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| U.S. Radiocommunications Sector  Fact Sheet | |
| **Working Party:** ITU-R WP 4C | **Document No:** US4C-18 |
| **Ref:** Resolution **249 (WRC-23)**,  Chairman’s Report 4C/77 Annex 1 | **Date:** 12 July 2024 |
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| **Purpose:** To further develop the working document addressing the studies called for under *resolves to invite the ITU Radiocommunication Sector* 1, 2, and 3 of Resolution **249 (WRC-23)** | |
| **Abstract:** The contribution will further develop the characteristics of the user space stations and service provider space stations for use in studies called for under *resolves to invite the ITU Radiocommunication Sector* 1, 2, and 3 of Resolution **249 (WRC-23)**.In addition, the contribution will look to consolidate text within section 2 and 3 as called for in the editor’s notes. Characteristics of relevant incumbent services under the purview of WP4C will also be added within section 5. | |

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| **Radiocommunication Study Groups** |  |
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| **12 July 2024** |
| **English only** |
| Annex 1 to Working Party 4С Chair’s Report | |
| WORKING DOCUMENT REGARDING WRC-27 AGENDA ITEM 1.11 | |
| Non-geostationary satellites operating space-to-space links in mobile-satellite service (MSS) allocations in the frequency bands 1 518-1 544 MHz, 1 545‑1 559 MHz, 1 610-1 645.5 MHz, 1 646.5-1 660 MHz,  1 670-1 675 MHz and 2 483.5‑2 500 MHz | |

Glossary of abbreviations

AMS(R)S: Aeronautical Mobile Satellite (Route) Service

ARNS: Aeronautical Radionavigation Service

ISS: Inter satellite service

LEO: Low earth orbit

MSS: Mobile satellite service

Non-GSO: Non-geostationary orbit

RNSS: Radionavigation Satellite Service

[More details to be included]

List of relevant publications

[To be populated later]

# 1 Introduction

The landscape of satellite communications has seen a significant uptick in the deployment and operation of small non-geostationary (non-GSO) satellites, particularly those on short-duration missions. This surge is largely attributed to the advent of very small satellites, sometimes referred to as “cubesats”, along with other small Low Earth Orbit (LEO) satellite missions. These advancements have explored the potential for continuous access across their orbits, leveraging operating host non-GSO mobile-satellite service (MSS) systems. Concurrently, geostationary (GSO) MSS operators are also providing communications access to LEO satellites via space-to-space links.

In response to this, numerous administrations worldwide have embarked on authorizing small satellites, including cubesats, on an experimental basis. This trend underscores a growing recognition of the potential these small-scale satellites hold for a myriad of applications. The number of experimental authorizations for transmissions between non-GSO space stations such as cubesats or small satellites and GSO satellite systems, as well as between non-GSO space stations and non-GSO systems, is on the rise. These developments are pivotal, considering that many non-GSO small satellite and cubesats satellites traditionally operate with limited and non-real-time connectivity to Earth stations.

By harnessing space-to-space communication between such lower-altitude non-GSO small-sat and cubesat satellites (“user space stations”)[[1]](#footnote-1) and non-GSO and GSO MSS service provider space stations[[2]](#footnote-2) operating at higher orbital altitudes, to relay data to or from the ground, a new realm of possibilities has opened up. This approach makes data available in near-real-time, significantly enhancing the availability and value of instrument data for applications requiring low latency. The evolving regulatory landscape and the increasing experimental authorizations reflect a collective move towards maximizing the utility of satellite networks, paving the way for innovative communication solutions that transcend traditional orbital and operational boundaries.

Resolution **249 (WRC-23)** established agenda item 1.11 for WRC-23, related to space-to-space links among non-geostationary and geostationary satellites in the frequency bands 1 518-1 544 MHz, 1 545-1 559 MHz, 1 610-1 645.5 MHz, 1 646.5-1 660 MHz, 1 670-1 675 MHz and 2 483.5-2 500 MHz.

# 2 Examples of user space station missions with space-to-space links within in the frequency bands allocated to MSS

Small satellite user space stations are planned for a number of applications, including:

– Scientific purposes

– Transmission of orbital information

– Orbital tracking

– Weather observation

– Commercial endeavours

These missions often involve experiments to test survivability and functionality of onboard components, such as retroreflector arrays for optical communication, RNSS receivers for precise positional information, and advanced communication suites for data transmission. Additionally, they aim to develop identification and precision tracking capabilities for enhanced space situational awareness, test propulsion systems, and validate radar technologies for weather remote sensing. Missions often use cubesats for such applications. The use of MSS systems, relying on No. **4.4** of the Radio Regulations, is a common thread among these missions, enabling continuous contact with ground stations, supporting command and control operations, and facilitating low-latency, low-data rate communications.

In addition to cubesats, other LEO satellites could make use of space-to-space links in the MSS to provide a communications link between spacecraft and ground. This application could be of particular interest to operators of scientific, weather forecasting, earth observation and imaging missions which have a requirement to transmit the data collected by the payload sensors from space to ground. There is sometimes a requirement for the data to be transferred within minutes of acquisition which can be accomplished due to the near global coverage provided by some MSS systems. Space-to-space links could also be used to provide mission control for the spacecraft.

In the current Radio Regulations, MSS allocations in 1 – 3 GHz do not include a space-to-space directional indicator. As a consequence, such operations may be conducted only on a non-interference basis, relying on No.**4.4** of the Radio Regulations. RR No. **1.25**, however, explicitly acknowledges the inclusion of space-to-space communications within the mobile-satellite service (MSS), stating that the service may involve communication “between space stations used by this service.” This provision indicates that space-to-space links, when operated within an MSS allocation, are permissible under the current regulatory structure, potentially without the need for additional allocations or specific regulatory provisions for space-to-space operations beyond the addition of a space-to-space direction indicator.

The absence of a transmission direction indicator in the Table of Allocations raises concerns about the operation of space-to-space links in MSS allocations, particularly in the context of maintaining compatibility with the established Earth-to-space and space-to-Earth transmission directions defined in the ITU Radio Regulations. The unique situation in the frequency band 1 613.8-1 626.5 MHz, which accommodates both uplink and downlink directions, underscores the need for clarity in regulatory provisions regarding the directionality of space-to-space transmissions.

While RR No. **1.25** provides a foundational basis for the development and operation of space-to-space links within MSS allocations, the practical implementation of such links may necessitate the amendment of the ITU Radio Regulations at WRC-27.

# 3 Satellite-to-satellite technical characteristics and operational parameters

*[Editor’s Note: Membership is invited to provide other example characteristics, if any.]*

System Characteristics [and regulatory considerations] for studies are given below. Qualitative descriptions of service provider systems are given in Annex A.

## 3.1 GSO

### 3.1.1 GSO MSS Service Providers

#### 3.1.1.1 Characteristics in the frequency bands 1 518-1 559 MHz, 1 626.5-1 660 and 1 670‑1 675 MHz

Portions of these frequency bands are shared among GSO MSS operators and generally inter-operator coordination issues are managed through regular multi-lateral coordination meetings, through a process agreed among the relevant Administrations. The frequencies available to any particular operator are defined for different geographic areas and hence the LEO spacecraft terminal may have to switch frequencies during the orbit or utilize a single frequency available globally.

Any potential changes to the Radio Regulations in these bands should be based on operation of LEO spacecraft with GSO MSS networks and should ensure that harmful interference is not caused to other GSO MSS networks.

Regarding the uplink bands, 1 626.5-1 660 MHz and 1 670-1 675 MHz, some parts of these bands are shared with the MetAids, the fixed service, the mobile service, and the meteorological‑satellite service. In general, the operation of terminals on board a LEO spacecraft transmitting towards a GSO MSS satellite represents a benign sharing situation. Therefore, no significant interference issues to other services are anticipated.

It is also noted that whilst WRC-27 agenda item 1.11 excludes the band portions shared with radio astronomy *resolves* 3 of Resolution **249 (WRC-23)** highlights the need for compatibility studies with primary services allocated in adjacent bands, including radio astronomy. Therefore, these studies need to be addressed.

For any sharing and protection studies for the coexistence of existing GSO MSS services with any new MSS space links allocations, the following GSO MSS characteristics for different terminals can be used. These are based on the characteristics found in ITU-R M.1184 but updated for modern GSO MSS operations:

|  | IDP | C | Hand held (GSPS) | Land | | Maritime | | Aeronautical | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| High gain | Low gain | High gain | Low gain | High gain | Low gain |
| Service | LMSS | MMSS | LMSS | LMSS | LMSS | MMSS | MMSS | AMSS AMS(R)S | AMSS AMS(R)S |
| Typical mobile station tx antenna gain (dBi) | 0 | 0 | 2 | 17 | 14 | 18 | 11.5 | 12 | 6 |
| Antenna type (example) | Patch | Quad helix | Quad Helix | Phased array | Phased array | Phased array | Phased array | Phased array | Phased array |
| Typical antenna size | 5 cm | 5 cm diameter | 12 cm | 50 cm diameter | 30 cm diameter | 55 cm diameter | 30 cm diameter | 2 panels 60  60 cm | 20  15 cm |
| Mobile earth station receive figure of merit (*G*/*T*) (dB(K–1)) | -26 | −23 | -23 | −9 | −12 | −7 | −15.5 | −13 | −19 |
| Minimum mobile earth station e.i.r.p./channel (dBW) | 8.7 | 7.3 | -2 | 18 | 13 | 16 | 12.3 | 13.8 | 9.7 |
| Maximum mobile earth station e.i.r.p/ channel (dBW) | 13.5 | 11 | 5 | 21 | 16 | 23 | 16.1 | 22 | 17.1 |
| User data rate | 600 bit/s | 600 bit/s | Voice Service | 500 kbit/s | 250 kbit/s | 500 kbit/s | 250 kbit/s | 500 kbit/s | 250 kbit/s |
| Modulation | 32ary FSK | BPSK | GMSK | 16-QAM | 16-QAM | 16-QAM | 16-QAM | 16-QAM | 16-QAM |
| Minimum Satellite e.i.r.p./channel (dBW) | 22.30 | 16.6 | 40.5 | 40.5 | 40.5 | 40.5 | 40.5 | 40.5 | 40.5 |
| Maximum satellite e.i.r.p/channel (dBW) | 27.4 | 21.8 | 44.5 | 44.5 | 44.5 | 44.5 | 44.5 | 44.5 | 44.5 |
| Uplink  channel spacing (nominal) (kHz) | 2.5 | 5 | 50 | 200 | 200 | 200 | 200 | 200 | 200 |
| Downlink channel spacing (nominal) (kHz) | 2.5 | 5 | 200 | 200 | 200 | 200 | 200 | 200 | 200 |
| Satellite peak antenna gain (dBi) | 22 | 22 | 44 | 44 | 44 | 44 | 44 | 44 | 44 |
| Satellite noise temperature (K) | 630 | 630 | 630 | 630 | 630 | 630 | 630 | 630 | 630 |

*[Editor’s Note: Protection criteria are relevant to MSS as a potentially affected service, and should be considered for migration to Section 5.]*

Interference criteria for the mobile-satellite service is found in ITU-R Recommendation M.1183‑0, which provides:

*that the maximum level of interference power in any such digital channel caused by the transmitters of another mobile-satellite network or fixed-satellite network, should not exceed for more than (100 – X)% of any month, 6% of the total noise power at the input to the demodulator which would give rise to the desired performance objectives[.]*

The methodology for determining performance objectives for narrow-band channels in mobile satellite systems using geostationary satellites not forming part of the ISDN is contained in Recommendation ITU‑R M.1228, and other ITU-R M series recommendations may be relevant.

*[Editor’s note: Is ISDN in use anywhere?]*

#### 3.1.1.2 Other GSO Service Provider Information

*[Editor’s Note: Characteristics of other GSO MSS Service Providers in other frequency bands may be provided]*

### 3.1.2 User Space Station Characteristics for communication with GSO MSS Service Providers

Example User station characteristics to be used for studies are as follows:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Example LEO User Space Station characteristics | Antenna Type | | | |
| Patch | Low Gain | Intermediate Gain | High Gain |
| Transmit Band (MHz) | 1 626.5-1 645.5, 1 646.5-1 660.0, 1 670-1 675 | | | |
| Receive Band (MHz) | 1 518-1 544, 1 545-1 559 | | | |
| Channel Bandwidth (kHz) | 200 | 10.5, 21, 42, 84, 189 | | |
| Maximum E.i.r.p. (dBW) | −1 to 10 dBW | 10 | 15.1 | 20 |
| Antenna type | patch/omni | Steerable/switched-multi | | |
| Transmit Antenna Gain (Front Lobe) (dBi) | 5 | 5 | 6 | 11 |
| Receive Antenna Gain/Noise Temperature (G/T) (dB/k) | −30 dB/k to −24 dB/k | −20 | −19 | −13 |

*[Above general considerations and Earth-to-space/space-to-Earth MSS characteristics for review]*

## 3.2 Non-GSO

### 3.2.1 Non-GSO MSS Service Provider Characteristics

3.2.1.1 MSS Characteristics in the frequency bands 1 616-1 626.5 MHz

*[TBD][M.1184]*

|  |  |
| --- | --- |
| System  Parameter |  |
|
| *Polarization* | |
| Feeder link | RHCP |
| Service link | RHCP |
| *Direction of transmission* | Earth-to-space |
| *Frequency bands* (GHz) | |
| Feeder link | 30 |
| Service link | 1.6 |
| *Orbit* |  |
| Altitude (km) | 780 |
| Satellite separation (degrees) | 32.7 |
| Number of satellites | 66 |
| Orbital planes | 6 |
| Inclination angle (degrees) | 86 |
| *Satellite antennas* | |
| Number of beams (service link) | 48 |
| Beam size (km2) | 1.8  105 to 7  105 |
| Average beam side lobes (dB) | –20 |
| Beam frequency reuse | 0.167 |
| *Link characteristics* | |
| Nominal user e.i.r.p. (dBW) | –4 to 6 (peak) |
| EOC satellite *G*/*T* (dB(K–1)) | –3 to 10 |

3.2.1.2 [MSS Characteristics in the frequency bands 1 610-1 626.5 MHz and 2 483.5-2 500 MHz]

[TBD]

### 3.2.2 User Space Station Characteristics for non-GSO MSS service providers

**Technical characteristics of Cubesat transmission to NGSO MSS systems (service return link)**

***[(from ITU-R Rec. M.1184, Table 4a, NGSO System A)]***

|  |  |  |
| --- | --- | --- |
| System  Parameter | A | |
|
| *Transmission parameters* | |
| Modulation | QPSK | |
| Coding | FEC | |
| Access scheme | FDMA/ TDMA | |
| Duplex scheme | TDD | |
| *Transmission parameters* (*cont.*) | |
| Frame length (ms) | 90 | |
| Burst rate (kbit/s) | 50 | |
| Chip rate (Mchip/s) | Not applicable | |
| RF carrier spacing (MHz) | 0.04167 | |
| RF channel bandwidth (MHz) | Not applicable | |
| Modulation bandwidth (MHz) | 0.0315 | |
| *Required Eb*/*N*0(dB) | 6.1 | |
| *Maximum MES antenna gain towards the horizon* (dBi) | 0 | |
| *Maximum permissible levels of interference power* | \* | |
|  | |

# 4 Incumbent Services Parameters for Study

*[* *Details will be populated after receipt of liaison statements from ITU-R WPs responsible for these services.]*

## 4.1 Mobile-Satellite Service

**4**.**1.1** **For the Band 1616-1626.5 MHz**

**4.1.2 For the Band 1610-1626.5 MHz**

**4.1.3 For the Bands 1626.5-1645.5/1646.5-1660 MHz**

## 4.2 Other existing primary services allocated in the same frequency bands

**4**.**1.1** **For the Band 1616-1626.5 MHz**

**4.1.2 For the Band 1610-1626.5 MHz**

**4.1.3 For the Bands 1626.5-1645.5/1646.5-1660 MHz**

## 4.3 Other existing primary services allocated in adjacent frequency bands; and

## 4.4 Existing passive services allocated in adjacent frequency bands

# 5 Space-to-Space Link Compatibility with [] Incumbent Services

The use of space-to-space links may create potential for interference different from what could be encountered with frequency sharing among the existing allocated services. The ability for space-to-space links to function compatibly with incumbent services is dependent on several factors that include orbital parameters, antenna patterns and power levels and should be investigated thoroughly.

The studies conducted under this Agenda Item could focus exclusively on the transmissions in the uplink (Earth-to-space) direction. This is based on the understanding that the downlink (space-to-Earth) transmissions of the service provider space stations will operate, under MSS authorizations in place, to serve their Earth based terminals. Therefore, the existing regulatory framework and operational practices continue to govern these downlink transmissions, ensuring no additional interference or compatibility issues, and that new space-to-space receivers shall not claim protection from these transmisssions.

[This determination that downlink transmissions in space-to-Earth direction do not require additional study is based on several factors. First, the service provider downlink transmissions will not be altered. Thus, the operational parameters of downlink transmissions from MSS satellites remain consistent regardless of whether the data is being relayed to another space station or directly to an Earth station on the ground. The core interaction and potential interference concerns remain confined to the established satellite-to-Earth link. Second, the current regulatory provisions effectively manage and mitigate interference for Earth-to-space and space-to-Earth transmissions.] The addition of space-to-space links, operating under the same regulatory protections, does not introduce new interference risks that would necessitate additional studies. Therefore, provided that downlink direction transmissions from service providers are suitably coordinated with existing, notified or recorded systems, no change is expected to the interference environment to incumbent services in the downlink bands 1 518-1 544 MHz, 1 545-1 559 MHz, 1 670-1 675 MHz, and 2 483.5-2 500 MHz.

## 5.1 Space-to-space links in the bands 1 518-1 544, 1 545‑1 559 MHz, 1 626.5-1 645.5 MHz, 1 646.5-1 660 MHz, and 1 670-1 675 MHz

**5.1.1 Aeronautical Mobile Telemetry in 1 518-1 525 MHz in Region 2**

In the United States, the 1 518-1 525 MHz frequency band is allocated to the fixed and mobile services on a primary basis, and the use of the band by the aeronautical mobile service for telemetry has priority over other uses by the mobile service. Further, in the band 1 518-1 525 MHz, stations in the mobile-satellite service shall not claim protection from aeronautical mobile telemetry stations in the mobile service in the territory of the United States (see Nos. 5.343 and 5.344). The operation of the mobile-satellite service over the territory of the United States in the 1 518-1 525 MHz band is subject to PFD limits specified in RR No. 21.16, Table 21-4.

## 5.1.2 Space-to-space links in the band 1 616-1 626.5 MHz

*[TBD]*

5.1.3 Space-to-space links in the bands 1 610-1 626.5 MHz and 2 483.5-2 500 MHz

*[TBD]*

5.1.4 Space-to-space links in the bands 1626.5-1645.5/1646.5-1660 MHz

# 6 Summary

*[TBD]*

ANNEX A

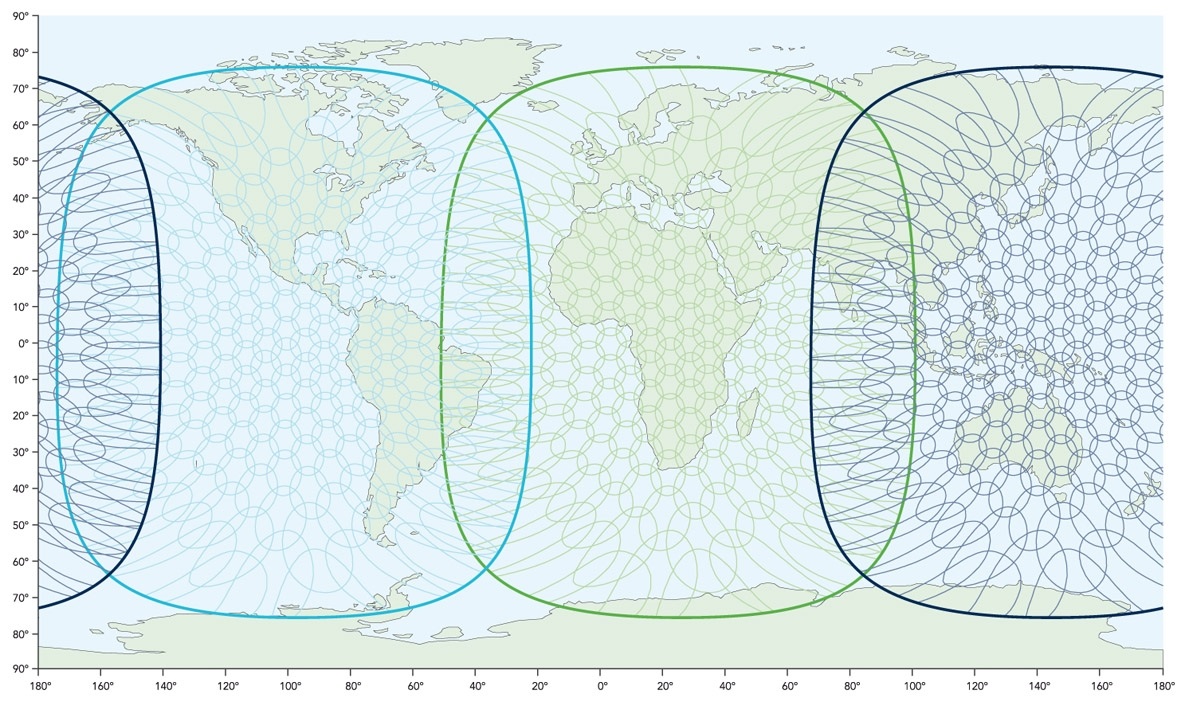
System descriptions

# A.1 Space-to-space links between LEO user satellites and GSO MSS service provider network satellites

GSO MSS systems operate in the frequency bands 1 518-1 559 MHz (space-to-Earth) and 1 626.5‑1 660 MHz and 1 670-1 675 MHz (Earth-to-space). These bands are used for the service links to terminals on ships and aircraft and land portable terminals. The feeder links, connecting the GSO satellite with the ground network operate in other frequency bands, for example, C-band and Ku-band FSS bands. The service links at 1.5/1.6 GHz typically make use of multiple spot beams formed by the spacecraft antenna. An example of spot beam coverage from 3 GSO satellites is shown in Figure 1.

Figure 1

Example of spot beam coverage from 3 GSO MSS satellites



MSS operators have developed modified mobile earth stations that may be placed on a LEO spacecraft. As long as the LEO spacecraft is located within a GSO MSS satellite spot beam, it may communicate with the GSO spacecraft. Three GSO satellites equally spaced in geostationary orbit allow connectivity for almost 100% of the time, as shown in Figure 2.

Figure 2

LEO satellite within coverage of GSO MSS satellites



The data rates that can be provided are similar to those provided to terrestrial terminals. For this application, using a backgroundIP protocol, up to 200 kbit/s both to and from the spacecraft is provided.

# A.2 Space-to-space links between LEO user satellites and non-GSO MSS service provider system satellites

[Note: this material will be updated in a future revision of this document.]

[The non-GSO HIBLEO-2 satellite system operates within the 1 616-1 626.5 MHz band employing 66 low earth orbit satellites that support user-to-user, user‑to-gateway, and gateway-to-gateway communications. The 66 satellites are evenly distributed in six orbital planes with an 86.4° inclination. The HIBLEO‑2 satellite constellation is depicted in Figure 1. The satellites orbit at an altitude of 780 kilometres and have an orbital period of approximately 100 minutes 28 seconds.

Figure 1

HIBLEO-2 satellite constellation

A yellow globe with red lines around it

Description automatically generated

The near polar orbits of the HIBLEO-2 satellite constellation provide global coverage from pole‑to‑pole [as depicted in Figure 2].

Figure 2

HIBLEO-2 satellite coverage



All communication services are provided independent of latitude and longitude position on the globe. Ship-to-shore, shore-to-ship and ship-to-ship communications are provided by a constellation of low earth orbiting satellites with overlapping coverage areas, providing ubiquitous coverage.

The first-generation constellation was implemented in 1998. It is now being replaced even as many of the original satellites are still working. Second-generation satellites are being launched that include advance technology and functionality. The entire HIBLEO-2 satellite constellation is to be replaced before the end of 2018.

Voice, broadcast data, short burst data and “push-to-talk” services are provided globally on a 24×7 basis. Service bearing communications is networked between the satellites in the constellation over inter-satellite links operating on Ka-band frequencies. The inter-satellite links provide connectivity between satellites without going through a terrestrial earth station. Data is transferred to the ground through one of the ground stations around the globe.

As mentioned above, the near polar orbits of the HIBLEO-2 satellite constellation provide global coverage from pole to pole. Further the characteristics of this system can also be found in Report ITU‑R M.2369.]

ANNEX B

Relevant portions of the Table of Allocations for reference

*[Editor’s Note: These tables may not be in the final document, but are included here for reference]*

**Allocations within frequency band 1 518-1 559 MHz**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Allocation to services | | | | |
| Region 1 | Region 2 | | Region 3 | |
| 1 518-1 525  FIXED  MOBILE except aeronautical mobile  MOBILE-SATELLITE (space-to-Earth) 5.348 5.348A 5.348B 5.351A | | 1 518-1 525  FIXED  MOBILE 5.343  MOBILE-SATELLITE (space-to-Earth) 5.348 5.348A 5.348B 5.351A | | 1 518-1 525  FIXED  MOBILE  MOBILE-SATELLITE (space-to-Earth) 5.348 5.348A 5.348B 5.351A |
| 5.341 5.342 | | 5.341 5.344 | | 5.341 |
| 1 525-1 530  SPACE OPERATION (space-to-Earth)  FIXED  MOBILE-SATELLITE (space-to-Earth) 5.208B 5.351A  Earth exploration-satellite  Mobile except aeronautical  mobile 5.349  5.341 5.342 5.350 5.351  5.352A 5.354 | | 1 525-1 530  SPACE OPERATION (space-to-Earth)  MOBILE-SATELLITE (space-to-Earth) 5.208B 5.351A  Earth exploration-satellite  Fixed  Mobile 5.343  5.341 5.351 5.354 | | 1 525-1 530  SPACE OPERATION (space-to-Earth)  FIXED  MOBILE-SATELLITE (space-to-Earth) 5.208B 5.351A  Earth exploration-satellite  Mobile 5.349  5.341 5.351 5.352A 5.354 |
| 1 530-1 535  SPACE OPERATION (space-to-Earth)  MOBILE-SATELLITE (space-to-Earth) 5.208B 5.351A 5.353A  Earth exploration-satellite  Fixed  Mobile except aeronautical mobile  5.341 5.342 5.351 5.354 | | 1 530-1 535  SPACE OPERATION (space-to-Earth)  MOBILE-SATELLITE (space-to-Earth) 5.208B 5.351A 5.353A  Earth exploration-satellite  Fixed  Mobile 5.343  5.341 5.351 5.354 | | |
| 1 535-1 559 MOBILE-SATELLITE (space-to-Earth) 5.208B 5.351A   * 1. 5.351 5.353A 5.354 5.355 5.356 5.357 5.357A 5.359 5.362A | | | | |

Table 2

**Allocations within frequency band 1 610-1 626.5 MHz**

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| 1 610-1 610.6  MOBILE-SATELLITE (Earth-to-space) 5.351A  AERONAUTICAL RADIONAVIGATION | 1 610-1 610.6  MOBILE-SATELLITE (Earth-to-space) 5.351A  AERONAUTICAL RADIONAVIGATION  RADIODETERMINATION- SATELLITE (Earth-to-space) | 1 610-1 610.6  MOBILE-SATELLITE (Earth-to-space) 5.351A  AERONAUTICAL RADIONAVIGATION  Radiodetermination-satellite (Earth-to-space) |
| 5.341 5.355 5.359 5.364  5.366 5.367 5.368 5.369  5.371 5.372 | 5.341 5.364 5.366 5.367  5.368 5.370 5.372 | 5.341 5.355 5.359 5.364 5.366 5.367 5.368 5.369 5.372 |
| 1 610.6-1 613.8  MOBILE-SATELLITE (Earth-to-space) 5.351A  RADIO ASTRONOMY  AERONAUTICAL RADIONAVIGATION | 1 610.6-1 613.8  MOBILE-SATELLITE (Earth-to-space) 5.351A  RADIO ASTRONOMY  AERONAUTICAL RADIONAVIGATION  RADIODETERMINATION-SATELLITE (Earth-to-space) | 1 610.6-1 613.8  MOBILE-SATELLITE (Earth-to-space) 5.351A  RADIO ASTRONOMY  AERONAUTICAL RADIONAVIGATION  Radiodetermination-satellite (Earth-to-space) |
| 5.149 5.341 5.355 5.359 5.364 5.366 5.367 5.368 5.369  5.371 5.372 | 5.149 5.341 5.364 5.366  5.367 5.368 5.370 5.372 | 5.149 5.341 5.355 5.359 5.364 5.366 5.367 5.368 5.369  5.372 |
| 1 613.8-1 621.35  MOBILE-SATELLITE (Earth‑to‑space) 5.351A  AERONAUTICAL RADIONAVIGATION  Mobile-satellite (space-to-Earth) 5.208B | 1 613.8-1 621.35  MOBILE-SATELLITE (Earth-to-space) 5.351A  AERONAUTICAL RADIONAVIGATION  RADIODETERMINATION-SATELLITE (Earth-to-space)  Mobile-satellite (space-to-Earth) 5.208B | 1 613.8-1 621.35  MOBILE-SATELLITE (Earth‑to‑space) 5.351A  AERONAUTICAL RADIONAVIGATION  Mobile-satellite (space-to-Earth) 5.208B  Radiodetermination-satellite (Earth-to-space) |
| 5.341 5.355 5.359 5.364 5.365 5.366 5.367 5.368 5.369 5.371 5.372 | 5.341 5.364 5.365 5.366 5.367 5.368 5.370 5.372 | 5.341 5.355 5.359 5.364 5.365 5.366 5.367 5.368 5.369 5.372 |
| 1 621.35-1 626.5  MARITIME MOBILE-SATELLITE (space-to-Earth) 5.373 5.373A  MOBILE-SATELLITE (Earth‑to‑space) 5.351A  AERONAUTICAL RADIONAVIGATION  Mobile-satellite (space-to-Earth) except maritime mobile satellite (space-to-Earth) | 1 621.35-1 626.5  MARITIME MOBILE-SATELLITE (space-to-Earth) 5.373 5.373A  MOBILE-SATELLITE (Earth‑to‑space) 5.351A  AERONAUTICAL RADIONAVIGATION  RADIODETERMINATION-SATELLITE (Earth‑to‑space)  Mobile-satellite (space-to-Earth) except maritime mobile satellite (space-to-Earth) | 1 621.35-1 626.5  MARITIME MOBILE-SATELLITE (space-to-Earth)  5.373 5.373A  MOBILE-SATELLITE (Earth‑to‑space) 5.351A  AERONAUTICAL RADIONAVIGATION  Mobile-satellite (space-to-Earth) except maritime mobile satellite (space-to-Earth)  Radiodetermination-satellite (Earth‑to‑space) |
| 5.208B 5.341 5.355 5.359 5.364 5.365 5.366 5.367 5.368 5.369 5.371 5.372 | 5.208B 5.341 5.364 5.365 5.366  5.367 5.368 5.370 5.372 | 5.208B 5.341 5.355 5.359 5.364 5.365 5.366 5.367 5.368 5.369 5.372 |

Table 3

**Allocations within frequency band 1 626.5-1 660 MHz**

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| 1 626.5-1 660 MOBILE-SATELLITE (Earth-to-space) 5.351A  5.341 5.351 5.353A 5.354 5.355 5.357A 5.359 5.362A 5.374  5.375 5.376 | | |

Table 4

**Allocations within frequency band 1 670-1 675 MHz**

|  |  |  |
| --- | --- | --- |
| Allocation to services | | |
| Region 1 | Region 2 | Region 3 |
| 1 670-1 675 METEOROLOGICAL AIDS  FIXED  METEOROLOGICAL-SATELLITE (space-to-Earth)  MOBILE  MOBILE-SATELLITE (Earth-to-space) 5.351A 5.379B   * 1. 5.379D 5.379E 5.380A | | |

Table 5

**Allocations within frequency band** 2 483.50-2 500 MHz

1. A user space station is considered to be a space station transmitting in the MSS allocation (Earth-to-space) towards MSS service provider space stations at higher altitudes and receiving in the MSS allocation (space-to-Earth) from MSS service provider space stations at higher altitudes, all within the notified beams of the service provider MSS network or system. [↑](#footnote-ref-1)
2. An MSS service provider space station is considered to be a space station transmitting in an MSS allocation (space-to-Earth) towards user space stations at lower altitudes and receiving in the MSS allocation (Earth-to-space) from user space stations at lower altitudes, all within the notified beams of the service provider MSS network or system. [↑](#footnote-ref-2)