The International Amateur Radio Union

Since 1925, the Federation of National Amateur Radio Societies
Representing the Interests of Two-Way Amateur Radio Communication

Amateur Satellites Short Info Paper

Purpose

The purpose of this paper is to provide basic information for IARU Member societies, who act as the Point of Contact for individual amateurs and educational institutes who wish to operate a space station operating in bands allocated to the amateur-satellite service. This document should be read in conjunction with the more detailed information available at the IARU website

IARU frequency coordination

Spectrum is a scarce resource that must be managed to ensure efficient use. Amateurs have maintained an effective tradition of self-regulation. Satellite frequencies in bands allocated to the amateur-satellite service are coordinated by the IARU Satellite Frequency Coordination Panel. Satellites using spectrum allocated to the amateur-satellite service may operate under amateur licenses and within the definition of the amateur-satellite service specified in Article 25 (Amateur services) of the ITU Radio Regulations (RR). The IARU believes the definition is sufficiently broad to encompass nearly all educational satellite projects that include giving students hands-on experience with radiocommunication which are conducted under an amateur license. Educational and university satellite projects will only be coordinated when there is an identified amateur component and the mission is to teach and train students in satellite communication techniques and building and launching satellites. The person responsible for the satellite communications must be a licensed radio amateur. The IARU will only coordinate a non-amateur satellite if an administration directs in writing that it be operated in an amateur-satellite band under an experimental or other non-amateur license.

Different categories of short duration satellite missions

Most amateur satellites will be in a non-geostationary orbit (NGSO). The International Telecommunication Union (ITU) has identified three main categories for satellites with a short duration mission.

- **Educational and amateur radio missions**. These are satellite missions with the sole aim of educating people about space, electronics and all aspects of physics involved in space; as well as satellites used for amateur radio "self-training and communication", with no pecuniary interest (Note), as defined in Article 1 of the RR.

  (Note) Reference to readers: "Pecuniary interest" means payment or other financial interest.

- **Experimental and research missions** are missions with one or more of the following purposes:
  - To demonstrate a novel space technology in the space environment
  - To perform a proof-of-concept for a certain application involving one or more nanosatellites and pico satellites
  - To perform space research (primarily earth-orbiting, but also lunar and deep space applications).
  - In general these missions will use frequency bands allocated to the space operation, space research and Earth exploration-satellite services.
- **Commercial missions**, i.e. delivering a certain service in certain areas of applications with a clear pecuniary interest, will operate in frequency bands allocated to that specific service. Examples include missions for Earth observation and telecommunication.

Features for the amateur-satellite system

An amateur-satellite system which is used for providing an amateur-satellite service consists of amateur earth stations and an amateur space station. Some of the essential characteristics of the amateur-satellite service are platforms with propagation beacons, transponders between various amateur bands, telemetry platforms that monitor the essential functions of the satellite, and command and control functionality. In building and operating the system the operators (radio amateur license holders) must obtain permission from the administration to which the network/operators belongs.

Each administration may have its band plan allocating frequencies for telecommunication services, but in an amateur-satellite system, the IARU has established its three Regional band plans taking into account the sharing between the amateur service and amateur-satellite service and the global nature of the satellite service. Therefore, it is expected that the system builder and operators will use frequency bands allocated in each IARU Regional band plan.

Combined missions: A combined satellite mission has an amateur payload and a separate payload that belongs to a different service. Both payloads, including for tracking, telemetry and command for the operation of the satellite (TT&C) shall use frequencies allocated to their own specific service. It is not permitted to operate an amateur-satellite system in combination with other telecommunication services. For example, the operation of the system, in which the maritime mobile service is used in the earth to space direction and the amateur-satellite service is used in the space to earth direction, is not permitted.

Frequency bands available for the amateur-satellite service

In the ITU Radio Regulations, some frequency bands are allocated to the amateur-satellite service exclusively or on a shared basis with other radiocommunication services on a primary or a secondary base. Based on these ITU frequency allocations, the IARU designates frequency bands to be used for the amateur-satellite service in the IARU three Region's band plans, taking into account the sharing between the amateur service and amateur-satellite service and the global nature of the amateur-satellite service. The following table shows frequency allocations to the amateur-satellite service which are extracted from the ITU Radio Regulations and IARU Regions 1, 2 and 3 band plans. It should be noted that information such as any bandwidth restrictions or permitted modes of operation allowed in each frequency band is not included in this Table. The more detailed, information is available in each Regional band plan, if applicable.

Table Frequency allocation to the amateur-satellite service

Note: In all Regions, a center frequency shall be selected so that a necessary guard band is provided at the lower and upper edges of each frequency band. .

ITU Radio Regulations			IARU Band Plans		
Region 1	Region 2	Region 3	Region 1	Region 2	Region 3
7 000-7 100 kHz (Primary)			Not mentioned		
14 000-14 250 kHz (Primary)			Not mentioned		
18 068-18 168 kHz (Primary)			Not mentioned		

21 000-21 450 kHz (Primary)		Not mentioned	
24 890-24 990 kHz (Primary)		Not mentioned	
28 000-29 700 kHz (Primary)		29 300-29 510 kHz	
144-146 MHz (Primary)		144.0 – 144.025 MHz (Note 1)	
		145.8 – 146 MHz	
435-438 MHz (Note 2, Secondary)		435-438 MHz	
1 260 – 1 270 MHz (Note 2, Up-link, Secondary)		1 260 – 1 270 MHz (Note 2, Up-link Secondary)	
2 400 – 2 450 MHz (Note 2, Secondary)		2 400 – 2 450 MHz (Notes 2 and 3, Secondary)	
Not allocated	3 400 – 3 410 MHz (Note 2, Secondary)	Not allocated	3 400 – 3 410 MHz (Notes 2 and 3, Secondary)
5 650 – 5 670 MHz (Note 2, Up-link for Secondary		5 650 – 5 670 MHz (Notes 2 and 3, Up-link Secondary	
5 830-5 850 MHz (Down-link, Secondary)		5 830-5 850 MHz (Note 3, Down-link Secondary)	
10.45-10.5 GHz (Secondary)		10.45-10.5 GHz (Note 3, Secondary)	
24-24.05 GHz (Primary)		24-24.05 GHz (Note 3, Primary)	
47-47.2 GHz (Primary)		47-47.2 GHz (Note 3, Primary)	
76-77.5 GHz (Secondary)		76-77.5 GHz (Note 3, Secondary)	
77.5-78 GHz (Primary)		77.5-78 GHz (Note 3, Primary)	
78-81.5 GHz (Secondary)		78-81.5 GHz (Note 3, Secondary)	
134-136 GHz (Primary)		134-136 GHz (Note 3, Primary)	
136-141 GHz (Secondary)		136-141 GHz (Note 3, Secondary)	
241-248 GHz (Secondary)		241-248 GHz (Note 3, Secondary)	
248-250 GHz (Primary)		248-250 GHz (Note3, Primary)	

Note 1: In Region 1 this band is used for down link only.

Note 2: This band is allocated to the amateur-satellite service by **RR 5.282**.

Note 3: Region 3 bandplan says that societies should consult with the amateur satellite community for proposed satellite operating frequencies before deciding local bandplans above 1300 MHz.

The procedure for the IARU Satellite Frequency Coordination

Member States (countries) of the ITU have agreed to maximise the use of the radio frequency spectrum and to minimise interference through a treaty called the International Telecommunication Convention.

A space station operating in the amateur-satellite service is required to be notified via the ITU by the national regulator “notifying administration” under Article 11.2 of the RR since the use of a frequency assignment may cause harmful interference to a service of another administration. Prior to notification, in accordance with RR Article 9.1, the notifying administration of such networks is required to send to the ITU Radio Communications Bureau (BR) the advance publication information (API) not earlier than 7 years and preferably not later than 2 years before the date of bringing into use. The data to be submitted for the notification of the space station is specified in RR Appendix 4. Submission to ITU should be done through the national radio communication administration.

For reference: there is an exemption from the notification procedure under RR Article 11 for earth stations in the amateur-satellite service (RR Article 11.14 : Frequency assignments to ship stations and to mobile stations of other services, to stations in the amateur service, to earth stations in the amateur-satellite service, and those to broadcasting stations in the high-frequency bands allocated to the broadcasting service between 5 900 kHz and 26 100 kHz which are subject to Article 12 shall not be notified under this Article.) However, space stations in the amateur-satellite service are not exempted from the notification procedure under RR Article 11.

Prior to the notification of frequencies, coordination for amateur radio satellites is provided by the IARU through its Satellite Advisor, a senior official appointed by the IARU Administrative Council, its top policymaking body. The IARU Satellite Advisor is assisted by an Advisory Panel of qualified amateurs from all three IARU Regions. Some administrations, for example Japan, USA, require frequency coordination by the IARU prior to the API application.

A frequency Coordination request for an amateur-satellite service space station is made using the IARU Amateur Satellite Frequency Coordination Request Form. The form is available at http://www.iaru.org/satellite.html The IARU Amateur Satellite Frequency Coordination Request Form has a field for filling in the API number as received from ITU when performing the notification. If the information is not available at the time of filing in the

IARU form, it should be forwarded when available. More detailed information is available at ARS-Tutorial

Encryption

With the exception of control signals exchanged between earth command stations and space stations in the amateur-satellite service all amateur signals shall not be encoded for the purpose of obscuring their meaning. To meet this requirement, operators of satellites in the amateur-satellite service must publish full details of their modulation, encoding and telemetry formats and equations before launch.

Regulatory background

ITU Radio Regulations

- ARTICLE 1 Terms and definitions
  - No. 1.56 *amateur service:* A *radiocommunication service* for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorized persons interested in radio technique solely with a personal aim and without pecuniary interest.
  - No. 1.57 *amateur-satellite service:* A radiocommunication service using *space stations* on earth *satellites* for the same purposes as those of the *amateur service*.
  - No. 1.96 *amateur station:* A *station* in the *amateur service*.
- ARTICLE 22 Space services
  - No. 22.1 § 1 Space stations shall be fitted with devices to ensure immediate cessation of their radio emissions by telecommand, whenever such cessation is required under the provisions of these Regulations.
- ARTICLE 25 Section I - Amateur service. This section applies to terrestrial amateur stations as well as amateur satellite stations. Of particular interest for amateur satellite stations:
  - No. 25.2A 1A) Transmissions between amateur stations of different countries shall not be encoded for the purpose of obscuring their meaning, except for control signals exchanged between earth command stations and space stations in the amateur-satellite service. (WRC-03)
- ARTICLE 25 Section II - Amateur-satellite service

- No. 25.10 § 6 The provisions of Section I of this Article shall apply equally, as appropriate, to the amateur-satellite service.
- No. 25.11 § 7 Administrations authorizing space stations in the amateur-satellite service shall ensure that sufficient earth command stations are established before launch to ensure that any harmful interference caused by emissions from a station in the amateur-satellite service can be terminated immediately (see No. **22.1**). (WRC-03)

Note: The most important things are that amateur stations shall not be used for radiocommunication services other than the amateur-satellite service, shall not be used for any commercial purpose, shall not be operated by a person without an Amateur license issued by the administration of the country to which the station in question is subject and the person shall not be compensated for the operation.

Relevant ITU Resolutions

- RESOLUTION 642 Relating to the bringing into use of earth stations in the amateur-satellite service.

Relevant ITU Reports

- Report ITU-R SA.2312-0 Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites.
- Report ITU-R SA.2348-0 Current practice and procedures for notifying space networks currently applicable to nanosatellites and pico satellites.