

Bharti Airtel Limited

India & South Asia
Airtel Center, Plot No. 16,
Udyog Vihar, Phase-IV,
Gurugram - 122015

www.airtel.in
Call + 91 124 4222222
Fax + 91 124 4248063



Ref: No. RP/FY21-22/062/1000

Dated: 10.01.2022

To,

Shri Syed Tausif Abbas, Advisor (NSL)
Telecom Regulatory Authority of India,
Mahanagar Door Sanchar Bhawan,
JawaharLal Nehru Marg,
New Delhi – 110 002.

Subject: Response to Consultation Paper on Auction of Spectrum in frequency bands identified for IMT/5G

Dear Sir,

This is in reference to TRAI's Consultation Paper on Auction of Spectrum in frequency bands identified for IMT/5G dated 30.11.2021 (CP No. 8/2021).

In this regard, please find enclosed our response for your kind consideration.

Thanking You,

Yours' Sincerely,
For Bharti Airtel Limited

A handwritten signature in black ink, appearing to read 'Rahul Vatts', is placed over a light blue rectangular background.

Rahul Vatts
Chief Regulatory Officer

Encl: a.a

Response to TRAI CP on “Auction of Spectrum in frequency bands identified for IMT/5G”

Executive Summary

5G is a transformational technology and will be the backbone of a digitally connected India. It will play a vital role in the nation’s journey towards becoming a \$5 trillion economy and bringing high speed broadband access to every citizen through applications such as Fixed Wireless Access.

Moreover, Telecommunications is an essential service and as stated in the National Digital Telecommunications Policy 2018, it is important that the services be affordable while ensuring the sector remains sustainable. Therefore, we believe that the affordability of 5G services and the viability of the telecommunications industry, would enable massive investments for 5G, and these should underpin the Hon’ble Authority’s overall recommendations on the pricing / auction of spectrum in the frequency bands identified for IMT/ 5G.

Building on these important tenets, this TRAI consultation paper discusses how to deploy what is in fact the critical lifeblood of mobile networks, i.e. spectrum, for the purposes of allocation for 5G services. Additionally, while the TRAI has raised some very pertinent questions and we answer them exhaustively, **it is our view and submission that the Authority also needs to consider certain critical aspects when framing its recommendations. We list them over the remaining course of this document.**

A. Spectrum policy must take into account the ‘Public Good’

Mobile networks resiliently absorbed the shock from the Covid-19 pandemic and against the most insurmountable odds, kept a nation of one billion, connected. Offices were able to operate remotely, schools and colleges conducted classes online, customers purchased goods and services online and were even able to consult a doctor from the safety of their homes.

This underscores the importance of spectrum as a national resource for the ‘**Public Good**’, a fact that has also been endorsed by the Hon’ble Telecom Minister¹. Additionally, the National Digital Communications Policy (NDCP) -2018 also alludes to spectrum as a key natural resource for public benefit².

The cost of spectrum impacts the total cost of telecommunications services and the sustainability of the telecommunications industry itself. To ensure that every Indian gets access to 5G, it is essential therefore that the **spectrum allocation and pricing has as its bedrock the element of ‘Public Good’**.

B. Unsold and unutilised spectrum is a waste of precious national resource and represents the loss of a vital socio economic opportunity

During the past few auctions, substantial portions of the spectrum on offer went unsold due to high reserve prices. As the Table 1 below reflects, in the 2016 and 2021 auctions, ~60% of the spectrum remained unsold and in particular, the 700 MHz spectrum got zero bids. The primary reason for this was the steep reserve price for the various spectrum bands.

Table 1

¹ <https://www.zeebiz.com/india/news-public-good-element-in-spectrum-pricing-now-widely-recognised-telecom-minister-ashwini-vaishnaw-173290>

² Strategy 1.2 of the NDCP 2018, Page-7

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Statement of Spectrum put for auction, sold and unsold (Year-wise and Band-wise)																	
	700 MHz		800 MHz		900 MHz		1800 MHz		2100 MHz		2300 MHz		2500 MHz		Total- Year-wise		
Auction	Spectrum		Spectrum		Spectrum		Spectrum		spectrum		spectrum		Spectrum		Spectrum- Analysis		
	Put for auction	Sold	Put for auction	Sold	Put for auction	Sold	Put for auction	Sold	Put for auction	Sold	Put for auction	Sold	Put for auction	Sold	Put for auction	Sold	% of Unsold
2010	0	0	0	0	0	0	0	0	465	465	1320	1320	0	0	1785	1785	0%
2012	0	0	95	0	0	0	295	127.5	0	0	0	0	0	0	390	127.5	67%
2013	0	0	95	30	42.5	0	57.5	0	0	0	0	0	0	0	195	30	85%
2014	0	0	0	0	46	46	385.2	307.2	0	0	0	0	0	0	431.2	353.2	18%
2015	0	0	108.75	86.25	177.8	168.2	99.2	93.8	85	70	0	0	0	0	470.75	418.25	11%
2016	770	0	73.75	15	9.4	0	221.6	174.8	360	85	320	320	600	370	2354.75	964.8	59%
2021	660	0	230	150	98.8	38.4	355	152.2	175	15	560	500	230	0	2308.8	855.6	63%
Total- Bandwise	1430	0	602.5	281.25	374.5	252.6	1413.5	855.5	1085	635	2200	2140	830	370	7935.5	4534.35	43%
Unsold Spectrum Bandwise (%)	100%		53%		33%		39%		41%		3%		55%		43%		

Source: DoT, TRAI and Bharti-Airtel's Regulatory Economic Analysis

Further, if we were to look at the global picture, we would find that with the right pricing regulators can get a significant majority of the spectrum put to auction and sold successfully. This is represented by the Table 2.

Table 2

Sl. No	Country	Spectrum Bands	Auction/Award date	Quantum of Spectrum Offered	% of Spectrum sold
1	UK	700 MHz	2021-April	80 MHz	100%
		3600MHz	2021-April	120 MHz	100%
		3400 MHz	2018-April	150MHz	100%
		2300 MHz	2018-April	40 MHz	100%
2	Finland	25.1-27.5 GHz	2020-June	2400 MHz	100%
3	USA	600MHz	2017-April	70 MHz	100%
		28GHz	2019-Jan	1650 MHz	100%
		24GHz	2019-May	700MHz	100%
		37 GHz,39GHz &47 GHz	2020-Mar	3400 MHz	99.90%
4	Spain	3600-3800 MHz	2018- July	200 MHz	100%
5	Sweden	700 MHz	2018-Dec	40 MHz	100%
		3600 MHz	2020-May	80 MHz	Local License
6	Austria	3410-3800 MHz	2019- Mar	390 MHz	100%
7	Australia	3575-3700 MHz	2018- Dec	125 MHz	100%

Source: NRAs & TSPs websites and Bharti-Airtel's Regulatory Economic Analysis

Moreover, it is well known that the Indian Telecom Service Providers have much lower spectrum allocations while serving one of the highest customer bases per MHz than their global peers. This puts immense pressure on the network infrastructure, while a large chunk of this precious national resource sits idle doing no good.

That is not all. All unsold and unutilized spectrum represents a massive socio-economic opportunity lost for India. This precious national resource could have been deployed for further augmenting network capacities when data usage is surging. It could also help bridge the digital divide by taking services deeper into rural pockets.

We therefore request that the Hon’ble Authority take **note of the fact that the reserve prices from the last few auctions** yielded a very low uptake of spectrum on offer. We also draw attention to the fact that the pricing set in the past is not sustainable.

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C. The economic model for the spectrum auction should be built on the ‘Multiplier Effect’ of 5G networks and not revenue maximisation

Ubiquitous 5G networks that are accessible to customers, enterprises and governments alike can unlock a huge growth multiplier effect for the connected Indian economy and bring new opportunities for the youth. In our view, the Authority must align its objectives in the following manner:

- **Reduce spectrum as an input cost for TSPs and instead allow them to deploy resources on wider roll-outs to bring 5G to all and support India’s \$5 trillion economic goal.**
- **Allocate interference free and clean spectrum that enables TSPs to offer a high quality of services to support the future of India’s industry automation (Industry 4.0), its start-up ecosystem, Fintech evolution, and Digital India.**
- **Build a 5G ecosystem to ensure that the return on present investments is sustainable and can help fund future technologies, including 6G.**

D. Industry health must be taken into account if we are to ensure that sustainable network investments are able to unlock the potential of the spectrum deployed.

Creating wireless network infrastructure is capital-intensive and has a long gestation period. It also requires operators to continually (annually) invest in expanding coverage, increasing capacity for traffic, keeping up with technological development and innovation so as to avoid obsolescence and remain competitive and relevant in the market.

5G networks require up to 3 to 5 times more sites and fiberisation and this means continued capex. This requires the industry’s financial health to be sound. However, the current industry KPIs paint a challenging picture. While investments have increased, the profitability (EBT %) for TSPs till 2020-21 has been negative as depicted in Table 3.

Table 3

As % of Revenue - FY 2020-21		
	KPIs (%)	Industry
1	Opex	56%
2	EBITDA Margin	44%
3	Depreciation and Amortization Exp.	32%
4	EBIT Margin	12%
5	Finance Costs (Net)	19%
6	EBT/PBT Margin	-6%

Source: TSPs quarterly Reports and Bharti Airtel Regulatory Economic Analysis

It is also a fact that annualized spend on spectrum as a percentage of access service revenue (GR) has constantly moved-up. We highlight this anomalous situation in Table 4 below:

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Table 4

Statement of Spectrum sold and its annualised spectrum amortisation per year as a % of annual revenue (Historical Basis)								
Year of Spectrum Auction	Gross Revenue of the year for Access Services	Auction Value generated (in cr.)	Quantity of Spectrum sold (in MHz)	Period of spectrum	Annual spectrum cost	Cummulative spend per year on Spectrum repayment	%age of GR for AS	%age of GR for Wireless
2010(2010-11)	131,682	76,664	1,785.00	20	3,833	3,833	2.91%	
2012(2012-13)	160,176	9,642	127.50	20	482	4,315	2.69%	
2013 (2012-13)	160,176	4,114	30.00	20	206	4,521	2.82%	
2014(2013-14)	174,811	61,162	353.20	20	3,058	7,579	4.34%	
2015 (2014-15)	193,902	113,932	418.25	20	5,697	13,276	6.85%	
2016(2016-17)	205,502	64,809	964.80	20	3,240	16,516	8.04%	
2021(2020-21)	204,742	77,815	855.60	20	3,891	20,407	9.97%	11%
		408,138	4,534.35		20,407			

Source: DoT,TRAI and Bharti-Airtel's Regulatory Economic Analysis

This is an unsustainable situation for the industry and is reflected in the high proportion of unsold spectrum put to auction from time to time. This clearly indicates that the reserve prices set by TRAI are not actually reserve prices at all but an attempt to set the market value of spectrum. Moreover, the auctions conducted in 2010, 2014 and 2015 were outliers, held as they were in the backdrop of license expiry and business continuity fears (2014-2015), limited spectrum supply and an unclear roadmap of availability, and should be deemed as such.

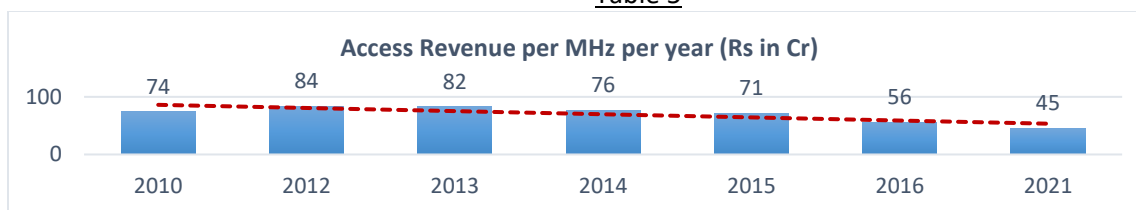
In the current scenario, the Authority must account for the financial health of the Indian telecom operators. This means that the operators must be supported in their ability to sustainably invest in networks, services and spectrum while generating reasonable returns on those investments.

E. 5G is an altogether different ballgame now - Techno-commercial spectrum valuation approaches of the past need a refresh.

We believe that the current techno-commercial approach to spectrum valuation is irrelevant for 5G. To cover a similar geography (vs 4G) using higher 5G frequency bands requires networks to be denser and this means significantly higher investment. Such investments would be used not only for access / radio but also for the entire network from RAN, Core transmission (Fiber, wireless backhauls) and build an ecosystem of devices that are secure and trusted, among other things.

The falling revenue realization per MHz over the last decade (see Table 5) need to be addressed since this constant reduction in revenue-generating ability of spectrum seems to suggest that the expectation of bidders about the incremental value of spectrum will be lower in 2022 than it was previously.

Table 5



Source: TRAI and Bharti-Airtel's Regulatory Economic Analysis

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In addition to above, there are a few other critical factors (covered in detail in our response) that could significantly influence the valuation of spectrum in India and should therefore be taken into account. These include the following:

- Rationalising spectrum prices is key to India’s digital leadership and its sustainability
- Spectrum pricing must align with national telecommunications policy objective of investments in 5G network and ecosystem, ensuring sustainable and affordable access to digital communication
- Digital economy dynamics have altered market reality and its underlying key assumptions: Traffic on networks continue to surge exponentially, putting constant pressure on the spectrum deployed. The revenue realization ability of traffic has been decoupled from the service. In 5G, this situation is expected to exacerbate due to virtualization, digitalization and IP-fication of services across sectors.
- Technical efficiency using propagation is not relevant in 5G due to the network densification needs of higher bands.
- The TRAI’s past valuation methods (and assumptions therein) need relook given the altered market realities including health of industry and revenue generation ability. Its previous approaches like the Indexation of past prices, avoided Cost method are not relevant due to the changed dynamics of the 5G era. It is no longer enough to augment additional capacity for the same traffic and avoid cost.
- The international experiences suggest that incremental revenue from 5G has been negligible, and unable to recover its incremental cost
- The TRAI’s spectrum pricing exercise must emerge from industry’s incremental / aggregate RoCE and incremental / marginal revenue generation ability in the spectrum band(s) being valued.

Since the additional MHz of spectrum deployed in the network is likely to yield little or no additional revenue, the reserve prices set or market prices achieved in past auctions should no longer form the basis for setting the levels of reserve prices for the new auctions. The pricing cum valuation exercise must leave reasonable investible surplus in the hands of the producer, i.e., the MNOs.

The underlying principle for the valuation approach should ensure that the right balance among the three key stakeholders i.e. (i) The Consumer, (ii) the Government and (iii) the Producer; so as to ensure that each of the three are able to generate an economic surplus.

In view of the above, we recommend that the Authority’s valuation exercise should take an altogether fresh approach; one that takes into account the marginal/incremental revenue generation from 5G services.

The Marginal / Incremental revenue approach:

The marginal /incremental revenue approach for setting the reserve price of various spectrum bands is a pragmatic one – an ‘a priori’ method that considers the amount of investments required to create a working 5G network. Under this, marginal revenue is expected to be generated from 5G services, and how it ultimately brings the desired level of profitability, in the form of incremental ROCE and aggregate ROCE.

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Our analysis of this approach suggests that to meaningfully cover India (assuming 75%-80% coverage to start with), the required 5G investments excluding the spectrum cost will be around INR 50,000 Crore. To break-even for this investment level, a TSP would need to attain at-least 20% increase in revenue.

Preliminary study of few global operators’ incremental revenue post-5G launch suggests that assuming even 10% revenue increase is itself a stretched assumption.

Keeping the above in view, we recommend that TRAI’s spectrum prices should at best be nominal and thus not be more 10% of the prices recommended earlier in 2018.

While the above key parameters should form the core of TRAI’s valuation cum reserve price determination exercise, **there are some other critical recommendations that will have an important bearing on the spectrum valuation and auction, as also on speedy rollout of 5G services.**

F. 5G Spectrum should be interference-free, clean and immediately usable and Backhaul will be critical

In the upcoming auctions, only absolutely clean, ready to use immediately and interference free spectrum should be put to auction.

This has not always been the case and is borne out by the experience of Airtel in circles like Punjab and Gujarat where it was unable to deploy this critical resource acquiring spectrum worth thousands of crores during past auctions, Airtel has been unable to deploy this critical resource on its networks.

Backhaul is critical for 5G:

To handle surging network traffic at access level, there needs to be much higher aggregate capacity available at backhaul. Unfortunately, in India, that has remained elusive for quite some years now. In the imminent 5G future when billions of devices are likely to be connected, and IoT applications, high throughput and low latency will be needed at end to end, limited backhaul availability will severely constrain the vision and objectives of Digital India.

The TRAI in the past has recommended that MNOs should be allocated Microwave carriers available with the DoT but this has not yet been implemented. We urge the Authority to reiterate the recommendation to the Government forthwith.

However, this allocation, while useful, will hardly be able to serve the current traffic on the networks by itself. **To satisfy the requirements of 5G, the high capacity backhaul in E-band remains fundamental.** While the TRAI had also recommended allocating E-Band to licensed operators, the decision is still pending with the Government.

In view of the importance of high capacity backhaul for 5G, we urge the Authority to recommend allocating the E-band spectrum bundled with the 5G spectrum.

If these decisions are taken, the bidding operators will also consider them in their bidding strategy.

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G. Ease & simplify the Spectrum auction payment terms

- No upfront payment for spectrum acquired through auctions.
- No interest should be charged on spectrum installment payment.
- Provide moratorium for total of 6 years
- Recover spectrum price in balance 24 years post 6-year moratorium period

H. Spectrum Cap

- **Band-wise:**
 - a. Reduce the spectrum cap from 50% to 35% in the sub-GHz band.
 - b. 35% cap may also be imposed for 3.3GHz and mmWave separately
- **Overall Cap:**
 - c. Overall cap of 35% should be continued with. For computation of overall cap of 35%, 3300-3670 MHz and 24.25-28.5 GHz bands should also be included.

I. Private Captive Network & spectrum leasing

Licensed Mobile operators are best suited to deliver the necessary support to industrial use cases and support private cellular networks in India. Also allow Licensed Mobile operators to offer spectrum on lease.

We now provide our section-wise, question wise response to the TRAI Consultation Paper.

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Issues for consultation

Chapter II - Auction Related Issues [Q 1 to 33]: Responses

Q.1 Whether spectrum bands in the frequency range 526-617 MHz, should be put to auction in the forthcoming auction? Kindly justify your response.

Q.2 If your answer to Q1 above is in affirmative, which band plans and duplexing configuration should be adopted in India? Kindly justify your response.

Q.3 In case your answer to Q1 is in negative, what should be the timelines for adoption of these bands for IMT? Suggestions to make these bands ready for adoption for IMT may also be made along with proper justification.

Airtel Response:

Auction of 526-617 MHz:

We submit that **the spectrum band 526-617 MHz should not be auctioned in the forthcoming auctions as presently there is no supporting ecosystem for this band.** It is pertinent to mention here that it takes significant time in the development of an ecosystem from the time a band is identified at ITU. Therefore, this band should be auctioned in India only once ITU and 3GPP define band plan for these bands and the ecosystem for these bands is developed.

Moreover, the Cabinet, in its recent decision, has already announced that spectrum auctions will be conducted annually. Therefore, we do not see any reason to auction any spectrum for which there is no ecosystem readiness.

526-617 MHz to be reserved for IMT:

As mentioned in the Consultation Paper, ITU has identified spectrum in 470-698 MHz as an IMT band in Region 2 & Region 3 and frequency arrangement for the 526-582 MHz and 582-617 MHz bands have not been defined by ITU. Agenda item 1.5 of WRC-23 is dealing with this band for Region 1 and the outcomes will be available after WRC-23. **Since, the band for IMT in Region 3 has already been identified, including India, it should be reserved for IMT usage only.**

Moreover, this spectrum is ideal for the indigenous development of rural broadband technology and India could lead market development by getting it harmonised in ITU & 3GPP as part of 5G evolution or 6G technology.

Q.4 Do you agree that 600 MHz spectrum band should be put to auction in the forthcoming auction? If yes, which band plan and duplexing configuration should be adopted in India? Kindly justify your response.

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Airtel Response:

We suggest that an incentive-based approach be adopted for the 600 MHz band to increase the penetration of mobile services beyond the requirements prescribed in the licenses.

Incentive based approach for 600 MHz - The 600MHz spectrum could be given free of cost to operators with stringent rollout obligations to cover economically unviable and uncovered areas. This would give an immense boost to rural broadband coverage and enhance Government reach for path-breaking societal interventions in the rural hinterland.

Band Configuration - We recommend using globally defined spectrum band configuration (n71) for 600 MHz spectrum in the current auctions.

3GPP & ITU have standardised 600MHz spectrum from 617MHz to 698MHz as NR band. This is commonly termed the n71 band with an uplink from 663MHz to 698MHz and a downlink from 617MHz to 652MHz (with duplexing separation of 46MHz between Uplink and Downlink). This spectrum band configuration has been **allocated in Canada and deployed on a mass commercial scale across the country in USA. There are about 200 smartphones / devices which support the n71 band configuration** (Source: GSA report).

APT is considering two options for expanding the spectrum by 2x5MHz through spectrum band configuration. One of the options will increase duplexing separation to 51MHz and the other option will reduce the Rx & Tx gap from 11MHz to 6MHz. Key aspects to note for the same are as follows:

Benefits of new definition

- New definition would increase spectrum availability from 2x35MHz to 2x40MHz

Challenges of new definition

- Would impact design of the radio unit at base station & user equipment
- Would need development of new radio modules
- Would not be able to benefit from economies of scale of existing smartphones supporting the n71 band
- Smartphones supporting n71 band would not be able to work on this configuration (viz. for global roaming)
- Similarly, smartphones supporting the new band configuration would not be able to work with networks deployed with the n71 band
- Band configuration would need to be changed going forward (if initial deployments are made in n71 and then changed to a new band configuration to expand 5MHz spectrum) and this would need a change of the radio units deployed at the site

The Authority also needs to take note that there should be no geographical isolation or additional filtering required from mobile base stations operating in the 617-698 MHz band so that they are able to co-exist with the terrestrial TV transmitters deployed in the 526-582 MHz band.

After taking into account all these aspects, we would **recommend a globally defined spectrum band configuration (n71) in the current auctions. This would allow operators to leverage the existing ecosystem, to reap benefits from economies of scale and ensure interoperability.** All these factors would also be helpful

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if this band could be allotted to licensees free of cost with stringent roll out obligations to cover economically unviable areas.

As far as the new band plan is concerned, **depending on the take up of spectrum in the auction and the status of adoption of the APT proposal, the new band plan could be considered in future auctions.**

Q.5 For 3300-3670 MHz frequency range, which band plan should be adopted in India? Kindly justify your response.

Airtel Response:

Band Plan for 3300-3670 MHz:

We recommend that n78 (3300-3800MHz) be adopted in India, as it has been defined by 3GPP & ITU for the allocation of the 3.5GHz spectrum and has been adopted by more than 150 networks globally. Additionally, **on taking into consideration the economies of scale in the n78 spectrum band**, we recommend using n78 as the spectrum band to be adopted in India.

In addition, we wish to highlight the criticality of Allocation of Interference Free Spectrum:

The availability of contiguous and interference free spectrum is critical if spectrum is to be used efficiently. Therefore, we request the Government to ensure that the **allocated spectrum is completely free of external interference and is contiguous for immediate network deployment and the rollout of service for public good.** In this regard, **we have provided detailed inputs in our response to Question-16 on the interference issues to be considered for 3300-3670 MHz.**

We would like to highlight the interference and contiguity challenges TSPs have faced in certain spectrum allocations in the past that have hampered the deployment of the allocated spectrum for commercial services. One instance is that of the 900MHz spectrum in Punjab & Gujarat. Certain spots of this frequency band were having fragmented allocation to TSPs thereby stalling their plans for efficient deployment of mobile broadband services in these service areas.

Table 6:

Circle	Spectrum auctioned but not made available contiguous	Contiguity challenge since (From Month and Year)
Gujarat	4.2 MHz - 900 Band	Mar-21
Punjab	2.6 MHz - 900 Band	Nov-2015/Mar-2016

Due to the above more than 30% of the lifespan (and hence its associated market value) of the 900 MHz spectrum has already elapsed in Punjab and that this inefficient usage has caused a considerable loss to TSP and subscribers alike.

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Similarly, interference was faced in past in the 2100MHz spectrum allocated in 2011 in circles like Jammu and Kashmir, Punjab, Himachal Pradesh, Rajasthan. This led to non-utilization of the spectrum for 3G/4G services in these circles for more than six years which in turn meant a considerable loss of investment in spectrum as also of the opportunity to deploy mobile broadband services in these circles. Clearly, despite paying thousands of crores to the Government, TSPs were neither able to deploy this critical resource in networks more efficiently nor for the public good of our customers.

Therefore, we request that in the upcoming auctions only absolutely clean, interference free spectrum is put to auction – spectrum that is immediately allocatable and usable.

Lastly, it is critical to Bundle E-band with 5G mid-band Spectrum:

To satisfactorily meet the requirements of 5G, the high capacity backhaul in *E-band* is fundamental. We request the Authority to recommend allocating the *E-band* spectrum mandatorily bundled with the mid-band 5G spectrum assigned through auction using the following approach:

- **2 channels (of 250MHz each) of E-band for upto 40MHz**
- **3 channels (of 250MHz each) of E-band for 60MHz and**
- **4 channels (of 250MHz each) of E-band for 80MHz**

It is critical that only that spectrum which is interference free and usable from day one is put up for spectrum auction, and E-band is allocated with the mid-band spectrum as indicated above.

Q.6 Do you agree that TDD based configuration should be adopted for 24.25 to 28.5 GHz frequency range? Kindly justify your response

Airtel Response:

We **recommend the TDD based configuration** for the mmWave spectrum as high bands beyond 3GHz have been globally adopted since the TDD spectrum is valid for the C-band spectrum as well as the mmWave spectrum.

Q.7 In case your response to Q6 is in affirmative, considering that there is an overlap of frequencies in the band plans n257 and n258, how should the band plan(s) along with its frequency range be adopted? Kindly justify your response.

Q.8 Whether entire available spectrum referred by DoT in each band should be put to auction in the forthcoming auction? Kindly justify your response.

Airtel Response:

We recommend that spectrum **from 24.25GHz to 27.5GHz should be allocated in India using the n258 band plan for IMT services.** The same is explained below.

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Band Configuration and Global Ecosystem:

N257 & n258 band definitions (as per 3GPP) are as follows:

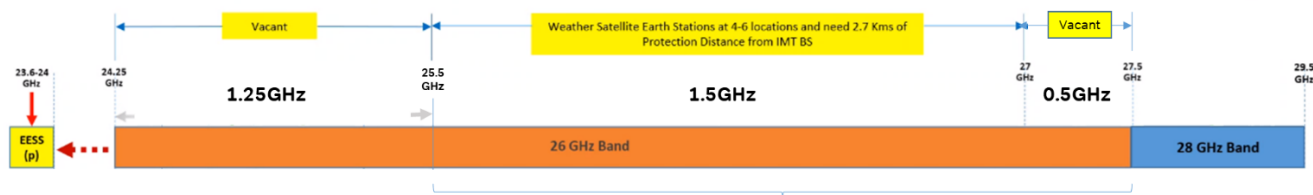
Band Configuration	Spectrum band	Channel bandwidth
N258	24.25GHz – 27.5GHz	50/100/200/400
N257	26.5GHz – 29.5GHz	50/100/200/400

Globally, around 20-25 operators have been assigned in the n257 or n258 bands, with one of the band plans being adopted in each country. There are around 50-60 devices (which are mostly FWA types of devices,) that support these band plans. Countries like Finland, Italy, Singapore, Thailand, Hong Kong, Indonesia, South Korea, Taiwan, US, Chile, Uruguay have been assigned full or partial spectrum in the n258/n257 band.

Due to the low coverage characteristics of this high band, this spectrum is most commonly used for fixed wireless services.

Availability in India:

The below diagram depicts the availability of 24.25GHz to 28.5GHz in India:



As per above:

- **Spectrum from 24.25GHz to 27.5GHz is clearly available for IMT use.** Out of this, 24.25GHz to 25.5 is completely interference free. Spectrum beyond 27.5GHz is being planned or used for satellite services.
- Radio units in this band support either of the band plans and **there are no units which support ultra wide bands from 24.25GHz to 28.5GHz.**
- Moreover, having a single band plan would also ensure that there is no allocation across bands, which would eliminate the challenges occurring in deployment.

Considering the above, spectrum from 24.25GHz to 27.5GHz using the n258 spectrum band should be allocated in India for IMT services. This would provide 3.25GHz of spectrum for TSPs, which is sufficient if we consider 800MHz of spectrum per operator.

Furthermore, the 28GHz band starting from 27.5GHz is being utilised by satellites for broadband and mission critical government services. If this satellite spectrum is further reduced, it would impact the serving capacity and offered quality of services in the uncovered regions which are hard to serve from the terrestrial networks.

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Global momentum exists for expanded satellite use of the 28GHz for satellite broadband services worldwide:

- Most countries are following the WRC-15 decision and oppose any 5G/IMT in the 28 GHz band.
- The ITU 5G report recognises the WRC-15 recommendation and has also excluded 28 GHz from studies on the international harmonisation of mmWave bands for IMT by WRC-19.
- The CEPT 5G Roadmap identifies 28 GHz for satellite broadband/ESIMs and has excluded it for IMT/5G usage.
- ATU, RCC all support adjacent 26 GHz band for IMT/5G. None of them supports IMT/5G usage in the 28 GHz Band.

Considering the above, spectrum from 24.25GHz to 27.5GHz that uses the n258 spectrum band should be allocated in India for IMT services.

Q.9 Since upon closure of commercial CDMA services in the country, 800 MHz band is being used for provision of LTE services,

- a. Whether provision for guard band in 800 MHz band needs to be revisited?**
- b. Whether there is a need to change the block size for 800 MHz band? If yes, what should be the block size for 800 MHz band and the minimum number of blocks for bidding for existing and new entrants?**

(Kindly justify your response)

Airtel Response:

We recommend retaining the same spectrum block size and other conditions as the last auction (i.e., 2021 Auctions) for the 800 MHz band since it is already being used by operators for providing services and was acquired by TSPs in the auctions held as recently as 2021, for a 20-year period.

Operators have acquired spectrum in the 800 MHz band in 2021 and in previous auctions as per the block size and minimum spectrum prescribed in the respective spectrum auctions. Considering that they are likely to have acquired spectrum in this band for their immediate use with possible plans for additional acquisition in the forthcoming auction, **changing plans in the new auction will impact their strategy in terms of acquiring additional spectrum.** This will not be in consonance with the principle of instilling confidence among bidders in order that they make long term investments in spectrum. Therefore, it is recommended the spectrum block size and other conditions be kept the same as that of the last auction.

In case of any change is proposed in channel plan/block size it should be ensured that guard band between 800MHz and 900MHz should be continue to be maintained at 1.6MHz to ensure no adverse impact on the continuity of telecom operations & millions of subscribers being served by 900MHz band.

Q.10 Do you agree that in the upcoming auction, block sizes and minimum quantity for bidding in 700 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands, be kept same as in the last auction? If not, what should be the band-wise block sizes and minimum quantity for bidding? Kindly justify your response

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Airtel Response:

We recommend retaining the same spectrum block size and other conditions as the last auction (i.e., 2021 Auctions) for the 700 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands as all these (except 700 MHz) are already being used by operators for providing services.

Q.11 In case it is decided to put to auction spectrum in 526-698 MHz bands, what should be the optimal block size and minimum quantity for bidding? Kindly justify your response.

Airtel Response:

Please refer to our response to Question 1. We recommend that this spectrum should only be auctioned after its global harmonization, final definition within ITU and development of ecosystem. The block size and minimum spectrum should be considered in future auctions as per global development/adoption in this band.

The Authority also needs to take note that there should be no more geographical isolation or additional filtering required from mobile base stations operating in the 617-698 MHz band for co-existing with the terrestrial TV transmitters deployed in the 526-582 MHz band.

Q.12 What should be optimal block size and minimum quantity for bidding in 3300-3670 MHz band? Kindly justify your response.

Airtel Response:

As per standards, channel size defined for the n78 spectrum band is 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100. For better user experience, it is recommended having a higher quantity of spectrum for 5G as compared to 4G (which is typically 20MHz per band). Hence, globally, operators have been assigned / allocated spectrum that is typically between 40MHz – 100MHz for 5G services in this band.

We therefore recommend having a block size of 10MHz and a minimum quantity of 20MHz per operator in the n78 spectrum band.

Q.13 What should be optimal block size and minimum quantity for bidding in 24.25-28.5 GHz? Kindly justify your response.

Airtel Response:

The spectrum in the mmWave band is primarily used for FWA services, for providing wireless broadband with the fiber type of experience that requires higher bandwidth. The channel size defined in the 24.25GHz to 28.5GHz spectrum band is 50, 100, 200 & 400MHz. Considering its higher bandwidth requirements globally, spectrum in this band should be allocated to operators in the range of 100-800MHz.

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Hence, **we recommend keeping the block size in 24.5-27.5 GHz at 100MHz.**

The minimum bidding quantity should be kept as 400MHz for new entrants (who do not hold any spectrum in any band) operators and 100MHz for operators that already have spectrum in any band >2GHz.

Q.14 Whether any change is required to be made in the existing eligibility conditions for participation in Auction as specified in the NIA for the spectrum Auction held in March 2021, for the forthcoming auction? If yes, suggestions may be made in detail with justification.

Q.15 In your opinion, should the suggested/existing eligibility conditions for participation in Auction, be made applicable for the new spectrum bands proposed to be auctioned? If not, what should be the eligibility conditions for participating in Auction? Kindly justify your response.

Airtel Response:

We submit that **eligibility conditions for participation in the forthcoming auction should be kept the same as specified by the NIA for auctions held in March 2021.**

The inclusion of new bands in auctions cannot be a trigger to change eligibility conditions since these new spectrum bands such as 3.5GHz & 24.25-28.5GHz will also be used for 5G services and need FDD spectrum to deploy NSA architecture. Devices & radio infrastructure in 24.25GHz - 28.5GHz support only the NSA mode and can only work with at least one FDD spectrum band as anchor.

Moreover, eligibility conditions specified in the NIA 2021 are quite flexible as they allow all non-licensees to bid for the spectrum so long as they give an undertaking that they will procure a license.

Q.16 Is there a need to prescribe any measure to mitigate possible interference issues in 3300-3670 MHz and 24.25-28.5 GHz TDD bands or it should be left to the TSPs to manage the interference by mutual coordination and provisioning of guard bands? Kindly provide justification to your response.

Q.17 In case your response to the above question is in affirmative,
a. whether there is a need to prescribe provisions such as clock synchronization and frame structure to mitigate interference issues, as prescribed for existing TDD bands, for entire frequency holding or adjacent frequencies of different TSPs? If yes, what should be the frame structure? Kindly justify your response.
b. Any other measures to mitigate interference related issues may be made along with detailed justification.

Airtel Response:

We reiterate that interference-free, contiguous spectrum is a pre-requisite for the successful deployment of network. In the past, TSPs have faced interference or contiguity-related challenges in the deployment of spectrum for commercial services.

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The 900MHz spectrum allocated in Punjab & Gujarat is a prime example of how usage by other users affected the contiguity of spectrum allotted to TSPs. This not only led to the TSPs in question losing their investment but also the opportunity to provide a better service experience to users. It also resulted in them stalling the plans for the deployment of mobile broadband services in concerned LSAs and in a generally inefficient use of spectrum. More than 30% of the lifespan of the spectrum (and hence its associate market value) has been lost for the TSP in such LSA.

Similarly, the 2100MHz spectrum allocated in 2011 in border circles like Jammu and Kashmir, Punjab, Himachal Pradesh, Rajasthan had interference. This led to the non-utilisation of spectrum for 3G/4G services in these circles for more than six years. Again this led to TSPs losing their investment as well as the opportunity to provide mobile broadband services on this spectrum in these circles.

Overall recommendations for spectrum allocation in 3.5GHz for IMT usage

- **Auction only interference free spectrum from 3.43GHz to 3.67GHz**, thereby providing 240MHz of clear spectrum for three operators (rational provided in section below)
- Illustratively, one can split this clean 240 MHz of spectrum in three chunks of 80MHz each (considering 35% spectrum cap).
- Allocate spectrum won by operators in respective blocks of 80MHz such that any operator, acquiring less than 80 MHz, can enhance its spectrum up to 80MHz without need for other operators to move their operating frequency spots.
- Contiguously allocate spectrum to TSPs, ensure that it is not changed during the lifespan of the network.
- Allocate the same block of 80MHz to operators across all the circles so that there can be no intersystem interference amongst operators.
- Stipulate that 5G radios deployed in this band should co-exist with FSS deployment beyond 3.7GHz and below 3.43GHz with out of band emissions as specified by 3GPP standards.

Overall recommendation for spectrum allocation in 24.25GHz – 28.5GHz for IMT usage

- Auction interference free spectrum from 24.25GHz to 25.5GHz on priority, thereby providing 1.25GHz of clear spectrum for three operators.
- Illustratively, one can split this 1.25GHz of spectrum in three chunks of 400MHz each of contiguous spectrum (considering 35% spectrum cap).
- Allocate spectrum won by operators in respective blocks of 400MHz such that operators acquiring less than 400MHz can enhance their spectrum up to 400MHz without other operators needing to move their operating frequency spots.
- Contiguously allocate spectrum to TSPs, ensure that it is not changed during the lifespan of the network.
- Allocate the same block of 400MHz to all operators across all circles so that there is no inter system interference among operators.
- Stipulate that 5G radios deployed in this band should co-exist with Weather satellite earth stations beyond the 25.5GHz and below the 24.25GHz bands without band emissions as recommended by WRC-19.

Spectrum in 25.5GHz to 27GHz should be kept for future expansion of operator.

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Rationale for above recommendations – concerns about interference in the 3.5GHz & 26GHz bands (mmWave) which need to be taken care of before the spectrum is put to auction and allocated post-auction:

1. In-band interference from external systems

For 3.5GHz spectrum, interference scenarios are described below.

- a) **3.3GHz to 3.4GHz:** We understand that due to usage by the Defence/ Navy, in-band interference would be caused to sites using 3.3GHz to 3.4GHz spectrum across the coastal areas. Considering India’s vast coast line, significant geographical areas could be impacted by this interference. Hence, it should be ensured that **this part of the spectrum is auctioned after it is fully vacated by the Navy / Defence. Alternatively, this part of the IMT spectrum can be allocated to licensed TSPs with restriction for indoor usage like is being done in China and Hong-Kong where-in this band is determined for IMT systems, and in-principle limited for indoor usage for public mobile services.**
- b) **3.4GHz to 3.425GHz:** In-band interference will be caused in 3.4GHz to 3.425GHz due to the use of this band by the NAVIC system. **DOS has indicated that there should be a buffer zone ranging from 350-1400 km for any macro site deployed adjacent to the NAVIC earth station. Even if we consider a 130 km buffer zone, TSPs will not be able to cover:**
- Approx. 70 million of the population
 - More than 600 towns in the buffer zone
 - Around 60,000 villages in the buffer zone
- c) **Coexistence with Aviation System**
- Aviation safety issues are being discussed globally these days. It is critical to identify any interference from a 5G system operating in the 3.5 GHz band (3.3 – 3.67GHz) with radar altimeters deployed in the Indian aviation systems. **No radar system should operate from 3.3GHz to 3.67GHz. If there are any existing operations, these should be moved by at least 100 MHz or more from the operating range of 5G networks.** (Exact frequency separation between 3.5 GHz 5G band and Radar shall be decided depending upon the permitted noise floor in the Aviation radar system and spurious out of band emissions from 5G BTS and 5G mobile phones operating within aircraft and airports).

Sufficient band pass rejection needs to be implemented in the radar receiver systems if they are operating in bands adjacent to 5G networks.

Considering the criticality of interference free spectrum to TSPs, we recommend that only two parts of the spectrum be auctioned. In other words, only spectrum from 3.43 GHz to 3.67GHz that is free of all external interference and will allow unconstrained deployment, should be put up for auction in this band.

d) For 24.25GHz – 27.5GHz spectrum, interference scenarios are described as below:

In-band interference from 25.5GHz to 27GHz from weather satellite earth stations should be considered while allocating this spectrum. As per WRC-19, an isolation zone of 3 Kilometers would be required for co-

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existence of weather earth stations with cellular networks operating in this band. Considering the same, it is recommended to allocate clean spectrum from 24.25GHz to 25.5GHz to operators. This would enable at least 400MHz of interference-free spectrum per operator.

Spectrum from 25.5GHz to 27GHz can be allocated in addition to the non-interfering spectrum (provided that any TSP demands higher than 400MHz) with the condition that there be a 3-kilometre geographical separation from weather earth stations. Any future deployment of these weather earth stations should be well defined in the NIA to keep TSPs informed.

2. Adjacent band interference from external system

a) For 3.5GHz spectrum, interference scenarios are described next.

i) Adjacent system interference from FSS system deployed beyond 3.67GHz

FSS (Satellite) usage in 3.6GHz to 4.2GHz is common in the Asia-pacific and other parts of the world. IMT deployments in 3.5GHz need to co-exist with FSS such that out of band emissions from IMT or the cellular network do not interfere with FSS operations. Similarly, FSS needs to ensure that its deployments do not receive a signal in the spectrum band being used for IMT deployments.

Globally, regulators have ensured that there is a buffer of at least 50-100MHz between the IMT and FSS deployments to ensure minimal impact on performance and user experience in both the networks. Examples of the buffer/guard band used in various countries which deploy IMT in 3.5GHz and FSS in an adjacent band are as below:

Table 7

Country	3.5 GHz allocation		FSS – IMT guard band
	Start Freq.	Stop Freq.	
China	3400	3600	50MHz
Brazil	3300	3700	100MHz
Hongkong	3400	3600	100MHz
Singapore	3450	3650	50MHz
Indonesia	3400	3600	100MHz

In India, FSS deployment beyond 3.67GHz is being used by MSO/cable operators to download content from broadcasters. It is understood that there are two key satellites (as mentioned in the table below) which are operating adjacent to the 3.67GHz spectrum:

Operating Satellites	Spectrum usage		No. of channels
	Start Frequency	Stop Frequency	
Asiasat 7	3640	3700	10
Gsat, Intelsat, Asiasat	3706.5	3718	28
	3719	3737	19
	3738	3750	1

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We understand that channels downloaded by MSO/LCOs from Asiasat-7 are being moved to other satellites or spectrum bands, **thereby making 3670MHz – 3700MHz the buffer/guard band between the IMT and FSS deployments. This transfer should be completed before spectrum in 3.6 to 3.67GHz is allocated to TSPs for IMT deployment to avoid any disruption to these channels or delays in rollout of the IMT network.** This guard band should be maintained in future and no satellite usage should be allowed within a 30MHz guard band at any time in future across the country.

Post this move, the nearest FSS deployment would begin from 3700MHz, thereby providing 30MHz of guard band between IMT and FSS deployments. TSPs should be allowed to deploy BTS sites in the allocated spectrum up to 3.67GHz assuming that the out of band emission from the cell sites (operating till 3.67GHz) would comply with the ACLR (Adjacent Channel Leakage Ratio) and OOBE (out of band emission) specifications defined in 3GPP standards. There should be no other geographical isolation or additional filtering required from mobile base stations for co-existing with FSS deployments.

On the same lines, FSS deployments should be restricted to receive signal only in their designated spectrum band, i.e., from 3.7GHz – 4.2GHz. Existing MSO / LCO operators having wide band receivers (from 3.4GHz to 4.2GHz) should be asked to restrict their reception only from 3.7GHz onwards by putting or replacing the requisite receive filters in their system. Such a change of filter should be carried out by MSO / LCO without it costing the TSPs anything. No new MSO / LCO should be allowed to deploy new stations in the 3670-3700MHz band. Existing MSO / LCO having DTH receivers should be asked to register on the government’s web portal and provide their location(s) of deployment so that TSPs are able to take the precautions necessary when deploying base stations around these locations.

In summary, our recommendations are as follows:

- **TV channels and other services on Asiasat-7 to be moved to other satellites, thereby vacating 3670-3700MHz of spectrum from any satellite use. This should be done immediately and implemented before the auction of spectrum.**
- All existing MSO / Satellite Users in 3.7GHz and above band to deploy receiver filters from 3.7GHz to 4.2GHz to ensure that they are not receiving signals from base stations deployed in the 3.5GHz band.
- All existing MSO / Satellite Users in the 3.7GHz and above band to register on the government’s web portal to identify the location of their deployments. This portal should be made available to TSPs to ensure that they are able to take the necessary precautions in the 3.5GHz band around deployment of the base stations (say within 1-2km).
- No new MSO / Satellite user to be allowed to deploy any service within 3670MHz – 3700MHz and new deployments to be within 3.7GHz – 4.2GHz.
- 5G base stations to be deployed in 3.5GHz band to be compliant to adjacent channel leakage ratio (ACLR) as specified in 3GPP standards. In case of any interference from the base stations reported beyond the 3.7GHz band (within 2Km from the MSO / Satellite earth station), TSP should ensure additional transmission filtering to prevent interference to the MSO / Satellite receivers beyond 3.7GHz.

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ii) Adjacent system interference from NAVIC system deployed in 3.4GHz to 3.425GHz

5G base stations deployed in the spectrum adjacent to the spectrum being used by NAVIC (3.4GHz – 3.425GHz) would lead to out of band emissions in the NAVIC band. The out of band emission from such base stations should comply with specifications defined in the 3GPP standards. Considering these specifications, the base stations using spectrum adjacent to 3.4GHz & 3.425GHz should be able to co-exist with the NAVIC earth stations.

However, any mandated isolation zone defined or required by DoS in the vicinity of locations with NAVIC earth stations should be clearly defined in the NIA. This would ensure that the operators have a clear understanding about the loss of opportunity due to non-deployment of their 5G services in such isolation zones.

In case spectrum from 3.3GHz to 3.4GHz is restricted only to indoor usage, the problem of co-existence with the NAVIC location would be only limited to the adjacent channel of 3.425GHz. This adjacent channel issue can be mitigated by having at least 5MHz of separation from 3.425GHz, i.e., **5G spectrum auction for outdoor deployment should begin from 3.43GHz to 3.67GHz.**

NAVIC earth stations operating in 3.4GHz to 3.425GHz should ensure they use receiver band pass filters which work specifically in this band to avoid reception of signal from IMT sites.

b) For 24.5 – 27.5GHz spectrum, the interference scenarios are described below.

i) Adjacent system interference from Weather satellite earth station system deployed in 25.5GHz to 27GHz band

5G site deployments in 25.5GHz to 27GHz would co-exist with the six weather satellite stations deployed in India. The co-existence study has been concluded recently in WRC-19, and recommendations as per resolution 242 should be followed for deployment of base stations using spectrum from the 25.5GHz to 27GHz band.

WRC Outcome : Resolution 242 (WRC-19)

- Take practical measures to ensure outdoor BS Tx antenna are normally pointing below the horizon
- Mechanical pointing needs to be at or below the horizon
- As far as practicable, sites for IMT BS employing values of e.i.r.p. per beam exceeding 30 dB(W/200 MHz) be selected so that direction of maximum radiation of any antenna will be separated from the geostationary satellite orbit, within the line-of-sight of the IMT base station, by ± 7.5 degrees

If required by DoS, an isolation zone should be defined for the deployment of base stations in the vicinity of the existing weather satellite earth station. **These isolation zones should also be part of the NIA so that operators are able to assess and calculate the lost opportunity due to restricted deployment and accordingly bid for spectrum.**

DoS should also define a roadmap featuring all future weather earth stations being considered in India so that TSPs are able to evaluate the opportunity before participating in spectrum auctions.

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ii) Adjacent system interference from nearby EESS (Satellite) operating in 23.6GHz to 24GHz band

5G deployments in 24.25GHz onwards would be adjacent to the EESS satellite systems operating in the 23.6GHz to 24GHz band. For this, WRC-19 has recommended specifications for base stations and mobile stations as follows;

- **IMT base stations** : - 33 dB(W/200 MHz)
 - - 39 dB(W/200 MHz) wef 1st September 2027
 - Grandfathering to existing base stations
- **IMT mobile stations** : - 29 dB(W/200 MHz)
 - - 35 dB(W/200 MHz) wef 1st September 2027.
 - Grandfathering to existing mobile stations in use

These guidelines should be followed for the deployment of 5G in the 24.25GHz band as well.

3. In-band interference within operators

In-band interference within operators arise due to the TDD nature of usage in the 3.5GHz spectrum. It is critical for all networks to be synchronised in time to avoid any uplink and downlink coordination based interference among the networks of multiple operators. Given past experience of TDD usage in B40 (2.3GHz) & B41 (2.5GHz), the following practice should be adopted to avoid inter system interference in the 3.5GHz & mmWave bands:

- All networks and sites to be synchronised with GPS signal.
- All outdoor site deployments should use the same mode of DL/UL configuration, which should be defined in the NIA.

4. Other aspects to be considered for allocation of spectrum in 3.5Ghz band

Considering the aggressive timeline for the launch of 5G, operators have to use the existing radio units even though they have limited operating bandwidth. Therefore, spectrum allocation **should be future proof for all operators in the clean part of 3.5GHz (i.e., 3.43GHz to 3.67GHz)**. Provision should be made for the acquisition of 80MHz of spectrum by three operators by allocating spectrum in such a way **that there is no change of spectrum spots allocated to TSPs during the lifespan of the network**. Further, allocation of spectrum to TSPs should be uniform across all circles to avoid inter system interference.

Q.18 Whether the roll-out obligations for 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz as stipulated in the NIA for last auctions held in March 2021 are appropriate? If no, what changes should be made in the roll out obligations for these bands?

Airtel Response:

We recommend continuing with the current approach of prescribing no rollout obligations for a licensee if the licensee has already met these obligations once using any technology. We believe that there is no relevance to the concept of rollout obligations for an existing licensee (who has already rolled out its network) as the new spectrum is acquired by it to only augment its network capacity.

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Further, it is in the interests of the licensee, who has paid the market determined price for spectrum, to derive maximum value from it. And from the Government’s perspective, the value of spectrum has already been realised by selling it at a market determined price.

Hence, there should be no rollout obligations for existing operators who have met the mobile broadband rollout obligations in 4G.

However, **any new operator should have rollout obligations as defined in the earlier NIAs**. These should be valid for any new operator who can meet the rollout obligations using the new spectrum bands or through unsold spectrum in other FDD / TDD bands put to auction in the planned auctions.

Q.19 What should be associated roll-out obligations for the allocation of spectrum in 526-698 MHz frequency bands? Should it be focused to enhance rural coverage? Kindly justify your response.

Airtel Response:

As discussed earlier in our response to question no. 4, to increase the penetration beyond requirements in the licenses, TRAI may like to consider an incentive based approach in the 600MHz band. For example, and we recommend this, operators could be given the 600MHz spectrum at a price that recovers the cost of administering the spectrum but with rollout obligations for them to cover in uneconomic and uncovered areas.

Additionally, since operators have only limited finances and will need to balance their spectrum requirements within this limitation, our suggested incentive-based approach could help deploy 600MHz spectrum for the purpose.

Q.20 What should be associated roll-out obligations for the allocation of spectrum in 3300-3670 MHz frequency band? Kindly justify your response.

AND

Q.21 What should be associated roll-out conditions for the allocation of spectrum in 24.25 to 28.5 GHz frequency range? Kindly justify your response.

AND

Q.22 While assessing fulfilment of roll out obligations of a network operator, should the network elements (such BTS, BSC etc.), created by the attached VNO, be included? If yes, kindly suggest the detailed mechanism for the same. Kindly justify your response

Airtel Response:

We reiterate our recommendation to continue with the current approach of prescribing no rollout obligations for a licensee if the licensee has already met these once with any technology. In other words, there should be no rollout obligations for existing operators who have met the rollout obligations.

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Imposing such obligations serves no purpose especially once the licensee has rolled out its network as the new spectrum is acquired by it only to augment its network capacity. The new spectrum such as the 3.5GHz & mmWave band would work with the existing 4G network deployed by existing TSPs in the NSA architecture, for instance.

These spectrum bands will be used for building additional capacity over and above the 4G network coverage deployed by existing TSPs. Hence, existing operators should not have any new rollout obligations as coverage obligations are already covered in liability for existing TSPs.

However, any new operator should have rollout obligations as defined in the earlier NIAs. The new operators can meet the rollout obligations using the new spectrum or through unsold spectrum in other FDD / TDD sold in the planned auctions.

Q.23 Whether there is a need to review the spectrum cap for sub-1 GHz bands? If yes, what should be the spectrum cap for sub-1 GHz bands. Kindly justify your response.

Airtel Response:

Yes. Given the increase in spectrum availability in the sub-GHz band (through additional spectrum in the 600MHz band), we propose maintaining 35% as a maximum cap in the Sub-GHz band.

Earlier the sub-GHz supply used to be limited and TSPs had access to barely 10-15MHz of it. Since a few new bands are also being added in sub-GHz, it is logical to lower the cap to 35% while giving wider choice to TSPs to access this spectrum.

Q.24 Keeping in mind the importance of 3300-3670 MHz and 24.25- 28.5 GHz bands for 5G, whether spectrum cap per operator specific to each of these bands should be prescribed? If yes, what should be the cap? Kindly justify your response.

Airtel Response:

We recommend that the TRAI consider separate spectrum cap of 35% each for the 3300-3670 MHz and 24.25-28.5 GHz bands.

Such a spectrum cap will ensure fair competition and enable both the existing TSPs and any new entrant to have equal chance of obtaining the spectrum in these bands.

Q.25 Whether there should be separate spectrum cap for group of bands comprising of 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz bands together? If yes, kindly suggest the cap along with detailed justification.

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Airtel Response:

No, the current overall cap of 35% should be continued. We recommend that there should not be any separate cap for the group of bands comprising 1800MHz, 2100MHz, 2300MHz and 2500MHz.

Q.26 Whether overall spectrum cap of 35% requires any change to be made? If yes, kindly suggest the changes along with detailed justification.

Airtel Response:

No, the overall spectrum cap of 35% should be continued with.

Over the last decade, the Indian Telecom sector has consolidated to four operators (three private operators per circle). But since newer bands are proposed to be auctioned in the upcoming auctions, the supply of spectrum available in the Industry will increase. To avoid concentration of spectrum with one TSP and ensure that even a new entrant can procure spectrum in the future, it is imperative that there is a cap on how much a particular TSP can procure. **The overall spectrum cap of 35% will ensure that a TSP can procure a reasonable, but not excess, quantity of spectrum.**

As regards sub-GHz, earlier its supply used to be limited and TSPs had access to barely 10-15MHz of sub-GHz. Now, since a few new bands are also being added in sub-GHz, it is logical to lower the cap to 35% while giving wider choice to TSPs to access this spectrum.

Hence, we submit that **the overall spectrum cap of 35% should be maintained** as different bands in 5G have complementary roles (coverage vs capacity), which would lead the operators to invest in different bands to meet their requirements. Thus, it is apt to maintain an overall spectrum cap of 35%.

Further, given the increase in spectrum availability in the sub-GHz band (through additional spectrum in 600MHz band), maintaining 35% as a maximum cap in the Sub-GHz band as well is recommended.

Q.27 For computation of overall spectrum cap of 35%, should the spectrum in 3300-3670 MHz and 24.25-28.5 GHz bands be included? Kindly justify your response.

AND

Q.28 Any other suggestion regarding spectrum cap may also be made with detailed justification

Airtel Response:

Yes, for computation of overall spectrum cap of 35%, the spectrum in 3300-3670 MHz and 24.25-28.5 GHz bands should also be included.

This is in line with the current practice wherein the following principles for the calculation of overall and band wise caps for an LSA are followed:

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- All spectrum assigned to TSPs, including the quantity of spectrum whose rights to use were put to auction but remained unsold, spectrum whose rights to use were assigned but subsequently surrendered by the TSPs or taken back by the licensor and the quantity of spectrum whose rights to use are being put to auction would be counted for the purpose of the spectrum cap.
- The spectrum which may become available to DoT for commercial use after its refarming from other uses (such as Defence) at different points of time would not be counted for determining the spectrum caps until its rights to use are put to auction.

Q.29 What should be the process and associated terms and conditions for permitting surrender of spectrum for future auctions? Kindly justify your response.

Airtel Response:

We recommend that the process of surrendering spectrum be simplified for future auctions. Any TSP who intends to surrender spectrum should be permitted to give a prior notice to DoT along with a processing fee (as explained in our response to subsequent questions).

Subsequently, DoT may process the case of surrendering and issue a confirmatory letter to this effect. While acknowledging the request of surrender of spectrum, DoT may ensure that that TSP has cleared the spectrum deferred payments related to that spectrum only.

Q.30 What provisions may be created in the spectrum surrender framework so that any possible misuse by the licensees, could be avoided? Kindly justify your response.

Airtel Response:

We do not see any reason/concern to create further provisions to safeguard the spectrum surrender framework. After all, spectrum can only be acquired by a licensee at a very high cost and a minimum spectrum tenure of 10 years is still a very long commitment for any TSP. This implies that only serious contenders would take the decision to invest in spectrum and subsequently invest in the network rollout. Hence it is not likely that the spectrum surrender provision will be misused.

Furthermore, given India’s vibrant secondary market (spectrum trading), a TSP would exercise the option of surrender only if it is unable to exit/sell it to other licensees, which means surrender is probably its last option to exit and cut its losses.

Q.31 In case a TSP acquires spectrum through trading, should the period of 10 years to become eligible for surrender of spectrum, be counted from the date of original assignment of spectrum or from the date of acquisition through spectrum trading? Kindly justify your response.

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Airtel Response:

We submit that the surrendering policy for new spectrum should be aligned with the policy announced by the Government as part of its telecom reforms. The eligibility period for surrender of spectrum should be counted from the date of original assignment of spectrum.

Since spectrum trading does not have any effect on the validity of the traded spectrum, it should not have any effect on the eligibility for surrender either.

Put simply, it should be counted from date of assignment of spectrum to the TSP who was first assigned its right to use.

Q.32 Whether provision for surrender of spectrum should also be made available for the existing spectrum holding of the TSPs? If yes, what should be the process and associated terms and conditions? Kindly justify your response.

Airtel Response:

The Cabinet/ Government has already approved spectrum surrender for all spectrum acquired in future.

We recommend that the spectrum surrender policy not be extended to spectrum acquired by TSPs in the past as this would be akin to changing conditions for TSPs post spectrum acquisition. These conditions, if known earlier, would have influenced the strategy employed by the particular TSP. Since it wasn't, it is like changing the rules of a game once the game has already begun. Hence, there should not be any policy to allow surrender of spectrum acquired in past auctions or existing spectrum held by TSPs.

However, in order to ensure better utilization of existing spectrum, TSPs should be allowed to exchange their existing spectrum with unsold spectrum in past auctions or new spectrum in upcoming auctions.

For any number of reasons, some of the existing spectrum holdings of the TSPs remain under-utilised/ stay idle in the spectrum pool of that TSP. However, the same spectrum could be useful to other TSPs based on their business strategy.

For better utilisation of the spectrum and to ensure a minimal amount of spectrum remains idle, TSPs should be allowed to exchange their existing holding of auctioned spectrum in one band with the spectrum available with the Government in another band that fits the business strategy of the TSP.

For example, one TSP may like to switch some part of its 1800MHz spectrum holdings with the 800/900 MHz spectrum band available with the Government based on its business requirements while being revenue neutral. This can be done by paying the difference in amount, which can be calculated based on the last auction-determined price.

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If the auction determined price is more than a year old, then the prevailing market rates should be determined by indexing the last auction price with the interest as mentioned in the recent NIA for spectrum auction. By facilitating this, spectrum resources can be usefully and efficiently employed without any resulting loss to the exchequer. This will ensure that TSPs have the right combination of various spectrum bands to support their business needs.

The above approach will allow the efficient use of spectrum acquired by TSPs in past auctions, without the need of any provision for surrender of spectrum purchased in past auctions.

Q.33 Whether spectrum surrender fee be charged from TSPs? If yes, what amount be levied as surrender fee? Kindly justify your response.

Airtel Response:

The Cabinet introduced the provision for surrender of spectrum to better utilise spectrum and to encourage business. To be in consonance with this principle, we recommend that a liberal policy be formulated with regard to the surrender of spectrum and any ensuing fee.

A licensee would be constrained into surrendering spectrum either because it was not able to use the spectrum or because of financial concerns or because it was unable to trade in India’s vibrant secondary market (spectrum trading). Failure to trade would also mean that a TSP is exercising this option of surrender probably as the last option to cut its losses.

It would be a double whammy for an operator (who is in financial distress and is not being able to utilise spectrum) to also pay a hefty spectrum surrender fee. This fee would probably deter the TSP, especially one with financial constraints, from ever surrendering the spectrum. Therefore, any hefty fee charged for surrender of spectrum would be against the very basic premise of ensuring efficient utilisation of spectrum and encouraging business.

Moreover, as per the Cabinet’s decision, the licensee will be liable to give one year’s advance notice for surrender of spectrum. This will allow DoT to auction the surrendered spectrum almost immediately since spectrum auctions are planned to take place annually and additionally ensure that there is no loss to the exchequer in such a framework.

Hence, we recommend that the spectrum surrender fee be charged only to the extent of recovering administrative costs. For any license, an application processing fee of INR 50,000 is charged by DoT. The same amount could be charged as a spectrum surrender fee.

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Chapter III - Questions [Q 34 to 67] on Valuation and Reserve Price of Spectrum: Responses

At the outset please note our detailed submissions made at the *Executive Summary* of this response, wherein we have inter alia highlighted certain critical aspects that the Authority should consider when framing its recommendations viz.

- Spectrum policy must take into account the ‘Public Good’
- Unsold and unutilised spectrum is a waste of precious national resource and represents the loss of a vital socio economic opportunity
- The economic model for the spectrum auction should be built on the ‘Multiplier Effect’ of 5G networks and not revenue maximisation
- Industry health must be taken into account if we are to ensure that sustainable network investments are able to unlock the potential of the spectrum deployed.
- 5G is an altogether different ballgame - Techno-commercial spectrum valuation approaches of the past need a refresh

In continuation to the above, we provide additional arguments as under:

- 1. Spectrum pricing must align with national telecommunications policy objective of investments in 5G network and ecosystem, ensuring sustainable and affordable access to digital communication**
- 2. Rationalising spectrum prices is key to India’s digital leadership and its sustainability**
- 3. The technical efficiency using propagation is not relevant in 5G, and, network traffic decoupled with revenue**
- 4. The international experiences suggest that incremental revenue from 5G has been negligible, and unable to recover its incremental cost**
- 5. The TRAI’s past valuation methods (and assumptions therein) need relook given the altered market realities including health of industry and revenue generation ability**
- 6. The TRAI’s spectrum pricing exercise must emerge from industry’s incremental / aggregate RoCE and incremental / marginal revenue generation ability in the spectrum band(s) being valued.**

The above is highlighted as under:

1. Key National Policy Objectives – Optimal Spectrum Pricing, Investments and Building a 5G ecosystem:

The Government and the Parliamentary Standing Committee on Information Technology have recognised the importance of affordability and sustainable access to digital communications, including spectrum pricing.

Under the Connect India Mission of NDCP 2018, Strategy 1.2, the Government considers spectrum a key natural resource for public benefit:

“1.2 Recognizing Spectrum as a key natural resource for public benefit to achieve India’s socio-economic goals, ensure transparency in allocation and optimise availability and utilisation by...”

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Further, sub-Strategy 1.2 (b) v talks about

“Optimal Pricing of Spectrum to ensure sustainable and affordable access to Digital Communications”

Taking all this together, it is difficult to dispute that spectrum is the key resource for telecom services and that the availability of adequate spectrum at an affordable price is crucial for public good, superior service and customer experience and that, since it is an intrinsic input for wireless services, will affect the output pricing of services to consumers.

Further, the report of the Hon’ble Standing Committee on Information Technology (2020-21): Seventeenth Lok Sabha is of the view:

*“Considering the stress in the sector and that the 5G ecosystem is yet to be developed, keeping such a huge reserve price for 3.3 GHz to 3.6 GHz will undoubtedly have an adverse impact on the ability of the TSPs to fully rollout 5G in the country. Considering the stress in the sector and that the 5G ecosystem is yet to be developed, **keeping such a huge reserve price for 3.3 GHz to 3.6 GHz will undoubtedly have an adverse impact on the ability of the TSPs to fully rollout 5G in the country..**the Committee are of the **view that long-term consumer benefit should be the guiding principle and not short term revenue maximization.** The Committee recommend that the issue of high spectrum prices is looked into **and DoT/TRAI should come out with a convincing spectrum pricing policy that is sustainable, affordable and acceptable to all, focusing on consumer interest and socio economic goals of our country...**”*

2. Rationalizing spectrum pricing with revenue is key to India’s digital leadership

As India strives to emerge as a global digital leader on the back of its telecom connectivity, the role of pro-investment policies becomes crucial in terms of boosting network and fiber roll-out. Spectrum auctions will play a crucial role in accelerating the 5G roll-out so long as they do not end up drawing away vital financial strength from the Telcos because of an insurmountably high total price tag.

The Hon’ble Authority should ensure that spectrum’s reserve price is assessed in a way that enables TSPs to continue to provide better coverage and more resilient services, as well as build robust infrastructure. Most importantly, TSPs, being providers of essential services as well as enablers of the digital economy, need to be sustainable and profitable. We must therefore remember that affordable spectrum would mean a rapid 5G rollout, whereas the reverse could lead to delays.

3. Technical efficiency using propagation is not relevant to 5G:

5G requires densification of networks because it uses higher frequency bands. The reliance on the propagation characteristic of a radio signal in effect manifests itself in the need to build more cell sites when using these higher range frequencies. These extra cell sites are needed to obtain the same level of coverage that lower frequency operators enjoy but with fewer cell sites.

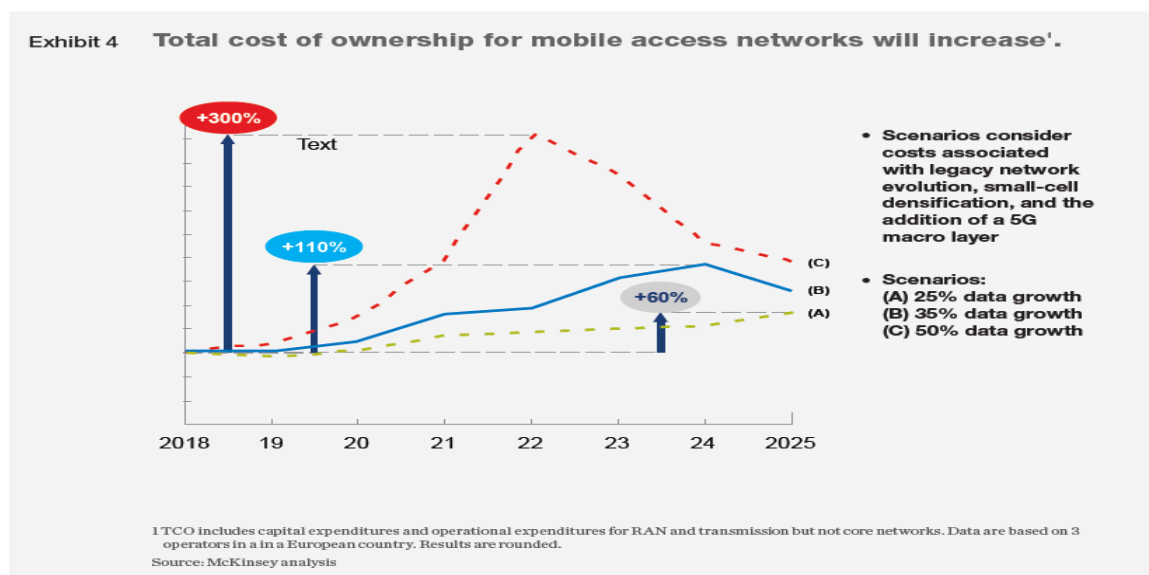
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However, the difference in terms of magnitude in the number of sites required depends on a number of factors including density of demand, existing deployment of network, use cases of a particular technology that can be deployed in a frequency band.

Global firm, McKinsey, commenting on this in a piece of analysis³ in 2018 indicated that:

“...Even if new spectrum is introduced, mobile operators will need to increase their infrastructure investment significantly to overcome certain limitations. For example, high-frequency spectrum provides extra capacity but comes with much greater propagation limitations...”

The analysis also indicated that the total cost of ownership (TCO) for mobile access networks in cases of 5G would increase between 60% to 300% (depending upon data traffic growth assumed to be between 25% and 50%).



Digital Economy dynamics have altered the market reality and underlying key assumptions:

The Authority must also consider the facts of new age digital economy. While traffic on networks has grown and will continue to grow exponentially, putting constant stress on spectrum requirements has caused the revenue realisation ability of traffic to be decoupled from service.

Today, in digital economies, it is end user applications and use cases that drive user demand not a network provider or MNO.

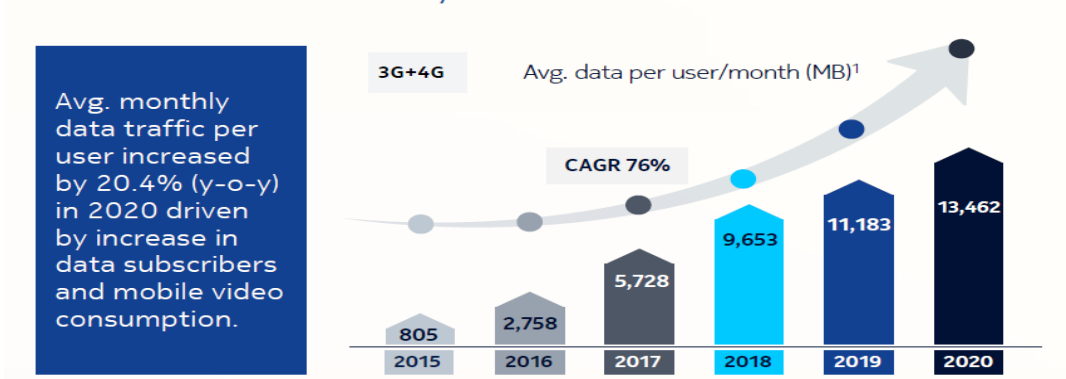
Various statistics indicate that an Indian user today spends on average 5 hours on his/her mobile. However, the realisation from such traffic to MNOs is not disruption proof. As per Nokia’s mBit report in 2021:

³ The road to 5G: The inevitable growth of infrastructure cost, Mckinsey

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- Overall avg. data usage per month registered a CAGR of 76% from 2015-2020 reaching 13.5 GB in December 2020
- With ~5 hours of daily time spent on smartphones, India is one of the highest consumers of data per day, surpassing China.

Avg. monthly data usage per user has increased almost 17 times over last five years



Further, as per Ericsson⁴, today, the Indian subcontinent is one of the regions with the highest GB usage per smartphone. With such exponential surge on networks, the realization from data usage has fallen. It means that as Telcos we are under constant stress to invest in networks and capacities even though finding the revenue to fund this investment is hard to come by.

Therefore, in our view, by looking at technical parameters like propagation and spectral efficiency (which would have been more relevant in spectrum starved/constrained times) in isolation and by not taking into consideration whether incremental revenue can continue to be generated at the same rate as in previous generations in the changed competitive landscape, we are falling prey to making assessments that may fail to take into account/mimic market reality and expectation.

4. International experience - incremental revenue realisation from 5G is unable to recover incremental cost

The overall revenue growth two years after their 5G roll out of countries⁵ like USA, Korea and Hong Kong, the early movers in 5G, remained within the ~2-3% level (average). This was in line with the growth pre 5G rollout. And, while it may be argued that the past 2 years were impacted by the Covid-19 pandemic, we believe that in the case of Telecom connectivity, people actually increased their consumption of digital services. This shows that while overall traffic on networks may have increased, the revenue realization has not been meaningful.

⁴ Ericsson Mobility Report, November 2021

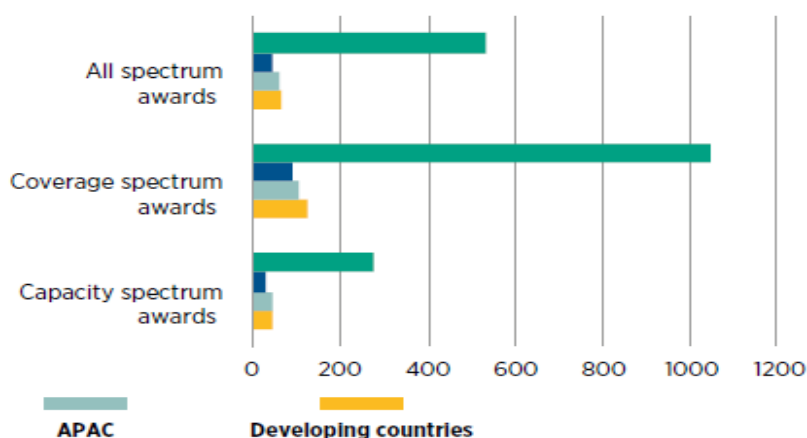
⁵ Please refer to second table in section F below

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This means that incremental revenue realization from 5G has been unable to recover its incremental cost and make any real gain for the TSPs.

Further, based on a recent study conducted by GSMA⁶ on India’s spectrum pricing, we note that on an average, Indian TSPs seem to be paying significantly higher amount for spectrum awards per million of US\$ revenue on account of annualized cost for all spectrum awarded between 2010-2021, compared to global average (median)⁷.

Median unit prices: India versus global and regional comparators, 2010–2021 (per million of revenue (\$)⁹)



The above means that put together, all auction awards since 2010 in India have been 10 times of the global average. **Therefore, to align with the international pricing benchmarks there is an urgent need to reduce the prices by nearly 90%.**

The Authority needs to duly consider the above.

5. TRAI’s previous spectrum valuation approaches:

Ideally, the reserve prices recommended should encourage purchase of *ALL* the spectrum but at a price that is discovered through the auction process, not set by the seller.

Indexation of historic prices – We believe that this should not be considered because expectations of the future change over time, especially if they were based in the past.

This method also simply assumes that the value of spectrum grows in a compound fashion over time. As we show in this response, this is not true. The market reality and expectation on incremental revenue and

⁶ India’s 5G Future – Maximising Spectrum Resources, GSMA, September 2021 (<https://www.gsma.com/spectrum/wp-content/uploads/2021/09/India-5G-Spectrum.pdf>)

⁷ Per GSMA, this metric calculates the unit price of an individual assignment of spectrum (at country level) based on the amount paid divided by the amount of MHz assigned, the licence length and annual operator revenues. It represents an estimate of the unit spectrum cost based on the existing value of the market.

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profitability generation has constantly gone southwards whereas the need for investments to serve exploding traffic on networks has gone northwards, i.e. in the opposite direction.

Avoided cost approach – In the past, the Authority has also considered this approach. However, such approaches may produce widely differing results depending on the assumptions made about future demand, technological changes and the future of spectrum supply. Such models can be too unstable to give confidence that reserve prices set thus will lead to successful auctions.

As we explain in case of the producer surplus approach below, this approach is not relevant any more.

Producer surplus approach – TRAI has also used the producer surplus approach to value spectrum in the past. This approach involves calculating the network infrastructure costs avoided from having additional spectrum. This additional spectrum allows the operator to lower the number of sites needed to meet its anticipated growth. This model implicitly assumes that it is profitable to serve the growth in traffic.

However, we do not agree with this approach. This implicit assumption of profitable growth is no longer relevant in the 5G scenario, where infrastructure needs to be much denser and investment in the higher capacity bands greater.

Secondly, in the earlier generation up to 3G, different operators at different levels of spectrum holdings simply needed additional capacity spectrum to serve traffic growth and growth in traffic and revenue realization followed the same trajectory. In the cases of 4G and definitely of 5G, the sensitive assumptions will be unable to account for evolution of the mobile market.

We therefore do not consider that the producer surplus approach provides a robust basis for valuing spectrum in the Indian context. In the new 5th generation of technologies the capex intensity is likely to be higher than previous generations as technology life cycles are shortening.

6. Our recommended approach: Marginal / Incremental Revenue

The cardinal principle of pricing is that price should equal marginal cost. It pays any business entity to continue to produce and sell as long as the incremental revenues cover the incremental costs. This is an important criterion for 5G where altogether newer CAPEX and OPEX will be required.

Preliminary studies suggest that to meaningfully cover India with 5G connectivity (assuming 75%-80% coverage to start with), a TSP would require close to INR 50,000 Crores of capex, excluding spectrum cost. An incremental Profit and Loss for this amount of 5G investment is tabulated below:

Incremental P&L for 5G Investment	Amount in INR Crores	
	Scenario 1 5%	Scenario 2 10%
Incremental Revenue in %		
Incremental Revenue in Rs Crs	3,500	7,000
LF @ 8%	-280	-560
Network Opex (Rental / Energy / AMC for 5G equipment	-3,500	-3,500
Depreciation @ 8 years of life	-6,250	-6,250
Interest @ 6%	-3,000	-3,000
PBT	-9,530	-6,310

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The current ROCE being low and in single digits, with addition of 5G CAPEX (considered without the cost of acquiring spectrum), even if revenue is assumed to increase by 10% from the current levels (scenario 2 in above table), then too the incremental ROCE will remain negative.

To break-even on the investment of INR 50K crore for 5G, a TSP would require +20% revenue upside from current levels. However, globally we have not seen much incremental revenue (details in below chart) coming out of 5G launch and hence even the 10% increase in revenue is a stretched assumption.

Sr. No.	Country	Network Operators	Launch Date	Currency	Pre 5G CAGR	Post 5G launch CAGR
1	US	AT&T, Verizon	Dec'18	USD (Mn)	5%	-2%
2	South Korea	SK Telecom, KT Corporation and LG Plus	April'19	Korean Won (Mn)	1%	3%
3	Hong Kong	3 Mobile and China Mobile	1-Apr-20	RMB (Mn)	0%	3%

Source: TSPs' websites, and Bharti Airtel Analysis

If we further include the cost of spectrum, the financials and ROCE will become further stressed. This means that an incremental / marginal revenue approach should be the guiding driver for TRAI's valuation exercise.

We accordingly recommend a **Marginal/Incremental revenue** approach that takes into consideration the amount of investments required to create a working 5G network under which marginal revenue is expected to be generated from 5G services, and what it will take to ultimately bring the desired level of profitability in the form of incremental ROCE and aggregate ROCE.

In view of the above, we recommend the TRAI's spectrum prices should at best be nominal and in any case not be more than 10% of the 2018 recommended prices. This would encourage network investments and massive rollout of 5G network at the earliest.

We believe above approach can produce an outcome that will be in the long-term interests of the country, and accelerate the growth of the digital economy.

Q.34 Which factors are relevant in the spectrum valuation exercise and in what manner should these factors be reflected in the valuation of spectrum? Please give your inputs with detailed reasoning.

Airtel Response:

The following factors are relevant in the spectrum valuation exercise:

- Demand and supply of services
- Micro and macroeconomic position of the country

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- Financial position of the mobile industry
- Country’s policies on spectrum, i.e., spectrum as public good
- Consumer behaviours and consumer benefit
- Rural and digital divide
- Overall socio-economic welfare derived from spectrum allocation
- Driving efficient use of spectrum
- Fostering sustainable and efficient competition
- Promoting innovation in networks and services
- Device ecosystem which is critical for effectively using spectrum
- Need for spectrum for continuity of business vs. building new services or new capacity / coverage layers
- Number of operators in the market or demand of spectrum at any point of time
- Making spectrum available for critical services (e.g., first responder network) and rural broadband connectivity
- Viability of business model

These factors should be reflected via an appropriate valuation model (i.e., Marginal/Incremental Revenue) in a manner such that it ensures the affordability and sustainability of the telecommunications sector.

The reserve price for all spectrum bands in the past has followed a combination of valuation models/approaches, which have discovered a price which is not sustainable in the long term. However, the success of some bands and unsuccessful auctions in others clearly indicate that there are other factors (potential revenue, free cash flow and profitability) which impact the success of spectrum auctions.

Considering the learnings from previous auctions, there is a need to re-look at the approach for valuation of spectrum balancing the long term public good, the continuous impact on the national economy and its growth due to investment in telecom infra with the one-time revenue opportunity of the sale of spectrum.

Q.35 In what manner, should the extended tenure of spectrum allotment from the existing 20 years to 30 years be accounted for in the spectrum valuation exercise? Please support your response with detailed rationale/ inputs.

Airtel Response:

Telecom is a capital intensive industry with a gestation period of 10-15 years and this has also been recognised under the Income Tax Act (Section 80IA). Therefore, for determining the value of spectrum, the increased validity of the license period (from the existing 20 years to 30 years) should not be simply multiplied as a variable to the calculation.

It needs to be acknowledged that with shortening technology life cycles, competitive pressure from adjacent industries, substitutable services and continuing innovations, the pressure on TSPs’ revenue generation ability will always multiply. Thus, increasing the validity of spectrum from 20 to 30 years is not going to

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confer any substantial advantage except that of giving a longer-term certainty for TSPs for planning and recovering their investments.

We must recall that with every generation of new technology, it is actually the TSPs’ commercials (revenue and margins) that come under pressure. It shows that telecommunication services have turned more into essential utilities, and that we have to strive ever harder to find new revenue streams and funding opportunities for increasing CAPEX/OPEX.

There are new extraneous factors like national security considerations, cybersecurity and the privacy journey of a user who expects ever more heightened levels of security that are all driving the overall costs of a Telco. Then there are new challenges on the energy front, too, that TSPs are dealing with. For example, the operating costs for Telcos are changing too, a major part of that being driven by climate-related activity that as per the GSMA⁸ has accelerated in the telecom sector markedly over the last 18 months and driven up energy costs.

“...Energy costs now represent 20-40% of telecoms opex, which will be exacerbated as 5G takes hold, with average data usage expected to rise fourfold by 2025. The clear demand among telcos for energy-efficient solutions has invited a significant level of innovation among equipment vendors and others in the supply chain...”

Therefore, we believe and recommend that the Authority should not simply transpose the increased number of years of spectrum duration into its valuation exercise. It is merely one of the many variables that could impact valuation and all such factors should be accounted for together rather than in isolation.

Q.36 What could be the likely impact of the following auction related telecom reforms announced by the Government in September 2021 on the valuation of various spectrum bands?

(a) Rationalization of Bank Guarantees to securitize deferred annual spectrum payment instalments in future auctions

(b) No spectrum usage charges (SUC) for spectrum acquired in future auctions

(c) Removal of additional SUC of 0.5% for spectrum sharing

(d) Provision for surrender of spectrum in what manner, should the above provisions be accounted for in the valuation of spectrum? Please support your response with detailed justification

Airtel Response:

It needs to be acknowledged that the reform package announced by the Government in September 2021 only helps to address issues concerning liquidity, procedures and structural needs under the present licensing framework and current state of affairs of the telecom industry. It helps in addressing concerns of the industry around present investments, cash flow challenges faced by TSPs and helps the banks tide over the exposure suffered by the telecom sector.

⁸ <https://data.gsmaintelligence.com/research/research/research-2021/radar-the-sustainable-telco>

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We note that there was no waiver of any liability required to be paid by TSPs, rather only deferment of such liabilities with NPV protection to the Government. Further, via this announcement the Government has also tried to correct some legacy anomalies which were having an impact on the financial sustainability of the TSPs.

Hence this package should not have any bearing on the valuation of the various spectrum bands in the upcoming and future auctions.

Q.37 Whether the auction determined prices of March 2021 auction be taken as the value of spectrum in the respective band for the forthcoming auction in the individual LSA? Should the prices be indexed for the time gap (even if less than one year or just short of one year)? If yes, please indicate the basis/ rate at which the indexation should be done, with reasons.

Airtel Response:

No. Considering that in the March 21 auctions, considerable amounts (63%) of spectrum quantum remained unsold, the same cannot and should not be considered as an auction determined price or market discovered price in any band. In-fact, no bids were received in the 700 MHz and 2500 MHz bands. This has been well noted by the DoT itself in its reference letter to TRAI.

Statistically, the value of spectrum sold was barely 19% of the total spectrum worth put to auction at TRAI’s recommended reserve price for different bands across different LSAs.

Analysis of March 2021 Spectrum Auction		
Particulars	Total Qty. (in MHz)	Total Reserve Price (in Cr)
Put to Auction in March 2021	2308.80	400396.20
Sold in March 2021	855.60	77820.81
Percentage of Sales	37%	19%

Source: DoT’s letter No. L-14006/01/2021-NTG and Bharti-Airtel’s Regulatory Economic Analysis

The above statistics demonstrate that the spectrum bands valued by the TRAI even at its reserve prices are highly overpriced compared to market reality and expectation. Hence the March 2021 prices or any reserve prices set previously cannot be the basis for the present exercise.

In conclusion, the March 2021 prices have no relevance for any of the bands for the purpose of the new auctions. **The entire exercise should be done afresh for every band and there is also absolutely no point in doing any indexation over the March 2021 value.**

Q.38 If the answer to the above question is in negative, whether the valuation for respective spectrum bands be estimated on the basis of the various valuation approaches/methodologies being followed by the Authority in the previous recommendations, including for those bands (in an LSA) for which either no bids were received, or spectrum was not offered for auction?

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Airtel Response:

No, it should not. The outcome of the spectrum auction can be argued to validate the valuation approaches/methodologies followed provided no extraneous factors like spectrum renewal or artificial supply constraints are included. Since neither of these two were factors in the March 2021 auction, including them would lead to a loss of confidence in the valuation approach followed by the Authority.

We cannot urge strongly enough that in the present exercise, assumptions around technical efficiency, ability to generate incremental revenue at healthy ROCE, use cases, and critical factors such as elements of public good should be considered.

We recommend that the valuation exercise be done afresh taking into consideration all the factors mentioned by us.

Q.39 Whether the method followed by the Authority in the Recommendations dated 01.08.2018 of considering auction determined prices of the auctions held in the previous two years be continued, or the prices revealed in spectrum auctions conducted earlier than two years may also be taken into account? Kindly justify your response.

Airtel Response:

No, none of the above. Please refer to our response to Q 37 and 38 above.

Furthermore, considerable time has lapsed since 2018 and the mobile industry has seen substantial changes (e.g., technological obsolescence, consolidation of operators, shifting monetary value from network operators to OTTs, significant disruption to existing business models impacting profitability), hence any reference to previous valuation exercises or auction determined prices followed in the past should not be considered.

It is important that the price discovered in a previous auction should not be treated as the market price. Rather spectrum should be treated as precious raw material for the socio-economic welfare of the nation, as already highlighted by us in our detailed submissions.

We reiterate that the entire valuation exercise for each band should be conducted afresh keeping the Indian context in perspective.

Q.40 Whether the valuation exercise be done every year in view of the Government’s intention to have an annual calendar for auction of spectrum? Please support your response with detailed justification.

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Airtel Response:

Yes, the valuation exercise should be carried out afresh every year. Since every auction is an independent exercise, especially so in the case of multi-band auctions, the bidders should choose their portfolio from among the bands on the basis of their particular needs and use cases.

We believe that since the reserve price and auction exercise should be exhaustively researched before being finalised, the Authority should carry out a market assessment to see market reality in terms of sustainability and affordability.

Q.41 Whether there is a need to bring any change in the valuation approaches/ methodologies followed by the Authority for spectrum valuation exercises in view of the changing dynamics in the telecom sector largely due to the usage of various spectrum bands by the TSPs in a technologically neutral manner? If yes, please provide suggestions along with a detailed justification about the methodology.

Airtel Response:

Yes, there is a need to make changes to the present valuation approaches / methodologies, especially since they were primarily devised in 2013. A considerable length of time has passed since 2013 and, importantly, the mobile industry has seen substantial changes over this period whether they be technological obsolescence, consolidation of operators, shifting monetary value from network operators/TSPs to OTTs, significant disruption to existing business models impacting profitability.

We note that in past valuation exercises⁹, TRAI has relied on technologically segregated financial and non-financial data with certain assumptions. These no longer seem relevant in the present ‘technology-neutral usage of spectrum framework’.

Therefore, there is a need to have a new valuation approach that may ensure the affordability, technology neutrality and sustainability that the telecommunications sector needs. **This new approach may be considered the ‘Marginal /Incremental Revenue Approach,’ and it would help proportionally determine the potential revenue generated by the additional spectrum bands acquired through the auction.**

Q.42 In your opinion, what could be the possible reasons for the relative lack of interest for the spectrum in the 2500 MHz band? Could this be attributed to technological reason(s) such as development of network/device ecosystem or availability of substitute spectrum bands or any other reasons(s)? Please support your response with detailed justification.

⁹ Please refer para 3.23 of the consultation paper

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Airtel Response:

Spectrum remaining unsold in the last two auctions indicates that the valuation of spectrum has multiple factors beyond technical and band wise efficiency. These include the infrastructural challenges faced in the deployment of bands and the decrease in revenue opportunity that the lack of a device ecosystem generates. It can also be inferred that the valuation exercise carried out for the spectrum bands failed to take into consideration the Indian market utility of the concerned band.

This is precisely the reason we urge that the valuation exercise cannot and should not be carried out in isolation looking at just the technical factors or the relative efficiencies. In fact, even where a device ecosystem is available, bands have failed to generate sufficient interest/revenue which only proves that every factor needs to be considered and a thorough and exhaustive evaluation carried out.

We believe that in the Indian market this has more to do with the level of reserve prices and the need for the TSPs to balance their requirements between spectrum and financials. This is why **we suggest that the valuation of each band be based on its economic value and business case, i.e. marginal revenue approach.**

Q.43 Whether the March 2021 auction determined prices be used as one possible valuation for the spectrum in 2300 MHz band for the current valuation exercise? If yes, should these prices be indexed for the time gap and at what rate? Please justify your response.

AND

Q.44 Whether auction determined prices of October 2016 (i.e. for the auction held earlier than two years) be used as one possible valuation for the spectrum in 2500 MHz band for the current valuation exercise? If yes, should these prices be indexed for the time gap and at what rate? Please justify.

AND

Q.45 Whether the value of the spectrum in 2300 MHz/ 2500 MHz bands should be derived by relating it to the value of spectrum in any other band by using technical efficiency factor? If yes, which band and what rate of efficiency factor should be used? If no, then which alternative method should be used for its valuation? Please justify your response with rationale and supporting studies, if any.

Airtel Response:

Kindly first refer to answers to questions no 37 to 39.

No, the March 2021 auction determined prices cannot be used as one possible valuation for the spectrum in 2300 MHz band for the current valuation exercise. The same is true qua queries raised at Q no. 44 & 45 too.

The analysis of the last 7 auctions suggests that the spectrum bands valued by TRAI even at its reserve prices are highly overpriced compared to market reality and expectation. Hence the March 2021 prices or reserve prices set previously cannot be the basis for the present exercise.

In other words, the March 2021 prices have no relevance for any of the bands for the purpose of new auctions. The entire exercise should be done afresh for every band.

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A similar corollary can be extended to the 2016 auctions as well, when only 41% of MHz of spectrum was sold worth only 12% of the value of the spectrum put to auction. Thus even 2016 cannot be considered a model/benchmark for valuation. Furthermore, in the last 6 years (since 2016), the market has undergone significant change in terms of technology, competition, revenue realization and other factors. Therefore, it is imperative that the exercise for 2500MHz and also for 2300MHz should be carried out afresh.

Valuation of any spectrum band (2300 MHz/ 2500 MHz bands) should be based on its economic value and business case, i.e., marginal revenue approach. There are various factors which impact valuation beyond technical efficiency. These include the incremental Capex & Opex needed for rollout, incremental revenue and device ecosystem for spectrum usage, etc.

Q.46 In your opinion, what could be the possible reasons for the relative lack of interest for the spectrum in the 700 MHz band? Could this be attributed to technological reason(s) such as development of network/device ecosystem or availability of substitute spectrum bands or any other reasons(s)?

Airtel Response:

700MHz spectrum has been unsold in the last two auctions, despite its reserve price being reduced by about 50% during the last auction. This indicates that the valuation of spectrum has multiple factors beyond technical and band wise efficiency such as the very high reserve price, the lack of a device ecosystem leading to lower revenue opportunities and the infrastructural challenges faced in deployment, etc.

Clearly, the high valuation of 700 MHz itself does not seem consistent with market expectation and reality. While the band may be argued to have an advantage in terms of propagation relative to another band, that in and of itself is not enough. If only one parameter overwhelms the valuation exercise instead of the exercise being focused on the need of 700MHz for rural coverage, there is a high chance that even such an important band could remain unsold.

Additionally, with operators already having basic coverage available in the 800MHz/900MHz bands, putting an unrealistically high price on sub-GHz bands will not necessarily generate interest. **We are of the opinion that the valuation of the unsold spectrum in 700MHz should be balanced with the goal of enhancing rural broadband and its impact on GDP growth.**

Q.47 Whether the value of spectrum in 700 MHz band be derived by relating it to the value of other spectrum bands by using a technical efficiency factor? If yes, with which spectrum band, should this band be related and what efficiency factor or formula should be used? Please justify your views with rationale and supporting studies, if any.

AND

Q.48 If your response to the above question is in negative, what other valuation approach (es) be adopted for the valuation of 700 MHz spectrum band? Please support your response with detailed methodology

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Airtel Response:

The valuation and resultant reserve price of 700MHz was based on the relative technical efficiency parameter, and this aspect has been tested in the last two auctions where it has remained unsold, even after a price reduction in the last auction.

We therefore do not believe that 700MHz or for that matter any other band should be valued from such an aspect alone. While this is one of the variables, theoretical efficiency in any model should be balanced with realistic assumptions around market need and the incremental revenue that TSPs can generate.

In our view, 700 MHz spectrum is very important for building rural 5G network as well as first responder services. It has been globally allocated to private operators for building rural networks and deepening indoor coverage.

In order to further enhance rural connectivity and give rural customers the same experience as their urban counterparts, sub-GHz bands (700MHz included) can be very useful for India, especially given that even after concerted efforts at building fiber connectivity to GPs and rural locations through the BBNL project, there have been significant delays due to the challenges of deploying fiber in remote rural locations.

The Sub-GHz spectrum deployed for 5G would be a very effective way by which to build last mile rural broadband network for homes, small and enterprise businesses and even warehouses and the agriculture value chain in rural areas. It is very unfortunate that even though there is the opportunity to leverage sub-GHz spectrum for rural connectivity, spectrum in the Sub-GHz spectrum like 700MHz has been unsold in the last two spectrum auctions.

Considering this, the Government should consider allocating the spectrum in the 700MHz band to TSPs at a cost which may only allow it to recover administrative costs (or nominal costs) via auction. The same should be tied up with rollout obligations, especially for rural towns and villages. At least 30-40MHz of sub-GHz spectrum per operator would be required for any meaningful 5G service.

Globally, the 700MHz band has been used for 4G network mainly for indoor and rural coverage. This band is not so efficient because its capacity is very low. Cost per GB for this band is relatively higher than the 1800MHz band layer.

The 700MHz band for 5G network would be mainly for providing indoor and rural 5G services. Experience and capacity on this band with 2x10MHz (or 2x20MHz) spectrum would be significantly lower than the 3.5GHz band (with 80MHz of spectrum). Beyond this, there are other cost factors that would impact valuation of spectrum in the 700MHz band

- Availability of device ecosystem which limits on-boarding of traffic in this layer
- Challenge of deployment of antenna for two low band spectrum (one for 4G & other for 5G)
- Higher cost per GB due to lower capacity of the sub-GHz layer

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Value of spectrum should also be balanced against indirect benefits due to the growth of GDP from digital services, potential increase in GST from new services and higher GDP, and building digital connectivity for improving rural economy, digital enterprises and a startup ecosystem in India.

Therefore, in view of this analysis, the valuation of the 700MHz band should be based on its economic value and business case, i.e., marginal revenue approach.

Q.49 Whether the valuation of the 3300-3670 MHz spectrum band should be derived from value of any other spectrum band by using technical efficiency factor? If yes, what rate of efficiency factor should be used? If no, which other method(s) should be used for its valuation? Please justify your response with rationale and supporting documents, if any

Airtel Response:

At the outset of this section’s start we have highlighted that relative technical efficiency using simple propagation characteristics of another band(s) is not a right approach, much less relevant in case of 5G since to build a good 5G network, mix of multiple bands across low-mid-and high range frequencies will be deployed. The importance of mid-band and high range mmWave bands will be more, and these bands will drive requirement of network densification by deploying more capex and opex.

However, for sake of a simplicity, and as a starting point, we can consider the following:

The 1800MHz band was used as the base layer (coverage cum capacity band) for 4G. Similarly, the 3500MHz band can be used as the base layer for 5G services.

Even for the purpose of comparison, if we consider the relative efficiency of 3.5GHz with 1.8GHz, to derive spectrum value for 3.5GHz from 1800MHz band pricing, we should consider various factors impacting the TCO which are beyond coverage factor of these two bands.

TCO for 5G deployment in 3.5GHz (which is the coverage band for 5G) includes factors such as additional sites, higher capex & opex per site compared to the 1800 band site, significant augmentation of fiber, E-band radio and new site build-outs for additional sites.

The following is the comparison of TCO for 5G in 3.5GHz with 4G in the 1800MHz band based on industry inputs:

Parameter	Cost factor of 5G (in 3.5GHz) compared to 4G (in 1.8GHz)
Number of sites	3x
Cost factor for existing sites	
Capex per site including Core	3x
Opex per site (existing sites)	2x
Backhaul per site (fiberization)	5x

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Over and above the factors that we took into consideration for cost ownership in the comparison between the deploying of 5G in the 3.5GHz bands and of 4G in the 1800MHz band, there would be additional TCO factors for any new sites to be deployed for the 3.5GHz band.

On combining the above factors and the current market results from other jurisdictions we find that the valuation of 5G spectrum in the 3.5GHz band in India should be 1/10th of previously recommended reserve price of mid-band.

Q.50 In case you are of the opinion that frequencies in the range 526- 698 MHz should be put to auction in the forthcoming spectrum auction, whether the value of 526-698 MHz be derived by using technical efficiency factor? If yes, with which spectrum band, should this band be related and what efficiency factor or formula should be used? Please justify your suggestions.

AND

Q.51 If your response to the above question is in negative, which other valuation approach(es) should be adopted for the valuation of these spectrum bands? Please support your suggestions with detailed methodology, related assumptions and any other relevant factors.

Airtel Response:

The sub-GHz spectrum is very important for building a rural 5G network as well as for first responder services. It has been globally allocated to private operators for building rural networks and deep indoor coverage. This would be in-lieu of the same private operators building the network with rollout obligations to the Government, which would bridge the rural-urban digital divide. At least 30-40MHz of spectrum would be required for any meaningful 5G services using the sub-GHz spectrum.

In order to further enhance rural connectivity and give rural customers a similar experience as their urban counterparts, sub-GHz bands can play a very useful role in India, especially given that the huge effort towards building fiber connectivity to GPs and rural locations through the BBNL project has been delayed significantly due to the challenges of deploying fiber in remote rural locations.

The Sub-GHz spectrum deployed for 5G would be a very effective way to build the last mile rural broadband network for homes, small and enterprise businesses and even warehouses and the agriculture value chain in rural areas. It is very unfortunate that the spectrum in the 700MHz band has been unsold in the last two spectrum auctions when it could have been leveraged to build rural connectivity.

Considering the above, the Government should consider allocating the spectrum in the 600MHz band to TSPs at a price that recovers the cost of administering the spectrum. The same should be tied up with rollout obligations specially for rural towns & villages.

Valuation of 600MHz on the technical efficiency factor

We would like to highlight at the very outset that the technical efficiency factor should not be seen in isolation and only from the traffic carrying capacity or coverage perspective alone. The sub-GHz band has been used for

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the 4G network mainly in terms of indoor and rural coverage. This band is not so efficient because the capacity of the band is very low. Cost per GB for this band is relatively higher than for the 1800MHz band layer.

Similarly, sub-GHz for the 5G network (mainly 600MHz) would be mainly for providing indoor and rural 5G services. Experience and capacity on this band with the 2x10MHz (or 2x20MHz) spectrum would be significantly lower than that of the 3.5GHz band (with 80MHz of spectrum). Beyond this, there are other cost factors which would impact the valuation of spectrum in the 600MHz band. These include:

- Availability of device ecosystem which limits on-boarding of traffic in this layer
- Challenge of deployment of antenna for two low band spectrum (one for 4G and the other for 5G)
- Higher cost per GB due to lower capacity of the sub-GHz layer

The value of spectrum should also be balanced against the indirect benefits accrued from the growth of GDP from digital services, potential increase in GST from new services and higher GDP, and building digital connectivity to improve the rural economy, digital enterprises and startup ecosystem in India.

Valuation of 600MHz band should be based on its economic value and business case, i.e., marginal revenue approach.

Q.52 Whether the value of spectrum in 24.25 - 28.5 GHz band be derived by relating it to the value of other bands by using technical efficiency factor? If yes, with which spectrum band, should this band be related and what efficiency factor or formula should be used? Please justify your suggestions.

AND

Q.53 If your response to the above question is in negative, which other valuation approaches should be adopted for the valuation of these spectrum bands? Please support your suggestions with detailed methodology, related assumptions and other relevant factors.

Airtel Response:

No, we do not believe that the valuation of mmWave can be or should be basis relative technical efficiency of other bands. The millimeter Wave (mmWave) spectrum is the capacity band for 5G. Being a high band, its propagation is very low and it has a very low coverage span. In India, propagation is further reduced due to the “brick, mortar and concrete” based construction of our buildings.

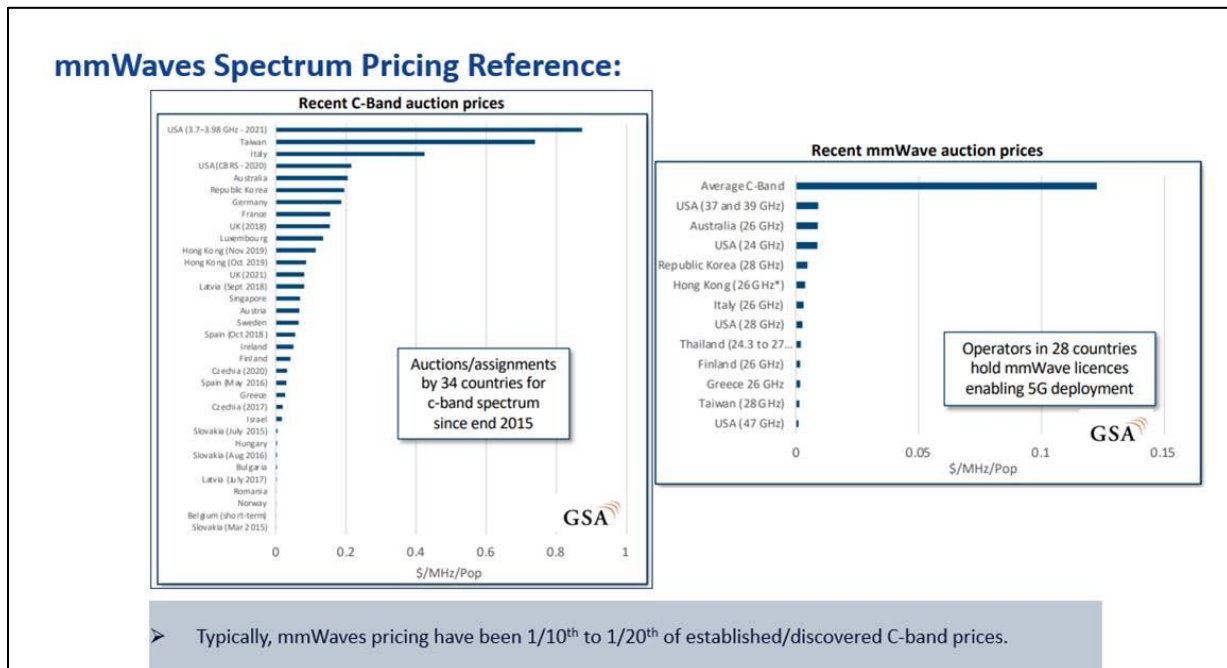
Due to the challenging nature of its propagation, the mmWave spectrum is not commonly deployed in smartphones. It has not been used in any of the 5G smartphones launched in the India market and even globally a very limited number of smartphones support these bands. So there isn’t much of an opportunity to use the mmWave band for mobile broadband services.

Hence, the spectrum is mainly used for Fixed Broadband Access for providing last mile access to residential and business customers. As per link budget estimates and trials done in India, coverage of this band was limited to 250-300mts from the cell site for FWA services.

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Clearly the above factors impact the monetisation opportunity of the mmWave band. It is limited to the FWA services and that too only at hotspots of 250mts from the cell site. For connecting these sites, sites with the mmWave band require mandatory fiberisation, thereby increasing the cost of these sites.

Considering these aspects, incremental revenue from mmWave band is marginal while the cost of these sites is very high. Globally, the mmWave band has been valued at 1/10th or 1/20th (i.e., lower) the C band spectrum.



Source: GSA

It is evident, therefore, that due to its limitations (technical, use cases and high Capex), the mmWave pricing has been significantly lower compared to mid-band, typically 1/10th or 1/20th of mid-band.

In some countries, the regulators have also allocated mmWave spectrum to TSPs administratively, e.g., Hong Kong¹⁰ or through a beauty contest approach in Japan¹¹.

Q.54 Whether international benchmarking by comparing the auction determined price in countries where auctions have been concluded be used for arriving at the value of these new bands? If yes, then what methodology can be followed in this regard? Please explain.

AND

Q.55 For international benchmarking, whether normalization techniques be used for arriving at the valuation of these new bands in the Indian context? If yes, please justify your response with rationale /literature, if any.

¹⁰ https://www.ofca.gov.hk/en/news_info/press_releases/index_id_1891.html

¹¹ <https://5gobservatory.eu/japan-assigns-5g-spectrum-to-four-operators/>

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Airtel Response:

International benchmarking can be considered. It should be normalised as per MHz / ARPU / Pop and/or as annualised cost of spectrum as a percentage of the industry’s wireless revenue.

We would like to highlight that the trends in countries like USA, Korea and Hong Kong, which were early 5G movers, suggest that 2 years after rolling out 5G, the overall revenue growth for Telcos in these countries remains within ~2-3% level (average). This again is in line with the growth pre 5G rollout. This means that the incremental revenue realisation from 5G is unable to confer any real gain, and thus should form the basis of a valuation exercise.

Also, please refer to the chart shared in response to Q53 in the context of mmWave spectrum international pricing benchmarks.

Q.56 Whether a common methodology/ approach should be used for valuation of all sub-1 GHz bands, which are currently planned for IMT? If yes, suggest which methodology/ approach should be used. Please give your views along with supporting reasoning and documents/ literature, if any

Airtel Response:

No, valuation of any spectrum band should be based on its economic value and business case.

Q.57 Whether the extrapolated ADP based on a time-series analysis, may be considered as the valuation itself or some normalization may be performed taking into account the financial, economic and other parameters pertaining to a particular auction? If yes, which factors should be considered and what methodology should be followed?

Airtel Response:

No, the extrapolation of ADP based on a time-series analysis will not produce a true and fair estimation of the reserve price(s), since the previous auction determined prices are not sustainable in the present circumstances due to substantial changes (e.g., technology obsolesce, consolidation of operators, shifting monetary value from network operators to OTTs, significant disruption to existing business models impacting profitability) having occurred since then.

500MHz,600MHz,700MHz,3300-3670MHz and the mmWave bands do not have any reference price for ADP and no trend-line can be determined for the same.

Therefore, the entire exercise should be carried out again for every band based on incremental revenue and ROCE, i.e., Marginal Revenue approach.

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Q.58 Whether the value arrived at by using any single valuation approach for a particular spectrum band should be taken as the appropriate value of that band? If yes, please suggest which single approach/method should be used. Please justify your response.

AND

Q.59 In case your response to the above question is negative, will it be appropriate to take the average valuation (simple mean) of the valuations obtained through the different approaches attempted for valuation of a particular spectrum band, or some other approach like taking weighted mean, median etc. should be followed? Please justify your response.

Airtel Response:

Reserve price for all spectrum bands in the past has followed a combination of valuation models/approaches, which have discovered a price which is not sustainable in the long term. However, the success of some bands and unsuccessful auctions in other bands clearly indicate that there are factors beyond modeling (potential revenue, free cash flow and profitability) that impact the success of spectrum auction.

Considering the learnings from previous auctions, there is a need to re-look at the approach for valuation of spectrum balancing the long term public good, continuous impact on the national economy and its growth due to investment in telecom infra with the one-time revenue opportunity of spectrum sale.

The valuation of the respective spectrum bands should be based on its economic value and business case. In such cases, a marginal / incremental revenue approach should be the preferred approach since it would be proportionate to the potential revenue generated by the additional spectrum bands acquired through the auction.

Q.60 Is there any valuation approach other than those discussed above or any international auction experience/ approach that could be used for arriving at the valuation of spectrum for 700 MHz/ 800 MHz/ 900 MHz/ 1800 MHz/ 2100 MHz/ 2300 MHz/ 2500 MHz/ 3300-3670 MHz/ 24.25 - 28.5 GHz/ 526 - 698 MHz bands? Please support your suggestions with a detailed methodology and related assumptions.

Airtel Response:

Please refer to our responses to question nos 59 and 34. The valuation exercise should be done for each individual band **based on its economic value and business case, i.e., marginal revenue approach** (incremental revenue generation ability).

We also believe that international benchmarking can be a good way to sense check TRAI’s valuation exercise, provided both are duly adjusted to ARPU/Revenue and GDP levels, and adjusted for India market dynamics (i.e., financial health, affordability needs).

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Q.61 Should the reserve price be taken as 80% of the valuation of spectrum? If not, then what ratio should be adopted between the reserve price for the auction and the valuation of the spectrum in different spectrum bands and why?

Airtel Response:

There is a need to set reserve prices at levels that are sufficient to keep non-serious players out, but also low enough to achieve vibrant price discovery.

To enable competitive bidding and price discovery in the auction, it is important that the reserve price is set below the valuation of the marginal bidder¹².

The UK’s Regulator OFCOM states¹³ that *we wish to set reserve prices below market value to avoid unsold spectrum, encourage participation and allow a margin for price discovery.*

The European Commission in one of its recommendations¹⁴ on incentives for investments in 5G networks, recommends the following to its member states:

“Member States are invited to set reserve prices by using a methodology, including benchmarking for the specific band under consideration, financial valuation models and/or other models. When using a benchmarking exercise as input, prices should be adjusted to consider the country specific circumstances, such as population, licence duration and coverage obligations, among others, and, when justified, with the exclusion of exceptional cases (statistical outliers). Member States should avoid revenue maximization.”

Typically, the reserve price of spectrum is set at a discount to the estimated value to allow a cushion in the level of the reserve price to see price discovery in the auction.

We note that in the past, TRAI has recommended setting the reserve price as 80% of the valuation of the spectrum. However, the analysis of auction outcomes suggests that this approach of 80% is not able to discover the market price since most of the winning prices were nearer the reserve price and significant amounts of spectrum remained unsold. Therefore, we see a very strong case for further bringing down the discounting factor to a level that generates competitive bidding.

We accordingly submit that the reserve price of the spectrum band should be taken as 50% of the valuation of the spectrum.

¹² In any auction, the market price is revealed when the marginal bidder either reduces its demand or leaves the auction. Put simply, in each LSA, there will be as many valuations of spectrum as there are operators, but there is only one market price for spectrum

¹³ Statement on Award of the 700 MHz and 3.6-3.8 GHz spectrum bands dated 13th March 2020

¹⁴ Common Union Toolbox for Connectivity, available at <https://digital-strategy.ec.europa.eu/en/news/connectivity-toolbox-member-states-agree-best-practices-boost-timely-deployment-5g-and-fibre>

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Q.62 Whether the realized/ auction determined prices achieved in the March 2021 auction for various spectrum bands can be directly adopted as the reserve price in respective spectrum bands for the forthcoming auction? If yes, should these prices be indexed for the time gap since the auction held in March 2021 and at which rate the indexation should be done?

Airtel Response:

No, they cannot. Considering that in the March 21 auction, considerable amounts (63%) of spectrum remained unsold, the same cannot be considered as auction determined prices or market discovered prices in any band. In fact, no bids were received in the 700 MHz and 2500 MHz bands. This has been well noted by the DoT itself in its reference letter to TRAI.

Statistically, the value of spectrum sold was barely 19 % of the total which was worth Rs. 4,00,396.20 Crore, put to auction at TRAI’s recommended reserve price for different bands across different LSAs.

Analysis of March 2021 Spectrum Auction		
Particulars	Total Qty. (in MHz)	Total Reserve Price (in Cr)
Put to Auction in March 2021	2308.80	400396.20
Sold in March 2021	855.60	77820.81
Percentage of Sales	37%	19%
<i>Source: DoT's letter No. L-14006/01/2021-NTG and Bharti-Airtel's Regulatory Economic Analysis</i>		

The above statistics demonstrate that the spectrum bands valued by TRAI even at its reserve prices are highly overpriced compared to market reality and expectation. Hence the March 2021 prices or reserve prices set previously cannot be the basis for the present exercise.

Therefore, the March 2021 prices have no relevance for any band for the purpose of new auctions. **The entire exercise should be done afresh for every band.** And, as a corollary to this, there is no point in doing any indexation over the March 2021 value either.

Q.63 Should the method followed by DoT in the previous auction in respect of collecting bid amount from the successful bidder in case spectrum is not available in a part of the LSA be followed in the forthcoming auction? Please justify your response in detail.

AND

Q.64 What percentage rate of upfront payment should be fixed in case of each spectrum band?

Airtel Response:

For the spectrum acquired in the 2021 auctions, operators opting to make deferred payments were required to make an upfront payment of 25% for the sub-GHz bands and 50% for the rest of the bands. Making hefty

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upfront payments for a resource which is to be utilised over a period of 20 years causes a strain on the finances of operators.

The core tenet of the recent Cabinet Reforms was to increase availability of cash with the operators by providing a moratorium on dues. If operators are again forced to make hefty upfront payments for acquiring spectrum in the upcoming auctions, then it will effectively negate the relief provided by the Cabinet decision and will again engulf operators into a further deep financial crisis.

Therefore, no upfront payment for spectrum acquired in the upcoming auctions should be required. Operators should be required to make payments in the form of annual instalments only (post 6 year moratorium), spread over the remaining 24 year spectrum duration period.

Q.65 What should be the applicable period of moratorium for deferred payment option?

Airtel Response:

The Cabinet decision to provide a moratorium period of four years was taken with due understanding of the current financial state of the Industry and the threat to the current market structure. However, to be on track to roll out 5G in the country, we understand that there will need to be spectrum auctions conducted regularly as prescribed by the Cabinet.

The current moratorium on new auctions is 2 years which would mean that for spectrum acquired in Q2 FY-2022-23, the first instalment would require to be paid in the calendar year 2025, whereas for the spectrum acquired in 2021 Auctions, payments will have to be made in calendar year 2024. Around the same period, i.e., 2026, the moratorium granted by Cabinet will also expire, due to which operators will have to make hefty payments for their pending AGR dues.

These back to back payments for different auctions and pending AGR dues will put the finances of operators under stress and will ultimately defeat the very objective of providing the moratorium period of 4 years announced in the cabinet reforms.

In view of above, we request that a total moratorium of at least 6 years be allowed in the forthcoming auctions.

Q.66 How many instalments should be fixed to recover the deferred payment?

Airtel Response:

We submit that a total of 24 installments after the 6-year moratorium period be fixed to recover the deferred payment.

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We believe that recovering the payment for spectrum in 24 instalments spread over the period of spectrum can meet the objective of securing revenue for the exchequer while also alleviating the financial burden on TSPs and giving them enough liquidity to invest in the network to ensure maximum utilisation of spectrum for the public good.

Q.67 What rate of discount should be used while exercising prepayment/deferred payment option, in order to ensure that the net present value of payment/ bid amount is protected? Please support your suggestions for Q64 to Q67 with proper justifications

Airtel Response:

The investments in spectrum are the single biggest expense incurred by TSPs in their business and the acquired spectrum is to be utilised over a period of 20 years (for past auctions). Considering this, in the past spectrum auctions, the Government has allowed TSPs to make annual spectrum instalments spread over 16 years to enable them to keep investing in network infrastructure.

However, the obligation to pay huge interest on deferred spectrum payments defeats this objective, as it burdens the TSPs’ finances and impairs their ability to make investments in the network rollout. The Telecom sector needs huge additional investments to seamlessly implement 5G networks (USD 60-70 billion¹⁵). Therefore, access to investible funds will be critical to ensure 5G roll-out across the country.

Hence, to alleviate the financial burden on the TSPs and to enable them to roll out 5G services, **the better approach would be that payments for winning bids be based on equated annual installment payment schedule spread over the life of the spectrum (after the expiry of six-year moratorium period). Unlike present system, there should be no interest to be paid on annual instalments.** Given spectrum is used over the limited period (unlike other countries where it’s for perpetuity e.g. US), it is only fair for the payments be made in the same manner.

The clarity on payment terms would also enable the bidders to value the spectrum accordingly.

¹⁵ As per TRAI estimates (https://traai.gov.in/sites/default/files/White_Paper_22022019_0.pdf)

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Chapter IV - Questions [Q 68 to 73] on Spectrum for Private Cellular Networks: Responses

Q.68 To facilitate the TSPs to meet the demand for Private Cellular Networks, whether any change(s) in the licensing/policy framework, are required to be made. If yes, what changes are required to be made? Kindly justify your response.

Airtel Response:

It needs to be acknowledged that Licensed Mobile operators are best suited to deliver the necessary support to industrial use cases, and support private cellular networks in India. The advantages are multifold:

1. **Experience in running efficient mobile networks:** MNOs or TSPs have long years of experience in deploying spectrum efficiently and offering multiple services integrating a multitude of technologies. They will be able to deliver 5G services using *low, mid-band and high-band frequency ranges* to support the full range of industrial use cases across local and wide area deployments. TSPs can support these through:
 - a) **Spectrum leasing/sharing:** A carefully planned spectrum leasing/sharing approach can be a viable option for supporting verticals who want to build private networks
 - b) **Higher bandwidth use-cases** or device densities with access to wider spectrum
 - c) Use cases that may require **network access outside of the confines** of the industrial campus with service continuing onto the public network
2. **Ability to slice the network:** This allows the network to be designed to adapt to the requirements of each use case with benefits such as:
 - a. Each slice is an isolated end-to-end network tailored to fulfil diverse requirements requested by a particular application but on the same physical network infrastructure
 - b. Coverage over wider areas, capacity on demand. It can leverage the design and maintenance ability of mobile networks without entering that complexity
 - c. 3GPP continues to evolve mobile network specifications and add new capabilities. As TSPs adopt new features they can make them available to all their tenants
3. **Ability to offer a wide range of secure solutions to verticals:** The TSPs are able to offer a wide range of managed solutions to industrial customers including 5G capabilities like 5G virtual networking for point-to-point connections, 5G private networks that cover a certain area, 5G+cloud, where vertical industry applications are deployed on the public cloud and connected through the 5G network and 5G edge computing for ultra-low latency processing.
4. **TSPs as valued partners of vertical while dealing with regulatory requirements:** It is expected that for the majority of private and dedicated network deployments, TSPs will in some way be involved. Considering their ability to deal with regulatory obligations, TSPs can be a valued partner to industrial enterprises in complying with these operational obligations.

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Accordingly, there may be amendments required to the licensing framework to facilitate these (or any new emerging) options.

We therefore recommend the Authority to consult with the stakeholders on putting an appropriate framework that allows spectrum leasing and slicing both, taking into consideration use cases that are emerging and will be served by TSPs.

Q.69 To meet the demand for spectrum in globally harmonized IMT bands for private captive networks, whether the TSPs should be permitted to give access spectrum on lease to an enterprise (for localized captive use), for a specific duration and geographic location? Kindly justify your response.

Airtel Response:

Yes, the licensed TSPs should be permitted to offer access spectrum on lease to an enterprise, on a voluntary mutually negotiable basis.

5G technology has been conceived as a potent tool for Industry 4.0 and has brought with it techniques such as Network Slicing so that networks can be tailored to meet the demand of different Industry verticals, which require specific SLAs.

As rightly recognised by TRAI in its consultation paper, **leasing of spectrum could result in efficient utilisation of spectrum as the TSPs will be utilising the access spectrum for the provision of mobile services in a majority of the geography, and the same spectrum will be utilised by the enterprise in its limited geography for their private captive network. This option will enable TSPs to better monetise the spectrum, as an additional revenue stream could be created. Further, the TSPs will be in a better position to manage the interference issues which may arise due to captive usage of spectrum by the enterprise.**

Moreover, today, millions of enterprises are using telecom connectivity and solutions to run their businesses at affordable prices. The enterprise market is quite competitive in nature. Therefore, any apprehension that the Industries would not be able to get the spectrum from TSPs or the price for such spectrum would be higher, etc. are unfounded since it is in the interests of the TSPs to monetise the spectrum in the most effective and efficient manner.

Therefore, considering the advantage for TSP networks in satisfying industrial use case demands, **TSPs should be the natural choice, and be allowed to lease spectrum to vertical users for specific periods and locations on a commercial arrangement basis, with due intimation to the licensor / regulator. This approach will be beneficial due to the following advantages:**

- a. **Coordinated use of spectrum avoids interference issues** as it will be leased by enterprises from the licensed operators who would be aware about their leasing arrangements with different entities.

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- b. **Most effective and efficient use of spectrum** as this arrangement will not require reserving any spectrum exclusively for Private Networks and both Private and Public Networks will be able to make use of the spectrum through a coordinated approach.
- c. **The Government will earn a revenue on the licensed spectrum** as the opportunity of earning revenue from leasing the licensed spectrum to enterprises will be duly factored by TSPs while bidding for the spectrum. Moreover, any revenue being earned from such leasing will be subjected to the Licence Fee at the hands of the telecom operators.
- d. **Regulatory requirements can be enforced** on the enterprises operating Private Networks through TSPs who will be leasing their licensed spectrum to these entities

**Q.70 In case spectrum leasing is permitted,
i. Whether the enterprise be permitted to take spectrum on lease from more than one TSPs?**

Airtel Response:

We do not foresee any requirement by the enterprises to lease spectrum from more than one TSP as we believe the bandwidth provided by one TSP can effectively meet the requirement of an enterprise. Therefore, it is suggested that one enterprise may be permitted to lease spectrum from only one Access Service Provider in an LSA in order to have a simplified framework for the leasing of spectrum and to avoid any complexities that may arise due to the enterprise accessing and using spectrum from multiple operators.

Furthermore, if there is a need for augmenting capacity at a private location, all TSPs are in a position through their licensed spectrum holding in various bands to augment the original offering and give a better experience to the enterprise user.

**Q.70 In case spectrum leasing is permitted,
ii. What mechanism may be prescribed to keep the Government informed about such spectrum leasing i.e., prior approval or prior intimation?
iii. What timeline should be prescribed (in number of days) before the tentative date of leasing for submitting a joint request by the TSPs along with the enterprise, for approval/intimation from/to the Government?**

Airtel Response:

Under the spectrum leasing model, TSPs will be required to enter into an arrangement with multiple enterprises for leasing their licensed spectrum. Considering the expected high volume of such arrangements and the infancy of such a framework, it will not be correct to introduce a requirement of prior approval. Since this model will be coordinated through TSPs, there should not be any issues of interference etc. which obviates the need for prior approval.

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However, to keep Authorities (DoT/TRAI) informed about such arrangements, an intimation period may be prescribed to each TSP, e.g., within 15 days of operationalization of such a Captive Network. We believe that any heavy-touch regulatory requirement, without any evidence of harm, may adversely affect the wide-scale deployment of such a framework.

Q.70 In case spectrum leasing is permitted,

iv. Whether the spectrum leasing guidelines should prescribe duration of lease, charges for leasing, adherence of spectrum cap provisions, roll out obligations, compliance obligations. If yes, what terms and conditions should be prescribed?

v. What other associated terms and conditions may be prescribed?

vi. Any other suggestion relevant to leasing of spectrum may also be made in detail. (Kindly justify your response)

Airtel Response:

The proposed framework of leasing spectrum to enterprises should be based on market driven forces. Even today, almost all the facets of enterprise businesses are driven by market forces as different enterprises have their specific requirements with respect to SLAs, which are decided mutually between service providers and enterprises. **On this principle, we recommend that:**

- The duration of spectrum leasing arrangements between TSP and enterprise should be decided on the basis of mutual agreement between the particular TSP and Enterprise and can be up to the period of expiry of the tenure of the TSP’s spectrum.
- Charges of spectrum leasing should be decided mutually between the TSP and enterprise.
- There should not be any cap on the amount of spectrum that an enterprise can lease from a service provider provided that it is leasing spectrum from an Access Service Provider in one LSA. Enterprises can decide, based on their requirement, the TSP from whom they wish to lease spectrum.
- There should not be any conditions or roll out obligation as this spectrum is not being used exclusively for Private Networks.
- Since the arrangement is being done only under an intimation which does not involve any administrative overheads to DoT, there should not be any charges payable to the government for leasing of spectrum.

Overall, we submit that a liberal policy should be formulated for the leasing of spectrum by TSPs to enterprises as these enterprises will be just like other users/customers of TSPs. We sincerely reiterate that any heavy touch regulatory requirement, without any evidence of harm, may adversely affect the wide uptake of such a framework.

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Q.71 Whether some spectrum should be earmarked for localized private captive networks in India? Kindly justify your response

AND

Q.72 In case it is decided to earmark some spectrum for localized private captive networks, whether some quantum of spectrum be earmarked (dedicatedly) from the spectrum frequencies earmarked for IMT services and/or spectrum frequencies earmarked for non-IMT services on location-specific basis (which can coexist with cellular-based private captive networks on shared basis)? Kindly justify your response with reasons.

AND

Q.73 In case it is decided to earmark some quantum of spectrum for private captive networks, either on exclusive or shared basis, then

a) Spectrum under which band(s) (or frequency range) and quantum of spectrum be earmarked for Private Network in each band? Inputs may be provided considering both dedicated and shared spectrum (between geographically distinct users) scenarios.

b) What should be the eligibility conditions for assignment of such spectrum to private entities?

c) What should be the assignment methodology, tenure of assignment and its renewal, roll-out obligations

d) What should be the pricing mechanism for assignment of spectrum in the band(s) suggested for private entities for localized captive use and what factors should be considered for arriving at valuation of such spectrum?

e) What should be the block size and spectrum cap for different spectrum band(s) suggested in response to point (a) above.

f) What should be the broad framework for the process of (i) filing application(s) by enterprise at single location, enterprise at multiple locations, Group of companies. (ii) payment of spectrum charges, (iii) assignment of frequencies, (iv) monitoring of spectrum utilization, (v) timeline for approvals, (vi) Any other

g) Any other suggestion on the related issues may also be made with details. (Kindly justify your response with reasons)

Airtel Response:

No. We reiterate that we do not support setting aside any IMT spectrum for localised private captive networks in India. Setting aside^{16,17} licensed spectrum can have consequences for other consumer or enterprise users of mobile services and may also be insufficient to meet the needs of many industrial verticals in terms of coverage, capacity, latency and uplink/downlink ratios. We believe that the spectrum leasing model as described above is the best approach to meet the objectives without any wastage of spectrum.

The Authority should think holistically about the needs of vertical networks as well as public and businesses more widely.

We now highlight the disadvantages and risks associated with allocation of spectrum exclusively for localised/ private captive networks:

¹⁶ Mobile Networks for Industry Verticals: Spectrum Best Practice, GSMA

¹⁷ <https://www.gsma.com/spectrum/wp-content/uploads/2020/11/Mobile-Networks-for-Industry-Verticals.pdf>

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1. **Loss to exchequer:** Setting aside spectrum for verticals in the core 5G bands will deprive the exchequer of due revenues. The policy objective of enabling industrial use cases can be met by using spectrum leasing/sharing/slicing via licensed TSPs without compromising the fiscal aspect.
2. **Risk to 5G:** 5G requires broad, contiguous bands of spectrum to support applications well. But taking away chunks of spectrum to dedicate them to verticals runs the serious risk of fragmenting the available spectrum. Setting aside spectrum for verticals in 5G bands also risks serious damage to 5G services for consumers and businesses. It can threaten the wider success of 5G – including slower rollouts, worse performance and reduced coverage.
3. **Inefficient allocation and uneven playing field:** Spectrum set-aside exclusively for verticals in core bands risks being underused and can undermine fair spectrum awards. It can put the licensed MNOs at serious financial (auction vs non-auction) and competitive disadvantage vis a vis unlicensed/delicensed private networks for the same commercial opportunity.
4. **Coexistence challenges:** Policymakers should consider the coexistence challenges when different use cases need to be supported in the same band. Carefully consider options and consult stakeholders about what it means to offer support to verticals without undermining other users.
5. **Law Enforcement:** Telcos have experience and can serve the LI requirements for LEAs whereas dealing with it through independent private networks can be very complex.
6. **Investments and expertise:** The level of investment and availability of relevant experts necessary to design, implement or operate the private network to establish an enterprise owned private network may be daunting for most. While MNOs’ core business is connectivity and efficient spectrum deployment, an enterprise’s business risks may de-prioritise its investments into private networks.

If at all the Government or the Authority is keen to support such not so efficient use cases of captive private networks, we believe the same should be done only in the unlicensed bands which are available today in sufficient quantum.

Q.74 What steps need to be taken to facilitate identification, development and proliferation of India specific 5G use cases for different verticals for the benefit of the economy and citizens of the Country? Kindly provide detailed response with rationale.

Airtel Response:

There are various use cases that are being tested globally and in India as well. Some use cases that may emerge across verticals/sectors are as below:

Industrial: 5G in India is expected to provide the network to transform manufacturing, mining, and construction design and processes through the development of smarter factories and machinery enabling

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higher-quality outputs and enhancing safety through the remote control of equipment in some high-risk scenarios. The transfer of heavy data such as 3D models and historic data sets could empower manufacturers to make timely and informed decisions. Companies have also been experimenting with ART (Augmented Reality Troubleshooting), allowing remote trouble-shooting, thereby improving response times.

Healthcare: 5G enabled technologies such as IoT, big data analytics, artificial intelligence and machine learning can overhaul the healthcare system. Enhancing safety, increasing energy efficiency, improving air quality, enabling efficient transportation and boosting the overall quality of life is the need of the hour. The stimulus for making cities smarter could be driven by 5G.

5G can deliver improved healthcare in locations lacking trained specialists or populations without the means to travel to top hospitals, moving care closer to the patients. Remote diagnosis using 5G-enabled wearables consisting of multiple types of medical devices and sensors, robotics, and other devices can enable distant medical professionals to diagnose some conditions without an in-person visit.

Agriculture: Though India ranks third in agriculture and farm output globally, given the country’s agro-climatic conditions, the sector fulfils only 50 to 60% of the potential yield for most of the crops. This unrealised potential can be attributed to various challenges broken across its value chain and addressed by 5G.

Automotive: Significant investment in the research for V2X (Vehicle to everything) communication could enable a plethora of use cases and features such as collision avoidance, real-time traffic routing, pedestrian safety alerts, emergency braking, etc.

Education: Expected increased availability and access due to high-quality, affordable internet options that enable distance learning, which could also help to close the gap between the urban and rural populations by providing equal opportunity to education.

Steps required to facilitate identification, development and proliferation of India specific 5G use cases:

1. Policy support: The Government(s) should be first to support TSPs and industry in handholding by becoming the anchor tenants of sectoral use cases. The Telecom ministry and Regulator should become champions of the Telco industry when it comes to pitching 5G services and solutions offered by TSPs to other ministries like Ministry of SME/MSME, Heavy industries, Healthcare, HRD, Agriculture. The DoT / TRAI can work with Telcos to identify the needs of such sectors and bring them closer as an ecosystem from the perspective of facilitating use case development.

We highlight here that the role of Government and Regulator should be limited to act as facilitator/bridge among various cross departments/ministries and industry and not extended to mediator in techno-commercial negotiations of use cases. With this approach, all stakeholders can generate value for society and economy alike.

2. Ecosystem support: Development of these use cases can be backed by multiple trials by Operators & OEMs in various geographies and scenarios to ensure quality offerings. Building an R&D ecosystem, formulating test beds can provide proof of concept and study of use cases.

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3. **Start-ups:** Various startups contributing to different sectors can be given a chance to bring churn in innovation. Furthermore, ‘Digital India’ initiatives like ‘BharatNet’ and ‘Smart Cities’, along with a high rate of fiberisation across various parts of India with favourable policies and affordable ROW, will empower the 5G roll out.

4. **Collaboration among wider stakeholders:** To ensure accelerated 5G deployment, you need to have strong collaboration among stakeholders like industries, Telcos and academia. Many of the current use cases are technically supported by the functional drivers of 5G and activated through multi-stakeholder cooperation and collaboration.

Regulators, industry associations, network operators, service/ technology providers must engage to develop use cases that will maximise the opportunities 5G will bring across sectors. Defining collaboration frameworks and models to initiate and sustain cooperation more effectively will be increasingly important moving forward.
