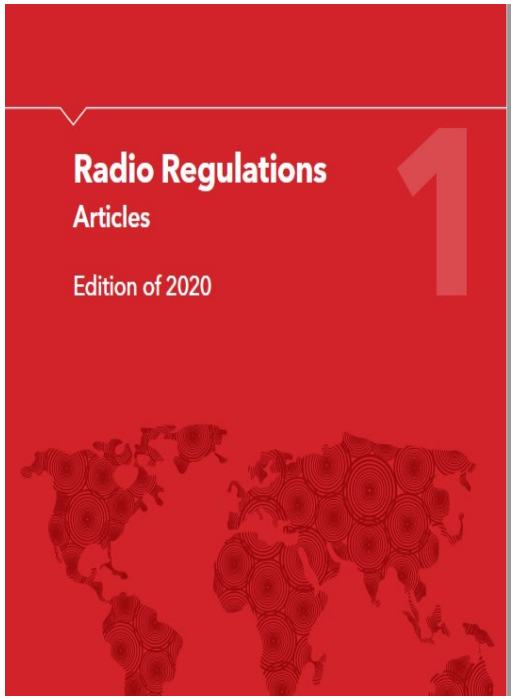
Inter-Satellite Links

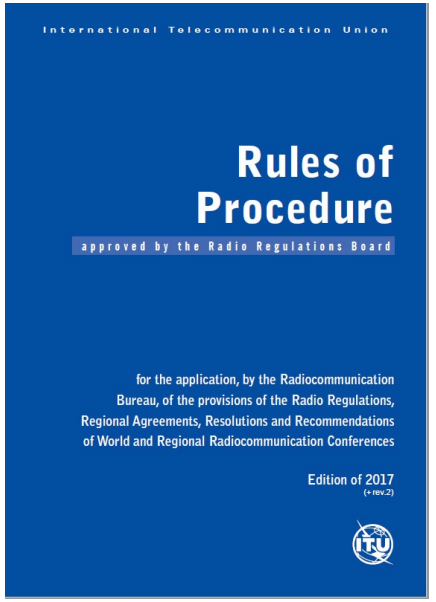
ITU – BR – SSD – SPR

2021 August

Key Items

- Radio Regulations
- Rules of Procedure
- Preface
- AP4 Specific Items
- Study Group 4 / WP 4A
- Common Errors





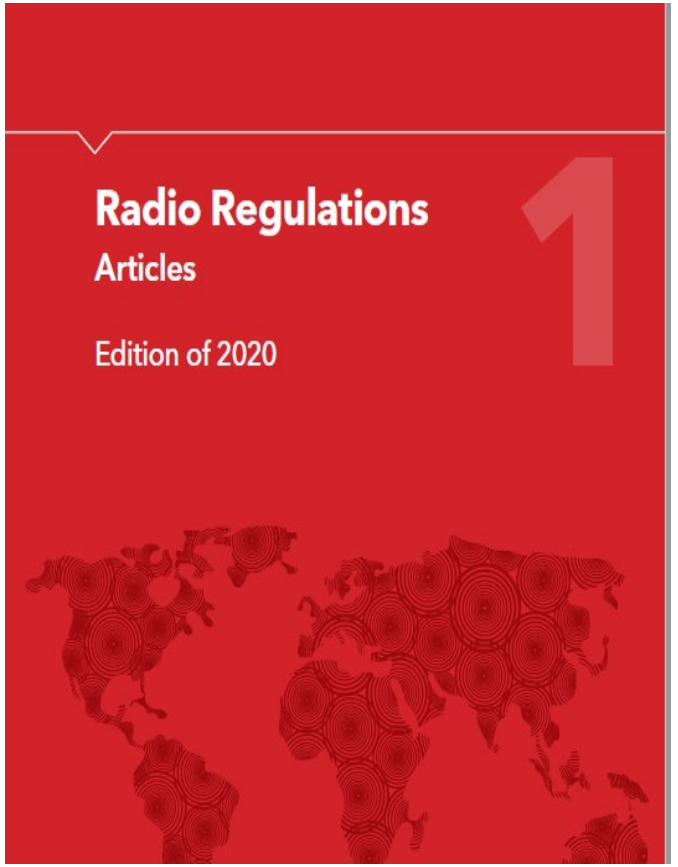
Related Definition

RR No. 1.21 fixed-satellite service: A radiocommunication service between earth stations at given positions, when one or more satellites are used; the given position may be a specified fixed point or any fixed point within specified areas; in some cases this service includes satellite-to-satellite links, which may also be operated in the inter-satellite service; the fixed-satellite service may also include feeder links for other space radiocommunication services.

RR No. 1.22 inter-satellite service: A radiocommunication service providing links between artificial satellites.

RR No. 1.114 ***multi-satellite link****:* A radio link between a transmitting *earth station* and a receiving *earth station* through two or more *satellites*, without any intermediate *earth station*.

A multi-satellite link comprises one up-link, one or more satellite-to-satellite links and one down-link.



Related Definition

RR No. 1.51 ***Earth exploration-satellite service****:*

A *radiocommunication service* between *earth stations* and one or more *space stations*, which may include links between *space stations*, in which:

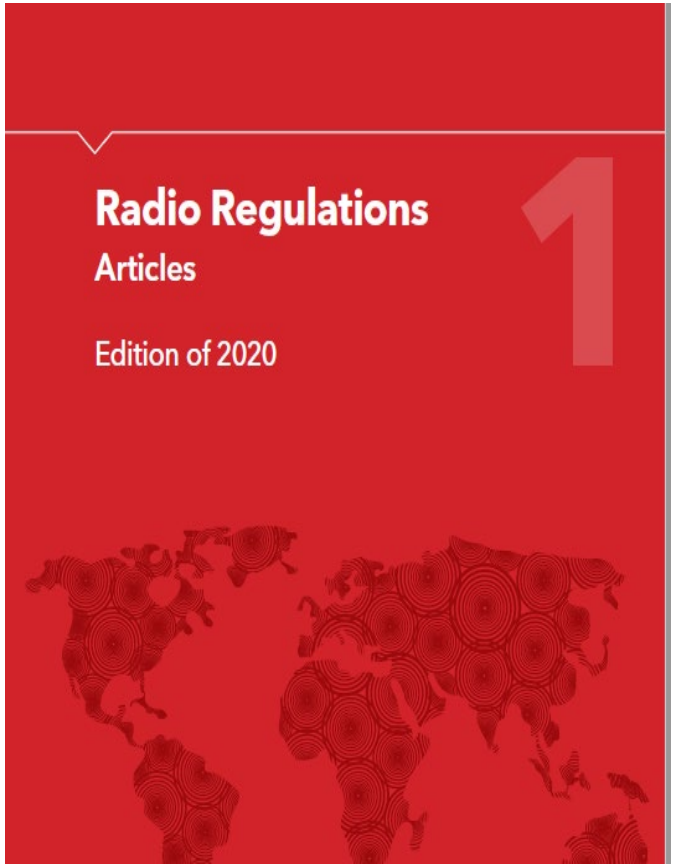
– information relating to the characteristics of the Earth and its natural phenomena, including data relating to the state of the environment, is obtained from *active sensors* or *passive sensors* on Earth *satellites*;

– similar information is collected from airborne or Earth-based platforms;

– such information may be distributed to *earth stations* within the system concerned;

– platform interrogation may be included.

This service may also include *feeder links* necessary for its operation.



Allocation

There are allocations for inter-satellite service, as shown here for examples, in accordance with the Table of Frequency Allocation under RR Article **5**

For example:

Allocation to services		
Region 1	**Region 2**	**Region 3**
22.55-23.15	FIXED INTER-SATELLITE 5.338A MOBILE SPACE RESEARCH (Earth-to-space) 5.532A 5.149	
23.15-23.55	FIXED INTER-SATELLITE 5.338A MOBILE	
24.45-24.65 FIXED INTER-SATELLITE MOBILE except aeronautical mobile 5.338A 5.532AB	**24.45-24.65** FIXED 5.532AA INTER-SATELLITE MOBILE except aeronautical mobile 5.338A 5.532AB RADIONAVIGATION 5.533	**24.45-24.65** FIXED INTER-SATELLITE MOBILE 5.338A 5.532AB RADIONAVIGATION 5.533
24.65-24.75 FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE except aeronautical mobile 5.338A 5.532AB	**24.65-24.75** FIXED 5.532AA INTER-SATELLITE MOBILE except aeronautical mobile 5.338A 5.532AB RADIOLOCATION-SATELLITE (Earth-to-space)	**24.65-24.75** FIXED FIXED-SATELLITE (Earth-to-space) 5.532B INTER-SATELLITE MOBILE 5.338A 5.532AB

Allocation

In addition to inter-satellite service, it is possible to use services allocated where there is an allocation in the "space-to-space" direction, otherwise it would require the application of RR No.**4.4**.

For example:

Allocation to services		
Region 1	Region 2	Region 3
1 164-1 215	AERONAUTICAL RADIONAVIGATION 5.328 RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.328B 5.328A	
1 215-1 240	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.328B 5.329 5.329A SPACE RESEARCH (active) 5.330 5.331 5.332	
1 240-1 300	EARTH EXPLORATION-SATELLITE (active) RADIOLOCATION RADIONAVIGATION-SATELLITE (space-to-Earth) (space-to-space) 5.328B 5.329 5.329A SPACE RESEARCH (active) Amateur 5.282 5.330 5.331 5.332 5.335 5.335A	
2 025-2 110	SPACE OPERATION (Earth-to-space) (space-to-space) EARTH EXPLORATION-SATELLITE (Earth-to-space) (space-to-space) FIXED MOBILE 5.391 SPACE RESEARCH (Earth-to-space) (space-to-space) 5.392	

Check Specific Footnote

- Pay attention to the relative specific footnotes of Article **5** if any

For example

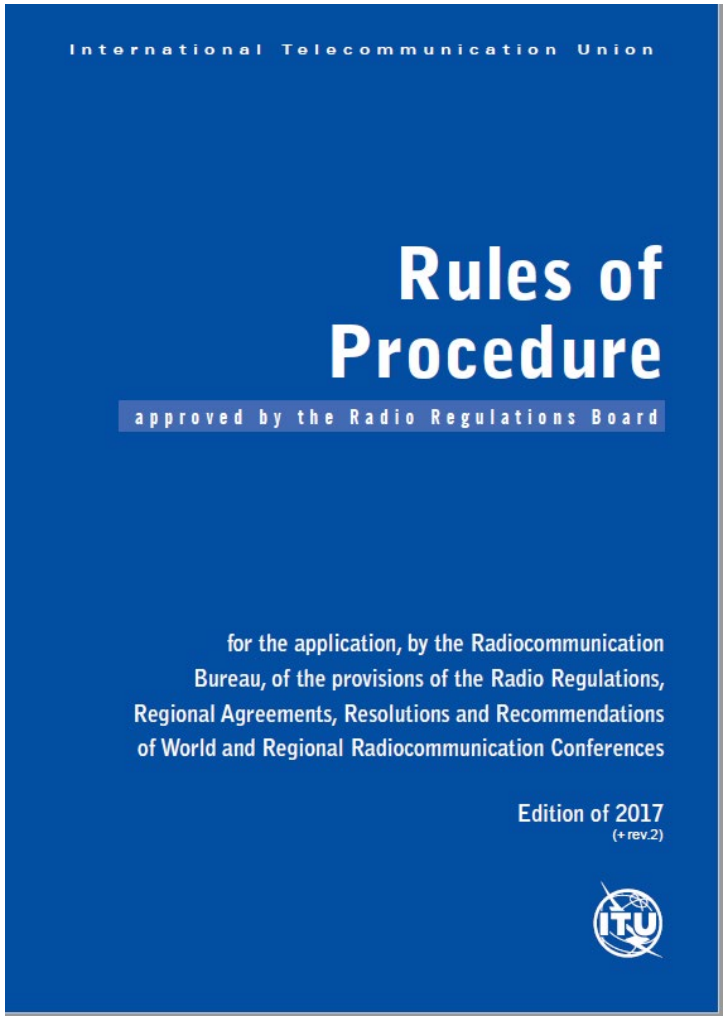
5.328B The use of the bands 1 164-1 300 MHz, 1 559-1 610 MHz and 5 010-5 030 MHz by systems and networks in the radionavigation-satellite service for which complete coordination or notification information, as appropriate, is received by the Radiocommunication Bureau after 1 January 2005 is subject to the application of the provisions of Nos. **9.12**, **9.12A** and **9.13**. Resolution **610 (WRC-03)*** shall also apply; however, in the case of radionavigation-satellite service (space-to-space) networks and systems, Resolution **610 (WRC-03)*** shall only apply to transmitting space stations. In accordance with No. **5.329A**, for systems and networks in the radionavigation-satellite service (space-to-space) in the bands 1 215-1 300 MHz and 1 559-1 610 MHz, the provisions of Nos. **9.7**, **9.12**, **9.12A** and **9.13** shall only apply with respect to other systems and networks in the radionavigation-satellite service (space-to-space). (WRC-07)

5.329 Use of the radionavigation-satellite service in the frequency band 1 215-1 300 MHz shall be subject to the condition that no harmful interference is caused to, and no protection is claimed from, the radionavigation service authorized under No. **5.331**. Furthermore, the use of the radionavigation-satellite service in the frequency band 1 215-1 300 MHz shall be subject to the condition that no harmful interference is caused to the radiolocation service. No. **5.43** shall not apply in respect of the radiolocation service. Resolution **608 (Rev.WRC-19)** shall apply. (WRC-19)

5.329A Use of systems in the radionavigation-satellite service (space-to-space) operating in the bands 1 215-1 300 MHz and 1 559-1 610 MHz is not intended to provide safety service applications, and shall not impose any additional constraints on radionavigation-satellite service (space-to-Earth) systems or on other services operating in accordance with the Table of Frequency Allocations. (WRC-07)

5.392 Administrations are urged to take all practicable measures to ensure that space-to-space transmissions between two or more non-geostationary satellites, in the space research, space operations and Earth exploration-satellite services in the bands 2 025-2 110 MHz and 2 200-2 290 MHz, shall not impose any constraints on Earth-to-space, space-to-Earth and other space-to-space transmissions of those services and in those bands between geostationary and non-geostationary satellites.

Check Rules of Procedure when necessary



For example

RR No. 5.543 The band 29.95-30 GHz may be used for space-to-space links in the Earth exploration-satellite service for telemetry, tracking, and control purposes, on a secondary basis.

Rules of Procedure
relating to inter-satellite link

No. 5.543

- The Board concluded that this provision is an additional allocation to the Earth exploration-satellite
- service for inter-satellite links. The use of the words “telemetry, tracking, and control purposes” leads the Board to understand that the use is limited to space operation.

Specific Appendix 4 information

Some specific Appendix **4** information required for an associated space station:

- **C.10.a** For an associated space station:
  - **C.10.a.1** the identity of the station
  - **C.10.a.2** if the associated space station is in the geostationary orbit, its nominal longitude

- **C.8.f.1** the space station's nominal equivalent isotropically radiated power(s) (e.i.r.p.) on the beam axis

- **C.8.f.2** the associated space station's nominal equivalent isotropically radiated power(s) (e.i.r.p.) on the beam axis

Co-polar Antenna radiation pattern
for GSO satellite network with inter-satellite link

- **Item B.3.c.1 of Appendix 4** *the co-polar antenna radiation pattern*

  In the case of geostationary space stations required only for an antenna radiation beam that is directed towards another satellite

- Specifically, for inter-satellite link, if it's GSO corresponding with NGSO which are not subject to coordination, then the antenna radiation pattern for space station is required for API and have to be provided as attachment, which cannot be captured in the Gims yet.
- If it's provided as equations, formulae, or a table describing all parts of the pattern, the Bureau will then assign the pattern ID in the Antenna Pattern Library, available at http://www.itu.int/en/ITU-R/software/Pages/ant-pattern.aspx , and capture the pattern ID in the notice database, when possible, for publication.
- Diagrams submitted as images are not usable by technical examination software.

Notice Capture

To capture a group for an inter-satellite link via the BR software SpaceCap:

- service area is not required
- no associated earth station required in the group
- at least one associated space station captured for the group
- transmitting and receiving should be separated in different beams
- Antenna pattern is required for space station (beam level) only
- Associated Earth stations and associated space stations can not be captured in the same group, must be separated into different groups

Name of associated space station

- Item **C.10.a.1** of Appendix **4**

- In an API or Coordination request, it is acceptable to have an associated space station which has not yet been submitted in another filing
- In a notification notice, the associated space station must already have been submitted as an API, coordination request or notification
- Only names of satellite networks registered in the ITU database is acceptable
- Commercial names of the satellite system (e.g. Iridium, Globalstar, GPS) are not acceptable
- If the communication of inter-satellite link is within the same constellation system, it can be captured as the same name of the satellite network for the constellation system

Preface

- Class of Station

- Not only ES can be used for inter-satellite service

- **For example:**
  EN, EH, EW, EC … and others can also be used for space-to-space links

Symbol	Space Station Class of Station
E1	Space research (active sensor) space station
E2	Space research (passive sensor) space station
E3	Space station in the Earth exploration-satellite service (active sensor)
E4	Space station in the Earth exploration-satellite (passive sensor)
E5	Space station in the aeronautical mobile-satellite (R) service
E6	Space station in the aeronautical mobile-satellite (OR) service
EA	Space station in the amateur-satellite service
EB	Space station in the broadcasting-satellite service (sound broadcasting)
EC	Space station in the fixed-satellite service
ED	Space telecommand space station
EE	Space station in the standard frequency-satellite service
EF	Space station in the radiodetermination-satellite service
EG	Space station in the maritime mobile-satellite service
EH	Space research space station
EI	Space station in the mobile-satellite service
EJ	Space station in the aeronautical mobile-satellite service
EK	Space tracking space station
EM	Space station in the meteorological-satellite service
EN	Space station in the radionavigation-satellite service
EO	Space station in the aeronautical radionavigation-satellite service
EQ	Space station in the maritime radionavigation-satellite service
ER	Space telemetering space station
ES	Station in the inter-satellite service
ET	Space station in the space operation service
EU	Space station in the land mobile-satellite service
EV	Space station in the broadcasting-satellite service (television)
EW	Space station in the earth exploration-satellite service
EY	Space station in the time signal-satellite service

Subject to Coordination or Not

For GSO communicating with NGSO

9.2 Amendments to the information sent in accordance with the provisions of No. **9.1** shall also be sent to the Bureau as soon as they become available. The use of an additional frequency band, or modification of the orbital location for a space station using the geostationary-satellite orbit, the modification of the reference body or the modification of the direction of transmission for a space station using a non-geostationary-satellite orbit, as well as the use of inter-satellite links of a geostationary space station communicating with a non-geostationary space station which are not subject to the coordination procedure under Section II of Article **9**, will require the application of the advance publication procedure[10]. (WRC-19)

See also § 6 of the RoP related with No. **11.32** for more details

Study Groups

- Currently being studied under Study Group 4 in Working Party 4A

- **WRC-23 AI 1.17** to determine and carry out, on the basis of the ITU-R studies in accordance with Resolution **773 (WRC-19)**, the appropriate regulatory actions for the provision of inter-satellite links in specific frequency bands, or portions thereof, by adding an inter-satellite service allocation where appropriate;

  Resolution **773 (WRC-19)** – Study of technical and operational issues, and regulatory provisions for satellite-to-satellite links in the frequency bands 11.7-12.7 GHz, 18.1-18.6 GHz, 18.8-20.2 GHz and 27.5-30 GHz

- Latest Chairman's Report on the meeting of Working Party 4A (14-28 July 2021):

  https://www.itu.int/md/R19-WP4A-C-0392/en

Common Errors (1)
- seen in submissions

For Associated space station:

- Satellite network name does not exist in ITU publication

  Example:

  ❖Filings submitted with commercial names for associated space stations (e.g. IRIDIUM, GLOBALSTAR, and GPS) rather than satellite network filings registered with the ITU. These will receive unfavorable findings because satellite networks with these names do not exist in the ITU database.

- Corresponding beam names do not exist in ITU publication

  ❖Beam names must correspond to what is published for the associated space station.

Common Errors (2)
- seen in submissions

- Antenna Pattern missing for space station – not found in any attachment
  - ❖ Make sure that the antenna pattern diagram, if any, provided for beam is attached with the filing.

- Submitting only one beam for satellite-to-satellite link, receiving and transmitting beams are not submitted in the same filing
  - ❖ This is not an error, but highlighted here in case it is an omission on the part of the notifying administration
  - ❖ Note that no space-to-space direction exists in SpaceCap for inter-satellite link, it has to be captured as either transmitting or receiving.

Common Errors (3)
- seen in submissions

- Both associated earth stations and associated space stations are captured in the same group
  - ❖ this is not allowed for the same group, it must be separated into different groups

- If it's not allocated for inter-satellite service, please do not use "ES" as the class of station:

  Example:

  - ❖ If class of station ES is submitted for the bands in the bands 2025-2110 MHz and 2200-2290 MHz, it will be unfavourable. Although there are space-to-space in these bands, it is necessary to submit as EH, EW, and ET in accordance with Table of Frequency Allocation, otherwise request for No.4.4 is required.

Common Errors (4)
- seen in submissions

- If the satellite network is using band where there is no allocation for space-to-space link, please request for the application of No. **4.4** for this frequency band, noting the obligations spelt out in No. **4.4** and its associated Rules of Procedure

  Example:

  A notification is submitted for inter-satellite link using 435-438 MHz for class of station "ES", with a request for No.**4.4**. However, there is no statement of confirmation of meeting the requirements of § 1.6 of the Rules of Procedure relating to No. **4.4**, which states that, prior to bringing into use any frequency assignment to a transmitting station operating under No. **4.4**, administrations shall determine:

  a) That the intended use of the frequency assignment to the station under No. **4.4** will not cause harmful interference into the stations of other administrations operating in conformity with the Radio Regulations;

  b) What measures it would need to take in order to comply with the requirement to immediately eliminate harmful interference pursuant to No. **8.5**.

Contact Points

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