Consultation Paper No. 14/2014

Telecom Regulatory Authority of India

Consultation Paper

on

Valuation and Reserve Price of Spectrum: 2100 MHz Band

2nd December, 2014

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Written Comments on the Consultation Paper are invited from the stakeholders by 15th December 2014 and counter-comments by 19th December 2014. 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 Arvind Kumar, Advisor (Networks, Spectrum and Licensing), TRAI on the email ID trai.jams@gmail.com

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Open House Discussion (OHD) on this Consultation Paper will be held on 22nd December 2014 at New Delhi. This may be treated as an advance notice for the OHD.

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CHAPTER–I: INTRODUCTION

The Reference from Department of Telecommunications (DoT)

1.1 The Government proposed to auction spectrum in the 900/1800 MHz band in February 2015 and sought the Authority's recommendations. In its Recommendation of 15th October 2014, the Authority emphasized *inter-alia,* the need for making additional spectrum available in the 900/1800 MHz bands as well as in the 2100 MHz band. The Authority recommended that auctions in the 2100 MHz band should be carried out along with the auction of spectrum in the 900/1800 MHz bands.

1.2 Through its letter dated 16th October 2014 **(Annexure 1.1)**, the DoT communicated that the Government was planning auction of right to use spectrum in the 2100 MHz, 2300 MHz and 2500 MHz bands, preferably along with the auction of spectrum in the 800 MHz, 900 MHz and 1800 MHz bands. The DoT sought TRAI's recommendations in terms of clause 11(1)(a) of TRAI Act 1997 as amended on :

a. The applicable reserve price for 2100 MHz, 2300 MHz and 2500 MHz bands for all the Licence Service Areas (LSA), both where spectrum was available in the entire LSA as well as where spectrum was only partially available in an LSA; and
b. The auction of the right to use a spectrum in a band with varying validity period (less than 20 years) so that expiry of the validity period of the right to use spectrum in a band in an LSA occurs at same time.

1.3 Through its letter of 27.11.2014 (**Annexure-1.2**), the DoT communicated that the Government is taking action to release some spectrum presently with Defence for commercial use. The DoT requested TRAI to expedite the process for its recommendations on the reserve price of 2100 MHz band and related issues so that the auction of spectrum being released by Defence could be conducted along with

the auction of spectrum in the 800/900/1800 MHz bands scheduled in February 2015.

1.4 At the outset, it is pertinent to recall the history of the allocation of spectrum in the 2100 MHz band, also referred to as 3G spectrum in India.

Auction of 3G Spectrum in 2010

1.5 On 22nd May 2006, the DoT sought TRAI's recommendations on the methodology for allotment of spectrum in the 2100 MHz band (3G) and its pricing. TRAI submitted its recommendations on 'Allocation and pricing of spectrum for 3G and broadband wireless access services' on 27th September 2006. In the recommendations, the Authority, *inter-alia*, recommended that allocation of 3G spectrum should be carried out in blocks of 2x5 MHz through a simultaneous ascending e-auction process. Specific roll-out obligations for 3G and BWA services were also recommended by the Authority.

1.6 The Authority recommended the following reserve prices for one block of 2 x 5 MHz for 20 years in the 2100 MHz band:

Table 1.1

Categories of LSAs	Reserve price in Rs. Crore for 2 x 5 MHz in 2100 MHz
Delhi, Mumbai, and Category 'A'	80
Chennai, Kolkata and Category 'B'	40
Category 'C'	15

1.7 On 1st July 2008, the Government referred back to TRAI some of the recommendations on auction of spectrum in the 2100 MHz band including the reserve price, the auction process, and the amount of spectrum to be allocated. In its reference the DoT proposed that, based on the experience of successful 3G auctions in some countries, the reserve price for a block of 2x5 MHz in the 2100 MHz band should be

0.5% of GDP[1]. In the case of India, it would come out to be US$ 0.5 billion or about Rs 2100 crore which was twice the reserve price recommended by TRAI. Accordingly, the DoT proposed the reserve price given in Table 1.2 below. On 12th July 2008, the Authority accepted the proposals of DoT with some minor modifications.

Table 1.2

Categories of LSAs	Reserve price in Rs. Crore for 2 x 5 MHz in 2100 MHz
Delhi, Mumbai, and Category 'A'	160
Chennai, Kolkata and Category 'B'	80
Category 'C'	30

1.8 The Government further revised the reserve prices for 2100 MHz (3G) spectrum upwards from what it had proposed in its communication of 1st July 2008 (as was agreed to by TRAI) and fixed the following reserve prices for 3G spectrum in the NIA (Notice Inviting Application) which was issued on 25th February 2010.

Table 1.3

Categories of LSAs	Reserve price in Rs. Crore for 2 x 5 MHz in 2100 MHz
Delhi, Mumbai, and Category 'A'	320
Kolkata and Category 'B'	120
Category 'C'	30

1.9 The 2100 MHz auction was held in April-May 2010. The Government put to auction three blocks (each block of 5 MHz paired) 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. BSNL and MTNL were not required to participate in the auction, but were required to match the winning price achieved in the respective LSAs as payment for spectrum allotted to them.

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

1.10 A simultaneous ascending e-auction was held over the internet. The auction prices realized were many times more than the reserve price. The details of the prices discovered through the auction are given in Table 1.4 below.

Table 1.4

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

Type	LSA	Reserve Price for 3G spectrum for 2x5MHz (Rs Cr)	3G Price discovered in auction (2x5MHz) (Rs Cr)	No of times the Auction determined price was more than Reserve Price for 3G
Metro	Delhi (DEL)	320	3,316.93	10.37
Metro	Mumbai (MUM)	320	3,247.07	10.15
Metro	Kolkata (KOL)	120	544.26	4.54
A	Maharashtra (MH)	320	1,257.82	3.93
A	Gujarat (GUJ)	320	1,076.06	3.36
A	Andhra Pradesh (AP)	320	1,373.14	4.29
A	Karnataka (KTK)	320	1,579.91	4.94
A	Tamil Nadu (TN)	320	1,464.94	4.58
B	Kerala (KL)	120	312.48	2.60
B	Punjab (PB)	120	322.01	2.68
B	Haryana (HR)	120	222.58	1.85
B	UP (East)	120	364.57	3.04
B	UP (West)	120	514.04	4.28
B	Rajasthan (RAJ)	120	321.03	2.68
B	Madhya Pradesh (MP)	120	258.36	2.15
B	West Bengal (WB)	120	123.63	1.03
C	Himachal Pradesh (HP)	30	37.23	1.24
C	Bihar (BH)	30	203.46	6.78
C	Orissa (OR)	30	96.98	3.23
C	Assam (AS)	30	41.48	1.38
C	North East (NE)	30	42.3	1.41
C	Jammu & Kashmir (J & K)	30	30.3	1.01
Total		**3500**	**16,750.58**	**4.79**

1.11 This Consultation Paper (CP) is confined to the 2100 MHz band for the reasons given in Para 1.3. Other matters referred by the DoT in its letter dated 16th October 2014 will be taken up separately.

1.12 The paper comprises four chapters. This chapter provides a brief introduction and a summary of the previous spectrum auction in the 2100 MHz band held in 2010. The second chapter discusses likely availability of spectrum in the 2100 MHz band. The third chapter discusses possible methodologies for valuing and determining reserve prices and related issues. The fourth chapter summarizes the issues for consultation.

CHAPTER–II: AVAILABILITY AND UTILIZATION OF SPECTRUM

Availability of Spectrum in the 2100 MHz band

2.1 The 2100 MHz band is one of the most internationally harmonized spectrum bands. Globally, this band is primarily being used for 3G services (HSPA/HSPA+).

2.2 At present, in India, out of 2x60 MHz available in the 2100 MHz band, 4 blocks of 2x5 MHz (total 2x20 MHz) have been assigned in all the LSAs while a fifth block has been assigned in five LSAs (Punjab, Bihar, West Bengal, Jammu & Kashmir and Himachal Pradesh). In its recommendations of 15th October, the Authority recommended that the entire 2x60 MHz in the 2100 MHz band should be made available for commercial use. If required, Defence may be assigned spectrum in the 1900 MHz band (1910-1920/1980-1990 MHz).

2.3 In its reference of 16th October 2014, the DoT did not indicate the quantum of spectrum available in the 2100 MHz band. On a specific query from TRAI, the DoT responded in its letter of 14th November 2014, intimating that deliberations with Defence for vacation of spectrum in the 2100 MHz band were already in process. The DoT further stated that there are three possible scenarios:

a. Spectrum may not be released by Defence, which implies that no spectrum may be available in the 2100 MHz band for auction. In case no spectrum is released by Defence in 2100 MHz in the timeline for the forthcoming auction, the same will not be included in the NIA.

b. Defence has released 20 MHz (4 blocks of 5 MHz each) out of 25 MHz (5 blocks of 5 MHz each) in 2100 MHz band allocated to DoT under the MoU with Defence (in 1920-1980 MHz) on a pan-India basis and one more block of 5 MHz in 5 LSAs (This is what was auctioned in 2010). Discussions with Defence are under

way to release one block of 5 MHz in the remaining 17 LSAs. It is possible that 5 MHz spectrum may be released by Defence in 17 LSAs; and, in such a scenario, only one block of 5 MHz spectrum will be available in 17 LSAs in 2100 MHz.

c. Deliberations for swapping 2100 MHz band spectrum (allocated to Defence as per MoU) with an equal amount of spectrum in the 1900 MHz band are also in process[2]. Thus, in addition to the release of 5 MHz spectrum in 17 LSAs, Defence may release 15 MHz (3 blocks) on pan-India basis by swapping 2100 MHz spectrum for 1900 MHz spectrum.

2.4 In 2010, the Government put to auction three blocks (each block of 5 MHz paired) in the 17 LSAs and four blocks in the remaining 5 LSAs. All blocks were sold. None of the bidders could obtain the spectrum on a pan-India basis. The list of successful bidders is given in Table 2.1 below. Apart from the operators mentioned in the Table, one block (2x5MHz) was also won by STEL in three LSAs, viz. Bihar, Orissa and Himachal Pradesh. However, STEL did not commence 3G services as the UAS license issued to STEL was subsequently cancelled.

Table 2.1

Service Area wise list of operators having spectrum in 2100 MHz band

S.No.	Type	LSA	MTNL	BSNL	Vodafone	Bharti	RTL	Aircel	Tata	Idea
1	Metro	DEL	Yes		Yes	Yes	Yes			
2	Metro	MUM	Yes		Yes	Yes	Yes			
3	Metro	KOL		Yes	Yes		Yes	Yes		
4	A	MH		Yes	Yes				Yes	Yes
5	A	GUJ		Yes	Yes				Yes	Yes
6	A	AP		Yes		Yes		Yes		Yes

[2] The DoT and Defence have agreed to share 300 MHz bandwidth in the 1700-2000 MHz band with each retaining 150 MHz. The DoT's share consists of 2x55 MHz (i.e. 110 MHz) in 1800 MHz band (1710-1765 MHz/1805-1860 MHz). It also includes 15 MHz (1900-1907.5 MHz/1980-1987.5 MHz) of spectrum in the 1900 MHz band. The remaining 25 MHz spectrum of the total 150 MHz earmarked for commercial use is used as uplink frequencies in the 3G spectrum band (1920-1980 MHz / 2110-2170 MHz). The issue that is being discussed here is swapping of 2x7.5 MHz spectrum in the 1900 MHz band (earmarked to DoT) with 15 MHz of spectrum in the 1920-1980 MHz band (earmarked to Defence) which, along with corresponding downlink frequencies in 2110-2170 MHz band, will make additional 3x5 MHz of 2100 MHz band available for commercial use.

7	A	KTK		Yes		Yes		Yes	Yes	
8	A	TN		Yes	Yes	Yes		Yes		
9	B	KL		Yes				Yes	Yes	Yes
10	B	PB		Yes			Yes	Yes	Yes	Yes
11	B	HR		Yes	Yes				Yes	Yes
12	B	UP (W)		Yes		Yes			Yes	Yes
13	B	UP (E)		Yes	Yes			Yes		Yes
14	B	RAJ		Yes		Yes	Yes		Yes	
15	B	MP		Yes			Yes		Yes	Yes
16	B	WB		Yes	Yes	Yes	Yes	Yes		
17	C	HP		Yes		Yes	Yes			Yes
18	C	BH		Yes		Yes	Yes	Yes		
19	C	OR		Yes			Yes	Yes		
20	C	AS		Yes		Yes	Yes	Yes		
21	C	NE		Yes		Yes	Yes	Yes		
22	C	J&K		Yes		Yes	Yes	Yes		Yes
		Total	**2**	**20**	**9**	**13**	**13**	**13**	**9**	**11**

2.5 Some of the important provisions made in the NIA dated 25th February 2010 for the auction of spectrum in the 2100 MHz band are discussed in the succeeding paras.

Roll-out obligations

2.6 To ensure the efficient use of spectrum and provide a reasonable level of service to a wide cross-section of customers, roll-out obligations were mandated for the licensee to whom spectrum was assigned in the 2010 auction. In the Metro category LSA, the licensee was required to provide street-level coverage in at least 90% of the LSA within five years of the effective date[3]. In Category A, B and C LSAs, 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

[3] 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.

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

2.7 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.

2.8 TRAI has recently asked the TSPs, who acquired 3G and/or BWA spectrum, to furnish the progress made so far to meet roll-out obligations. While submitting their reports about the status of the roll-out, the TSPs raised some critical issues regarding compliance with roll-out obligations. The TSPs with 2100 MHz spectrum, submitted that the DoT had released a provisional TSTP (Test Schedule – Test Procedure) in 2012 for testing roll-out obligations. As there were several practical difficulties in the provisional test schedule, it is under review of the DoT and a final test schedule is yet to be released. The TSPs further submitted that in the absence of test schedules, it may not be possible for them to offer 3G roll-out services for testing.

2.9 The TSPs have also submitted that the DoT has not finalised the list of Rural SDCAs for Rajasthan and North-East LSAs. For the remaining LSAs, the list of Rural SDCAs was published by the DoT three years after the assignment of spectrum. However, the list has several errors and this too is under review by the DoT.

Q1. In the auction for 2100 MHz spectrum held in 2010, certain roll-out obligations were mandated for the successful bidders. Stakeholders are requested to suggest if any changes are required or whether the same roll-out obligations should be mandated in the forthcoming auction, along with justification.

Spectrum Cap

2.10 In the 2010 auction for spectrum in the 2100 MHz band, no single bidder was allowed to bid for more than one block (2x5 MHz) of spectrum in an LSA. In recent auctions held for spectrum in the 800/900/1800 MHz bands, the spectrum cap for an operator in each of the LSAs in a band was prescribed as 50% of the total spectrum assigned in a band subject to a maximum of 25% of the total assigned spectrum across all bands[4] for telecom services. Spectrum put to auction was also counted for calculating the spectrum cap.

2.11 At present, no TSP has a pan-India presence with 2100 MHz spectrum. In case only one block of 5 MHz is available for auction, one option could be that only those TSPs be allowed to participate in the auction that do not have 2100 MHz spectrum in the LSA. This may lead to an increase in the number of TSPs providing services using spectrum in the 2100 MHz band.

2.12 In the above context, stakeholders are requested to comment on the following:

Q2. Whether a bidder should be allowed to bid for more than one block of spectrum, in case a sufficient quantum of spectrum (more than one block in LSA) is put to auction?

Q3. Whether the spectrum caps (of 50% of total spectrum in a band/25% of total spectrum assigned across bands) prescribed in recently held auctions in the 800/900/1800 MHz bands should also be prescribed for the upcoming auctions in the 2100 MHz band?

Q4. In case only one block of 5 MHz of spectrum in 2100 MHz is available in an LSA, should only those TSPs be allowed to participate who do not have 2100 MHz spectrum in that LSA at present?

[4] 800MHz, 900 MHz, 1800MHz, 2100 MHz, 2300MHz and 2500 MHz spectrum bands.

CHAPTER-III: VALUATION AND RESERVE PRICE

3.1 The exercise to value and set reserve price (RP) for 2100 MHz spectrum – often referred to as the 3G band – is dependent on the availability of cost, revenue and other information pertaining to this band. As pointed out on earlier occasions, the demand for spectrum as a natural resource is a derived demand, viz., it derives from the demand for the services that require spectrum as an input. As explained in greater detail in paragraphs 3.1 to 3.8 of the Authority's Consultation Paper "Valuation and Reserve Price of Spectrum" of 23rd July 2013, the interplay of demand and supply results in the revelation of the market price for the spectrum through the mechanism of an auction. Theoretically, this enables the most efficient allocation of spectrum as a natural resource.

3.2 Unlike the other spectrum bands (800 MHz/900 MHz/1800 MHz), extensive information – both financial and non-financial – is not available in the case of the 2100 MHz band. In this CP, the Authority has endeavoured to outline the valuation methodologies in the backdrop of limited information availability, while keeping in view the previous auction experience and technical and economic factors.

Use of 2010 auction determined prices

3.3 The last available market determined price for the 2100 MHz band is from the auction that took place in 2010. One approach to the valuation of 2100 MHz band for the forthcoming auction could be to utilise the price information revealed 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 for the 'Auction of 3G and BWA Spectrum' included 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".

3.4 At the same time, the fact that the 2010 auction was conducted in a supply-constrained scenario cannot be lost sight of. The demand for spectrum in the 2100 MHz band was conditioned by the excessive competition engendered by entry of new licencees in 2008. Further, as discussed in Chapter I, the reserve prices for the 2010 auction were set in a 'top-down' manner; some rough and ready measures such as initially linking the reserve prices to the GDP formed the basis for the reserve-price-setting exercise. Later valuation exercises conducted by the Authority took the 'bottom-up' approach whereby the valuation was done on the basis of LSA-specific factors. The changes in the techno-economic circumstances since the time of the 2010 auction also need to be considered while approaching the valuation exercise based on the prices revealed in that auction. These changes include both substantial aspects - such as the likely demand for 3G services in the background of the evolution of the ecosystem for 4G/ LTE technology, the likely availability of spectrum in other bands such as 700 and 2500 MHz, etc., - as well as issues of perception regarding the value of 2100 MHz spectrum for rolling out next generation services demanded by consumers. The background in which auctions subsequent to 2010 – some perceived as 'failures' and others as having succeeded in meeting the respective auction objectives (as in February 2014) – cannot be ignored in this context.

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

Q5. Should the indexed value of May 2010 auction determined prices of 2100 MHz spectrum be used as one possible valuation for 2100 MHz spectrum in the forthcoming auction? If not, why not? And, if yes, what rate should be adopted for the indexation?

Technical Efficiency

3.6 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. One way of valuing spectrum could be to establish relative values using proportional factors based on relative technical efficiency, as has been done before in valuing 800/ 900/ 1800 MHz spectrum.

3.7 The Authority had acknowledged[5] in its Recommendations of 23rd April 2012 on 'Auction of Spectrum' that the number of base stations required for the coverage of the same area in UMTS 2100 is 1.2 times compared to UMTS 1800, based on the report prepared by consultant Vilicom Limited for ComReg, the Ireland regulator. In other words, 2100 MHz spectrum is technically 0.83 times as efficient as 1800 MHz spectrum. Based on these, the Authority had taken the view that 1800 MHz spectrum is 1.2 times more technically efficient than 2100 MHz spectrum, and could be valued accordingly. This factor was also used by the Authority in one of the models for valuation of 1800 MHz spectrum in its October 2014 Recommendations. In this context, stakeholders are requested to respond to the following question:

Q6. Should the value of the 2100 MHz spectrum be derived on the basis of the value of the 1800 MHz spectrum using the technical efficiency factor (0.83) as discussed above?

[5] See paragraphs 3.78 to 3.80 of Recommendations of 23rd April 2012 on 'Auction of Spectrum'.

Estimation of the Value of Spectrum by Assessing Producer Surplus on Account of Additional Spectrum in 2100 MHz Band

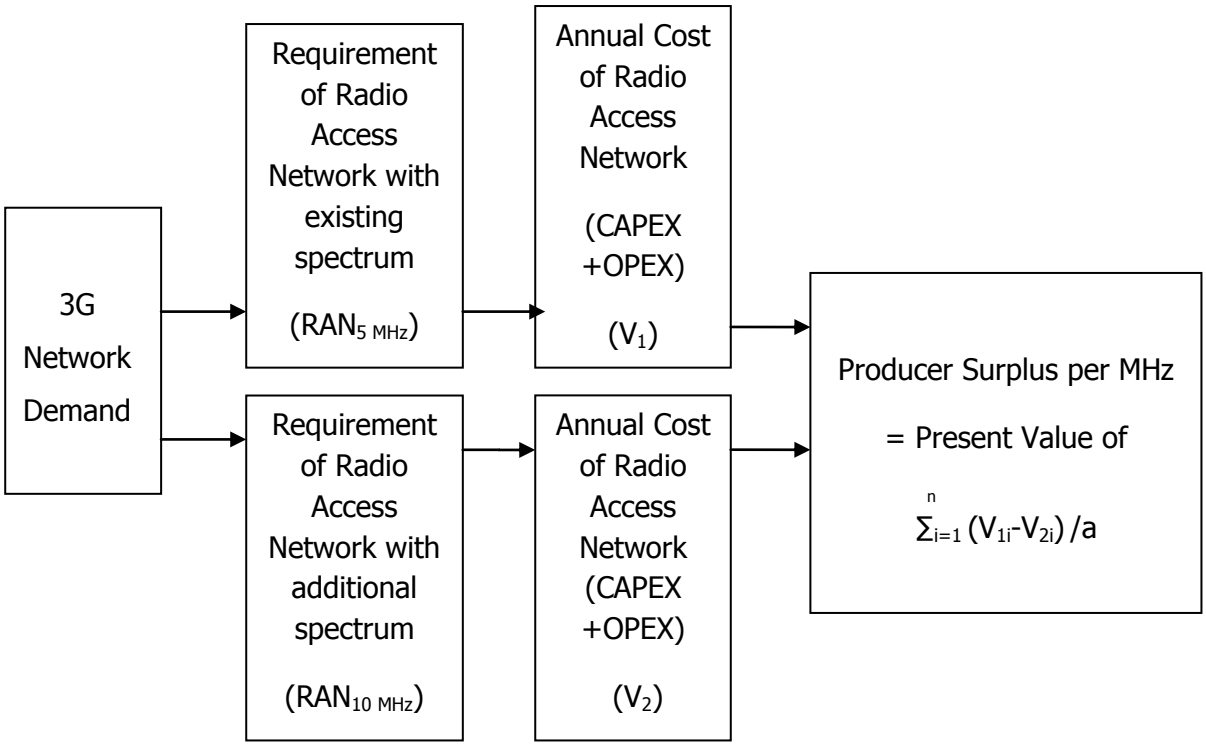
3.8 Another approach to valuation of 2100 MHz spectrum is by estimating the producer surplus that could accrue to the potential buyer. The opportunity of cost savings in the Radio Access Network (RAN) on getting an additional 5MHz spectrum in the 2100 MHz band by an average TSP having 5MHz spectrum in the 2100 MHz band in an LSA can be estimated using the Producer Surplus model. Since there is an inverse relationship between the quantum of spectrum allocated and the expenditure on the RAN required for serving a particular level of demand, the allocation of an additional 5 MHz spectrum in 2100 MHz to a TSP already having 5 MHz would create a producer surplus. The model is based on the valuation that one existing average TSP is likely to place on additional spectrum in the 2100 MHz band. The key elements of this approach are discussed below.

3.9 Consider a TSP having 5 MHz of spectrum in the 2100 MHz band in an LSA. The TSP has drawn its long-term demand model, and thereby, it has made projections of its RAN requirements in each year with 5 MHz of spectrum available to it. To fulfill its RAN requirements, it has to make capital expenditure (CAPEX) on the RAN apart from incurring operating expenditure (OPEX) to run the RAN every year. Accordingly, the TSP has estimated the total expenditure on the RAN to be incurred in each year during the next 20 years which shall be required to fulfill the projected demand. In case the TSP obtains an additional 5 MHz of spectrum in the 2100 MHz band today, the CAPEX and OPEX on the network in each succeeding year (required to fulfill the same demand) would be lower owing to the inverse relationship between spectrum deployed and the expenditure on the network. A working hypothesis is that the value that the TSP places on the additional spectrum is approximately equal to the cost savings upon it acquisition.

3.10 In the model, the present values (PV) of the expenditures (CAPEX + OPEX) to be incurred during the next 20 years for the two cases described above - with 5 MHz of spectrum and 10 MHz of spectrum – may be estimated for an average TSP having an average 3G Internet subscriber base, average 3G data (Internet) usage per subscriber per month, spectrum holding of 5MHz in the 2100 MHz band and average capital costs and operating costs in each service area on the basis of data provided by the TSPs and the industry benchmarks. The difference of the present value in the two cases is termed Producer Surplus. A block schematic diagram of the model is given below:

Figure: 3.1

Block Schematic Diagram of the Producer Surplus Model



3.11 Since 3G spectrum in the 2100 MHz band is being put to use primarily for data (Internet) usage, this model takes into account (i) the number of 3G data (Internet) subscribers and (ii) 3G data usage per subscriber per month to compute 3G network demand.

3.12 The value of producer surplus would vary for every TSP depending on its projected demand (i.e. subscriber and data usage) and cost of operation of RAN (OPEX and CAPEX). Therefore, the average of the values of producer surplus for various TSPs would best capture the expected value of producer surplus i.e.

E (Producer Surplus) = Average of producer surplus of various TSPs

3.13 To arrive at the expected value of producer surplus for a hypothetical average TSP, the following assumptions and industry benchmarks could be used:

(i) Number of 3G data (Internet) subscribers of hypothetical average TSP's in an LSA

= Total 3G data (Internet) subscribers in an LSA as on 31.03.2014 * HHI of the segment[6]/10,000

(ii) 3G Data (Internet) usage per subscriber per month in the LSA for the hypothetical average TSP

= (Total 3G data usage in the month in an LSA) *divided by* (Total no. of 3G data subscribers in the month in the LSA)

(iii) Since the present subscriber base of 3G data users is small and is likely to grow at a much faster pace in the future, the annual growth of 3G data subscribers would be significantly more than the annual growth of overall subscriber base taken in the recent spectrum valuation exercises. **Annexure 3.1** indicates the growth rates assumed for this purpose.

(iv) The rate of growth of 3G data (Internet) usage per subscriber per month may be considered to be the same as the rate of growth of data usage per subscriber per month in the recent spectrum valuation exercises.

(v) Average 3G data capacity of a Node B with 5 MHz spectrum in the busy hour could be assumed to be 1.6 GB.

[6] **Herfindahl–Hirschman Index (HHI**) is a measure of the size of firms in relation to the industry and an indicator of the amount of competition among them. HHI/100 would represent the percent market share of the hypothetical average TSP.

(vi) Owing to advancements in the radio technology, the data capacity of radio equipment could be assumed to increase with passage of time.

(vii) Busy hour load as a percent of total usage of 3G data in a day may be assumed to be 7%.

(viii) In F.Y. 2014-15, the average 3G data throughput in busy hour of a Node B (on LSA level) may be assumed to be 50% of 3G data capacity of a Node B in the busy hour. Further, the average 3G throughput of a node B as a proportion of the 3G data capacity of a Node B in the busy hour could be assumed to be growing with the passage of time.

(ix) The capital cost of a Node B and its associated equipment in the network may be assumed to be Rs. 10 Lakh.

(x) The annual operating cost of a Node B and its associated equipment in the network in an LSA can be computed on the basis of the proportion of annual operating cost of RAN to the Gross Block (GB) of RAN in the LSA as reported by the TSPs in the accounting separation Report (ASR).

Annual operating cost of a Node B and its associated equipment in an LSA = Rs. 10 Lakh * (Total annual operating costs of RAN of TSPs)/ (Total Gross Block of RAN of TSPs)

(xi) The capital cost and annual operating cost per Node B could be assumed to remain the same over time.

3.14 On the basis of the above assumptions and industry benchmarks, the producer surplus on account of an additional 5 MHz of spectrum in the 2100 MHz band could be estimated as below:

Producer surplus on account of additional spectrum of 5 MHz

= (Present value of the expenditure on RAN during the next 'y' years with only 5 MHz of spectrum in 2100 MHz band) *minus* (Present value of the expenditure on the RAN during the next 'y' years with additional 5 MHz of spectrum in 2100 MHz band)

3.15 Stakeholders are requested to respond to the following question:

Q7. Should the value of spectrum in the 2100 MHz band be estimated on the basis of the producer surplus model outlined above? Please provide your views on the assumptions made. Please support your response with justification, calculations and relevant data along with the results.

Model Based On Growth in Data Usage

3.16 The 2100 MHz spectrum band is being used for deployment of 3G network operating across various LSAs. TSPs are providing 3G services mainly for the wireless mobile Internet, suggesting that the 3G service is mainly used for provision of data services. For GSM subscribers, the 3G data usage is growing at a much higher pace than 2G data usage. Information available with the Authority indicates that the quarterly growth for 3G data usage ranges between 15% and 27% in 2013-14 as against of 6% and 13% in the case of 2G data usage.

3.17 It is also well recognized that the future growth of telecommunications will centre more on data than voice. In fact, the demand for data is likely to be the driver in the next phase of growth in telecommunications. The approach based on growth in data usage attempts to model the potential value of the 2100 MHz spectrum keeping in view current trends in 3G data usage as well as in 3G subscribers (using Internet). Apart from delivering data services, 2100 MHz spectrum is also used for providing voice services in the Indian telecom market. It appears reasonable to assume that the 3G network would cater to about 10% to 15% of the total voice traffic.

3.18 In this background, it was noted that an approach based on projected data revenue could be attempted for arriving at one possible valuation of the 2100 MHz spectrum. Such an approach would estimate the value of spectrum from the perspective of an access service provider (providing 2G services but having no 2100 MHz spectrum) willing to

invest the net revenue potential from 3G subscribers over the licence time horizon of 20 years for acquiring 2100 MHz spectrum. The NPV of the projected revenue surplus over 20 years (net of related expenses/costs) would potentially represent the maximum amount which a buyer would be willing to pay for acquiring the spectrum. It is obvious that the business model adopted by different service providers would influence the respective valuations if firm-level calculations are adopted. Hence, aggregate data of the 3G data segment has been used in the valuation exercise using this approach.

3.19 The figures given by TSPs for F.Y. 2013-14 are used as the base figures in this exercise. Based on the data/information available, the following assumptions could be made:

(i) A bottom-up approach should be adopted for each LSA.

(ii) The model assumes that TSPs who have spectrum in other bands but not in 2100 MHz spectrum, will procure 2100 MHz spectrum on the basis of its revenue potential from data services.

(iii) The hypothetical TSP (having 2G spectrum in an LSA but not holding 2100 MHz spectrum in that LSA) -named TSP 'X' is the potential bidder. It could be assumed that TSP-'X' would bid for a block of 5 MHz in 2100 MHz spectrum. It is presumed that the hypothetical TSP will roll-out for 2100 MHz and will be in position to offer services after one year of acquiring spectrum i.e. 2016-17.

(iv) In F.Y. 2016-17, it could be assumed that TSP-'X' will acquire 10% share of 3G subscribers (using internet services). This share will increase over a period of time to 20%.

(v) Data usage charge per MB could be assumed the same for 3G band and 2G bands (in the absence of segregated revenue

information). The Data ARPU for subsequent years could be projected on the basis of the year-wise data download growth rates as adopted by the Authority in its Recommendations of October 2014 on valuation of 900 MHz spectrum and 1800 MHz spectrum.

(vi) The share of revenue from voice services in 2100 MHz spectrum could be assumed at 10% in view of the fact that the 2100 MHz spectrum is projected and used as an efficient band for providing data services and, therefore, it is unlikely that share of voice service on this band will grow significantly.

(vii) It could be assumed that data tariffs will decline by 5% every year up to the F.Y. 2018-19 and stabilize thereafter as in the Recommendations of February 2014/ November 2014 on 800 MHz spectrum.

(viii) Projected growth rate of 3G subscribers (using data/ internet) is given in **Annexure 3.1**.

(ix) The projected revenue from 2100 MHz spectrum could be calculated as the product of projected Data ARPU and projected average number of 3G subscribers (using internet services) plus the projected revenue from voice services.

(x) Additional costs (e.g., network operating and maintenance cost including rental costs for infrastructure services etc.) will be incurred for deploying 2100 MHz spectrum.

(xi) Investment (Capex) required per 3G subscriber (denoted as 'I_s') excluding spectrum auction fee and one time licence fee, could be estimated as Rs 1200 per subscriber[7].

(xii) Capital investment for the first year (2016-17) would be equal to the 3G subscribers multiplied by the investment required per subscriber. For subsequent years, additional capital investment

[7] It may be noted that the per line investment (Capex) was taken as Rs 1500 per subscriber in the revenue surplus model adopted by the Authority in valuation of 1800 MHz band in its October 2014 Recommendations (see Annexure 3.3 of the October 2014 Recommendations). In the present case, the figure could be lower (i.e., taken as Rs 1200 per subscriber) since the investment requirement is for an incremental 3G subscriber.

is calculated on the basis of the number of incremental subscribers. Capital investment per year can be projected for a period of 20 years in the following manner:

Capital investment (year 2016-17) = $N_{S\,(2016\text{-}17)} \times I_S$

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

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

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

(xiv) Return on capital investment (net) is allowed @ 15%.

(xv) Revenue surplus (i.e. revenue net of costs and return on capital investment) is calculated for 20 years. The NPV of revenue surplus is computed using a discounting factor of 12.5%.

(xvi) To calculate the value per MHz of the 2100 MHz spectrum for each LSA, the NPV of net revenue potential of that LSA is divided by the 5MHz (assumed MHz that TSP 'X' would bid for).

3.20 Stakeholders are requested to respond to the following question:

Q8. Should the value of spectrum in the 2100 MHz band be estimated on the basis of the growth in data usage outlined above? Please provide your views on the assumptions made. Please support your response with justification, calculations and relevant data along with the results.

Valuation of Spectrum: Single Approach *versus* Multiple Approaches

3.21 To assess the value of spectrum, various approaches have been posed for consultation in the foregoing section. It is not be possible to say deterministically that any single valuation approach is absolutely correct. Any of these valuations could actually materialize in the market place. Rather than rely on one method, prudence suggests it would be better to use a number of methods to arrive at a reasonable final valuation and then to base a reserve price on such valuation.

Given this background, in its September 2013 Recommendations (as well as in subsequent valuation exercises), the Authority took the view that rather than following a deterministic approach, it was best to work with a probabilistic average valuation that captures the range of possible valuations attempted. On the assumption of equal probability of occurrence, an expected average valuation for 900/ 1800 MHz spectrum was worked out as the simple mean of the different valuations attempted.

3.22 Stakeholders are requested to respond to the following question:

Q9. Would it be appropriate to value the 2100 MHz spectrum as the simple mean of the values arrived from different valuation approaches as discussed above? If no, please suggest with justification which single approach should be adopted to value the 2100 MHz spectrum?

RESERVE PRICE ESTIMATION

3.23 A reserve price refers to the minimum amount that the owner of an item will accept as the winning bid amount. RP prevents the auction from being won at a price lower than the minimum price the owner is ready to accept. RP is clearly related to the valuation of spectrum. It is important to note here that it is not the eventual realized price in the auction; it is the starting point for an ascending price auction. An RP set lower than the expected value of the object will enable price discovery and the final bid price is likely to be much higher than the RP. The concepts of auction efficiency, revenue maximization, and RP, along with international practices were discussed in detail in the Authority's Consultation Paper dated 23rd July 2013 on "Valuation and Reserve Price of Spectrum".

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

spectrum band. The same principle was adhered to in the Recommendations of February 2014 and November 2014 for 800 MHz spectrum and the Recommendations of October 2014 for 900/ 1800 MHz spectrum.

3.25 Stakeholders are requested to respond to the following question:

Q10. What should be the ratio adopted between the reserve price for the auction and the valuation of the spectrum of 2100 MHz band?

CHAPTER-IV: ISSUES FOR CONSULTATION

Q1. In the auction for 2100 MHz spectrum held in 2010, certain roll-out obligations were mandated for the successful bidders. Stakeholders are requested to suggest if any changes are required or whether the same roll-out obligations should be mandated in the forthcoming auction, along with justification.

Q2. Whether a bidder should be allowed to bid for more than one block of spectrum, in case a sufficient quantum of spectrum (more than one block in LSA) is put to auction?

Q3. Whether the spectrum caps (of 50% of total spectrum in a band/25% of total spectrum assigned across bands) prescribed in recently held auctions in the 800/900/1800 MHz bands should also be prescribed for the upcoming auctions in the 2100 MHz band?

Q4. In case only one block of 5 MHz of spectrum in 2100 MHz is available in an LSA, should only those TSPs be allowed to participate who do not have 2100 MHz spectrum in that LSA at present?

Q5. Should the indexed value of May 2010 auction determined prices of 2100 MHz spectrum be used as one possible valuation for 2100 MHz spectrum in the forthcoming auction? If not, why not? And, if yes, what rate should be adopted for the indexation?

Q6. Should the value of the 2100 MHz spectrum be derived on the basis of the value of the 1800 MHz spectrum using the technical efficiency factor (0.83) as discussed in Chapter III?

Q7. Should the value of spectrum in the 2100 MHz band be estimated on the basis of the producer surplus model outlined in Chapter III? Please provide your views on the assumptions made. Please support your response with justification, calculations and relevant data along with the results.

Q8. Should the value of spectrum in the 2100 MHz band be estimated on the basis of the growth in data usage outlined in Chapter III? Please provide your views on the assumptions made. Please support your response with justification, calculations and relevant data along with the results.

Q9. Would it be appropriate to value the 2100 MHz spectrum as the simple mean of the values arrived from different valuation approaches as discussed in Chapter III? If no, please suggest with justification which single approach should be adopted to value the 2100 MHz spectrum?

Q10. What should be the ratio adopted between the reserve price for the auction and the valuation of the spectrum of 2100 MHz band?

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-14006/01/2014-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 availablity of Spectrum in 2300 MHzand 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 1.2

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: 27.11.2014

To,

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

Subject: TRAI's recommendations on the Reserve Price for Auction of Right to Use of spectrum in 2100 MHz band.

I am directed to say that the Department had requested TRAI's recommendations on the reserve price of spectrum in the 2100 MHz band vide its letter No. L-14006/01/2014-NTG dated 16.10.2014. Government is taking action to release some spectrum presently with Defence for commercial use.

2. It is requested that TRAI may kindly consider an expedited process for its recommendations on the reserve price of 2100 MHz band and related issues so that auction of the spectrum being released by Defence may be conducted along with auction of spectrum in 1800 MHz, 900 MHz and 800 MHz bands scheduled in February 2015.

(R. B. Prasad)
Joint Wireless Adviser

Annexure 3.1

PROJECTED 3G DATA SUBSCRIBERS GROWTH RATES

Year	Growth rates
2014-15	16%
2015-16	16%
2016-17	14%
2017-18	14%
2018-19	12%
2019-20	10%
2020-21	8%
2021-22	8%
2022-23	4%
2023-24	4%
2024-25	3%
2025-26	3%
2026-27	2%
2027-28	2%
2028-29	1%
2029-30	1%
2030-31	0.5%
2031-32	0.5%
2032-33	0.5%
2033-34	0.5%
2034-35	0.5%