



30TH WORLD RADIOCOMMUNICATION SEMINAR

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Geneva, Switzerland

Submission of NGSO satellite systems and networks subject to coordination

Vladislav Beregovskiy
Space Services Department
ITU Radiocommunication Bureau

www.itu.int/go/wrs-22

#ITUWRS



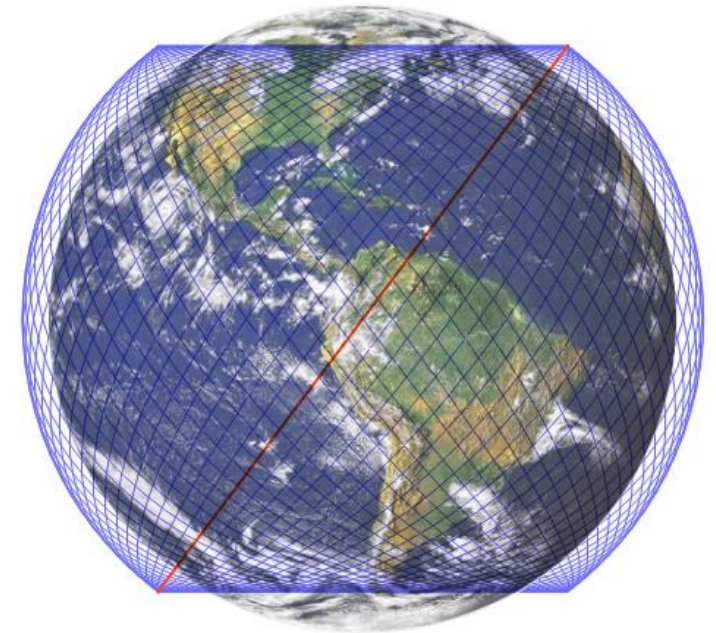
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Section 1 – NGSO networks

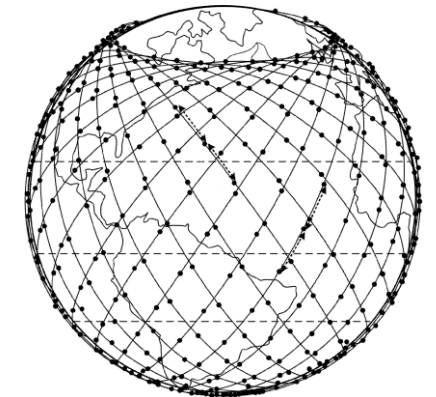
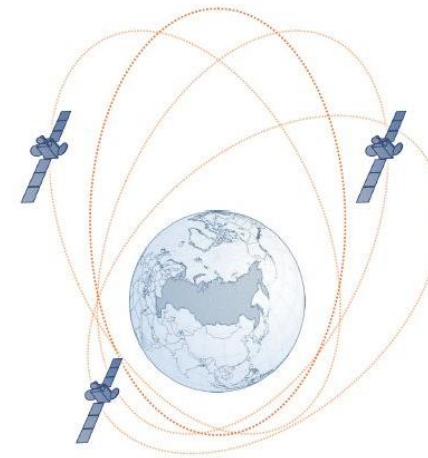
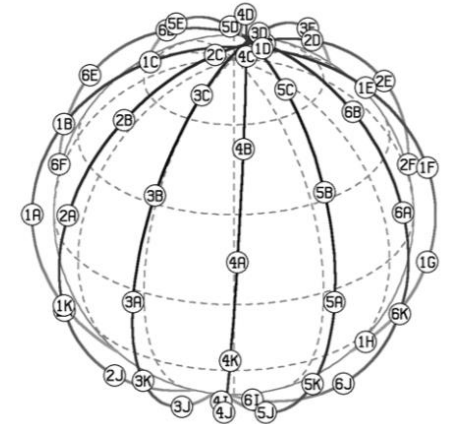
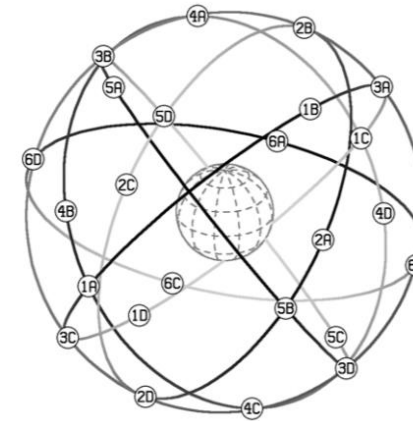
- The rapid increase of non-geostationary satellite projects, especially satellite mega-constellations in the low Earth orbits (LEO), represents an important innovation in satellite technology and leads to an increase in the number and complexity of NGSO satellite networks submitted to the Radiocommunication Bureau

Starlink Initial Phase
1,584 satellites into 72 orbital planes
of 22 satellites each



Examples of NGSO systems today

- ❑ Space science missions, navigation and mobile-satellite systems (Iridium, Globalstar, GPS, Glonass, etc.)
- ❑ Communication satellites in the elliptical orbits (Express-RB, etc.)
- ❑ Satellite constellations (or mega-constellations) providing broadband Internet access (O3B, Starlink, One-Web, Amazon, etc.)



Section 2 – Regulations of the CRC NGSO networks

- Coordination procedure:
 - ✓ *No. 9.21*
 - ✓ *No. 9.11A (Nos. 9.12, 9.12A and 9.14)*
- NGSO satellite systems shall not cause unacceptable interference to and shall not claim protection from GSO networks in the FSS and BSS (*No. 22.2*), and
- Article 22 EPFD limits to protect GSO from NGSO:
 - ✓ *Nos. 22.5C, 22.5D, 22.5F or 22.5L*



No. 9.21 and No. 9.11A of the Radio Regulations

9.21 *p)* for any station of a service for which the requirement to seek the agreement of other administrations is included in a footnote to the Table of Frequency Allocations referring to this provision. (WRC-2000)

for example

5.461 *Additional allocation:* the bands 7 250-7 375 MHz (space-to-Earth) and 7 900-8 025 MHz (Earth-to-space) are also allocated to the mobile-satellite service on a primary basis, subject to agreement obtained under **No. 9.21**.

9.11A *e)* for a station for which the requirement to coordinate is included in a footnote to the Table of Frequency Allocations referring to this provision, the provisions of Nos. 9.12 to 9.16 are applicable; (WRC-2000)

for example

5.523B The use of the band 19.3-19.6 GHz (Earth-to-space) by the fixed-satellite service is limited to feeder links for non-geostationary-satellite systems in the mobile-satellite service. Such use is subject to the application of the provisions of **No. 9.11A**, and No. 22.2 does not apply.

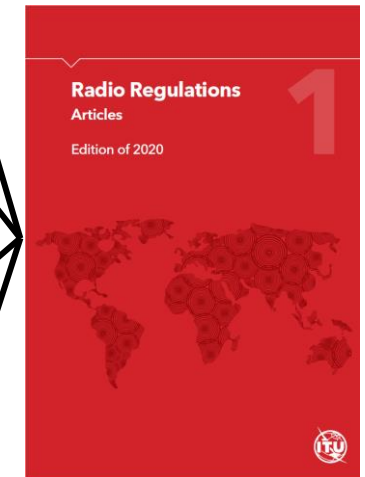


Table for No. 9.11A in the Rules of Procedure

TABLE 9.11A-1

Applicability of the provisions of Nos. 9.11A-9.15 to stations of space services

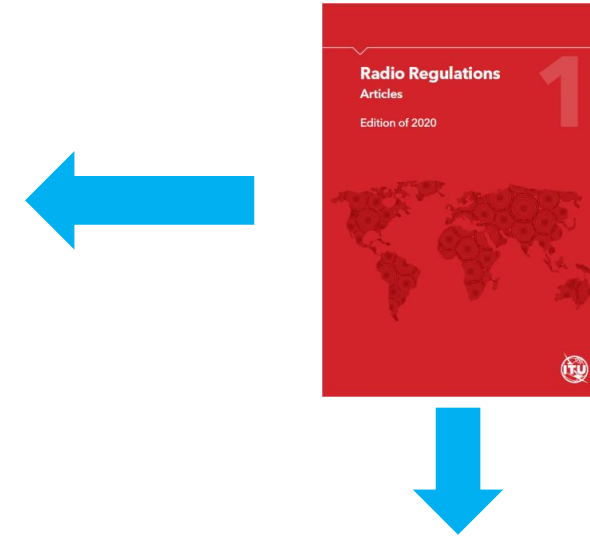
1	2	3	4	5	6	7
Frequency band (GHz)	Footnote No. in Article 5	Space services mentioned in a footnote referring to Nos. 9.11A, 9.12, 9.12A, 9.13 or 9.14, as appropriate	Other space services or systems to which Nos. 9.12 to 9.14 provision(s) apply equally, as appropriate	Applicable Nos. 9.12 to 9.14 provision(s), as appropriate	Terrestrial services in respect of which No. 9.14 apply equally	Notes
19.3-19.6	5.523B	FIXED-SATELLITE (limited to non-GSO MOBILE-SATELLITE SERVICE feeder links)		---	9.12, 9.12A, 9.13	---
	5.523D	FIXED-SATELLITE (GSO with coordination information received as of 18.11.1995 and non-GSO MOBILE-SATELLITE SERVICE feeder links) (see also No. 5.523C)				
19.6-19.7	5.523D	FIXED-SATELLITE (GSO with coordination information received as of 22.11.1997 and non-GSO MOBILE-SATELLITE SERVICE feeder links) (see also No. 5.523E)	FIXED-SATELLITE (GSO with coordination information received as of 22.11.1997 and non-GSO) (see also No. 5.523E)	↑	9.12, 9.12A, 9.13	---
19.7-20.1	5.484A	FIXED-SATELLITE (non-GSO)	MOBILE-SATELLITE (Non-GSO) (Region 2)	↓	9.12	---
20.1-20.2	5.484A	FIXED-SATELLITE (non-GSO)	MOBILE-SATELLITE (Non-GSO)	↓	9.12	---
27.5-28.6	5.484A	FIXED-SATELLITE (non-GSO)	FIXED-SATELLITE (Non-GSO) in the band 27.5-27.501 GHz (5.538)	↓	9.12	---
28.6-29.1	5.523A	FIXED-SATELLITE	---		9.12, 9.12A, 9.13	---
29.1-29.5	5.536A	FIXED-SATELLITE (GSO) (see also Nos. 5.523C and 5.523E) and non-GSO MOBILE-SATELLITE SERVICE feeder links)	---		9.12, 9.12A, 9.13	---
29.5-29.9	5.484A	FIXED-SATELLITE (non-GSO)	MOBILE-SATELLITE (Non-GSO) (Region 2)	↑	9.12	---
29.9-30	5.484A	FIXED-SATELLITE (non-GSO)	MOBILE-SATELLITE (Non-GSO) FIXED-SATELLITE (Non-GSO) in the band 29.999-30 GHz (5.538)	↑ ↓	9.12	



Satellite networks subject to EPFD limits (1 of 3)

For non-GSO in the fixed-satellite service only:

Frequency ranges subject to EPFD limits (MHz)	Direction	Limits Information
3700 - 4200	E	Article 22, Table 22-1E↓, BW: 4 kHz
5925-6725	R	Article 22, Table 22-2↑, BW: 4 kHz
10700 - 11700	E	Appendix 5, Table 5-1, No. 9.7B↓, BW: 40 kHz
		Article 22, No. 22.5C4↓, BW: 40 kHz
		Article 22, Table 22-1A↓, BW: 40 kHz
		Article 22, Table 22-3↔, BW: 40 kHz
11700 - 12200	E	Appendix 5, Table 5-1, No. 9.7B↓, BW: 40 kHz
		Article 22, No. 22.5C4↓, BW: 40 kHz
		Article 22, No. 22.5C8↓, BW: 40 kHz
		Article 22, Table 22-1A↓, BW: 40 kHz
		Article 22, Table 22-1D↓, BW: 40 kHz
12200 - 12750	E	Article 22, No. 22.5C8↓, BW: 40 kHz
		Article 22, Table 22-1D↓, BW: 40 kHz
		Article 22, RR 22.5C4↓, BW: 40 kHz
		Article 22, Table 22-1A↓, BW: 40 kHz
		Appendix 5, Table 5-1, No. 9.7B↓, BW: 40 kHz
		Article 22, Table 22-3↔, BW: 40 kHz
12500 - 13250	R	Article 22, Table 22-2↑, BW: 40 kHz
13750 - 14500	R	Article 22, Table 22-2↑, BW: 40 kHz



- Limit indicates ↑ – Earth Station EIRP mask is required (item A.14.b of Appendix 4)
- Limit indicates ↓ – Space Station PFD mask is required (item A.14.c of Appendix 4)
- Limit indicates ↔ – Space Station EIRP mask is required (item A.14.a of Appendix 4)

Satellite networks subject to EPFD limits (2 of 3)

For NGSO in fixed-satellite service only:

Frequency ranges subject to EPFD limits (MHz)	Direction	Limits Information
17300 - 18100	R	Article 22, Table 22-2↑, BW: 40 kHz
17800 - 18600	E	Article 22, Table 22-3↔, BW: 40 kHz
		Article 22, Table 22-1B↓, BW: 40 kHz
		Appendix 5, Table 5-1, No. 9.7B↓, BW: 1000 kHz
		Article 22, Table 22-1B↓, BW: 1000 kHz
19700 - 20200	E	Article 22, Table 22-1C↓, BW: 40 kHz
		Appendix 5, Table 5-1, No. 9.7B↓, BW: 1000 kHz
		Article 22, Table 22-1C↓, BW: 1000 kHz
27500 - 28600	R	Article 22, Table 22-2↑, BW: 40 kHz
29500 - 30000	R	Article 22, Table 22-2↑, BW: 40 kHz
37500 - 42500	E	Article 22, No. 22.5L↓, BW: 40 kHz
		Article 22, No. 22.5L↓, BW: 1000 kHz
47200 - 50200	R	Article 22, No. 22.5L↑, BW: 40 kHz
		Article 22, No. 22.5L↑, BW: 1000 kHz
50400 - 51400	R	Article 22, No. 22.5L↑, BW: 40 kHz
		Article 22, No. 22.5L↑, BW: 1000 kHz

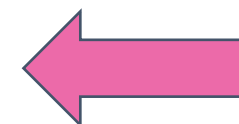


Limit indicates ↑	– Earth Station EIRP mask is required (item A.14.b of Appendix 4)
Limit indicates ↓	– Space Station PFD mask is required (item A.14.c of Appendix 4)
Limit indicates ↔	– Space Station EIRP mask is required (item A.14.a of Appendix 4)

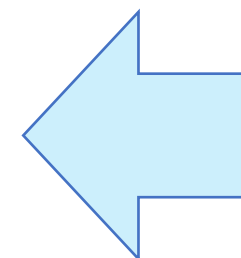
Satellite networks subject to EPFD limits (3 of 3)

For non-GSO in the fixed-satellite service only:

Frequency ranges subject to EPFD limits (MHz)	Direction	Limits Information
3700 - 4200	E	Article 22, Table 22-1E↓, BW: 4 kHz
5925 - 6725	R	Article 22, Table 22-2↑, BW: 4 kHz
10700 - 11700	E	Appendix 5, Table 5-1, No. 9.7B↓, BW: 40 kHz
		Article 22, No. 22.5C4↓, BW: 40 kHz
		Article 22, Table 22-1A↓, BW: 40 kHz
		Article 22, Table 22-3↔, BW: 40 kHz
11700 - 12200	E	Appendix 5, Table 5-1, No. 9.7B↓, BW: 40 kHz
		Article 22, No. 22.5C4↓, BW: 40 kHz
		Article 22, No. 22.5C8↓, BW: 40 kHz
		Article 22, Table 22-1A↓, BW: 40 kHz
		Article 22, Table 22-1D↓, BW: 40 kHz
12200 - 12750	E	Article 22, No. 22.5C8↓, BW: 40 kHz
		Article 22, Table 22-1D↓, BW: 40 kHz
		Article 22, RR 22.5C4↓, BW: 40 kHz
		Article 22, Table 22-1A↓, BW: 40 kHz
		Appendix 5, Table 5-1, No. 9.7B↓, BW: 40 kHz
Article 22, Table 22-3↔, BW: 40 kHz		
12500 - 13250	R	Article 22, Table 22-2↑, BW: 40 kHz
13750 - 14500	R	Article 22, Table 22-2↑, BW: 40 kHz



Not subject to coordination procedure under Section II of Article 9 RR



Subject to coordination procedure under No. 9.11A

Section 3 – Receivability

- ❑ Submit SNS and GIMS databases with correct structure (**Important** to use SpaceCap to capture filings and GIMS to create database with graphical data)
- ❑ Capture in SNS format database all mandatory data items in accordance with Appendix 4 RR
- ❑ Submit EPFD information (limited or extended set), including EIRP, PFD masks and links between these masks and beams (if applicable)
- ❑ Submit notes which cannot be captured in databases
- ❑ Submit all databases, notes and EPFD information (if applicable) with e-Submission system at the same time

§ 3.5 - 3.8 of the Rules of Procedure concerning Receivability

- If the information or clarification is provided within that period of 30 days, the date of receipt established by the Bureau will be considered as the formal date of the notice
- If the information or clarification is not provided within the above period of 30 days, the submission shall be considered incomplete and the Bureau will establish new formal date of receipt when the complete information is received

Appendix 4 of the Radio Regulations

Table of characteristics to be submitted for space and radio astronomy services
 (Rev.WRC-12)

TABLE A
 GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK OR SYSTEM,
 EARTH STATION OR RADIO ASTRONOMY STATION (Rev.WRC-19)

Items in Appendix	A - GENERAL CHARACTERISTICS OF THE SATELLITE NETWORK OR SYSTEM, EARTH STATION OR RADIO ASTRONOMY STATION	Advance publication of a geostationary-satellite network	Advance publication of a non-geostationary-satellite network or system subject to coordination under Section II of Article 9	Advance publication of a non-geostationary-satellite network or system not subject to coordination under Section II of Article 9	Notification or coordination of a non-geostationary-satellite network or system subject to coordination under Article 2A of Appendix 30 or 30A	Notification or coordination of a non-geostationary-satellite network or system	Notification or coordination of an earth station (including notification under Appendices 30A or 30B)	Notice for a satellite network in the broadcasting-satellite service under Appendix 30 (Articles 4 and 5)	Notice for a satellite network (feeder-link) under Appendix 30A (Articles 4 and 5)	Notice for a satellite network in the fixed-satellite service under Appendix 30B (Articles 6 and 8)	Items in Appendix	Radio astronomy
A.1	IDENTITY OF THE SATELLITE NETWORK OR SYSTEM, EARTH STATION OR RADIOASTRONOMY STATION										A.1	
A.1.a	the identity of the satellite network or system	X	X	X	X	X		X	X	X	A.1.a	
A.1.b	the beam identification In the case of Appendix 30 or 30A, required only for modification, suppression or notification of Plan assignments In the case of Appendix 30B, required only for a network derived from the Allotment Plan								+	+	A.1.b	
A.1.e	Identity of the earth station or radio astronomy station:										A.1.e	
A.1.e.1	the type of earth station (specific or typical)						X				A.1.e.1	
A.1.e.2	the name of the station						X				A.1.e.2	X
A.1.e.3	For a specific earth station or radio astronomy station:										A.1.e.3	
A.1.e.3.a	the country or geographical area in which the station is located, using the symbols from the Preface						X				A.1.e.3.a	X
A.1.e.3.b	the geographical coordinates of each transmitting or receiving antenna site constituting the station (latitude and longitude in degrees and minutes) For a specific earth station, seconds are to be provided if the coordination area of the earth station overlaps the territory of another administration						X				A.1.e.3.b	X
A.1.f	Administration and intergovernmental organization symbol:										A.1.f	
A.1.f.1	the symbol of the notifying administration (see the Preface)	X	X	X	X	X	X	X	X	X	A.1.f.1	X
A.1.f.2	if the notice is submitted by the notifying administration in association with other administrations, the symbols of each of the administrations (see the Preface)	+	+	+	+	+		+	+	+	A.1.f.2	
A.1.f.3	if the notice is submitted on behalf of an intergovernmental satellite organization, the symbol of that organization (see the Preface)	+	+	+	+	+		+	+	+	A.1.f.3	
A.1.g	indicator showing that the non-GSO satellite system is planned to be operated in accordance with Resolution 32 (WRC-19) Required for advance publication and notification			X		+					A.1.g	
A.1.g.1	Not used										A.1.g.1	
A.1.g.2	Not used										A.1.g.2	

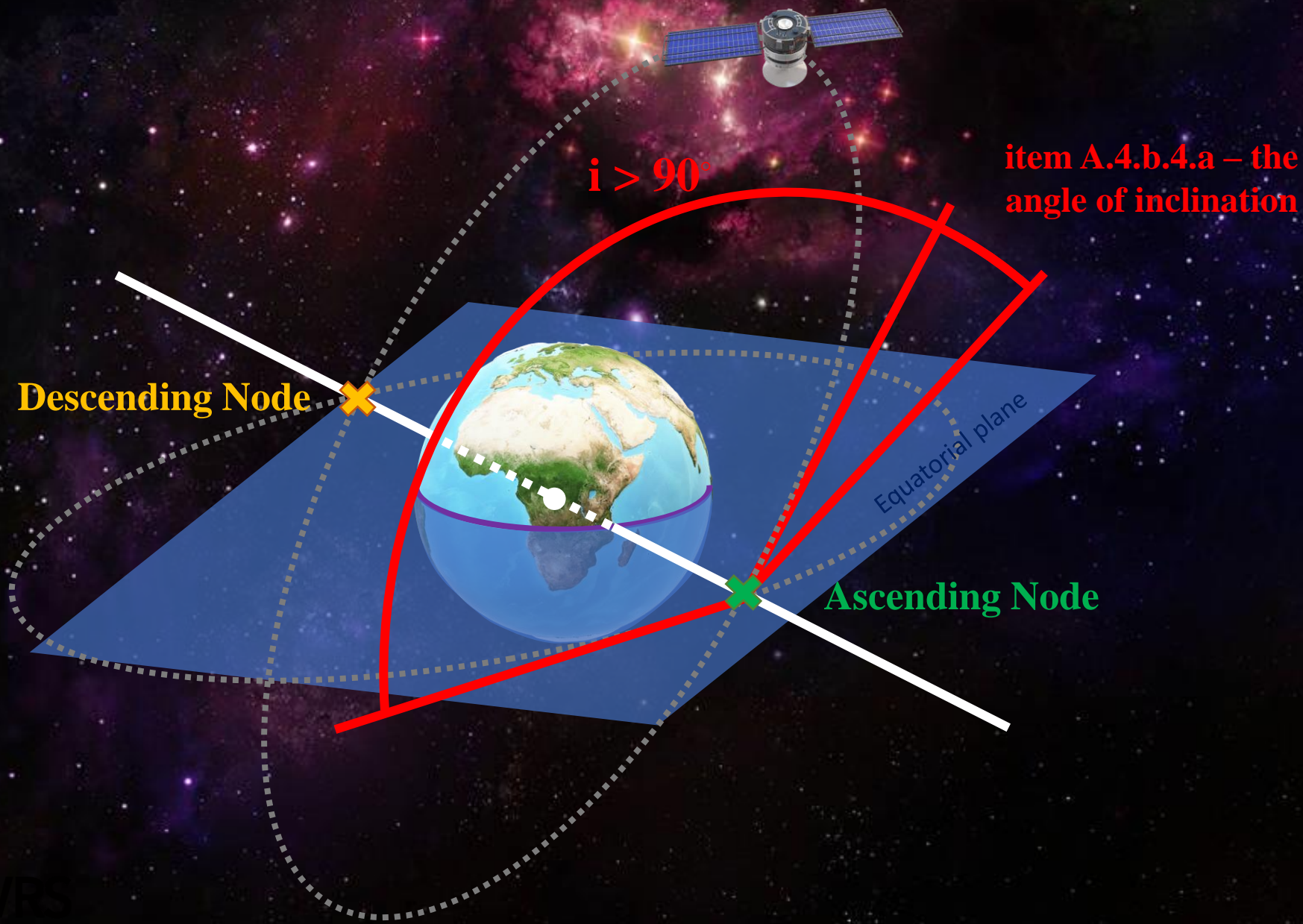
Notification or coordination of a non-geostationary-satellite network or system

- X - Mandatory information
- + - Mandatory under the conditions
- O - Optional information
- C - Mandatory if used as a basis to effect coordination with another administration
- - The data item is not applicable to the corresponding notice

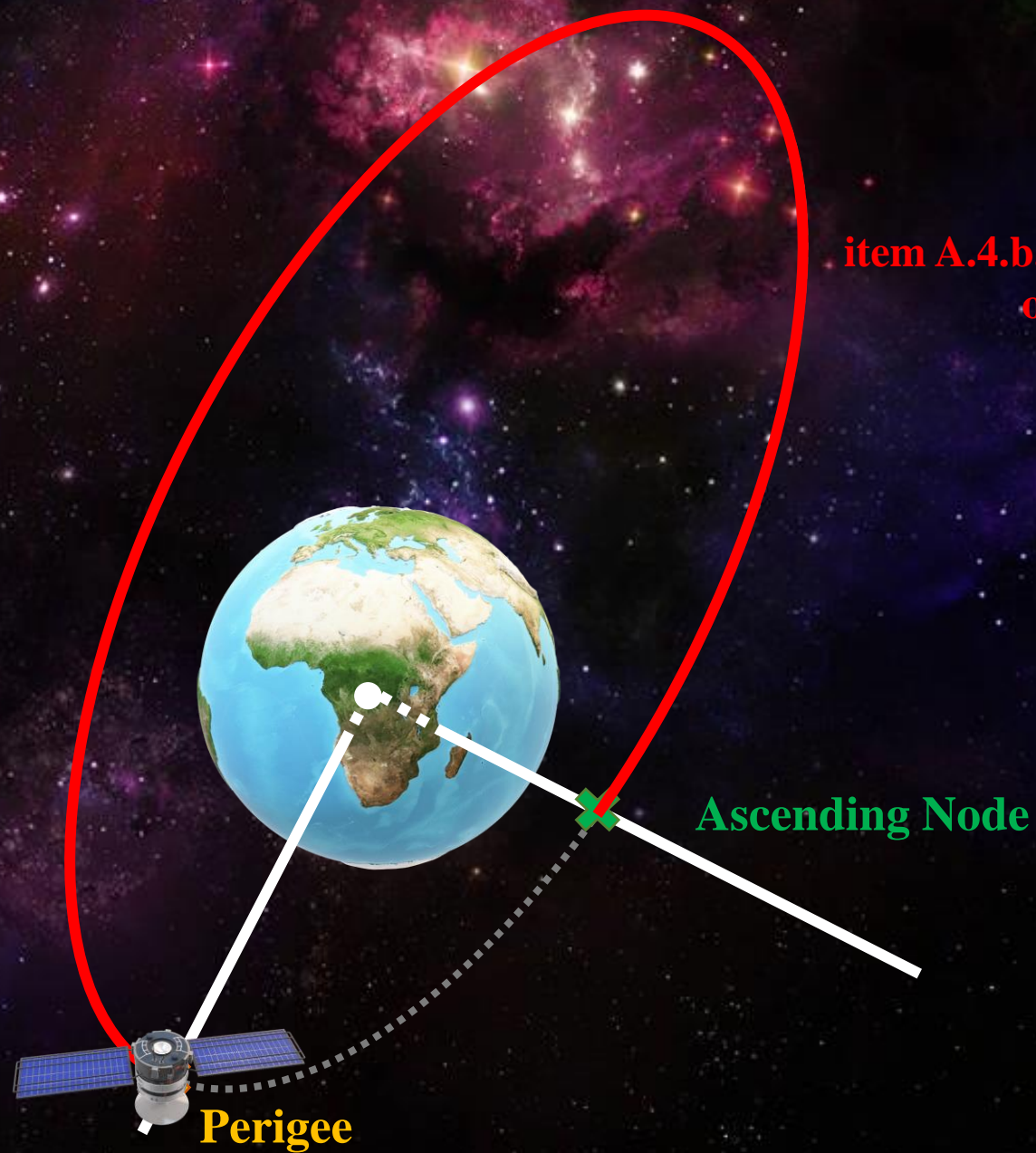
Mandatory AP4 items for Keplerian elements

- ❑ Apogee and perigee, minimum operating height (items **A.4.b.4.d**, **A.4.b.4.e**, **A.4.b.4.f** of Appendix 4)
- ❑ Inclination of orbit (item **A.4.b.4.a** of Appendix 4)
- ❑ Argument of perigee (item **A.4.b.4.i** of Appendix 4)
- ❑ Phase angle of the satellite within its orbital plane (item **A.4.b.4.h** of Appendix 4)
- ❑ Right ascension of ascending node (RAAN) (item **A.4.b.4.g** of Appendix 4)
- ❑ Longitude of ascending node (LAN) (item **A.4.b.4.j** of Appendix 4)

Inclination angle

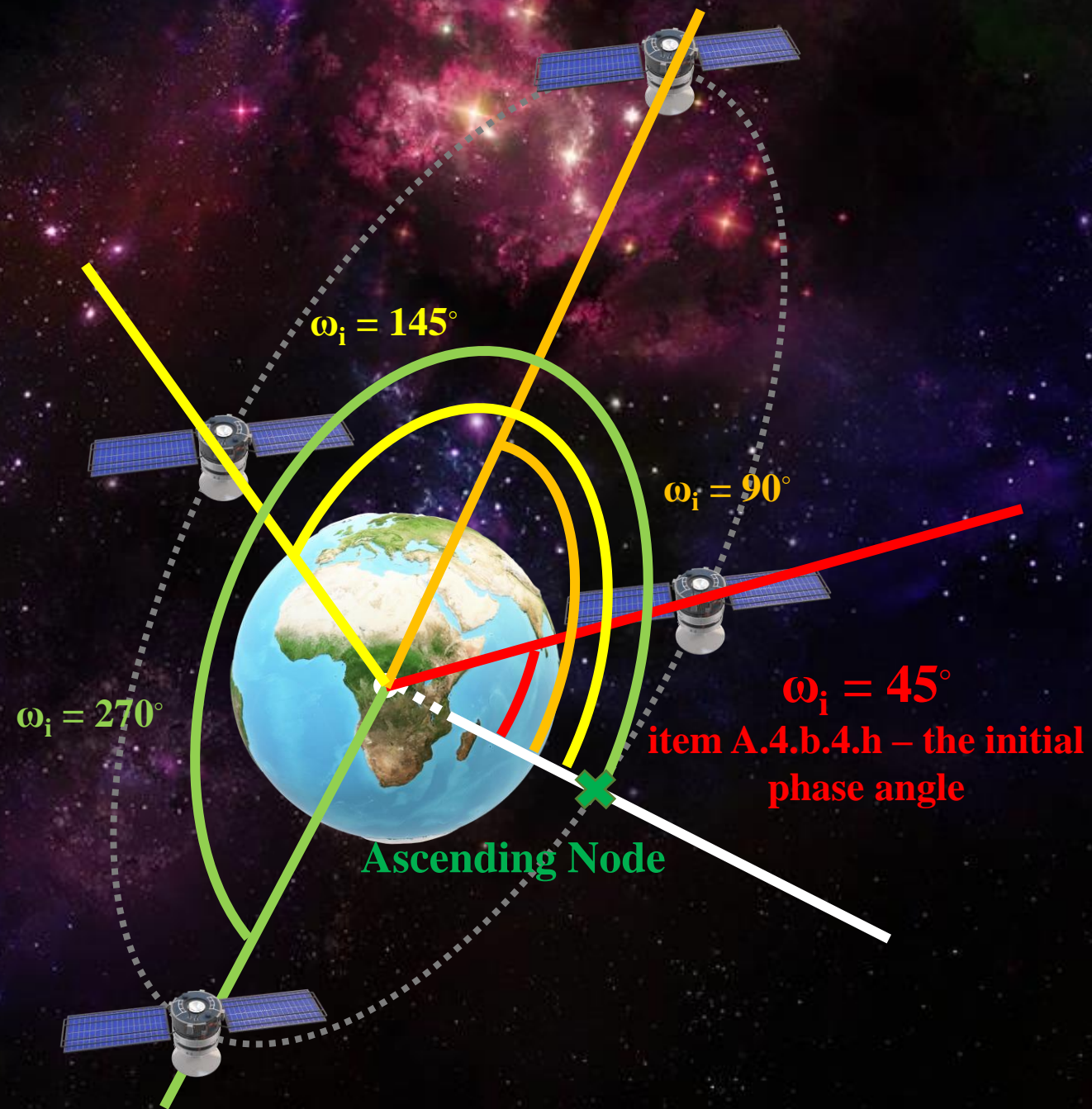


Argument of perigee



ω_p
item A.4.b.4.i – the argument
of perigee

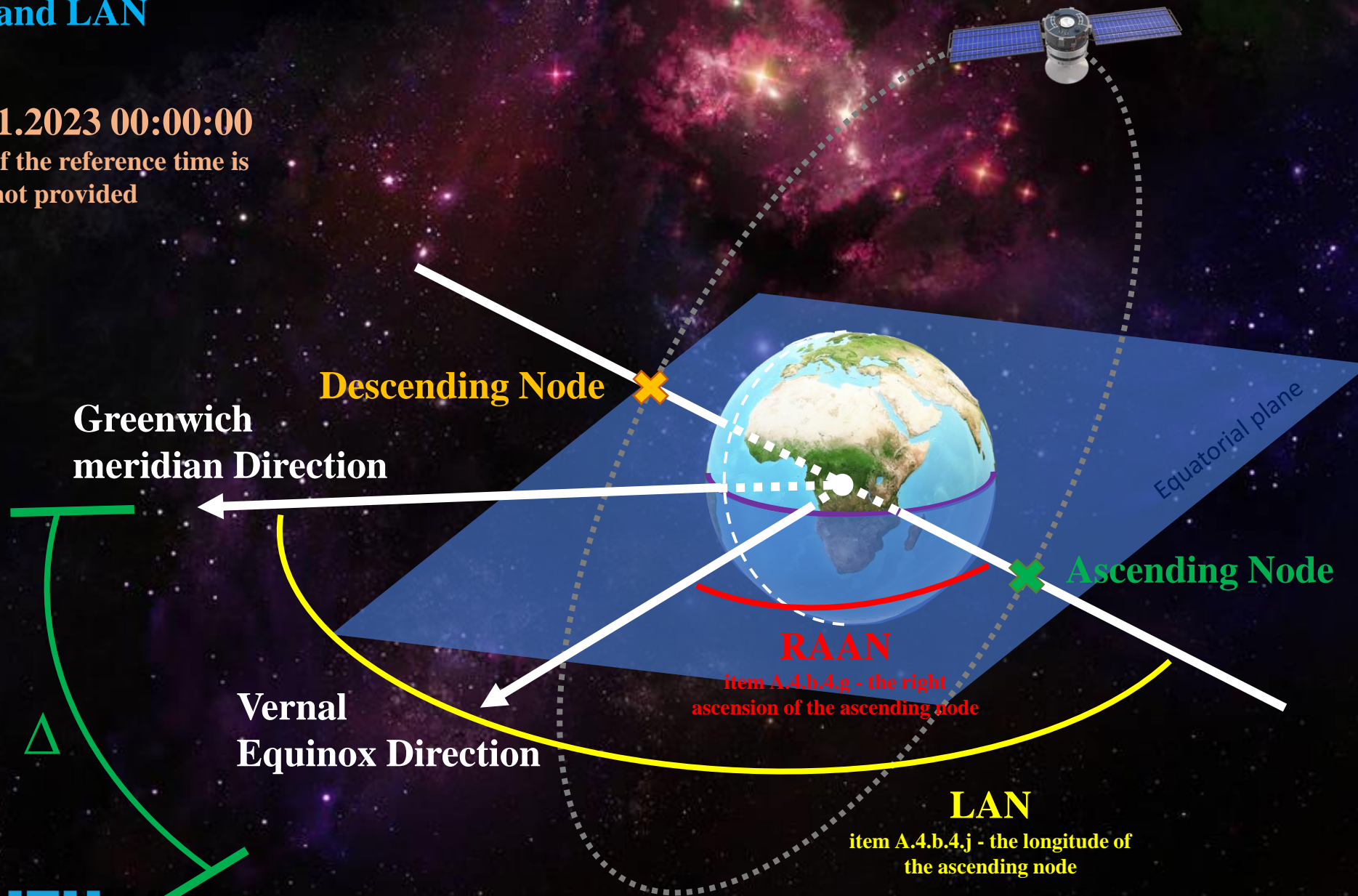
Initial phase angle



RAAN and LAN

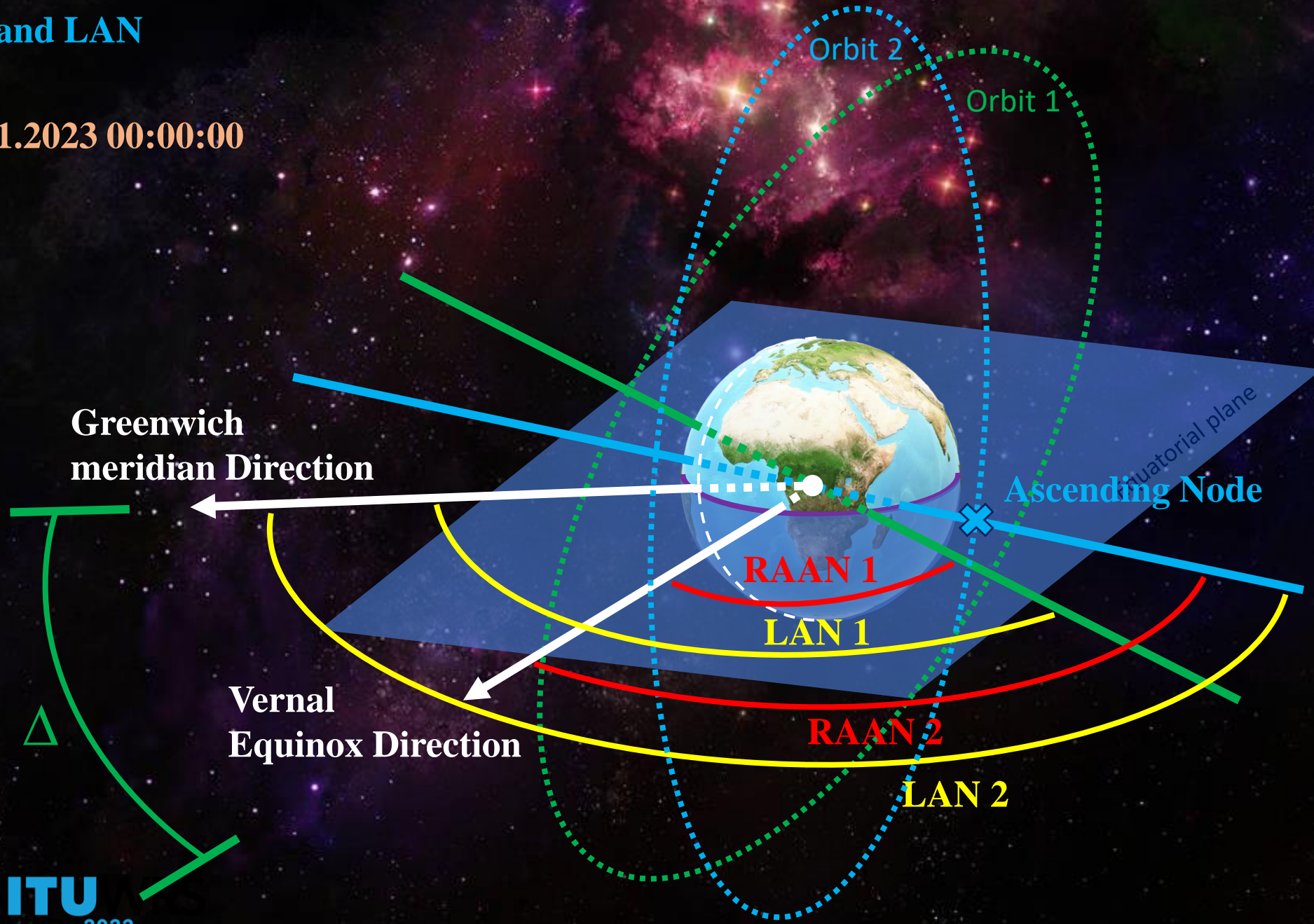
$t = 01.01.2023\ 00:00:00$

Note: $t=0$ if the reference time is not provided



RAAN and LAN

t = 01.01.2023 00:00:00



ITU
2022



RAAN and LAN

t = 01.01.2023 00:00:00

$$\Delta = \underbrace{\text{LAN}_i - \text{RAAN}_i}_{> 0}$$

> 0

$$\Delta = \underbrace{\text{LAN}_i - \text{RAAN}_i}_{< 0} + 360^\circ$$

< 0

Mandatory AP4 items for networks subject to coordination under *No. 9.11A*

- ❑ For the satellite transmitting and receiving antenna beams:
 - ✓ the orientation angle alpha, in degrees (item **B.4.a.3.a.1** of Appendix 4)
 - ✓ the orientation angle beta, in degrees (item **B.4.a.3.a.2** of Appendix 4)
- ❑ For transmitting beams, the satellite antenna gain as a function of elevation angle at a fixed point on the Earth (item **B.4.b.2** of Appendix 4)
- ❑ For each beam, the maximum and average beam peak EIRP (item **B.4.b.4** of Appendix 4)
- ❑ For each carrier, the type of modulation (item **C.9.a.1** of Appendix 4)
- ❑ For each group, the type of multiple access (item **C.9.c.1** of Appendix 4)
- ❑ For each group, the spectrum mask (item **C.9.c.2** of Appendix 4)
- ❑ The appropriate information required to calculate the affected region only for groups with frequency bands between 1 and 3 GHz for MSS (item **C.11.b** of Appendix 4)

Mandatory AP4 items for networks subject to Nos. 22.5C, 22.5D, 22.5F and 22.5L (limited set)

□ Capture in the SRS database:

- ✓ the maximum number of non-geostationary satellites receiving simultaneously with overlapping frequencies from the associated earth stations within a given cell (item **A.4.b.7.a** of Appendix 4)
- ✓ the average number of associated earth stations with overlapping frequencies per square kilometre within a cell (item **A.4.b.7.b** of Appendix 4)
- ✓ the average distance, in kilometres, between co-frequency cells (item **A.4.b.7.c** of Appendix 4)
- ✓ the minimum elevation angle at which any associated earth station can transmit to or receive from a non-geostationary satellite (item **A.4.b.7.cbis** of Appendix 4)
- ✓ the type of zone (based on topocentric angle or satellite-based angle for establishing the exclusion zone) and the width of the zone, in degrees (items **A.4.b.7.d.1** and **A.4.b.7.d.2** of Appendix 4)
- ✓ Maximum number of non-geostationary satellites transmitting with overlapping frequencies to a given location within the latitude range from -90 to 90 degrees (item **A.4.b.6.a.1** of Appendix 4)
- ✓ an indicator showing whether the space station uses station-keeping to maintain a repeating ground track (items **A.4.b.6.c** and **A.4.b.6.d** of Appendix 4)
- ✓ an indicator showing whether the space station should be modelled with a specific precession rate of the ascending node of the orbit instead of the J2 term (items **A.4.b.6.e** and **A.4.b.6.f** of Appendix 4)
- ✓ the longitudinal tolerance of the longitude of the ascending node (items **A.4.b.6.j** of Appendix 4)

□ EIRP, PFD masks and masks links (A.14)

EIRP, PFD masks to be provided in XML format

PFD mask for space station:

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <satellite_system ntc_id="1" sat_name="TEST">
3   <pfd_mask mask_id="1" low_freq_mhz="17700" high_freq_mhz="18600" refbw_khz="1000"
4     type="azimuth_elevation" a_name="latitude" b_name="azimuth" c_name="elevation">
5     <by a a="-0.20">
6       <by b b="-18.30">
7         <pfd o="-18.3">-200</pfd>
8         <pfd o="18.3">-200</pfd>
9       </by b>
10      <by b b="0">
11        <pfd o="-18.3">-200</pfd>
12        <pfd o="18.3">-200</pfd>
13      </by b>
14    </pfd_mask>
15    <?xml version="1.0" encoding="UTF-8"?>
16    <satellite_system ntc_id="1" sat_name="TEST">
17      <pfd_mask c_name="deltaLongitude" b_name="alpha" a_name="latitude"
18        type="alpha_deltaLongitude" low_freq_mhz="18000" high_freq_mhz="18600"
19        mask_id="2" refbw_khz="40">
20        <by a a="-55">
21          <by b b="-90">
22            <pfd o="-69">-1000.0000</pfd>
23            <pfd o="-68">-136.1789</pfd>
24            <pfd o="-60">-135.6897</pfd>
25            <pfd o="-50">-135.0559</pfd>
26          </by b>
27          <by b b="0">
28            <pfd o="-40">-134.4230</pfd>
29            <pfd o="30">-133.8318</pfd>
30            <pfd o="20">-133.3382</pfd>
31            <pfd o="10">-133.0056</pfd>
32            <pfd o="0">-132.8876</pfd>
33            <pfd o="10">-133.0056</pfd>
34            <pfd o="20">-133.3382</pfd>
35            <pfd o="30">-133.8318</pfd>
36            <pfd o="40">-134.4230</pfd>
37            <pfd o="50">-135.0559</pfd>
38            <pfd o="60">-135.6897</pfd>
39            <pfd o="68">-136.1789</pfd>
40            <pfd o="69">-1000.0000</pfd>
41          </by b>
42        </by a>
43      </pfd_mask>
44    </satellite_system>
```

EIRP mask for earth station:

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <satellite_system ntc_id="1" sat_name="TEST">
3   <eirp_mask es mask_id="1" low_freq_mhz="17300" high_freq_mhz="18100"
4     min_elev="5" a_name="latitude" d_name="separation angle"
5     refbw_khz="40" ES_ID="-1">
6     <by a a="90">
7       <eirp d="0">46</eirp>
8       <eirp d="0.2">3.5</eirp>
9       <eirp d="1">3.5</eirp>
10      <eirp d="40">-22</eirp>
11      <eirp d="180">-22</eirp>
12    </by a>
13    <by a a="-90">
14      <eirp d="0">46</eirp>
15      <eirp d="0.2">3.5</eirp>
16      <eirp d="1">3.5</eirp>
17      <eirp d="40">-22</eirp>
18      <eirp d="180">-22</eirp>
19    </by a>
20  </eirp_mask es>
21 </satellite_system>
```

EIRP mask for space station:

```
1 <?xml version="1.0" encoding="utf-8"?>
2 <satellite_system ntc_id="1" sat_name="TEST">
3   <eirp_mask_ss mask_id="3" low_freq_mhz="18000" high_freq_mhz="20200"
4     a_name="latitude" d_name="separation angle">
5     <by a a="-55">
6       <eirp d="0">19</eirp>
7       <eirp d="20">19</eirp>
8       <eirp d="21">8.55</eirp>
9       <eirp d="31">-13.79</eirp>
10      <eirp d="41">-20.81</eirp>
11      <eirp d="51">-25</eirp>
12      <eirp d="180">-25</eirp>
13    </by a>
14    <by a a="55">
15      <eirp d="0">19</eirp>
```

- ❑ Make sure that only one PFD or EIRP mask provided for the same orbital planes (or satellites) per frequency range
- ❑ Note that multiple PFD or EIRP masks for the same frequency range are currently receivable only if they apply to different orbital configurations, or different orbital planes (or satellites)



Resolution 770 (WRC-19)

“Application of Article 22 of the Radio Regulations to the protection of geostationary fixed-satellite service and broadcasting-satellite service networks from non-geostationary fixed-satellite service systems in the frequency bands 37.5-39.5 GHz, 39.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz”

- ❑ The Bureau is currently unable to examine NGSO FSS systems subject to the single-entry provision given in *No. 22.5L RR* due to a lack of available software
- ❑ In accordance with resolves 3 of Resolution **770** (WRC-19) it is required to provide:
 - ✓ all necessary information sufficient to demonstrate compliance with *No. 22.5L*
 - ✓ a commitment that the NGSO FSS system complies with the limits given in *No. 22.5L*
- ❑ In accordance with the decision of 84th meeting of the Radio Regulations Board, such FSS frequency assignments may be given qualified favourable findings on condition that administration provide all the required Appendix 4 data items and a commitment that the NGSO satellite network complies with limits of *No. 22.5L*

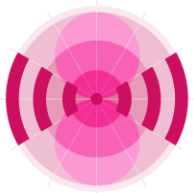
“Constellation”

- ❑ WRC-19 added mandatory data item **A.4.b.1.a** of Appendix 4 – an indicator of whether the NGSO satellite system represents a “constellation”
- ❑ The term “constellation” describes a satellite system, for which the relative distribution of the orbital planes and satellites is defined
- ❑ NGSO systems in frequency bands subject to the provisions of Nos. **9.11A**, **22.5C**, **22.5D**, **22.5F** or **22.5L** are always considered as “constellations”

Multiple configurations

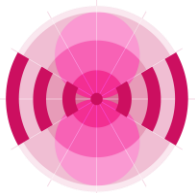
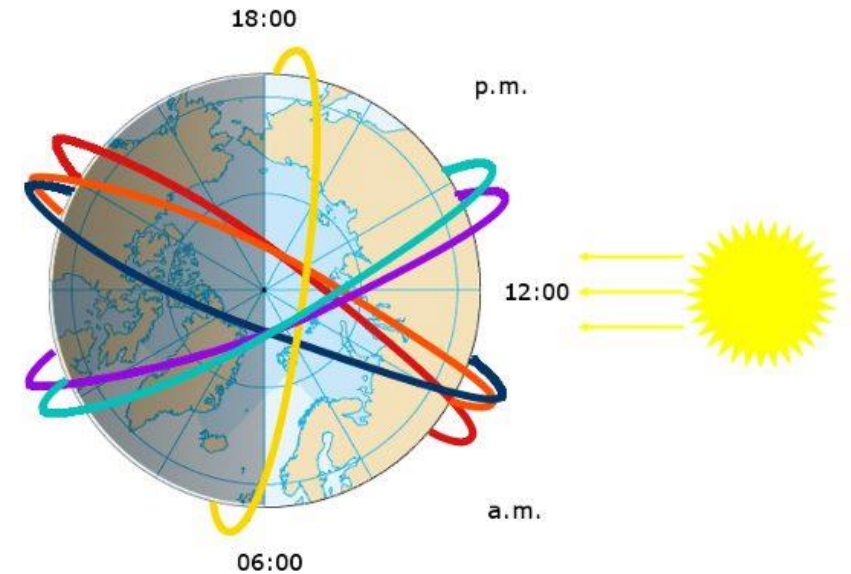
- ❑ WRC-19 added mandatory, for NGSO satellite system represents a “constellation”, data item **A.4.b.1.b** of Appendix 4 – indicator of whether all the orbital planes describe:
 - ✓ a single configuration where all frequency assignments to the satellite system will be in use or
 - ✓ multiple configurations that are mutually exclusive where a sub-set of the frequency assignments to the satellite system will be in use on one of the sub-sets of orbital parameters to be determined at the notification and recording stage of the satellite system

Note: In this case identification of the number of sub-sets (item **A.4.b.1.c** of Appendix 4) and the orbital planes’ id numbers that are associated with each of the mutually exclusive configurations (item **A.4.b.1.d** of Appendix 4) are required
- ❑ In accordance with Council Decision 482 (Modified 2020), for a coordination request of a NGSO satellite network containing different mutually exclusive sub-sets, cost recovery charges will be separately computed for each of the sub-sets



Sun-synchronous orbit

- ❑ WRC-19 added mandatory data item **A.4.b.4.m** of Appendix 4 – an indicator of whether the space station uses sun-synchronous orbit or not
- ❑ This data item is mandatory only in frequency bands not subject to the provisions of *Nos. 9.12 or 9.12A*, i.e. subject to *No. 9.21* only
- ❑ A sun-synchronous orbit is a nearly polar orbit around the Earth, in which the satellite passes over any given point of the Earth surface at the same local time.
- ❑ More technically, an orbit will be sun-synchronous if the precession rate equals the angular rate of the motion of the Earth about the Sun, which is 360° per year, i.e. approximately 1 deg/day



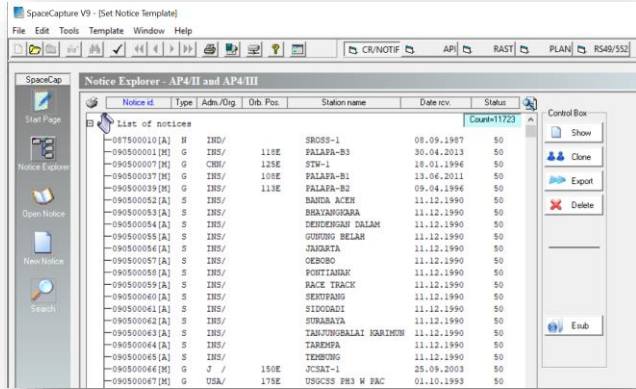
Graphical information in GIMS for CRC NGSO networks

- ❑ Capture all graphical data with GIMS, such as:
 - ✓ Space station radiation pattern (item **B.3.c.1** of Appendix 4)
 - ✓ Earth station radiation pattern (item **C.10.d.5.a** of Appendix 4)
 - ✓ Antenna gain vs Elevation angle (item **B.4.b.2** of Appendix 4)
 - ✓ Service area (item **C.11.a** of Appendix 4)
 - ✓ Affected region (item **C.11.b** of Appendix 4)
 - ✓ Spectrum mask diagram (item **C.9.c.2** of Appendix 4)
- ❑ Cross-validation option with BRSIS Validation is now available for validating the SNS format database against the GIMS format database for NGSO satellite systems

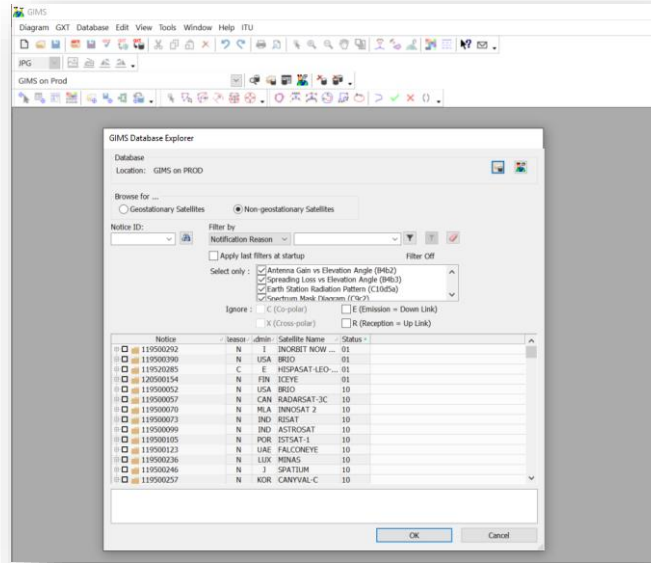
**Mandatory in
GIMS format
from SNSv9.1**

Section 4 – BR software

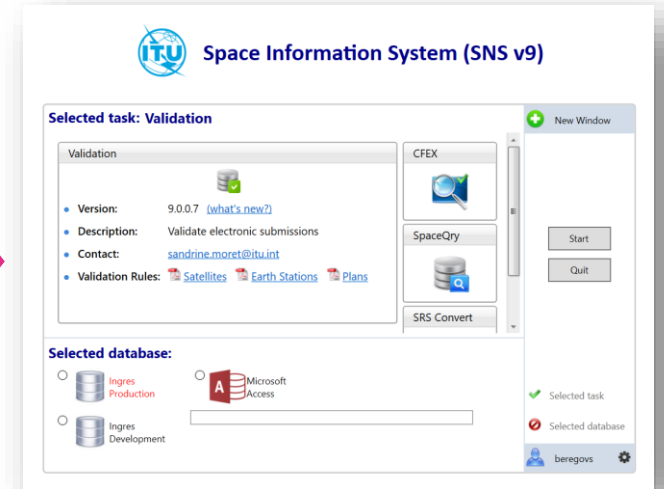
SpaceCap v. 9.1



GIMS v. 9.1



BRSIS Validation v.9.1



(No FATAL errors!)



```

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  <spid_mask mask_id="1" low_freq_mhz="1700" high_freq_mhz="18000" refsw_khz="1000"
  type="azimuth_elevation" a_name="latitude" b_name="azimuth" c_name="elevation"
  by_a="0" by_b="0" by_c="0" />
  <antenna ntc_id="1" encoding="UTF-8">
    <antenna_position ntc_id="1" encoding="UTF-8">
      <satellite_system ntc_id="1" sat_name="TEST">
        <spid_mask mask_id="1" low_freq_mhz="1700" high_freq_mhz="18100"
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        refsw_khz="40" by_a="1" by_b="1" by_c="1" />
        <by_a a="90" />
        <by_b b="46" />
        <by_c c="18" />
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      <by_b b="20" />
      <by_c c="19" />
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  </antenna_position>
</satellite_system>
  </by_a a="55" />
  <by_b b="20" />
  <by_c c="19" />
</xml>

```



ATTACHMENTS

= SUCCESS!

SpaceCap for CRC NGSO networks (1 of 5)

NonGeoStationary Notice:1

Notice Station Beam

Notice Id: 1 Administration: AFG Status: 01 Date: 09/14/2022

A1a. Identity of the Satellite Network: TEST

A4b1. Number of Orbital Planes: 4 A4b2. Reference body: [T] Earth A4b1a. Constellation: Y

A4b3a. Nbr of Satellites to NH: A4b3b. Nbr of Satellites to SH: A4b1b. Multi Configuration Type: (M) Multiple A4b1c. No of sub-sets: 2

Orbital information

Orb. info. for sat. networks subject to No. 9.11A Orb. info. for sat. networks subject to No. 22.5 C. D. F. L

Orbital Plane id	1d. Orbital set id	4a. Incln Angle	4b. Satellites in the plane	4c. Period ddd	4c. Period hh	4c. Period mm	4d. Apogee	4d. apog exp	4e. Perigee	4e. perig exp	4f. Minimum Altitude	4f. Min Alt exp	4m. space station uses sun-synchronous orbit	4n. local time reference	4o. HH
1	1	15.00	2	0	1	35	500.00	0	500.00	0	500.00	0	no		
2	1	89.00	2	0	1	35	500.00	0	500.00	0	500.00	0	yes		
3	2	45.00	2	0	1	35	500.00	0	500.00	0	500.00	0	no		
4	2	67.00	2	0	1	35	500.00	0	500.00	0	500.00	0	no		

List of Available Beams: Beam EBEAM

A15a. Commitment to meet epfd limits (applicable bands 10.7-12.75 GHz depending on region) Yes No

A17a. Commitment to meet power-flux density limits (applicable bands 1164-1215 MHz) Yes No

A18a. Commitment of aircraft earth station (applicable bands 14-14.5 GHz) Yes No

BR104. Commitment under resolves 3 of Res 770 [applicable bands 37.5-42.5 GHz, 47.2-50.2 GHz and 50.4-51.4 GHz] Yes No

A.17b,d,e Compliance with PFD or EPFD limits Enter PFD or EPFD values

Mandatory information!
If it's indicated that there are "Multiple configurations" please provide the number of sub-sets

Mandatory information!
Indicate configuration ID for each orbital plane if it's indicated that there are "Multiple configurations".
Information concerning "sun-synchronous" orbits is mandatory only for satellite networks subject to coordination under **No. 9.21**

Do not forget to provide commitments and PFD values for concerned frequency bands if any

SpaceCap for CRC NGSO networks (2 of 5)

Notice: Station

Notice Id: 1 Administration: AFG Status: 01 Date: 09/14/2022

A1a. Identity of the Satellite Network: TEST

A4b1. Number of Orbital Planes: 4 A4b2. Reference body: (T) Earth A4b1a. Constellation: Y

A4b3a. Nbr of Satellites to NH: A4b3b. Nbr of Satellites to SH: A4b1b. Multi Configuration Type: (M) Multiple

A4b1c. No of sub-sets: 2

Orbital information: Orb. info. for sat. networks subject to No. 9.11A

Orbital Plane id	4b. Satellites in the plane	4i. Argument of the Perigee (degrees)	4j. Longitude ascending node	4g. Right Ascension (degrees)
1	2	0	0	30
2	2	0	90	120
3	2	0	180	210
4	2	0	270	300

Satellite Number	4h. Initial phase angle (Degrees)	4k. Reference Date (MM/DD/YYYY)	4l. Reference Time (HH:mm:ss)
1	0	01/01/2023	00:00:00
2	180	01/01/2023	00:00:00

Select Date and Time for all satellites on all Orbital Planes: 01/01/2023 00:00:00 Set

All satellites in all orbital planes must use the same values of A4b4k and A4b4l

Mandatory information for networks subject to coordination under *No. 9.11A*

Convenient tool for capturing of the initial phase angle (item **A.4.b.4.h** of Appendix 4)

SpaceCap for CRC NGSO networks (4 of 5)

Notice Id: 1 Administration: AFG Satellite Network: TEST

Characteristics of the Beam

B2. Receiving Beam Transmitting Beam

B1a. Beam Designation: EBEAM Old Beam Designation (if changed)


B1b. Steerable Beam Add of the Beam Mod Sup

Beam has Sensors

Antenna Characteristics

B3a1. Maximum Isotropic Gain +/- dBi: 3

Antenna Radiation Pattern

B3c1. Co-polar Radiation Pattern Id: 609  ND-SPACE ==> APSND_499V01

B4a. Orbit Link

B4a3a. Satellite Beam Orientation

A1. Angle Alpha: 0 A2. Angle Beta: 0

Angles Alpha and Beta not provided. See Attachment No.

B4b2 Gain vs Elevation Angle

If not provided in GIMS, please provide as attachment no. 1

B3b1b Apply RoP No. 21.16 power flux-density (pfd) limits to steerable beams

Limits will be met by applying the method in Annex 1 to RoP No. 21.16

Limits will be met by applying other method in attachment No.

B.2.a.1 Space station only transmits when visible from the notified service area

B.2.a.2 the minimum elevation angle: 20

B4b4.	
a. Maximum E.I.R.P. at 4kHz	b. Average E.I.R.P. at 4kHz
+/- dBW: 0	+/- dBW: 0
c. Maximum E.I.R.P. at 1MHz	
+/- dBW: 20	+/- dBW: 20

If antenna radiation pattern is provided in GIMS, then keep this field empty

Mandatory information for transmitting beams of satellite networks subject to coordination under **No. 9.11A**

Attachment number should be provided if no diagram is provided in GIMS

Mandatory information if it's indicated that beam is steerable

SpaceCap for CRC NGSO networks (5 of 5)

NonGeoStationary Notice:1

Coordination Notice | Special Section Station | Assoc Earth Station Beam | **Assoc Space Station Group** | Emissions | Frequencies

Notice: 1 Satellite Network: TEST Beam Id: EBEAM E Group Id: 1 Split Grp Id:

3. Observed Frequencies and Related Characteristics

Add Mod Sup of the group BR Identification of the Group to be modified/suppressed Page No. BR Data

Characteristics Common to a Group of Frequencies **General Characteristics**

C3a. Assigned Frequency Bandwidth: 500000 (kHz)

C2c. Frequency assignments are filed under No.4.4

C4a. Cls Str: EC C4b. Nat Srv: CD Station of

C6. Polarization Type: M Mixed Polarization

If linear, provide angle: °

B4b5. Peak Ptd: C8d1. Maximum Total Peak Power: 20 dBW

C8d2. Contiguous Bandwidth: 500000 (kHz)

C11a. Service Area (to be provided in Gims): Service Area No. (diag provided in Gims): 1

C11b. Affected Region: Attachment No.: 1 or Diag No. in Gims

C9c1. Type of Multiple Access: Attachment No.: 1

C9c2. Spectrum Mask: Attachment No.: 1 or Diag No. in Gims

A4b7cbis. Min. elev. angle:

Remarks:

All service area diagrams shall be captured in GIMS

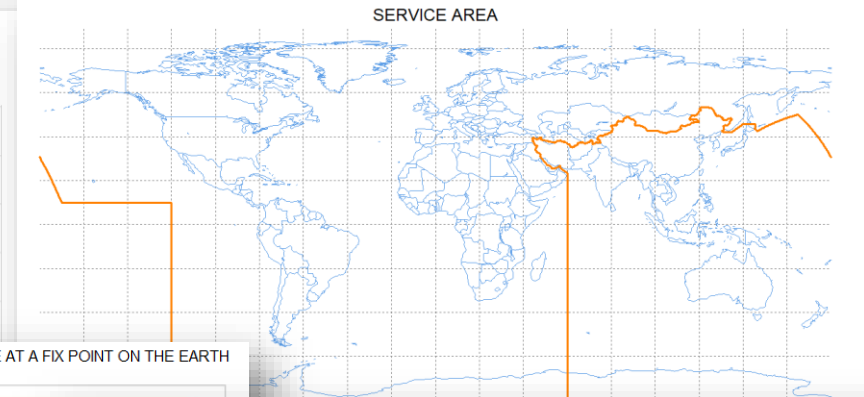
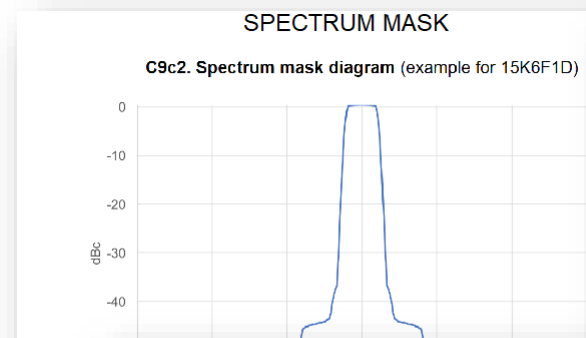
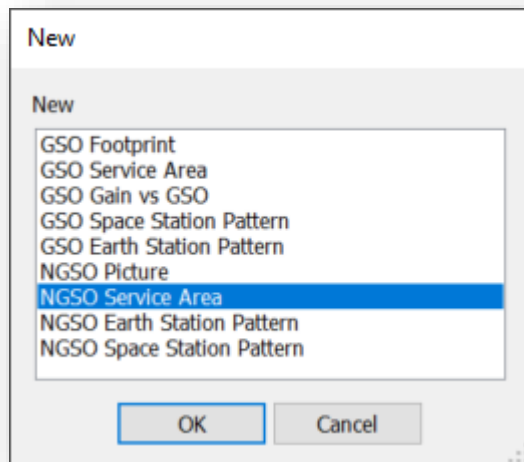
Service area number shall be provided for each group (it can be different for different groups within one beam)

Mandatory information for satellite networks subject to coordination under **No. 9.11A**

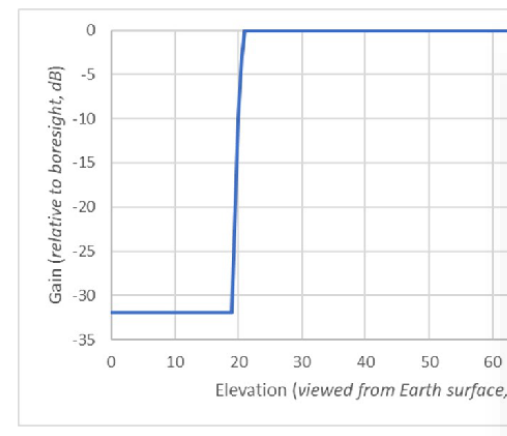
Affected region is mandatory only for satellite networks in the MSS in frequency bands between 1 and 3 GHz

Mandatory information for frequency assignments subject to limits given in **Nos. 22.5C, 22.5D, 22.5F or 22.5L**

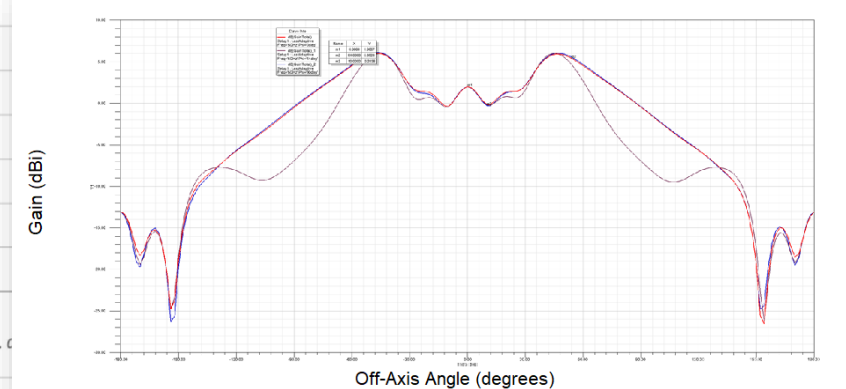
Graphical information in GIMS for CRC NGSO networks



SATELLITE ANTENNA GAIN AS A FUNCTION OF ELEVATION ANGLE AT A FIX POINT ON THE EARTH

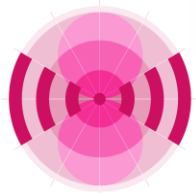
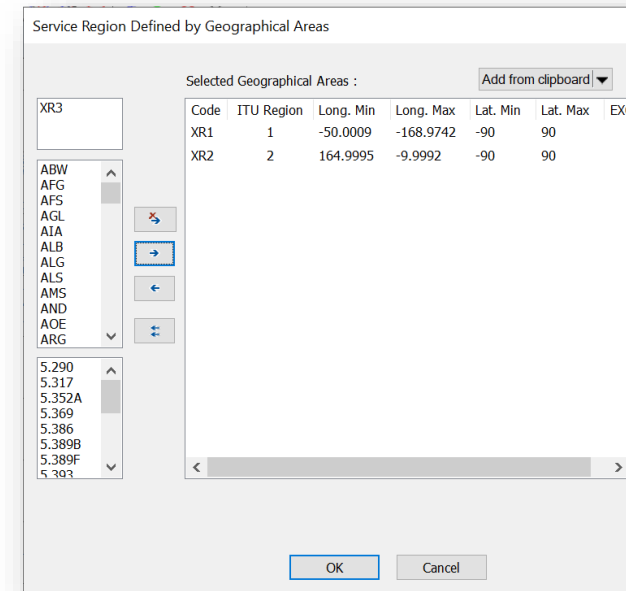
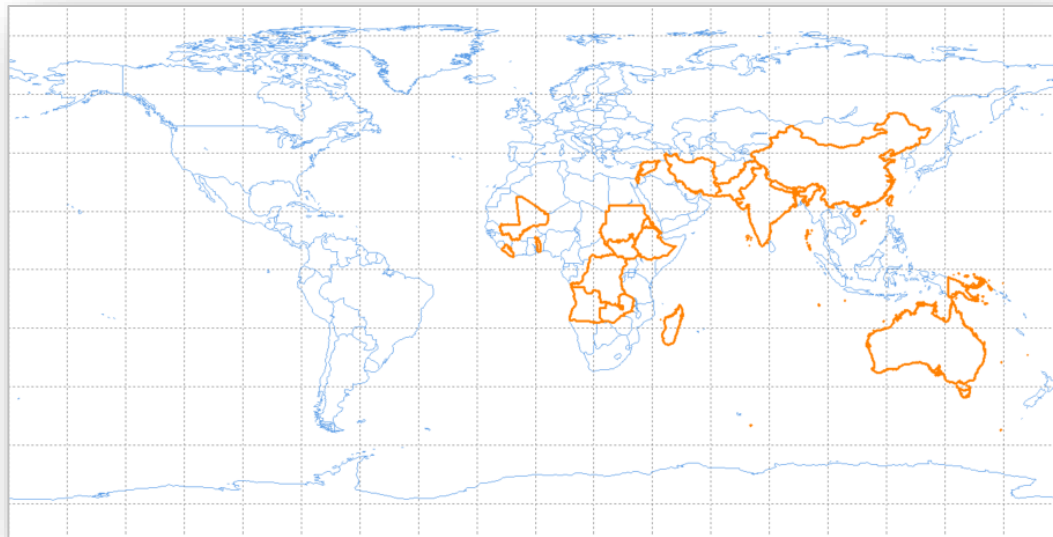


SPACE STATION TRANSMITTING CO-POLAR ANTENNA RADIATION PATTERN



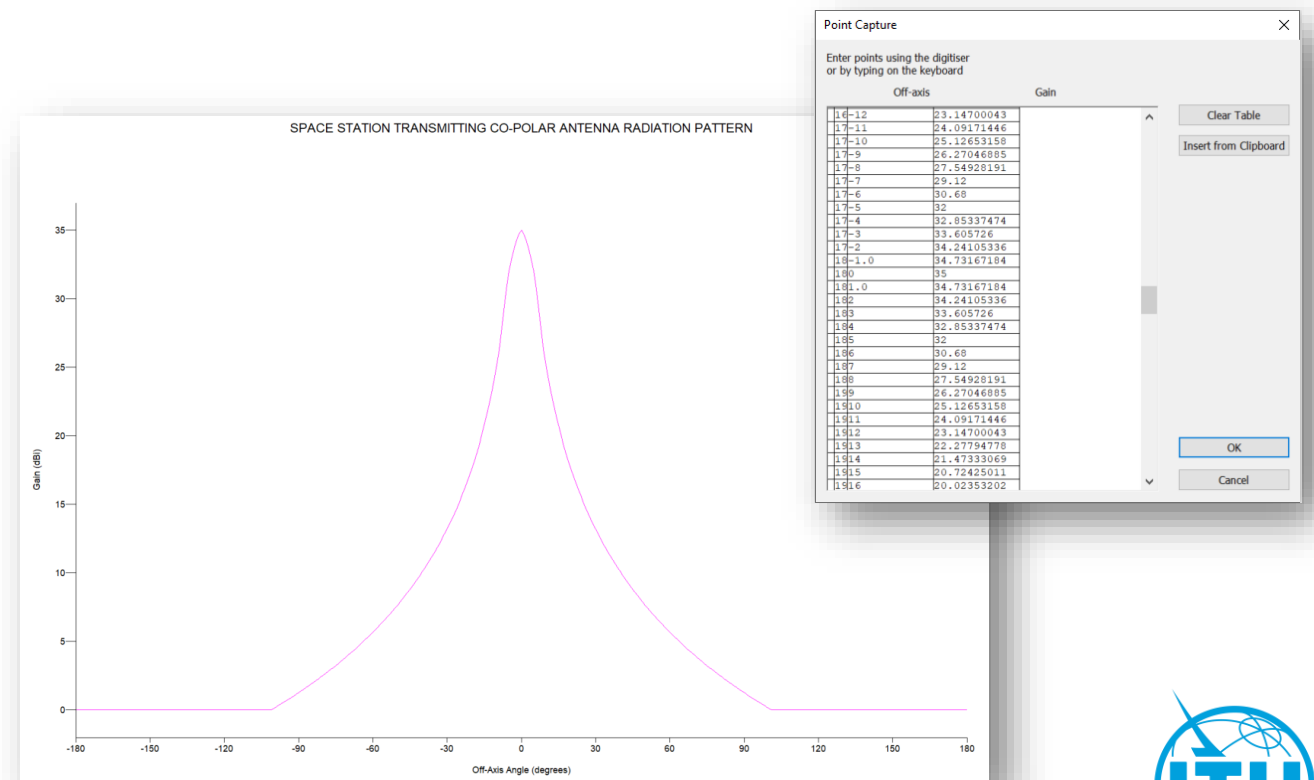
Service area diagrams in GIMS

- ❑ Visualization service area in the map
- ❑ Possibility to include and exclude countries from service area
- ❑ Possibility to form service area which will complies with restrictions described in the different footnotes of RR (such as *No. 5.369*, *No. 5.386*, etc.)



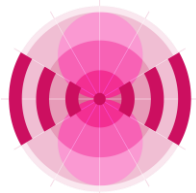
Space station/Earth station antenna radiation pattern diagrams in GIMS

- ❑ Create antenna patterns with the Mouse Capture Tools
- ❑ Digitize an antenna pattern from an Image
- ❑ Capture by points (table mode)
- ❑ Use a digitizer to capture a diagram on paper



Section 5 – Modification of CRC NGSO networks

- ❑ To create MOD use “Clone” function in SpaceCap software
- ❑ Add new orbital planes (if any) and keep only orbital planes that are intended to be modified/suppressed or orbital planes associated with beams that are intended to be modified/suppressed
- ❑ Set appropriate action codes for additional (action code “A”), modified (action code “M”) or suppressed (action code “S”) orbital planes, no action code is required for other orbital planes
- ❑ Properly indicate action codes (“A”, “M” or “S”) for beams, groups and/or associated Earth stations/space stations and delete unchanged “existing” beams and/or groups
- ❑ Note that for all beams that were associated with modified (or added in some cases) orbital planes the action code “M” should be set
- ❑ Clearly indicate in attachment if you would like to keep or modify graphical data or/and EPFD information for MOD (if you would like to modify such information kindly provide it within your submission)



Action codes of orbital planes for MOD of CRC NGSO networks

Orbital information in the originally submitted CRC NGSO network:

A4b. Orbital Information for each Orbital Plane, where the Earth is the reference body													
	Orbital Plane id	4a. Incln Angle	4b. Satellites in the plane	4c. Period ddd	4c. Period hh	4c. Period mm	4d. Apogee	4d. apog exp	4e. Perigee	4e. perig exp	4f. Minimum Altitude	4f. Min Alt exp	4m. space station uses sun-synchro-nous orbit
▶	1	15.00	2	0	1	35	500.00	0	500.00	0	500.00	0	no
	2	89.00	2	0	1	35	500.00	0	500.00	0	500.00	0	yes
	3	45.00	2	0	1	35	500.00	0	500.00	0	500.00	0	no
	4	67.00	2	0	1	35	500.00	0	500.00	0	500.00	0	no

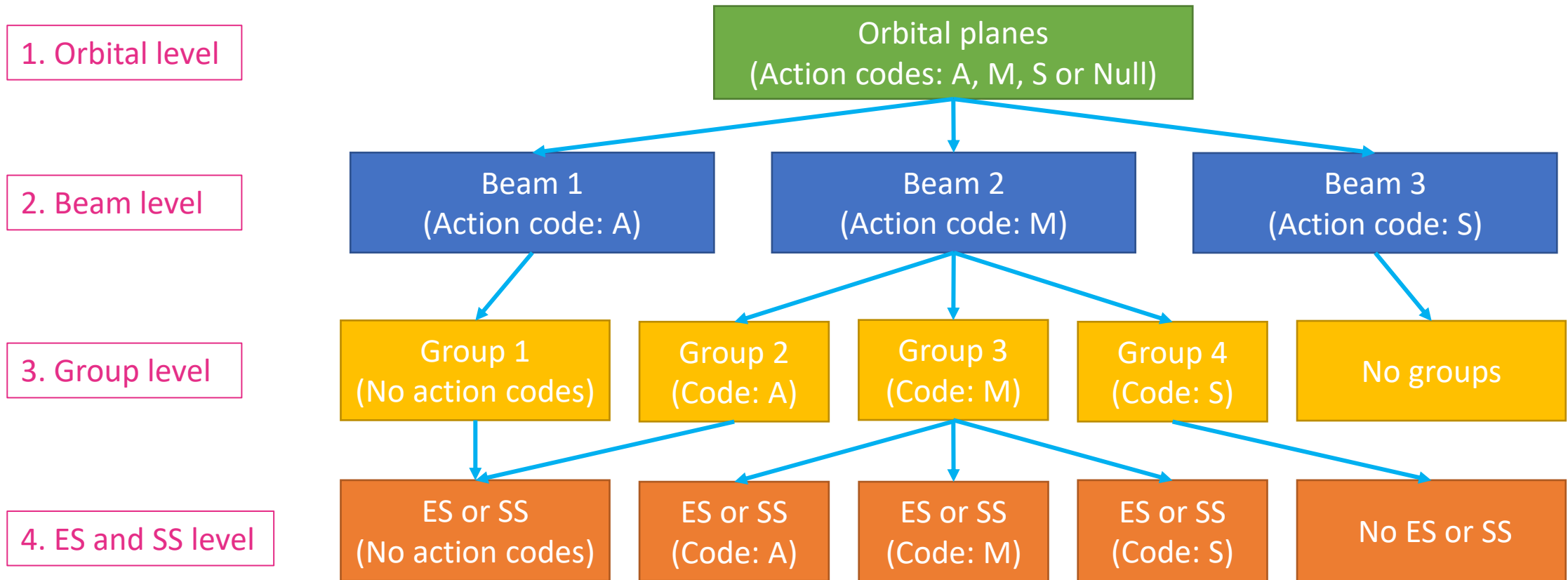
Orbital information for MOD of CRC NGSO network:

A4b. Orbital Information for each Orbital Plane, where the Earth is the reference body														
	Action code	Orbital Plane id	4a. Incln Angle	4b. Satellites in the plane	4c. Period ddd	4c. Period hh	4c. Period mm	4d. Apogee	4d. apog exp	4e. Perigee	4e. perig exp	4f. Minimum Altitude	4f. Min Alt exp	4m. space station uses sun-synchro-nous orbit
	M	1	25.00	2	0	1	35	500.00	0	500.00	0	500.00	0	no
		2	89.00	2	0	1	35	500.00	0	500.00	0	500.00	0	yes
	S	3	45.00	2	0	1	35	500.00	0	500.00	0	500.00	0	no
	A	5	33.00	2	0	1	35	500.00	0	500.00	0	500.00	0	no

For example, your intention is:

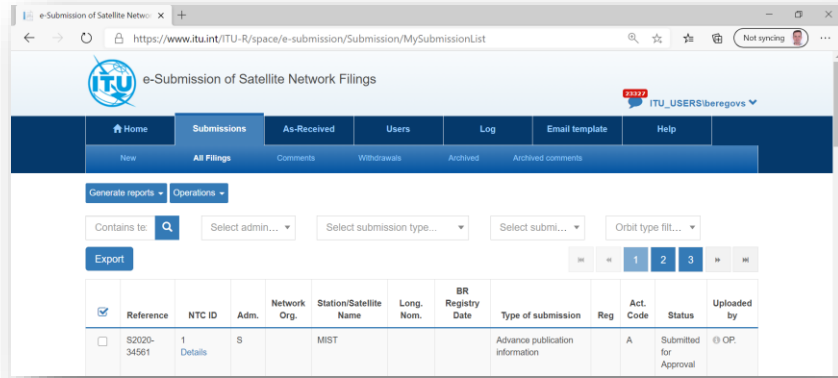
- To modify the angle of inclination for the orbital plane 1 from 15 to 25 degrees
- To modify characteristics of beams (including groups or/and associated Earth/space stations) linked with the orbital plane 2
- To suppress orbital plane 3
- To not modify characteristics of the orbital plane no. 4 and any beam linked with this orbital plane
- To add orbital plane 5 and link it with existing or new beams

Action codes for MOD of CRC NGSO networks

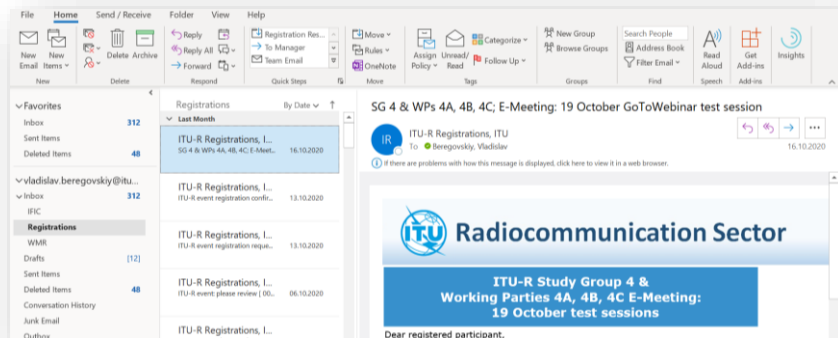


Section 6 – Submission of CRC NGSO networks

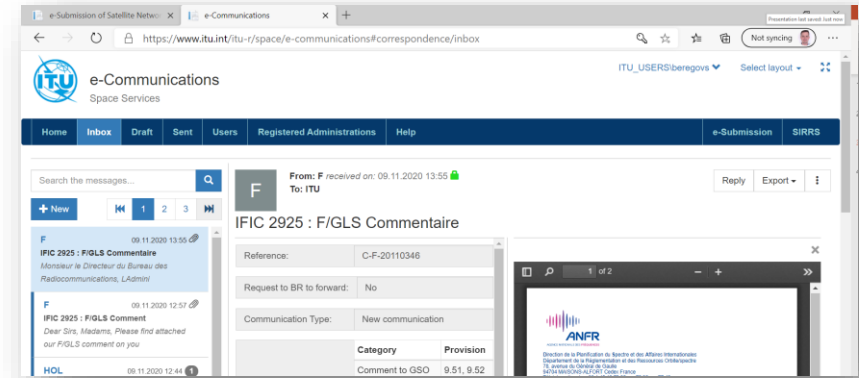
E-Submission of Satellite Network Filings



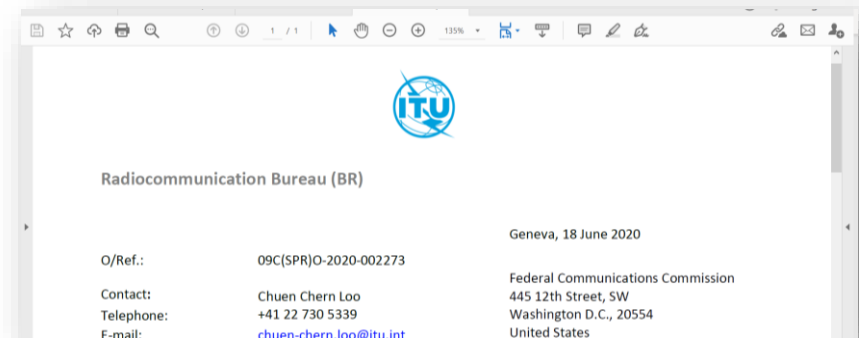
E-mail (BRmail@itu.int)



E-Communications for administrative correspondence related to space services



Postal Mail (not recommended)



E-Submission for CRC NGSO networks

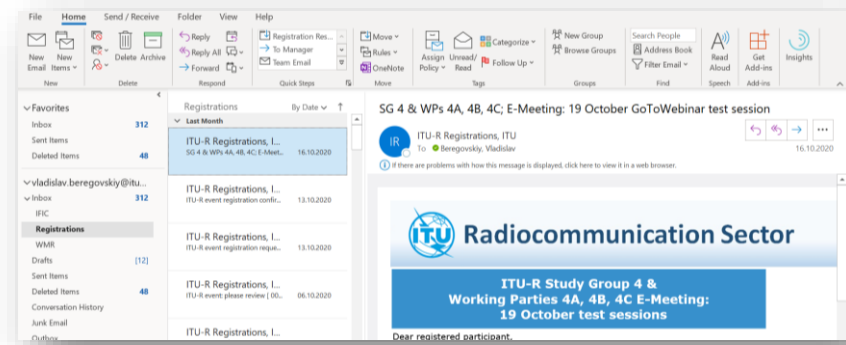
- All graphical data shall be submitted in graphics data format compatible with BR's data capture software **GIMS** in accordance with Resolution **55** (Rev.WRC-19)
- EPFD information (EIRP, PFD masks) shall be submitted **at the same time with other complete information, including SNS format database, GIMS database and notes from administration**

<input checked="" type="checkbox"/>	Reference	NTC ID	Adm. Org.	Network Org.	Station/Satellite Name	Long. Nom.	BR Registry Date	Type of submission	Reg	Act. Code	Status	Uploaded by
<input type="checkbox"/>	S2020-34561	1 Details	S		MIST			Advance publication information		A	Submitted for Approval	OP.
<input type="checkbox"/>	CHN2020-34558	120520210 Details	CHN		GALAXY-3B		06.11.2020	Coordination Request		A	Published As-Received	ADM.
<input type="checkbox"/>	CHN2020-34558	1	CHN		GALAXY-3B		06.11.2020	Advance publication information		A	Submitted for Approval	ADM.

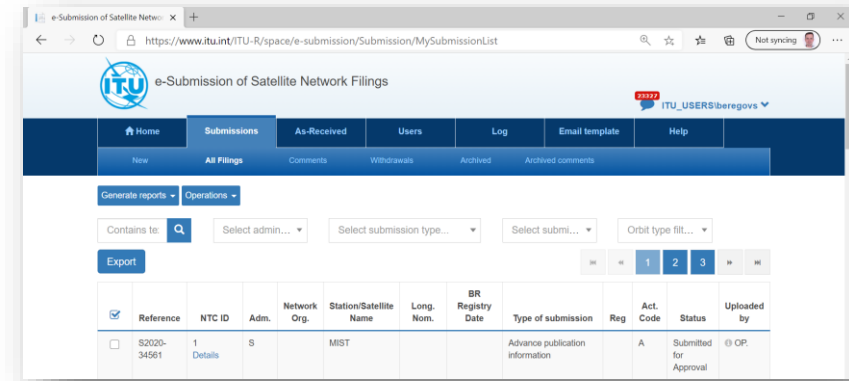
Submission for missing or corrected databases

- Note that missing or corrected databases should be submitted through the “Others” category via the e-Submission system, by e-Communication, or e-mail to brmail@itu.int

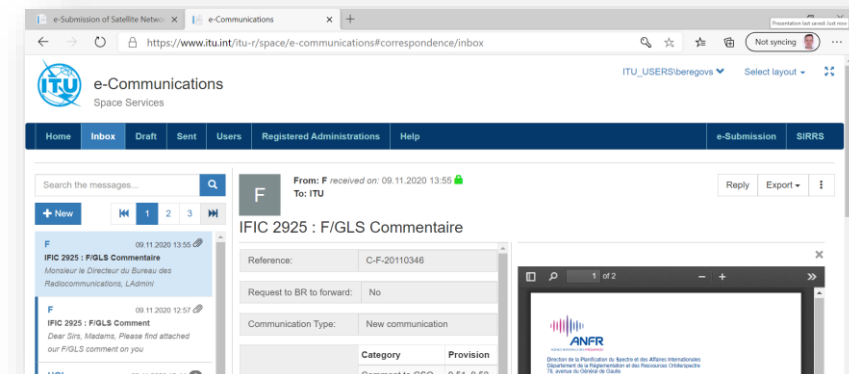
E-mail (BRmail@itu.int)



E-Submission of Satellite Network Filings



E-Communications for administrative correspondence related to space services



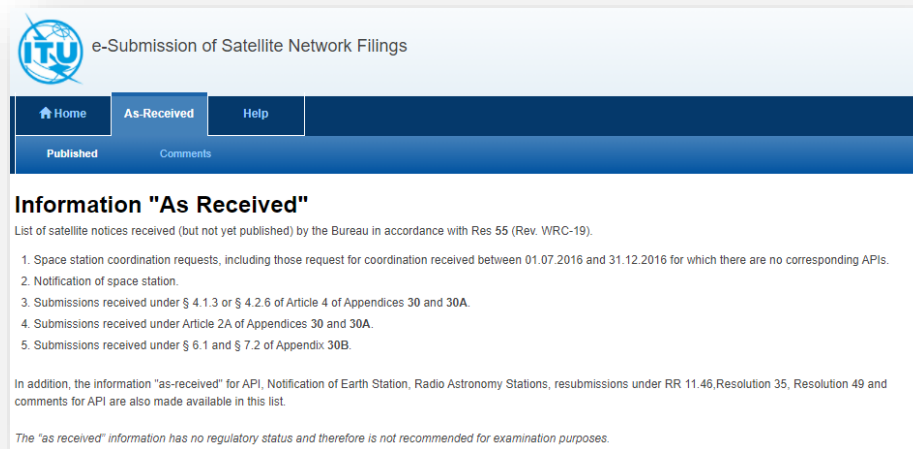
Section 7 – Publication of CRC NGSO networks

- ❑ In accordance with Resolution 55 (Rev. WRC-19), the Bureau shall make available coordination requests “As-Received” within 30 days of the submission date
- ❑ On receipt of the complete information, the Bureau shall establish the date of receipt of the notice. After its examination the Bureau shall publish this information in the BR IFIC
- ❑ For coordination requests “qualified favourable” findings may be established for frequency assignments subject to EPFD limits. However, the submitted PFD and EIRP masks shall be published in the BR IFIC
- ❑ In accordance with Circular letter CR/414, the Bureau reviews its findings and the coordination requirements after EPFD examination is complete. The results of the EPFD examination will be published in the BR IFIC

Publication “As-Received”

- Once administration submits its notice through e-submission, the Bureau shall publish this information “As-received”. And therefore, if administration provided all required information within submission, then you can find this information on the ITU website for “As received” publications:

<https://www.itu.int/ITU-R/space/asreceived/Publication/AsReceived>



The screenshot shows the ITU website interface for "e-Submission of Satellite Network Filings". The navigation bar includes "Home", "As-Received", and "Help". Below the navigation bar, there are tabs for "Published" and "Comments". The main content area is titled "Information 'As Received'" and contains a list of satellite notices received by the Bureau. The list includes five items: 1. Space station coordination requests, 2. Notification of space station, 3. Submissions received under Article 4 of Appendices 30 and 30A, 4. Submissions received under Article 2A of Appendices 30 and 30A, and 5. Submissions received under Article 6.1 and 7.2 of Appendix 30B. A note at the bottom states: "The 'as received' information has no regulatory status and therefore is not recommended for examination purposes."

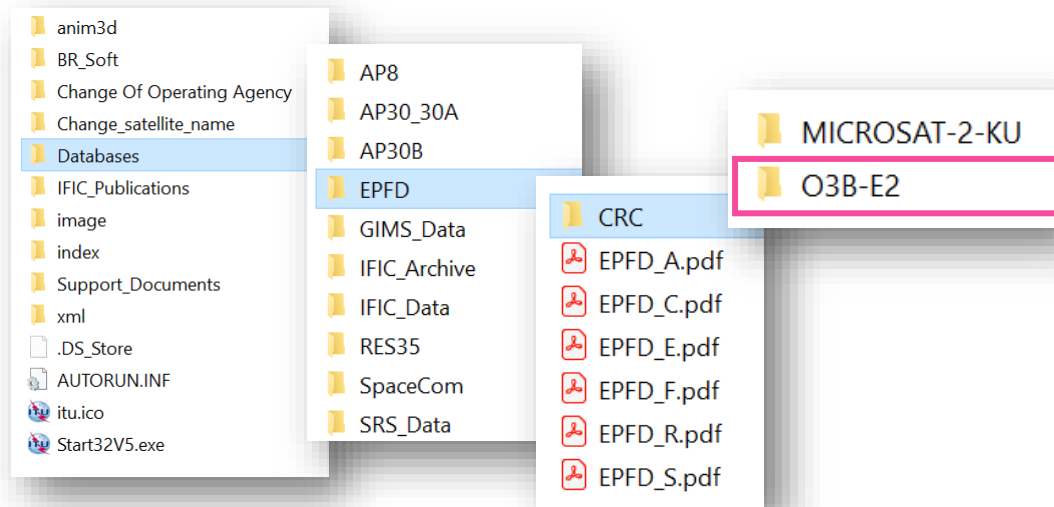
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NTC ID	Adm.	Network Org.	Station/Satellite Name	Long. Nom.	▼ BR Registry Date	Type of submission	Reg	Act. Code
122520026	USA		USARGOS4		03.03.2022	Coordination Request		A
122520025	ROU		ROU-MILSATCOM3-26.5E	26.5 E	01.03.2022	Coordination Request		A
122520024	ARG		ARSAT-P	58 W	15.02.2022	Coordination Request		A
122520023	RRW		GUHUZA-2		13.02.2022	Coordination Request		A
122520022	INS		KOMINFO-3	113 E	03.02.2022	Coordination Request		A
122520021	D		CSIOT_NBIOT22		03.02.2022	Coordination Request		A
122520020	USA		USASAT-NGSO-9A		02.02.2022	Coordination Request		A
122520019	THA		THAISAT-142E	142 E	19.01.2022	Coordination Request		A
122520018	SUI		SPACELOOP-1B		06.01.2022	Coordination Request		A

Publication of EPFD data

- Together with the publishing of the coordination request, the Bureau publishes EPFD input data, including PFD and EIRP masks and, once the notice is examined under Article 22, the results of EPFD examination will be in BR IFIC and in the EPFD data and EPFD examination results website:

<https://www.itu.int/en/ITU-R/space/Pages/epfdData.aspx>



EPFD data and EPFD examination results

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Data for Article 22 examination with respect to compliance with equivalent power flux density limits under Nos. 22.5C, 22.5D, 22.5F, as appropriate, for non-geostationary satellite systems in fixed-satellite service.

You can find the explanation of the different files and further information about the EPFD validation.

Satellite name	ID number	Adm	Org	ssn_ref	ssn_rev	IFIC No	IFIC date	Files	Remarks
O3B-E2	121520132	G		CR/C	5629	2965	22.02.2022	Input	
MICROSAT-2-KU	318520418	USA		CR/C	4932	2965	22.02.2022	Input Result Summary	
TELSTAR-LEO-2	121520147	CAN		CR/C	5621	2964	08.02.2022	Input	
USASAT-NGSO-2A	321520122	USA		CR/C	5609	2964	08.02.2022	Input	
GW-S	319520420	CHN		CR/C	5377	2963	25.01.2022	Input Result Summary	
WESAT-1	319520418	CHN		CR/C	5172	2963	25.01.2022	Input Result Summary	
KBSAT-NGSO-P	121520071	D		CR/C	5618	2963	25.01.2022	Input	
RAFANET-1	121520090	ISR		CR/C	5612	2963	25.01.2022	Input	

Thank you!

ITU – Radiocommunication Bureau

Questions to brmail@itu.int or vladislav.beregovskiy@itu.int

