Reference: MOAIS-17:0002
Date: 2017-11-03
Attending to this matter: Sanjay Tanwar

Your Reference: 10/2017
Your Date: 28.08.2017

Mr. Syed Tausif Abbas,
Advisor (Networks, Spectrum and Licensing),
TRAI
New Delhi.

Ericsson Response to TRAI Consultation Paper No. 10-2017 titled "Auction of Spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-3400 MHz and 3400-3600 MHz bands"

Dear Sir,

Ericsson welcomes the opportunity to provide response on the TRAI Consultation Paper No. 10/2017 on auction of spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-3400 MHz and 3400-3600 MHz bands. We appreciate the efforts of Government of India to facilitate timely deployment of 5G in India, by ensuring availability of the required spectrum in different frequency ranges to meet the diverse 5G requirements.

Ericsson hereby submits the detailed response, as attached to this letter, for your kind consideration.

Yours sincerely,

For Ericsson India Pvt. Limited,

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Ericsson Response to TRAI Consultation Paper No. 10/2017

Auction of Spectrum in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz, 2500 MHz, 3300-3400 MHz and 3400-3600 MHz bands

TRAI Consultation on Spectrum

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1. Overview

1.1. India Landscape

India's rapid growth in digital adoption has set the stage for fundamental change among the country's consumers. Mobile industry is one of the key contributors to GDP and the contribution is expected to grow to ~8.2% of the country GDP in 2020. 4G mobile handsets are expected to grow 4 times to ~700 million constituting ~80% of the handsets in use by 2020. At the same time, high speed data is both becoming ubiquitous and mass affordable. Proliferation of digital content is further driving consumption of mobile data.

India is consistently witnessing evolution towards newer technologies with the number of GSM subscriptions decreasing since 2015. LTE and WCDMA/HSPA technologies are together expected to represent 50% of all subscriptions by 2020. Noticeable consumer trends like full HD/4K streaming, collaborative gaming, mobile screens becoming preferred screen for 51% TV hrs./ week, 42% of all TV and video watching time for millennials is 'on demand' content and rapid growth in smart TV adoption are pointing towards a latent demand for 5G. Government's Digital India vision and focus on Smart Cities will further accelerate the demand for IoT and 5G. Operators are expected to begin 5G trials starting 2018.

In addition to the exponential rise in data rates and traffic capacity, 5G will bring an integration of diverse use cases and deployment scenarios including societal and industrial IoT applications. 5G would comprise diversity across type of users, content, application and access technologies, each necessitating specific technical performance requirements.

5G promises ultra-reliable and low-latency communication with support for ten times as many devices in an area as supported by LTE. Although it promises peak data rates of multi Gbps, the focus would be on ensure a more uniform enhanced user experience across the coverage area. This would hugely help the first adapters to provide differentiated customer and app experience to consumers in addition to opening new revenue doors.

Most importantly, 5G promises to unleash the full potential of IoT by enabling cross-industry use cases supported by an ecosystem of enhanced capacity, data rates, low latency and long battery life.

1.2. Spectrum considerations for 5G

1.2.1. General

Considering that the 4G networks are the foundation of the 5G infrastructure and that 5G will encompass services for both consumers and business, including vertical sectors, the spectrum policy and regulatory framework needs to be upgraded to the 5G era by aligning the regulation applicable to most applications running on terrestrial networks, but also to the wireless component of transport, audio-visual, health, energy, and Internet of Things/M2M services. Consistency in spectrum management between the different spectrum users should be achieved.

Also, network configurations are evolving constantly to better meet users' needs in terms of indoor and outdoor coverage and to improve quality of service: new radio base stations are installed on a regular basis to increase the networks' capacity and their size deems to better match the ultra-dense architectures. As such a high number of smaller cells is estimated to make part of the new 5G networks and regulatory and administrative frameworks should evolve to take into consideration rules that adapt to the processing of volumes of requests by the administrations.

Given that, very large spectrum blocks would be needed for 5G services across specific target areas and the connectivity would be a fundamental enabler for all industries, and also given the enormous debt situation of the industry, the emphasis may be given to larger block-sizes of spectrum and pricing mechanism has to be given a fresh look to make it possible for successful launch of 5G.

Ericsson is of the view that there is enormous potential for LTE to reach deeper penetration for mobile broadband which is expected to touch 200 million subscriptions by the end of 2017. This amounts to merely 20% penetration and hold enormous scope for expansion. Operators should focus on deployments of Gigabit LTE on wide scale, to serve as a base for 5G/NR deployments when it is launched.

Initial 5G deployments likely to be non-standalone configurations in mid-bands. Combination of 4G and 5G bands is expected as traffic increases and new use cases mature. Standalone 5G deployments will gradually get access to 4G spectrum in mid-low bands.

When 5G NR is introduced in networks and 5G NR capable devices come to the market, it will be important for operators to quickly build 5G NR coverage to be able to attract and retain attractive customers and offer the new use-cases/services that 5G technology will enable.

While higher frequencies typically have more available bandwidth and hence more capacity, it would be highly beneficial for operators to combine these high frequencies with 5G NR channels on lower-bands, that we call '5G anchor bands'. By combining the higher and lower bands using carrier aggregation functionality in 5G, operators will be able to offer the 5G NR coverage and capacity that will be expected from their customers.

The 5G Anchor band role could, also be performed by using lower-frequency LTE bands in combination with higher-frequency 5G NR channels by using 'dual connectivity' functionality, where consumer devices use LTE and 5G NR simultaneously. This could be an interesting option in India for FDD bands B1, B3, and B8, together with the TDD bands B41, and B42 together with 3300-3400 MHz to be specified. Over time, these bands can then be evolved to 'real' 5G NR bands. The 3.3-3.6GHz band consists of up to 300 MHz of contiguous spectrum enabling wide channel bandwidth.

India has identified bands 3300-3400MHz & 3400-3600 MHz as the primary band for the introduction of 5G services in India before 2020. It is indeed interesting and encouraging to see that Region 3 Asia is spearheading this band as primary. Making sure a timely deployment plan for this band is crucial for the 5G network rollout in India.

We believe TDD frequency arrangement is optimal in this band for enabling seamless evolution of LTE deployment to 5G NR. The harmonized adoption of these mid-bands will affect huge critical mass for rapid ecosystem development and economies of scale.

3GPP, as part of Release 15 is working on channel planning for 3300-3400 MHz band for LTE deployment that will pave the path for seamless progression to 5G across the entire range of 3300-4200 MHz. There is considerable momentum across stakeholders to implement early LTE deployments in this range to seamlessly evolve to 5G subsequently.

The 3300-3600 MHz band therefore provides the opportunity for a flexible and early deployment for 4G/LTE capacity in India, to be later an important band for 5G either as a *standalone NR or dual-connectivity LTE/NR implementation together with mmWave spectrum. To achieve a 5G experience using the 3300-3600 MHz bands there is an expectance for a spectrum block of around 50-100 MHz/operator in the mid-band ranges combined with the order of 500-1000 MHz or more per operator in parts of the early mmWave range 24.25-43.5 GHz*. *In addition, there are also other bands being specified in 3GPP for NR that are today used in India like the 1800 MHz, 2100 MHz, and the 2600 MHz bands that can in future can be integrated as 5G bands*.

The currently available radio and baseband products in the market now, can work with LTE and are easily upgradable to 5G NR. This means that operators will have a robust and future-proof installed base. This also results in that equipment for transport and radio site material can be the same for LTE and 5G NR and will have a high level of potential reuse.

The introduction of 5G NR in an LTE network can follow different scenarios, depending on the specific situation for the operator. *One possibility is that the operator launches 5G first on a new frequency, keeping the LTE frequency usage unchanged. This is a very likely scenario, since the traffic load on LTE is most likely very high at the time when 5G NR is being introduced*. *Device penetration for 5G NR will be low in the early days, which means that operators will not have the possibility to quickly change from LTE to 5G NR on existing spectrum.* However, when time passes, more people will have 5G NR capable devices and at a certain point in time, the operator will have the possibility to change from LTE to 5G NR standard on their installed base, instantaneously adding additional 5G NR capability to their sites.

On other sites, with lower traffic load, operators will have the possibility to change earlier from LTE to 5G NR, for instance to quickly increase their 5G NR coverage area, which might be an important aspect to attract and retain customers.

Equally important is the tight interworking between LTE and 5G NR that is needed to offer customers an uninterrupted high experience in the network when moving around, also during the initial phases of 5G NR build-out, when the 5G NR coverage can be expected to be patchy. Fallback to LTE should be smooth and instantaneous and tight interworking needs to be secured in the packet core network and the radio baseband processing equipment.

All this means that we can expect a very smooth and seamless evolution for operators when introducing 5G NR functionality to their existing networks.

The following figure (figure 1) exhibit some of the vital steps of evolving a 3G/4G networks towards 5G. The first steps involve a multi-standard radio, allowing a dynamic use of the radio and spectrum resources based on changing end-user demand in 2G, 3G and 4G over time. LTE advanced and Massive IoT functionality like carrier aggregation and NB-IoT in the deployed 4G network. The second three steps allow so called 5G specified functionality to be implemented as ‘5G SW plug-ins’ in a modern 4G network. The final step in the evolution of a 3G/4G network is implementing 5G NR carrier allowing for an order of magnitude higher system bandwidth.

The key benefits of an efficient NW evolution to 5G is about:

- Maximizing the re-use of 3G/4G investments
- Optimizing the use of valuable 3GPP spectrum
- Allowing end-user demand driven use of resources, minimizing redundant investments

Ultimately, it’s about maximizing the use of valuable spectrum resources allowing for best user experience at lowest possible TCO (total cost of ownership) – safeguarding high performance and the production cost of existing and future services.

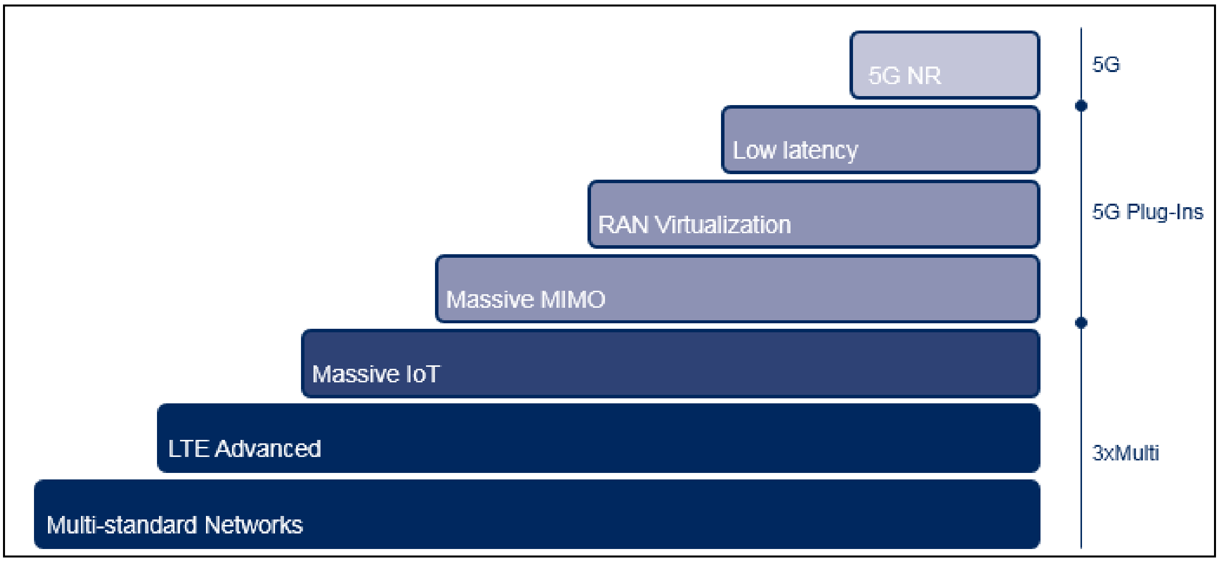

Figure 1 – Key steps in evolving a mobile network towards 5G

Maximizing the use of valuable spectrum and access network resources, safeguarding network performance and the production cost of existing and future services.

ANNEXURE

CHAPTER-IV: ISSUES FOR CONSULTATION

Question 3

What should be optimal block sizes and minimum quantity for bidding in (a) 3300-3400 MHz and (b) 3400-3600 MHz bands, keeping in mind both the possibilities i.e. frequency arrangement could be FDD or TDD? Please justify your response.

Ericsson response –

As per ITU-R Radio Regulations (2016), there is a large consensus for 3400-3600 MHz band which facilitates economies of scale in Region 3 –

Figure 2 – Support for Mid-bands in ITU-R Radio Regulations (2016)

Besides, as per GSA reports, momentum is building around these bands for 5G, in other regions / countries as well as detailed in the schematic below -

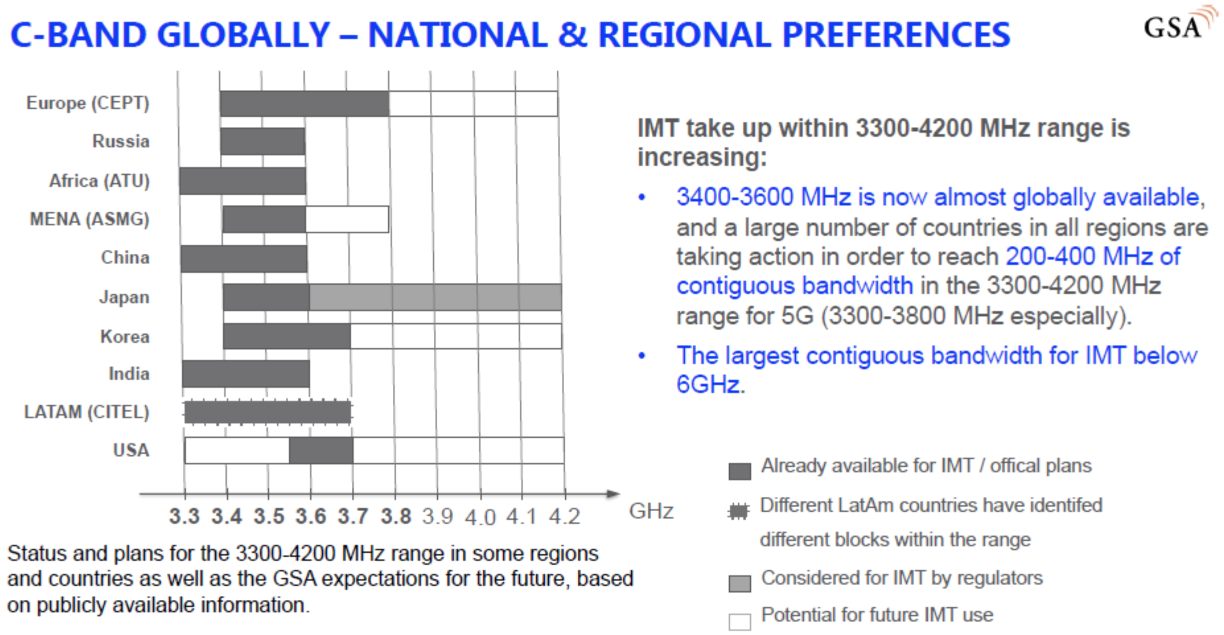

Figure 3 – Global momentum on Mid-bands

As a natural evolution from 4G to 5G which is being designed with TDD as prime focus, Ericsson would request TDD frequency arrangement for 3300-3400 and 3400-3600MHz bands.

3GPP is working on 5G-NR channel arrangements for 3300-4200 MHz which is an important first step towards creation of a 5G ecosystem across the whole range.

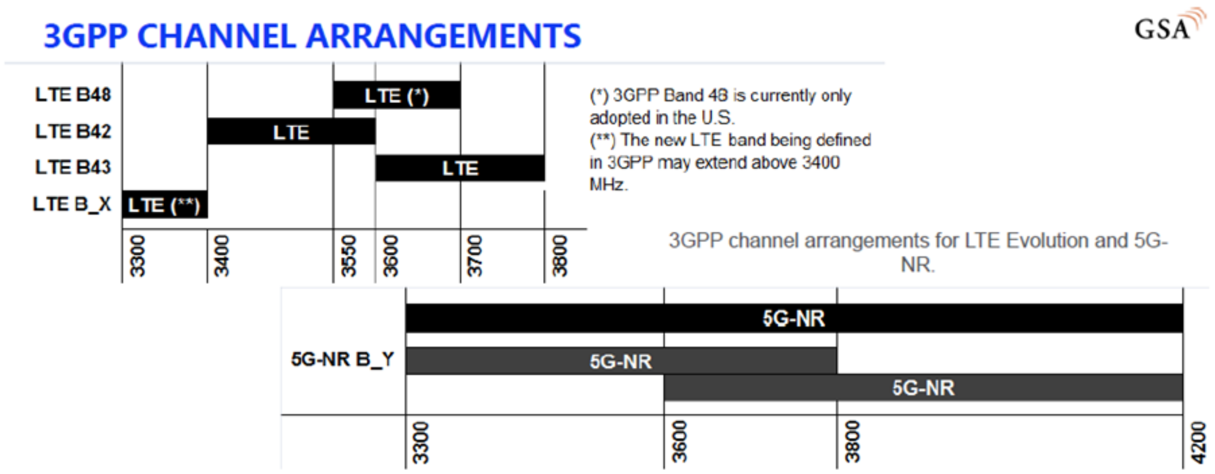

Figure 4 – 3GPP Channel Arrangements for 3300-4200 MHz range

To offer multi-gigabits/s mobile broadband services (MBB), 5G would essentially require large contiguous spectrum blocks per operator to roll out 5G services, Ericsson requests TRAI to recommend larger and contiguous block sizes. The 3300-3400 and 3400-3600 MHz bands provision a total of 300 MHz spectrum which is adequate to facilitate a minimum block size of 50 MHz or 60 MHz or 80 MHz or 100 MHz blocks, to be held by individual operators.

NR bands, combinations and bandwidths

The 3GPP is working on developing the various channel size configuations based on various sub-carrier spacings (different SCS's to address various diverse use cases) for both LTE refarming bands and 3.3-4.2 GHz mid-band range. While the work is in progress, a broad indicative view may be had from the table belolw –

LTE Refarming bands for 5G-NR –

Table - I

	SCS (15 KHz)	SCS (30 KHz)	SCS (60 KHz) (over 1 GHz bands)
	Channel Sizes (MHz)		
Band 1	5, 10, 15, 20	10, 15, 20	10, 15, 20
Band 3	5, 10, 15, 20, 25	10, 15, 20, 25	10, 15, 20, 25
Band 7	5, 10, 15, 20	10, 15, 20	10, 15, 20
Band 8	5, 10, 15, 20	10, 15, 20	NA
Band 20	5, 10, 15, 20	10, 15, 20	
Band 28	5, 10, 15, 20	10, 15, 20	
Band 41	10, 15, 20, 40, 50	10, 15, 20, 40, 50, 60	10, 15, 20, 40, 50, 60
Band 66	10, 15, 20, 40	10, 15, 20, 40	10, 15, 20, 40
Band 70	5, 10, 15, 20, 25	10, 15, 20, 25	10, 15, 20, 25
Band 71	5, 10, 15, 20	10, 15, 20	NA

C-Band (for 5G-NR) -

Table - II

	SCS (15 KHz)	SCS (30 KHz)	SCS (60 KHz) (over 1 GHz bands)
	Channel Sizes (MHz)		
3.3-4.2GHz range	10, 15, 20, 25, 40, 50	10, 15, 20, 25, 40, 50, 60, 80, 100	10, 15, 20, 25, 40, 50, 60, 80, 100

For mmW ranges (for 5G-NR) –

The follownog thought is building up-

Table - III

	SCS (60 KHz)	SCS (120 KHz)
	Channel Sizes (MHz)	
24.25 – 29.5 GHz	50, 100, 200	[50], 100, 200, 400
31.8 – 33.4 GHz	50, 100, 200	50, 100, 200, 400
37-40 GHz	50, 100, 200	50, 100, 200, 400

To be specific, we recommend a minimum block size of 10MHz with a minimum average holding of 50 MHz per operator for 5G/NR deployments.
