



अंतराफलक आवश्यकताओं के लिए मानक  
टीईसी <दस्तावेज़ सं: नई नंबरिंग स्कीम के अनुसार>  
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STANDARD FOR INTERFACE REQUIREMENTS

TEC <document no. as per new numbering scheme>

(Earlier No. TEC/IR/\_\_\_\_\_)

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< NAME OF THE INTERFACE FOR PRODUCT >



ISO 9001:2015

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Release \_\_: Month, Year

## FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

## ABSTRACT

This Standard for Interface Requirements for a Product/Equipment pertains to.....

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## HISTORY SHEET

Sr. No.	Title	IR No.	Remarks
1.	Standard for Non Geostationary Satellite Orbit Communication Networks		First Issue

## 1.0 INTRODUCTION & SCOPE

1.1 This document contains the Mandatory Technical Requirements and Operational Requirements for all Non Geostationary satellite orbit (NGSO) based communication networks providing Fixed Satellite Services (FSS) [or Broadcast Satellite Services (BSS)] in Ku and Ka band. The mandatory Interface Requirements contained in this document are technical requirements only; while the regulatory & legal requirements are specified in the License conditions. Necessary clearances shall have to be taken from Government of India, including DoT, TEC, DoS, WPC, NOCC, DGCA before commencing operations.

[IAFI RESPONSE] : Editorial Change

[SPACE X RESPONSE] : SpaceX strongly recommends not limiting NGSO bands to only the Ku and Ka band, and to allow for the possibility of future NGSO systems that will be able to use additional bands allocated for FSS use. These include frequencies within the VHF band, Q/V bands, and E band - all of which will play essential roles in the deployment of NGSO systems for both broadband as well as low bit-rate IOT/M2M uses.

1.2 The document also contains the satellite technical parameters for link calculations and the link budget format.

1.3 Satellite networks are expected to be used for Earth Station in Motion (ESIM) on vehicle/vessel/aircraft communicating with NGSOs in the FSS Telecommunication and Broadcasting services including but not limited to two-way multimedia applications, Intermediate Data Rate (IDR) channels, digital MCPC, closed user group (CUG) digital voice telephony, digital SCPC, video conferencing, Digital Satellite News Gathering (DSNG) with acknowledgement, Direct-To-Home (DTH) television with/without return channel, digital cinema, Digital Video Broadcast (DVB) with RCS, HD TV, 3D TV, satellite radio, digital audio broadcast, Tele-education, Tele-medicine, Tele-agriculture etc. The technical and operational requirements are necessary for meeting international regulatory requirements and optimizing the network resources.

[SIA RESPONSE] : Highlighted portions added. Underlined portions removed

*[Editor's Note: Stakeholders to provide input if NGSO systems are to be used for BSS services too. If yes, relevant inputs may be provided in subsequent sections of the document for BSS]*

[IAFI RESPONSE] : We do not expect that NGSO will be used for BSS.

**[SES RESPONSE]** : O3b & O3b mPOWER only operates in Ka band. There is no BSS allocation in the Ka band frequency range of 27-31 GHz and 17.7-21.2 GHz according to Article 5 of the ITU-R Radio Regulations. As such, there is no intention for O3b/O3b mPOWER to provide services in the BSS.

## 2.0 APPLICABLE DOCUMENTS

### 2.1 ITU Radio Regulations

2.1.1 ITU-R Radio Regulations- Article 21 "Terrestrial and space services sharing frequency bands above 1 GHz"

2.1.2 ITU-R Radio Regulations- Article 22 "Space Services"

### 2.2 ITU Recommendations

**[IAFI RESPONSE]** : ITU Recommendations → ITU Recommendations and Reports

2.2.1 ITU-R Recommendation **S.1503** (Functional description to be used in developing software tools for determining conformity of non geostationary-satellite orbit fixed-satellite service systems or networks with limits contained in Article 22 of the Radio Regulations).

**[JIO RESPONSE]** : Highlighted portion changed from S.1503 → S.1503-3  
The version in force.

**[SES RESPONSE]** : Same as JIO RESPONSE

2.2.2 ITU-R Recommendation S.672-4 (Satellite antenna radiation pattern for use as a design objective in the fixed-satellite service employing geostationary satellites)

**[AMAZON RESPONSE]** : Suggest that this be removed as this pertains to GSO

**[IAFI RESPONSE]** : Add another point

Please add Report ITU-R S.2261

**2.2.3** ITU-R Report S.2261 (Technical and operational requirements for earth stations on mobile platforms operating in non-GSO FSS systems in the frequency bands from 17.3 to 19.3, 19.7 to 20.2, 27 to 29.1 and from 29.5 to 30.0 GHz)

**[JIO RESPONSE]** : Added other relevant ITU-R Recommendations

**2.2.3** ITU-R Recommendation S.580-6 (Off-axis transmit and receive Radiation pattern)

**2.2.4** ITU-R Recommendation S.524-9 (Off-axis EIRP Density Limits)

**2.2.5** ITU-R Recommendation S.726-1 (Spurious emission limits)

**2.2.6** ITU-R Recommendation S.729 (Control and Monitoring of VSAT Networks)

**2.2.7** ITU-R Recommendation S.1428-1 (Reference earth-station radiation patterns for non-geostationary satellite systems between 10-30 GHz)

**[NELCO RESPONSE]** : Added this relevant ITU recommendations

ITU-R Report S.2261 “the Technical and operational requirements for earth stations on mobile platforms operating in non-GSO FSS systems in the frequency bands from 17.3 to 19.3, 19.7 to 20.2, 27 to 29.1 and from 29.5 to 30.0 GHz.”

[**SES RESPONSE**] : Added other relevant ITU-R Recommendations (SAME AS JIO RESPONSE) and included version in force for ITU-R Rec S.1503 for the sake of consistency

[**SIA RESPONSE**] : Same as IAFI RESPONSE

[**VIASAT RESPONSE**] : Added another point

**2.2.3** ITU-R Recommendation S.1323-2 (Maximum permissible levels of interference in a satellite network (GSO/FSS; non-GSO/FSS; non-GSO/MSS feeder links)\* in the fixed-satellite service caused by other codirectional FSS networks below 30 GHz).

## 2.3 Other Standards

[**SPACE X RESPONSE**] : SpaceX strongly recommends the inclusion of ETSI EN 303 981 V1.2.1 (2021-04) - "Satellite Earth Stations and Systems (SES); Fixed and in-motion Wide Band Earth Stations communicating with non-geostationary satellite systems (WBES) in the 11 GHz to 14 GHz frequency bands; Harmonised Standard for access to radio spectrum"

2.3.1 ETSI EN 303 980 **V1.2.1** "Satellite Earth Stations and Systems (SES); Fixed and in-motion Earth Stations communicating with non-geostationary satellite systems (NEST) in the 11 GHz to 14 GHz frequency bands; Harmonised Standard for access to radio spectrum"

[**AMAZON RESPONSE**] : “Draft” word removed

This is not a draft. It has already been approved ETSI standard and the current version in force is ETSI EN 303 980 V1.3.1 (2022-10).

This standard is listed in the Official Journal of the European Union, with limitations. This means that it is a harmonized standard (freedom to self-certify) and where some clauses are not applied. A new version is underway to have unconditional approval

[**JIO RESPONSE**] : “Draft” word removed

Highlighted portion added

[**SES RESPONSE**] : Same as JIO RESPONSE

[**SIA RESPONSE**] : “Draft” word removed

2.3.2 ETSI EN 303 979 **V2.1.2** "Satellite Earth Stations and Systems (SES); Harmonised Standard for Earth Stations on Mobile Platforms (ESOMP) transmitting towards satellites in non-geostationary orbit, operating in the 27,5 GHz to 29,1 GHz and 29,5 GHz to 30,0 GHz frequency bands covering the essential requirements of article 3.2 of the Directive 2014/53/EU"

[**AMAZON RESPONSE**] : Regarding “ETSI EN 303 979”

This standard has two problems

1. Its scope is explicitly limited to traditional antennas (mechanical dish + LNA), so basically new MOBILE terminals using phased array antennas do not have a standard.
2. The antenna diagram in the standard (RX side) is unduly stringent for future NGSO mobile terminals using phased arrays. The RX diagram in the standard is intended to make the terminal resilient to



interference, but phased arrays achieve the same aim with smaller antennas and RF interference mitigation techniques

In line with what said above, during its last meeting (end of November 22) ETSI decided to open a work item to update EN 303 979.

The current standard is not suitable for the current status of the technology and this is acknowledged by ETSI. Since it will take at least 1.5 years to have a new standard.

In conclusion, we suggest the TEC document explicitly states that the standards EN 303 699 and EN 303 979 are not mandatory.

**[JIO RESPONSE]** : Highlighted portion added

**[SES RESPONSE]** : Same as JIO RESPONSE

2.3.3 ETSI EN 303 699 **V1.1.1** "Satellite Earth Stations and Systems (SES); Fixed earth stations communicating with non-geostationary satellite systems in the 20 GHz and 30 GHz FSS bands; Harmonised Standard for access to radio spectrum"

**[AMAZON RESPONSE]** : "Draft" word removed

The standard is not a draft. It is not listed in the official journal of the EU, and thus it is not a European harmonized standard, but nevertheless it an ETSI standard (current version in force: [ETSI EN 303 699 V1.1.1 \(2021-02\)](#))

ETSI is working on updating it.

Regarding "ETSI EN 303 699"

This standard (EN 303 699) has two problems

1. Several clauses and test methods implicitly assume traditional antennas (mechanical dish + LNA), so that the standard cannot be applied to non-fixed terminals using phased array antennas
2. The antenna diagram in the standard (RX side) is unduly stringent for future NGSO mobile terminals using phased arrays. The RX diagram in the standard is intended to make the terminal resilient to interference, but phased arrays achieve the same aim with smaller antennas and RF interference mitigation techniques

In line with what said above, during its last meeting (end of November 22) ETSI decided to open a work item to update EN 303 699.

The current standard is not suitable for the current status of the technology and this is acknowledged by ETSI. Since it will take at least 1.5 years to have a new standard.

In conclusion, we suggest the TEC document explicitly states that the standards EN 303 699 and EN 303 979 are not mandatory

**[IAFI RESPONSE]** : "Draft" word removed

This is now a published standard (i.e. not a draft)

[https://www.etsi.org/deliver/etsi\\_en/303600\\_303699/303699/01.01.01\\_60/en\\_303699v010101p.pdf](https://www.etsi.org/deliver/etsi_en/303600_303699/303699/01.01.01_60/en_303699v010101p.pdf)

**[JIO RESPONSE]** : "Draft" word removed

Highlighted portion added

**[NELCO RESPONSE]** : Same as IAFI RESPONSE

Another point added

**2.3.4** ETSI 303 981 Satellite Earth Stations and Systems (SES); Fixed and in-motion Wide Band Earth Stations communicating with non-geostationary satellite systems (WBES) in the 11 GHz to 14 GHz frequency bands; Harmonised Standard for access to radio spectrum.

[SES RESPONSE] : Same as JIO RESPONSE

For consistency, added current version number to the relevant ETSI document

[SIA RESPONSE] : “Draft” word removed

Add another point

**2.3.4** ETSI 303 981 Satellite Earth Stations and Systems (SES); Fixed and in-motion Wide Band Earth Stations communicating with non-geostationary satellite systems (WBES) in the 11 GHz to 14 GHz frequency bands; Harmonised Standard for access to radio spectrum.

### 3.0 Definitions

- i. **Earth Station in Motion (ESIM):** Earth Station designed to operate for both in-motion and stationary operations. ESIM operates in-motion on various platforms such as trains, maritime vessels, aircraft and other vehicles and, therefore, may be subject to occasional disturbances and interruptions in the satellite link.

[IAFI RESPONSE] : Highlighted portion removed

This is not a part of the ESIM definition. Furthermore, any wireless link may be subject to occasional disturbance and interruption

[NELCO RESPONSE] : Same as IAFI RESPONSE

Any ESIM may be subject to occasional disturbances

[SIA RESPONSE] : Same as IAFI RESPONSE

- ii. **EIRP<sub>Aggregate</sub>:** sum of the EIRP (Watts) within the nominated bandwidth of the ESOMP network.

[SES RESPONSE] : should this read “ESOMP” or should it refer to “ESIM” as used throughout this draft?

- iii. **EIRP<sub>max</sub>:** maximum EIRP capability of the earth station as declared by the manufacturer/operator.
- iv. **equivalent power flux density:** The sum of the power flux densities produced at a geostationary-orbit receive earth or space station on the Earth’s surface or in the geostationary orbit, as appropriate, by all the transmit stations, including earth stations in motion, within a non-geostationary-orbit Fixed-Satellite Service system, taking into account the off-axis discrimination of a reference receiving antenna assumed to be pointing in its nominal direction.

[VIASAT RESPONSE] : Highlighted portion added

- v. **Network Control and Monitoring Center (NCMC):** NCMC is a facility that has the capability to remotely control earth stations and/or space stations operating as part of a satellite network or system.

[IAFI RESPONSE] : Highlighted portion added

#### 4.0 TYPES of NETWORKS

Satellite Network considered in this standard are broadly classified into telecom networks and broadcasting networks. The mandatory technical requirements specified in the subsequent sections mainly include frequency of operation, epfd values, spurious emission limits and other parameters relevant to network link engineering.

[AMAZON RESPONSE] : Highlighted portion suggested to be removed or be properly defined

[IAFI RESPONSE] : Reference to Broadcasting from this section could be deleted as broadcasting is not relevant for NGSO

#### 4.1 TELECOM NETWORK

A network which employs two-way communication and may also include one-way communication is a telecom network. Telecom networks are further classified into CUG networks, transmission networks and access networks.

##### 4.1.1 CUG VSAT NETWORKS

The CUG VSAT networks are used 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 or IoT/M2M devices.

This network can operate in Star, Mesh, or Hybrid configurations.

##### 4.1.1.1 STAR CONFIGURATION

In star type satellite network configuration, earth stations (VSAT) communicate

via Hub station or central station. Networks employing ESIMs shall follow Star topology only.

**[IAFI RESPONSE]** : Underlined portion deleted

Why this restriction? It limits the configuration to star only which should not be mandatory

**[SES RESPONSE]** : star → Star

a. For Remote VSATs (Static terminals): - Multiple carriers will be allowed for transmission from remote VSAT terminal (i.e. inbound data at Hub).

b. For ESIM terminals (“Communication On the Move” and “Communication On the Pause”): - Only one carrier will be allowed for transmission from remote VSAT terminal (i.e. inbound data to Hub).

**[AMAZON RESPONSE]** : The restriction of one carrier needs to be removed as, in the case of NGSO, the “make before break” scheme is followed, which means that a carrier is established to the upcoming satellite before the carrier is withdrawn on the receding satellite.

c. For Hub **Station**: - Multiple carriers will be allowed for transmission from Hub station (i.e. outbound data from **hub**).

**[IAFI RESPONSE]** : Limitations proposed in this section are not required and should not be mandatory

**[SES RESPONSE]** : Station → station

hub → Hub

Editorial amendment proposed

#### 4.1.1.2 MESH CONFIGURATION

Mesh type is called point-to-point configurations. In this mesh type network configuration, earth stations communicate directly via satellite. Multiple carriers will be allowed for transmission between VSATs.

#### 4.1.1.3 HYBRID CONFIGURATION

The Hybrid Configuration is a combination of **star** and Mesh configuration. The requirements for **mesh** configuration shall be applicable for VSATs having **mesh** connectivity and **star** configuration for star connectivity. For the terminals having both configurations, requirement of **mesh** connectivity shall be applicable.

**[SES RESPONSE]** : star → Star

mesh → Mesh

Editorial amendment proposed

#### 4.1.2 TRANSMISSION NETWORK

This network basically consists of connectivity between two nodes of a telecom service provider with no end-user connectivity.

#### 4.1.3 ACCESS NETWORK

This network shall provide access only to end user.

### 4.2 BROADCAST NETWORK

BROADCAST networks are further classified broadly into DTH networks, Distribution networks and DSNG networks. Total data rate of carrier on a transponder shall be limited to the transponder capacity for the DTH and distribution network.

#### 4.2.1 DTH NETWORK

A radio-communication service in which signals transmitted from satellite are intended for direct reception by the general public. In case of return DTH channel, the technical requirements for the same will be as per those for telecom network.

#### 4.2.2 DISTRIBUTION NETWORK

A broadcasting network in which signals transmitted from satellite are received by service providers and further retransmitted through terrestrial transmitters/cable network/DTH system.

#### 4.2.3 DSNG NETWORK SERVICES

DSNG terminal are used to gather information from a site with the help of a nomadic earth station. The video/audio is received by the control room of a broadcast station for further telecast/ broadcast. However, no live broadcast directly from DSNG to general public shall be permitted under any circumstances. MCPC mode is not permissible for DSNG terminal.

**[IAFI RESPONSE]** : Highlighted portion removed as it is confirmed that broadcasting is not relevant for NGSO

**[SIA RESPONSE]** : Same as IAFI RESPONSE

## 5.0 MANDATORY TECHNICAL REQUIREMENTS

### 5.1 FREQUENCY BANDS OF OPERATION

The equipment shall operate in the following sets of frequency bands in Table I below: Specific frequency band(s) may be indicated in the License agreement.

[SIA RESPONSE] : Highlighted portion added. Underlined portion removed

**Table I: Frequency Bands permitted for NGSO systems**

[SPACEX RESPONSE] : SpaceX strongly recommends the inclusion of all frequencies authorised for NGSO use at the ITU and especially within the VHF, Q/V, and E bands (as added to Table 1 under track-change mode).

Frequency band	Space to Earth (GHz)	Earth to Space (GHz)	Service
VHF	0.137-0.138	0.148-0.15005	FSS
Ku band	10.7-12.75	12.75-13.25 13.75-14.0 14.0-14.5 14.5-14.8 17.3-18.1	FSS
Ka Band	17.7-21.2	27-31	FSS/MSS
Q/V Band	37.5-43.5	47.2-50.2 50.4-51.4	FSS
E Band	71-76	81-86	FSS

[SPACEX RESPONSE] : Highlighted portions added

NOTE 1: - All the frequency bands mentioned in the table above, along with their associated services/application, shall be as per the extant National Frequency Allocation Plan.

NOTE 2: Specific frequency band(s) may be indicated in the License agreement.

[SIA RESPONSE] : Highlighted portion added

*[Editor's Note: Stakeholders to provide inputs on the frequency bands (clause 5.1) to be utilized for NGSO systems]*

[SES RESPONSE] : The frequency range for Ka band of 27-31 GHz and 17.7-21.2 GHz is appropriate

## 5.2 Single Entry EPFD LIMITS- *For protection of Geostationary Orbit Systems*

[SPACE X RESPONSE] : Underlined portions removed

SpaceX strongly recommends ensuring that these NGSO standards are made future proof through directly incorporating Article 22 of the ITU Radio Regulations by reference (and deleting specific epfd limits as these will evolve over time). Such an approach will ensure that India's NGSO standards remain concurrent with upcoming evolutions in the specific rules and requirements prescribed under Article 22 of the Radio Regulations.

[VIASAT RESPONSE] : Highlighted portion added

5.2.1 In frequency bands subject to epfd limits, An NGSO system operator must not cause unacceptable interference (to), and nor claim protection from, a GSO FSS (or GSO BSS) network. Accordingly, it must comply with the relevant the applicable epfd limits specified in Article 22 of the ITU RR and repeated in subsequent clauses. Also, the provisions no. 5.441, No. 5.484A and No. 5.487A of the current ITU-RR apply. subsequent clauses. as per Article 22 of the Radio Regulations (reproduced below).

[AMAZON RESPONSE] : This is not fully in line with the Radio Regulations. While article 22.2 states that NGSO shall not claim protection from nor interfere with GSO, this article is deactivated by 5.523A for the 18.8-19.3 GHz (space-to-Earth) and 28.6-29.1 GHz, where coordination under 9.11A is applied instead.

[IAFI RESPONSE] : Highlighted portion added. Underlined portions valid

[JIO RESPONSE] : Highlighted portion added.

[NELCO RESPONSE] : "subsequent clauses" removed rest same as IAFI RESPONSE

As below EPFD limits are as Article 22 of ITU's RR better to refer to Article 22 of RR and right so to be in sync with ITU regulations.

Another point added

**5.2.2** Resolution 76 (Rev. WRC-15) also applies in relation to the aggregate interference caused by all co-frequency non-GSO FSS systems into GSO FSS systems in the frequency bands as given in Table 1 above.

As below EPFD limits are as Article 22 of ITU's RR better to refer to Article 22 of RR and right so to be in sync with ITU regulations. Rather than reproducing it completely here which may be subject to error if there is any change in Article 22 or ITU's RR.

[SES RESPONSE] : Same as JIO RESPONSE  
Highlighted portion added

[SIA RESPONSE] : Same as IAFI RESPONSE  
Portions within ( ) removed  
Highlighted portion added

Add another point

**5.2.2** Resolution 76 (Rev. WRC-15) also applies in relation to the aggregate interference caused by all co-frequency non-GSO FSS systems into GSO FSS systems in the frequency bands under Table I above.

[SPACEX RESPONSE] : Point modified as given below

In the frequency bands covered by Article 22 of the ITU Radio Regulations, an NGSO system must not cause unacceptable interference to, or claim protection from, a GSO FSS or GSO BSS network. Accordingly, it must comply with rules contained in Article 22 of the ITU Radio Regulations

Another point added

**5.2.2** In the frequency bands not covered by Article 22, i.e. for Ka band 18.8-19.7 GHz (space-to-Earth) and 28.6-29.5 GHz (Earth-to-space), An NGSO system shall be subject to the application of the provisions of No. 9.11A and No. 22.2 does not apply. Operators shall cooperate to the maximum extent possible to coordinate pursuant to No. 9.11A with geostationary networks with a view to reaching results acceptable to all the parties concerned.

#### A ) EPFD limits applicable to NGSO systems' Earth Stations- *for protection of GSO space stations*

5.2.2 In certain frequency bands, the equivalent power flux density, epfd ↑, produced at any point in the geostationary orbit by emissions from all the earth stations in an NGSO system, shall be determined by the Network Control and Management Centre (NCMC) to ensure compliance with the epfd ↑ limit, as specified in Table 22-2 of No. 22.5D of current ITU-R Radio Regulations Article 22. unless otherwise coordinated.

[JIO RESPONSE] : Highlighted portions added.

[NELCO RESPONSE] : Highlighted word added

[SES RESPONSE] : Highlighted portion added  
Same as JIO RESPONSE

[SIA RESPONSE] : Same as NELCO RESPONSE

[SPACEX RESPONSE] : 5.2.2 point removed.



5.2.3 The applicable epfd ↑ limits as specified in Article 22 of ITU-Radio regulation are reproduced below in Table II for information:

[AMAZON RESPONSE] : We suggest just referring to the RR so that when RR is updated, the TEC IR document need not be updated.

[JIO RESPONSE] : 5.2.3 point removed

[NELCO RESPONSE] : Highlighted portion added

[SES RESPONSE] : Same as JIO RESPONSE

[SIA RESPONSE] : Same as NELCO RESPONSE

[SPACEX RESPONSE] : 5.2.3 point removed

Table II: Limits to the epfd ↑ radiated by non-geostationary-satellite systems

Frequency Band	epfd ↑ (dB(W/m <sup>2</sup> ))	Percentage of time epfd ↑ level may not be exceeded	Reference bandwidth (kHz)	Reference antenna beamwidth and reference radiation pattern
12.5-12.75 GHz 12.75-13.25 GHz 13.75-14.5 GHz	- 160	100	40	4° Recommendation ITU-R S.672-4, Ls = - 20
17.3-18.1 GHz	- 160	100	40	4° Recommendation ITU-R S.672-4, Ls = - 20
27.5-28.6 GHz	- 162	100	40	1.55° Recommendation ITU-R S.672-4, Ls = - 10
29.5-30 GHz	- 162	100	40	1.55° Recommendation ITU-R S.672-4, Ls = - 10

[JIO RESPONSE] : Above table removed

[SES RESPONSE] : Same as JIO RESPONSE

[SPACE X RESPONSE] : Table II removed

*[Editor's Note: Stakeholders to provide inputs on the epfd limits applicable across all frequency bands to be utilized for NGSO systems (as specified in clause 5.1)]*

[IAFI RESPONSE] : Editor's Note deleted

[JIO RESPONSE] : As clause 5.2.2 above has been proposed to be modified to refer to Table 22-2, this clause 5.2.3 is redundant and thus proposed to be removed

[SES RESPONSE] : As clause 5.2.2 above has been proposed to be modified to refer to Table 22-2, this clause 5.2.3 is redundant and thus proposed to be removed

5.2.4 The epfd ↑ limits, specified above, in Article 22 of ITU's Radio Regulations relate to equivalent power flux density, apply for all conditions and all modulations, which would be obtained under free-space propagation conditions, into a reference antenna and in reference bandwidth, as specified in Table II, for all pointing directions towards the Earth's surface visible from any given location in the geostationary satellite orbit.

[JIO RESPONSE] : Highlighted portion added. Underlined portions removed

[NELCO RESPONSE] : "specified above" removed  
Highlighted portion added  
Suggest to refer to Article 22 of ITU's RR

[SES RESPONSE] : Same as JIO RESPONSE

[SPACE X RESPONSE] : 5.2.4 point removed

5.2.5 The NGSO system operator shall declare the method and accuracy of uplink power control, if any, and demonstrate the capability of Network Control and Management Centre (NCMC) to ensure compliance with the epfd ↑ limits specified above.

[JIO RESPONSE] : Underlined portion removed

[SES RESPONSE] : Same as JIO RESPONSE  
Editorial amendments proposed

[SPACE X RESPONSE] : 5.2.5 point removed

B ) i. EPFD limits applicable to NGSO Space Stations- *for protection of GSO space stations*

[AMAZON RESPONSE] : Comment regarding point B) i. (including point 5.2.6, point 5.2.7 and Table II) Our suggestion is that this should be removed as this does not fall in the domain of earth station specifications.

5.2.6 In certain frequency bands, the equivalent power flux density,  $epfd_{is}$ , produced at any point in the geostationary orbit by emissions from all space stations in an NGSO system, including emissions from a reflecting satellite, for all conditions and for all modulation methods of modulation, shall comply with  $epfd_{is}$  limits, as specified in Table 22-3 of No. 22.5F of current ITU-R Radio Regulations Article 22. unless otherwise coordinated.

[JIO RESPONSE] : Highlighted portions added

[SES RESPONSE] : Same as JIO RESPONSE  
Highlighted portion added

[SIA RESPONSE] : Highlighted portion added

[SPACEX RESPONSE] : 5.2.6 point removed

5.2.7 The applicable  $epfd_{is}$  limits as specified in Article 22 of ITU Radio Regulations are reproduced below in Table II for information:

[JIO RESPONSE] : 5.2.7 point removed

[NELCO RESPONSE] : Highlighted portions added.

[SPACEX RESPONSE] : 5.2.7 point removed

Table III : Limits to the  $epfd_{is}$  radiated by non-geostationary-satellite systems

Frequency Band	$epfd_{is}$ (dB(W/m <sup>2</sup> ))	Percentage of time $epfd_{is}$ level may not be exceeded	Reference bandwidth (kHz)	Reference antenna beamwidth and reference radiation pattern
17.8-18.4	-160	100	40	4° Recommendation ITU-R S.672-4, L <sub>s</sub> = -20

...	...	...	...	...
-----	-----	-----	-----	-----

[JIO RESPONSE] : Above table removed

*[Editor’s Note: Stakeholders to provide inputs on the epfd limits applicable across all frequency bands to be utilized for NGSO systems (as specified in clause 5.1)]*

[JIO RESPONSE] : As clause 5.2.6 above has been proposed to be modified to refer to Table 22-3, this clause 5.2.7 is redundant and thus proposed to be removed]

[NELCO RESPONSE] : Highlighted portion for editorial change added

[SES RESPONSE] : Same as JIO RESPONSE

About last row : Inputs invited from stakeholders for epfd<sub>is</sub> limits applicable in other frequency bands  
As clause 5.2.6 above has been proposed to be modified to refer to Table 22-3, this clause 5.2.7 is redundant and thus proposed to be removed

[SIA RESPONSE] : Same as NELCO RESPONSE

[SPACEX RESPONSE] : Above table removed

**B ) ii. EPFD limits applicable to NGSO Space Stations- *for protection of GSO Earth stations***

5.2.8 In certain frequency bands, the equivalent power flux-density, epfd ↓ , at any point on the Earth’s surface visible from the geostationary-satellite orbit, produced by emissions from all the space stations of a non-geostationary-satellite system in the fixed-satellite service shall not exceed the limits specified in Tables 22-1A, 22-1B, 22-1C, 22-1D of No. 22.5C of ITU Radio Regulations Article 22. unless otherwise coordinated.

[JIO RESPONSE] : Highlighted portions added

[SES RESPONSE] : Same as JIO RESPONSE

[SPACEX RESPONSE] : 5.2.8 point removed

5.2.9 The epfd ↓ limits specified above in Article 22 of ITU Radio Regulations relate apply to emissions from all space stations, including emissions from a reflecting satellite, for all conditions and for all methods of modulation.

[JIO RESPONSE] : Highlighted portions added. “specified above” and “relate” removed

[NELCO RESPONSE] : Highlighted portion added  
Underlined portion in light blue valid

[SES RESPONSE] : Same as JIO RESPONSE  
Editorial amendments proposed

[SPACEX RESPONSE] : 5.2.9 point removed

[VIASAT RESPONSE] : Added another point

**5.3** Aggregate EPFD limits – for protection of GSO networks

1. The aggregate downlink interference into GSO earth stations caused by all NGSO systems operating co-frequency in the bands listed in Tables 22-1A to 22-1D of Article 22 shall not exceed the aggregate EPFD limits shown in Table 1A to 1D of Resolution 76 (Rev. WRC-15).
2. The aggregate uplink interference into GSO satellites caused by all NGSO systems operating co-frequency in the band 27.5-31 GHz shall not exceed the aggregate interference threshold limit in ITU-R S.1323-2.

### 5.3 Protection of fixed or mobile services

5.3.1 The power flux density (pfd) of the Earth's surface produced by emissions from a space station, including emissions from a reflecting satellite, for all conditions and for all methods of modulation, shall not exceed the limits specified in Section V of ITU-R Radio Regulations Article 21.

[SES RESPONSE] : Highlighted portion added

5.3.2 The pfd limits, specified above, relate to the pfd which would be obtained under assumed free-space propagation conditions and apply to emissions by a space station of FSS service where frequency bands are shared with equal rights with the fixed or mobile service as per NFAP.

[AMAZON RESPONSE] : Another point added

**5.3.3** In the frequency band 27.5-28.5 GHz for sharing of spectrum between IMT and Satellite, the following sharing conditions should be adhered to by both IMT and Satellite gateways as applicable

1. IMT base stations would operate in accordance with the existing 3GPP standards for local area base stations and/or indoor use with set power levels not exceeding TRP of 25 dBm/200 MHz, and the IMT base station antenna beams should be pointed below the horizon plane.
2. Existing and planned FSS GSO/NGSO gateway stations would operate within the frequency band 27.5-28.5 GHz in conformance with technical condition – such gateway stations should not generate a power flux density (PFD) exceeding -91 dBW/m<sup>2</sup>/MHz at 5 meters above the ground level at a distance of 2 km from the gateway antenna, but may exceed that value during periods of rain fade and or not more than 10% of the time.

[SES RESPONSE] : Editorial amendments proposed

### 5.4 POLARIZATION

Transmit and receive polarization of the satellite are linear/ circular over entire coverage. The earth station polarization angle should match the spacecraft polarization angle under clear sky conditions. Transmit and receive polarization sense of earth station shall be linear or circular for Ku and Ka bands.

**[IAFI RESPONSE]** : Requirements for the hub should be removed. Gateway design varies with the satellite system and there are typically no applicable standards. License application for any hub will in any case be evaluated on a case-by-case basis, together with the technical characteristics and interference potential. As such, there is no need to impose some values a priori which may unnecessarily exclude some designs.

## 5.5 HUB/ TELEPORT STATION REQUIREMENTS

### 5.5.1 Transmit cross-polar Isolations: Better than 33 dB on-axis

**[IAFI RESPONSE]** : Highlighted portion removed

**[JIO RESPONSE]** : 33dB → 30dB

This value was inherited from GSO IR/GR TEC (GSO Ka HUB antenna >8m), and it would be more practical for a lower value like 30 dB for smaller HUB antenna size e.g. 5.5m or even smaller for the case of O3b

**[NELCO RESPONSE]** : 33dB → 30dB

**[SES RESPONSE]** : Same as JIO RESPONSE

**[SIA RESPONSE]** : Same as IAFI RESPONSE

**[SPACEX RESPONSE]** : SpaceX strongly recommends the deletion of these polarisation requirements as these presume (large) parabolic antenna types. Many current (and near-future) NGSO systems are designed for the use of better, electronically steerable (phase array) antennas - which these requirements are incompatible with. SpaceX recommends that the TEC remove these requirements to ensure that operators can have the flexibility of deploying different and newer antenna design types.

### 5.5.2 Receive cross-polar Isolations: Better than 33 dB on-axis

**[IAFI RESPONSE]** : Highlighted portion removed

**[JIO RESPONSE]** : 33dB → 30dB

Same comment as above

**[NELCO RESPONSE]** : 33dB → 25dB

Transmit cross-polar isolation for Hub for NGSO not to be too stringent. Suggest to change it to 30db for Transmit and 25 dB for Receive

**[SES RESPONSE]** : Same as JIO RESPONSE

For Hub/Teleport station: the 33 dB value was inherited from TEC 42012 which in Ka band refers to antenna diameter >8m. In the case of NGSO (specifically O3b/O3b mPOWER Gateway terminals, we envisage to use smaller Hub antennas, e.g. 5.5m so cross-polar discrimination of 30 dB would be more appropriate

**[SIA RESPONSE]** : Same as IAFI RESPONSE

**[SPACEX RESPONSE]** : SpaceX strongly recommends the deletion of these polarisation requirements as these presume (large) parabolic antenna types. Many current (and near-future) NGSO systems are designed for the use of better, electronically steerable (phase array) antennas - which these requirements are incompatible with. SpaceX recommends that the TEC remove these requirements to ensure that operators can have the flexibility of deploying different and newer antenna design types.

## 5.6 EARTH STATION REQUIREMENTS

### 5.6.1 Transmit cross polar discrimination : Better than 30 dB on-axis

[AMAZON RESPONSE] :

1. These values are OK for antennas consisting of mechanical dishes, but not for phased array antennas
2. Prescribing minimal values for the cross-polar isolation is necessary for GSO systems where the operator has no control on the terminal, but for proprietary NGSO systems intra-system interference is handled at the overall system level and inter-system interference via coordination.

We suggest that these requirements are deleted.

[IAFI RESPONSE] : This limit is too stringent for some of the more compact user terminals and should be relaxed

[JIO RESPONSE] : 30dB → 19dB

This value was inherited from GSO IR/GR TEC (where GSO Ka terminal antenna is 2.4m), and it would be more practical for a lower value like 19 dB for smaller terminal antenna size e.g. 1.2m typical for the case of O3b mPOWER or even smaller to 0.2m~0.45m

[NELCO RESPONSE] : 30db → 15dB

30dB is too stringent for compact Ka band user terminals of NGSO system. Suggest it to be better than 15Db

[SES RESPONSE] : Same as JIO RESPONSE

[SIA RESPONSE] : 30dB → 33dB

[SPACEX RESPONSE] : SpaceX strongly recommends the deletion of these polarisation requirements as these presume (large) parabolic antenna types. Many current (and near-future) NGSO systems are designed for the use of better, electronically steerable (phase array) antennas - which these requirements are incompatible with. SpaceX recommends that the TEC remove these requirements to ensure that operators can have the flexibility of deploying different and newer antenna design types.

### 5.6.2 Receive cross polar discrimination : Better than 30 dB on-axis

[AMAZON RESPONSE] : Same as above

[IAFI RESPONSE] : Highlighted portion removed

No specific limit should apply in reception as operators will deploy a variety of user terminals to meet target throughput levels. Possible reduced performances in reception are a product/marketing/operational decision.

[JIO RESPONSE] : 30dB → 19dB

Same comment as above

[NELCO RESPONSE] : 30dB → 15dB

Cross pole discrimination to me kept lower for NGSO considering the latitude of the orbit position is lower and it is Ka-band.

[SES RESPONSE] : Same as JIO RESPONSE

For User Terminal station: the 30 dB value was inherited from TEC 42012 which in Ka band refers to antenna diameter >2.4m. We envisage to use smaller User Terminals, e.g. 1.0m (or even smaller i.e. 0.2m-0.45m) so cross-polar discrimination of 19 dB would be more appropriate

[SIA RESPONSE] : Same as IAFI RESPONSE

[SPACEX RESPONSE] : SpaceX strongly recommends the deletion of these polarisation requirements as these presume (large) parabolic antenna types. Many current (and near-future) NGSO systems are designed for the use

of better, electronically steerable (phase array) antennas - which these requirements are incompatible with. SpaceX recommends that the TEC remove these requirements to ensure that operators can have the flexibility of deploying different and newer antenna design types.

## 5.7 Transmit Spurious Limits (in any 100 KHz Band outside the operating frequency band)

### 5.7.1 Transmit On-axis and Off- axis spurious radiation Limits:

#### i. Static Earth Stations

a) Ku Band: As per ETSI EN 303 980 V1.2.1/ ETSI-EN 303 981

[JIO RESPONSE] : Highlighted portion added

[NELCO RESPONSE] : Highlighted portion added

[SES RESPONSE] : Same as JIO RESPONSE

[SIA RESPONSE] : Same as NELCO RESPONSE

b) Ka Band: As per ETSI EN 303 699 V1.1.1

[JIO RESPONSE] : Highlighted portion added

[SES RESPONSE] : Same as JIO RESPONSE

#### ii. ESIMs

a) Ku Band: As per ETSI EN 303 980 V1.2.1/ ETSI-EN 303 981

[JIO RESPONSE] : Highlighted portion added

[NELCO RESPONSE] : Highlighted portion added

[SES RESPONSE] : Same as JIO RESPONSE

[SIA RESPONSE] : Same as NELCO RESPONSE

b) Ka Band: As per ETSI EN 303 979 V2.1.2

[JIO RESPONSE] : Highlighted portion added. For consistency, added application version of the relevant ETSI document

[SES RESPONSE] : Same as JIO RESPONSE



## 5.8 Declaration of maximum EIRP:

- a) The NGSO system operator must declare the maximum EIRP capability of the earth stations and the gain of the antenna.
- b) The NGSO system operator shall declare if the design and operation of the satellite network permits more than one earth station to transmit simultaneously on a given carrier frequency, from a signal location. In such a case, the manufacturer shall also declare the maximum number N of such earth stations that may transmit simultaneously on a given carrier frequency, and the aggregate EIRP from the earth stations.

[AMAZON RESPONSE] : Regarding “transmit simultaneously”  
Please clarify what is the meaning of transmit simultaneously.

[NELCO RESPONSE] : signal → single

[SES RESPONSE] : Highlighted portion removed

[SIA RESPONSE] : Same as NELCO RESPONSE

*[Editor’s Note: Stakeholders to provide inputs on the extent of definition of ‘signal location’ to be considered in aforementioned clause. Inputs must be supported with international standards or global best practices]*

[JIO RESPONSE] : Clause 5.8 is actually redundant as Clause 5.2 already specifies epfd limits to protect GSO satellites. Thus, it is proposed to remove/delete this Clause 5.8. Further it should be noted that epfd limits compliance in Clause 5.2 applies to all transmitting stations in a given frequency whereas this Clause 5.8 is only seeking for the total EIRP from a specific signal location. This latter information will not be helpful in the case of protection of widebeam GSO network (deployed in Ku band) since the interference impact could come from multiple stations across India that have the possibility to transmit in the same given frequency due to the HTS spot beam design

[SES RESPONSE] : Same as JIO RESPONSE

## 5.9 Declaration of EPFD limits: compliance with applicable ITU Regulations :

[SPACEX RESPONSE] : Highlighted portion added. Underlined portion in pink make up the point

- a) The NGSO system operator must meet the EPFD limits specified in Art.22 of ITU Radio Regulations for all percentage of time values at all GSO earth station

locations and for all GSO satellite locations. As such, TEC may require additional compliance verification to ensure NGSO system operators meet all EPFD limits at all GSO earth station locations and for all GSO satellite locations. ITU software use does not preclude full compliance and demonstration of compliance with Art.22 as required by TEC. use ITU validation software to assess the compliance of rules under Article 22 of the ITU Radio Regulations epfd limits, as mentioned earlier in this document.

[SPACEX RESPONSE] : Highlighted portion added. “epfd limits” word removed

[VIASAT RESPONSE] : Highlighted portion added. Point valid only till highlighted portion.

- b) Prior to initiation of service, the operator must provide relevant information demonstrating compliance of the system with Article 22 of the ITU Radio Regulations declare the ITU findings and the input data files used for ITU review of epfd demonstrations.

[SPACEX RESPONSE] : Highlighted portion added. Underlined portion removed.

#### 5.10 Pointing Error:

- a) The NGSO operator shall declare the maximum antenna beam pointing error  $\delta\theta_{\max}$  for earth stations.
- b) The NGSO network shall have the means to detect antenna beam pointing errors specified above. This detection shall be performed over the range of azimuth and elevation angles for the intended purposes.
- c) The Earth stations must cease transmissions when pointing error exceeds  $\delta\theta_{\max}$  and shall not resume transmissions until the pointing error is within  $\delta\theta_{\max}$ .

5.11 EIRP Stability :  $\pm 0.5$  dB/24 hrs of the Target EIRP, for 95% of the pass

[AMAZON RESPONSE] : Regarding underlined portion in dark blue

There is no specific reference for EIRP stability that applies to NGSO FSS systems; for NGSO systems where the terminal is proprietary, there is no need to standardize EIRP stability. As such, we suggest this rule should be removed from this Standard.

**[IAFI RESPONSE]** : The “24 hrs” reference is not relevant for NGSO systems.

EIRP will be varied over each pass, equal to or less than the maximum rated terminal linear EIRP, dependent on path loss. A possible suggestion is  $\pm 1.3$  dB of the target EIRP level, for 95% of the pass

**[NELCO RESPONSE]** : 0.5dB  $\rightarrow$  1.3dB

“24 hrs” removed

Highlighted portion added

EIRP Stability of  $\pm 0.5$ dB/24hrs in quite aggressive considering that in NGSO multiple satellites are used with changing positions from any location using Electronic phased array antenna (mostly)

**[SIA RESPONSE]** : Same as NELCO RESPONSE

5.12 Transmit IM Products: 23 dB below two equal carriers at 6 dB output

back-off

**[AMAZON RESPONSE]** : Since IM Products are a subset of spurious emissions, above, there is no need for requirements specific to IM Products. As such, we suggest this rule should be removed from this Standard

5.13 Transmit harmonics : Better than -40 dBc upto second harmonic

**[AMAZON RESPONSE]** : Since harmonics are subset of spurious emissions, there is no need for requirements specific to harmonics. As such, we suggest this rule should be removed from this Standard.

5.14 Frequency Stability : Better than 1 ppm over the temperature range

of -5°C to + 60°C

5.15 Long term frequency stability: Better than 0.1 ppm over a day

6.0 NUMBERING PLAN (for user terminals):

VSAT as well as DSNG networks shall follow the unique ID for each terminal specified or approved by the Department of Telecom.

## 7.0 OTHER TECHNICAL AND OPERATIONAL REQUIREMENTS

**[VIASAT RESPONSE]** : Highlighted portion added

### 7.3 SATELLITE PARAMETERS

**To be mentioned:** The salient parameters of NGSO network to be declared for the purpose of link budgeting.

**[AMAZON RESPONSE]** : Predominantly the NGSO systems are proprietary in nature. So the link budgets are also proprietary to each system. The link budgets cannot be constructed using standard software/templates and values.

The salient parameters of O3b network for link budgeting:

Satellite Parameter	O3b-1st Gen	O3b-mPOWER
Frequency Band	Ka	Ka
Orbit	8,062 km Equatorial	8,062 km Equatorial
Number of beams per satellite	Up to 10 steerable user beams 2 steerable gateway beams	Electronic beam forming Up to 5344 beams in forward direction Up to 5344 beams in return direction
Maximum EIRP (dBW)	49.7	62
Saturation Flux Density (dBW/m <sup>2</sup> )	-101 to -90	-101 to -90
Polarisation	Circular	Circular
G/T (dB/K)	-2 to 5	-2 to 7.5
Bandwidth	216 MHz per transponder	Flexible from 15 MHz to 2500 MHz
X-POL Isolation (dB)	18.5 to 25	18.5 to 25

[JIO RESPONSE] : Highlighted portions added

[SES RESPONSE] : Same as JIO RESPONSE

[VIASAT RESPONSE] : Another point added

7.4 The NGSO operator must declare and maintain a suitable GSO arc avoidance angle taking into account the actual characteristics of affected GSO networks (such as satellite receiver noise temperature and antenna gain, and sizes and characteristics of user terminals).

7.4 The NGSO operator must declare satellite and orbital information, and or ephemeris data in a standard format and update it at the event of any change in the constellation. The following technical details must also be supplied:

- a) Number of total beams on each satellite serving the country
- b) Number of co-frequency beams on each such satellite
- c) Number and size of frequency channels on each such satellite

- d) The number of satellite beams used for transmissions on the same frequency in the same or overlapping areas at any given time
- e) How the NGSO system avoids interference to GSO networks created by earth station and satellite antenna sidelobes, and earth station antenna back lobes, particularly when phased array antennas are employed.

7.6 NGSO systems shall have an operational feature that allows them to immediately interrupt radio frequency emissions to ensure satisfaction of this non-interference requirement, and to cease emissions upon notice of unacceptable interference

7.7 If interference into a GSO network occurs, NGSO systems shall cease operations and not recommence operations until they address the cause of such interference by, among other things, increasing angular separation, reducing power, shaping antenna beams differently

7.8 If aggregate interference to a GSO network from signals transmitted by multiple NGSO systems is detected, and it is not possible to identify the NGSO system generating the interference, NGSO system operators shall cooperate with each other and take all necessary measures expeditiously to eliminate the interference

7.9 NGSO operator should operate with only  $1/n$  of the look angles in India, where  $n$  is the number of NGSO systems authorized to serve India in the same frequency band

7.10 NGSO operator should coordinate in good faith and in advance with other NGSO systems so that all  $n$  look angles may be used to serve India by those different NGSO systems.

7.11 Low Earth Orbit (LEO) systems should maintain an orbital tolerance of  $\pm 2.5$  km for the apogee and perigee of each NGSO satellite, and a  $0.5^\circ$  tolerance for each orbital inclination the NGSO system employs.

**[SES RESPONSE]** : Highlighted portion added. Underlined portion removed

It is proposed that Clause 7.4 be limited to satellite and orbital information consistent with those provided to the ITU-R when submitting NGSO satellite network filings. Information such as number of satellites on each orbital plane, number of orbital planes, right ascension angle on each orbital plane, inclination angle of each orbital plane, orbital period, apogee, perigee

[VIASAT RESPONSE] : Highlighted portions added

*[Editor's Note: Stakeholders to provide inputs on the content, format and mode of sharing ephemeris data for facilitating coordination among NGSO operators. Inputs must be supported with global best practices or examples].*

[AMAZON RESPONSE] : We propose providing a notification of coordination agreement with the corresponding NGSO operating in the same frequency band rather than the requirement of providing ephemeris data.

[JIO RESPONSE] : Orbital information such as number of satellites on each orbital plane, number of orbital planes, and orbital parameters (right ascension angle, inclination angle, orbital period, apogee, perigee) are submitted to the ITU-R as a part of satellite network filings, will be provided]

## 7.5 LINK BUDGET FORMAT

To be mentioned: Sample format for link calculation to be submitted prior to initiation of service.

[AMAZON RESPONSE] : Predominantly the NGSO systems are proprietary in nature. So the link budgets are also proprietary to each system. The link budgets cannot be constructed using standard software/templates and values.

*[Editor's Note: Stakeholders to provide inputs for sample format of link budget calculations that may be applicable to NGSO systems. Inputs must be supported with relevant ITU Recommendations, international standards and global best practices].*

[JIO RESPONSE] : Existing format of link budget used for GSO may be utilized for NGSO as well

[SES RESPONSE] : Please see Annex 1 for Sample NGSO Link Budget template

## 8.0 Additional Mandatory Requirements applicable to Earth Stations in Motion (ESIM):

[SPACEX RESPONSE] : Everything from here onwards have been removed

### **A) Control and Monitoring Functions : Network Control and Monitoring Centre (NCCM)**

8.1 The NGSO network shall operate under the control of a Network Control and Monitoring Centre NCCM. ESIM are subject to permanent monitoring and

control by a Network Control and Monitoring Centre (NCMC) or equivalent facility.

[SIA RESPONSE] : Highlighted portion added. Underlined portions removed

8.2 ESIM should be capable of receiving and acting upon at least “enable transmission” and “disable transmission” commands from the NCMC or equivalent facility.

8.3 It shall be possible to shut down transmissions from an ESIM terminal through the Network Control Centre if the operation of the ESIM terminal is found to cause harmful interference to any other satellite network or terminal.

8.4 ESIM must transmit their geolocation (latitude and , longitude and altitude in case of an aircraft) to NCMC in the subject network in real time, whenever communicating with the network, at least every 1 minute, for tracking purpose(s).

[SIA RESPONSE] : Highlighted portion added. Underlined portions removed

8.5 It shall be possible to define the service area contour through the NCMC. The ESIM shall operate only in the specified service area contour in accordance with the service area requirements as defined in the license conditions. The operation of the ESIM shall shut down from the Indian gateway as soon as it goes out of the defined service area. Such functions must be implemented in NCMC should have capability to allow or cease transmission from ESIM based on geofencing.

[IAFI RESPONSE] : Highlighted portion deleted and replaced by the following:

NCMC should have capability to allow or cease transmission from ESIM based on geofencing. The Gateway in India may be used to provide services within India or outside India, subject to compliance with any applicable international and national law at the location of the ESIM.

(IAFI Alternative suggestion proposed to allow for the gateway to be potentially used also on a regional/sub-regional basis.)

[NELCO RESPONSE] : “The operation.....implemented in” removed

Highlighted portion added

Underlined portion valid

As part of TEC IR guidelines, it should be reference to the capability of NCMS to allow or cease from ESIM. Such artificial restriction will be counter-productive for business and make India less lucrative for NGSO operator to setup the gateways in India or else will make the overall services for India more expansive. Rather Usage of Gateways in India should be promoted to be used by other countries as well to make more cost efficient.

Moreover, at the start of paragraph it anyway refers “The ESIM shall operate only in the specified service area contour in accordance with the service area requirements as defined in the license conditions”

[SIA RESPONSE] : Same as NELCO RESPONSE  
should → shall

8.6 The NCMC shall facilitate the LIM/LIS requirements as per the license conditions along with the following:

- a. The Law Enforcement Agency (LEA) should get intercepted content in en-clair form along with meta-data (including geolocation, session details, IPDR/CDR etc) for any type of communication through ESIM terminal.
- b. The NCMC should have facility to monitor all ESIM terminals in the network.
- c. The details of the devices connected through in-built WiFi hotspot in ESIM terminal should be retrievable/viewable at NCMC.
- d. The ESIM network should have a proper authentication mechanism to uniquely identify each user. Moreover, the NGSO network should have technical capability to facilitate retrieval of any information in respect of LIM and Lawful Access to information.
- e. Immediate cessation of service to some or all ESIM terminals in a geographical area as per directive of Government of India should be feasible at NCMC.

## **B) General Requirements**

8.7 For each ESIM terminal (whenever the terminal is online or communicating with the network) a record of its geographic location (latitude, longitude; and altitude in case of aircraft based ESIM), transmit frequency, bandwidth, satellite used and on-axis EIRP shall be time annotated and maintained for a period of not less than one year. Records shall be updated recorded at time intervals no greater than 1 minute while the ESIM terminal is online or communicating NGOs in the FSS transmitting. ESIM shall have a means of determining its geographic location at a resolution of at least 100 metres in case of land based ESIM and .....



metres in case of vessel or aircraft based ESIM. In addition, the ESIM terminal may have compatible with the radio navigation system being used (eg: GPS, GSM/ NAVIC) or any other receiver for location fixing

**[AMAZON RESPONSE]** : Our comments:

1. Altitude for ESIM can be provided from an onboard GPS and cannot be linked to the Aircraft's altimeter.
2. Lat/Long and Altitude can be provided with a granularity of one minute. The transmission parameters can be provided on demand.

**[IAFI RESPONSE]** : Highlighted portions added. Underlined portions have been deleted  
For ESIM, it is not possible to define tracking based on a specific distance since the speed can be different

**[NELCO RESPONSE]** : Highlighted portion added

**[SES RESPONSE]** : TEC should consider eliminating the data logging requirement in clause 8.7. The U.S. Federal Communications Commission decided in 2018 to eliminate a nearly identical data logging requirement as no longer necessary (see FCC 18-138 [\[link here\]](#), at para. 24). The Commission found that, after many years of authorizing ESIM operations, it had never requested any of the logged data. ESIM operators reported that they had never been requested for such data and that it was onerous to maintain such data.

**[SIA RESPONSE]** : Highlighted portion added. Underlined portions removed  
“ESIM shall have a means.....receiver for location fixing” changed and considered a new point as mentioned below:

**8.8** ESIM shall have a means of determining its geographic location resolution as under:

- a) at least 100 metres in case of land based ESIM; and
- b) ..... metres in case of vessel or aircraft based Maritime ESIM and Aeronautical ESIM. In addition, the ESIM terminal may have GPS/NAVIC or any appropriate receiver for location fixing.

**8.8** The ESIM terminal on entering the Indian territory shall set-up communication link only through the Hub/Gateway station in the Indian territory.

**8.9** On entering and while in the Indian territory, the ESIM shall use the regional IP addresses as allocated to Indian service providers.

**8.10** The Wi-Fi access provided on board the vehicle shall be as per the relevant regulatory conditions of India like the frequency bands of operation (which shall be as per the prevalent National Frequency Allocation Plan (NFAP), EIRP etc.

# ANNEXURES

*(To be specified)*

## **Annexure-1**

### **SIA-India Comments**

The TEC document on Earth Station Terminals (vehicle/vessel/aircraft) on non-GSO networks in the FSS was objectively reviewed through intense discussion/consultation processes with the stakeholders in the satellite sector by SIA-India and accordingly following are suggested:

1. As no relevance was seen to include materials on BSS in NGSO context, the relevant materials referring to BSS in the document are deleted. Furthermore, the stakeholders were of the view that NGSO operators are not promoting BSS in NGSO constellations considering business viability. Hence, TEC may like to consider a separate document, if necessary.
2. An opinion was expressed whether the document can include relevant materials on Q/V bands as well, besides Ku and Ka bands. TEC may please mull over and decide. It is to be noted that the utility of Q/V bands for the stated purposes in the document are still in progress. It should also be noted that satellite systems constantly develop and innovate, and their utilization of future frequency bands such as Q and V band is expected to occur in the future, this role is increasingly being recognized.
3. It is proposed the document completely concentrate on satellite earth station terminals. As a result, few materials (only) relating to hubs/gateways were excluded. It may be noted that the Gateway design varies with satellite system and hence no applicable standards and to be evaluated on a case-by-case basis for licence.
4. The relevance of Section 4 (types of networks especially VSAT) may be reviewed. We understand that ESIM can operate under Hybrid Configuration. This needs to be clarified and reviewed in the document. Similarly, the intent behind -one carrier-4.1.1.1b may be clarified.
5. In Section 5.2, it is opined that mere mention of Article 22 would suffice and no need to reproduce the efd limits of NGSO systems in Table -II and Table III. It seems redundant and a review is required.
6. In Section 5. 5, it is opined that Transmit/Receive Polarization is stringent for NGSO systems. Even the revised limit proposed also too stringent for some NGSO system and further discussion/review is needed for a realistic value.
7. Section 5.5.2 Receiver Cross Polarization limit is deleted. In this regard, it may be noted that no specific limit is applicable, as the operators are expected to deploy a variety of user terminals to meet target throughput level. Possible reduced performances in the reception are a product/marketing/operational decision.
8. In section 5.10, it is opined that the given EIRP stability is too stringent and hence it is proposed to revise as  $\pm 1.3$  dB of the target EIRP level, for 95% of the pass.

9. The directive under Section 7.4 is not understood and clear. Whether a Standard Format will be annexed to this document to enable Declaration by the NGSO operators.
10. In Section 8.7, it is to be verified whether 1 minute interval to update the records is acceptable specification?
11. With reference to Para 8.8, it is pertinent to note that it is difficult to define tracking of ESIM based on distance, since the speed varies. Therefore, a compatible radio navigation system such as GPS/NAVIC receiver etc. would suffice for determining geographic location resolution. May like to review.
12. With reference to Section 5.8 a) regarding use of ITU validation software to assess the epfd limits compliance, it is understood that the ITU validation software checks only the epfd levels at one location whereas a number instances (even in India) have been noticed wherein epfd limits of NGSO systems exceeding the limit and WP 4A of ITU-R is currently looking into the issue. Hence, TEC may consider and initiate appropriate action at the national level.
13. In Section 8.6, LIM/LIS is requirements is not properly addressed. Therefore, this requirement should be adequately defined in the document.
14. As regards Section 8.6 on NCMC capabilities, the following is suggested:

“NCMC should have capability to allow or cease transmission from ESIM based on geofencing. The Gateway in India may be used to provide services within India or outside India, subject to compliance with any applicable international and national law at the location of the ESIM.”

TEC may examine the feasibility.