Submission to the Telecom Regulatory Authority of India (TRAI):

Comments on Consultation Paper 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

OCTOBER 4TH, 2017

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Table of Contents

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1. Executive Summary

Samsung Electronics Co., Ltd (hereinafter Samsung) is pleased to submit a response to the TRAI consultation paper 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"[1]. Samsung is grateful for the opportunity to work with the TRAI and to support India be a global wireless leader, and realize the economic and social benefits of mobile communications.

In section 2, Samsung provides comments and suggestions on the issue for questions listed in consultation paper. Samsung fully supports the consultation by the TRAI relating to mobile communications to provide additional spectrum bands for 3G and 4G. These additional spectrum bands would be important to support reliable mobile communication services in India. On the other hand, we believe that it is also important to take into account new spectrum bands for future communications, in the view of the so called 5G, which are being requested by global markets and expected to be made available around 2020. In this regard, Samsung strongly suggests the TRAI to take into account further spectrum bands i.e. including, both below 6 GHz bands and mmWave bands, to enable all 5G deployment options. In order to drive an early 5G market appropriately and to realize the full potential of 5G, Samsung would especially encourage the TRAI to introduce both bands i.e. below 6 GHz focusing on 3.4 GHz band and mmWave bands focusing on 24 – 40 GHz bands (esp. 28 GHz) at the same time, as described in this document. We strongly believe that such advance consultation and preparation is necessary and aligned with the emerging National Telecom Policy (NTP) discussions (for example, 100% coverage of 10 Gbps across urban India, and 1 Gbps across rural India), and will be essential to realize the ambitious and key programs such as Digital India, Smart Cities, Make in India and BharatNet, established by Govt. of India to accelerate technology adoption and utilization.

Finally, Samsung would like to thank the TRAI for the opportunity to comment on the consultation, and looks forward to working closely with the TRAI for spectrum aspects in a continuous manner.

2. Comments and Suggestions

In this section, Samsung provides comments and suggestions for some questions listed in the consultation paper.

Q1. (a) In your opinion when should the next access spectrum auction be held?
(b) If the spectrum auction is held now, should the entire spectrum be put to auction or should it be done in phased manner i.e. auction for some of the bands be held now and for other bands later based on development of eco system etc?
Please give your response band wise and justify it.

Samsung is of the view that the appropriate timing for the next auction in India would be depended on a situation of mobile traffic in India and key national programs of the Govt. of India. Several spectrum bands have been provided to the Indian mobile operators by auctions. Taking into account global trends, Samsung supports bands 700 MHz, 1.8 GHz, 2.1 GHz, 2.3 GHz and 2.5 GHz as listed in the consultation paper, which could be provided for 4G service continuously in a phased manner depending on availability of spectrum, i.e. wherever largest spectrum is available, priority should be

1 Available at http://trai.gov.in/sites/default/files/Spectrum_CP_28082017.pdf

given to that band. We recognize that LTE penetration ratio in India is increasing rapidly, and with the significant mobile subscriptions of nearly 1.2 billion, it is imperative that adequate planning becomes very essential. Further, it is expected that more spectrum bands for LTE in India would be required based on growing needs from market, users and mobile operators.

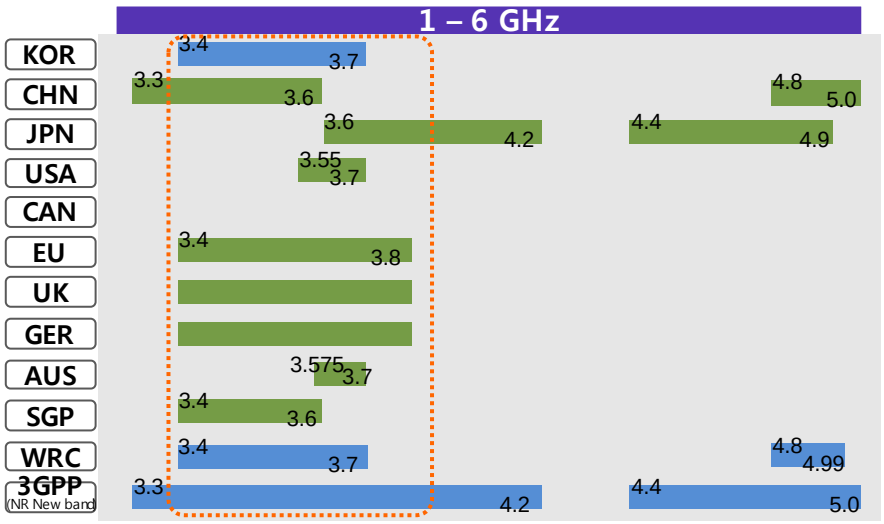
Moreover, Samsung suggests the TRAI to consider not only spectrum bands for 3G/4G but also spectrum bands for 5G for future auction for mobile communications in India.

Q2. Do you agree that in the upcoming auction, block sizes and minimum quantity for bidding in 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz, be kept same as in the past auction? If not, what should be the band-wise block sizes? Please justify your response.

No specific suggestion. On the other hand, it is well recognized that the LMLC (Low Mobility Large Cell) is one of the key features for 5G service in India. As noted in Report ITU-R M.[IMT-2020.EVAL], bands below 1 GHz such as 700 MHz could be considered for LMLC service. It may therefore be required that the Govt. of India carefully estimate the timing of auction, block sizes, etc., as appropriate.

Q3. 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.

According to outcomes from WRC-15, 3.3-3.4 GHz band was identified towards IMT for India in accordance with Radio Regulations 5.429F. As well, the band 3.4-3.6 GHz was also identified to IMT for India by WRC. At present, there is a huge momentum in the global market to use 3.3-3.6 GHz band for 5G service as illustrated in the following figure:



[Figure 1. Global spectrum outlook for 5G focusing on C-band]

And the band 3.3-3.6 GHz was defined as one of the spectra for 5G NR in 3GPP. Of course, the key spectrum band might be focused on 3.4-3.6 GHz taking into account movements from several leading countries. However there is a merit when the band 3.3-3.6 GHz would be provided to IMT services at the same time. Therefore, we believe that the entire band from 3.3 GHz to 3.6 GHz could be provided to Indian mobile communication market, to meet the local market needs within India. Furthermore,

TDD frequency arrangement would be better option than FDD frequency arrangement from efficient spectrum usage and global harmonization perspective, because a FDD frequency arrangement would require to almost double-up the spectrum for uplink and downlink. In our view the block size of 20 MHz seems optimal as the minimum quantity for bidding in 3.3 GHz to 3.6 GHz.

Meanwhile Samsung fully understands this consultation is only focusing on spectrum band below 6 GHz in order to be considered for 3G and 4G market in India. However, as noted above, Samsung suggests the TRAI to consider 5G spectrum not only including bands below 6 GHz focusing on 3.4/3.5 GHz band, but also mmWave bands focusing on 26/28[2] GHz bands. And we expect that the Indian administration has an interest in mmWave bands for 5G, because the Indian administration proposed some candidate frequency bands above 24 GHz at WRC-15[3]. For your reference, we provide some useful information enclosed in the Appendix of this document, "**Global trends on 5G spectrum in mmWave bands"**.

Q4. Do you think that the roll-out conditions for 700 MHz, 800 MHz, 900 MHz, 1800 MHz, 2100 MHz, 2300 MHz and 2500 MHz stipulated in the last auctions held in October 2016 are appropriate? If no, what changes should be made in the roll out obligations for these bands?

We understand that the roll-out conditions for both 2.3 GHz band and 2.5 GHz band were required 1) to provide the street-level coverage in at least 90% of the LSA within 5 years for Metro LSAs and 2) to provide at least 50% of the rural SDCAs are covered within 5 years of the effective date for non-Metro LSAs. Meanwhile the roll-out obligations for other bands such as 700 MHz, 850 MHz and 1.8 GHz were to provide within 1 year. We are of the view that both 2.3 GHz band and 2.5 GHz band are very important bands for mobile communication services in India. Therefore, we strongly support that the roll-out obligations for 2.3 GHz band and 2.5 GHz band should be changed from 5 years to 1 year, taking into account current mobile deployment and service situations in India. With that, change of roll-out obligations for these bands would produce good results from future auctions and would expand mobile communication market in India.

Q5. Should there be any rollout obligations in 3300-3400 MHz and 3400-3600 MHz bands? If yes, what should these be? Please justify your response.

Taking into account global trends of 3.3 – 3.6 GHz band for 5G usage, we propose these bands (3.3 GHz – 3.6 GHz) should be used for 5G in India as described Q3 above. Once again, these bands are very important for 5G era, considering their global adoption for 5G in many regions around the world.

At present, many within mobile industry are absorbed in development and preparation for these bands for 5G. However, we think that the market for these bands would be well-matured only after a few years. In this regard, the roll-out obligations for these bands should be allowed a reasonable period for preparation, as appropriate. Thus, we propose the roll-out obligation for these bands as follows:

1) For Metro LSAs, to provide the street-level coverage in at least 90% of the LSA within 5 years

2) For Non-Metro LSAs, to provide at least 50% of the rural SDCAs are covered within 5 years

[2] 26 GHz band (24.25-27.5 GHz) and 28 GHz band (26.5/27.5-29.5 GHz)

[3] WRC-15 contribution from India (Addendum 24 to Document 107)

Q6. Is there a need to prescribe spectrum cap in bands 3300-3400 MHz and 3400-3600 MHz? What spectrum cap provisions should be kept for 3300-3400 MHz and 3400-3600 MHz spectrum bands? Should these bands be treated as same or separate bands for the purpose of calculation of spectrum cap?

As we suggested in Q3 above, 3.3 – 3.6 GHz band would be appropriate band for 5G. Currently many administrations are taking into account wide spectrum cap for this band. In addition, the channel bandwidth for this band is up to 100 MHz in 3GPP. Moreover, this band compared to other bands below 6 GHz can provide wide spectrum band for eMBB usage scenario. Therefore, we propose the spectrum cap for this band to 100 MHz.

For Q7 to Q19, we do not provide specific comments.

3. Acronyms and Abbreviation

3GPP	3rd Generation Partnership Project
CEPT	Conference of European Postal and Telecommunications administrations
EC	European Commission
eMBB	Enhanced Mobile Broadband
FCC	Federal Communications Commission
FDD	Frequency Division Duplex
FSS	Fixed Satellite Service
FWA	Fixed Wireless Access
GSA	Global mobile Suppliers Association
IMT	International Mobile Telecommunications
ITU	International Telecommunications Union
LSA	License Service Area
MIC	Ministry of Internal Affairs and Communications
MIIT	Ministry of Industry and Information Technology
MIMO	Multiple Input Multiple Output
mMTC	Massive Machine Type Communications
MSIP	Ministry of Science, ICT and Future Planning
NR	New Radio
R&O	Report and Order
TDD	Time Division Duplex
URLLC	Ultra-reliable and Low Latency Communications

WRC	World Radiocommunication Conferences

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Appendix: 1

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Appendix 1

Global trends on 5G spectrum in mmWave bands

Recently, many countries and regions such as USA, Korea, Japan, China and Europe have announced their 5G spectrum strategy and roadmap judging that the year 2018-2020 is the right time to deploy 5G commercial systems.

The US FCC R&O (FCC 16-89[4]) and the European 5G Action plan[5] provide representative cases.

The US FCC decided to provide 28 GHz, 37-38.6 GHz (hereinafter 38 GHz) and 38.6-40 GHz (hereinafter 39 GHz) as licensed bands as well as 64-71 GHz (hereinafter 66 GHz) as unlicensed band for early 5G market as announced in their policy and technical regulation on July 14th, 2016. It is expected that the first pre-standard 5G commercial services will be provided by operators in USA from early 2018 using the 28 GHz band for Fixed Wireless Access (FWA) service as the first band for 5G among the mmWave bands. Currently 5G FWA deployment has been led by US operators including AT&T and Verizon supported by number of multiple mobile equipment industry leaders. With a combination of operators' and equipment vendors' efforts, the commercialization of 5G FWA using 28 GHz band will begin in early 2018. And it is expected that 5G mobile service using 28 GHz band would begin in 2019 onwards.

The European Commission (EC) invites the Member States to deploy early 5G networks by the end of 2018, followed by fully commercial 5G services by the end of 2020 by publishing the 5G Action Plan. In November 2016, the European Commission and the 48 CEPT[6] countries agreed that the 24.25-27.5 GHz (hereinafter 26 GHz) band should be one of the "pioneer bands" for 5G in Europe. And the 3.4-3.8 GHz band would be a strategic band for 5G in Europe.

On January 21st, 2017, Korea MSIP announced[7] the K-ICT Spectrum Plan in order to use the 28 GHz (26.5-29.5 GHz) band and 3.4-3.7 GHz for 5G commercial service. In particular, the Republic of Korea is planning to use the 28 GHz band for not only 5G trial services during the 2018 Winter Olympic Games but also 5G commercial services before 2020.

Japan MIC published the final report[8] on the 2020 Japan Radio Policy on July 15th, 2016 with regard to their 5G candidate spectrum bands including the 3-4 GHz bands and the 28 GHz band, in order to realize 5G in 2020.

On May 2017, Singapore IMDA released their consultation paper to hear views from industry for 5G spectrum focusing on 3.5 GHz and 28 GHz band.

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4 Available at https://apps.fcc.gov/edocs_public/Query.do?numberFld=&numberFld2=&docket=14-177&dateFld=&docTitleDesc=

5 Available at https://ec.europa.eu/digital-single-market/en/news/communication-5g-europe-action-plan-and-accompanying-staff-working-document

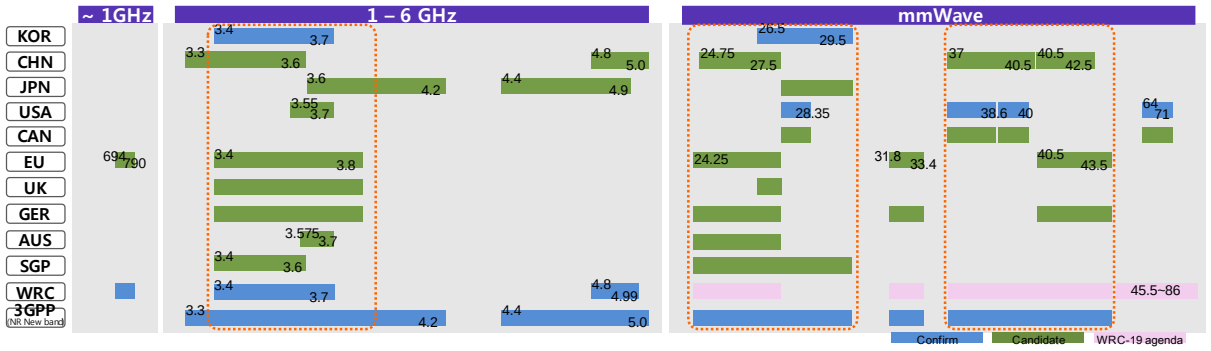
6 http://apps.ero.dk/eccnews/dec-2016/index.html

7 Available at http://msip.go.kr/cms/www/mdFile32.jsp?path=/cms/www/news/news/report/__icsFiles/afieldfile/2017/01/19/170118%2520%25EC%2584%259D%25EA%25B0%2584%2520(%25EB%25B3%25B4%25EB%258F%2584)%2520K-ICT%2520%25EC%258A%25A4%25ED%258E%2599%25ED%258A%25B8%25EB%259F%25BC%2520%25ED%2594%258C%25EB%259E%259C%2520%25EC%2588%2598%25EB%25A6%25BD.pdf (only provided in Korean). Especially, the band 27.5-28.5 GHz will be provided by 2018, and both 26.5-27.5 GHz and 28.5-29.5 GHz bands will also be provided by 2021. However, both 26.5-27.5 GHz and 28.5-29.5 GHz bands will also be provided by 2018 together with the band 27.5-28.5 GHz when user and network equipment for those bands would be available early.

8 Available at http://www.soumu.go.jp/main_sosiki/kenkyu/denpa_2020/02kiban09_03000328.html

On June 2017, China MIIT opened their public consultation to hear views and comments from industry on the 3 – 4 GHz bands, the 26 GHz band and the 40 GHz band for 5G usage in China.

The following figure summarizes the 5G spectrum outlook in the world:

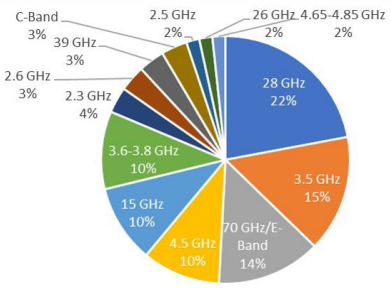


[Figure 2. Global spectrum outlook for 5G]

The ITU-R has proved the technical feasibility for mobile services in the bands above 6 GHz in the Report ITU-R M.2376[9], and the ITU resolves to emphasize the new generation 5G from 2020 by approving Resolution ITU-R 56[10] on naming and introducing "IMT-2020" to the IMT technology family. Recommendation ITU-R M.2038[11] for IMT-2020 deployed by ITU members expected from 2020 onwards stresses a need of mmWave bands to support the different usage scenarios (eMBB, mMTC and URLLC) requiring from several hundred MHz up to at least 1 GHz of contiguous bandwidth. In addition, Report ITU-R M.2370[12] anticipates that global IMT traffic will grow in the range 10-100 times during the years 2020 to 2030. This means that IMT traffic growth via 5G deployment will be explosive and the availability of mmWave bands will be a critical factor to relieve the traffic explosion.

Moreover, WRC-15 established Agenda Item 1.13 for WRC-19 to identify frequency ranges from 24.25 GHz to 86 GHz for IMT-2020 systems to satisfy the requirements of high data traffic such as in dense urban areas and/or in peak times.

Finally, we would like to draw your attention to a recently published report from GSA[13] that shows the distribution of number of 5G demonstrations and trials by stated spectrum band.



[Figure 3. Distribution of 5G Trials]

9 Report ITU-R M.2376 "Technical feasibility of IMT in bands above 6 GHz", July 2015

10 Resolution ITU-R 56-2 "Naming for International Mobile Telecommunications", RA-15, October 2015

11 Recommendation ITU-R M.2083 "IMT-Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond, September 2015

12 Report ITU-R M.2370 "IMT traffic estimates for the years 2020 to 2030", July 2015

13 GSA Report "5G Update – Global Market Trials", Sep 2017

In summary, Samsung recognizes that 5G using bands below 6 GHz and mmWave bands will be necessary to support services that will penetrate into our practical life starting before 2020. Accordingly, Samsung recommends that the TRAI takes into account 5G commercialization 2020 onwards. In particular Samsung believes the frequency bands in the ranges below 40 GHz especially 3.5 GHz, 26 GHz, 28 GHz and 38/39 GHz will be the focus for early equipment eco-system development before 2020. The ability for the mmWave bands, especially the 28 GHz band, to provide high performance and capacity in dense urban areas and in peak times will be a significant and essential driver for 5G services both for mobile access and fixed wireless access, based on a liberalized regulatory and licensing approach.