



The International Amateur Radio Union

IARU

The IARU Satellite Frequency Coordination

Frequency Coordination for spacecraft using the Amateur Satellite Service

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The International Amateur Radio Union

IARU

- Founded in Paris 1925
- Sector member of ITU-R and ITU-D
- Represents the interests of national amateur radio member societies at the ITU and with RTOs (Regional Telecommunication Organizations)
- Represents the interests of two way amateur radio communication
- Has the role to coordinate satellite frequencies within the bands allocated to the amateur radio service
- Three Regional bodies similar to ITU Regions 1, 2 and 3
- Represented at ITU and RTOs by the officers and other volunteers
- Three international officers:
 - ❖ President Tim Ellam, VE6SH (CAN)
 - ❖ Vice-President Ole Garpestad, LA2RR (NOR)
 - ❖ Secretary Rod Stafford, W6ROD (USA)
- International NGO - headquartered in Newington, Connecticut, USA



What is the Amateur Service?

Amateur Service

- It is a radio communications service
- for the purpose of self-training, intercommunication & technical investigation
- and is performed by duly authorized persons interested in radio technology without monetary interests.

Amateur Satellite Service

- A radiocommunication service
- using space stations (satellites) and earth stations,
- for the same purpose as the amateur service





What do Radio Amateurs do?

Amateur radio is a popular technical hobby about the skill and fascination of communicating using radio. It covers a wide range of different activities and interests and here are some of them:

- Operate two-way radiocommunication – radio operating technics and message handling
 - ❖ Communicate in on many different frequencies and in different modes and modulation: Shortwave, VHF/UHF/microwave, Satellite, Earth-Moon-Earth, Tropo and Meteor Scatter. Digital and analogue voice and data modes, morse code
 - ❖ On the air Contests (max number of stations, longest distance)
 - ❖ Records (number of counties, longest distance on microwave)
- Continues to contributes to and demonstrate innovations Electronics
 - ❖ Developed packet radio
 - ❖ Automatic Packet Reporting System (APRS), usually utilizing GPS
 - ❖ Antenna designs
 - ❖ Digital voice and images
 - ❖ Software Designed Radio (SDR)
- Provides national and international Amateur Radio Disaster Communications
- Provides Public Service during disasters



What do Radio Amateurs cont...

- Amateurs Explore Signal & Propagation Phenomena
 - ❖ Observe, measure and record signals
 - ❖ Explore propagation modes, anomalies
 - meteor scatter
 - Earth-Moon-Earth (EME)
 - sporadic-E, Trans-equatorial spread-F
 - ❖ Numerous HF, VHF, UHF beacons
 - Promotes International Friendships and Understanding
 - Provides Learning Opportunities
 - ❖ Radio amateurs train themselves in
 - electronics
 - radio wave propagation
 - telecommunications techniques,
 - ❖ becoming a technical human resource for industry, government & the public.
 - Develops a nation's human resources
 - Is a disciplined & self-regulating service
- ❑ *There are nearly 3 million licensed radio amateurs worldwide.*
- ❑ **Amateur Radio continues to grow in both membership and technology advancement.**



Radio Amateurs and Space

- First **OSCAR** (**O**rbiting **S**atellite **C**arrying **A**mateur **R**adio) in 1961
- First two-way amateur-satellite contact: Germany-Switzerland
OSCAR 3 March 1965,
- Since then there has been many projects with satellites carrying amateur radio:
the largest spacecraft was Oscar 40 in 2000 >500kg launch mass
the longest lived is Oscar 7 launched in 1974 and still going strong
- There are specific AMSAT (Amateur Radio in Space) Organizations in more than 24 countries world-wide.
- Amateur Radio is a permanent part of ISS with many of the astronauts having a radio amateur license.
- A number of Amateur satellites have been designed and constructed by university students with the help of local amateurs and amateur-satellite organizations. Some examples:
 - Stellenbosch University (South Africa)
 - University of Surrey (UK)
 - University of Mexico
 - Weber State University (USA)



Currently active & future satellites

Number of current active Satellites in the Amateur Satellite Service allocated bands

44 satellites with downlinks and/or beacons in the 435MHz (70cms) band.

8 satellites with downlinks and/or beacons in the 145MHz (2m) band.

11 satellites that incorporate transponders:

- 3 FM voice satellites
- 6 Linear Transponder voice satellites
- 2 Digital data satellites

Future Satellites (almost all of them small pico or nano satellites)

There are over 100 projects planned for launch within the next 24/36 months

- About 50 of these are QB50 ones.
- Most going to LEO
- One going to GEO (Two linear transponders on Es'Hailsat in 2016)



Usage of the bands

A number of different bands are allocated to the amateur satellite service on a primary or secondary basis. It is mainly bands above 28 MHz (10m) that are used for this purpose.

- Primary – can claim protection from interference from secondary users
- Secondary – shall not cause harmful interference to primary users and can not claim protection from interference from primary users

But stations in the amateur satellite service can not claim protection from one another and must accept interference from other stations in the Amateur satellite service

To minimize interference and chaos between internal uses in the amateur and amateur satellite service, we have:

- Bandplans
Self-regulatory agreement on how to share an allocation between various amateur and amateur satellite application, user groups, modulation types etc.

A VHF band plan may have separate segments for modes like EME, weak signal DX, FM simplex, digital voice, FM repeaters, digital data, APRS and satellite just to mention a few.

For example in the 144 – 146 MHz band, the segments 144.002-144035MHz and 145.794 – 146 MHz are designated for the amateur satellites.
- Frequency coordination
By assigning different frequencies to each user within the selected band segment mutual interference is minimized . Unique or exclusive frequencies are not possible – all have to be shared to some extent



Amateur satellite service allocations

Wavelength	Frequency band (MHz) (R = Region)	Applications
10 m	28 000-29 700 (primary)	This band is used primarily in conjunction with an input or output in the 144 MHz band.
2 m	144-146 (primary) Satellite: 145.794 – 146	These bands are in heavy use by numerous amateur satellites for inputs and outputs.
70 cm	435-438 (secondary) RR No. 5.282	
23 cm	1 260-1 270 (secondary) Earth-to-space only RR No. 5.282	These bands are used as alternatives to the 144 MHz and 435 MHz bands because of congestion.
13 cm	2 400-2 450 (secondary) RR No. 5.282	
9 cm	3 400-3 410 (secondary) Regions 2 and 3 only RR No. 5.282	



Amateur satellite service allocations

Wavelength	Frequency band (MHz) (R = Region)	Applications
5 cm	5 650-5 670 (Secondary) Earth-to-space only RR No. 5.282	These bands are used for experimental amateur satellites.
	5 830-5 850 (secondary) Space-to-earth only	
3 cm	10.45-10.5 (secondary)	These bands are used for experimental amateur satellite communications.
1.2 cm	24-24.05 (primary)	
6 mm	47-47.2 (primary)	These bands are used for experimental amateur satellites.
4 mm	76-77.5 (secondary)	
	77.5-78 (primary)	
	78-81 (secondary)	
2 mm	134-136 (primary)	
2 mm	136-141 (secondary)	
1 mm	241-248 (secondary)	
1 mm	248-250 (primary)	



Amateur Satellite Service

Who can use the bands allocated to the Amateur Satellite Service?

- Licensed radio amateurs (must have a national amateur radio license valid for those bands in question)
- Must obey and follow the rules and regulations given in the license as well as the ITU (RR) radio regulations:

RR 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*.

RR 1.57 *amateur-satellite service:*

A *radiocommunication service* using *space stations* on earth *satellites* for the same purposes as those of the *amateur service*.

NOTE: “Without pecuniary interest” means that you may accept free will donations of goods and services, that is, with nothing required in return. You may not sell services or data to anyone for any reason.

- Before asking for help from IARU with frequency coordination in the amateur-satellite service, make sure that your proposed operation meets the treaty requirements. (The IARU Satellite Advisor as well as the national amateur radio society may be able to help).
- Ultimately, the decision of whether the proposed operation is appropriate for the amateur-satellite service rests with your country’s administration (your national telecommunication regulator). Therefore, before sending your frequency coordination request to IARU, we suggest that you consult with your administration to determine whether the amateur satellite service or another radiocommunication service is appropriate for your operation.



Why IARU Frequency Coordination

Why is frequency coordination necessary ?

- To avoid or minimize interference with and from other users in the same band

Amateur radio satellites present a special problem because satellites have global effect. Only a global frequency coordination system can work. Uncoordinated satellites will cause harmful interference to stations around the world and receive interference from them — which could result in mission failure.

Coordination serves everyone's best interests!

When to make the Frequency Coordination Request to the IARU

- Make your frequency coordination request as far in advance as possible. Remember, coordination takes account of your own needs and the needs of others. Receiving coordination early enough makes design and construction easier and less expensive. In any event, be sure to make your request while it is still possible to change operating frequencies in response to the Satellite Advisor's recommendations.
- If planning (preliminary design review), filing and frequency coordination start at the same time there won't be any time pressure.

Who makes the frequency coordination request to the IARU?

- The prospective space station licensee must make the coordination request, as that person will be **responsible** for space station **transmitter operations**.



Satellite Advisory Panel

IARU Satellite Advisor

Hans van de Groenendaal, ZS6AKV

Advisory Panel

Region 1

Graham Shirville, G3VZV
Norbert Notthoff, DF5DP
Mike Rupprecht, DK3WN

Region 2

Lee McLamb, KU4OS
Art Feller, W4ART

Region 3

Shizuo Endo, JE1MUI

Special Advisors

Ray Soifer, W2RS
Jan King, VK4GEY/W3GEY

All e-mail addresses see: <http://www.iaru.org/satellite.html>



Where to find help on the WEB

<http://www.iaru.org/satellite>

Amateur Radio Satellite Frequency Coordination

The IARU Administrative Council has appointed Hans van de Groenendaal ZS6AKV as the IARU Amateur Satellite Advisor. He has appointed a panel of experts to assist him to coordinate frequencies and assist satellite builders and prospective builders with advise.

Advisory Panel

IARU Satellite Advisor

Hans van de Groenendaal, ZS6AKV: h.....@intekom.co.za

Region 1

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Jan King, VK4GEY/W3GEY: j.....@eclipticenterprises.com

Materials

- [Amateur Satellites](#)
- [Frequency Coordination Request \[PDF\]](#)
- [Frequency Coordination Request \[doc\]](#)
- [Experimental Station Frequency Coordination Request \[PDF\]](#)
- [Experimental Station Frequency Coordination Request \[doc\]](#)
- [Satellite Frequency Coordination in the Two-Metre Band \[PDF\]](#)
- [International Forums](#)
- [Controlling Satellites \[PDF\]](#)
- [ITU requirements for Amateur Radio Satellites](#)
 - [ITU Amateur Satellite Registration Tutorial \[PDF\]](#)
 - [ITU Amateur Satellite Advance publication \(API\) Capture \[PDF\]](#)
 - [ITU Amateur Satellite Notification Capture \[PDF\]](#)

Frequency Coordination Status

Find the **current frequency coordination status** for new satellites.





Request Procedure:

What is the procedure to request an IARU Frequency Coordination?

Remember, the IARU can only coordinate frequencies within the band(s) allocated to the Amateur Satellite Service!

1. Determine if you can use the amateur satellite service bands (if your mission complies with the amateur regulations) and that you have a licensed radio amateur responsible for all transmissions
2. Select your band or bands of operation
3. If you are a purely scientific project, consider if you can implement some useful function to the radio amateur community (transponder/repeater etc.) as part of your mission or as a courtesy after the scientific part of your mission
4. Provide **your administration** with all information necessary for **them** to notify ITU, If necessary assist the administration with the API-information to the ITU
5. Fill the IARU Frequency Coordination form
Remember the IARU can only coordinate frequencies in bands allocated to the amateur satellite service in the international ITU radio regulations (RR).
6. Send the form (exclude the preface) by e-mail to the IARU Satellite Advisor (satcoord@iaru.org) . Use the requested file name syntax. Please also include additional project/program information by giving relevant URLs or other references.



Send in the form – check your status

7. Contact your National Communications Authority and ensure that they start the ITU procedures NOW!
8. Pay attention to any questions coming back from the satellite advisor and respond to them immediately. This is important otherwise your request will just be put on hold awaiting such response.
7. You can follow the status of your request on the WEB:
<http://www.iaru.org/satellite>
or
<http://www.amsat.org.uk/iaru>
7. When the coordination is complete, you will get a coordination letter by e-mail. Remember to share this information also with your administration.
8. Follow up information to the IARU Satellite Advisor as well as your national administration with launch details and remind your administration to have the satellite registered by ITU. This is important in order to solve any interference issues as well as to ensure that the use of the amateur satellite allocations are registered.

Remember:

Only national administrations can undertake the required ITU procedures.

	
The International Amateur Radio Union	
Since 1925, the Federation of National Amateur Radio Societies Representing the Interests of Two-Way Amateur Radio Communication	
IARU Amateur Satellite Frequency Coordination STATUS REPORT	
Back to IARU Satellite Page	For more information contact satcoord@iaru.org
Latest Sat to be updated : RadFXSat Updated on: 15 Feb 2015	
Sats which have formally requested Frequency Coordination (in process)	
Sats for which frequencies have been coordinated.	
Sats which we have INFORMAL information about.	
Download Jan King's Link Budget, etc Spreadsheets	

The IARU Amateur Satellite Frequency Coordination Status pages are hosted by [AMSAT-UK](#) as a service to the world wide Amateur Satellite Community



The Coordination Request Form

Content:

- Preamble with a short introduction and presentation of the IARU Frequency Coordination procedure including references to the various ITU radio regulation articles and procedures
- Details on where to find guidance and references on the web
- Details on who to contact for assistance
- E-mail address for where to send the filled form

The coordination process is easier than it looks at first sight!

- If you are able to build a satellite you should be able to provide the information needed for filing your satellite.
- The information required for the ITU Advanced Publication (API) is almost identical to the information required for the IARU frequency coordination.

Additional information

- Do not attach large files. Indicate the URL where the information is available



The form to fill



The International Amateur Radio Union

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

AMATEUR SATELLITE FREQUENCY COORDINATION REQUEST

(Make a separate request for each space station to be operated in the amateur-satellite service.)

Administrative information:

0	DOCUMENT CONTROL	
0a	Date submitted	(dd-MMM-yyyy)
0b	Expected launch date	(dd-MMM-yyyy)
0c	Document revision number (start at zero and increment with each revised request)	(0)
1	SPACECRAFT (published)	
1a	Name before launch	(often the name followed by a sequential letter)
1b	Proposed name after launch	(often the name followed by a sequential number)
1c	Country of license	
1d	API/A special section number	This reference number is assigned by ITU/BR <i>after</i> your administration has submitted its API notice to the ITU. Get the number from your administration and forward it to the IARU Satellite Advisor.



IARU coordination form

- The form should be filled with relevant technical and administrative data about the project.
- This information is more or less the same info that is requested by the ITU API process
- Detailed fields to fill:

Administrative

- ❖ Expected launch date
- ❖ Proposed Spacecraft name before and after launch
- ❖ API/A special section number -
This reference number is assigned by ITU/BR *after* your administration has submitted its API notice to the ITU. Get the number from your administration and forward it to the IARU Satellite Advisor.
This is a reminder to the project to get the administration to start this procedure preferably before the coordination form is sent.
- ❖ Name, contact information and position of Licensee and other people in the project
- ❖ Organisation – name, address, e-mail
 - National amateur Radio Society
 - National amateur Satellite organization



IARU coordination form

Space station Information

- ❖ Mission - *Describe in detail what the space station is planned to do.*
- ❖ *Duration*
- ❖ *Proposed transmitting and receiving plan*
 - *Frequency or frequency band*
 - *Output power (tx)*
 - *Description of modulation type and data rate - ITU emission designator*
 - *Antenna gain*
 - *Noise temperature (RX)*
- ❖ Physical structure – general description, dimensions, mass, antenna placement etc.
Give URL for drawings
- ❖ Functional description
- ❖ Power budget



Amateur Satellite Service

TELECOMMAND

- Telecommand Frequency plan
 - ❖ Frequencies
 - ❖ Emission designator
 - ❖ Common description of modulation and data rate
 - ❖ Link power budget
 - ❖ General description of cipher system
- Space station transmitter control.

*Explain **how** Telecommand stations will turn off the space station transmitter(s) immediately, even in the presence of user traffic and/or space station computer system failure.*

NOTE: *Transmitter turn off control from the ground is absolutely required.
Good engineering practice is to make this capability independent of all other systems.
<http://www.iaru.org/satellite/ControllingSatellites v27.pdf>*

RR 25.11 *Administrations authorizing space stations in the amateur-satellite service shall ensure that sufficient Earth command stations are established before launch to insure that any harmful interference caused by emissions from a station in the amateur-satellite service can be terminated immediately. (See No. **22.1**).*

RR 22.1 *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.*



IARU coordination form

Telemetry

- Telemetry frequencies
 - ❖ list all bands and frequencies
 - ❖ emission designator,
 - ❖ description of modulation type and data rate.,
 - ❖ link budget (Show link power budget or URL with detailed information)
- Details of telemetry (format(s) and equations)

Remember telemetry must be in a format accessible to radio amateurs (or a description must be published – give URL). To comply with the amateur satellite service, the telemetry data can not be encrypted.

RR 25.2A

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.

Please explain how other amateur radio operators will be able to receive the telemetry data.

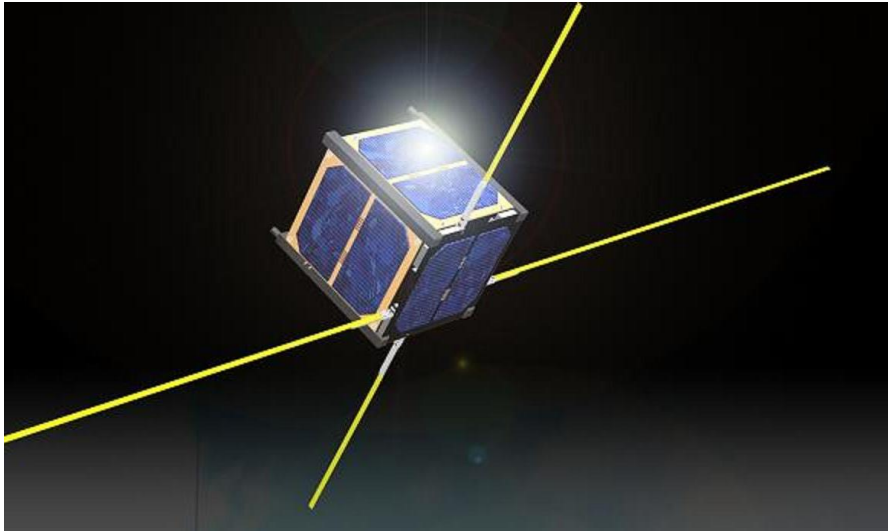


IARU coordination form

- Launch plans
 - ❖ Launch agency
 - ❖ Launch location
 - ❖ Expected launch date
 - ❖ Planned orbit - Launch data (agency/location/launch vehicle) will in most cases then also automatically give you the necessary approximate orbit data to fill in
 - ❖ **Which other satellites are expected on the same launch?**
- Earth station information
 - ❖ Description of a typical Earth station used to transmit signals to the planned space station.
Remember: an Earth station must be licensed in the country it transmits from.
 - ❖ Show link power budget for all Earth station transmit frequencies except telecommand (or give URL with detailed information)
 - ❖ Description of a typical Earth station to receive signals from the planned satellite.
 - ❖ Link power budget. - *Show complete link budgets for all Earth station receiving frequencies.*
- Signature
 - ❖ The form must be signed and the responsible radio amateur must tick a box to indicate whether or not he feels that the proposed operation in the amateur-satellite service is consistent with the radio regulations as interpreted by the preamble and if not to explain his interpretation.



Questions ?



FUNcube-1

Thank you !



Satellite Earth station