Telecom Regulatory Authority of India

Recommendations

on

Licensing Framework for Satellite-based connectivity for Low Bit Rate Applications

New Delhi, India

26th August 2021

Mahanagar Doorsanchar Bhawan

Jawahar Lal Nehru Marg

New Delhi – 110 002

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ANNEXURE

CHAPTER 1
INTRODUCTION

1.1 The Department of Telecommunications (DoT), through its reference vide letter dated 23rd November 2020 **(Annexure 1)**, under section 11(1)(a) of the TRAI Act, has requested TRAI (also referred to as the Authority) to furnish recommendations on the Licensing framework to enable the provisioning of satellite-based low-bit-rate applications for both commercial as well as captive usage.

1.2 The DoT, in its reference, has mentioned that the current licensing framework for satellite-based services has limitations with respect to the proposed satellite-based low-bit-rate services. Pointing out the constraints of the existing provisions, DoT has stated that there is a need for suitable licensing framework for:

(i) Providing such services on a commercial basis.

(ii) Organizations like State transport Authorities, Indian Railways, other fleet owners, disaster management agencies, etc., which may need to setup a Captive network for their own use (and not for selling the service). These Captive networks may be of the following two types:

a) Government owned entities like Police and security Agencies/PSUs/boards

b) Private companies

1.3 DoT has requested TRAI to examine all the factors holistically and recommend enabling provisions under the existing licensing framework of DoT, or suggest new licensing framework which must include the entry fee, license fee, bank guarantee, Network Operations and Control Centre (NOCC) charges, Spectrum Usage Charges (SUC)/royalty fee, etc.

1.4 Based on the reference received from DoT, the Authority issued a Consultation Paper (CP) on 'Licensing framework for Satellite-based low-bit-rate applications' on 12th March 2020, seeking comments of the stakeholders on the various issues involved in Licensing Framework for Satellite-based connectivity for low-bit-rate applications.

1.5 Written comments on the Consultation Paper were invited from the stakeholders by 9th April 2021 and counter-comments by 23rd April 2021. Upon request of some of the stakeholders, the last dates for submission of comments and counter-comments were extended respectively to 23rd April 2021 and 7th May 2021. The Authority received comments from 29 stakeholders and counter-comments from 4 stakeholders. These comments and counter-comments are available on TRAI's website www.trai.gov.in. An Open House Discussion (OHD) was conducted on 2nd June 2021 through video conferencing which had more than 130 participants from various stakeholders, including telecom service providers, satellite operator companies, consumer groups, associations and representatives from Central Ministries, Departments and State/UT Government and other organizations.

1.6 Considering that the satellite-based LBR applications and use cases, are very much relevant and important to the scope of various government agencies/ ministries/ departments/ state governments/PSUs/local bodies/ authorities; secretariat offices of various relevant Central Ministries, Departments and all the State/UT Governments were also requested to send their comments on the consultation paper. Comments have been received from some of the Ministries/ Departments which have been considered in formulation of these recommendations.

1.7 Satellite communication can provide coverage to the remotest and inaccessible areas of a geographically widespread country like India. The uniqueness and benefit of satellite technology cannot be underestimated. It can play an important role in enhancing crucial

nationwide communication infrastructure and bridging the digital divide in India. With the evolution of Satellite communication technologies, new types of applications based on low-bit-rate applications are emerging. Such applications require low cost, low power and small-size terminals that can effectively perform the task of signal transfer with minimum loss.

1.8 The typical applications/use cases utilizing a satellite networking protocol and sensor connectivity solutions are envisaged in numerous sectors such as agriculture, smart farming, deep-water applications, mission-critical services, oil and gas, fisheries, forestry, logistics, mining, industrial logistics, railways, remote utilities, disaster preparedness, manufacturing, aviation, maritime, security, weather and environmental monitoring sectors, etc. In order to provide services to such sectors, different satellite orbits and frequency bands can be selected based on the requirements of the application. Satellite orbits can be generally categorized as GEO (Geostationary Earth Orbit), MEO (Medium Earth Obit) and LEO (Low Earth Orbit).

1.9 Some applications/use cases, utilizing low-bit-rate satellite-based communication, are briefly discussed as below:

(i) <u>Supply Chain Management</u>

- Asset tracking: Vehicle fleet management, on-time delivery, real-time location, inventory, cold chain management of refrigerated items like medicine/food, etc.

(ii) <u>Smart Grids</u>

- Remote transmission towers monitoring, load distribution, supply/demand management.
- Sensor-based applications for Remote Industries and Connected Healthcare, Supervisory Control and Data Acquisition (SCADA) and many more.

(iii) Railways

- Geo-location of rolling stock assets, monitoring of safety systems in a train, mission critical two-way data, etc.

(iv) Disaster Management

- Delivery of real-time and geo-location alerts in case of floods, landslides, etc., emergency alert broadcasts and SOS messaging for fishing vessels, real-time tsunami alerts from marine buoys, detection of fires in rural forests or strategic buildings, managing logistics of NDRF vehicles, boats, fire engines, ambulances, etc., during natural disasters and accidents.

(v) Internal security

- Tracking of patrol vehicles, monitoring of critical logistics supplies through remote areas;
- Connectivity among coast guard vessels and monitoring of vessels at sea.

(vi) Fisheries

- Sensor-based connectivity is used for location and vessel monitoring, maritime boundary alerts;
- Geo-fenced fishing zones, for monitoring the cold chain of stored fish, two-way emergency messaging system for distressed vessels, inclement weather.

(vii) Health services response mechanism

- Ambulance and medical logistics tracking especially in rural areas, vehicle telemetry.
- Live monitoring of patients' diagnostics, etc.

(viii) Smart Agriculture:

- Monitoring soil conditions for critical inputs such as water, fertilizers and pesticides, etc.
- Harvest prediction, crop infestation/damage, yield, severe weather prediction, etc.
- Reaching out to remote villages, farmland.

1.10 IoT can create a positive impact in every walk of life, be it in the area of agriculture, fisheries, home automation, health or education, to name a few. IoT/M2M is a very important technology domain because it will help in automation and digitalization of various business and industrial processes. It will enable organizations to improve their customers' experience and provide greater transparency to end users as well as improve efficiency of their businesses. There is a need for ensuring that IoT/M2M becomes easily accessible to all citizens and businesses across the country.

1.11 Based on the written comments received from the stakeholders, views shared by the stakeholders during the OHD and its own analysis, the Authority has finalized these recommendations. This Chapter gives introduction and background information on the subject. Chapter 2 discusses certain issues involved and analysis of the responses from the stakeholders on the specific questions posed in the CP. Chapter 3 discusses the current Licensing framework for satellite-based services, their scope and limitations for low-bit-rate applications and specific recommendations for inclusion of satellite-based connectivity for low-bit-rate applications have been given. Chapter 4 summarizes the recommendations.

CHAPTER 2

SATELLITE-BASED CONNECTIVITY FOR LOW-BIT-RATE APPLICATIONS

2.1 With the evolution of communication technologies, new types of applications are emerging based on low-bit-rate communication. Connectivity is one of the most significant components of such low-bit-rate IoT ecosystem. An IoT ecosystem needs ubiquitous, resilient and seamless connections at all times to run efficiently. Satellites have a unique advantage to provide such connectivity even in the remotest parts of the country, helping to achieve an unprecedented level of connectivity and stability that terrestrial networks alone are not capable to deliver.

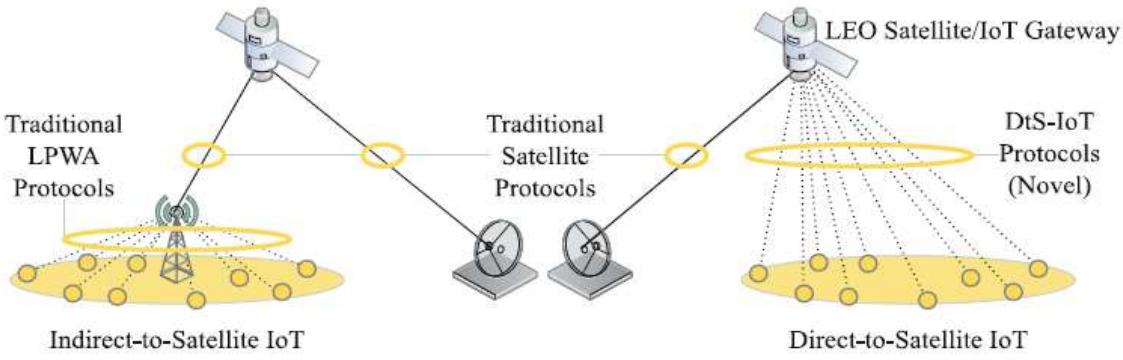
A. Satellite Connectivity Models for Low-Bit-Rate Applications

2.2 Mainly there are two models, as shown in Figure 1, for provision of satellite-based connectivity for IoT and low-bit-rate applications:

(i) Hybrid model consisting of LPWAN and Satellite,

(ii) Direct to satellite connectivity.

Figure 1[1].Models for provision of Satellite-based connectivity for IoT and low-bit-rate applications



[1]https://www.researchgate.net/publication/336050788_Direct-To-Satellite_IoT_-_A_Survey_of_the_State_of_the_Art_and_Future_Research_Perspectives_Backhauling_the_IoT_Through_LEO_Satellites

Various other models may be derived using combination or adaptation of these models to suit the specific requirements of the use case being catered for.

(i) Hybrid (LPWAN + Satellite) or Indirect Model

2.3 In such an architecture, each sensor and actuator in a network may communicate with the satellite through an intermediate sink node, i.e., Low Power Wide-Area Network (LPWAN) or LPWAN gateway. In LPWAN, a network server coordinates several gateways through a reliable backhaul and in turn gateways interact through wireless links with potentially billions of low-power devices.

2.4 In this model, the LPWAN gateway is equipped with traditional satellite terminal and a traditional LPWA Radio Interface to communicate with the sensor or actuator nodes in the area. These networks communicate with low-cost localized gateways to concentrate larger numbers of IoT devices in their vicinity, even thousands. But this limits the area of deployment as it is confined to the coverage of the LPWAN gateway node on ground.

2.5 The LPWAN technologies have been standardized by 3GPP[2]. The LPWAN technologies possess several characteristics that make them particularly attractive for applications requiring low mobility and low levels of data transfer (100s of bps to several 100s of kbps).

Their main characteristics are as below:

- Low power consumption (to the range of nanoamp) that enable devices to last for 10 years on a single charge
- Optimized data transfer (supports small, intermittent blocks of data)
- Low unit device cost

[2] https://www.gsma.com/iot/wp-content/uploads/2016/10/3GPP-Low-Power-Wide-Area-Technologies-GSMA-White-Paper.pdf

- Simplified network topology and deployment
- Improved outdoor and indoor penetration coverage compared with existing wide-area technologies
- Secured connectivity and strong authentication
- Integrated into a unified/horizontal IoT/M2M platform, where operators have this in place
- Network scalability for capacity upgrade

2.6 Some LPWAN technologies suitable for IoT are LoRa, Sigfox, LTE-M or NB-IoT. These are specifically designed to share the properties of WPAN and cellular networks, i.e., low power and long range (more than 10 km). The NB-IoT technology operates on licensed spectrum, which is a subset of LTE Bands. On the other hand, LoRaWAN uses linear frequency modulation in the unlicensed frequency range in sub-1 GHz band. For example, it operates on unlicensed 900 MHz ISM frequency band in South America and unlicensed 868 MHz ISM frequency band in Europe[3].

(ii) Direct-to-Satellite Model

2.7 This type of architecture allows devices to directly communicate with the satellite without the need of any intermediate ground gateway. The satellite receives data from IoT devices and transmits the data to the ground station nearest to the device and the data gets stored in the application server for further processing. This model can be used for wide area sensor network with sensors spread over wide geographical territory to provide low-cost, low-power, secured direct-to-orbit satellite connectivity for the Internet of Things.

2.8 Direct-to-satellite is a more preferred solution in challenging scenarios such as:

[3] https://www.researchgate.net/publication/336050788_Direct-To-Satellite_IoT_-_A_Survey_of_the_State_of_the_Art_and_Future_Research_Perspectives_Backhauling_the_IoT_Through_LEO_Satellites

(i) In disaster or natural calamities areas where rapid and infrastructure-less deployments are required as not much hardware is available or possible to arrange.

(ii) In areas where the devices are on the move, placement of a LPWAN gateway would not be economically viable and preferred.

(iii) In areas with very low device density where a gateway solution is not profitable.

(iv) Ideal for wide area sensor network with sensors spread over wide geographical territory.

2.9 However, many of the existing satellite networks are not commercially suitable for supporting millions of direct connections, which are required in IoT applications. For commercial applications that require numerous devices, it is desirable that the end device costs should be very low, they should consume very low power and should require very low maintenance. Many of the existing satellites may not be suitable for direct satellite to device connections. At present, only a few companies are looking to explore such direct satellite to device connections.

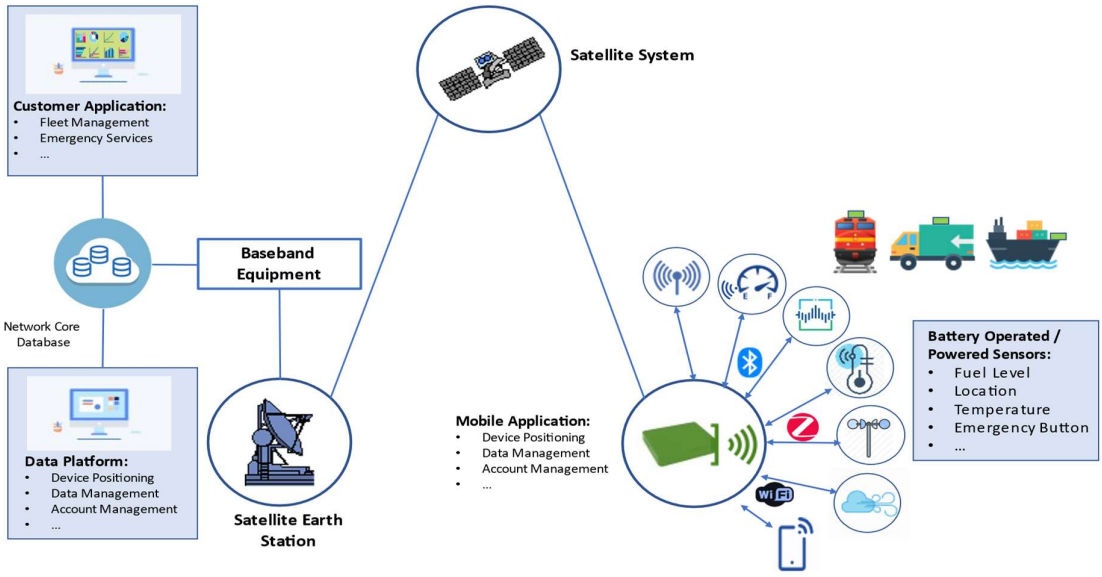
2.10 For most antennas, the beam width is indirectly proportional to the size of the antenna, i.e., a small footprint antenna has limited gain and directivity; thus produces a wide beam. This results in unwanted emissions toward adjacent satellites in the GEO arc and other LEO or MEO satellites or terrestrial receivers. Therefore, to minimise such harmful interference into other systems, direct-to-satellite IoT terminals need to comply with defined power spectral density (PSD) masks.

(ii) Aggregator Model

2.11 A slight variation of Direct-to-Satellite model, this model consists of a user terminal which acts as an aggregator or a hub. The aggregator can aggregate data from the surrounding sensors (typically up to 100 or 1000 sensors) via Bluetooth, Wi-Fi, Zigbee or other low power mesh networks. It collects data from these sensors and then transmits it

directly to the satellite. These aggregators are typically powered by solar panels and may be mounted on mobile objects like railway fleet, containers, fishing vessels or mounted at fixed locations such as agricultural farm, gateway at a windfarm, etc. These aggregators have two-way capabilities and receive data from the satellite and distribute it to the array of Bluetooth, Wi-Fi, or Zigbee sensors.

Figure 2. Aggregator Models



2.12 In view of the above, the following issue was raised in the consultation paper for the comments of the stakeholders: *There are two models of provision of Satellite-based connectivity for IoT and low-bit-rate applications — (i) Hybrid model consisting of LPWAN and Satellite and (ii) Direct to satellite connectivity.*

(i) Whether both the models should be permitted to provide satellite connectivity for IoT devices and low-bit-rate applications? Please justify your answer.

(ii) Is there any other suitable model through which the satellite-based connectivity can be provided for IoT devices? Please explain in detail with justifications.

2.13 In response to the above question, the stakeholders are of a unanimous view that all the models should be allowed to be used and the decision regarding which service model or a combination of models, suitable for their requirements, are to be used, may be left to the service provider. The stakeholders have emphasized that there should be no restriction on providing satellite connectivity through any particular network topology or any combinations of topologies. The licensing framework should be minimal and flexible, enabling all the possible technologies that operate in accordance with the relevant ITU Radio Regulations.

2.14 Most of the stakeholders are of the view that any regulatory restrictions on the choice of technology may impede the growth and adoption of the appropriate technology. Cost of the satellite terminals, their capacity and latency could be the deciding factor for selection of the appropriate satellite solution as the IoT devices are expected to be dispersed geographically and in large numbers.

2.15 One of the stakeholders have opined that there are some use cases that require a Hybrid model where several IoT devices, usually of low power, are connected to a satellite terminal which serves for aggregating the data from these devices and connecting it to the relevant application server through satellite backhauling. Examples of such use cases can be seen in agriculture and mining. Other use cases may need a single IoT device which could connect directly to the satellite as in the case of asset tracking/management. In both the cases, the licensing framework should be flexible enough to encourage these important services. Network architecture should not be a part of licensing framework and this decision should be left to the Licensee.

2.16 One of the stakeholders has mentioned that only Direct-to-satellite connectivity should be permitted for IoT and low-bit applications as this type of connectivity is a preferred solution in scenarios where the deployments need to be fast and hardware dependency cannot be

allowed to restrict the connectivity requirements, for instance in disaster or natural calamities. Many of the existing satellite networks are not commercially suitable for direct-to-satellite connectivity as those satellite network systems were not designed to connect millions of devices spread in wider areas and that the satellite/hardware upgrades will follow the demand. It was further commented that once the 'Same Service Same Rules' principle is adopted in provision of satellite communication services and all possibilities of policy and commercial arbitrage are removed, then it would not matter on the type of model proposed. Once the policy is stabilized, then the market forces should be allowed to come up with the most conducive and beneficial model, instead of a mandated one.

2.17 For second part of the question, the stakeholders were requested to suggest any other suitable model through which the satellite-based connectivity can be provided for IoT devices. In response to this, some of the stakeholders have suggested the following models:

(i) Using any terrestrial communication technology for fronthaul and both satellite and terrestrial backhaul simultaneously.

(ii) Using an LPWAN gateway in motion on the ground using satellite connectivity for backhaul.

(iii) Using HAPS (High Altitude Platform Systems) for fronthaul, where the high-altitude platform serves as the gateway and satellite connectivity as backhaul.

(iv) Using a model consisting of an aggregator which aggregates data from surrounding sensors (typically up to 100 sensors) via Bluetooth, Wi-Fi, or other low power mesh networks and then transmits it to the satellite.

(v) Using a hybrid model consisting of Satellite connectivity with supplementary GSM connectivity. Wherever, GSM signal is available, the connectivity from GSM Network can be extended, in other cases the connectivity from satellite will work.

(vi) Use of other technologies that are being developed and deployed with direct satellite connectivity using cellular frequencies and standard power.

(vii) Using a model that is neither direct-to-satellite nor LPWAN. For example, a VSAT connected to a gateway at a windfarm, which has wired sensors/devices. Another example includes wind turbines which can be daisy chained through fibre optic cables and the data is then aggregated at a VSAT for backhaul. Similarly, a remote mobile tower itself may also leverage satellite connectivity as backhaul to offer IoT services terrestrially.

2.18 The stakeholders are of the view that there are already several possible models for providing satellite connectivity using innovative applications of existing and upcoming technologies. Therefore, the choice of model (or technology or system architecture) should be left open as a business decision.

Analysis

2.19 The Authority agrees with the view of the stakeholders of accommodating both the models in the Regulatory framework without any restrictions and that the end users should be allowed to determine which service model, or a combination of models is suitable for their requirements.

2.20 The Authority also recognises that each model has distinct advantages and disadvantages. Mandating a specific model may not be suitable for all applications and would inhibit optimisation of solutions as per the requirements. With the continuous evolution of Satellite Communications technologies, there may be newer efficient models and their combinations in the future for delivering various innovative solutions. The Authority has always promoted technology neutral solutions leaving ample scope for optimisation and growth of the industry.

2.21 Therefore, the Authority is of the view that leaving this decision on the service providers and end users to choose the model and the connectivity solution, that is best suited for their applications' requirements would be the best way forward. There should not be any mandate on the choice of model to provide satellite-based connectivity for IoT devices and low-bit-rate applications. It will not only provide them flexibility to deploy efficient solutions for their specific requirements but will also leave ample room for innovation and research for future needs and future technologies, resulting in better suited solutions for the end uses.

2.22 Further, it is the M2M Service providers who will be providing M2M and IoT services to the customers. M2M Service providers shall obtain the requisite connectivity from the authorized telecom service providers as per need. The best model of architecture and requisite connectivity, for a particular type of IoT/M2M service, will be decided by the M2M Service Providers. The satellite-based service licensees shall only be providing satellite-based connectivity solutions to the M2M Service providers.

2.23 Based on TRAI's Recommendations dated 5th September 2017 on "Spectrum, Roaming and QoS related requirements in Machine-to-Machine (M2M) Communications", DoT has issued "Draft Guidelines for Registration Process of M2M Service Providers (M2MSP) & WPAN/WLAN Connectivity Provider for M2M Services" on 22nd June 2021 seeking comments of the stakeholders. Accordingly, the framework for M2M service providers will be released by DoT.

2.24 In view of the above, the Authority recommends that:

For provision of Satellite-based connectivity for IoT and low-bit-rate applications, the relevant service licensees may provide connectivity as per the scope of their authorisation for any kind of network topology model, including the Hybrid model (consisting of

LPWAN and Satellite connectivity), Aggregator model and Direct-to-satellite model.

B. IoT Specific Satellite Constellations:

2.25 Low-Bit-Rate Applications or IoT applications require low power, low cost and small-size terminals that can effectively perform the task of signal transfer with minimum loss. The selection of satellite orbit depends on the requirements of the IoT application. Satellite orbits can be generally categorized as GEO (Geostationary Earth Orbit), MEO (Medium Earth Obit) and LEO (Low Earth Orbit).

2.26 LEO satellites are small satellites located at 500−1500 km from Earth and weigh <10kg. They orbit the Earth multiple times a day (up to 15 times). GEO satellites, on the other hand, are traditional heavier satellites (weighing <10,000 kg), positioned at an altitude of more than 35,786 km from the Earth, resulting in a propagation delay of approximately 250ms (500ms for the round trip)[4]. They orbit the Earth once in every 24 hours. MEO satellites lie in the space between GEO and LEO. As compared to GEO satellites, MEO satellites are much easier to manufacture and launch.

2.27 LEO satellites, being closer to the Earth, have very low latency and low atmospheric path loss as compared to GEO and MEO satellites. However, the cost of operation for LEO satellites is more as compared to MEO and GEO satellites, due to inherent requirement of a greater number of satellites for LEO constellation. MEO and GEO satellites provide efficient density of coverage in comparison to LEO satellites.

[4] https://www.itu.int/en/ITU-R/space/workshops/2019-SatSymp/PublishingImages/Pages/Programme/R-REP-M.2460-2019-PDF-E.pdf

(i) GEO Satellites Enabling IoT Applications

2.28 GEO satellites appear to be stationary when seen from a fixed point on Earth. It is possible to have aggregator model or Direct to Satellite model of architecture with such satellites. GEO satellites can also be a good choice for the hybrid approach, where terrestrial networks collect data and satellites serve as the backhaul.

(ii) LEO Satellites Enabling IoT Applications

2.29 LEO satellites are deployed closer to the Earth's surface and are much smaller than GEO satellites. Communication enabled by LEO satellites reduces path loss, requires less terminal power and needs less antenna directivity and antenna gain. These characteristics are well-suited for designing an IoT application around low cost, low power, low latency and small-size terminal solution.

2.30 Unlike GEO, the LEO satellites move speedily in reference to the Earth's ground surface and have small ground coverage in comparison to GEO. The continuous motion of LEO satellites poses a challenge in smooth signal transmissions for IoT applications and in forms of increased number of handoffs from one satellite to another for seamless connectivity. So, they require relatively dense constellation of satellites to ensure that any particular ground terminal is always covered by at least one LEO satellite of the constellation. Therefore, global commercial deployments usually consist of more than a hundred satellites. IoT applications leveraging LEO satellite communications require steerable antennas with designs optimized for specific use cases.

(iii) MEO Satellites Enabling IoT Applications

2.31 MEO satellites are located at an altitude of 2000 km to 35,786 km. They have wider service coverage area and longer orbital time period as compared to LEO satellites. They have the advantage of lower path loss

and are less costly, lighter and have less latency as compared to GEO satellites. However, they also have a drawback that their location keeps on changing with respect to a point on earth. Hence, they give rise to a highly time variant communication channel and therefore need steerable antennas. A suitable antenna design is necessary for maintaining synchronization with the MEO satellites.

2.32 In view of the above, the following question was raised in the Consultation Paper for the comments of the stakeholders: *Satellite-based low-bit-rate connectivity is possible using Geo Stationary, Medium and Low-Earth orbit Satellites. Whether all the above type of satellites should be permitted to be used for providing satellite-based low-bit-rate connectivity? Justify your answer.*

2.33 In response to this question, majority of the stakeholders are in favor of permitting all types of satellite constellations viz GEO, MEO, LEO, for low-bit-rate applications without any restrictions on any specific type of satellite or satellite orbital constellation, since some of the requirements will need permanent connections where geostationary satellite will be required and in certain applications where latency will be important, LEO satellites may be required. Thus, the choice of type of satellite should be left to the service providers so that they can choose the satellites as per their requirements.

2.34 As a solution to digital divide in the country, one of the stakeholders suggested use of hybrid networks, including GSO + NGSO or GSO + terrestrial DSL or wireless configurations. Some of the stakeholders suggested that the regulatory framework need to accommodate broadband IoT applications as well. One of the stakeholders suggested that the regulations should not restrict satellite operators to offer their infrastructure for IoT businesses.

2.35 One of the stakeholders has stated that LEO and MEO satellite constellations are being planned primarily for broadband/high

throughput communication services and these networks will also be capable to support Narrowband IoT/M2M. In view of this, the stakeholders have requested the Authority to ensure that this should not be misused to get any special benefit or regulatory arbitrage to the networks using these constellations as the services provided through these constellations will be providing fully substitutable and competing services with 4G/5G.

2.36 A few stakeholders are of the view that GEO satellites are better suited to enable these applications as against LEO and MEO satellites, since the ground terminals of LEO and MEO may be complex and costly to meet IoT systems technical and business requirement. IoT/M2M services are in most cases low-data-rate applications that do not require very low latency. Only those constellations having a global coverage shall be allowed to ensure seamless integration of Indian ecosystem with Global ecosystem. Therefore, GEO satellites are capable to provide global and reliable coverage.

2.37 Some of the stakeholders have proposed the use of hybrid systems as these systems use many low cost terrestrial only IoT devices which allow meeting the cost point, in combination with few, 'satellite connected', aggregation terminals which provide ubiquitous connectivity. Also, hybrid systems are beneficial whenever the number of IoT devices in each of the network or application is high and controlling the cost per device is of essence for commercial success.

Analysis

2.38 As per the comments submitted by the stakeholders, most of the stakeholders have preferred the proposal of permitting all types of satellite constellations viz GEO, MEO, LEO, for low-bit-rate applications without any restrictions on any specific type of satellite or satellite orbital constellation and that the choice of type of satellite should be left to the service providers.

2.39 Each type of orbit has its own advantages and disadvantages for different types of applications and use cases. Therefore, the choice of suitable, competitive options for satellite IoT, need to be left to the service providers. In addition, with the advent of high throughput satellite systems in GEO, MEO and LEO, satellite-based IoT applications that require higher bit rates and lower latency can also be supported. Both Geo Stationary Orbit (GSO) and Non-GSO (NGSO) satellite systems are under constant technological improvement and changes to the constellation may occur over time. It is essential that the licensing regime should provide flexibility in terms of acceptance of modifications in technology as satellite technology is constantly evolving.

2.40 While GSO satellites are traditionally more expensive and require longer time to roll out the constellation, NGSO satellites are suited for smaller and cheaper satellites capable to provide more affordable solutions, the Authority is of the view that both GSO and NGSO are suited for low-bit-rate connectivity type of applications. Both types of satellites are already successfully used to provide satellite-based connectivity for IoT devices and low-bit-rate applications.

2.41 In view of the above, the Authority recommends that **All types of satellite viz. Geo Stationary Orbit (GSO) and Non-GSO (NGSO) satellites should be permitted to be used for providing satellite-based low-bit-rate connectivity.**

C. Possible frequency bands for Satellite-Based IoT Connectivity:

2.42 There are different frequency bands which are suitable for IoT connectivity such as L-band, S-band, C-band, Ku-band, Ka-band and other higher bands. All these bands are core frequency bands for satellite industry which are already in use today by many satellite systems.

2.43 Based on the above, the stakeholders were asked to comment on the following question:

There are different frequency bands in which communication satellites operate such as L-band, S-band, C-band, Ku-band, Ka- band and other higher bands. Whether any specific band or all the bands should be allowed to be used for providing satellite based IoT connectivity? Justify your answer.

2.44 In response to this, most of the stakeholders are of the view that all the existing Satellite Frequency bands, as per the NFAP, should be exploited to provide satellite services as different bands are used for communication systems having different characteristics. The decision on the specific frequency band to be used should be left to the service providers, based on their business/cost model.

2.45 A few stakeholders mentioned that VHF and UHF frequencies are also ideal to offer satellite-based IoT connectivity for low-data-rate applications and thus should be added in the list.

2.46 One of the stakeholders suggested a provision to be made in each such band to have sub-bands allocated for experimental purposes. The size of the sub-bands may be determined based on the available spectrum but be large enough to meaningfully serve the purpose of experimentation. In order to prevent misuse of this provision, it has been suggested that any mission using such spectrum be subject to compliance with Resolution 32 of WRC-19, otherwise known as ITU's definition of "short duration missions".

2.47 One of the stakeholders, while favouring the proposal of not restricting any band for low-bit-rate applications, mentioned that in recent years, Ku- and Ka-band are the main bands to provide satellite connectivity rather than the formerly used lower frequencies such as L band and C band. This is because these frequency bands require smaller size of the terminal antennae and provide higher capacity. L- and S-band are

important for the telecom and telemetry connectivity to the satellites themselves.

2.48 One of the stakeholders has mentioned, that the IMT bands may be more suitable for Direct-to-satellite model while non-IMT bands will be more suitable for backhaul use with LPWAN. In line with the global harmonization, they suggested that spectrum band that has been identified for IMT or being deliberated/likely to be adopted for IMT should not be used for satellite-based backhaul networks. These operators should be free to choose whether they want to use it for terrestrial or satellite-based network.

2.49 Another stakeholder suggested the possibility of using the shared Industrial Scientific Medical (ISM) band for IoT access by sharing this band with existing terrestrial wireless services.

2.50 Another stakeholder has requested the Authority to preserve Ku band (10.7-12.7 GHz and 14-14.5GHz) and Ka band (17.8-18.6, 18.8-19.3GHz and 27.5-29.1, 29.5-30 GHz) for Fixed Satellite Service (FSS) use only.

2.51 Whereas few stakeholders are in favour of permitting specific bands:

i. The existing bands up to Ka are sufficient to meet the requirements for GEO satellite.
ii. Only Ku- and Ka-band should be permitted with specific frequency range as frequency reuse will be better in Ka band with the spot beams which will be more suitable for the application. Till a considerable capacity in the Ka-band is available, Ku-band should serve the purpose.
iii. L-band should be permitted as it presents the highest reliability, mobility, global coverage, devices availability and can accommodate low data rates.
iv. The S-band, allocated to Mobile Satellite Service, should be permitted as it provides the unique opportunity to offer improved

interoperability between space and ground networks while not over complexifying the ground segment or the space segment and making the most efficient use of the spectrum.

Analysis

2.52 The Authority recognises that the preference of a particular frequency band is based on the application that is being served by the service provider, as different frequency bands have different characteristics. Other factors like antenna size, power requirements for devices in use, scalability, reliability of operations, flexibility, interoperability with terrestrial technologies, affordability, consistency of performance, the type of satellite and configurations, architectures, etc., contribute to deciding the appropriate frequency bands to be used for providing the connectivity.

2.53 The Authority is of the view that depending on the availability of ecosystem in different frequency bands and suitability for different type of use cases, all the permitted satellite frequency bands should be allowed to be used for the various applications. This will promote innovation in satellite communication market for low-bit-rate applications and enable better competition among the various service providers that will ultimately result in affordable and best quality service to the end users.

2.54 In view of the above, the Authority recommends that:

The Service Providers should be allowed to use any of the permitted satellite frequency bands for providing satellite-based low-bit-rate connectivity.

CHAPTER 3

CURRENT LICENSING FRAMEWORK FOR SATELLITE SERVICES

3.1 IoT and M2M devices require connectivity to send the data to their application servers. IoT devices operate mostly on wireless connectivity as the number of devices is usually very large. The common terrestrial wireless network for IoT connectivity may be cellular networks operating in the licensed frequency bands and Low Power Wide-Area Network (LPWAN) operating in unlicensed frequency bands. TRAI in its recommendations dated 5th September 2017 on "Spectrum, Roaming and QoS related requirements in Machine-to-Machine (M2M) Communications" has recommended that access service providers and LPWAN service providers may provide terrestrial wireless connectivity for IoT/M2M devices.

3.2 However, for the remote areas where the terrestrial networks are not available or for such IoT devices which are on the move and frequently go out of reach of terrestrial networks, satellite-based connectivity plays an important role for providing crucial communication infrastructure. Satellite-based connectivity services are already being provided by various operators under the respective authorization of Unified License. Therefore, there is a need to examine the scope of various authorizations of Unified License which permit provision of satellite-based services.

3.3 It has been pointed out by DoT in its reference that there are limitations in the existing licensing framework in respect of the proposed satellite-based low-bit-rate applications. Therefore, there is a need to examine that whether a new licensing framework will be required for the proposed satellite-based connectivity for low-bit-rate applications or existing authorizations may be suitably amended with enabling

provisions for providing such services on commercial as well as on captive basis.

3.4 In view of the above, the following question was raised in the consultation paper to elicit the comments of the stakeholders: *(i) Whether a new licensing framework should be proposed for the provision of Satellite-based connectivity for low-bit-rate applications or the existing licensing framework may be suitably amended to include the provisioning of such connectivity? Justify your answer.*

(ii) In case you are in favour of a new licensing framework, do suggest suitable entry fee, license fee, bank guarantee, NOCC charges, spectrum usage charges/ royalty fee, etc.

3.5 Most of the stakeholders have suggested that there is no need of any separate licensing framework for providing Satellite-based connectivity for low-bit-rate applications. However, it has been suggested that it is necessary to relax certain requirements in relation to the terminals' licensing to make the business case viable for IoT/M2M and to encourage the uptake of these services.

3.6 Many of the stakeholders, while emphasising the suitability of the existing licensing framework, have elaborated that these frameworks may be suitably amended for the provision of Satellite-based connectivity for modern digital, not only low-bit-rate, applications and services. All the existing service authorizations permit data connectivity and IoT is also a kind of data connectivity (albeit a low-data-rate), therefore, there is no need to recommend a new authorization for the niche IoT connectivity. One of the stakeholders has suggested suitable amendment of the existing authorizations for providing low-bit-rate Satellite Communication services on commercial as well as on captive basis at equitable terms.

3.7 One of the stakeholders has emphasised that telecommunication needs of fleet owners, railways, etc., in their normal course of business, must

be fulfilled through licensed networks only; therefore provisions for satellite services should be within the scope of existing UL licenses/Authorisations. As the services being provided are largely the same, the satellite-based solutions would compete with present terrestrial solutions, for providing services to the enterprise and end customers. Thus, the most suitable and robust approach would be that the IoT satellite-based solutions should be launched only under Unified License (Access Authorization), directly or as a complementary technology to terrestrial.

3.8 Some of the stakeholders have categorically stated that equitable licensing and regulatory provisions, as are applicable on terrestrial mobile networks, should also apply for providing satellite-based IoT services. Such equitable licensing and regulatory provisions must include but not be limited to license fee, privacy and security norms, verification, quality of services, etc.

3.9 One of the stakeholders has emphasized that Spectrum allocation, irrespective of the technology deployed, should be allocated through transparent and open auction process with necessary provisions in the Spacecomm policy or otherwise.

3.10 Most of the stakeholders are of the opinion that it is necessary to relax certain requirements related to the terminals' licensing to make business cases viable for IoT/M2M. A "blanket license" approach has been suggested by some of the stakeholders to be more suitable in respect of terminal licensing. Another stakeholder has suggested that there is a requirement for provision for blanket licensing for VSAT and Earth Stations in Motion (ESIM) within the FSS for satellite applications also, in addition to blanket licensing for terminal licensing.

3.11 Many of the stakeholders are of the view that whether it is a new licensing framework or changes in the existing licensing frameworks, its provisions need to be in line with the international best practices

and essentially incorporate light-touch licensing, predictable regulatory policies and timely approvals through a single-window clearance.

3.12 Some of the stakeholders are of the view that it would be difficult to incorporate desired changes in the existing frameworks to accommodate provision of satellite connectivity. Therefore, a common and simple licensing framework for satellite connectivity needs to be established, wherein all kinds of satellite-based connectivity solutions should be available under a single authorization and may be called as Satellite Service Authorisation.

3.13 Contrary to the above, some of the stakeholders have cautioned against creating more and more service types under the unified licensing regime for specific kinds of satellite applications. They have suggested to expand the existing satellite service categories to accommodate additional applications. They are of the view that having too many sub-categories of services, especially if subjected to different conditions, will defeat the purpose of a convenient unified licensing instrument and may artificially restrict the ability for service providers to tailor solutions to meet the market requirements.

3.14 A few stakeholders have emphasised that there is a need for an enabling environment for motivating global satellite network operators to invest in India. This could be encouraged by keeping entry fees and other charges low to generate investment and thereby growing the broader economy. Another stakeholder has elaborated that transparency, open sky policy, equal treatment for both domestic and foreign operators, one stop window and low fees the basic requisites to be incorporated in the licensing framework.

Analysis

3.15 As per the existing telecom licensing framework, introduced in 2013, a Unified License (UL) is required for providing all types of telecom services under the requisite authorization(s) in the entire country. Different authorizations issued by DoT pertaining to Satellite-based

Services are Commercial VSAT Closed User Group (CUG) Service, Global Mobile Personal Communication by Satellite (GMPCS) Service and INSAT Mobile Satellite System-Reporting (MSS-R) Service. Satellite-based connectivity services are already being provided by various licensees under the respective authorizations of the Unified License. Therefore, there is a need for a suitable amendment in the scope of the existing authorizations of Unified License, which permit the provision of satellite-based services, to enable the provision for providing low-bit-rate applications also.

3.16 From the comments of the stakeholders and their views expressed in the Open house discussion, it is amply clear that most of the stakeholders are of the opinion that there is no need for creation of any separate licensing framework for providing Satellite-based connectivity for low-bit-rate applications. However, they are of the common view that certain requirements in relation to the terminals licensing need to be relaxed to make the business case viable for Satellite-based connectivity for IoT/M2M applications. This would result in encouraging the uptake of these services in the country.

3.17 Satellite-based connectivity plays an important role for providing crucial communication infrastructure for the remote areas where the terrestrial networks are not available and for such IoT devices which are on the move and frequently go out of reach of terrestrial networks. Satellite-based connectivity services are already being provided by various operators under the respective authorizations of Unified License. Therefore, there is a need for suitable amendment in the scope of various authorizations of Unified License to permit provision of satellite-based connectivity for low-bit-rate applications. Enabling provisions are required for providing such services on commercial as well as captive basis.

3.18 The Authority is of the view that it is not advisable to introduce a separate new Licensing framework for providing satellite-based

connectivity for low-bit-rate application. The existing framework and the Authorisations available under the Unified license have the required flexibility and the current requirements can be accommodated in the license.

3.19 Therefore, in view of above the Authority recommends that:

The relevant existing authorizations under Unified Licensing framework may be suitably amended for enabling satellite-based low-bit-rate connectivity.

3.20 The scope of various UL authorizations dealing with provision of satellite-based connectivity and possibility of amendment are discussed below.

A. Global Mobile Personal Communication by Satellite (GMPCS) Service Authorization

3.21 Global Mobile Personal Communication by Satellite (GMPCS) Service authorization envisages provision of satellite phone service. The scope of GMPCS Service authorization, as provided in Clause 2 of Chapter XII of Unified License, is as below:

> *Clause 2.1 The licensee may provide, in its area of operation, all types of mobile services, including voice and non-voice messages, data services by establishing GMPCS Gateway utilizing any type of network equipment including circuit and/or packet switches.*
>
> *Clause 2.2 The Licensee shall establish Land Earth Station Gateway in India for the purpose of providing Global Mobile Personal Communication by Satellite (GMPCS) Service. GMPCS Service may be provided using one or more Satellite Systems provided that the Land Earth Station Gateway Switch is established separately in India for each Satellite System.*

3.22 The scope of GMPCS service includes voice and non-voice messages and data services. Therefore, GMPCS service provider may provide voice,

SMS (text) and internet service (data services) on satellite phones using satellite system. Provision of connectivity to IoT devices is not mentioned in the scope of service. However, it will be easier for a GMPCS service provider, having a Land Earth Station Gateway in India, to provide connectivity to the IoT devices in its service area. Enabling provisions may easily be incorporated in the scope of this authorization to enable the licensee to provide IoT connectivity. The existing infrastructure, ground segment as well as space segment, may be effectively utilized to provide this niche service. By expanding the scope of GMPCS service authorization, it can be made more commercially attractive.

3.23 Therefore, the following question was posed for comments of the stakeholders: *The existing authorization of GMPCS service under Unified License permits the licensee for provision of voice and non-voice messages and data services. Whether the scope of GMPCS authorization may be enhanced to permit the licensees to provide satellite-based connectivity for IoT devices within the service area? Please justify your answer.*

3.24 In response to this question, most of the stakeholders have mentioned that GMPCS service authorization have very stringent requirements, including establishing a satellite gateway in India. IoT/M2M should be permitted under GMPCS authorization, with appropriate relaxation of the terminals licensing scheme for providing cost effective IoT services.

3.25 Many of the stakeholders, while supporting GMPCS authorization as suitable for low-bit-rate connectivity, have opined that the GMPCS services should be expanded for facilitating ease of doing business. Enabling provisions may be incorporated in its scope. A framework under which a single authorization permits all kinds of satellite-based connectivity, be it Low Bit Rate, broadband or any other form of connectivity solutions should be the objective.

3.26 Some of the stakeholders have elaborated that the existing scope of service for GMPCS permits all types of services including IoT/low-bit-rate applications and makes sufficient scope for offering Satellite-based Connectivity for low-bit-rate Applications. Therefore, there is no need to change the scope of GMPCS authorization.

3.27 A few stakeholders are of the view that allowing GMPCS to offer such satellite-based IoT/M2M connectivity will create an overlap with services provided under commercial VSAT CUG license.

3.28 One of the stakeholders has mentioned that the very novel nature of IoT (more specifically on the S-band) should be captured in a new regulatory framework. The technical characteristics and capabilities of IoT systems in the S-band are very different from those of GMPCS systems at the time they were introduced. Furthermore, the GMPCS authorization would put some undue constraints on the deployment of IoT.

3.29 Another stakeholder has mentioned that the GMPCS authorisation, as is currently framed, allows data services, which theoretically covers IoT services through satellite also. However, in practice the conditions imposed on the GMPCS operators make it impossible for the small operators to provide services under this framework. Requirements related to the foreign equity participation, establishment of the gateway in the country, bank deposits, high recurrent licence fee in terms of Adjusted Gross Revenue (AGR) and a hefty bank guarantee makes market access impossible for smaller operators under the GMPCS licence.

3.30 All the stakeholders have echoed their views with respect to high costs associated with satellite communication like Spectrum Usage Charges, NOCC Charges, high AGR, per terminal licensing fees, multiple permissions and related regulatory costs and other levies which needs to be rationalised for providing cost-effective services. It has also been mentioned that the current GMPCS licensing conditions are very

challenging and as such these would not be a cost-effective way of providing satellite connectivity for IoT or broadband connectivity for IoT devices.

Analysis

3.31 The Authority acknowledges the issues highlighted by the various stakeholders and is of the view that enabling provisions are required to be incorporated in the scope of GMPCS Authorization, for providing affordable satellite-based connectivity for IoT devices.

3.32 Most of the stakeholders have supported the provision of satellite-based connectivity for IoT devices for low-bit-rate applications under the GMPCS service authorization. The stakeholders have also requested for relaxation in terminals licensing under this authorization. The GMPCS service authorization under Unified License permits the licensee to provide voice and non-voice messages and data services through satellite. The mobile personal communication through satellite is provided to the individual subscribers having handheld Satphone terminal which is directly communicating with satellite in the space. Usually, such type of service is provided using the lower satellite bands such as L band and S Band. Further, it is a SIM-based service and the handheld subscriber terminal contains a SIM for making communication service. Under the scope of data services under this authorization, the licensee may provide satellite-based data connectivity to the SIM based IoT/Aggregator devices. Accordingly, the scope of GMPCS service authorization under Unified License may be suitably amended to include provision of satellite-based low-bit-rate connectivity for IoT devices.

3.33 The stakeholders have also requested for relaxation in terminal licensing under GMPCs authorization. The frequency for Earth Station side and terminal side are assigned by WPC as per prescribed procedure. Currently, the spectrum charges are computed by WPC as prescribed by the DoT Order No. P-11014/34/2009-PP (III) dated 22nd

March 2012 (that is on formula basis and is proportional to number of terminals and frequency bandwidth used by licensee). The Annual Royalty charge (R) per frequency is calculated as per the following given below where a Bandwidth Factor (Bs) is applied as per the Table 3.1. Royalty 'R' is payable for an Uplink or a Downlink as per the following formula:

Royalty, R (in Rs.) = 35000 × Bs

Table 3.1: Bandwidth factor (B_S) for satellite communications

Bandwidth Assigned to a Frequency (W KHz)	Bandwidth factor, B_s for an uplink		Bandwidth factor, B_s for a downlink	
	Broadcast	Others	Broadcast	Others
Up to and including 100 KHz	0.25	0.20	NIL	0.20
More than 100 KHz and up to and including 250 KHz	0.60	0.50	NIL	0.50
More than 250 KHz and up to 500 kHz	1.25@	1.00@	NIL	1.00@
For every 500 kHz or part thereof	1.25@	1.00@	NIL	1.00@

[@ for every 500 kHz or part thereof]

3.34 Apparently, the formula-based charging, wherein the spectrum charges are levied based on each link, is restrictive for growth of the satellite-based services in India, as it tends to penalize efficient use of the satellite frequency instead of promoting it. Formula based charging mechanism may be reasonable to be used in case of captive users, i.e., when an entity takes a license/spectrum for its own use and not for provision of commercial telecom services to the public.

3.35 It may be noted that in its various recommendations in the past, the Authority has recommended that the formula-based spectrum charges should be replaced with AGR based spectrum charges for the following services:

(a) *'Satellite based Services using Gateway installed in India under 'sui-generis' category' vide recommendations on 'Methodology for levy of Spectrum Charges for provision of Satellite-based Services using Gateway installed in India under 'sui-generis' category' dated 27th December 2018.*

(b) *'Public Mobile Radio Trunking Services (PMRTS)' vide recommendations on 'Method of allocation of spectrum for Public Mobile Radio Trunking Service (PMRTS), including auction, as a transparent mechanism' dated 20th July 2018.*

(c) *For using satellite frequencies under the NLD service license/ authorization vide recommendations on 'Provision of Cellular Backhaul Connectivity via Satellite Through VSAT Under Commercial VSAT CUG Service Authorization' dated 28th July 2020.*

3.36 The Authority, in its earlier recommendations as given below, had been recommending a flat rate of spectrum usage charge as 1% of AGR:

(a) *In its Recommendations dated 3rd October 2005 on 'Growth of Telecom services in rural India — The Way Forward', the Authority, in respect of Commercial VSAT services, had inter alia recommended that there should be a single rate of WPC fee (SUC) and the ceiling of 4% should be lowered to 1% to cover administrative charges only.*

(b) *In its recommendations on 'Spectrum Usage Charges and Presumptive Adjusted Gross revenue for Internet Service Providers and Commercial Very Small Aperture Terminal Service Providers' dated 7th March 2017, the Authority had, inter alia, viewed that "there should be a single rate of SUC for VSAT service and it should be only 1% to cover administrative charges; and recommended that SUC should not be more than 1% of AGR irrespective of data rate".*

(c) *In its recommendations on 'Method of allocation of spectrum for Public Mobile Radio Trunking Service (PMRTS) including auction, as a transparent mechanism' dated 20th July 2018, the Authority, inter-alia, recommended that "the SUC for the spectrum allocated to PMRTS shall be levied @ 1% of AGR".*

(d) *In its recommendations on 'Methodology for levy of Spectrum Charges for provision of Satellite based Services using Gateway installed in India under 'sui-generis' category' dated 27th December 2018, the Authority inter alia recommended that "the spectrum charges should be levied at 1% of the AGR of BSNL's satellite-based services under 'sui-generis' category".*

(e) *In its recommendations on 'Provision of Cellular Backhaul Connectivity via Satellite Through VSAT Under Commercial VSAT CUG Service Authorization' dated 28th July 2020, the Authority, inter alia, recommended that "Replacing the existing formula-based mechanism, Spectrum usage charges for using satellite frequencies under the NLD service license/authorization should be prescribed as 1% of AGR excluding the revenue from the licensed services other than satellite-based services".*

3.37 Earlier, the spectrum charges for BSNL's 'sui generis' licence for the provision of satellite-based Global Satellite Phone Service (GSPS) services was also formula based. TRAI, vide its recommendations dated 27th December 2018, inter alia, recommended that replacing the existing formula-based mechanism, spectrum charges should be levied at 1% of the AGR of BSNL's satellite-based services under 'sui-generis' category. The recommendation has been accepted by DoT and the notification has been issued by DoT on 28th June 2021 prescribing SUC as 1% of AGR for this 'sui-generis' license.

3.38 On the similar lines, the existing formula-based mechanism for calculation of Spectrum Usage Charges for using satellite frequencies under the GMPCS service authorization should be replaced with AGR based mechanism and the SUC should be prescribed as 1% of AGR. These charges should cover the entire spectrum charges for handsets/user devices as well as for Earth Stations. The methodology of assignment of spectrum is not a part of consultation of this paper. Therefore, the recommendations are being made considering the existing method of assignment of spectrum for GMPCS authorization.

3.39 In view of the above analysis and comments of the stakeholders, the Authority recommends that:

(i) The GMPCS service authorization under Unified License permits the licensee to provide voice and non-voice messages and data services. Under the scope of data services, the licensee may provide satellite-based data connectivity to the SIM-based IoT/Aggregator devices. Scope of GMPCS service authorization under Unified License may be suitably amended to include provision of satellite-based low-bit-rate connectivity for IoT devices.

(ii) Replacing the existing formula-based mechanism, Spectrum Usage Charges for using satellite frequencies under the GMPCS service authorization should be prescribed as 1% of AGR. These charges would cover the entire spectrum charges for handsets/user devices as well as for Earth Stations.

B. Commercial VSAT CUG Service Authorization

3.40 The Commercial Very Small Aperture Terminal (VSAT) Closed User Group (CUG) Service authorization envisages to provide data connectivity service to Closed User Groups. The scope of Commercial VSAT CUG Service authorization, as enumerated in Clause 2.1 of Chapter XIV of Unified License, is as below:

> *Clause 2.1 (i) The scope of service is to provide data connectivity between various sites scattered within territorial boundary of India using VSATs. The users of the service should belong to a Closed User Group (CUG). However, the VSAT licensee after obtaining ISP license may use same Hub station and VSAT (remote station) to provide Internet service directly to the subscribers and in this case VSAT (remote station) may be used as a distribution point to provide Internet service to multiple independent subscribers.*

(ii) Long distance carriage rights, granted for NLD, ILD and Access service, are not covered under the scope of this service.

(iii) The Closed User Group Domestic Data Network via INSAT Satellite System using VSAT shall be restricted to geographical boundaries of India.

(iv) The Licensee can set up a number of CUGs using the shared hub infrastructure.

(v) PSTN/PLMN connectivity is not permitted.

(vii) Data Rate, as specified in TEC Interface Requirements No. TEC-IR/SCB-08/02-SEP.2009, is allowed, subject to the compliance of the technical parameters as specified in TEC Interface Requirements No. TEC-IR/SCB-08/02-SEP.2009, as modified from time to time.

3.41 The scope of the Commercial VSAT CUG service authorization includes provision of data connectivity between various sites. However, the user should belong to a Closed User Group. Therefore, it is already within the scope of Commercial VSAT CUG service authorization to provide satellite-based connectivity solutions. The satellite-based low-bit-rate connectivity for IoT devices may also be provided under the scope of this license. However, scope of services permitted under this authorization is to be made technology agnostic and data speed agnostic. VSAT is a specific technology through which the data connectivity solutions are being provided under this authorization. The service provider may like to use any other latest technology to provide data connectivity solutions and for any speed denominations.

3.42 Satellite-based IoT connectivity required in the hybrid model (LPWAN + Satellite) is already permitted to be provided by the Commercial VSAT CUG service providers using the existing infrastructure of ground

segment and space segment. For direct-to-satellite connectivity, the antenna size and the technology used may be different from VSAT technology. This will require liberal approach in prescribing the technology or antenna size. Requirement of 'antenna on moving platform' will also be needed to be considered under VSAT authorization. TEC's Interface Requirements (IR) has recently been revised to accommodate various antenna size, data speeds and other relevant issues in respect of satellite-based services.

3.43 Currently, the Commercial VSAT CUG Service licensee is permitted to provide data connectivity solutions to a Closed User Group only. Even in CUG, the connectivity may be point to point for a single link or many links in single CUG. While envisaging satellite-based low-bit connectivity for IoT devices, there may be a CUG nature of user, or it may be a non-CUG also. It will depend upon the architecture being followed by the IoT provider who will obtain the satellite-based connectivity to its IoT devices through satellite.

3.44 In view of the above, the following questions were posed for inputs of the stakeholders:

(i) Whether the scope of Commercial VSAT CUG Service authorization should be enhanced to permit the use of any technology and use of any kind of ground terminals to provide the satellite-based low-bit-rate connectivity for IoT devices?

(ii) Whether the condition of CUG nature of user group should be removed to permit provision of any kind of satellite-based connectivity within service area? Justify your answer.

3.45 In response to the above, some of the stakeholders are of the view that Low-Bit-Rate connectivity for IoT devices is a subset of the data connectivity services and therefore is already included in the scope of VSAT service authorization. The scope of VSAT needs to be updated to clarify this inclusion.

3.46 The stakeholders have agreed that enabling VSAT service authorisation to provide satellite connectivity will boost the effective utilization of existing infrastructure and avoid duplicity of creation of similar infrastructure. This would lead to cost reduction of satellite-based services thereby permitting more liberal usage of the existing authorisation.

3.47 Many of the stakeholders are of the view that the scope is to be made technology agnostic and data speed agnostic and more liberalised by removing the restrictions of the CUG. However, one of the stakeholders has advocated for technology neutral approach permitting any kind of ground terminals to provide only for backhaul connectivity, but not for direct-to-satellite connectivity.

3.48 One of the stakeholders has opined that in allowing different types of services under the Unified Licence to address satellite based IoT markets, it must be ensured that differing license requirements for different types of services are justified and do not distort competition.

3.49 A few stakeholders have highlighted that requirement of 'antenna on moving platform' should also be considered under VSAT CUG license. Land mobile connectivity should be included into the scope of satellite services authorization for provision of services to automobiles, trains and other on the move applications.

3.50 Another stakeholder is of the view that it would be prudent to make this authorization band agnostic and the decision on the frequencies, which may be used for satellite communications be as per the NFAP. Except for PSTN voice and broadcasting services, it should be possible to do any other voice, data and video applications, including low-bit-rate data applications.

3.51 One of the stakeholders has opined that amendment in VSAT CUG authorization, to provide satellite-based IoT service, will lead to regulatory confusion and non-compliance. Not only the CUG, but other

requirements like Antenna size, mobility, etc., will be required to be waived off to enable Satellite-based IoT services under this authorization of UL.

3.52 As per another stakeholder, satellite based IoT connectivity required in the hybrid model (LPWAN + Satellite) can be provided by the Commercial VSAT CUG service providers using the existing infrastructure of ground segment and space segment. For direct-to-satellite connectivity, the antenna size and the technology used may be different from VSAT technology. This will require liberal approach in prescribing the technology or antenna size.

Response to part (ii) of the question

3.53 In response to part(ii) of the question, some of the stakeholders have advocated that the CUG nature of user group should not be disturbed as removing this would defeat the basic purpose of this authorisation and would make this no different than an Access Services authorisation under which satellite usage is already allowed. Another stakeholder is of the view that more than one closed user groups should be allowed to enable different architectures. Any restrictions that limit the architecture in any way must be removed.

3.54 However, many of the stakeholders are of the view that the condition of CUG should be removed to permit any kind of satellite-based connectivity under this Authorization.

Analysis

3.55 The Authority agrees to the views of the stakeholders that the scope of Commercial CUG VSAT authorisation needs to be enhanced to permit use of any technology and ground terminals to provide the satellite-based low-bit-rate connectivity for IoT devices. The Commercial VSAT CUG service authorization under Unified License permits the licensee to provide data connectivity between various sites scattered within territorial boundary of India. Under the scope, the licensee may be

permitted to provide data connectivity for IoT devices also through satellite. Scope of Commercial VSAT CUG service authorization under Unified License may be suitably amended to include provision of satellite-based low-bit-rate connectivity for IoT devices.

3.56 The scope of Commercial VSAT CUG Service authorization need to be made technology and data speed agnostic. The licensee should be permitted to use any kind of ground terminals to provide the satellite-based low-bit-rate connectivity for IoT devices.

3.57 There is a clause in the scope of Commercial VSAT CUG service authorization that "the users of the service should belong to a Closed User Group (CUG)". Some of the stakeholders are in favour of removing the condition of CUG, whereas some other stakeholders have expressed concerns and have requested to continue the CUG nature of users in VSAT license.

3.58 A decision has been taken by the government to permit the VSAT operators to provide point to point satellite-based bandwidth to mobile operator for backhaul purpose. They will also be required to provide satellite-based connectivity to M2M Service providers for IoT devices. The M2M service providers, as per the guidelines being finalised by DoT, would be permitted to connect numerous IoT devices and provide service to the end users. Thus, the satellite-based connectivity provided by the VSAT service provider to the M2M service provider, shall continue to remain as a part of the CUG only. The M2M service provider, who will obtain the satellite-based connectivity to connect its IoT devices through satellite, from the VSAT service provider, could decide the architecture required to be followed to connect the IoT devices. Since Commercial VSAT CUG service providers do not provide any satellite-based connectivity services directly to an end user/subscriber (unlike of access services, where any end user/subscriber can subscribe the service), there is no need to remove the CUG nature of

users under this authorization. However, there is a need to take a liberal view while interpreting the definition of CUG nature of the service.

3.59 The low-bit-rate applications have immense potential in case of automobiles, railway fleet, ATM on wheels and other services that need connectivity on the move. The scope for this authorisation should also include the mobility of terminals for such applications.

3.60 TRAI has recommended in its various earlier recommendations, that there should be a single rate of Spectrum Usage Charges (SUC) and it should be only 1% to cover administrative charges for VSAT Services. In its earlier recommendations dated 7th March 2017 on 'Spectrum Usage Charges and Presumptive Adjusted Gross Revenue for Internet Service Providers and Commercial Very Small Aperture Terminal Service Providers' it has been recommended for Commercial VSAT services that the SUC should not be more than 1% of AGR, irrespective of the data rate. In view of this and after considering the comments of stakeholders, the Authority would like to reiterate its earlier recommendations.

3.61 In view of the above, the Authority recommends that:

(i) **The Commercial VSAT CUG service authorization under Unified License permits the licensee to provide data connectivity between various sites scattered within territorial boundary of India. Under the scope, the licensee may be permitted to provide data connectivity for IoT devices also through satellite. Scope of Commercial VSAT CUG service authorization under Unified License may be suitably amended to include provision of satellite-based low-bit-rate connectivity for IoT devices.**

(ii) **The Commercial VSAT CUG service providers should be permitted to use any technology, conforming to the TEC IR/GR, to provide the service.**

(iii) **TEC IR/GR may be modified to include the specifications regarding 'user terminal station on moving platform' for VSAT services.**

(iv) **In respect of SUC for Commercial VSAT CUG Service license, the Authority reiterates to make the SUC as 1% of AGR, irrespective of the data rate, as stated earlier in its recommendations dated 7th March 2017 on 'Spectrum Usage Charges and Presumptive Adjusted Gross Revenue for Internet Service Providers and Commercial Very Small Aperture Terminal Service Providers'.**

C. Captive VSAT CUG Service License

3.62 DoT, in its reference, has also requested for recommendations for Captive use of satellite-based network for captive IoT devices. It has been stated that organizations like State transport Authorities, Indian Railways, other fleet owners, disaster management agencies, etc., may need to setup a Captive network for their own use (and not for selling the service). These Captive networks may be of the following two types:

- Government owned entities like Police and security Agencies/PSUs/boards
- Private companies

Currently, the captive use of satellite-based connectivity is covered under the Captive VSAT CUG license. The scope of Captive VSAT CUG Service License is as below:

1. The captive VSAT Closed User Group Domestic Data Network via INSAT Satellite System shall be restricted to geographical boundaries of India.

2. Network will be used only for internal communication and non-commercial purposes of Licensee.

3. Neither users other than Licensee shall be given access to the network, nor third-party traffic shall be carried on the network.

4. The intent of this License is not to grant long distance carrier rights.

5. The scope of the service is to provide data connectivity between various sites scattered throughout India using Very Small Aperture Terminals (VSAT5). However, these sites should form part of a Closed User Group (CUG).

6. Captive VSAT service licensees can set up only one CUG for their own use.

7. A maximum Data Rate up to 2 Mbps per VSAT for Star configuration and 4 Mbps for Mesh configuration (including all carriers) is permitted subject to the compliance of the technical parameters as specified in TEC Interface Requirements No. TECIIR/SCB-08102 October 2013. The technical parameters mentioned in Interface Requirement for CUG Domestic VSAT Network namely No. TEC IR'SCB-08/02 Oct 2013 issued by T.E.C. to be strictly compiled with. Any other notification or modification thereof issued from time to time in this regard shall be binding.

3.63 As examined in case of Commercial VSAT CUG service authorization, the Captive VSAT CUG service license too will require certain changes and amendments, to enable the provision of captive data connectivity for low-bit-rate applications and IoT devices. The terms and conditions related to scope of service, technology used, antenna size, data bit rate, mobility of antenna, TEC's IR specifications, etc., need to be examined and considered. Further, as the annual license fee for captive VSAT license is Rs. 10,000/- per VSAT Terminal/Earth Station and expected number of IoT devices would be too large, the issue of license fee needs to be examined and a mechanism is to be evolved for a reasonable license fee.

3.64 In view of the requirement for Captive use of satellite-based network for IoT devices, inputs of the stakeholders were requested on the following questions:

(i) What should be the licensing framework for Captive licensee, in case an entity wishes to obtain captive license for using satellite-based low-bit-rate IoT connectivity for its own captive use?
(ii) Whether the scope of Captive VSAT CUG Service license should be modified to include the satellite-based low-bit-rate IoT connectivity for captive use?
(iii) If yes, what should be the charging mechanism for spectrum and license fee, in view of requirement of a large number of ground terminals to connect large number of captive IoT devices.

3.65 In response to the above-mentioned questions, most of the stakeholders are of the view that the scope of the Captive VSAT service Licenses can be modified to enable them to provide Low-Bit-Rate satellite connectivity for the IoT devices for their captive use.

3.66 One of the stakeholders is of the view that scope of Captive VSAT CUG should not be modified as it would lead to creation of propriety islands of IoT systems. Also meeting the Lawful Interception (LI) requirement for these captive users may not be economically viable. Another stakeholder has opined that IoT services are commercial services and thus, these services would not fall under captive CUG. The satellite-based IoT services should be offered only under Unified License (Access authorization).

3.67 Captive VSAT CUG service license should be treated as a special case of Commercial VSAT CUG Service authorization only and the licensee may be required to pay additional License fee, i.e., in addition to levies payable under Commercial VSAT CUG Service authorization.

3.68 Regarding spectrum charges the stakeholders suggested that it should continue to be charged on formula basis. However, the existing license

fee of Rs.10000 per VSAT terminal is unsuitable for low-bit-rate IoT applications and license fee should be charged only for VSAT terminals and not for the numerous IoT devices connected to the VSAT terminals.

Analysis

3.69 The scope of the Captive VSAT CUG service license is to provide data connectivity between various sites scattered throughout India using Very Small Aperture Terminals. The Authority feels that the scope of Captive VSAT CUG service license may be suitably amended to include provision of satellite-based low-bit-rate connectivity for IoT devices to be used only for internal communication and non-commercial purposes.

3.70 As per Captive VSAT CUG service license, the licensee shall pay license fee annually at Rs. 10,000 per annum per VSAT Terminal/ Earth stations installed. This annual license fee is in addition to the annual spectrum charges to be paid by the licensee for using satellite frequency for Earth Station side and terminal station side. The number of IoT devices is expected to be large, so the issue of license fee needs to be examined and a mechanism is to be developed for a reasonable license fee. The per terminal license fee should be charged only for the VSAT terminals and not for IoT/Aggregator devices connected to the VSAT terminals. For hybrid model of architecture and other models of connectivity, including Direct-to-Satellite and aggregator model also, the IoT devices should not be subjected to license fee/spectrum charges.

3.71 As per scope of the license, Captive VSAT service licensees can set up only one CUG for their own use. However, a Captive licensee may be interested to establish more than one CUG for different kind of use cases. The nature of IoT systems tends to be distributive and therefore it may require multiple 'Hubs' and different terminals, which may not be possible under one CUG. Therefore, the licensing framework must allow for more than one CUG.

3.72 The scope of Captive VSAT CUG Service license needs to be made technology and data speed agnostic. Further, low-bit-rate applications have immense potential in case of automobiles, railway fleet, ATM on wheels and other services that need connectivity on the move. The scope for this license should also include the mobility of terminals for such applications for captive use.

3.73 In view of the above, the Authority recommends that:

(i) The scope of the Captive VSAT CUG service license is to provide data connectivity between various sites scattered throughout India using Very Small Aperture Terminals. Under the scope, the licensee may be permitted to use data connectivity for IoT devices also through satellite. Scope of Captive VSAT CUG service license may be suitably amended to include provision of satellite-based low-bit-rate connectivity for IoT devices to be used only for internal communication and non-commercial purposes, i.e., for captive use only.

(ii) Captive VSAT CUG service licensees may be permitted to set up more than one CUG for their own use.

(iii) As per Captive VSAT CUG service license, the licensee shall pay license fee annually at Rs. 10,000 per annum per VSAT Terminal/Earth stations installed. There should not be any separate license fee for IoT/Aggregator devices which are connected to VSAT Terminal in hybrid model of architecture.

(iv) For any other model of architecture also, including Direct-to-Satellite and aggregator model, the IoT devices should not be treated as user terminal station for the purpose of levy of license fee and spectrum charges and should not be subjected to license fee and spectrum charges.

(v) The Captive VSAT CUG service licensee should be permitted to use any technology, conforming to the TEC IR/GR, for establishing its network for captive use.

(vi) TEC IR/GR may be modified to include the specifications regarding 'user terminal station on moving platform' for captive VSATs.

D. INSAT Mobile Satellite System-Reporting (MSS-R) Service Authorization

3.74 The scope of INSAT Mobile Satellite System-Reporting (MSS-R) Service authorization, as enumerated in Clause 2.1 of Chapter XV of Unified License, is as below:

> *Clause 2.1 The scope of service is to provide INSAT Mobile Satellite System-Reporting service, which is a one way Satellite-based messaging service available through INSAT. The basic nature of this service is to provide a reporting channel via Satellite to the group of people, who by virtue of their nature of work are operating from remote locations without any telecom facilities and need to send short textual message or short data occasionally to a central station. The service provides one way message reporting (Transmit only) facility from anywhere in India (Restricted to Geographical boundaries of India). INSAT-MSS Reporting Service is a low speed data service with the maximum capacity limited to 300 bps.*

3.75 As mentioned in the scope of this authorization, it is only one way satellite-based messaging service. DoT, in its reference, has mentioned that this is a low speed data service with maximum capacity limited to 300 bits per second (bps). Only one such license was issued, which is non-operative since last 5 to 6 years. This authorization has several limitations if compared to the connectivity requirement of satellite-based connectivity for IoT devices.

3.76 Based on the above details of INSAT MSS-R service authorization, the stakeholders were requested to comment on the following question: *"Whether the scope of INSAT MSS-R service authorization should be*

modified to provide the satellite-based connectivity for IoT devices? Justify your answer".

3.77 In response to the above, the stakeholders are of the view that given the fact that only one INSAT MSS-R service authorization license was issued, which too is non-operative since the last 5 to 6 years, this authorization may be scrapped from the list of authorizations of UL. One of the stakeholders has suggested that the only existing non-operational licensee under this authorisation, should be given an option to migrate to any other suitable and similar license authorisation.

3.78 One of the stakeholders has stated that the key objective of INSAT MSS-R service perhaps was Vehicle identification and tracking system. To maintain the integrity of such a system, it may not be advisable to mix this service with a commercial application.

3.79 Some of the stakeholders are of the view that these systems are for one way messaging only, so not suited for current requirement. Further this service authorization is of very little relevance in the current context and the scope of this service authorization can be subsumed under the satellite services authorization and this authorization can be done away with.

Analysis

3.80 Most of the stakeholders have echoed similar views and have opined that INSAT MSS-R authorization is not relevant anymore. It was designed for a specific purpose for connecting the remote locations, where one-way messages could be sent via satellite.

3.81 This authorization has several limitations in comparison to the connectivity requirement of satellite-based connectivity for IoT devices and has not been envisaged to cater to the current requirement of providing continuous connectivity to IoT devices. The Customer Premise Equipment (CPE) are expensive and need trained manpower to maintain them. Due to this reason, the services never took off as it did

not make a viable business case. The permissible data capacity is also very low in comparison to the current requirements.

3.82 The Authority is of the view that the scope of this license has limited applicability and currently, the service is not in operation. In the current scenario with availability of advanced technologies, two-way communication is extremely necessary, therefore this authorisation may not be relevant anymore and therefore, this authorisation may be removed from the list of authorisations under UL.

3.83 In view of the above, the Authority recommends that:

The scope of INSAT MSS-R service authorization is to provide INSAT-Mobile Satellite System Reporting service, which is a one-way Satellite based messaging service available through INSAT. As the service is not in operation and many technological developments have taken place in the field of satellite communication, DoT may consider closing this authorization.

E. National Long Distance (NLD) Service Authorization:

3.84 The scope of NLD Service authorization, as enumerated in Clause 2.1 of Chapter X of Unified License, inter alia, includes provision of Leased Circuit/Virtual Private Network services. Accordingly, NLD service providers may provide point-to-point bandwidth or point-to-multipoint bandwidth using wireline or wireless media, including satellite-based bandwidth. Such bandwidth or connectivity can be provided for connecting IoT devices too.

3.85 Therefore, provision of satellite-based connectivity to IoT devices is well within the purview of scope of NLD service authorization. However, the licensee must have Hub station, that is, satellite Earth station to facilitate such connectivity. With the above details and for further clarity on the issue, stakeholders were requested to comment on the following question: *(i) As per the scope mentioned in the Unified License*

for NLD service Authorization, whether NLD Service providers should be permitted to provide satellite-based connectivity for IoT devices. (ii) What measures should be taken to facilitate such services? Justify your answer.

3.86 In response to this question, some of the stakeholders are of the view that provision of satellite-based connectivity to IoT devices is well within the scope of NLD service authorization, subject to the licensee having a satellite Earth station in India. Wherever necessary, further clarity may be incorporated in scope of NLD and other such licenses as well.

3.87 Some of the stakeholders are of the view that the NLD authorization will require a suitable enablement to provide satellite-based connectivity for IoT devices. Another stakeholder, while agreeing for NLD service providers to provide IoT connectivity, further elaborated that NLD service providers will be essential to provide connectivity in the hybrid model consisting of satellite LPWAN. In such hybrid model, satellite operator typically shall provide the backhauling functionality while NLD service provider would provide the last hop/mile connectivity to the IoT devices.

3.88 One of the stakeholders has mentioned that NLD Licensees are already permitted to carry 'bearer' traffic for 'enterprise/bulk bandwidth' customers and they should be permitted for M2M SPs as well without any distinction between human or machine traffic and therefore, NLD Licensees should be permitted to carry traffic over Satellite media as well. In case of Satellite media, the levies as per satellite systems can be imposed in addition to those of the NLD services provided through terrestrial media.

3.89 One of the stakeholders opined that NLD service Authorization is not designed structurally to regulate satellite-based IoT like systems, so amendment in these frameworks, to provide satellite-based IoT based service, will lead to regulatory confusion and non-compliance. Another stakeholder is of the opinion that NLD is inter-circle backbone license

and not permitted to have direct connectivity to end customer terminals and further opined that under the scope mentioned in the Unified License of NLD service Authorization, NLD Service providers should not be permitted to provide Satellite-based connectivity for IOT devices.

3.90 One of the stakeholders has suggested that there are requirements that all the satellite services should be covered under a single authorization. As the satellite services authorization can provide backhauls to access service providers, it is of little relevance to permit NLD service providers to deploy satellite networks under the NLD authorization.

3.91 Many of the stakeholders have suggested for Streamlining the licensing framework for all satellite-based connectivity applications, not just low-bit-rate applications. The stakeholders have also pointed out that spectrum charging should be uniform and formula-based changing mechanism for spectrum should be done away with in favour of AGR-based charging.

Analysis

3.92 The Authority has examined the comments received from the stakeholders and acknowledges that the NLD service providers are already permitted to provide satellite-based bandwidth. Therefore, provision of satellite-based connectivity to IoT devices is well within the scope of NLD service authorization.

3.93 NLD Service license has a wide scope as the NLD Service provider is permitted to provide connectivity/bandwidth/links to all other licensees, including Access Service providers, Internet Service Providers and other NLD Service providers. It is, therefore, important to ensure that the NLD service licensee can provide the satellite-based connectivity to other licensees in a cost-effective manner so that the services can be delivered to the end users in remote and inaccessible areas at affordable prices.

3.94 It may be mentioned here that it will be the M2M service providers who will be providing the IoT/M2M services in the country. Such M2M Service providers will obtain the requisite connectivity form service licensees as per the specific requirements of the use cases. Therefore, various service licensees, including NLD service licensee, will be providing connectivity to the M2M service providers, as per scope of their license/authorization.

3.95 The spectrum charges for using satellite frequencies under the NLD service Authorization are very high as they are calculated on a formula basis involving the quantum of spectrum and number of terminals deployed.

Accordingly, in its Recommendations on 'Provision of Cellular Backhaul Connectivity via Satellite Through VSAT Under Commercial VSAT CUG Service Authorization' dated 28th July 2020, the Authority has recommended the following in respect of provision of satellite-based bandwidth by NLD service providers:

(i) *Replacing the existing formula-based mechanism, Spectrum usage charges for using satellite frequencies under the NLD service license/ authorization should be prescribed as 1% of AGR excluding the revenue from the licensed services other than satellite-based services.*

(ii) *The NLD service licensees should be asked to do the accounting separation and maintain the revenues accruing from the satellite-based services and other licensed services separately.*

3.96 In view of the above, the Authority recommends that

(i) The NLD service authorization under Unified License permits the licensee to inter alia provide the Leased Circuit services using wireline/wireless media, including satellite media. Scope of NLD service authorization may be suitably amended

to include provision of satellite-based low-bit-rate connectivity for IoT devices.

(ii) Recommendations made earlier vide Recommendations on 'Provision of Cellular Backhaul Connectivity via Satellite Through VSAT Under Commercial VSAT CUG Service Authorization' dated 28th July 2020, are reiterated in respect of provision of satellite-based bandwidth by NLD service providers:

a. ***Replacing the existing formula-based mechanism, Spectrum usage charges for using satellite frequencies under the NLD service license/ authorization should be prescribed as 1% of AGR excluding the revenue from the licensed services other than the satellite-based services.***

b. ***The NLD service licensees should be asked to do the accounting separation and maintain the revenues accruing from the satellite-based services and other licensed services separately.***

F. Satellite Systems

3.97 The satellite systems, capable of providing connectivity to IoT devices, are operating in all the three orbits, that is, Low Earth Orbit (LEO), Medium Earth Orbit (MEO) and Geostationary Earth Orbit (GEO). These satellite systems are using various permissible satellite frequency bands for providing the satellite-based bandwidth and connectivity.

3.98 Under the GMPCS service authorization of Unified license, the licensee is permitted to use any Satellite System be it domestic or foreign satellite system, provided that the Land Earth Station Gateway Switch is established in India for each Satellite System.

3.99 Under the Commercial VSAT CUG Service authorization, the required space segment shall be obtained by the Licensee from Department of

Space (DOS) on INSAT satellite on terms and conditions as specified by Department of Space (DOS) from time to time.

3.100 Further, as per the Flight and Maritime Connectivity Rules, 2018, issued by DoT on 14th December 2018, the In-Flight and Maritime Connectivity (IFMC) service provider shall be permitted to use either Indian satellite system or foreign satellite system capacity duly authorized through the Department of Space and the satellite gateway Earth station should be located within India. It is also mentioned that spectrum neutral approach shall be adopted in satellite system being used for providing IFMC services.

3.101 TRAI has been recommending for an 'Open-sky policy' for more than last 15 years and had made recommendations in "Accelerating Growth of Internet and Broadband penetration" dated 29th April 2004. It was recommended that "An Open-Sky policy should be adopted for VSAT operators and VSAT service providers should be allowed to work directly with any international satellite'. This view was further reiterated in its recommendations on "Delivering broadband quickly: What do we need to do?" dated 17th April 2015. It was also recommended, *inter alia*, that "A decision on the recommendation of the Authority on 'Open Sky' policy needs to be taken in the next 6 months. This will allow TSP/DTH/VSAT operators access to International Satellite Operators. This is the only way forward if we are serious about delivery access to otherwise remote and inaccessible areas or those with difficult terrains."

3.102 The satellite-based connectivity for IoT devices is possible through both GSO and NGSO satellite systems. It is, therefore, necessary that adequate satellite resources should be made available, either through domestic satellite systems or through foreign satellite systems, so that the telecom service providers may obtain and use the desired bandwidth without delay and at a reasonable price.

3.103 In view of the above discussion, the stakeholders were requested to comment on the following question: *(i) Whether the licensees should be permitted to obtain satellite bandwidth from foreign satellites in order to provide low-bit-rate applications and IoT connectivity. (ii) In case, the satellite transponder bandwidth has been obtained from foreign satellites, what conditions should be imposed on licensees, including regarding establishment of downlink Earth station in India.*

3.104 In response to these two questions, most of the stakeholders have strongly advocated the importance of the timely adoption of Open-Sky Policy and exploiting the innovations in the satellite technology to bring down the prices of satellite bandwidth, thereby making satellite services affordable. They also, have strongly advocated for extending the Open-Sky Policy to the Low-Bit-Rate Applications and IoT connectivity as well.

3.105 Further, many stakeholders have mentioned that the licensed service providers should have non-discriminatory access to obtain satellite bandwidth from any Indian or approved foreign GSO/NGSO satellite to enhance the satellite capacity and they should be allowed to hire transponders directly from foreign satellite owners provided the licensee must be mandated to establish Downlink Earth Station and gateway in India only, to ensure national security angle. The gateways should be able to access capacities on Indian and foreign satellites. Further, the foreign Satellites to be coordinated with ISRO and the foreign satellite companies should be having permanent establishments in India.

3.106 One of the stakeholders emphasized that new licensing regime should also encourage Indian satellite capacity providers both in the Government and the Private sector domain to create capacities within the country as early as possible to make them more cost effective.

3.107 Few stakeholders have highlighted the necessary rationalization of the charges, including Spectrum Usage Charges (SUC), license fees, doing away with the USOF component of the license fee, etc., to ensure that the services are enabled/facilitated and not restricted.

3.108 One of the stakeholders has suggested to adopt the FCC model for the authorization of satellite bandwidth. The stakeholder stated that the FCC model puts out a list of approved satellites from which service providers can choose to lease capacity. Satellite operators can get on the approved list, based on application for authorization and a technical and security evaluation. A few of the stakeholders have suggested that once foreign satellites have been included to compete, there should not be any additional condition on licensees compared to domestic licensees. The conditions should be uniform for both.

3.109 Few of the stakeholders have stated that mandatory establishment of an Earth station in India is likely to create undue constraints on the operators. For foreign satellites, it should be possible to satisfy lawful intercept requirements without an in-country hub, by requiring traffic to be mirrored or made available in-country in response to a lawful order. Further, the foreign satellite operators may be mandated to return data from the IoT devices in India to a local server within the country.

3.110 However, other stakeholders have opined that mirror copy gateways and point of presence, where the physical gateway is outside the country and only an interconnect point is available in the country, should not be allowed.

Analysis

3.111 Most of the stakeholders have advocated and favoured the adoption of "Open Sky Policy" to augment the satellite capacity needs to meet the growing requirements in the country. The need has arisen because of the technological innovations in connecting the unconnected via the GSO/NGSO satellite system.

3.112 In order to enhance the satellite capacity and to cope with the capacity crunch, there is a pertinent requirement that the licensed service providers should have non-discriminatory access to both domestic and foreign satellite capacity. For this, the operators should be allowed to

hire transponders directly from foreign satellite, ensuring mandatory requirement of establishing the downlink earth station in India.

3.113 As the capacity available with the Indian Satellites is inadequate to meet the current requirements, foreign satellite system can cater to meet the country's urgent satellite capacity needs. Foreign operators and domestic operators may be provided a level-playing field for healthy competition. At the same time, Indian satellite capacity providers both in the Government and Private sector domain need to be encouraged to create such capacities within the country, as early as possible to make the services more cost effective.

3.114 The Satellite Communication Space Segment is being liberalized by the government for participation of Non-Government Private Entities. However, it will take time to have adequate satellite capacity available in India through domestic satellites. Therefore, in the meantime, the Service Licensees should be permitted to obtain satellite bandwidth from foreign satellites in all the satellite bands in order to provide satellite-based services.

3.115 For permitting the foreign satellites, Government may come out with a list of approved satellites, from which service providers can choose to lease capacity. Satellite operators can get on the approved list based on application for authorization and a technical and security evaluation. Criteria such as establishment of Indian subsidiaries, bilateral trade relationship with the country of registration for orbital slots can be put for satellite operators and their satellites to be added to the list. Once added, the satellites should continue to remain in the list for the lifetime of the satellite, without having to go through the trouble of renewals. Once the sufficient domestic satellite capacities are available the dependencies on foreign capacities may be gradually reduced. The Government may come out with a roadmap detailing the schedule of launch of communication satellites and the availability of the domestic

satellite capacities in India to facilitate the service licensees to plan and optimize their capacity procurement.

3.116 Capacities available with foreign satellites should be leveraged with sufficient precautions. The licensee must be mandated to create the Earth Station/gateway in India for delivering the services, as per the existing guidelines to route the traffic generated from/to the Indian customers. This is important to ensure that there are adequate measures to ensure the security of the country and for monitoring purposes.

3.117 Further, the service licensees should be allowed to directly negotiate and execute agreement with foreign satellite providers for Satellite based communication services thus, avoiding the intermediaries.

3.118 In view of the above, **the Authority recommends that**:

i. **The Satellite Communication Space Segment is being liberalized by the government for participation of Non-Government Private Entities. However, it will take time to have adequate satellite capacity available in India through domestic satellites. Therefore, the Service Licensees should be permitted to obtain satellite bandwidth from foreign satellites in all the permitted satellite bands in order to provide satellite-based services.**

ii. **The Government may publish a list of approved foreign satellites/satellite systems based on their technical and security evaluation, from whom the service licensees may procure the satellite capacities. The service licensees should be permitted to choose the foreign satellite/satellite system from the approved list and to lease the satellite capacity directly from the chosen foreign satellite/satellite system.**

iii. **The Service licensees should be mandated to establish the Earth Station in India, corresponding to the chosen foreign**

satellite/satellite system, prior to using the leased capacities.

iv. **The current practice of permitting hiring of foreign capacity for a limited period of 3 to 5 years should be removed and the service licensees should be permitted to hire the foreign satellite capacities for a longer period as per need.**

v. **The service licensees should not be levied any kind of facilitation charges by the government when hiring foreign capacities from the approved list of foreign satellites/satellite systems.**

vi. **The Government may come out with a roadmap detailing the schedule of launch of communication satellites and the availability of the domestic satellite capacities in India to facilitate the service licensees to plan and optimize their capacity procurement.**

G. Making Satellite-Based Services Affordable in India

3.119 In order to make the satellite-based services affordable, a lot is required to be done at each stage. For example, if the capacity is hired from the satellite system for longer term period, the cost of satellite bandwidth will probably be lower than that for shorter periods. Providing choice to the VSAT operators to directly negotiate and execute agreement with the satellite system provider will also help in avoiding the intermediaries and making the satellite-based services affordable.

3.120 NOCC charges and other levies too need to be examined to move it to work-based charging. As has been mentioned earlier, TRAI in its various earlier recommendations had recommended that there should be a single rate of SUC and it should be only 1%, to cover the administrative charges. Vide recommendations on 'Provision of Cellular Backhaul Connectivity via Satellite Through VSAT Under Commercial VSAT CUG Service Authorization' dated 28th July 2020 it was also recommended

inter alia that the NOCC charges should be rationalized and it should be independent of the number of carriers assigned.

3.121 The cost of satellite-based services is expensive in the country due to which it has not been widely adopted by end users. In view of this, the following question was raised for the inputs of the stakeholders: "*The cost of satellite-based services is on the higher side in the country due to which it has not been widely adopted by end users. What measures can be taken to make the satellite-based services affordable in India? Elaborate your answer with justification".*

3.122 All the stakeholders are of the unanimous view that the cost of providing satellite services in India needs to be reduced. This could be made possible by simplifying the processes, adopting open-sky policy, sharing infrastructure and reduction of all type of levies, charges and adopting Single-window clearance.

3.123 The stakeholders have opined that currently, all the existing levies that include WPC, NOCC, SACFA add-up to the cost of bandwidth. Such expensive bandwidth pricing is limiting the VSAT operators from leveraging the satellite capabilities to serve the unconnected rural villages in India as it is commercially unviable. Therefore, existing regulatory charges should be rationalized and unified into one single levy and to recover only the cost of administering licensing activities.

3.124 Suitable measures need be taken holistically to make the satellite-based services affordable as well as competitive with respect to terrestrial services in India. Specific suggestions of the stakeholders in this regard are as under:

a. Providing choice to the operators to directly negotiate and execute agreement with the satellite operator, domestic or foreign. Non-discriminatory access to domestic and foreign satellite capacity should be allowed.

b. Long term Bandwidth Agreements up to say 10 to 15 years should be permitted.
c. Rationalising licensing costs, including reduction of NOCC charges, Spectrum Usage Charges (SUC) and other levies. Some stakeholders have advocated for waiver of License fee and SUC.
d. The multiple charges (NOCC, SACFA and other WPC charges) should be unified and should be charged as one single levy to recover administrative cost of license.
e. Reduction on custom duties and levies on satellite-based devices.
f. The actual revenue, generated by the satellite capacity used only, should be counted for the purpose of AGR calculations.
g. Slab-wise pricing: The bandwidth per unit price should go down with higher volume of bandwidth, user terminals and equipment necessary for setting up gateway earth stations.
h. Open up the choice of the frequency bands to the Service Provider and Technical restrictions imposed through the TEC IR/GR for the VSAT Services, as well as the IFMC Service or even the low-bit-rate IoT/M2M service should be removed.
i. The entire process for approval of satellite-based licensing should be online with a single-window clearance (from all ministries and departments) and within a defined timeframe.
j. License and clearance for gateway and land earth stations to be approved in a timely manner (preferably 60 days).
k. Reduction in the number of compliances and simplifying the processes.
l. Satellite terminals and devices should be fully delicensed.
m. Liberal, light-touch approach, easing the barriers to entry would make more satellite capacity immediately available to meet India's National Digital Communications Policy goals.

Analysis

3.125 Currently, the government has prescribed the following NOCC charges:

(i) NOCC charges for the use of space segment on pro rata basis @ Rs 21 Lakh per transponder per annum (36 MHz transponder) + applicable service tax and cess. (Reference: DoT Letter No. 59-146(2)/2003-SAT Dt. 29.10.2003)

(ii) NOCC charges for mandatory Performance Validation Testing of Earth Station/Antenna(e) @ Rs 6000 per antenna per trial + applicable service tax and cess.

3.126 The service licensee already pays the spectrum charges corresponding to the satellite frequency assigned to them. The spectrum charges paid by the service licensee should cover all the administrative, operational and testing charges. Accordingly, the Government should consider doing away with the NOCC charges.

3.127 The recommendations made in the previous issue like permitting hiring of foreign capacities for entire lifetime of satellite instead of 3 to 5 years, removal of facilitation charges by the government when hiring foreign capacities from the approved list of foreign satellites, leasing the satellite capacity directly from the chosen foreign satellite, reducing the role of intermediaries, would all lead to making the services cheaper and affordable.

3.128 In view of the above discussion, **the Authority recommends that the Government should consider doing away with the NOCC charges for use of space segment. The spectrum charges paid by the service licensee should cover all the administrative, operational and testing charges.**

H. Ease of Doing Business

3.129 The most important characteristic to attract investment and new players in a sector is the 'Ease of Doing Business'. The processes should

be clear, simple and transparent to applicants and should be available online, i.e., there should be minimum or no physical interface. Well-defined processes with specified timelines and transparency for clarity and ease of operations would prove to be a great enabler. Through the existing processes, there have been long delays reported in procurement of satellite bandwidth and there is an involvement of multiple agencies for seeking various clearances and approvals. It would be convenient to the applicants if there is single-window clearance for all kinds of satellite-based processes.

3.130 TRAI has earlier recommended several measures leading to simplification of processes and ease of doing business. In its recommendations on 'Ease of doing business' in telecom issued on 30th November 2017, as well as in broadcasting sector, issued on 26th February 2018, TRAI has recommended that the entire process of clearances, be it SACFA clearance or other approvals, as well as grant of all licenses and approvals, that are issued by WPC and various other agencies, should be made paper-less. There should be a single-window clearance system available and executed end-to-end through an online portal.

3.131 Further, there should not be any barriers to the carrier speeds. Higher data rates, which are now possible in satellite communications with the use of latest technologies, should be permitted without any restrictions.

3.132 In view of the discussion above, the stakeholders were requested to comment on the following question: *"Whether the procedure to acquire a license for providing satellite-based services in the existing framework is convenient for the applicants? Is there any scope of simplifying the various processes? Give details and justification".*

3.133 To attract investment and new players in a sector, most of the stakeholders in response to the above question, have advocated for simplification of processes, time-bound online approvals, reduction in number of compliances and number of approval agencies involved,

common portal for all agencies, etc. These should percolate to all parts of the sector and Satellite-based connectivity should not be an exception.

3.134 Specific suggestions from the stakeholders are as under:

(i) Simplified integrated, end-to-end coordinated single-window approval processes.

(ii) Common portal for all the agencies involved like ISRO, NOCC, DOT and WPC, wherein they all respond online in a time-defined manner.

(iii) User friendly, online and time-bound approval system.

(iv) Type Approval standards and harmonized frequency bands for both the IoT devices and Satellite Terminals based international ITU or FCC or ETSI standards need to be adopted.

(v) Transparency in the regulations to the point of making all guidelines, applications forms, fees and timelines and contact points publicly available.

(vi) Mechanism of coordination as per ITU-R framework should be implemented.

(vii) Reduction in the number of compliances.

Analysis

3.135 One of the provisions of NDCP-2018, has been revising the licensing and regulatory conditions that limit the use of satellite communications, such as speed barriers, band allocation, etc. The objectives of the NDCP-2018 can be achieved by simplifying the issues and removing the obstacles in growth of the satellite communication in India.

3.136 'Ease of Doing Business' is the most important characteristic for attracting investments and new players in the sector. The processes and permissions should be online, well-defined with specific timelines and transparent.

3.137 In the case of Satellite Service provisions there are multiple agencies involved, such as NOCC, DoS, DoT, WPC. There should be a common portal for all the agencies, wherein they all respond online in a time-defined manner. A model based on single-window clearance system is required at the national level to address the business challenges that often cripple the organizations with delays in processing/approving/ resolving the legitimate business requirements under the prevailing regulations.

3.138 The process should be simplified and provide a single window for the license application. The government agencies responsible for the various part of the license should come together and provide a unique interface to the applicant.

3.139 A single-window system has been conceptualized by the Department for Promotion of Industry and Internal Trade (DPIIT). The Hon'ble Minister of Finance, Government of India, during the budget speech on 1st February 2020, announced the setting up of an Investment Clearance Cell (ICC). The proposed ICC is being developed as an online portal that will act as a National Single Window System (NSWS). Invest India, a non-profit venture under DPIIT, Ministry of Commerce and Industry, manages the 'Ease of Doing Business' initiative named as 'Maadhyam' project, which is the NSWS to identify and apply for various approvals required to commence a business in India.

3.140 Currently under trial, the NSWS shall enable investors/entrepreneurs/ businesses to identify and obtain all clearances needed to start a new business operation in India through a single online portal. This platform shall provide the investors with information on pre-operations approvals required to commence a business in India. At present, the portal has more than 560 approvals/licenses from across 28+ central ministries/ departments and approvals/licenses from across 14 States. It offers the following services:

- Secure document repository
- Intelligent KYA System
- Track Status
- Central and State Approvals

3.141 The NSWS shall cover central pre-establishment and pre-operations Approvals/Registrations/Licenses/Clearances required by any investor, both domestic and global, before starting any business operations in India, including but not limited to registrations, licenses, permits and approvals. In addition, the NSWS will systematically integrate with the existing State Single Window Systems as well. To streamline the integration process, NSWS has a dedicated integration framework that provides multiple options for Ministries/ Departments/ States to onboard or integrate their existing IT portals and systems with NSWS. This depends on the current state of the respective ministries/departments/States, existing IT portals/systems and their preference. Departments may choose the integration options based on their existing IT infrastructure and requirements, including existing workflows.

3.142 Presently around 45 approvals from Ministry of Communications, including WPC are available on 'Maadhyam'. NOCC provide the network clearances before start of operations from any earth station accessing Satellite and also carried out the Monitoring and online operational control and co-ordination. However, NOCC approvals/ clearances are presently not included on the portal. Also, the service licensees are required to apply to Department of Space (DoS) for satellite transponder bandwidth, which is presently not integrated in the portal.

3.143 TRAI is already working on a consultation paper to seek detailed comments of the stakeholders on the various issues and difficulties being faced by them while starting and doing business in the telecom and broadcasting sector in the country. Based on the comments of the stakeholders and its own analysis on the matter, comprehensive recommendations will be made to the Government.

3.144 In view of the above, in the current context, the Authority recommends that:

(i) DoT should put in place a comprehensive, simplified, integrated, end-to-end coordinated, single-window online common portal, having inter-departmental linkages for transfer of application and information for parallel processing, for all the agencies involved in grant of various approvals/permissions/allocations, etc., like DoS, DOT, WPC and NOCC, wherein the service licensees can place their request and the agencies respond online in a transparent and time-bound manner.

(ii) All the guidelines, applications forms, fee details, processes, timelines and application status should be made transparently available on the portal.

(iii) The National Single Window System (NSWS) portal established by the Department for Promotion of Industry and Internal Trade (DPIIT), known as 'Maadhyam', may include Department of Space (DoS) also, as the service licensees are required to apply to DoS for satellite transponder bandwidth.

Any other comments

3.145 In addition to the specific questions, the stakeholders were requested to submit any other issues/suggestions relevant to the subject. In response the stakeholders have given the following inputs:

(i) Issues with respect to remote terminal size, permission of interplay of free market forces, imposition of nominal levies (licence fee and spectrum usage charges), removal of regulatory barriers on carrier speeds, permitting reselling of VSAT Services, liberalization of the CUG License, time delay in getting administrative approvals are required to be investigated.

(ii) Satellite connectivity to IoT devices especially in remote and sparsely populated areas should come under USO, for which, if need be,

necessary funding could be provided by the Government.

(iii) A blanket license that allows for deployment of large numbers of devices is essential, since applying for a license for each device would be too burdensome.

(iv) Infrastructure sharing must be allowed between DTH/VSAT/ Teleport/ Telecom, operating on the same satellite.

(v) Service Providers should be allowed to use/share the hired Satellite spectrum for any application or sub-lease the hired satellite bandwidth based on the business requirements.

(vi) The regulatory levies on provision of similar services (terrestrial and satellite) under different licenses should be charged similarly.

(vii) The 'Draft Spacecom Policy-2020' mandates bringing non-Indian orbital resources eventually under Indian administration. There should not be any need for this as this will discourage Indian operators from utilizing cheaper foreign satellite assets.

(viii) Subscriber verification norms must be simplified for IoT connections. NOCC validation of each ES/Antenna should be done away with. NOCC charges for space segment on per transponder per annum basis needs to be revised downwards.

3.146 The additional comments submitted by the stakeholders have been examined and it has been noted that some of the issues raised have already been covered in the recommendations and other issues are outside the scope of this consultation and have been noted for future reference.

CHAPTER 4
SUMMARY OF RECOMMENDATIONS

4.1 **The Authority recommends that for provision of Satellite-based connectivity for IoT and low-bit-rate applications, the relevant service licensees may provide connectivity as per the scope of their authorization for any kind of network topology model, including Hybrid model (consisting of LPWAN and Satellite connectivity), Aggregator model and Direct-to-satellite model.**

[Para 2.24]

4.2 **The Authority recommends that all types of satellite viz. Geo Stationary Orbit (GSO) and Non-GSO (NGSO) satellites should be permitted to be used for providing satellite-based low-bit-rate connectivity.**

[Para 2.41]

4.3 **The Authority recommends that the Service Providers should be allowed to use any of the permitted satellite frequency bands for providing satellite-based low-bit-rate connectivity.**

[Para 2.54]

4.4 **The Authority recommends that the relevant existing authorizations under Unified Licensing framework may be suitably amended for enabling satellite-based low-bit-rate connectivity.**

[Para 3.19]

4.5 **The Authority recommends that**:

(i) The GMPCS service authorization under Unified License permits the licensee to provide voice and non-voice messages and data services. Under the scope of data services, the licensee may provide satellite-based data connectivity to the

SIM-based IoT/Aggregator devices. Scope of GMPCS service authorization under Unified License may be suitably amended to include provision of satellite-based low-bit-rate connectivity for IoT devices.

(ii) Replacing the existing formula-based mechanism, Spectrum Usage Charges for using satellite frequencies under the GMPCS service authorization should be prescribed as 1% of AGR. These charges would cover the entire spectrum charges for handsets/user devices as well as for Earth Stations.

[Para 3.39]

4.6 **The Authority recommends that**:

(i) The Commercial VSAT CUG service authorization under Unified License permits the licensee to provide data connectivity between various sites scattered within territorial boundary of India. Under the scope, the licensee may be permitted to provide data connectivity for IoT devices also through satellite. Scope of Commercial VSAT CUG service authorization under Unified License may be suitably amended to include provision of satellite-based low-bit-rate connectivity for IoT devices.

(ii) The Commercial VSAT CUG service providers should be permitted to use any technology, conforming to the TEC IR/GR, to provide the service.

(iii) TEC IR/GR may be modified to include the specifications regarding 'user terminal station on moving platform' for VSAT services.

(iv) In respect of SUC for Commercial VSAT CUG Service license, the Authority reiterates to make the SUC as 1% of AGR, irrespective of the data rate, as stated earlier in its recommendation dated 7th March 2017 on 'Spectrum Usage Charges and Presumptive Adjusted Gross Revenue for

Internet Service Providers and Commercial Very Small Aperture Terminal Service Providers'.

[Para 3.61]

4.7 **The Authority recommends that**:

(i) The scope of the Captive VSAT CUG service license is to provide data connectivity between various sites scattered throughout India using Very Small Aperture Terminals. Under the scope, the licensee may be permitted to use data connectivity for IoT devices also, through satellite. Scope of Captive VSAT CUG service license may be suitably amended to include provision of satellite-based low-bit-rate connectivity for IoT devices to be used only for internal communication and non-commercial purposes, i.e., for captive use only.

(ii) Captive VSAT CUG service licensees may be permitted to set up more than one CUG for their own use.

(iii) As per Captive VSAT CUG service license, the licensee shall pay license fee annually at Rs. 10,000 per annum per VSAT Terminal/Earth stations installed. There should not be any separate license fee for IoT/Aggregator devices which are connected to VSAT Terminal in hybrid model of architecture.

(iv) For any other model of architecture also, including Direct-to-Satellite and aggregator model, the IoT devices should not be treated as user terminal station for the purpose of levy of license fee and spectrum charges and should not be subjected to license fee and spectrum charges.

(v) The Captive VSAT CUG service licensee should be permitted to use any technology, conforming to the TEC IR/GR, for establishing its network for captive use.

(vi) TEC IR/GR may be modified to include the specifications regarding 'user terminal station on moving platform' for captive VSATs.

[Para 3.73]

4.8 **The Authority recommends that**:

The scope of INSAT MSS-R service authorization is to provide INSAT-Mobile Satellite System Reporting service, which is a one-way Satellite based messaging service available through INSAT. As the service is not in operation and many technological developments have taken place in the field of satellite communication, DoT may consider closing this authorization.

[Para 3.83]

4.9 **The Authority recommends that:**

(i) **The NLD service authorization under Unified License permits the licensee to inter alia provide the Leased Circuit services using wireline/wireless media, including satellite media. Scope of NLD service authorization may be suitably amended to include provision of satellite-based low-bit-rate connectivity for IoT devices.**

(ii) **Recommendations made earlier vide recommendations on 'Provision of Cellular Backhaul Connectivity via Satellite Through VSAT Under Commercial VSAT CUG Service Authorization' dated 28th July 2020, are reiterated in respect of provision of satellite-based bandwidth by NLD service providers:**

a. ***Replacing the existing formula-based mechanism, Spectrum usage charges for using satellite frequencies under the NLD service license/ authorization should be prescribed as 1% of AGR excluding the revenue from the licensed services other than satellite-based services.***

b. ***The NLD service licensees should be asked to do the accounting separation and maintain the revenues accruing from the satellite-based services and other licensed services separately.***

[Para 3.96]

4.10 **The Authority recommends that**:

(i) The Satellite Communication Space Segment is being liberalized by the government for participation of Non-Government Private Entities. However, it will take time to have adequate satellite capacity available in India through domestic satellites. Therefore, the Service Licensees should be permitted to obtain satellite bandwidth from foreign satellites in all the permitted satellite bands in order to provide satellite-based services.

(ii) The Government may publish a list of approved foreign satellites/satellite systems based on their technical and security evaluation, from whom the service licensees may procure the satellite capacities. The service licensees should be permitted to choose the foreign satellite/satellite system from the approved list and to lease the satellite capacity directly from the chosen foreign satellite/satellite system.

(iii) The Service licensees should be mandated to establish the Earth Station in India, corresponding to the chosen foreign satellite/satellite system, prior to using the leased capacities.

(iv) The current practice of permitting hiring of foreign capacity for a limited period of 3 to 5 years should be removed and the service licensees should be permitted to hire the foreign satellite capacities for a longer period as per need.

(v) The service licensees should not be levied any kind of facilitation charges by the government when hiring foreign capacities from the approved list of foreign satellites/satellite systems.

(vi) The Government may come out with a roadmap detailing schedule of launch of communication satellites and

availability of the domestic satellite capacities in India to facilitate the service licensees to plan and optimize their capacity procurement.

[Para 3.118]

4.11 **The Authority recommends that Government should consider doing away with the NOCC charges for use of space segment. The spectrum charges paid by the service licensee should cover all the administrative, operational and testing charges.**

[Para 3.128]

4.12 **The Authority recommends that:**

(i) DoT should put in place a comprehensive, simplified, integrated, end-to-end coordinated, single window online common portal, having inter-departmental linkages for transfer of application and information for parallel processing, for all the agencies involved in grant of various approvals/ permissions/ allocations, etc., like DoS, DOT, WPC and NOCC, wherein the service licensees can place their request and the agencies respond online in a transparent and time-bound manner.

(ii) All the guidelines, applications forms, fee details, processes, timelines and application status should be made transparently available on the portal.

(iii) The National Single Window System (NSWS) portal established by the Department for Promotion of Industry and Internal Trade (DPIIT), known as 'Maadhyam', may include Department of Space (DoS) also, as the service licensees are required to apply to DoS for satellite transponder bandwidth.

[Para 3.144]

Annexure I (Chapter no. 1 Para no. 1.1)

Reference from DoT

Government of India / भारत सरकार
Ministry of Communications / संचार मंत्रालय
Department of Telecommunications / दूरसंचार विभाग
Satellite Division, DoT HQ
Sanchar Bhawan, New Delhi – 110001

No. 824-201/Policy/2020-SAT

Date: 23.11.2020

भारतीय दूरसंचार विनियामक प्राधिकरण
महानगर दूरसंचार भवन, नई दिल्ली-2
24 NOV 2020
डायरी सं. 5952

To

The Secretary
Telecom Regulatory Authority of India,
Mahanagar Doorsanchar Bhawan,
Jawahar Lal Nehru Marg (Old Minto Road),
New Delhi-110002

Sub: TRAI recommendations on licensing framework for Satellite based low bit-rate applications

With the evolution in Satellite Communication (SATCOM) technologies, new types of applications are emerging based on low bit-rate communications. The typical applications/use-cases utilizing a satellite networking protocol and sensor connectivity solution are envisaged in sectors like agriculture, fisheries, forestry, logistics, mining, industrial equipment, railways, remote utilities & infrastructure and disaster preparedness & response. A brief on such applications/use-cases utilizing low bit-rate satellite based communication is enclosed as Annexure-A.

2. The current licensing framework of Department of Telecommunications (DoT) with respect to satellite communication services and their limitations vis-à-vis the proposed satellite based low bit-rate services are as follows:

i. **Captive VSAT CUG License:** The scope of this license is to provide data connectivity between various sites scattered throughout India for captive use using Very Small Aperture Terminals (VSATs) which should form part of a Closed User Group (CUG). The licensees can set up only one CUG for their own use. The proposed low bit-rate services does not seem to fit suitably in this licensing framework because of the following reasons:

a. The remote terminals to be installed under the proposed low bit-rate services are of smaller size with typical antenna sizes less than 1 meter which is the least allowed size as prescribed in the applicable TEC IR.

b. The user terminal location is fixed in the Captive VSAT CUG service, whereas, the proposed low bit-rate service envisages possible deployments of remote terminals/sensors on moving platforms over

Page 1 of 3

land surface also. For such use-cases, no technical regulations exist as of now in the form of TEC IR/GR/standards.

c. This license is granted to establish, maintain and operate Captive VSAT CUG domestic data network via INSAT satellite system only, whereas, the proposed low bit-rate services can be used on other satellite systems as well.

d. For this license, the licensee has to pay license fee annually at Rs. 10,000/- per annum per user terminal installed. Since the proposed low bit-rate service envisages deployment of thousands of remote terminals/sensors as compared to VSAT terminals, the license fee may turn out to be exorbitantly high.

e. The WPC Royalty charge for this license is formula based and depends on the number of carriers. Applying the present formula for the present low bit-rate services may lead to exorbitant Royalty charges.

f. Also, NOCC charges are fixed at ₹ 21 lakhs per transponder (36 MHz) per annum and calculated on a pro-rata basis for a part of transponder.

ii. **Commercial VSAT CUG License:** The scope of this license is to provide data connectivity between various sites scattered throughout India using VSATs. The users of the service should belong to a CUG. This service is meant for commercial purpose and the license fee for this service is based on AGR. This license has limitations as stated in para 2.i.a, 2.i.b, 2.i.c and 2.1.f above.

iii. **Global Mobile Personal Communication by Satellite (GMPCS) License:** The scope of this license is to provide all types of mobile services including voice and non-voice messages, data services by establishing GMPCS Land Earth Station Gateway in India. At present, there is no GMPCS licensee. Only BSNL has been granted license for provision and operation of satellite based services using gateway installed in India under "sui-generis" category.

iv. **INSAT- Mobile Satellite System Reporting (MSS-R) License:** This is a commercial one way satellite based messaging service. This service provides one way message reporting (transmit only) facility from anywhere in India. This is a low speed data service with maximum capacity limited to 300 bps. Only one such license was issued which is non-operative since last 5-6 years. This license has following limitations:

a. INSAT MSS-R is a one-way reporting service only.

b. The data speed is limited to 300 bps.

c. There is no licensing framework for captive use of this service.

3. Considering the above, there is a need for suitable licensing framework in respect of the proposed satellite based low bit-rate services for:

i. Providing such services on commercial basis.

ii. Organizations like State Transport Authorities, Indian Railways, other fleet owners, disaster management agencies etc. which may need to setup a captive network for their own use (and not for selling the service). These captive networks may fall into two categories:

   a. Government authorities/Police & Security Agencies/PSUs/Board(s) which are government owned entities
   b. Private companies

4. TRAI is requested to examine all the above factors holistically and furnish their recommendations in terms of clause 11(1)(a) of TRAI Act 1997, as amended from time to time, to enable the provisioning of the proposed satellite based low bit-rate services under the existing licensing framework of DoT or suggest new licensing framework including the entry fee, license fee, bank guarantee, NOCC charges, spectrum usage charges/royalty fee etc. for such services for both commercial and captive usage.

Manish Singh
23/11/2020

(Manish Kumar Singh)
Asst. Director General (Satellite-I)
Satellite Division, DoT HQ
Ph. No. +91 11 23310167

Enclosed: As above.

ANNEXURE-A

Brief on use-cases utilizing narrowband, low bit-rate satellite based communication

The applications/use-cases utilizing a satellite networking protocol and sensor connectivity solution are discussed briefly in the following paras.

Logistics: Fleet management including monitoring and tracking movement of goods and services, geo-location of vehicles, SOS functionality, temperature monitoring of cargo, monitoring of fuel level etc.

Railways: Geo-location of rolling stock assets, monitoring of safety systems in a train, mission critical two-way data etc.

Disaster management: Delivery of real-time and geo-location alerts in case of floods, landslides etc, emergency alert broadcasts and SOS messaging for fishing vessels, real-time tsunami alerts from marine buoys, detection of fires in rural forests or strategic buildings, managing logistics of NDRF vehicles, boats, fire engines, ambulances etc. during natural disasters and accidents.

Internal security: Tracking of patrol vehicles, monitoring of critical logistics supplies through remote areas, connectivity among coast guard vessels and monitoring of vessels at sea.

Fisheries: The sensor based connectivity is used for location and vessel monitoring, maritime boundary alerts, geo-fenced fishing zones, monitor the cold-chain of stored fish and two-way emergency messaging system for distressed vessels, inclement weather.

Health services response mechanism: Ambulance and medical logistics tracking especially in rural areas, vehicle telemetry, live monitoring of patients' diagnostics etc.

Agriculture: Monitoring soil conditions for critical inputs such as water, fertilizers and pesticides etc.

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