolled out for the benefit of the masses, and (ii) with the timely roll-outs of the services, the Government starts getting revenue in the form of license fee and the spectrum usage charges. As per the existing license / NIA terms and conditions, the roll out has been specified based on the spectrum bands.

2.66 As the access spectrum is being put to auction since 2012, some of the stakeholders in response to few consultations papers have aired their views that once spectrum is purchased from the market through auction, there should not any roll out obligations. Some of the stakeholders have opined that roll out obligation should be generic and should not be linked to any particular technology as different spectrum bands can be used to provide the same service. Some of the existing service providers had opined that once they have completed their roll out obligations, they should not be mandated for additional roll out obligations for the spectrum purchased through new auction.

2.67 However, as mentioned in para 2.48, this is for the first time spectrum is being put to auction in 700 MHz band. Similarly, 2500 MHz band will be auctioned for the first time. The issue for consultation is what roll out obligation should be the roll-out obligation for the new bands being put to auction and whether there should be any roll out obligation for the remaining bands (800/900/1800/2100/2300 MHz) in case the existing service providers win spectrum in these bands.

Q10. Suggest an appropriate coverage obligation upon the successful bidders in 700 MHz band? Whether these obligations be imposed on some specific blocks of spectrum (as was done in Sweden and UK) or uniformly on all the spectrum blocks?

Q11. Should it be mandated to cover the villages/rural areas first and then urban areas as part of roll-out obligations in the 700 MHz band?

Q12. In the auction held in March 2015, specific roll-out obligations were mandated for the successful bidders in 800 MHz, 900 MHz, 1800 MHz and 2100 MHz spectrum bands. Stakeholders are requested to suggest:

(a) How the roll-out obligations be modified to enhance mobile coverage in the villages? Which of the approaches discussed in para 2.58 should be used?

(b) Should there be any roll out obligation for the existing service providers who are already operating their services in these bands.

Please support your answer with justification.

Q13. In the auction held in 2010, specific roll-out obligations were mandated for the successful bidders in 2300 MHz spectrum band. Same were made applicable to the licensee having spectrum in 2500 MHz band. Stakeholders are requested to suggest:

(a) Should the same roll-out obligations which were specified during the 2010 auctions for BWA spectrum be retained for the upcoming auctions in the 2300 MHz and 2500 MHz bands? Should both these bands be treated as same band for the purpose of roll-out obligations?

(b) In case existing service providers who are already operating their services in 2300 MHz band acquire additional block of spectrum in 2300 or 2500 MHz band,

should there be any additional roll out obligation imposed on them?

E. Band Plan in 2500 MHz band

2.68 In the 2500 MHz band¹⁶, ITU’s Recommendation ITU-R M.1036-3, has defined three alternative band plans as given in Table below.

**Table 2.16
ITU Band Plans in 2500 MHz band**

Frequency Arrangements	Paired Arrangements				Centre gap (2570-2620 MHz) usage
	Mobile station transmitter (MHz)-UL	Centre gap (MHz)	Base station transmitter-(MHz)-DL	Duplex separation (MHz)	
Option I	2500-2570	50	2620-2690	120	TDD
Option II	2500-2570	50	2620-2690	120	FDD DL, Corresponding UL in another unspecified band
Option III	Flexible FDD/TDD				

2.69 ITU Option 1 for the 2500 MHz band plan includes defined allocations of 2x70 MHz paired (FDD) spectrum (2500-2570/2620-2690 MHz) and a Centre Gap of 50 MHz (2570-2620 MHz) as unpaired (TDD) spectrum. ITU Option 2 is similar to Option 1 except that the 50 MHz center gap is allocated to downlink FDD operation, with paired uplink spectrum in another (unspecified) band. ITU Option 3 allows freedom of choice about the quantum of spectrum that is to be used as paired and unpaired blocks.

2.70 Various countries have focused primarily on Options 1 and 3. Option 2 is nowhere in use as it does not offer any spectrum for TDD option; also the paired uplink spectrum for the proposed FDD operations in the 50 MHz centre gap has not been specified. The ITU Option 1 band plan has been widely adopted in Europe. Many Asia-Pacific Countries also have adopted this option. A few operators have adopted TDD option in the entire 190 MHz band. Notable amongst them are Sprint

¹⁶ The 2500 MHz band is also referred to as 2600 MHz band in some administrations.

in USA, China Mobile, China Telecom and China Unicom in China and Softbank in Japan.

2.71 3GPP has standardized bands in 2500 MHz band as per ITU option 1 and 3 as given in Table below, which also includes number of commercially launched networks in each of the band plans.

**Table 2.17
Eco System in the 2500 MHz Band for LTE technology**

Band Number	Frequency Range	Duplexing Scheme	Commercially launched LTE networks	No. of devices
B7	2500-2570 MHz /2620-2690 MHz	FDD	86	
B38	2570-2620 MHz	TDD	10	752
B41	2496-2690 MHz	TDD	8	625

2.72 Presently, in India, out of the 190 MHz of spectrum in this band, 150 MHz is assigned to Department of Space (DoS) for Satellite Networks. Only 40 MHz are available for commercial use in frequency slots of 2535-2555 MHz and 2635-2655 MHz. The present position of spectrum availability and the assigned spectrum is as given in Table below:

**Table 2.18
Frequency spots in the 2500 MHz band**

S.No.	Type	LSA	Vacant Spot in 2500 MHz band (MHz)		Spectrum assigned to MTNL/BSNL (MHz)
1	Metro	DEL	2535-2555	2635-2655	
2	Metro	MUM	2535-2555	2635-2655	
3	Metro	KOL	2535-2555	2635-2655	
4	A	MH	2535-2555	2635-2655	
5	A	GUJ	2535-2555	2635-2655	
6	A	AP	2535-2555	2635-2655	
7	A	KTK	2535-2555	2635-2655	
8	A	TN	2535-2555	2635-2655	
9	B	KL	2535-2555		2635-2655
10	B	PB	2535-2555		2635-2655
11	B	HR	2535-2555		2635-2655
12	B	UP (W)	2535-2555		2635-2655
13	B	UP (E)	2535-2555		2635-2655

14	B	RAJ	2535-2555		2635-2655
15	B	MP	2535-2555		2635-2655
16	B	WB	2535-2555		2635-2655
17	C	HP	2535-2555		2635-2655
18	C	BH	2535-2555		2635-2655
19	C	OR	2535-2555		2635-2655
20	C	AS	2535-2555		2635-2655
21	C	NE	2535-2555		2635-2655
22	C	J&K	2535-2555		2635-2655
		Total	440 MHz	160 MHz	320 MHz

2.73 In order to adopt the FDD duplexing scheme as per band plan B7, which has a better developed device eco-system as compared to TDD based B41 band plan, there should be a duplexing spacing of 120 MHz between uplink and downlink frequencies. In 8 LSAs, two blocks of 20 MHz are available; still these cannot be used as Band 7 as the spacing between them is 100 MHz; not 120 MHz. In the other 14 LSAs, only 20 MHz unpaired spectrum is available. Therefore, it seems only B41 is the available option i.e. they can be used only as unpaired (TDD) blocks as per band B41.

F. Guard band requirement in TDD mode

2.74 In 2300 MHz band, two blocks of 20 MHz were assigned to the TSPs through auction held in 2010. DoT has proposed to auction one more block of 20 MHz in 16 LSAs in the 2300 MHz band. Already assigned frequency blocks as well as the vacant block, proposed to be auctioned, are shown in Table below:

**Table 2.19
Frequency spots in the 2300 MHz band**

S.No.	LSA	Assigned Spot 1	Assigned Spot 2	Vacant Spot
		MHz	MHz	MHz
1	DEL	2305.0-2325.0	2327.5-2347.5	2350.0-2370.0
2	MUM	2305.0-2325.0	2327.5-2347.5	2355.0-2375.0
3	KOL	2305.0-2325.0	2332.5-2352.5	2355.0-2375.0
4	MH	2305.0-2325.0	2327.5-2347.5	2355.0-2375.0
5	GUJ	2305.0-2325.0	2327.5-2347.5	2350.0-2370.0

6	AP	2302.5-2322.5	2347.5-2367.5	2325.0-2345.0
7	KTK	2302.5-2322.5	2325.0-2345.0	2350.0-2370.0
8	TN	2312.5-2332.5	2335.0-2355.0	2357.5-2377.5
9	KL	2302.5-2322.5	2325.0-2345.0	2350.0-2370.0
10	PB	2320.0-2340.0	2357.5-2377.5	
11	HR	2322.5-2342.5	2362.5-2382.5	
12	UP (W)	2320.0-2340.0	2357.5-2377.5	
13	UP (E)	2320.0-2340.0	2357.5-2377.5	
14	RAJ	2320.0-2340.0	2357.5-2377.5	
15	MP	2302.5-2322.5	2332.5-2352.5	2352.5-2372.5
16	WB	2305.0-2325.0	2332.5-2352.5	2355.0-2375.0
17	HP	2322.5-2342.5	2345.0-2365.0	2367.5-2387.5
18	BH	2302.5-2322.5	2335.0-2355.0	2357.5-2377.5
19	OR	2302.5-2322.5	2335.0-2355.0	2378.0-2398.0
20	AS	2302.5-2322.5	2325.0-2345.0	2347.5-2367.5
21	NE	2302.5-2322.5	2325.0-2345.0	2347.5-2367.5
22	J&K	2340.0-2360.0	2380.0-2400.0	
	Total	22 Spots	22 Spots	16 Spots

2.75 As can be seen from above table, frequency spots in the 2300 MHz band are not the same in all LSAs. In fact, guard band between adjacent blocks of spectrum are also different in various LSAs as can be in the Table below:

Table 2.20
Guard band between adjacent spectrum spots
in the 2300 MHz band

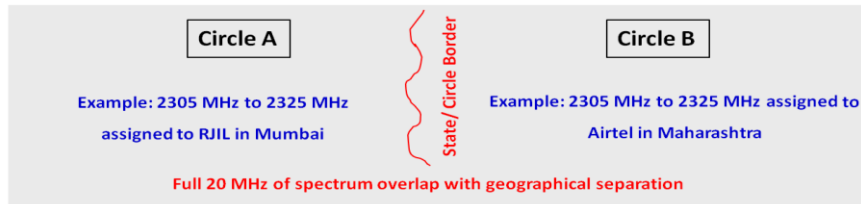
S.No.	LSA	Guard band	Guard band
		between Spot 1 and Spot 2	between Spot 2 and Spot 3
		MHz	MHz
1	DEL	2.5	2.5
2	MUM	2.5	7.5
3	KOL	7.5	2.5
4	MH	2.5	7.5
5	GUJ	2.5	2.5
6	AP	2.5	2.5
7	KTK	2.5	5
8	TN	2.5	2.5
9	KL	2.5	5
10	PB	17.5	No third spot
11	HR	20	No third spot
12	UP (W)	17.5	No third spot

13	UP (E)	17.5	No third spot
14	RAJ	17.5	No third spot
15	MP	10	0
16	WB	7.5	2.5
17	HP	2.5	2.5
18	BH	12.5	2.5
19	OR	12.5	23
20	AS	2.5	2.5
21	NE	2.5	2.5
22	J&K	20	No third spot

2.76 Guard band between adjacent spectrum blocks varies from LSA to LSA. Right now, in 10 LSAs, the guard band between adjacent spots, which have already been assigned, is only 2.5 MHz while in other LSAs, it is 7.5 MHz or more. After the assignment of additional spectrum spot, guard band in 14 LSAs on either or both sides of a spot will be 2.5 MHz. Surely 2.5 MHz guard band would pose challenges in mitigating interference in uncoordinated networks. If this issue is not properly addressed, likely interference may deteriorate the performance of a network resulting in reduced useable spectrum, less capacity in the network and unsatisfactory QoS.

2.77 The issue of interference has another dimension also. As mentioned earlier, frequency spots assigned are not the same in all the LSAs. Eg. in Karnataka, frequency slots assigned in 2300 MHz band are 2302.5-2322.5 MHz and 2325-2345 MHz while in the adjacent Tamilnadu LSA the assigned spectrum spots are 2312.5-2332.5 MHz and 2335-2355 MHz. In such a scenario, there will be overlap of frequencies amongst TSPs in the border area. In some LSAs, though both the spot frequencies are same, but TSPs have been assigned different frequency slots in adjoining LSAs. Complete or partial spectrum overlap between two TSPs may result in interference in the areas falling at the borders of two adjoining LSAs. Two cases have been depicted below:

Case 1: When same spectrum (Example: 2305 to 2325 MHz) is being allocated to two different operators in adjacent states/circles



Case 2: When only a part of the spectrum is overlapped between two different operators in adjacent states/circles



Due to fully/ partial frequency spectrum overlap between two operators, the geographical area on the circle borders will be severely interfered resulting in impaired service to customers.

2.78 To some extent, interference can be mitigated by putting sharp filters. However, considering large carrier size (20 MHz), filters may not be effective enough to deal with the interference issue, if the guard band is very less. It will also pose other challenges such as increased Capex, space constraint at towers etc. An alternate way to avoid interferences is the network synchronization. If the adjacent TDD networks are time-synchronized, it would be possible to use all spectrum resource and avoid guard band requirement between them.

2.79 Only synchronizing at the start of the frame is not enough to avoid interference between networks. It would also require the alignment of the downlink (DL) and uplink (UL) transmitted radio frames of the two TDD networks in the same coverage area. In TDD network, the frame structure (i.e. frame length and uplink-downlink ratio) can be configured as software parameter. Synchronizing the frame structure would require operators agreeing on common parameters.

2.80 It should be noted that agreement on a common UL/DL ratio decreases the flexibility of each operator with respect to the choice of the ratio. However synchronization also allows saving some spectrum that would be otherwise wasted in restricted blocks or guard bands, and therefore helps improve the overall capacity.

2.81 One option could be that frame synchronization parameters (frame length, uplink/downlink ratio) may be left to the operators who may agree on common parameters based on user/market requirements. It will require coordinated approach amongst the operators. However, it is quite possible that not all operators converge and agree to common parameters. Another way out could be that synchronization is mandated by the regulator/licensor and these parameters are also fixed by it.

2.82 In 2500 MHz band, as there is a gap of 100 MHz between two blocks of 20 MHz, there is no need for any coordination between the networks being deployed in these blocks. However, DoT is required to ensure that there is no interference issue from the users using the adjacent frequencies before putting these spectrum blocks to auction.

2.83 In view of the above discussion, stakeholders are requested to suggest:

Q14. Keeping sufficient guard band or synchronization of TDD networks using adjacent spectrum blocks are the two possible approaches for interference management. Considering that guard band between adjacent spectrum blocks in 2300 MHz band is only 2.5 MHz in a number of LSAs, should the network synchronization amongst TSPs be mandated or should it be left to the TSPs for the interference free operation in this band? Please support your suggestion with proper justifications.

Q15. In case, synchronization of the TDD networks is to be dealt by the regulator/licensor, what are the parameters that the regulator/licensor should specify? What methodology should be adopted to decide the values of the frame synchronization parameters?

Q16. If synchronization of the TDD networks is ensured, is there a need for any guard band at all? If no guard band is required, how best the spectrum left as inter-operator guard band be utilised?

G. Should ISP be eligible to acquire 2300 MHz band spectrum?

2.84 NIA dated 25th February 2010 for ‘Auction of 3G and BWA Spectrum’ permitted assignment of 2300 MHz band spectrum to an entity having a UAS/ CMTS licence or ISP Category ‘A’ licence; or that gives an undertaking to obtain a UAS licence or ISP Category ‘A’ licence through a New Entrant. Apart from spectrum in the 2300 MHz auctioned in 2010, there is no other instance where ISP licensee was allowed to acquire the access spectrum. E.g. in the auctions held in March 2015, any licensee that holds a UAS/ CMTS/ UL(AS)/UL with authorization for Access Services for that Service Area; or any licensee that fulfils the eligibility for obtaining a Unified License with authorization for Access Services; or any entity that gives an undertaking to obtain a Unified License for access service authorisation through a New Entrant Nominee as per DoT guidelines/licence was eligible to bid for the Spectrum in 800 MHz, 900 MHz, 1800 MHz and 2100 MHz band, subject to other provisions of the NIA.

2.85 After 2010, it is for the first time that spectrum in the 2300 MHz band would be put to auction. Spectrum in the 2500 MHz band would be put to auction for the very first time in the country. Earlier, it was envisaged that the spectrum in the 2300 MHz bands would be used for wireless broadband services by the ISPs and UASLs or CMSPs. Over a period of time, the technology and the device eco system has evolved and now same technology which is used in other bands can also be used in 2300 MHz band and 2500 MHz band. Therefore, the issue that needs deliberation is that should spectrum in 2300 MHz and 2500 MHz bands needs a separate treatment vis-à-vis other band as far as eligibility conditions to participate in an auction is concerned. More specifically, whether the ISP category ‘A’ licensee should be permitted to acquire the spectrum in these bands or the same eligibility criteria that have been made applicable for other

bands viz. 800 MHz, 900 MHz, 1800 MHz and 2100 MHz band should be made applicable for 2300 MHz and 2500 MHz bands also.

2.86 In view of the above discussion, stakeholders are requested to suggest:

Q17. Whether the ISP category ‘A’ licensee should be permitted to acquire the spectrum in 2300 and 2500 MHz bands or the same eligibility criteria that has been made applicable for other bands viz. 800 MHz, 900 MHz, 1800 MHz and 2100 MHz band should be made applicable for 2300 MHz and 2500 MHz bands also?

H. Liberalisation of administratively allotted spectrum in 900 MHz Band

2.87 In India, all spectrum to assigned through the auction process of 2012 and afterwards is liberalised. In other words, spectrum in any band can be used for deploying any services in any technology. However, before 2012, spectrum in the 800/900/1800 MHz bands was assigned administratively for a specific technology (either GSM or CDMA). It cannot be used for any other technology, until its use is liberalised. The issue of liberalising the spectrum in the 1800 MHz band was examined by the Authority in its recommendations on ‘Spectrum Valuation and Reserve Price’ dated 9th September 2013, wherein the Authority inter-alia made following recommendations on this issue:

“TSPs should be allowed to convert their existing 1800 MHz spectrum into liberalised spectrum only for the balance validity period of the spectrum assignment on payment of the auction determined amount. The auction determined amount will be prorated for the balance validity period of spectrum assignment. In case more than one set of market determined prices are available, the latest market determined prices available at the time when the TSP wants to liberalise its spectrum holding, should be applied. If the market determined prices are more than one year old, then these prices have to be suitably adjusted to reflect prevailing market conditions. One way of determining the prevailing market rates could be by indexing the last auction prices at the rate of SBI PLR. Another way could be the market price as realised through spectrum trading.”

2.88 The DoT has issued guidelines for liberalisation of administratively allotted spectrum in 800 MHz and 1800 MHz frequency bands on 5th November 2015, which are annexed at **Annexure 2.2**. At present there are no guidelines for liberalization of administratively allotted spectrum holding in 900 MHz band. Therefore, DoT, through a reference dated 06th November 2015 (**Annexure 1.3**), has sought the recommendations of the Authority on the liberalization of administratively allotted spectrum in the 900 MHz band.

2.89 One obvious choice is to frame the guidelines for liberalisation of administratively allotted spectrum in 900 MHz Band similar to what has been spelt out by DoT for 800 and 1800 MHz band. However, stakeholders can suggest any other feasible alternatives.

2.90 The liberalisation of spectrum gives liberty to the operators to deploy the latest technologies which permit optimal and efficient use of spectrum. Moreover, liberalization of spectrum is a precondition for spectrum sharing and spectrum trading. Also, the reconfiguration of frequencies amongst the operators for making it contiguous is permissible only if the spectrum is liberalized. Therefore, the issue for consultation is whether to make liberalization of spectrum mandatory.

Q18. Stakeholder are requested to comment on

(a) Whether the guidelines for liberalisation of administratively allotted spectrum in 900 MHz band should be similar to what has been spelt out by the DoT for 800 and 1800 MHz band? In case of any disagreement, detailed justifications may be provided.

(b) Should the liberalization of spectrum in 800, 900 and 1800 MHz be made mandatory?

CHAPTER-III: THE VALUATION AND RESERVE PRICE OF THE SPECTRUM

3.1 Radio spectrum is a unique, ubiquitous natural resource shared by a wide variety of services and with the growth in the telecommunication services it has become increasingly valuable. Unlike many other natural resources, it can be repeatedly reused and hence does not deplete. However, it has been considered as a limited – even scarce – natural resource because, given present technology, there is only a finite portion available for being put to valuable use at any point of time and thus, its valuation gains importance. It is well recognized that the economic valuation of spectrum depends on a number of variables. In functional form, one may posit that valuation of spectrum (V) is a function of available Market Information (I); Technological Factors (T); Macro and Micro Economic Variables (E) or, more simply;

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

Based on the functional relationship defined above, different approaches/methodologies were adopted in the past to arrive at spectrum value estimates.

3.2 The Government/DoT conducted a multi band spectrum auction (of 800 MHz, 900 MHz, 1800 MHz and 2100 MHz) in March 2015. The Government/DoT accepted the reserve price of these different bands recommended by the Authority with some modifications. The spectrum auction started on 4th March 2015 and ended after 115 clock rounds on 25th March 2015. Comparative statement (spectrum band wise) showing the valuation and reserve price recommended by the Authority, reserve price as fixed by the Government and auction determined/realized price in March 2015 auction is shown in Table 3.1 to Table 3.4. The LSAs where no spectrum has been put on auction have not been included in the tables.

Table 3.1
Auction of 1800 MHz Spectrum held in March 2015

(Rs. in crore)

LSA	Valuation per MHz arrived at by TRAI (Oct. 2014)	Reserve Price per MHz recommended by TRAI (Oct. 2014)	Reserve Price (RP) per MHz fixed by DoT (Jan. 2015)	Auction Price per MHz (P_{ADP}) (Mar. 2015)	Remarks (Auction Price v. DoT Reserve Price)
Kolkata	73	73	73	149	Higher than Reserve Price
Andhra Pradesh	169	163	169	243	Higher
Gujarat	238	238	238	238	Equal to Reserve Price
Karnataka	185	155	185	185	Equal
Tamil Nadu	225	208	225	225	Equal
Haryana	40	32	32	47	Higher
Kerala	94	75	75	83	Higher
Punjab	88	71	71	71	Equal
Rajasthan	107	60	60	73	Higher
U. P. (East)	122	97	97	107	Higher
U.P. (West)	95	95	95	96	Higher
Bihar	77	62	62	No bid	-
Himachal Pradesh	12	9	9	16	Higher
North East	26	11	11	11	Equal
Orissa	29	23	23	33	Higher

Note: (i) In 1800 MHz band, spectrum was sold in 14 LSAs, in 9 LSAs P_{ADP} exceed RP and in 5 LSAs, P_{ADP} was equal to RP.

(ii) Higher stand for 'Higher than Reserve Price' and Equal for 'Equal to Reserve Price.'

Table 3.2
Auction of 900 MHz Spectrum held in March 2015

(Rs. in crore)

LSA	Valuation per MHz arrived at by TRAI (Oct. 2014)	Reserve Price per MHz recommended by TRAI (Oct. 2014)	Reserve Price (RP) per MHz fixed by DoT (Jan. 2015)	Auction Price per MHz P_{ADP} (Mar. 2015)	Remarks (Auction Price v. DoT Reserve Price)
Andhra Pradesh	339	271	459	681	Higher than Reserve Price
Gujarat	424	339	424	673	Higher
Karnataka	357	286	370	558	Higher
Maharashtra	525	420	525	773	Higher
Haryana	80	64	76	151	Higher
Kerala	188	150	168	369	Higher
Madhya Pradesh	172	138	175	310	Higher
Punjab	177	141	151	361	Higher
Rajasthan	215	172	197	709	Higher
U. P. (East)	243	195	228	776	Higher
U.P. (West)	190	152	170	739	Higher
West Bengal	88	70	111	208	Higher
Assam	72	58	74	185	Higher
Bihar	154	123	148	444	Higher
Himachal Pradesh	24	19	27	57	Higher
North East	53	21	29	52	Higher
Orissa	58	47	67	139	Higher

Note: In 900 MHz band, in 17 LSAs where spectrum was sold, P_{ADP} exceed RP.

Table 3.3
Auction of 800 MHz Spectrum held in March 2015

(Rs. in crore)

LSA	Valuation per MHz arrived at by TRAI (Feb./Nov. 2014)	Reserve Price per MHz recommended by TRAI (Nov. 2014)	Reserve Price (RP) per MHz fixed by DoT (Jan. 2015)	Auction Price per MHz P_{ADP} (Mar. 2015)	Remarks (Auction Price v. DoT Reserve Price)
Delhi	617	494	617	848	Higher than Reserve Price
Mumbai	439	352	439	727	Higher
Kolkata	147	117	147	147	Equal to Reserve Price
Andhra Pradesh	234	187	234	606	Higher
Gujarat	275	220	275	278	Higher
Karnataka	303	242	303	No bid	-
Maharashtra	339	272	339	799	Higher
Tamil Nadu	360	288	360	No bid	-
Haryana	47	38	38	57	Higher
Madhya Pradesh	113	91	91	408	Higher
Punjab	106	85	85	86	Higher
U. P. (East)	167	134	134	134	Equal
U.P. (West)	119	95	95	95	Equal
West Bengal	71	57	57	57	Equal
Assam	35	28	28	82	Higher
Bihar	107	85	85	86	Higher
Himachal Pradesh	24	19	19	20	Higher

LSA	Valuation per MHz arrived at by TRAI (Feb./Nov. 2014)	Reserve Price per MHz recommended by TRAI (Nov. 2014)	Reserve Price (RP) per MHz fixed by DoT (Jan. 2015)	Auction Price per MHz P_{ADP} (Mar. 2015)	Remarks (Auction Price v. DoT Reserve Price)
Jammu & Kashmir	35	28	28	28	Equal
North East	26	11	11	25	Higher
Orissa	48	38	38	41	Higher

Note: In 800 MHz band, in 18 LSAs where spectrum was sold, in 13 LSAs P_{ADP} exceed RP and in 5 LSAs, P_{ADP} was equal to RP.

Table 3.4
Auction of 2100 MHz Spectrum held in March 2015

(Rs. in crore)

LSA	Valuation per MHz arrived at by TRAI (Dec.2015)	Reserve Price per MHz recommended by TRAI (Dec.2015)	Reserve Price (RP) per MHz fixed by DoT (Jan. 2015)	Auction Price per MHz P_{ADP} (Mar. 2015)	Remarks (Auction Price v. DoT Reserve Price)
Delhi	557	446	663	No bid	-
Mumbai	425	340	649	No bid	-
Kolkata	97	77	109	116	Higher than Reserve Price
Andhra Pradesh	229	183	275	No bid	-
Gujarat	244	195	258	258	Equal to Reserve Price
Karnataka	301	241	322	328	Higher
Maharashtra	284	227	301	301	Equal
Tamil Nadu	324	260	344	344	Equal
Haryana	54	44	46	46	Equal
Kerala	134	107	111	118	Higher
Madhya Pradesh	105	84	87	91	Higher
Rajasthan	105	84	87	140	Higher

LSA	Valuation per MHz arrived at by TRAI (Dec.2015)	Reserve Price per MHz recommended by TRAI (Dec.2015)	Reserve Price (RP) per MHz fixed by DoT (Jan. 2015)	Auction Price per MHz P_{ADP} (Mar. 2015)	Remarks (Auction Price v. DoT Reserve Price)
U. P. (East)	102	82	86	90	Higher
U.P. (West)	120	96	103	105	Higher
Assam	36	29	29	39	Higher
North East	19	8	8	11	Higher
Orissa	40	32	33	36	Higher

Note: In 2100 MHz band, in 14 LSAs where spectrum was sold, in 10 LSAs P_{ADP} exceed RP and in 4 LSAs, P_{ADP} was equal to RP.

3.3 It can be observed from the Table 3.1 to Table 3.4 that the achieved auction determined price (P_{ADP}) in March 2015 auction is higher than the Reserve Price (RP) set by DoT in many LSAs across various bands.

Valuation of Spectrum: Current Reference-Background

3.4 The current reference from DoT sought recommendations of the Authority on reserve price for multiple bands (i.e. 700/800/900/1800/2100/2300/2500 MHz band). Of these, some have been auctioned in the past, however 700 MHz and 2500 MHz band will be put on auction for the first time. At the same time, in 2300 MHz spectrum (auctioned in 2010) commercial operations have not been started till date (except in few cities). As informed by DoT, spectrum put to auction in 800/900/1800 MHz band is the sum of spectrum available due to expiry of licence and spectrum remained unsold in March 2015 auction. In 2100 MHz, it is the sum of spectrum that remained unsold in March 2015 auction and spectrum released by Defense under swapping arrangement. In 700 MHz, 2300 MHz and 2500 MHz fresh available spectrum would be put for auction. The reference from DoT sought recommendations from TRAI on reserve price for all 22 LSAs in 700 MHz band, 2100 MHz band

and 2500 MHz band, 10 LSAs in 800 MHz band, 8 LSAs in 900 MHz band, 9 LSAs in 1800 MHz band and 16 LSAs in 2300 MHz band.

The exercise to value and set reserve price for a spectrum band is dependent on the availability of cost, revenue and other information pertaining to that band. Unlike the spectrum bands (800 MHz/900 MHz/1800 MHz/2100 MHz), where historical information – both financial and non-financial – is available; it is not the case for 700/2300/2500 MHz bands.

Need for Fresh Exercise of Valuation versus Use of March 2015 Auction Determined Prices (800/900/1800/2100 MHz)

3.5 In view of the expiry of licences in different LSAs between May 2016 to March 2018; availability of additional spectrum; and spectrum remaining unsold in previous auctions, DoT has sought TRAI’s recommendations on the valuation and RP of spectrum in the 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands through letter no. L-14006/06/2015-NTG dated 9th July 2015. It is pertinent to mention here that DoT conducted spectrum auction for 800 MHz (in 20 LSAs), 900 MHz (in 17 LSAs), 1800 MHz (in 15 LSAs) and 2100 MHz spectrum (in 17 LSAs) in March 2015. Table 3.5 shows the band wise quantity of spectrum put on auction and bids received in March 2015 auction.

Table: 3.5

Spectrum Band	Quantity put on auction (in MHz) / (LSAs)	Quantity Sold* (In MHz)/ (LSAs)	Quantity sold (%)	Number of LSAs where no bid was received
800 MHz	108.75 (20 LSAs)	86.25 (18 LSAs)	79%	2
900 MHz	177.8 (17 LSAs)	168 (17 LSAs)	94%	-
1800 MHz	99.2	93.80	95%	1

	(15 LSAs)	(14 LSAs)		
2100 MHz	85 (17 LSAs)	70 (14 LSAs)	82%	3

* Full or Partially

3.6 In the auction for 800/900/1800/2100 MHz spectrum conducted by DoT in March 2015, spectrum was sold in most of the LSAs either partially or fully as can be seen from the demand (D) and supply (S) for the spectrum bands given in Table 3.6 below:

Table 3.6
Status of Sale of Spectrum in March 2015 Auction

LSA	800 MHz		900 MHz		1800 MHz		2100 MHz	
	% sold of spectrum put for sale	D and S of spectrum ¹⁷	% sold of spectrum put for sale	D and S of spectrum	% sold of spectrum put for sale	D and S of spectrum	% sold of spectrum put for sale	D and S of spectrum
Delhi	33%	D>S*	- [^]	-	-	-	0%	No Bid
Mumbai	100%	D>S	-	-	-	-	0%	No Bid
Kolkata	100%	D=S	-	-	100%	D>S	100%	D>S
Andhra Pradesh	60%	D>S*	100%	D>S	100%	D>S	0%	No Bid
Gujarat	100%	D>S	79%*	D>S	100%	D=S	100%	D=S
Karnataka	0%	No Bid	99%*	D>S	89%	D<S	100%	D>S
Maharashtra	67%	D>S*	100%	D>S	-	-	100%	D=S
Tamil Nadu	0%	No Bid	-	-	89%	D<S	100%	D=S
Haryana	100%	D>S	98%*	D>S	100%	D>S	100%	D=S
Kerala	-	-	100%	D>S	100%	D>S	100%	D>S
Madhya Pradesh	80%	D>S*	100%	D>S	-	-	100%	D>S
Punjab	67%	D>S*	100%	D>S	100%	D=S	-	-
Rajasthan	-	-	100%	D>S	96%	D>S*	100%	D>S
U. P. (East)	100%	D=S	90%*	D>S	100%	D>S	100%	D>S
U.P. (West)	100%	D=S	81%*	D>S	100%	D>S	100%	D>S
West Bengal	100%	D=S	100%	D>S	-	-	-	-
Assam	73%	D>S*	100%	D>S	-	-	100%	D>S
Bihar	100%	D>S	26%	D>S*	0%	No Bid	-	-

¹⁷D (Demand) > S (Supply) indicates that the auction determined price was higher than the reserve price in these LSAs. D = S and D < S indicate LSAs where the auction determined price did not exceed the reserve price.

* Indicates LSAs where the quantity left unsold was below the minimum quantity to bid. Therefore these LSAs have been treated at par with those all LSAs where demand > supply.

[^] Blank cell represent LSAs where no spectrum was put on auction.

LSA	800 MHz		900 MHz		1800 MHz		2100 MHz	
Himachal Pradesh	86%	D>S*	100%	D>S	100%	D>S	-	-
Jammu & Kashmir	86%	D>S*	-	-	-	-	-	-
North East	73%	D>S*	100%	D>S	90%	D<S	100%	D>S
Orissa	83%	D>S*	100%	D>S	100%	D>S	100%	D>S
Number of LSAs where $P_{ADP} > RP$ or entire quantity sold at given RP	18 LSAs out of 20 LSAs where spectrum was put on auction		17 LSAs out of 17 LSAs where spectrum was put on auction		11 LSAs out of 15 LSAs where spectrum was put on auction		14 LSAs out of 17 LSAs where spectrum was put on auction	

3.7 Thus, as can be seen from the Table 3.6 in 800 MHz band, in 18 LSAs out of 20 LSAs where spectrum was put for auction either P_{ADP} exceeded RP or entire quantity on offer was sold at given RP. Same was the scenario in 900 MHz band in all 17 LSAs, in 1800 MHz band in 11 LSAs out of 15 LSAs and in 2100 MHz band in 14 LSAs out of 17 LSAs. Therefore, a view could be taken that the realised price (i.e. P_{ADP}) in these LSAs where P_{ADP} exceeded RP or entire quantity on offer was sold at given RP was the market clearing price (P_{MCP}). On the other hand, in remaining LSAs in respective bands, realized price was not P_{MCP} as there was not enough demand for the spectrum put on auction though it was still an ‘auction determined price’. At the same time it could also be argued that since spectrum was sold in all these LSAs as recently as in March 2015, 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 (as can be seen from the Table 3.6 above).

3.8 Around 13 months have passed since the Authority made its Recommendations on valuation and reserve price of 1800 MHz and 900 MHz in October 2014, 12 months since Recommendations for 800 MHz were made in November 2014 and 10 months since Recommendations for 2100 MHz were made in January 2015; and a little over 6 months have passed since the successful conduct of the March 2015 auction. The need for fresh valuation and estimating RP of spectrum in these bands especially when the auction in these

bands has been conducted only in March 2015 (based on valuation and reserve price recommended by TRAI between October 2014 and January 2015), therefore, remains a moot question. As can be seen from the Table 3.5 above, 79% to 95% of the spectrum put up for sale in different band was bought by the bidders in the auction held in March 2015. It is not necessary that the results of a fresh estimation exercise will yield valuations that are significantly different from the TRAI's Recommendations on valuation and RP of spectrum made between October 2014 and January 2015, since the variables and inputs used in different approaches for valuation of spectrum would not have changed substantially. The only significant difference in the estimation would arise from factoring in the prices discovered in the March 2015 auction.

3.9 In this context, the Authority notes that the Notice Inviting Applications (NIA) of 25th February 2010 for 'Auction of 3G and BWA Spectrum' includes the following clause:

“Para 4.7: If a further round of auction for 3G spectrum or BWA spectrum takes place within 12 months from the date of completion of the current round or the relevant Auction, the Reserve Price in such a round will be the same as the Successful Bid Amount in the current round of the relevant Auction for the respective service area”

3.10 Further, the Authority stated in its Recommendations of 11th May 2010 on 'Spectrum Management and Licensing Framework' that:

“ Para 3.50: The Authority recommends that Government should bring additional blocks into 3G services at the earliest and offer the same at the highest price being discovered through the present auction to the remaining bidders in the order of bids. If, however, more than a year lapses from now for this exercise, a fresh auction needs to be conducted.”

3.11 It was also noted that the NIAs of 28th September 2012 (for 1800 MHz and 800 MHz) and 30th January 2013 (for 1800 MHz, 900 MHz and 800 MHz) for auction of spectrum included a clause which states that:

“Para 2.3: Existing CMTS/UAS/UL(AS) licensees can liberalise their existing spectrum holding in 1800 MHz band after payment of auction determined price.”

3.12 Further, the Authority took note of the NIA of 12th December 2013 for ‘Auction of Spectrum in 1800 MHz and 900 MHz band’ and NIA of 9th January 2015 for ‘Auction of Spectrum in 2100MHz, 1800 MHz, 900 MHz & 800 MHz Bands’ which stated that:

“Para 2.3:Existing CMTS/UAS/UL licensees can liberalise their existing spectrum holding in 1800 MHz band for the balance validity period of spectrum assignment after payment of auction determined price prorated for the balance validity period of the Spectrum Assignment.

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

If the auction determined price is more than one year old then the prevailing market rates would be determined by indexing the last auction price at the rate of SBI PLR....”.

3.13 From the above, one view could be taken that if any auction of spectrum in a particular band takes place within less than one year of the previous auction in the same spectrum band; there may not be a need for new exercise for valuation and RP or indexation of auction price for that spectrum band. It can be argued that the price revealed through an auction process should remain valid for assignment of spectrum in that band if done within one year. However, at the same time, none of the NIAs for auction of spectrum (November 2012, March 2013, February 2014 and March 2015) contain any explicit

clause that the auction determined price in a spectrum band shall be the RP for the next round of spectrum auction if it takes place within one year (unlike what was incorporated in the NIA dated 25th February 2010 for 'Auction of 3G and BWA Spectrum').

3.14 In September 2013 and subsequent Recommendations, the Authority had acknowledged that there are different ways to estimate the value of the spectrum, all of which have their merits as well as demerits. The details of the valuation methodologies/approaches followed for the valuation of various band (800/900/1800/2100 MHz) by the Authority in the past is placed at **Annexure-3.1**. In this regard one view could be that since the auction has been held as recently as March 2015, whether it would be prudent to go in for a fresh valuation exercise. On the other hand, an exercise can be undertaken to go in for a fresh valuation exercise with the latest and updated inputs. In this context, the following questions arise for consultation:

Q19. Can the prices revealed in the March 2015 auction for 800/900/1800/2100 MHz spectrum be taken as the value of spectrum in the respective band for the forthcoming auction in the individual LSA? If yes, would it be appropriate to index it for the time gap (even if this is less than one year) between the auction held in March 2015 and the next round of auction and what rate should be adopted for indexation?

Q20. If the answer to Q.19 is negative, should the valuation for respective bands be estimated on the basis of various valuation approaches/methodologies adopted by the Authority (as given in Annexure 3.1) in its Recommendations issued since 2013 including those bands (in a LSA) for which no bids were received or spectrum was not offered for auction?

VALUATION OF 700 MHz SPECTRUM

- 3.15 As a general principle in telecommunications, the wireless access networks operating on lower spectrum bands have better propagation characteristics and require lesser cell sites and could result in better cellular penetration at lower investment as compared to high frequency spectrum bands. This is an established fact of physics that the propagation losses of radio waves increase with the increase in the frequency band. The low-frequency spectrum holds the advantage of mobile signal traveling relatively longer distances which would result in reduction of costs (both OPEX as well as CAPEX) of covering less populated regions (e.g. in rural and remote areas) as well as providing enhanced indoor coverage compared to use of higher frequencies where additional cell sites would be required to be deployed to gain equivalent levels of coverage.
- 3.36 Like other spectrum bands, the valuation exercise for 700 MHz spectrum is also dependent on the availability of cost, revenue and other financial information. However, unlike the other spectrum bands such as 800 MHz/900 MHz/1800 MHz/2100 MHz spectrum band, no financial information is available in the Indian context for the 700 MHz spectrum to form a basis for its valuation. Moreover, 700 MHz spectrum is being contemplated for auction in India for the first time, thus, there is no historical auction data or prices available to have any comparison/analysis with auction prices or valuation of other bands.
- 3.37 In view of the above, the valuation approach of this spectrum band could be based on comparative values that could be achieved by using relative technical efficiency factor of other spectrum bands. This approach of valuation based technical efficiency factor has been adopted in the past exercises on the valuation of spectrum for other bands. In the Recommendations of 23rd April 2012 on 'Auction of Spectrum', the Authority based on available auction prices of 700 MHz

spectrum and 1800 MHz spectrum in European countries (in between 2008 and 2011) was of the opinion that reserve price of 700 MHz spectrum should be around 4 times of reserve price of 1800 MHz spectrum.

3.38 As per the report of ZTE¹⁸ on “APT 700MHz Best Choice for Nationwide Coverage¹⁹”, a comparative uplink edge rate from dense urban to rural environments and the coverage radius of a single site utilizing 700 MHz spectrum and 1800 MHz spectrum has been shown in the Table 3.7 below:

Table 3.7
Comparative UL Cell Range and Coverage Area of
700 MHz & 1800 MHz Spectrum

Spectrum Band	Cell Edge User Throughput (kbps)	Dense Urban	Urban	Suburban	Rural
		512	256	128	64
700 MHz	UL cell range (km)	0.70	1.21	3.37	8.48
	Coverage Area (km ²)	0.95	2.84	22.16	140.37
800 MHz	UL cell range (km)	0.63	1.09	3.04	7.65
	Coverage Area (km ²)	0.78	2.33	18.06	114.22
1.8 GHz (1800 MHz)	UL cell range (km)	0.38	0.64	1.67	4.40
	Coverage Area (km ²)	0.27	0.80	5.42	37.71

3.39 As can be seen from the above Table 3.7, the 700MHz spectrum band has more comparative advantage than the both bands in terms of UL cell range as well as coverage area and therefore could be considered as a preferred band for deployment and providing services keeping all other things constant.

3.40 In view of the above, the following questions arise for consultation in this regard:

¹⁸A Chinese [multinational telecommunications equipment](#) and systems company

¹⁹<http://www.gsma.com/spectrum/wp-content/uploads/2013/07/ZTE-LTE-APT-700MHz-Network-White-Paper-ZTE-June-2013.pdf>

- Q21. Should the value of 700 MHz spectrum be derived on the basis of the value of 1800 MHz spectrum using technical efficiency factor? If yes, what rate of efficiency factor should be used? Please support your views along with supporting documents/literature.**
- Q22. Should the valuation of 700 MHz spectrum be derived on the basis of other sub-GHz spectrum bands (i.e. 800 MHz/900 MHz)? If yes, what rate of efficiency factor should be used? Please support your views along with supporting documents/literature.**
- Q23. In the absence of financial or non-financial information on 700 MHz, no cost or revenue based valuation approach is possible. Therefore, please suggest any other valuation method/approach to value 700 MHz spectrum band along with detailed methodologies and related assumptions.**

VALUATION OF THE 2300 MHZ SPECTRUM

3.41 Like other spectrum bands, valuation exercise for 2300 MHz (unpaired) spectrum is also dependent on the availability of cost, revenue and other information pertaining to this band. However, unlike the other spectrum bands (800 MHz/900 MHz/1800 MHz/2100 MHz), both financial and non-financial information – is not available in the case of the 2300 MHz spectrum. The Authority, in this backdrop of non-availability of any financial or non-financial information, has endeavored to estimate the valuation of 2300 MHz spectrum based on the available information as discussed in following paragraphs.

Use of 2010 Auction Determined Prices

3.42 The last available market determined price for the 2300 MHz band is from the auction that took place in 2010. For the forthcoming auction, one approach to value the 2300 MHz band spectrum could be to

utilise the price realized in the 2010 auction. The approach could factor in the elapse of time since the previous auction by indexing the market revealed prices using a suitable indexation factor. In this context, the Authority notes that the Notice Inviting Applications (NIA) of 25th February 2010 (Para 4.7) for the 'Auction of 3G and BWA Spectrum' stipulates that in case of auction within 1 year from date of completion of relevant auction, the reserve price would be same as successful bid amount for the respective LSA.

3.43 The reserve prices for the 2010 auction were set in a 'top-down' manner; however later valuation exercises for different spectrum bands conducted by the Authority took the 'bottom-up' approach whereby the valuation was done on the basis of LSA-specific factors. The non-availability of historical financial or non-financial information on 2300 MHz spectrum is a constraint in estimating value of 2300 MHz using 'bottom-up approach'; this practically leaves in a situation where 2010 auction prices are available as best indicative value of 2300 MHz spectrum.

3.44 Stakeholders are requested to respond to the following question in this regard:

Q24. Should the value of May 2010 auction determined prices be used as one possible valuation for 2300 MHz spectrum in the next round of auction? If yes, then how? And, if not, then why not?

Technical Efficiency

3.45 Another way of valuing 2300 MHz spectrum could be to establish relative values with other spectrum bands using technical efficiency, as has been done before in valuing 800/ 900/ 1800/ 2100 MHz spectrum. Spectrum in different bands differs in respect of technical efficiency in terms of transmission or propagation characteristics. As a general principle (with other things remaining constant), a network built around a lower frequency spectrum costs less than a network

built around a higher frequency spectrum. This is because the strength of the signal requires fewer cell sites to be built. This factor has an important bearing on the value of different bands of spectrum.

3.46 The Authority in various Recommendations in recent past had derived the value of the spectrum in one band on the basis of value of spectrum in another, using the technical efficiency factor.

3.47 The following question arises for consultation in this regard:

Q25. Should the value of the 2300 MHz spectrum be derived on the basis of the value of any other spectrum band using the technical efficiency factor? If yes, please indicate the spectrum band and technical efficiency factor with 2300 MHz spectrum along with supporting documents.

VALUATION OF THE 2500 MHz SPECTRUM BAND

3.48 So far as 2500 MHz is concerned no valuation or auction of 2500 MHz spectrum band has taken place so far in India. There is also no supporting financial data with regard to revenue, investment and cost available to form a basis for the valuation of 2500 MHz spectrum band. A scan of the on-line information reveals that world-over 2500 MHz spectrum band is considered less valuable as compared to lower frequency bands.

Valuation of 2500 MHz Spectrum based on 2300 MHz spectrum value

3.49 Since both 2300 MHz and 2500 MHz spectrum bands are suitable for broadband use and in 2010 when the auction of 2100 MHz and 2300 MHz spectrum was done by the DoT, DoT allotted the 2500 MHz spectrum to the PSUs viz., BSNL and MTNL in place of 2300 MHz band on the administrative price equal to auction price of 2300 MHz band.

3.50 Therefore, one approach to valuation of the 2500 MHz spectrum could be to have the same value as determined for 2300 MHz spectrum.

3.51 The following question arises for consultation in this regard:

Q26. Should the valuation of the 2500 MHz spectrum be equal to the valuation arrived at for the 2300 MHz spectrum? If no, then why not? Please support your comments with supporting documents/literature.

General

Q27. Is there any other method/approach than discussed above that could be used for arriving at the valuation of 700/800/900/1800/2100/2300/2500 MHz spectrum bands or any international auction experience/ approach that could be used for valuation of any of these bands? Please support your suggestions with detailed methodology and related assumptions.

Valuation of Spectrum: Single Approach *versus* Multiple Approaches

3.52 To assess the value of different spectrum bands, various approaches (specific to respective spectrum band) have been discussed above. In case a fresh valuation approach is to be adopted (i.e., without adopting the prices revealed, indexed or not, in the March 2015 auction as the valuation), it would not be possible to say deterministically that one of these valuations is absolutely the right approach. Each approach of valuing spectrum under respective band has its merits and drawbacks. Any of these valuations could actually materialize in the market place. A priori, there is no reason to pick one particular valuation as more likely than another. Therefore the Authority in its September 2013 Recommendations and its subsequent Recommendations on valuation and reserve price of spectrum (for different bands) took the view that rather than following a deterministic approach, it is best to work with a probabilistic average valuation (through simple mean) that captures the range of possible valuations that have been attempted. Rather than count on

one method, prudence suggests it would be better to rely on a number of such models to arrive at a final reasonable valuation and then to compute reserve price on such valuation.

3.53 The following question arises for consultation in this regard:

Q28. As was adopted by the Authority in September 2013 and subsequent Recommendations and adopting the same basic principle of equal-probability of occurrence of each valuation, should the average valuation of the spectrum band be taken as the simple mean of the valuations obtained from the different approaches/methods attempted for that spectrum band? If no, please suggest with justification that which single approach under each spectrum band, should be adopted to value that spectrum band.

Reserve Price Estimation

3.54 A reserve price (RP) refers to the minimum amount that the owner of an item would accept as the winning bid amount of that item. RP prevents the auction bid to be won at a price lower than the minimum price the owner is intending to accept. It is important to note here that RP is not the eventual realized price of an item in the auction; it is the starting point for an ascending price auction. The RP set lower than the expected value of the object will enable price discovery and the final bid price is likely to be higher than the RP depending on other factors such as supply and demand situation, amount of availability of that item in future etc. The concepts of auction efficiency, revenue maximization and RP, along with international practices were discussed in detail (Chapter IV) in the Consultation Paper on "Valuation and Reserve Price of Spectrum" dated 23rd July 2013.

3.55 The Authority in its Recommendations of September 2013 on "Valuation and Reserve Price of Spectrum", as a general principle, had recommended that the RP should be fixed at 80% of the average

valuation of the spectrum band. The same principle was followed to in the Recommendations of February 2014 for 800 MHz spectrum as well as the Recommendations of October 2014 and December 2014 for 900/1800 MHz spectrum and for 2100 MHz spectrum respectively.

3.56 It has been observed that Notice Inviting Applications for auction of spectrum in different bands issued by the Government of India since 2014, on many occasions the RPs recommended by the Authority was modified by the Government. For example, in NIA (January 2015) for 1800 MHz spectrum and 800 MHz spectrum, the RPs for Metro/ Category 'A' LSAs were set equal to 100% of the average valuation of respective spectrum band instead of RP recommended by the Authority, however for rest of the LSAs, Government accepted the same RPs that were recommended by the Authority.

3.57 The following question arises for consultation in this regard:

Q29. What should be the ratio adopted between the reserve price for the auction and the valuation of the spectrum in different spectrum bands and why?

Q30. Should the realized prices in the recent March 2015 auction for 800/900/1800/2100 MHz spectrum bands be taken as the reserve price in respective spectrum bands for the forthcoming auction? If yes, would it be appropriate to index it for the time gap (even if less than one year) between the auction held in March 2015 and the forthcoming auction? If yes, then at which rate the indexation should be done?

CHAPTER-IV: ISSUES FOR CONSULTATION

- Q1. Whether the entire spectrum available with DoT in the 800 MHz band be put for auction? Justify your answer.**
- Q2. How can the spectrum in the 800 MHz band, which is not proposed to be auctioned due to non-availability of inter-operator guard band, be utilised?**
- Q3. What should be the block size in the 700 MHz band?**
- Q4. Whether there is any requirement to change the provisions of the latest NIA with respect to block size and minimum quantum of spectrum that a new entrant/existing licenses/expiry licensee is required to bid for in 800, 900, 1800 and 2100 MHz bands. Please give justification for the same.**
- Q5. What should be the block size in the 2300 MHz and 2500 bands?**
- Q6. Considering the fact that one more sub-1 GHz band (i.e. 700 MHz band) is being put to auction, is there a need to modify the provisions of spectrum cap within a band?**
- Q7. Is there any need to specify a separate spectrum cap exclusively for the spectrum in 700 MHz band?**
- Q8. Should a cap on the spectrum holding within all bands in sub-1 GHz frequencies be specified? And in such a case, should the existing provision of band specific cap (50% of total spectrum assigned in a band) be done away with?**
- Q9. Should 2300 MHz and 2500 MHz bands be treated as same band for the purpose of imposing intra-band Spectrum Cap?**
- Please support your suggestions for Q6 to Q9 with proper justifications.**

Q10. Suggest an appropriate coverage obligation upon the successful bidders in 700 MHz band? Whether these obligations be imposed on some specific blocks of spectrum (as was done in Sweden and UK) or uniformly on all the spectrum blocks?

Q11. Should it be mandated to cover the villages/rural areas first and then urban areas as part of roll-out obligations in the 700 MHz band?

Q12. In the auction held in March 2015, specific roll-out obligations were mandated for the successful bidders in 800 MHz, 900 MHz, 1800 MHz and 2100 MHz spectrum bands. Stakeholders are requested to suggest:

(a) How the roll-out obligations be modified to enhance mobile coverage in the villages? Which of the approaches discussed in para 2.58 should be used?

(b) Should there be any roll out obligation for the existing service providers who are already operating their services in these bands.

Please support your answer with justification.

Q13. In the auction held in 2010, specific roll-out obligations were mandated for the successful bidders in 2300 MHz spectrum band. Same were made applicable to the licensee having spectrum in 2500 MHz band. Stakeholders are requested to suggest:

(a) Should the same roll-out obligations which were specified during the 2010 auctions for BWA spectrum be retained for the upcoming auctions in the 2300 MHz and 2500 MHz bands? Should both these bands be treated as same band for the purpose of roll-out obligations?

(b) In case existing service providers who are already operating their services in 2300 MHz band acquire

additional block of spectrum in 2300 or 2500 MHz band, should there be any additional roll out obligation imposed on them?

Q14. Keeping sufficient guard band or synchronization of TDD networks using adjacent spectrum blocks are the two possible approaches for interference management. Considering that guard band between adjacent spectrum blocks in 2300 MHz band is only 2.5 MHz in a number of LSAs, should the network synchronization amongst TSPs be mandated or should it be left to the TSPs for the interference free operation in this band? Please support your suggestion with proper justifications.

Q15. In case, synchronization of the TDD networks is to be dealt by the regulator/licensor, what are the parameters that the regulator/licensor should specify? What methodology should be adopted to decide the values of the frame synchronization parameters?

Q16. If synchronization of the TDD networks is ensured, is there a need for any guard band at all? If no guard band is required, how best the spectrum left as inter-operator guard band be utilised?

Q17. Whether the ISP category 'A' licensee should be permitted to acquire the spectrum in 2300 and 2500 MHz bands or the same eligibility criteria that has been made applicable for other bands viz. 800 MHz, 900 MHz, 1800 MHz and 2100 MHz band should be made applicable for 2300 MHz and 2500 MHz bands also?

Q18. Stakeholder are requested to comment on

(a) Whether the guidelines for liberalisation of administratively allotted spectrum in 900 MHz band should be similar to what has been spelt out by the DoT for 800 and 1800 MHz band? In case of any disagreement, detailed justifications may be provided.

(b) Should the liberalization of spectrum in 800, 900 and 1800 MHz be made mandatory?

- Q19. Can the prices revealed in the March 2015 auction for 800/900/1800/2100 MHz spectrum be taken as the value of spectrum in the respective band for the forthcoming auction in the individual LSA? If yes, would it be appropriate to index it for the time gap (even if this is less than one year) between the auction held in March 2015 and the next round of auction and what rate should be adopted for indexation?**
- Q20. If the answer to Q.19 is negative, should the valuation for respective bands be estimated on the basis of various valuation approaches/methodologies adopted by the Authority (as given in Annexure 3.1) in its Recommendations issued since 2013 including those bands (in a LSA) for which no bids were received or spectrum was not offered for auction?**
- Q21. Should the value of 700 MHz spectrum be derived on the basis of the value of 1800 MHz spectrum using technical efficiency factor? If yes, what rate of efficiency factor should be used? Please support your views along with supporting documents/literature.**
- Q22. Should the valuation of 700 MHz spectrum be derived on the basis of other sub-GHz spectrum bands (i.e. 800 MHz/900 MHz)? If yes, what rate of efficiency factor should be used? Please support your views along with supporting documents/literature.**
- Q23. In the absence of financial or non-financial information on 700 MHz, no cost or revenue based valuation approach is possible. Therefore, please suggest any other valuation method/approach to value 700 MHz spectrum band along with detailed methodologies and related assumptions.**
- Q24. Should the value of May 2010 auction determined prices be used as one possible valuation for 2300 MHz spectrum in the next round of auction? If yes, then how? And, if not, then why not?**

- Q25. Should the value of the 2300 MHz spectrum be derived on the basis of the value of any other spectrum band using the technical efficiency factor? If yes, please indicate the spectrum band and technical efficiency factor with 2300 MHz spectrum along with supporting documents.**
- Q26. Should the valuation of the 2500 MHz spectrum be equal to the valuation arrived at for the 2300 MHz spectrum? If no, then why not? Please support your comments with supporting documents/literature.**
- Q27. Is there any other method/approach than discussed above that could be used for arriving at the valuation of 700/800/900/1800/2100/2300/2500 MHz spectrum bands or any international auction experience/ approach that could be used for valuation of any of these bands? Please support your suggestions with detailed methodology and related assumptions.**
- Q28. As was adopted by the Authority in September 2013 and subsequent Recommendations and adopting the same basic principle of equal-probability of occurrence of each valuation, should the average valuation of the spectrum band be taken as the simple mean of the valuations obtained from the different approaches/methods attempted for that spectrum band? If no, please suggest with justification that which single approach under each spectrum band, should be adopted to value that spectrum band.**
- Q29. What should be the ratio adopted between the reserve price for the auction and the valuation of the spectrum in different spectrum bands and why?**
- Q30. Should the realized prices in the recent March 2015 auction for 800/900/1800/2100 MHz spectrum bands be taken as the reserve price in respective spectrum bands for the forthcoming auction? If yes, would it be appropriate to index it for the time gap (even if**

less than one year) between the auction held in March 2015 and the forthcoming auction? If yes, then at which rate the indexation should be done?

Annexure 1.1

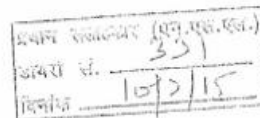
Government of India
Ministry of Communications and IT
Wireless Planning and Coordination (WPC) Wing,
Sanchar Bhawan, 20, Ashok Road, New Delhi - 110001

No.L-14006/06/2015-NTG

Dated: 09.07.2015

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 right to use of Spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz and 2100 MHz, 2300 MHz and 2500 MHz bands - reg.

Sir

The undersigned is directed to state that the Government is planning to auction of right to use of spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands in the forthcoming auction. The status of availability of spectrum in these bands is as under:

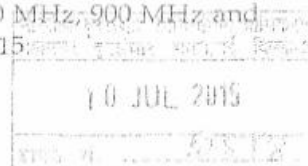
2. 700 MHz band:

2.1 TRAI had made its recommendation on reserve price and other related issues for 700 MHz band along with the other bands in April 2012. Thereafter, band plan for 700 MHz was recommended by TRAI in March 2013.

2.2 Presently, 770.0 MHz (FDD) of spectrum is available in 700 MHz band (35 MHz (FDD) spectrum in each of 22 LSAs). It is pertinent to mention that during the period March 2013 to March 2015, 3 rounds of spectrum auction in various bands have been conducted. It is felt that reserve price as recommended by TRAI for 700 MHz band in April 2012 does not seem to be appropriate in the present scenario. Therefore, it is necessary to get fresh recommendations for auction of spectrum in 700 MHz band in the light of development taken place during the period since April 2012.

3. 800 MHz, 900 MHz and 1800 MHz Bands:

3.1 It is noted that 8 service licenses are due to expire during May 2016 to March 2018. A total of 20.0 MHz, 12.4 MHz and 22.0 MHz spectrum will be released due to expiry of these 8 licenses in 800 MHz, 900 MHz and 1800 MHz bands respectively. The availability of spectrum in these bands is limited to spectrum to be released due to expiry of these 8 service licenses and unsold spectrum in 800 MHz, 900 MHz and 1800 MHz bands during last spectrum auction held in March 2015.



3.2 It is also pertinent to mention that the harmonisation of 1800 MHz band with Defence and Telecom Service providers is underway. If harmonisation process gets completed before the commencement of process for conducting of forthcoming auction, spectrum releases from harmonisation in 1800 MHz band will be added into the availability of 1800 MHz band.

4. 2100 MHz Band:

4.1 Defence has agreed, in principle, for swapping 15.0 MHz spectrum in 2100 MHz band with 1900 MHz band in all the service areas. Further, 15.0 MHz spectrum (5.0 MHz spectrum each in AP, Delhi and Mumbai service areas) remains unsold during last spectrum auction held in March 2015. Therefore, 345 MHz of spectrum (15.0 MHz each in 19 service areas and 20 MHz each in 3 service areas) in 2100 MHz band is available for auction.

5. 2300 MHz and 2500 MHz Bands:


5.1 TRAI was requested to give recommendations on the Reserve Price for auction of right to use of Spectrum in 2100 MHz, 2300 MHz and 2500 MHz bands vide this Ministry letter No. L-14006/01/2014-NTG dated 16.10.2014. TRAI had made recommendations on 2100 MHz band (**Valuation and Reserve Price of Spectrum: 2100 MHz Band dated 31.12.2014**) only. The recommendations on the Reserve Price and associated conditions for auction of right to use of Spectrum in 2300 MHz and 2500 MHz bands are awaited.

6. Service area wise details of availability of spectrum in various bands is at Annexure-I. The availability of spectrum in all the bands in all the service areas can vary vis-à-vis indicated in the Annexure-I.

7. TRAI is, therefore, requested to:

(a) provide recommendations on applicable reserve price and associated conditions for auction of spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz and 2100 MHz bands for all the services areas under the terms of clause 11(1)(a) of TRAI Act 1997 as amended by TRAI Amendment Act 2000.

(b) expedite the recommendations on applicable reserve price for 2300 MHz and 2500 MHz bands for all the services areas.


(R. B. Prasad)
Joint Wireless Adviser

Availability of spectrum in various bands

S. No.	Service Area	700 MHz	800 MHz	900 MHz	1800 MHz	2100 MHz	2300 MHz	2500 MHz
1	Andhra Pradesh	35.00	6.25		4.40	20.00	20.00	40.00
2	Assam	35.00				15.00	20.00	20.00
3	Bihar	35.00		4.60	2.00	15.00	20.00	20.00
4	Delhi	35.00		6.20	2.20	20.00	20.00	40.00
5	Gujarat	35.00	3.75	3.00	4.40	15.00	20.00	40.00
6	Haryana	35.00		0.20		15.00		20.00
7	Himachal Pradesh	35.00				15.00	20.00	20.00
8	Jammu & Kashmir	35.00				15.00		20.00
9	Karnataka	35.00	1.25	0.20	0.20	15.00	20.00	40.00
10	Kerala	35.00				15.00	20.00	20.00
11	Kolkata	35.00				15.00	20.00	40.00
12	Madhya Pradesh	35.00	1.25			15.00	20.00	20.00
13	Maharashtra	35.00	6.25			15.00	20.00	40.00
14	Mumbai	35.00	5.00	6.20	2.20	20.00	20.00	40.00
15	North East	35.00			0.80	15.00	20.00	20.00
16	Orissa	35.00				15.00	20.00	20.00
17	Punjab	35.00	5.00		4.40	15.00		20.00
18	Rajasthan	35.00	5.00		4.80	15.00		20.00
19	Tamil Nadu	35.00	1.25			15.00	20.00	40.00
20	Utter Pradesh (East)	35.00	1.25	0.60		15.00		20.00
21	Utter Pradesh (West)	35.00		1.20		15.00		20.00
22	West Bengal	35.00				15.00	20.00	20.00
		770.00	36.25	22.20	25.40	345.00	320.00	600.00

Annexure 1.2

Government of India
Ministry of Communications and IT
Wireless Planning and Coordination (WPC) Wing
Sanchar Bhawan, 20, Ashok Road, New Delhi - 110001

No.L-14006/01/2014-NTG

Dated: October 16, 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 right to use of Spectrum in 2100 MHz, 2300 MHz and 2500 MHz bands - reg.

Sir

The undersigned is directed to state that the Government is planning auction of right to use of spectrum in 2100 MHz, 2300 MHz and 2500 MHz bands, preferably along with the auction of spectrum in 800 MHz, 900 MHz and 1800 MHz bands. The status of availability of spectrum in these three bands is as under:

2.1 2100 MHz band:

At present, no vacant spectrum is available with the Department in 2100 MHz band. Discussions with Defence are underway for release of one block of 5 MHz of spectrum in 2100 MHz and the possibilities are that the Defence may release spectrum with the availability either for entire service area or partial basis (i.e. released spectrum will not be available for entire service area). Spectrum in 2100 MHz band will be put for auction only after release of spectrum by Defence.

2.2 2300 MHz and 2500 MHz Bands:

Details of availability of spectrum in these two bands are attached at **Annexure**.

3. Further, the department has so far conducted spectrum auction in different bands since 2010 with a validity period of 20 years of right to use spectrum. The administratively assigned spectrum in 800 MHz, 900 MHz and 1800 MHz bands is co-terminus with expiry of service licenses. This has created a situation where TSPs are providing services in a service area, having spectrum with different validity period of right to use spectrum even in the same band.

3.1 The feasibility of auctioning varying validity periods of right to use spectrum (less than 20 years) so that expiry of validity period of right to use spectrum in a band in a service area occurs at same time may also be considered.

4. TRAI is, therefore, requested to provide recommendations on the following in terms of clause 11(1)(a) of TRAI Act 1997 as amended by TRAI Amendment Act 2000.:

- (a) Applicable reserve price for 2100 MHz, 2300 MHz and 2500 MHz bands for all the services areas in both the cases i.e. spectrum available in entire service area and spectrum partially available in a service area.
- (b) Auction of right to use of spectrum in a band with varying validity periods (less than 20 years) so that expiry of validity period of right to use spectrum in a band in a service area occurs at same time.



(R. B. Prasad)
Joint Wireless Adviser

Annexure

Details of availability of Spectrum in 2300 MHz and 2500 MHz bands

S. No.	Service Area	Frequency spot in 2300 MHz Band	Frequency spot in 2500 MHz Band		Total Available Spectrum in (MHz)
1	Andhra Pradesh	2325.0-2345.0	2535-2555	2635-2655	60
2	Assam	2347.5-2367.5	2535-2555		40
3	Bihar	2357.5-2377.5	2535-2555		40
4	Delhi	2350.0-2370.0	2535-2555	2635-2655	60
5	Gujarat	2350.0-2370.0	2535-2555	2635-2655	60
6	Haryana		2535-2555		20
7	Himachal Pradesh	2367.5-2387.5	2535-2555		40
8	Jammu & Kashmir		2535-2555		20
9	Karnataka	2350.0-2370.0	2535-2555	2635-2655	60
10	Kerala	2350.0-2370.0	2535-2555		40
11	Kolkata	2355.0-2375.0	2535-2555	2635-2655	60
12	Madhya Pradesh	2352.5-2372.5	2535-2555		40
13	Maharashtra	2355.0-2375.0	2535-2555	2635-2655	60
14	Mumbai	2355.0-2375.0	2535-2555	2635-2655	60
15	North East	2347.5-2367.5	2535-2555		40
16	Orissa	2378.0-2398.0	2535-2555		40
17	Punjab		2535-2555		20
18	Rajasthan		2535-2555		20
19	Tamil Nadu	2357.5-2377.5	2535-2555	2635-2655	60
20	Utter Pradesh (East)		2535-2555		20
21	Utter Pradesh (West)		2535-2555		20
22	West Bengal	2355.0-2375.0	2535-2555		40
		320 MHz	440 MHz	160 MHz	920 MHz

Annexure 1.3

Government of India
Wireless Planning and Coordination (WPC) Wing
Ministry of Communications and IT
Sanchar Bhawan, 20, Ashok Road, New Delhi - 110001

No. L-14010/04/2015-NTG

Dated: 06.10.2015

To,

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

Subject: Recommendations on the Liberalization of Administratively allotted Spectrum in 900 MHz band - reg.

Sir

The undersigned is directed to state that the Government has already made provisions for liberalisation of administratively allotted spectrum holding in 800 MHz and 1800 MHz bands. At present, there is no provision for liberalisation of administratively allotted spectrum holding in 900 MHz band.

2. Presently, 3 private telecom service providers in 8 service areas besides state owned PSUs (BSNL & MTNL) are holding administratively allotted spectrum in 900 MHz band. Details of TSPs along with service area and quantum of administratively allotted spectrum in 900 MHz band and expiry of their service license are attached.

3. TRAI is, therefore, requested to provide recommendations on liberalisation of administratively allotted spectrum in 900 MHz band.

say like to see
data stage/pl

R. B. Prasad
06.10.2015

(R. B. Prasad)
Joint Wireless Adviser

**Administrative allotted Spectrum holdings in 900 MHz by Telecom Service providers
as on date**

Sl. No.	Service Area	Name of the Telecom Service providers	Quantum of Administrative allotted spectrum in 900MHz Band	Effective date of expiry of License
1	Assam	Bharti Airtel Limited	1.80 MHz	07.07.2024
		Aircel/Dishnet Wireless Ltd.	4.40 MHz	20.04.2024
2	Bihar	Bharti Airtel Limited	6.20 MHz	09.02.2024
3	Jammu & Kashmir	Bharti Airtel Limited	6.20 MHz	09.02.2024
		Aircel/Dishnet Wireless Ltd.	4.40 MHz	20.04.2024
4	North East	Aircel/Dishnet Wireless Ltd.	4.40 MHz	20.04.2024
5	Orissa	Bharti Airtel Limited	6.20 MHz	09.02.2024
6	Uttar Pradesh (East)	Bharti Airtel Limited	6.20 MHz	09.02.2024
7	Uttar Pradesh (West)	Vodafone South Ltd.	6.20 MHz	12.03.2024
8	West Bengal	Bharti Airtel Limited	4.40 MHz	10.02.2024
		Vodafone South Ltd.	4.40 MHz	22.03.2024
9	Delhi and Mumbai	MTNL	6.2 MHz each	09.10.2017
10	All service areas except Delhi & Mumbai	BSNL	6.2 MHz each	28.02.2020

A. Countries where APT700 FDD (band28) band plan is being adopted as a prime band for Long Term Evolution (LTE) technology

- (a) **APAC/Oceania:** (23 countries including Australia, Japan, Malaysia, Nepal, New Zealand, South Korea and Singapore)
- (b) **Latin America region** (13 countries including Argentina, Brazil, Colombia and Mexico)
- (c) **Middle East:** UAE has also confirmed adoption APT700 FDD (band 28)
- (d) **Europe:** Finland, France, Germany, Sweden and UK

B. Countries (13) where APT700 band 28 is licensed to mobile operators

Argentina, Australia, Brazil, Chile, Ecuador, Fiji, Japan, Mexico, New Zealand, Panama, Papua New Guinea, South Korea, and Taiwan.

C. Commercially launched APT700 band 28 networks

12 commercial networks have launched their services in this band plan. The details are as per table below:

ATP700 Network	Country
Digicel	Papua New Guinea
FarEasTone	Taiwan
Taiwan Mobile	Taiwan
Vodafone	New Zealand
Optus	Australia
Telstra	Australia
Spark	New Zealand
Asia Pacific telecom	Taiwan
C and W	Panama
Movistar	Panama
Ambit Microsystems	Taiwan
Claro	Panama

D. User devices launched by key suppliers

139 APT700 (band 28) user devices are launched by key suppliers including Acer, Apple, Asus, Foxconn/InFocus, Fujitsu, HTC, Huawei, LG, Motorola, Samsung, Sierra Wireless, Sony, TCL/Alcatel and ZTE. 121 devices are smartphones.

Annexure 2.1

Annexure-I (After auction March 2015)

CDMA CARRIERS ASSIGNMENTS & AVAILABILITY

S. No.	Sat. Channel no	1	42	83	124	0.0	185	226	267	308	0.0	399	410	451	492	0.0	553	594
Band Width		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23	1.23	1.23		1.23	1.23
Carrier		870.03	871.25	872.49	873.72		875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		885.59	887.82
Metro Service Area																		
1	Delhi	TTML	available (unsold)	available (unsold)		SSTL	RCL	RCL	RCL	RCL		TTL	TTL	TTL	TTL		SSTL	SSTL
		Mar-15					185	226	267	308		399	410	451	492		553	594
		870.03	871.25	872.49		874.02	875.55	876.78	878.01	879.24		881.07	882.3	883.53	884.76		885.59	887.82
Vacation by MTNL																		
2	Mumbai	TTML	TTML	TTML	TTML		TTML	TTML		R/L	R/L	R/L	R/L		RCL	RCL	RCL	RCL
		1	42	83	124		Mar-15	Mar-15		Mar-15	Mar-15	Mar-15	Mar-15		471	512	553	594
		870.03	871.25	872.49	873.72		875.55	876.78		878.01	879.24	881.07	882.3		884.18	885.39	886.59	887.82
Vacation by MTNL																		
3	Kolkata	AVAILABLE	BSNL	RCL		TTL	TTL		SSTL	TTL		SSTL	SSTL		RCL	RCL	RCL	RCL
		42	Mar-15	144	185		226	267		308		399	410		451	492	539	574
		870.03	871.25	872.79	874.32	875.55	877.08	878.64		880.17	881.4		883.53	884.76	885.99	887.22		
Vacation by BSNL																		
A Service Areas																		
4	AP	AVAILABLE	BSNL	TTML	TTML	TTML		TTL	TTL	TTL		RCL	RCL	RCL	RCL		available (unsold)	available (unsold)
		42	Mar-15	Mar-15	Mar-15		226	267	308		399	410	451	492		885.59	887.82	
		870.03	871.25	872.79	874.02	875.25	876.78	878.01	879.24		881.07	882.3	883.53	884.76				
Vacation by BSNL																		
5	Gujarat	TTL	TTL	SSTL	SSTL		AVAILABLE	TTL	BSNL	BSNL		SSTL	RCL	RCL		RCL	RCL	RCL
		1	42	93	134		226	279	BSNL		399	410	451	492		512	553	594
		870.03	871.25	872.79	874.02		875.55	876.78	878.37	879.5		881.07	882.6	883.83		885.39	886.59	887.82
Vacation by BSNL																		
6	Maharashtra	TTML	TTML	TTML	TTML		TTML	TTML	available (unsold)		BSNL	BSNL	AVAILABLE	RCL	RCL	RCL	RCL	
		1	42	83	124		Mar-15	Mar-15	878.01		347	388	882.87	471	512	553	594	
		870.03	871.25	872.49	873.72		875.55	876.78	878.01		880.41	881.64	882.87	884.13	885.39	886.59	887.82	
Vacation by BSNL																		
7	Karnataka	AVAILABLE	BSNL	BSNL		SSTL	TTL	TTL	TTL		available (unsold)	RCL	RCL	RCL	RCL		SSTL	SSTL
		42	83		185	226	267		399	410	451	492		553	594			
		870.03	871.25	872.49	874.02	875.55	876.78	878.01	879.54	881.07	882.3	883.53	884.76		885.59	887.82		
Vacation by BSNL																		
8	Tamil Nadu	AVAILABLE	BSNL	BSNL		SSTL	TTL (only Chennai)	TTL	TTL		available (unsold)	RCL	RCL	RCL	RCL		SSTL	SSTL
		42	83		185	226	267		399	410	451	492		553	594			
		870.03	871.25	872.49	874.02	875.55	876.78	878.01	879.54	881.07	882.3	883.53	884.76		885.59	887.82		
Vacation by BSNL																		

available (unsold) may be read as "was put on auction in March 2015 but remained unsold"

Vacation by MTNL/BSNL may be read as "this carrier was put on auction in March-2015 and got sold & effective date for reckoning a period of 20 years for right to use the spectrum is date of vacation by MTNL/BSNL as the case may be"

CDMA CARRIERS ASSIGNMENTS & AVAILABILITY

S. No.	Stel.Ch/Channel no	1				42				83				124				0.0	185				220				267				308				0.0	369				410				451				492				0.0	558				594			
		Band Width		1.23		1.23		1.23		1.23		1.23		1.23		1.23			1.23		1.23		1.23		1.23		1.23		1.23		1.23		1.23			1.23		1.23		1.23		1.23																		
		Carrier		870.03		871.25		872.49		873.72		874.02		875.55		876.78			878.01		879.24		881.07		882.3		883.53		884.76		885.99		887.22			888.45		889.68		890.91																				
S. No.	"C" Service Area																																																											
17	ASSAM	AVAILABLE	BSNL	BSNL	available (unsold)	RJL	RJL	RJL	RJL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL																							
			42	83		Mar-15	Mar-15	Mar-15	Mar-15					Mar-15	Mar-15	Mar-15	Mar-15					Mar-15	Mar-15	Mar-15	Mar-15					Mar-15	Mar-15	Mar-15	Mar-15																											
		870.03	871.25	872.49	874.02	875.55	876.78	878.01	879.24	881.07	882.3	883.53	884.76	885.99	887.22	888.45	889.68	890.91	12.12 (MHz)	12.12 (MHz)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																						
18	BIHAR	AVAILABLE	BSNL	BSNL	RJL	TTL	TTL	TTL	RJL	RCL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RJL	RJL		RCL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RJL	RJL	RJL	RJL	available (unsold)	available (unsold)	0.0	RJL	RJL	RJL	RJL																							
			42	83	Mar-15	185	220	267	Mar-15	369	410	451	492					Mar-15	Mar-15		Mar-15	Mar-15	Mar-15	Mar-15					Mar-15	Mar-15	Mar-15	Mar-15																												
		870.03	871.25	872.49	874.02	875.55	876.78	878.01	879.54	881.07	882.30	883.53	884.76	885.99	887.22	888.45	889.68	890.91	12.12 (MHz)	12.12 (MHz)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																						
19	HP	AVAILABLE	BSNL	BSNL	RCL	RCL	TTL	TTL	RJL	available (unsold)	available (unsold)	0.0	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL																						
			42	83	Mar-15	Mar-15	220	267	Mar-15	available (unsold)	available (unsold)		410	451					Mar-15	Mar-15		Mar-15	Mar-15	Mar-15	Mar-15					Mar-15	Mar-15	Mar-15	Mar-15																											
		870.03	871.25	872.49	874.02	875.25	876.78	878.01	879.54	880.77	882.30	883.53	885.99	887.22	888.45	889.68	890.91	12.12 (MHz)	12.12 (MHz)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																						
20	J&K	AVAILABLE	BSNL	BSNL	available (unsold)	DEFENCE				RCL	RCL	RJL	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL																						
			42	83						Mar-15	Mar-15	Mar-15	410	451					Mar-15	Mar-15		Mar-15	Mar-15	Mar-15	Mar-15					Mar-15	Mar-15	Mar-15	Mar-15																											
		870.03	871.25	872.49	874.02	878.81	879.54	880.77	882.30	883.53	885.99	887.22	888.45	889.68	890.91	12.12 (MHz)	12.12 (MHz)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																							
21	NE	AVAILABLE	BSNL	BSNL	available (unsold)	RCL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RJL	RJL	RJL	RJL	available (unsold)	available (unsold)	0.0	RJL	RJL	RJL	RJL	available (unsold)	available (unsold)	0.0	RJL	RJL	RJL	RJL	available (unsold)	available (unsold)	0.0	RJL	RJL	RJL	RJL																							
			42	83		Mar-15	Mar-15	Mar-15	Mar-15					Mar-15	Mar-15	Mar-15	Mar-15					Mar-15	Mar-15	Mar-15	Mar-15					Mar-15	Mar-15	Mar-15	Mar-15																											
		870.03	871.25	872.49	874.02	875.55	876.78	878.01	879.24	881.07	882.3	883.53	884.76	885.99	887.22	888.45	889.68	890.91	12.12 (MHz)	12.12 (MHz)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																						
22	ORISSA	AVAILABLE	BSNL	BSNL	RCL	available (unsold)	TTL	TTL	RJL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL	available (unsold)	available (unsold)	0.0	RCL	RCL	RCL	RCL																						
			42	83	Mar-15	available (unsold)	220	267	Mar-15	369	410	451					Mar-15	Mar-15	Mar-15	Mar-15				Mar-15	Mar-15	Mar-15	Mar-15					Mar-15	Mar-15	Mar-15	Mar-15																									
		870.03	871.25	872.49	874.02	875.25	876.78	878.01	879.54	881.07	882.30	883.53	885.99	887.22	888.45	889.68	890.91	12.12 (MHz)	12.12 (MHz)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																						

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

Guard Band
 Vacant : Less than a carrier

- Note: 1. Requirement of Government for 4 carriers each in Assam and NE, and two carriers in J & K is under consideration.
2. Inter operator guard band of 270/300/600 KHz, has been kept while assigning CDMA carriers in different service areas as per the availability. Any alteration to the existing inter-operator guard band from the existing may require re-configuration of carriers by the incumbent operators.
 3. In some of service areas, availability of CDMA carriers are without inter-operator guard band.
 4. One block of 1.25 MHz (paired) CDMA spectrum signifies allotment of 1.23 MHz (paired).
 5. Carriers shown above are center frequency having band width of 1.23MHz .
 6. Carrier frequencies shown above may vary slightly after harmonisation



No. J-14025/212/2015-CDMA

Government of India
Ministry of Communication & Information Technology
Department of Telecommunication
Wireless Planning and Coordination Wing
Sanchar Bhawan, New Delhi

Dated: 05th November, 2015

Guidelines for Liberalisation of Administratively allotted Spectrum in 800 MHz and 1800 MHz frequency bands.

In accordance with the Clause 42.10 of UL amendment dated 05.11.2015, Clause 43.11 of UASL amendment dated 05.11.2015 and Clause 46.7 of CMTS amendment dated 05.11.2015 as well as the various provisions for liberalisation of spectrum in 800 MHz and 1800MHz frequency bands contained in Notice Inviting Applications (NIAs), relating to auction of spectrum held since 2012 onwards, the competent authority hereby, lays down the following terms, conditions and charging criterion in this regard:

1. Existing CMTS/UAS/UL with access service authorization licensees may liberalise their entire administratively allotted spectrum holding in 800MHz and 1800MHz band in a Service Area for the balance validity period of right to use spectrum.
2. Administratively allotted spectrum in 800 MHz and 1800 MHz bands refers to the spectrum allotted prior to auction of right to use spectrum in November 2012.
3. Liberalisation of spectrum in 800MHz and 1800MHz frequency bands will be considered only after a written request for liberalising the entire spectrum, pertaining to a frequency band and LSA, accompanied by a non-refundable processing fee amounting to Rs 50, 000/- per service area in the form of a DD/ Pay Order drawn in favour of PAO (HQ), DoT, New Delhi is received by WPC Wing, DoT from a Telecom Service Provider.
4. After the in-principle approval of the competent authority that the liberalisation of administratively allotted spectrum of the TSP is permitted subject to receipt of necessary payment in this regard, a Demand note to the concerned TSP indicating the total amount payable and due date of payment and terms of payment will be issued by Department.
5. The spectrum will be required to be liberalised for the balance validity period of right to use the same after payment of auction determined price prorated for the balance validity period.
6. The entry fee paid will be pro-rated for the balance validity period of the right to use spectrum and will be deducted from the total amount to be paid by the TSP for liberalising the spectrum.
7. In case more than one set of auction determined prices are available, the latest auction determined prices for the respective frequency band as available at the time of calculation of charges/ amount payable for liberalisation of spectrum, would be applied.
8. If the auction determined price is more than one year old then the prevailing market rates would be determined by indexing the last auction price at the rate of SBI PLR.

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9. The *date for calculation* of the total amount due for liberalisation will be the thirtieth day from the date of issue of Demand note and the same will be taken as the *Effective Date* of liberalisation.
10. Payment of One Time Spectrum Charges (OTSC) by the TSPs will continue to be governed by this Ministry's Order P-11014/19/2008-PP (Pt.I) dated 28th December 2012 & dated 15th March 2013. In case the spectrum gets liberalised, the OTSC will be charged up to the *date for calculation* of charges for liberalising the spectrum and the same has to be paid by the licensee. However, if such demand is pending due to judicial intervention barring any coercive action, a bank guarantee equal to this amount shall be submitted pending final outcome of judicial process.
11. Payment will be required to be made within (30) thirty days from the date of issue of Demand note, failing which the Demand note will be deemed to have expired and the TSP will be required to make a fresh request for liberalisation of his administratively held spectrum, if he so desires.
12. A revised frequency allotment will be issued by WPC Wing, DoT after receipt of necessary payment.
13. After getting the spectrum liberalised, the TSPs may combine the same with the spectrum acquired by them in the same band through auctions/ trading.
14. SUC will be required to be paid for the liberalised spectrum as prescribed by the Government from time to time.
15. Notwithstanding above, the liberalized spectrum will be governed by all the relevant conditions laid down in respective NIAs issued from time to time and the relevant service license i.e. CMTS/ UAS/ UL and their amendments.
16. The above guidelines shall not be applicable for liberalisation of a frequency band in a service area where auction determined price is not available for that band.


05.11.2015

(Bhagirath)

Deputy Wireless Advisor
to the Govt. of India

Copy to:

1. All concerned
2. Wireless Finance Division, DoT
3. Director, Wireless Monitoring Organisation.
4. DDG (AS-I), DoT
5. Director, IT, DoT for uploading on DoT website
6. Sr. DWA (ASMS) for uploading on WPC Wing website

Annexure 3.1

Methodologies and Approaches to Spectrum Valuation

Spectrum Band	Valuation Approach/ Methodology	Date and Para Number of Recommendation on Valuation and Reserve Price of Spectrum	Remarks
1800 MHz	Market Data Analysis: Single variable correlation or multiple regression	Annexure 4.1 of September 2013 Recommendations	This approach can also be attempted for 800 MHz, 900 MHz and 2100 MHz spectrum bands.
	Producer Surplus Model	Annexure 4.2 of September 2013 Recommendations	-
	Production Function Approach	Annexure 4.3 of September 2013 Recommendations	This approach can be extended for Category C LSAs also this time, since the subscriber growth in these LSAs have moved beyond cities and roll-out obligations have been achieved to a large extent. Also due to non-availability of auction price in 1800 MHz and 2100 MHz band in March 2015 auction, no ratio (as was calculated in previous exercise) could be computed.
	Revenue Surplus Model	Annexure 3.3 of October 2014 Recommendations	-
	Use of Last auction determined price	Para 3.64 and Annexure 4.4 of September 2013 Recommendations	This approach can also be considered for other spectrum bands where auction determined market prices are available.
800 MHz	Producer Surplus Model	Annexure 3.2 of February 2014 Recommendations and Annexure A of Authority's response of 27 November 2014 to reference received from DoT on February 2014 Recommendations	-
	Technical Efficiency Approach	Para 3.1 to 3.4 of December 2013 Consultation Paper	-
	Potential Growth in Data Services	Annexure 3.3 of February 2014 Recommendations	-

Spectrum Band	Valuation Approach/ Methodology	Date and Para Number of Recommendation on Valuation and Reserve Price of Spectrum	Remarks
		and Annexure A of Authority's response of 27 November 2014 to reference received from DoT on February 2014 Recommendations	
800 MHz	Use of March 2015 Auction Determined Prices of 900 MHz in valuation of 800 MHz band	Para 3.68 of February 2014 Recommendations	This approach can similarly be used in valuation exercise of 900 MHz band.
900 MHz	Technical Efficiency Approach	Para 4.45 to 4.47 of September 2013 Recommendations	-
	Economic Efficiency Approach	Annexure 4.5 of September 2013 Recommendations and Annexure 3.5 of October 2014 Recommendations	-
2100 MHz	Technical Efficiency Approach	Para 3.8 to 3.10 of December 2014 Recommendations and Para 3.6 and 3.7 of December 2014 Consultation Paper	-
	Data Usage Growth Model	Para 3.6 to 3.7 of December 2014 Consultation Paper and Annexure 3.4 of December 2014 Recommendations	-
	Producer Surplus Model	Annexure 3.3 of December 2014 Recommendations	-
	Use of Last auction determined price	Para 3.3 to 3.7 of December 2014 Recommendations	-

Note: The data and information used as inputs in above mentioned valuation approaches/models will be updated with available latest data and information.