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Response to TRAI Consultation Paper No. 6/2023; Consultation Paper on Assignment of Spectrum for Space-based Communication Services

Dear Sir,

AsiaSat has had the honor of providing satellite capacity and being a part of India's telecommunications infrastructure ever since the launch of AsiaSat's first satellite, AsiaSat 1, in 1990. Over these three decades, AsiaSat has had the privilege to work with numerous Indian service providers providing a multitude of applications and services to the Indian community and is looking forward to continue this in the years to come.

In this respect, AsiaSat is pleased to offer its replies on the Consultation Paper No. 6/2023 on Assignment of Spectrum for Space-based Communication Services. In the attachment to this letter, responses are given in respect of selected questions contained in the consultation paper. AsiaSat would be pleased to offer any additional information that TRAI might seek or to respond to any other questions that TRAI might have.

Yours Sincerely



Per Hovstad
Principal Spectrum Engineer
Asia Satellite Telecommunications Co. Ltd.

Attachments: 1



ATTACHMENT

AsiaSat response to questions in TRAI Consultation Paper on Assignment of Spectrum for Space-based Communication Services

Q1. For space-based communication services, what are the appropriate frequency bands for (a) gateway links and (b) user links, that should be considered under this consultation process for different types of licensed telecommunications and broadcasting services? Kindly justify your response with relevant details.

AsiaSat response: Satellite links are an important part of India's telecommunication infrastructure, providing internet and broadband connections countrywide, connecting remote and sparsely populated areas and connecting 4G and 5G cells to the mobile network through backhaul links. Satellites furthermore provide TV distribution, including direct-to-home and cable TV head-end feeds and satellite news gathering and video distribution links between studios, domestically and internationally. Satellite links furthermore plays a crucial role in disaster relief operations. In later years, satellite connections also have become an integral part of the IMT ecosystem, providing 5G applications such as IoT and M2M connections.

To further develop India's telecommunication infrastructure and connect the yet unconnected villages and areas to provide internet, broadband and 4G/5G mobile connections, satellite links will be even more important, offering the often only realistic and economic solution.

In the frequency bands most commonly used by communication satellites such as C-, Ku- and Ka-band, earth stations use highly directional antennas enabling reception of one satellite while efficiently discriminating signals from satellites at other orbit locations. This means that at the same location on ground, signals from a large number of satellites can be received at the same frequency, both geostationary and non-geostationary satellites. Compatibility between all these satellite networks is governed by ITU regulatory provisions.

This extensive re-use by satellite networks of the same frequencies at the same geographic location has enabled satellite connections to be offered in a competitive manner, providing efficient and economic telecommunications solutions. This is also seen in the current telecommunications infrastructure of India where many operators implement a multitude of services using multiple satellites, many of which operate at the same frequencies.

For India to retain its telecommunications infrastructure and further develop this to meet its objectives, it is crucial to ensure continued competitive satellite offerings and enable use of the capacity a large number of satellites to meet the evolving needs in an economic and efficient manner.

To achieve this, it is important that multiple users can use the same scarce frequency resources with multiple satellite networks at the same location. Granting exclusive rights to one user and/or one satellite network for a given frequency band in an area

would bring to a halt the current use of satellite resources in the Indian telecommunication infrastructure with its widespread frequency re-use and hinder further developing the telecommunication infrastructure to reach the hitherto unserved, or underserved, areas of India.

For these reasons, to the best of knowledge of AsiaSat, no other country has allocated frequency resources for space-based communications through an auctioning process and those few that have tried have failed for the same reasons.

For frequency bands like C-, Ku- and Ka-band, where frequency re-use between several satellite networks is feasible and currently is widespread throughout India, granting exclusive rights to one user and/or one satellite network through auctioning therefore is strongly inadvisable.

Q2. What quantum of spectrum for (a) gateway links and (b) user links in the appropriate frequency bands is required to meet the demand of space-based communication services? Information on present demand and likely demand after about five years may kindly be provided in two separate tables as per the proforma given below:

AsiaSat response: Spectrum requirement for individual gateway links and user links will vary significantly depending on application, magnitude of operation and customer base etc. and can vary from around 100 kHz to several hundreds of MHz per link (bearing in mind that each link consist of an uplink and a downlink at different frequencies). In respect of frequency range, satellite users typically will lease capacity in satellite transponders (channels) that are available for lease. The actual frequency therefore could be anywhere within the frequency range of the satellite.

Common C-, Ku- and Ka-band frequency ranges identified by ITU for satellites that may be used in India include:

C-band	3 400-4 200 MHz	Downlink (space-to-Earth)	Frequency band not subject to ITU space plans
	5 850-6 725 MHz 7 025-7 075 MHz	Uplink (Earth-to-space)	
	4 500-4 800 MHz	Downlink	Frequency band subject to ITU space plans (RR Appendix 30B)
	6 725-7 025 MHz	Uplink	
Ku-band	10.95-11.2 GHz 11.45-11.7 GHz 12.2-12.75 GHz	Downlink	Frequency band not subject to ITU space plans
	13.75-14.5 GHz	Uplink	
	10.7-10.95 GHz 11.2-11.45 GHz	Downlink	Frequency band subject to ITU space plans (RR Appendix 30B)
	12.75-13.25 GHz	Uplink	

	11.7-12.2 GHz	Downlink	Frequency band subject to ITU space plans (RR Appendix 30)
	14.5-14.8 GHz 17.3-18.1 GHz	Uplink	Frequency band subject to ITU space plans (RR Appendix 30A)
Ka-band	17.7-20.2 GHz	Downlink	Frequency band not subject to ITU space plans
	27.0-30.0 GHz	Uplink	

Within these ranges identified by ITU, India may select all or sub-bands for use for satellite operation within India. In particular the frequency bands not subject to ITU space plans are commonly used by satellites offering services to Indian customers.

Type of service	Name of the satellite system	Type of satellite (GSO / LEO/ MEO)	Frequency range and quantum of spectrum required							
			User Link (Earth to space UL)		User Link (Space to Earth DL)		Gateway Link (Earth to space UL)		Gateway Link (Space to Earth DL)	
			Frequency range	Quantum (in MHz)	Frequency range	Quantum (in MHz)	Frequency range	Quantum (in MHz)	Frequency range	Quantum (in MHz)
Access										
Internet										
NLD										
ILD										
GMPCS										
VSAT CUG Commercial										
Captive VSAT CUG										

Machi ne to Machi ne (M2M)										
DTH										
Telepo rt										
DSNG										
HITS										
IFMC										
Any other rele vant servi ce (pleas e specify)										

Q3. Whether there is any practical limit on the number of Non-Geo Stationary Orbit (NGSO) satellite systems in Low Earth Orbit (LEO) and Medium Earth Orbit (MEO), which can work in a coordinated manner on an equitable basis using the same frequency range? Kindly justify your response.

AsiaSat response: AsiaSat is a GSO satellite operator and expresses no view on this.

Q4. For space-based communication services, whether frequency spectrum in higher bands such as C band, Ku band and Ka band, should be assigned to licensees on an exclusive basis? Kindly justify your response. Do you foresee any challenges due to exclusive assignment? If yes, in what manner can the challenges be overcome? Kindly elaborate the challenges and the ways to overcome them.

AsiaSat response: The C-, Ku- and Ka-band spectrum currently is shared by a multitude of satellite users to form the Indian telecommunications infrastructure as of today and more satellite users sharing the same spectrum is needed for India to meet its objectives of developing the telecommunication infrastructure. Assigning portions of this spectrum on an exclusive basis would be contrary to current use and the need of India to further develop its telecommunications infrastructure. It is also to be noted that just ISRO alone is offering the same spectrum for use at the same locations in India from multiple satellite networks in multiple orbit locations. Assigning spectrum on an exclusive basis therefore is strongly advised against. See also the reply to Q1.

India is sovereign to determine its spectrum and licensing legislation, e.g. in respect of spectrum allocation for satellite vs. spectrum allocation for terrestrial use,

coordination procedures between multiple domestic satellite operators and also in respect of landing rights issues and requirements for satellite networks registered to ITU through other countries to be allowed to offer services in India. However, one important element is that no matter what kind of landing rights policy is adopted, in a given geographic area, more than one user must be able to access a given portion of spectrum and in respect of more than one satellite networks.

Q5. In case it is decided to assign spectrum in higher frequency bands such as C band, Ku band and Ka band for space-based communication services to licensees on an exclusive basis,

- (a) What should be the block size, minimum number of blocks for bidding and spectrum cap per bidder? Response may be provided separately for each spectrum band.
- (b) Whether intra-band sharing of frequency spectrum with other satellite communication service providers holding spectrum up to the prescribed spectrum cap, needs to be mandated?
- (c) Whether a framework for mandatory spectrum sharing needs to be prescribed? If yes, kindly suggest a broad framework and the elements to be included in the guidelines.
- (d) Any other suggestions to ensure that that the satellite communication ecosystem is not adversely impacted due to exclusive spectrum assignment, may kindly be made with detailed justification.

Kindly justify your response.

AsiaSat response: Assigning C-, Ku- and/or Ka-band satellite spectrum to one licensee on an exclusive basis would inevitably lead to an adverse impact on India's satellite communication ecosystem and is therefore strongly advised against. See also replies to Q1 and Q4.

Q6. What provisions should be made applicable on any new entrant or any entity who could not acquire spectrum in the auction process/assignment cycle?

- (a) Whether such entity should take part in the next auction/assignment cycle after expiry of the validity period of the assigned spectrum? If yes, what should be the validity period of the auctioned/assigned spectrum?
- (b) Whether spectrum acquired through auction be permitted to be shared with any entity which does not hold spectrum/ or has not been successful in auction in the said band? If yes, what measures should be taken to ensure rationale of spectrum auction and to avoid adverse impact on the dynamics of the spectrum auction?

(c) In case an auction based on exclusive assignment is held in a spectrum band, whether the same spectrum may again be put to auction after certain number of years to any new entrant including the entities which could not acquire spectrum in the previous auction? If yes,

(i) After how many years the same spectrum band should be put to auction for the potential bidders?

(ii) What should be the validity of spectrum for the first conducted auction in a band? Whether the validity period for the subsequent auctions in that band should be co-terminus with the validity period of the first held auction?

Kindly justify your response.

AsiaSat response: Assigning access to C-, Ku- and/or Ka-band spectrum on an exclusive basis is strongly advised against. See replies to Q1 and Q4.

Q7. Whether any entity which acquired the satellite spectrum through auction/ assignment should be permitted to trade and/or lease their partial or entire satellite spectrum holding to other eligible service licensees, including the licensees which do not hold any spectrum in the concerned spectrum band? If yes, what measures should be taken to ensure rationale of spectrum auction and to avoid adverse impact on the dynamics of the spectrum auction? Kindly justify your response.

Q8. For the existing service licensees providing space-based communication services, whether there is a need to create enabling provisions for assignment of the currently held spectrum frequency range by them, such that if the service licensee is successful in acquiring required quantum of spectrum through auction/assignment cycle in the relevant band, its services are not disrupted? If yes, what mechanism should be prescribed? Kindly justify your response.

Q9. In case you are of the opinion that the frequency spectrum in higher frequency bands such as C band, Ku band and Ka band for space- based communication services should be assigned on shared (non- exclusive) basis, -

(a) Whether a broad framework for sharing of frequency spectrum among satellite communication service providers needs to be prescribed or it should be left to mutual coordination? In case you are of the opinion that broad framework should be prescribed, kindly suggest the framework and elements to be included in such a framework.

(b) Any other suggestions may kindly be made with detailed justification. Kindly justify your response.

AsiaSat response: It is advisable that India have a national legislation and landing rights policy to regulate satellite usage within India.

In respect of satellite users, it is advisable that service providers and earth station operators are licensed, depending on the application and the frequency band to be used, either individually or through blanket licensing. Such licensing would then need to lay out who is entitled to provide services in India and under what conditions, including relationship with terrestrial services in shared bands.

In respect of technical compatibility between satellite networks, ITU has frequency coordination procedures and criteria to ensure compatibility between satellite networks of different countries. For foreign satellites to be granted landing rights to offer services in India, one requirement could be that all required frequency coordination in the frequency band in question is completed with Indian satellite networks.

If/when more than one satellite operator is foreseen to operate through ITU filings submitted through India, in addition to the ITU procedures to ensure international compatibility, India needs to have domestic procedures and criteria in place to ensure technical compatibility between satellite networks of different Indian satellite operators. India is sovereign to determine what these procedures and criteria should be and ITU provides no directives in respect of domestic coordination. To develop domestic coordination procedures, one approach could be to base this on the same ones as those of ITU for international coordination, but possibly in a simplified manner.

Q10. In the frequency range 27.5-28.5 GHz, whether the spectrum assignee should be permitted to utilize the frequency spectrum for IMT services as well as space-based communication services, in a flexible manner? Do you foresee any challenges arising out of such flexible use? If yes, in what manner can the challenges be overcome? Kindly elaborate the challenges and the ways to overcome them.

AsiaSat response: In respect of IMT and space communication services sharing the 27.5-28.5 GHz band, for this to be technically feasible, there are two criteria that need to be ensured and need to be a part of the IMT licensing requirements:

- a. The aggregation of interference into receiving satellites by all transmitting IMT stations within the coverage area of the satellites must be at an acceptable level.
- b. Deployment of future transmitting Earth stations must not be hindered in areas where IMT systems are deployed.

To meet a. above, there would need to be limits for transmitting IMT stations in the direction of space. While one single IMT transmitter may not cause significant interference, the aggregation of interference from all transmitting IMT stations within the coverage of the satellite has the potential to cause significant interference. Due to this aggregation of interference from multiple IMT transmitters, possibly originating from several countries, if interference occurs, it is not possible to point at one interfering source to have the situation rectified. For this reason, it is important that as a part of the licensing conditions, limits are imposed on individual IMT base stations

that take into account the aggregating effect and ensures that interference received by the satellites is at a satisfactory level.

AsiaSat has not conducted any studies on what would be the appropriate limits and are not aware of any studies specific for this frequency band, but notes that there currently are several discussions on-going in ITU in respect of protection of receiving satellites from IMT transmissions. AsiaSat also notes that Resolution 242 as established by WRC-19 provides limits aimed at protecting receiving satellites from interference from IMT transmitters, amongst others in the adjacent 27.0-27.5 GHz band where satellite applications should be expected to be similar.

Noting that energy going into space is wasted energy for IMT, it is in the interest of the IMT industry itself to limit such emissions to the maximum extent possible. It is also known that new IMT antenna technology allows beams to be dynamically created in the direction of the desired user terminal. This should also have the effect of reducing the energy transmitted into space. Imposing limits on IMT transmitters in respect of emissions into space therefore may not lead to significant limitations on the deployment of IMT systems.

In respect of b. above, without the right precautions, transmitting Earth stations can interfere with nearby receiving IMT stations. This in turn could lead to limitations on deployment of new transmitting Earth stations once IMT is deployed. However, it is worth noting that possibly with the exception of some few large teleports, transmitting Earth stations will only transmit in a fraction of the IMT band, normally only up to some few megahertz. There will also be frequency bands, e.g. in the 24.25-24.65 and 25.25-27.0 GHz ranges, that are not allocated to satellite use and where there is no potential for interference. Moreover, compared to IMT deployment, transmitting Earth stations will be few and far between. If IMT stations avoid using that particular frequency band in the vicinity of the transmitting Earth station, there would be no interference and no need to limit the earth station deployment.

To avoid limitations on the deployment of transmitting Earth stations, in its simplest form, IMT could be licensed on a non-protected basis in respect of transmitting earth stations and IMT operators will adopt the interference mitigation strategy that they see best fit for their purpose.

One option for IMT operators to mitigate interference from transmitting Earth stations would be to make use of knowledge about the location and operational frequency band of transmitting Earth stations. The IMT network could then be arranged such that the frequencies overlapping with the transmitting Earth station are not used in cells in the vicinity of that Earth station. When Earth stations are removed or established, the IMT system could amend its frequency use to adapt to the changed scenario. To achieve this, Cognitive Radio Systems supported by Software Defined Radio techniques could be used whereby the IMT system obtains information about the interference environment in an area, e.g. through monitoring the interference environment or through accessing a database where Earth station operators would submit information about location and frequency band used of their Earth stations.

To meet a. and b. above, requirements for IMT networks must be laid out as a part of the licensing conditions such that they are taken into account already in the IMT system design. Trying to implement such interference mitigation measures after deployment is likely to prove difficult and costly.

Q11. In case it is decided to permit flexible use in the frequency range of 27.5 - 28.5 GHz for space-based communication services and IMT services, what should be the associated terms and conditions including eligibility conditions for such assignment of spectrum? Kindly justify your response.

AsiaSat response: To allow sharing between space-based communication and IMT in the 27.5-28.5 GHz band, requirements a. and b. as laid out in the response to Q10 above need to be met and these need to be a part of the licensing conditions for IMT such that they are taken into account in the IMT system design, before deployment takes place.

Q12. Whether there is a requirement for permitting flexible use between CNPN and space-based communication services in the frequency range 28.5-29.5 GHz? Kindly justify your response.

AsiaSat response: It is not clear if there is a need to open up for CNPN use in 28.5-29.5 GHz. However, should such use be considered, it is important that this is done in a manner that enables space-based communications to continue to operate and to develop in an efficient manner.

Q13. Do you foresee any challenges in case the spectrum assignee is permitted to utilize the frequency spectrum in the range 28.5-29.5 GHz for cellular based CNPN as well as space-based communication services, in a flexible manner? What could be the measures to mitigate such challenges? Suggestions may kindly be made with justification.

AsiaSat response: Challenges associated with sharing between CNPN and space-based communications would be essentially the same as the requirements to enable co-existence with space-based communication would apply as those for co-existence with IMT in 27.5-28.5 GHz. See responses to Q10 and Q11.

Due to the more limited deployment, interference into receiving satellites would be expected to be less of a problem than for IMT deployment. On the other hand, this band includes the frequency bands where non-geostationary satellite systems are seen to have their main focus and for this reason, larger and more dynamic deployment of transmitting Earth stations, possibly in a ubiquitous manner and/or use of mobile Earth stations, may be expected. Not to hinder development of space-based communications, it is important that this is taken into account in licensing conditions and CNPN system design.

Q14. Whether space-based communication services should be categorized into different classes of services requiring different treatment for spectrum assignment? If yes, what should be the classification of services and which type of services should fall under each class of service? Kindly justify your response. Please provide the following details:

AsiaSat response: In C-, Ku- and Ka-band, the bands 11.7-12.2 and 21.4-22 GHz are allocated by ITU for broadcasting services (downlink) and the 14.5-14.8, 17.3-18.1 and 24.65-25.25 GHz are allocated for feederlinks (uplink) for broadcasting services. Other than that, all other satellite allocated bands in these frequency ranges are generally allocated by ITU for general satellite use and satellites are seen to be built with transponders that can provide a multitude of applications in any of the frequency bands of its transponders.

For this reason, apart from the above mentioned bands, it is not desirable to subdivide the frequency bands and assign different applications to different frequency bands.

One exception would be the 14.3-14.5 and 29.5-30 GHz uplink bands which are not shared with terrestrial services and where it seen to be common to allow ubiquitous deployment of transmitting Earth stations, e.g. for VSAT (very small aperture terminal) and mobile terminals, through blanket licensing.

Another exception would be the 13.75-14.0 GHz band where ITU impose limitations on minimum Earth station antenna size (1.2 m for geostationary satellite networks and 4.5 m for non-geostationary satellite systems) and also power flux density limits along shores and national borders.

a) Service provider-wise details regarding financial and market parameters such as total revenue, total subscriber base, total capital expenditure etc. for each type of service (as mentioned in the Table 1.3 of this consultation paper) for the financial year 2018-19, 2019-20, 2020-21, 2021-22, and 2022-23 in the format given below:

Type of service:				
Financial year	Revenue (Rs. Lakh)	Subscriber base	CAPEX for the year (Rs. Lakh)	Depreciation for the year (Rs. lakh)
2018-19				
2019-20				
2020-21				
2021-22				
2022-23				

b) Projections on revenue, subscriber base and capital expenditure for each type of service (as mentioned in the Table 1.3 of this consultation paper) for the

whole industry for the next five years starting from financial year 2023-24, in the format given below:

Type of service:			
Financial year	Revenue (Rs. Lakh)	Subscriber base	CAPEX for the year (Rs. Lakh)
2023-24			
2024-25			
2025-26			
2026-27			
2027-28			

Q15. What should be the methodology for assignment of spectrum for user links for space-based communication services in L-band and S-band, such as-

- (a) Auction-based
- (b) Administrative
- (c) Any other?

Please provide your response with detailed justification.

AsiaSat response: AsiaSat has no L- or S-band operation and expresses no view on this.

Q16. What should be the methodology for assignment of spectrum for user links for space-based communication services in higher spectrum bands like C-band, Ku-band and Ka-band, such as

- a) Auction-based
- (b) Administrative
- (c) Any other?

Please provide your response in respect of different types of services (as mentioned in Table 1.3 of this consultation paper). Please support your response with detailed justification.

AsiaSat response: For C-, Ku- and Ka-band, assignment of spectrum should be such that the spectrum is used as efficiently as possible and in a competitive manner, re-

used by as many users and satellite networks as possible. To obtain this, spectrum for user links for space-based communications should be assigned through administrative procedures that ensures this takes place in an orderly and technically compatible manner. See also replies to Q1, Q2 and Q4 in this respect.

Q17. Whether spectrum for user links should be assigned at the national level, or telecom circle/ metro-wise? Kindly justify your response.

AsiaSat response: If there is a need to differentiate frequency assignments in different parts of the country, e.g. as a result of international commitments or compatibility with other services, this could be included in the national legislation and licensing conditions. However, in the outset, it is believed that the most effective spectrum usage offering the best telecommunication services in India would come from licensing conditions that are as uniform as possible pan-India.

Q18. In case it is decided to auction user link frequency spectrum for different types of services, should separate auctions be conducted for each type of services? Kindly justify your response with detailed methodology.

AsiaSat response: It is strongly advised against auctioning any kind of space services in C-, Ku- and/or Ka-band. See replies to Q1 and Q4 in this respect.

Q19. What should be the methodology for assignment of spectrum for gateway links for space-based communication services, such as

- (a) Auction-based
- (b) Administrative
- (c) Any other?

Please provide your response in respect of different types of services. Please support your response with detailed justification.

AsiaSat response: Like for user links, in C-, Ku- and Ka-band, there should be a national legislation giving administrative rules regulating the operation and establishing licensing conditions. See also replies to Q1, Q2, Q4 and Q16 in this respect.

Q20. In case it is decided to auction gateway link frequency spectrum for different types of services, should separate auctions be conducted for each type of services? Kindly justify your response with detailed methodology.

AsiaSat response: It is strongly advised against auctioning any kind of space services in C-, Ku- and/or Ka-band. See replies to Q1 and Q4 in this respect. It is also to be noted that different types of services are provided throughout the entire C-, Ku- and Ka-band satellite spectrum depending on availability of free transponders in the satellites.

Q21. In case it is decided to assign frequency spectrum for space-based communication services through auction,

- (a) What should be the validity period of the auctioned spectrum?
- (b) What should be the periodicity of the auction for any unsold/available spectrum?
- (c) Whether some mechanism needs to be put in place to permit the service licensee to shift to another satellite system and to change the frequency spectrum within a frequency band (such as Ka- band, Ku-band, etc.) or across frequency bands for the remaining validity period of the spectrum held by it? If yes, what process should be adopted and whether some fee should be charged for this purpose?

Kindly justify your response.

AsiaSat response: It is strongly advised against auctioning any kind of space services in C-, Ku- and/or Ka-band. See replies to Q1 and Q4 in this respect.

Q22. Considering that (a) space-based communication services require spectrum in both user link as well as gateway link, (b) use of frequency spectrum for different types of links may be different for different satellite systems, and (c) requirement of frequency spectrum may also vary depending on the services being envisaged to be provided, which of the following would be appropriate:

(i) to assign spectrum for gateway links and user links separately to give flexibility to the stakeholders? In case your response is in the affirmative, what mechanism should be adopted such that the successful bidder gets spectrum for user links as well as gateway links.

or

(ii) to assign spectrum for gateway links and user links in a bundled manner, such that the successful bidder gets spectrum for user link as well as gateway link? In case your response is in the affirmative, kindly suggest appropriate assignment methodology, including auction so that the successful bidder gets spectrum for user links as well as gateway links.

AsiaSat response: It is advised strongly against granting access to spectrum for satellite links through auctioning. See also response to Q1 and Q4 in this respect. For C-, Ku- and Ka-band, gateway links and user links are established on the same kind

of transponders in the satellites, in the same frequency bands, depending on availability of free transponders. There is therefore no justification for assigning different frequency bands for gateway and user links. See also response to Q2.

Q23. Whether any protection distance would be required around the satellite earth station gateway to avoid interference from other satellite earth station gateways for GSO/ NGSO satellites using the same frequency band? If yes, what would be the protection distance (radius) for the protection zone for GSO/ NGSO satellites?

AsiaSat response: There is no need for protection zones or separation distances between earth stations using the same frequency band when these are operating in the same direction of transmission since there will be no potential interference between them. In teleports, it is customary that several earth stations simultaneously use the same frequency band at the same location, in respect of satellites at different orbit locations.

Q24. What should be the eligibility conditions for assignment of spectrum for each type of space-based communication service (as mentioned in the Table 1.3 of this Consultation Paper)? Among other things, please provide your inputs with respect to the following eligibility conditions:

(a) Minimum Net Worth

(b) Requirement of existing agreement with satellite operator(s)

(c) Requirement of holding license/ authorization under Unified License prior to taking part in the auction process.

Kindly justify your response

AsiaSat response: It is advised strongly against granting access to spectrum for satellite links at C-, Ku and/or Ka-band through auctioning as this would be detrimental for India's current telecommunications infrastructure and its ability to further develop. See also response to Q1 and Q4 in this respect. For C-, Ku- and Ka-band, all sorts of applications are seen to be offered throughout the entire satellite spectrum depending on the availability of free satellite capacity to lease. For this reason, there generally should be no particular distinction between what application could be offered in what frequency band (see also response to Q14).

Operators using space-based communications to offer services range from the largest telecom operators providing a wide range of services pan India and internationally to the smallest operators offering broadband connections or IMT backhaul to a village. There therefore should be no requirement on the minimum size of operation for a service provider to be licensed.

As a part of the licensing application process, it is customary to specify the satellite network with which the operation will take place, ITU references for this satellite network and other relevant characteristics. Such requirements will also enable Indian authorities to verify that the operation is in compliance with Indian legislation, that the spacecraft is authorized to be used to provide services in India (e.g. that the spacecraft has been granted landing rights for India) and that the operation is in compliance with Indian international commitments (e.g. coordinated limits). See also response to Q9.

Q25. What should be the terms and conditions for assignment of frequency spectrum for both user links as well as gateway links for each type of space-based communication service? Among other things, please provide your detailed inputs with respect to roll-out obligations on space-based communication service providers. Kindly provide response for both scenarios viz. exclusive assignment and non-exclusive (shared) assignment with justification.

AsiaSat response: With access to frequency resources for space-based communication being granted through an open non-exclusive licensing process, service providers will need to specify the satellite with which they will provide their services. This requires a contract with the satellite operator. Due to the cost of holding such contracts, service providers are not likely to obtain licenses without real plans to roll out the intended services. There therefore would seem to be no need to specify particular roll-out or milestone requirements for space-based communications used by service providers.

Q26. Whether the provisions contained in the Chapter-VII (Spectrum Allotment and Use) of Unified License relating to restriction on crossholding of equity should also be made applicable for satellite-based service licensees? If yes, whether these provisions should be made applicable for each type of service separately? Kindly justify your response.

Q27. Keeping in view the provisions of ITU's Radio Regulations on coexistence of terrestrial services and space-based communication services for sharing of same frequency range, do you foresee any challenges in ensuring interference-free operation of space-based communication network and terrestrial networks (i.e., microwave access (MWA) and microwave backbone (MWB) point to point links) using the same frequency range in the same geographical area? What could be the measures to mitigate such challenges? Suggestions may kindly be made with justification.

AsiaSat response: When the ITU Radio Regulations allocate a frequency band for multiple services, this does not mean that these services are technically compatible with each other, but provisions and criteria are contained in the Regulations to obtain international compatibility. Domestically, countries are sovereign to adopt whatever provisions and criteria they see fit and ITU and the Radio Regulations do not provide any provisions.

In respect of compatibility between microwave links and space-based communication sharing the same band in C-, Ku- or Ka-band, although theoretically there is a potential for interference between the two, in practice, since both use highly directive antennas, experience has shown that interference is rare to occur. In those few cases where interference has occurred, this can normally be mitigated relatively easily on a case-by-case basis, e.g. by moving one of the antennas to obtain site shielding.

Q28. In what manner should the practice of assignment of a frequency range in two polarizations should be taken into account in the present exercise for assignment and valuation of spectrum? Kindly justify your response.

AsiaSat response: To obtain compatibility between space-based communication links using the same spacecraft or spacecraft with moderate orbital separation, at C-, Ku- and Ka-band, it is normally possible to re-use the same frequency on two orthogonal polarizations. For compatibility with terrestrial services, it may be more difficult to make use of polarization discrimination since different propagation paths and reflections from buildings etc. may change the polarization orientation or disrupt the polarization purity.

Q29. What could be the likely issues, that may arise, if the following auction design models (described in para 3.127 to 3.139) are implemented for assignment of spectrum for user links in higher bands (such as C band, Ku band and Ka band)?

- a. Model #1: Exclusive spectrum assignment
- b. Model#2: Auction design model based on non-exclusive spectrum assignment to only a limited number of bidders

What changes should be made in the above models to mitigate any possible issues, including ways and means to ensure competitive bidding? Response on each model may kindly be made with justification.

AsiaSat response: It is advised strongly against granting access to spectrum for satellite links at C-, Ku and/or Ka-band through auctioning as this would be detrimental for India's current telecommunications infrastructure and its ability to further develop it. See also response to Q1 and Q4 in this respect.

Q30. In your opinion, which of the two models mentioned in Question 29 above, should be used? Kindly justify your response.

AsiaSat response: See response to Q29.

Q31. In case it is decided to assign spectrum for user links using model # 2 i.e., non-exclusive spectrum assignment to limited bidders ($n + \Delta$), then what should be

(a) the value of Δ , in case it is decided to conduct a combined auction for all services

(b) the values of Δ , in case it is decided to conduct separate auction for each type of service

Please provide detailed justification.

AsiaSat response: See response to Q29.

Q32. Kindly suggest any other auction design model(s) for user links including the terms and conditions? Kindly provide a detailed response with justification as to how it will satisfy the requirement of fair auction i.e., market discovery of price.

AsiaSat response: See response to Q29.

Q33. What could be the likely issues, that may arise, if Option # 1: (Area specific assignment of gateway spectrum on administrative basis) is implemented for assignment of spectrum for gateway links? What changes could be made in the proposed option to mitigate any possible issues?

AsiaSat response: See response to Q29.

Q34. What could be the likely issues, that may arise, if Option # 2: Assignment of gateway spectrum through auction for identified areas/ regions/ districts is implemented for assignment of spectrum for gateway links? What changes could be made in the proposed option to mitigate any possible issues? In what manner, areas/regions/ districts should be identified?

AsiaSat response: See response to Q29.

Q35. In your view, which spectrum assignment option for gateway links should be implemented? Kindly justify your response.

AsiaSat response: Licensing of space-based communications in C-, Ku- and Ka-band should be open and non-exclusive, maximizing the spectrum usage and spectrum users in India to support current use and efficient and economic further development of India's telecommunication infrastructure. See also response to Q1 and Q4.

Q36. Kindly suggest any other auction design model(s) for gateway links including the

terms and conditions? Kindly provide a detailed response with justification as to how it will satisfy the requirement of fair auction i.e., market discovery of price? Q37. Any other issues/suggestions relevant to the subject, may be submitted with proper explanation and justification. Q38. In case it is decided for assignment of spectrum on administrative basis, what should be the spectrum charging mechanism for assignment of spectrum for space-based communications services

i. For User Link

ii. For Gateway Link

Please support your answer with detailed justification.

AsiaSat response: See response to Q29.

Q39. Should the auction determined prices of spectrum bands for IMT /5G services be used as a basis for valuation of space-based communication spectrum bands

i. For user link

ii. For gateway link

Please support your answer with detailed justification.

AsiaSat response: Spectrum bands acquired for IMT/5G services will give the user exclusive rights to a given band in a given geographic area. C-, Ku- and Ka-band space-based spectrum resources is shared between a large number of users in the same geographic area, each providing its services in India and generating revenue for India through that operation. The two types of spectrum usage are completely different and cannot be compared.

Assigning spectrum resources to space-based communications in C-, Ku and/or Ka-band through auctioning is strongly advised against and licensing should be open and non-exclusive, maximizing the spectrum usage and spectrum users in India to support current use and efficient and economic further development of India's telecommunication infrastructure. See also response to Q1 and Q4.

Q40. If response to the above question is yes, please specify the detailed methodology to be used in this regard?

Q41. Whether the value of space-based communication spectrum bands

- i. For user link
- ii. For gateway link

be derived by relating it to the value of other bands by using a spectral efficiency factor? If yes, with which spectrum bands should these bands be related to and what efficiency factor or formula should be used? Please support your response with detailed justification.

AsiaSat response: C-, Ku- and Ka-band space-based spectrum resources is shared between a large number of users, each providing its services in India and generating revenue for India through that operation. Assigning spectrum resources to space-based communications in C-, Ku and/or Ka-band through auctioning is strongly advised against and licensing should be open and non-exclusive, maximizing the spectrum usage and spectrum users in India to support current use and efficient and economic further development of India's telecommunication infrastructure. See also response to Q1 and Q4.

Q42. In case of an auction, should the current method of levying spectrum fees/ charges for satellite spectrum bands on formula basis/ AGR basis as followed by DoT, serve as a basis for the purpose of valuation of satellite spectrum

- i. For user link
- ii. For gateway link

If yes, please specify in detail what methodology may be used in this regard.

AsiaSat response: See response to Q29.

Q43. Should revenue surplus model be used for the valuation of space-based spectrum bands

- i. For user link
- ii. For gateway link

Please support your answer with detailed justification.

AsiaSat response: See response to Q29.

Q44. Whether international benchmarking by comparing the auction determined prices of countries where auctions have been concluded for space-based communication services, if any, be used for arriving at the value of space-based communication spectrum bands:

- i. For user link
- ii For gateway link

If yes, what methodology should be followed in this regard? Please give country-wise details of auctions including the spectrum band quantity put to auction, quantity bid, reserve price, auction determined price etc. Please support your response with detailed justification.

AsiaSat response: To the best of AsiaSat’s knowledge, and for very good reasons, no countries have auctioned spectrum for space-based communications in C-, Ku- or Ka-band. See also response to Q1.

Q45. Should the international administrative spectrum charges/fees serve as a basis/ technique for the purpose of valuation in the case of satellite spectrum bands

- i. For user link
- ii. For gateway link

Please give country-wise details of administrative price being charged for each spectrum band. Please specify in detail terms and conditions in this regard.

AsiaSat response: It is customary to charge an administrative licensing fee for operators using space-based communications. These fees vary significantly from country to country depending on the national policy, but generally are aimed at reflecting the cost of administering the licenses and the processing of the licensing application. The revenue for the country is obtained through the services provided by the licensee.

As an example, in Hong Kong, an “open skies” policy is applied where space based communications can be offered through foreign or domestic registered satellites alike, following a licensing scheme and with licensing fees as indicated in the below tables. The links to the Hong Kong government provided in the tables gives more details in this respect. There are three different types of licenses, some of which are associated with licensing fees:

- Outer space license
This is the license to operate a space object (satellite) in accordance with the UNOOSA Outer Space Treaty and the responsibilities undertaken by the licensing state in this respect. For in-orbit operation, this responsibility will normally be undertaken by the same country as that granting the Space Station Carrier License (see below) and requirements in respect of the satellite operator normally are to document a safe satellite operation and having the required insurances.

- **Space Station Carrier License**
This is the license to operate the satellite under specified ITU filings and also to conduct the required telemetry, tracking, ranging and commanding functions (TTC&R) to safely control and operate the satellite. This license is granted by the country having submitted the relevant filings to ITU. Licensing requirements normally include compliance with ITU rules and filed and coordinated characteristics and limitations.

- **Unified Carrier License**
This license allows to operate fixed radio stations in Hong Kong (Earth stations in the case of space-based communications) for communication with fixed radio station outside Hong Kong or with mobile radio stations.

- **Spectrum Utilization Fee**
For certain particularly congested frequency bands, Hong Kong has imposed a "Spectrum Utilization Fee". For space-based communications, the frequency bands subject to this fee is C-band uplink and parts of X-band uplink (noting that the latter is very little used for commercial space-based communications and the congestion should stem from other use).

License	Annual License fee (HKD)	Reference	Validity
Outer Space License	Free of charge	Cap. Outer Space Ordinance https://www.elegislation.gov.hk/hk/cap523	Not specified
Space Station Carrier License (SSCL)	1st year initial fee: HKD 450,000 anniversary 2 nd year and after: HKD 150,000	Cap. 106V Telecommunications (Carrier Licences) Regulation https://www.elegislation.gov.hk/hk/cap106V!en	20 years
Unified Carrier License (UCL)	External services only, or of radiocommunication services (where moving stations are primarily for use in locations other than on land) only: HKD 100,000	Cap. 106V Telecommunications (Carrier Licences) Regulation https://www.elegislation.gov.hk/hk/cap106V!en	15 years

In addition, for some frequency bands, including some satellite uplink bands, Hong Kong authorities charge a spectrum utilization fee (SUF) based on transmissions from earth stations. The relevant part for satellite uplinks is shown in the table below.

Spectrum Utilization fee (SUF)	Cap. 106AE Telecommunications (Level of Spectrum Utilization Fee) (Fixed and Other Links) Regulation (elegislation.gov.hk)		
Frequency Band (MHz)	5875-6425	6425-7075	8275-8400
SUF/MHz/annum	HK\$432	HK\$3600	

Q46. If the answer to above question is yes, should the administrative spectrum charges/fees be normalized for cross country differences? If yes, please specify in detail the methodology to be used in this regard?

Q47. Apart from the approaches highlighted above which other valuation approaches can be adopted for the valuation of space-based communication spectrum bands? Please support your suggestions with detailed methodology, related assumptions and other relevant factors.

Q48. Should the valuation arrived for spectrum for user link be used for valuation for spectrum for gateway links as well? Please justify.

Q49. If the answer to the above is no, what should be the basis for distinction as well as the methodology that may be used for arriving at the valuation of satellite spectrum for gateway links? Please provide detailed justification.

Q50. 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 support your answer with detailed justification.

Q51. 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 support your answer with detailed justification.

Q52. Should the reserve price for spectrum for user link and gateway link be taken as 70% of the valuation of spectrum for shared as well as for exclusive assignment? 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 in case of (i) exclusive (ii) shared assignment and why? Please support your answer with detailed justification.

Q53. If it is decided to conduct separate auctions for different class of services, should reserve price for the auction of spectrum for each service class be distinct? If yes, on what parameter basis such as revenue, subscriber base etc. this distinction be made? Please support your answer with detailed justification for each class of service.

Q54. In case of auction based and/or administrative assignment of spectrum, what should the payment terms and associated conditions for the assignment of spectrum for space-based communication services relating to:

- i. Upfront payment
- ii. Moratorium period
- iii. Total number of instalments to recover deferred payments
- iv. Rate of discount in respect of deferred payment and prepayment

Please support your answer with detailed justification.

AsiaSat response: For non-exclusive licenses for space-based communications, payment for administrative filing fees could be charged in different ways. Annual upfront payment generally would appear to be a common and logical approach.

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