Response of Hughes India to Consultation 6/2023

At the outset, Hughes would like to thank the Telecommunications Regulatory Authority of India ("TRAI") for advancing this important consultation on the assignment of spectrum for space-based communications Services.
Hughes Networks Systems, LLC (Hughes) and its affiliates (collectively "EchoStar") were among the earliest global communications companies to invest in the communications sector in India and have been leading in space-based communications services for decades.

Hughes Communications India Pvt. Limited (HCI) is a Joint Venture of Hughes Network Systems, LLC, the leading global provider of broadband satellite networks and services, and Bharti Airtel Limited, India's premier communications solutions provider.

HCI has a VSAT base of around 180,000 VSATs. With unmatched reach and scale, the company is the largest satellite service operator in India, well positioned amid the changing regulatory environment to serve the emerging connectivity requirements of business and government customers with an enhanced product portfolio and operational efficiencies. HCI provides broadband networking technologies, solutions and services, including a full range of managed network services, for government offices and enterprises across segments like banking, aeronautical and maritime mobility, small to medium sized businesses, education, and telecom backhaul, retail, energy, education and government.

Hughes works with a vision of "Powering the networks on which people everywhere depend." The connected future is here. India has a diverse landscape and many underserved and unserved geographies. Hughes through its many Government driven USOF project initiatives reaches out to the rural masses effectively. The border areas, forest and insurgent prone areas pose a challenge. However, it is these aspirational districts that we endeavour to connect and do so with the help of robust technology , manpower and team spirit. It's in India, where via telemedicine and govt driven "E Sanjeeveni" programs, healthcare providers in towns and villages take online classes taught by experts from major urban clinics. HCI also supplied Quick Deploy Antennas (QDA) to the NDRF for humanitarian aid in the recent earthquake at Turkey and Syria.

EchoStar Corporation, Hughes' parent company, has been a leader in the development of broadband and mobile satellite services. Today, its subsidiary, Hughes Network Systems, LLC is a global broadband provider and manufacturer of satellite ground equipment. This includes operating a fleet of broadband satellites in the Ka band which provide high-speed broadband services throughout the Americas.

In addition, its affiliate has under construction its Lyra network, a global IoT low earth orbit (LEO) satellite network in the 1980-2010 MHz and 2170-2200 MHz (2 GHz band) for IoT services with deployment planned for late 2024.
After many years of lagging behind, the commercial and private space industry in India is set to grow multi-fold as Indian start-ups, global players and breakthrough technologies enter the market. TRAI has shown a strong understanding of the intricacies of SpaceCom spectrum in formulating probing questions and thoughts. We believe there will be an involved multi-party consultation process with recommendations that will be balanced, in line with global practices and ensure that the budding SpaceCom industry reaches its fullest potential.

Presently, India is assigning spectrum for satellite communication services on an administrative basis with formula-based charging for some services and a percentage of AGR-

based charging for other services.

In this context, we wish to make the following submissions as regards the mode of allocation of satellite spectrum in India.

Satellite spectrum is a shared resource and so, fundamentally, it cannot be auctioned as it cannot be exclusively assigned. The basic prerequisite of a resource that is to be auctioned, is that it should be available for sale as discrete, unique products. Satellite spectrum does not satisfy this elementary criterion.

World over, satellite spectrum is authorized for 'right-to-use' by all administrations and is allocated only by administrative process. Unlike terrestrial spectrum, satellite spectrum is never exclusively assigned to the operator but coordinated internationally and shared among multiple operators for different orbital slots and all types of satellites. Thus, the terrestrial concept of exclusivity does not apply in case of satellite spectrum and therefore auctioning is not applicable. Moreover, any commodity to be auctioned must be free from encumbrances. The satellite spectrum has international encumbrances.

As spectrum auctions are not feasible, countries have resorted to auctioning a combination of orbital resources and spectrum. However, a country can auction only the orbital resources that belong to it and not orbital resources that belong to some other country. Many countries which attempted the combination of orbital resources and spectrum have stopped doing so as it wasn't feasible or the auctions failed.

United States	The United States last conducted a satellite auction in 2004 for three domestic orbital slots for broadcasting services. Since then, it has abandoned satellite auctions completely for legal and policy reasons. Both domestic and foreign satellites are authorized administratively.
Brazil	Brazil abandoned satellite auctions for Brazilian orbital slots in 2020, noting its inefficiency and the fact that virtually no country in the world uses this method for assigning satellite spectrum. Authorizations to use satellite capacity/spectrum can now be applied and obtained administratively both for Brazilian and foreign satellites.
Thailand	Thailand attempted to auction Thai orbital slots in 2021 for the first time, but it was cancelled twice. The Government is now considering allocating the Thai orbital slots directly.
Mexico	Mexico is one of the few countries that still has a requirement to auction domestic satellite slots. However, the last time Mexico did an auction for orbital slots allotted to Mexico was in 2014 and it failed. Moreover, in relation to foreign satellites, service providers can apply for administratively for landing rights and the use of spectrum in Mexico. The list of authorized providers in the various frequency bands and for the various satellite systems is available online.

Satellite services are almost the only method available for reaching broadband connectivity to the rural and remote regions as also to regions affected by disaster. Hence, auctions which are known to invariably result in high prices, would push up the cost of the service and thus go against public interest or public good and severely impact the wider socio-economic welfare.

Satellite services are truly akin to social welfare services and need to be nurtured, protected and fostered in the public interest.

We submit our answers to the consultation and remain available to provide additional information.

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.

The most widely used frequency bands for space-based applications are available in L-Band, S-Band, C Band, Extended-C band, Ku-Band & Ka-Band, utilized based on the applications and satellite footprint.

For broadband communications, the Ka and Ku bands are the workhorse for both user and gateway links. In addition, other frequency bands including the V and Q bands must also be included to support continued growth. Hughes is prepared to utilize these frequencies to bring broadband services to India.

In addition, EchoStar is constructing a global 2 GHz mobile satellite system, Lyra, in the 1980-2010 MHz and 2170-2200 MHz band for IoT services with initial deployment in 2024. This will be supplemented in the 2026 time frame with a wide band MSS system in the 2 GHz band that will support direct-to-device and other services. The 2 GHz band will be used for service links and these systems will use the 6 GHz band the Ka band for feeder links.

It is critical that these frequency bands remain available for these services and that TRAI considers additional spectrum to be made available as user demands are increasing for broadband and other connectivity services.

HUGHES
An EchoStar Company

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:

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	N/A	GEO/MEO/LEO	S	45	S	40	C/X Ka Q/V	50 2500 5000	C/X Ka Q/V	100 2700 4000
Internet	N/A	GEO/MEO/LEO	Ka	4000	Ka	3500	Q/V	5000	Q/V	4000
NLD	N/A	GEO/MEO/LEO	Ext-c Ku Ka	300 1250 4000	Ext-c Ku Ka	300 2050 3500	Ext-c Ku/ka Ka	300 1250/4000 4000	Ext-c Ku/Ka Ka	300 2050/3500 3500
ILD										
GMPCS	N/A	GEO/LEO/MEO	S	45	S	40	C/X Ka Q/V	50 2500 5000	C/X Ka Q/V	100 2700 4000
VSAT CUG (Commercial)	N/A	GEO/LEO	Ext-c Ku Ka	300 1250 4000	Ext-c Ku Ka	300 2050 3500	Ext-c Ku/ka Ka	300 1250/4000 4000	Ext-c Ku/Ka Ka	300 2050/3500 3500
Captive VSAT CUG	N/A	GEO	C Ext-c Ku Ka	625 300 1250 4000	C Ext-c Ku Ka	800 300 2050 3500	C Ext-c Ku Ka	625 300 1250 4000	C Ext-c Ku Ka	800 300 2050 3500

M2M										
DTH										
Teleport										
DSNG										
HITS										
IFMC	N/A	GEO/LEO	Ku Ka	1250 4000	Ku Ka	2050 3500	Ku Ka	1250 4000	Ku Ka	2050 3500
Any other relevant service (please 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.

This answer needs to be addressed at least in two parts: NGSO FSS and NGSO MSS.

Regarding FSS, Resolution 76 (Rev.WRC-15) contains the basis for the protection of GSO FSS and GSO BSS networks from the accumulated effects of multiple NGSO systems operating in the Ku and Ka bands, by establishing the aggregate EPFD limits to be met by all operational NGSO systems. Nonetheless nor Resolution 76, nor any other provision in the Radio Regulations (RR) establish a regulatory limit for the number of operational NGSO systems. In this regard, the RR implemented the so-called single-entry EPFD limits, which are the power limits that every single NGSO system needs to comply with when submitting a filing to the ITU. The way these single-entry limits were calculated was dividing the aggregate limit by 3.5. So, if more than 3 NGSO systems operate there is no guarantee that the aggregate limits will be respected.

Regarding MSS, it has to be taken into account that unlike FSS, different MSS systems cannot operate simultaneously using the same frequency band in the same geographical area. And as a matter of fact, it has been demonstrated that such impossibility for sharing spectrum is extensive to any two services that rely on the ubiquitous deployment of user terminals, as it happens with the mobile-satellite and terrestrial mobile services. For instance, Resolution 212 (Rev.WRC-19) clearly established that the use of the S band (1885-2025 MHz and 2110-2200 MHz) by both the terrestrial and satellite component of IMT in the same geographical area is not feasible, unless complex and restrictive mitigation techniques are implemented on both services. Given the above, for multiple MSS systems (either GSO or NGSO) to operate in the same frequency range, the most common solution is to implement band segmentation, i.e., divide the available frequency range into equal or proportionate paired segments and exclusively assign one segment to each system. Therefore, the number of MEO/LEO MSS systems that can operate in the same frequency range, depends on the total spectrum available on such range, and the spectrum requirements for each system according to the services to be provided.

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.

World over, satellite spectrum is authorized for 'right-to-use' by all administrations and is allocated only by administrative process. Unlike terrestrial spectrum, satellite spectrum is never exclusively assigned to the operator but coordinated internationally and shared among multiple operators for different orbital slots and all types of satellites. Thus, the terrestrial concept of exclusivity does not apply in case of satellite spectrum and therefore auctioning is not applicable. Moreover, any commodity to be auctioned must be free from encumbrances. Satellite spectrum has international encumbrances.

Fixed satellite services are able to share frequency bands with one another using reasonable technical parameters and the ITU coordination process. First, for geostationary orbit satellites, orbital separation is necessary for enabling sharing. For NGSO systems there are clear rules available in the ITU Radio Regulations that enable the shared use of the spectrum resource either with specific operational limits such as the Article 22 limits or under satellite coordination in accordance with Article 9.11A in co-primary frequency bands.

This means that satellite operators inherently share frequency bands in the FSS and are not exclusive.

Justification of our response:

1. Satellite spectrum is a shared resource and so, fundamentally, it cannot be auctioned as it cannot be exclusively assigned. The basic prerequisite of a resource that is to be auctioned, is that it should be available for sale as discrete, unique products. Satellite spectrum does not satisfy this elementary criterion.
2. Satellite spectrum along with orbital resources are used for cross-border services. Any attempt to auction this spectrum will result in reciprocation from other countries where Indian service providers will provide coverage as per the new space policy and such reciprocation will hurt Indian interests.
3. Orbital resources can be modelled to plots of land and spectrum can be equated to the road used to access the plots. Plots of land can be auctioned (in combination with the right-to-use roads to access plots). Roads in isolation cannot be auctioned. Usage of roads is not exclusive and any attempt to auction will block certain plot owners/users.
4. Auction is a poor price discovery mechanism in the case of satellite spectrum as the winning bidder will have to still share the spectrum with other users. There is no motivation for the bidder to be the highest bidder.
5. As a result, auctioning of satellite spectrum can lead to cartelization among satellite users.
6. Satellite spectrum has different use cases - feeder links, backhaul, retail, broadcast, DTH, DSNG etc. It is very difficult to arrive at a reserve price as the revenue potential for each of these use cases are different.
7. The auction of satellite spectrum will be unable to protect against monopolies as one of the bidders can arbitrarily increase the price for a small quantum of spectrum and others have to buy at the same price and the same might not be attractive to newer players entering the market.
8. Every operator is not expected to enter the market at the same time and many may miss out the auction, but will still need access to the spectrum
9. Any segmentation of the satellite spectrum will reduce the usability of the spectrum by the operators and thus further reduce its value.
10. Satellite use cases cannot be segregated LSA wise and different LSAs will have different revenue potential
11. As a result of the above points, many countries have resorted to administrative assignment of spectrum, yet setting a price for the spectrum using an open consultation process for deciding the right price instead of an auction
12. As spectrum auctions are not feasible due to the above points, countries have resorted to auctioning a combination of orbital resources and spectrum. However, a country can auction only the orbital resources that belong to it and not orbital resources that belong to some other country. Many countries which attempted the combination of orbital resources and spectrum have stopped doing so as it wasn't feasible or the auctions failed.
13. Flexi use of spectrum sounds logical, but would be difficult to implement considering spectrum won in auction for IMT purpose needs to be shared with other satellite players.
14. Flexi assignment of spectrum across services will lead to confusion as satellite players participating in a satellite spectrum auction can potentially demand for providing IMT services - Reverse flexi use
15. Satellite services are almost the only method available for reaching broadband connectivity to the rural and remote regions as also to regions affected by disaster. Hence, auctions which are known to invariably result in high prices, would push up the cost of the service and thus go against public interest or public good and severely impact the wider socio-economic welfare. Satellite services are truly akin to social welfare services and need to be nurtured, protected and fostered in the public interest.

16. Satellite broadband is being deployed to serve the unserved and underserved areas of the country. For example, the Government decision to connect far flung islands and border areas of North-East through satellite broadband would be jeopardized if the said spectrum bands for the satellite to deliver satellite broadband were to be auctioned to service providers, who would like to use it for either terrestrial purposes or any other application. Such a move would be counter-productive to the digital dreams of the country and run contrary to the objectives of inclusivity and 'Sabka Saath, Sabka Vikas' - to which the nation and Government are committed.

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 upto 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.

a) Hughes does not support the auction of satellite spectrum whether on an exclusive or shared basis. Instead, TRAI should follow the ITU's first come first served approach to licensing and utilize the technical rules of the ITU Radio Regulations and the coordination process to enable sharing among satellite networks in these bands in the FSS.

b) Hughes addresses sharing issues between satellite networks further below but does not support auctions which is addressed in this question.

c) Spectrum sharing is critical for satellite services that can share spectrum. As discussed further below, the fixed satellite service bands are feasible for sharing regimes. However, for widely deployed services, like mobile satellite service, sharing is generally not feasible.

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.

As discussed above, Hughes does not support an auction approach for the FSS.

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.

Hughes supports spectrum leasing by licensed satellite operators in the FSS and the MSS as long as the lease is required to abide by TRAI technical and operational requirements. Hughes urges that any leasing be required to be approved by TRAI and that the licensee also remain responsible for the operations of the lease. The licensee should be allowed to set the financial and other terms of the lease, as long as the terms are consistent with TRAI regulations.

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.

Existing operators need certainty to support their users. Accordingly, it is critical that TRAI grandfather these licensees for a reasonable period of time (i.e., a reasonable number of years, such as the duration of their license term). These licensees should also be allowed to obtain renewals, etc. under the yet-to-be-defined licensing process.

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.

Hughes supports the use of the ITU Radio Regulations and the coordination process, coupled with a first-come, first-served approach to spectrum assignment in the FSS. In terms of GSO sharing with either GSO or NGSO operators, this sharing should be governed by the ITU radio regulations as explained in Question number 4 by using reasonable technical parameters and the ITU coordination process. For GSO networks orbital separation is necessary for enabling sharing, for NGSO systems either with specific operational limits such as the Article 22 limits or under satellite coordination in accordance with Article 9.11A in co-primary frequency bands.

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.

First, based on what we have seen with IMT deployment in 28 GHz, it is largely skeptical, and few countries have been successful. For instance, South Korea just reallocated this spectrum from IMT back to FSS.

However, should such systems come to fruition, Hughes urges TRAI not allocate these bands to IMT. It is incredibly difficult for broadband satellite systems in the 27.5-28.5 GHz band to share spectrum with IMT services because IMT is a widely deployed service and broadband satellite service is also widely deployed. Accordingly, an allocation of spectrum to IMT in this band would limit by 1 GHz the amount of spectrum available to meet critical broadband needs in India. Accordingly, Hughes urges TRAI to consider the better approach which would be to enable sharing between FSS operators to share the 28 GHz band and provide IMT spectrum in other bands.

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.

Hughes does not support this approach. It has been demonstrated time and time again that two widely deployed services cannot share the same band except through geographic or band separation. Adopting such an approach would result in valuable spectrum being underutilized by both services.

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.

The importance of the 28GHz band for satellite services remains crucial for various applications, such as broadband connectivity, disaster recovery, remote sensing, and broadcasting. Ensuring the integrity and undisrupted functioning of these satellite services is vital for the global community. Any approach to license Captive Non-Public Networks (CNPN) need to be on a non-interference/non-protection basis to ensure that satellite services in the 28GHz band continue to operate without harmful interference.

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.

Since 27.5-30Ghz falls under the Ka band and is critical for High-Capacity Broadband Communications using Next Generation Satellites, this spectrum must also be earmarked exclusively for Satellite Broadband services –both for user terminals as well as for gateways. Hence, we firmly advise that this band should not be utilized for mixed/flexible use i.e. both terrestrial and satellite. It should only be exclusively preserved for satellite use

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:

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)**

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.

Hughes' affiliates have over 20 years of experience in the S band including operations and holding licenses in over 25 markets. Our experience is that the most efficient use of the S band spectrum is achieved when MSS spectrum is authorized on an administrative basis. Such a framework should include the applicant meeting certain minimum requirements, such as operational experience, planned coverage, etc. and a reasonable, cost-based licensing and annual fee.

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.

For broadband satellite services in the Ka-band, TRAI should adopt an administrative process, as discussed below.

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

National level is the most efficient for satellite services. Because of the wide areas served by satellite-networks, it would be spectrally and economically in-efficient to utilize a metro-wise or similar sized license areas. First, satellite beams tend to be fairly large (larger than metro-areas in many cases). In addition, there would need to be appropriate guard bands or geographic separation that would impact the feasibility of such an approach.

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.

Hughes does not support auctions for any satellite spectrum authorizations for

the reasons discussed herein.

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.

As discussed herein, Hughes does not support the auction of satellite spectrum including gateway links. In fact, Hughes has never observed the successful auction of gateway spectrum. The only country that tried this approach, was the United States, which received no satellite bidders.

The better approach is to use an administrative process to assign spectrum. Gateways are individually authorized earth stations and multiple earth stations can be operated in the same bands with certain geographic separation. Accordingly, the spectrum, while of value, is widely shared and there is not reason for auction. In addition, auctions would add unnecessary cost and complexity to the network, increasing costs to consumers and delay in the deployment times.

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.

Hughes does not support the auction of gateway spectrum for any service for the reasons discussed above. In fact, the one time that we know of gateways being auctioned was a failure. This occurred when the FCC attempted to auction gateways in 27.5-28.35 GHz band; there were no FSS bidders.

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.

Hughes does not support the auction of satellite spectrum.

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.

We do not support auctions, but a satellite operator in any licensing process should be able to request an authorization for user and feeder links at the same time. Failure to allow bundling would render the satellite network unusable if both types of spectrum are not authorized.

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?

Coordination distance around gateway stations are highly dependent on a number of variables, including the frequency range, the type of system (GSO/NGSO) and the size of the antennas in the gateway. For instance, for GSO BSS/FSS gateways in the Ku/Ka range using a 13 meter antenna with an typical elevation angle above 20°, the separation distance to another similar gateway would be roughly 300-400 km. On the other hand, for a NGSO MSS gateway, the situation is somewhat more complex as such gateways employ multiple antennas (2-5) and are in constant movement as they are always tracking the NGSO satellites, this implies that elevation angles are variable. As an example, for an NGSO MSS gateway employing 2.4 m antennas using spectrum in the C/X range, would require a separation distance of around 2400 km.

ITU Recommendations also provide a broad reference framework to estimate the separation distance required by gateways. One example is Recommendation ITU-R SM.1448-1 on the Determination of the coordination area around an earth station in the frequency bands between 100 MHz and 105 GHz.

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

Hughes does not support auctions for allocation of spectrum for satellite based services. The question begins with asking what should be the eligibility conditions for assignment of spectrum but ends up assuming that there will be an auction. Spectrum must be assigned in an administrative manner for the various reasons outlined in our response and that in order to be eligible for spectrum allocation the only requirement should be that the entity must have a service license /authorization.

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.

For GSO operators and NGSO operators, we recommend that TRAI follow the ITU regulations for milestones for both systems including Bringing Into Use. This should be the same whether spectrum is exclusive or shared.

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.

We do not support the application of these provisions to satellite based licensees. The restrictions on crossholding are primarily intended to promote competition by preventing a single promoter to own or control more than one operator or license within the same service area. Access service licenses are issued on a service area basis whereas this concept is not applicable to satellite based services.

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.

Article 21 of the Radio Regulations establishes diverse coexistence criteria for terrestrial and space services sharing frequency bands above 1 GHz. For instance, for their own protection receiving stations in the fixed service operating in frequency bands shared with space radiocommunication services (space-to-Earth) should avoid directing their antennas towards the geostationary-satellite orbit if their sensitivity is sufficiently high that interference from space station transmissions may be significant. In particular, in the frequency bands 13.4-13.65 GHz and 21.4-22 GHz, it is recommended to maintain a minimum separation angle of 1.5° with respect to the direction of the geostationary-satellite orbit. Other measures for terrestrial services to implement are provided in Section II of Article 21 (21.3 to 21.7, including Table 21-2). Measures for satellite earth stations are provided in Sections III and IV, in the form of EIRP limits and minimum elevation angle. Finally, measures to be applied by transmissions from space stations are established in Section V in the form of power-flux density limits in table 21-4.

Additionally for terrestrial stations and earth stations, operating in frequency bands shared with equal rights between terrestrial radiocommunication and space radiocommunication services, shall be selected having regard to the relevant ITU-R Recommendations with respect to geographical separation between earth stations and terrestrial stations. A good example is ITU-R Recommendation ITU-R SM.1448-1 on the Determination of the coordination area around an earth station in the frequency bands between 100 MHz and 105 GHz.

To answer the specific question, and in view of the above, the coexistence between space-based communication services and terrestrial services does not represent any challenge at all as the existing regulatory framework provided by the ITU Radio Regulations and Recommendations is complete and comprehensive. Particularly for terrestrial services such as microwave access (MWA) and microwave backbone (MWB) point to point links, the coexistence with satellite services is a common scenario, where both services have operated for decades.

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.

The assignment of frequency in different polarizations shouldn't be taken into consideration, rather it should be left to the satellite operators to decide as is the current practice followed.

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.

We do not support auctions for allocation of spectrum for satellite-based service for the various reasons stated herein.

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

N/A

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+ Δ), 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.

Hughes does not support the use of auctions to assign satellite spectrum.

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.

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?

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?

N/A

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

Gateways should be assigned using an administrative licensing approach. This is most efficient. Gateway stations are generally regarded as individually licensed stations, i.e., to be authorized by means of specific regulatory instrument, either a permit or a license. Gateways are not earth stations to be massively or ubiquitously deployed, as satellite systems that employs them are normally designed to require a reduced number of gateways. Additionally, among the characteristics of a gateway is the high power needed to transmit high-capacity signals into space, which involves the use of large antennas. These characteristics make them more propose to generate interference in its vicinity, and therefore a higher regulatory control is required. As explained in the response to Question 23, gateways also require large separation distances, particularly those employed for NGSO systems, and therefore the specific location of gateways must be strictly recorded, which can be achieved by means of an individual license.

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.

Administrative cost-based processing is the most efficient. The licensor should be able to recoup all costs associated with processing and maintaining licenses and the associated regulatory regime. This will result in reasonable fees that will result in less costs being passed on to consumers.

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.

No, IMT is a different service entirely. It is a mobile service available in urban and other areas that tens of million and more subscribers use. Satellite is different. For instance, even in India, it is unlikely that broadband will be deployed to more than one million terminals. In addition, the use of IMT auction prices are likely to negatively impact deployment plans. Unlike terrestrial IMT, satellite operators must make significant investment to launch a satellite network before any revenue is received. This means that the added costs of an auction, especially based on IMT auction results, will likely make it economically difficult if not impossible to deploy their networks. In addition, the costs will result in prices to end users being passed on to consumers.

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.

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.

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.

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.

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.

Please find the list of the countries charging administratively for spectrum assignment.

Country	Spectrum and VSAT fees	Tariff structure	**Normalized Fee** (5 years @5000 user terminals)	**Resulting Fee** (per user terminal per year)
CANADA	None	US$ **0.00**	US$ **0**	**0.00**
EUA	No spectrum fee. Instead, an annual fee of US$ 325 is charged for each blanket license (one blanket license can include thousands to millions of VSATs)	US$ **325.00**/year/license	US$ **1,625**	**0.07**
MEXICO	None for Ka band. No VSAT fee.	US$ **0.00**	US$ **0**	**0.00**
COLOMBIA	Spectrum fees are now charged on a per license basis. The fee for a blanket license is around $US 1500/year	US$ **1500.00**/year/license	US$ **7,500**	**1.50**
PERU	Spectrum fees are calculated on the base of the used throughput per user terminal. Taking our typical user throughput in Peru we got a spectrum fee of US$ 28/year/terminal.	US$ **28.00**/year/terminal	US$ **700,000**	**28.00**
BRAZIL	No spectrum fee. Instead, a one-time fee of US$ 50 is charged for each installed VSAT, with a renewal annual fee of US$ 25 per VSAT.	US$ **50** one-time US$ **25.00**/year/terminal	US$ **750,000**	**30.00**
CHILE	Spectrum fees are calculated on the base of the effective spectrum per user terminal. The applicable formula results in annual fees per terminal, which decrease as the number of terminals increase. Applying the formula for our services in Chile we got the following example: - From 11 to 100 terminals US$ 201.37/year/terminal - From 101 to 1,000 terminals US$ 50.24/year/terminal - From 1,001 to 10,000 terminals US$ 17.69/year/terminal - From 10,001 to 50,000 terminals US$ 7.32/year/terminal	11 terminals: US$ **201.37**/year/terminal 101 terminals: US$ 5**0.24**/year/terminal 1,001 terminals: US$ **17.69**/year/terminal 10,001 terminals: US$ **7.32**/year/terminal	US$ **442,250**	**17.69**
ARGENTINA	Spectrum fees are calculated by a formula based on the effective spectrum used by each user terminal. Applying the formula for our services in Argentina we got a spectrum fee of US $1.22/month/terminal.	US$ **15.00**/year/terminal	US$ **375,000**	**15.00**

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?

Administrative prices should be specific to the country's costs. So, India needs to determine its individual administrative costs.

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 installments to recover deferred payments

Rate of discount in respect of deferred payment and prepayment Please support your answer with