Joint Response

of APSCC, CASBAA, ESOA and GVF

to the

Consultation Paper

issued by the

Telecom Regulatory Authority of India

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

The Asia-Pacific Satellite Communications Council (APSCC), CASBAA Ltd. (formerly the Cable and Satellite Broadcasting Association of Asia), the EMEA Satellite Operators' Association (ESOA), and the Global VSAT Forum (GVF) welcome the opportunity to provide responses to the Consultation Paper issued by the Telecom Regulatory Authority of India (TRAI) 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 (the "**Consultation**").[1]

APSCC is a non-profit international association representing all sectors of satellite and/or space-related industries, including private and public companies, government ministries and agencies, and academic and research entities. The overall objective of APSCC is to promote communications and broadcasting via satellite as well as outer space activities in the Asia-Pacific for the socioeconomic and cultural welfare of the region.[2]

CASBAA is the leading non-profit trade organization in the Asia-Pacific region seeking to promote multi-channel television via cable, satellite, broadband and wireless networks. CASBAA Ltd. represents around 100 Asia-focused corporations, which in turn provide connections and content to more than 500 million households.[3]

ESOA is a non-profit organization established with the objective of serving and promoting the common interests of EMEA satellite operators. The Association is the reference point for the European, Middle Eastern and African satellite industry and today represents the interests of 34 members, including

[1] Consultation Paper No. 10/2017, dated 28th August 2017.

[2] More information on APSCC can be found at www.apscc.or.kr.

[3] More information on CASBAA can be found at www.casbaa.com.

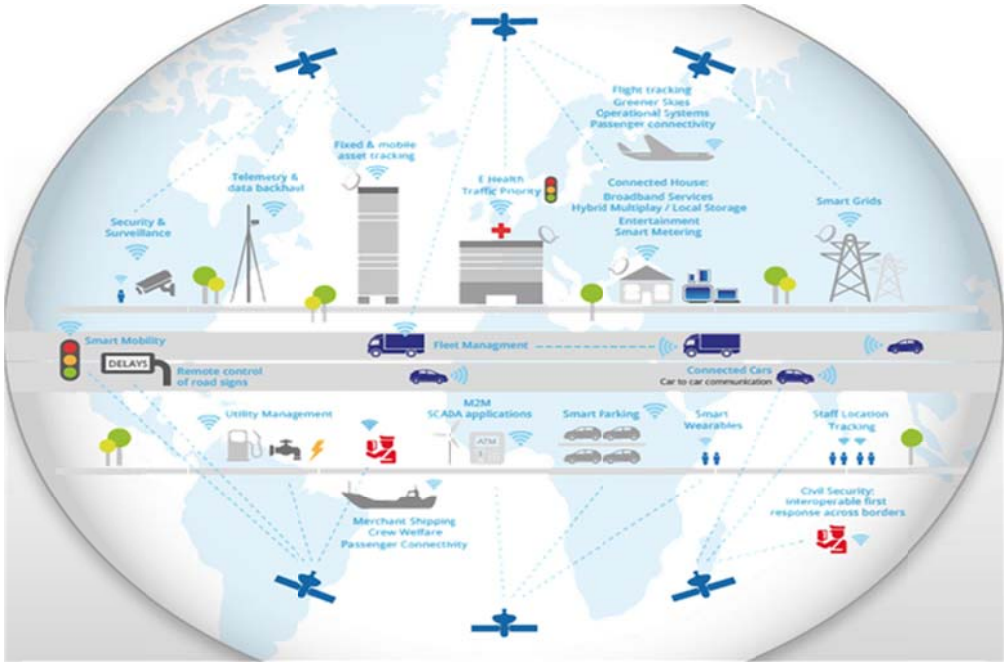
satellite operators who deliver information communication services across the globe as well as EMEA space industry stakeholders and space insurance brokers.[4]

GVF serves as the unified voice of the global satellite communications industry. It brings together organizations engaged in the delivery of advanced broadband and narrowband satellite services to consumers, and commercial and government enterprises worldwide.[5]

1. The Role of Satellites in 5G

The C-Band frequencies between 3400–4200 MHz have been a cornerstone of many satellite services for decades. In addition to its key function in providing connectivity within and to areas with high rain fall rates, where its low susceptibility to rain fade make it the most reliable commercial fixed satellite service (FSS) band, C-band is used for a number of other critical functions as will be explained below.

We would also like to make it clear from the outset that our organizations and the satellite industry as a whole, support the introduction of 5G/IMT services. Indeed, many of our members are actively involved in providing infrastructure and services that will be critical to the success of 5G, and satellites already form a ubiquitous and critical part of the existing global communications infrastructure, as detailed in the figure below.



[4] More information on ESOA can be found at www.esoa.net.

[5] More information on GVF can be found at www.gvf.org.

The visions of the potential applications that will be part of the emerging 5G ecosystem generally include three key usage scenarios:

(a) enhanced mobile broadband;

(b) massive machine-type communications; and

(c) ultra-reliable and low-latency communications.

These 5G usage scenarios are quite diverse in their technical characteristics. Notably, most 5G use cases do not have the extreme bandwidth and/or latency requirements that will only be supported by future 5G terrestrial technologies. As a result, satellites – in both geostationary (GEO) and non-geostationary (non-GEO) orbits – can and will play important roles in supporting the key 5G usage scenarios, including emerging 5G applications (as explained below), just as satellites support 2G, 3G and 4G/LTE networks today. In this regard, satellite technologies will play an important role in the future 5G ecosystem, including:

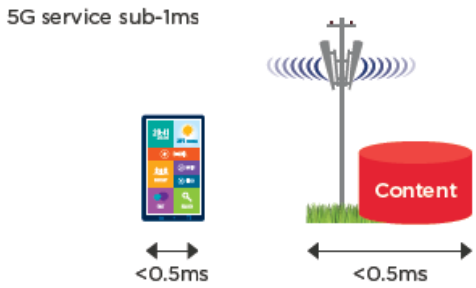
a. To extend terrestrial 5G networks to places they would not otherwise reach, which is essential for a digitally inclusive society.

b. To efficiently support machine-to-machine (M2M) / Internet-of-things (IoT) networks through direct delivery (e.g., connected cars, planes and ships) or backhauling of M2M/IoT data to and from remote locations.

c. To help terrestrial 5G networks meet the low latency (<1ms) requirements of some of the new 5G applications through efficient multicasting of commonly accessed content to storage caches at multiple 5G base stations.

   While most 5G applications (e.g., IoT) will not require such low (<1ms) latency, it is projected that a few, still-emerging applications might (e.g., virtual reality (VR) and autonomous driving). According to the GSM Association (GSMA), "any service requiring such a low latency will have to be served using content located very close to the customer, possibly at the base of every cell, including the many small cells that are predicted to be fundamental to meeting densification requirements."[6]

[6] *See* GSMA Intelligence, *Analysis: Understanding 5G: Perspectives on future technological advancements in mobile*, at 12-13 (Dec. 2014), available at https://www.gsmaintelligence.com/research/2014/12/understanding-5g/451/.



d. To restore connectivity when existing terrestrial networks have been disabled (*e.g.*, after a natural disaster).

Other 5G applications we can identify include:

a. Backhaul for terrestrial mobile networks (e.g., 3G, 4G and 5G in the future).

b. Governmental / institutional closed-user groups.

c. Oil & gas services at fixed locations.

d. Distance learning, telemedicine.

e. Voice over IP (VoIP).

Satellite communications already play comparable roles in today's 2G, 3G and 4G/LTE networks, and are well placed to continue playing such roles for 5G networks as more High Throughput Satellites (HTS) in both GEO and non-GEO orbits are deployed, and as smaller, more advanced, versatile and lower-cost ground antennas and terminals are developed and introduced in the communications marketplace.

We acknowledge the TRAI's decision to auction the 3300-3600 MHz frequency range for IMT. However, as discussed in this response, there is a need for TRAI to examine and understand the extent of deployment of FSS earth stations in the C-band in India, and what will happen to these terminals should they face interference from IMT network deployments. While no one disputes that mobile data traffic is increasing, TRAI should encourage mobile operators to first improve the network density and efficiency within their existing spectrum before asking for additional spectrum which is already extensively used by other services.

2. The Need to Have Continued and Sustainable Access to Spectrum

The 3600-4200 MHz band is currently used by several services, including the Fixed Satellite Service (FSS). FSS earth stations (FSS-ES) are bringing significant economic benefit to India. In a world powered by demand for information and advances in access technology, accessing data communication over satellite services is becoming a very cost-effective reality, resulting in further growth in data traffic especially in the 3600-4200 MHz spectrum due to the coverage attributes that C-band provides.

Most of the world's coverage via C-band is anchored through FSS earth stations that heavily use the 3600-4200 MHz band. C-band frequencies are used for intercontinental links and links with high reliability requirements, including broadcast distribution and satellite telemetry tracking and control. Satellite operators rely heavily on this band because it has a number of advantages over other frequency bands. These advantages include:

- Reach. The large geographic coverage area of C-band satellite beams allows for whole regions or continents to be connected – resulting in a very cost-effective communications network.

- Resilience. C-band is resistant to rain fade. As a result, services provided in C-band offer extremely high reliability, even during heavy rain at or near the uplink and/or downlink stations.

For satellite communications to play their critical and vital role in the development and evolution of the 5G ecosystem, they need continued, sustainable and harmonized access to spectrum. In this context, we would like to underline the fact that certain of the TRAI's statements in the Consultation are incorrect and present risks regarding continuity of critical satellite-based services in India.

The TRAI states in paragraph 2.23 of the Consultation that "Internationally, there appears to be growing interest in use of the 3400-3800 MHz band for Mobile Broadband (MBB)", and in paragraph 2.24 that "as spectrum in frequency range 3300-4200 MHz is likely to emerge as primary band for early 5G introduction, therefore a number of countries in different regions are taking action in order to reach 200-400 MHz of contiguous bandwidth in the 3300-4200 MHz frequency range for 5G."

It is important first to stress the fact that decisions at the 2015 World Radiocommunication Conference (WRC-15) with respect to the identification of spectrum for IMT in the 3400-4200 MHz band[7] were as follows:

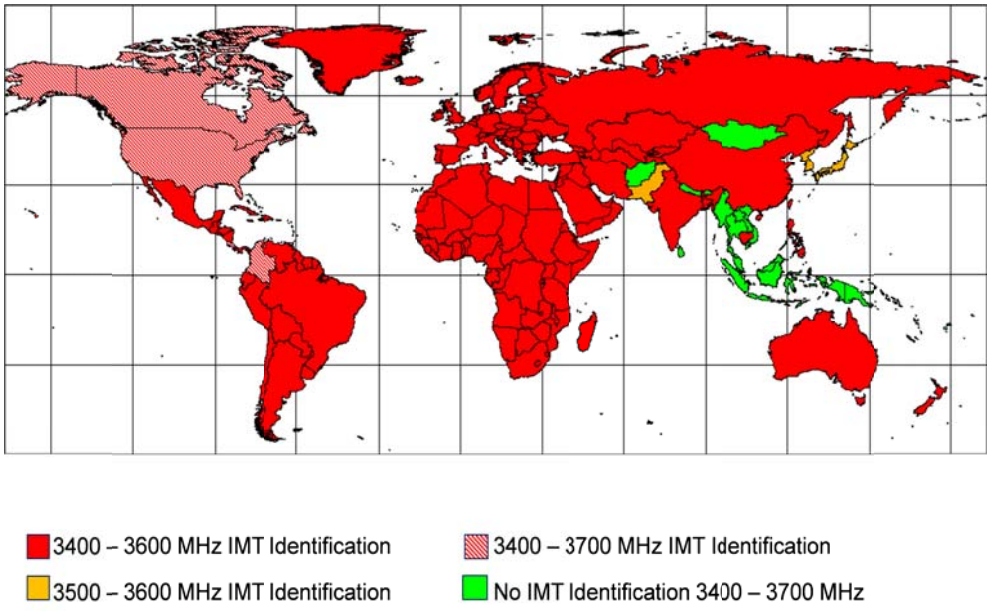
- The 3400-3600 MHz band has an identification for IMT in ITU Regions 1 and 2. In ITU Region 3, the band is identified for IMT in a few countries (including India) under ITU Radio Regulation Nos. 5.432B and 5.433A.

- The 3600-3700 MHz band has been identified for IMT in only four (4) countries in ITU Region 2 (Americas), with no such identification in any other part of the world including India.

- **The 3700-4200 MHz band was preserved for FSS globally in all ITU Regions**.

[7] See Resolution 223 (WRC-15).

The graphic below summarizes the decisions at WRC-15 with respect to the C-band.



WRC-15 further decided not to include frequency bands in the 3600-4200 MHz range on the agenda of WRC-19 for possible identification for 5G. The Indian Administration was instrumental in reaching this conclusion. This is not surprising, as five out of the eight communications satellites launched by ISRO since 2014 carry C-band or extended C-band payloads. It should also be noted that cable systems throughout India rely on C-band for the efficient distribution of video programming around the country to around 100 million households – around 40% of all Indian households. Therefore, we feel that it is incorrect for TRAI to state that the frequency range 3600-4200 MHz will emerge as the primary band for 5G introduction, and this is particularly incorrect in India.

Regarding India's decision to auction the 3300-3600 MHz frequency range for IMT, TRAI should first examine to what extent there are already licensed FSS earth stations in the C-band and what will happen to them. Depending on the number of such earth stations, the services they are providing and their location, it may not be feasible to require such earth stations to vacate the 3400-3600 MHz band. An alternative would be to grandfather them and allow them to continue to operate, with appropriate mechanisms to protect them from IMT interference (e.g., a minimum separation distance or coordination zone around the earth station). The methodology for calculating the necessary separation distances can be found in ITU Report ITU-R S.2368, produced by Joint Task Group 4-5-6-7.[8] In any event, the presence of FSS earth stations in the 3400-3600 MHz frequency range will have to be taken in any valuation of the spectrum to be auctioned.

[8] Report ITU-R S.2368-0, Sharing studies between International Mobile Telecommunication-Advanced systems and geostationary satellite networks in the fixed-satellite service in the 3 400-4 200 MHz and 4 500-4 800 MHz frequency bands in the WRC study cycle leading to WRC-15 (06/2015), available online at http://www.itu.int/pub/R-REP-S.2368-2015.

3. C-band Frequencies Are Used by the Satellite Industry to Provide Critical Services in India

C-band satellite services are critical globally, particularly so in India. C-band frequencies are widely used for media applications, for bringing video content from their providers to digital or analog cable head-ends, and to the distribution facilities of Direct-to-Home (DTH) service providers. C-band is also used for government and public sector communication networks, for corporate applications, as well as for trunking between India's mainland and the Andaman and Nicobar Islands and Lakshadweep. In addition, C-band frequencies in the 4500-4800 MHz range are primarily used by VSAT networks for communications services supporting the stock markets, cellular backhaul and critical banking networks.

India is intensely rainfall-prone, making C-band spectrum important for the delivery of many services via satellite. C-band is the most reliable FSS band in areas with high rainfall rates. In contrast, some of the countries listed in the TRAI Consultation as investigating the identification of further parts of the C-band spectrum for IMT do not experience the same frequent, heavy rainfall rates as India, and consequently do not rely on the C-band frequencies as much as India does for its communications needs.

Aside from the rain fade resistance aspect of C-band frequencies, this spectrum band also permits wide-beam coverage. This is essential for coverage of large geographic areas, even entire continents or across continents. Again, in the case of India, this is a critical advantage over other frequency bands used to provide satellite services.

In this regard, it is important to note the fact that the Consultation does not address the need for protection of current and future satellite stations operating in C-band from possible undue interference from IMT deployments in the 3300-3400 MHz and 3400-3600 MHz bands. The Consultation is silent on the issue of interference from IMT stations and the need to adopt protection measures, despite the fact that high-power terrestrial IMT/5G transmissions below 3600 MHz could prevent the use of the C-band above 3600 MHz as a result of out-of-band emissions from IMT systems, overload of the satellite receiver's Low Noise Block Converter (LNB) or intermodulation effects.

TRAI should note that it is not at all certain that such impacts from terrestrial stations on satellite stations can be effectively addressed through interference mitigation measures, such as filtering, RF screening, and the imposition of power limits around receive earth station sites. Even if such measures could be implemented, there are actual implementation costs (e.g., costs of upgraded equipment, labor and downtime, among others) and ongoing performance impacts (e.g., installation of a filter to shield a satellite station operating above 3600 MHz band would reduce performance across the entire C-band receive spectrum) that must first be addressed before considering how IMT stations will be allowed to operate in the C-band. Protection of satellite stations from undue interference is essential in order for satellite services to continue to provide critical communications services and connectivity to Indian businesses, consumers and government users.

We also recommend that TRAI maintain some rollout obligations on IMT networks across all of the C-band ranges being considered for these networks, while recognizing that it will take longer for mobile operators to roll out in the higher portions of the band. In addition, we would recommend that TRAI permit voluntary spectrum trading between the successful bidders and each other, and between them and other qualified but unsuccessful bidders. We further recommend that in releasing spectrum through auction, TRAI does not bind it to specific technical standards for the duration of the allocations, as

technical standards change faster than regulations and, long term, such binding can reduce the efficiency of spectrum utilization if not frequently reviewed.

Finally, we recommend that TRAI auction all the capacity in the 3300–3400 MHz band first before opening the 3400–3600 MHz band for auction, as the latter higher band is likely to require more careful coordination measures with more existing C-band satellite stations, particularly TV receive-only (RO) stations feeding cable head-ends.

4. Conclusion

For over 40 years, the satellite sector has used C-band frequencies for FSS services. Today, there are more than 170 geostationary satellites operating in the C-band, providing essential services to a multitude of consumers around the world and new C-band FSS earth stations are continually being deployed on a regular basis, not to mention the countless number of receive-only earth station antennas used for TV reception that are distributed globally.

Nevertheless, we appreciate that the TRAI has opened the 3400–3600 MHz band to terrestrial mobile services. This has led to the need to protect satellite networks from the resulting interference and to assure that critical coordination takes place. The best method to doing this is via geographical separation. This is necessary to ensure regulatory certainty to access to satellite spectrum in C-band which is necessary for satellite operators to continue to make the investments required to meet user demands for high-throughput satellite services across the world.

For the reasons stated above, we urge TRAI to adopt measures that adequately protect existing and future satellite services in C-band, in particular services in the bands above 3600 MHz that could be impacted by out-of-band emissions from IMT stations. We would recommend that TRAI impose operational and deployment conditions on mobile operators using the 3400-3600 MHz band for IMT services that ensure that such use does not create any interference to higher frequency bands and, in particular, to satellite receiving terminals deployed above 3600 MHz.

APSCC, CASBAA, ESOA and GVF have the following section-specific comments and recommendations. Only the questions for which we have comments are copied below.

Q.1 (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.

APSCC, CASBAA, ESOA and GVF recommend that TRAI auction all the capacity in the 3300–3400 MHz band first, before opening the 3400–3600 MHz band for auction, as the higher band is likely to require more careful coordination measures with more existing C-band reception systems, particularly TV RO stations feeding cable headends.

Lessons learnt from coordination required in the lower part of the C-band should enable better planning and execution of coordination measures required in the higher portions of the C-band that are being considered for IMT network deployments.

Q.5 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.

In general, APSCC, CASBAA, ESOA and GVF urge TRAI to encourage mobile operators, wherever possible, to first improve the network density and efficiency within their existing spectrum before bidding for additional spectrum which is already extensively used by other services.

APSCC, CASBAA, ESOA and GVF thus recommend that TRAI maintain some rollout obligations across all of the C-band spectrum being considered for auction, while recognising that it will take longer for mobile operators to roll out in the higher portions of this band, not only because IMT networks will be using these bands for the first time and will need time to optimize coverage with relatively untried equipment, but also because of the greater need for frequency coordination measures with existing FSS C-band services, particularly TV RO stations.

In addition, we recommend that TRAI permit voluntary spectrum trading between the successful bidders and each other, and between them and other qualified but unsuccessful bidders.

We further recommend that in releasing spectrum through auction, TRAI does not bind it to specific technical standards for the duration of the allocations, as technical standards change faster than regulations and, long term, such binding can reduce the efficiency of spectrum utilisation if not frequently reviewed.

Q.14 Whether the valuation of the 3300-3400 MHz spectrum bands and 3400-3600 MHz spectrum bands 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, then which alternative method should be used for its valuation? Please justify your response with rationale and supporting documents.

APSCC, CASBAA, ESOA and GVF do not propose any particular valuation mechanism, but suggest that the need for careful coordination with potentially thousands of TV RO stations -- let alone other existing FSS reception antennas -- may complicate, delay and magnify cost of the IMT rollout in these bands, especially the 3400–3600 MHz band as compared to rollouts in the more established mobile bands.

Regarding India's decision to auction the 3300-3600 MHz band for IMT, TRAI should examine to what extent there are already licensed FSS earth stations in the C-band and what to do with them. Depending on the number of such earth stations, the services they are providing and their location, it may not be feasible to require such earth stations to vacate the 3400-3600 MHz band. An alternative would be to grandfather them and allow them to continue to operate, with appropriate mechanisms to protect them from IMT interference (e.g. a minimum separation distance or coordination zone around the earth station). The methodology for calculating the necessary separation distances can be found in ITU Report ITU-R S.2368. In any event, the presence of FSS earth stations in the 3400-3600 MHz will have to be taken in any valuation of the spectrum to be auctioned for IMT.

The current Consultation does not address the need for protection of current and future satellite stations operating in C-band from possible undue interference from IMT deployments in the 3300-3400 MHz and 3400-3600 MHz bands. The Consultation is silent on the issue of interference from IMT stations and the need to adopt protection measures, despite the fact that high-power terrestrial IMT/5G transmissions below 3600 MHz could prevent the use of the C-band above 3600 MHz as a result of out-of-band emissions from IMT systems, overload of the satellite receiver's LNB Converter or intermodulation effects.

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