Registering an Amateur Satellite

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1. Introduction

This document is intended to serve as a guide with respect to the formal coordination of an amateur radio satellite. This process will only be valid for the coordination of an amateur radio payload on a commercial mission or a radio amateur satellite operating without any pecuniary interests. Failure to do so will lead to a rejection of the request by the IARU[1].

This document is purely intended as a guide and is written based off my experience with registration of the FossaSat-1 satellite, who's registration process has not yet been completed. This document will be updated as the coordination process progresses.

The registration of the FossaSat-1 satellite has been carried out under Spanish legislation with the Spanish Ministry of Industry, Energy, Digital Advance & Tourism. Documents for the ITU[2] & IARU will not differ between countries, documents intended for national regulatory agencies will however differ from country to country.

2. Who? When? Where?

Only a registered radio amateur is able to act as responsible satellite operator in the request, this person will be legally in charge of the operation of the satellite during the request process and in the case of any interference caused by the satellite.

It is strongly suggested to start the registration of your satellite as soon as possible, normal processing times for these requests usually take from around 6 months to year but can be theoretically last up to 7 years (very uncommon). A good moment to submit the coordination request is after completing your preliminary design review, specific

[1] http://www.iaru.org/satellite.html
[2] https://www.itu.int/en/ITU-R/space/Pages/supportSmallSat.aspx

frequency or modulation information can be modified during the request but it is necessary to have a common basis.

The registration process of an amateur satellite is divided in 2 main parts, the ITU API[3] (Advanced Publication Information) submission and the IARU frequency coordination request. The API itself is a file created by ITU software explained later in this document. It is a mandatory requirement that the licensing administration files an API with the ITU in order to receive a special API/A number, this should be preferably done before requesting frequency coordination from the IARU. All documents for your national regulatory agency / ITU & IARU should be prepared beforehand and preferably sent at the same time.

The registration of FossaSat-1 in Spain did not involve the need of any insurance, countries such as the UK however require a launch insurance which greatly increases the cost, we recommend you plan your registration country ahead to avoid future complications. The cost of the registration depends on your regulatory agency's fees, in Spain the total amounted to just under EUR 200.

The timeline for our request is as follows:

- Find who is in charge of the ITU submission in your national regulatory agency and what documents you need to submit
- Prepare documentation needed for ITU / National regulatory agency & IARU
- Send out documentation to ITU / National regulatory agency & IARU
- Process the request with the IARU until they accept the request and you have received the API/A number.

3. ITU API Request / National Regulatory Agency

Your API request can only be submitted through your national regulatory agency, additionally they are in charge of handling other requests such as adding your satellite to the United Nations Register of Objects Launched into Outer Space[4]. Finding out who is in charge of this process within your country is not as trivial as it may seem and personally took me a couple months of calls to find said person.

[3] https://www.itu.int/en/ITU-R/space/WRS14space/API.pdf
[4] http://www.unoosa.org/oosa/en/spaceobjectregister/index.html

Besides the API digital document itself, your national regulatory agency will require a number of legal declarations and technical documents to carry out the request. Here is the list of documents requested by the Spanish authorities:

- Declaration of non-pecuniary interest (Self – explanatory)
- Technical report of the satellite (In our case a 20-page document explaining all technical aspects of the satellite and its functionality)
- Declaration of radiocommunications equipment (Description of the radio telecommunications equipment used on the satellite and the ground station/s)
- Satellite callsign request (Self-explanatory)
- Orbit / spectrum resource request (Legal request, depends on national legislation)
- IARU frequency coordination letter (The letter which is intended to be sent to the IARU)
- API file (Explained in part 4)

Luckily, we were able to obtain the satellite callsign request and orbit / spectrum resource request from a national university that had previously launched an amateur satellite. These requests are subject to national legislation and obviously vary from country to country, you can probably find some information online regarding what laws to base your request off.

4. API File Creation

The API file contains all information regarding the satellite network and its parameters, it is the document needed by the ITU for them to give you an API/A number. This API file is created using the ITU's SpaceCap V8[5] and SpaceVal[6] software. This software should be updated using SpaceRefdb[7] prior to creating the API. SpaceCap has a basic interface that will "guide" you through entering the necessary information to create the API. The software is very glitchy and generally flawed, it personally took us weeks of trying before we could get it to work properly, contacting the ITU might help.

I will not explain the full process on how to complete the API document but will only explain the less obvious aspects of it that could be confusing. No official manuals exist on using this software but the following presentations will be useful.

[5] https://www.itu.int/en/ITU-R/software/Pages/spacecap.aspx
[6] https://www.itu.int/en/ITU-R/software/Pages/spaceval.aspx
[7] https://www.itu.int/en/ITU-R/software/Pages/spacerefdb.aspx

https://www.itu.int/en/ITU-R/space/WRS14space/API.pdf - This presentation outlines the validation process and general information about the request, it is not essential and seems to be targeted to the national regulatory agencies.

https://www.itu.int/en/ITU-R/space/AmateurDoc/ARS-API_help.pdf - **This is the main document** showing slides of what needs to be filled in, it does not explain then but merely points at sections with red boxes and arrows. A lot of commons sense and guess work is needed.

https://www.itu.int/en/ITU-R/space/Documents/cubesat-1_%20API.mdb – This is an example API .mdb file.

https://www.itu.int/en/ITU-R/space/Documents/API-Steps%20to%20modify%20the%20sample%20cubesat-1%20database.pdf – This document also shows how to file the API with some additional information, it seems to be the updated version of the previous presentation that modifies the provided .mdb file.

https://www.itu.int/en/ITU-R/space/Documents/To%20convert%20API%20to%20notification%20(1).pdf – This is an extra step that is necessary, it converts the API to a notification to be added to the final zip file containing the .mdb file changed to a .itu file and the .mdb notification.

https://www.itu.int/en/ITU-R/space/publicationLegend/legend_E.pdf - This is an explanation of all the codes used in the SpaceCap software and will be needed.

Things to take in mind / possible confusions:

- Orbital Plane Information A4b4 is just an estimated orbit based off your estimated launch, this needs to be filled regardless of your knowledge on your launch from what we understand. Minimum altitude should be same as perigee if not known.
- C4a. Should be EA.
- Antenna radiation patterns can be found here: https://www.itu.int/en/ITU-R/software/Pages/ant-pattern.aspx
- C6 asks for polarization angle for linear antennas, if spacecraft is passively stabilized this cannot be a static number.
- C11a. service area should be XAA if global on uplink and downlink beam.

- Select other in A3a. if your administration is not on the list
- A2b. Period of validity of the request, we selected 5 years.
- Emissions requires some complicated data, especially the Maximum power density C8a2/C8B2 that is explained here: https://www.itu.int/en/ITU-R/space/WRS16space/WRS-16%20avg%20BW.pdf
- C8e1 C/N is carrier to noise ratio in dB.
- The ITU emissions designator must be a combination of 9 alphanumeric characters following this code:
  https://www.comreg.ie/media/dlm_uploads/2015/12/ComReg0834.pdf
  You must add hyphens to complete the 9 characters
- You must select a carrier frequency, this will get changed anyways with the IARU.

  Once all the required API information has been completed you should check every page using the black tick validation at the top right of the page, when greeted with an error code check it with the data in the following link:
  https://www.itu.int/en/ITU-R/software/Documents/spaceval/VR8Ap42e.pdf

  Once all the pages are checked you can check the document using the green tick in the API notice explorer, you will most likely be greeted by a plethora of fatal and non-fatal warnings. You must have no fatal warnings to submit the API, the only non-fatal warning you should have is the satellite name not being registered.

  Once completed export the document and make a notification copy following the information outlined in the link previously mentioned.

5. IARU Frequency Coordination form

The IARU requires that you send them a request via email, information on how to carry out this form is very well explained and can be found in the following links:

- http://www.iaru.org/satellite.html Home Page of the IARU satellite coordination division.
- http://www.iaru.org/amateur-radio-satellite-frequency-coordination.html Introduction on requesting the frequency coordination.
- http://www.iaru.org/uploads/1/3/0/7/13073366/iaru_amateur_satellite_coordination_request_instructions_01aug17.docx Instructions on the satellite request form.
- http://www.iaru.org/uploads/1/3/0/7/13073366/iaru_amateur_satellite_coordination_request_v39.doc Request form itself, updated periodically.

While filling in the form take in mind the following things:

- A radio amateur with longer experience is more preferable.
- Contacting your national AMSAT and National Amateur Radio Society for help & a recommendation is preferable.
- Describe thoroughly what relevance your mission has to the radio amateur community.
- 4d4 should be the same as the ITU API (Similarly to all other radio modulation and general information)
- 4d6 must include a radiation pattern diagram, we used CST Studio (It's free)
- 5b is very important and must count with a proper control system, explain this thoroughly and understand it by reading the following document: http://www.iaru.org/uploads/1/3/0/7/13073366/controllingsatellites_v27.pdf
- 5c1 should have a registered ground station.
- 7 must be once again estimated launch plans.

The IARU holds meeting every month and announces them on their satellite home page, make sure to send the documentation at least 2 days before the scheduled meeting.

Once the request has been made you can check its status here:
http://www.amsat.org.uk/iaru/

Additionally, they will get in contact with your through email.

6. Conclusion

Registering a satellite is as hard as it seems, but with some patience it should be no problem for most people. We still have not completed the registration process for FossaSat-1 and will update this document as the situation progresses. I have probably forgotten certain issues with SpaceCap or its related software, additionally I am more than happy to share our documentation with others.

Feel free to ask me any questions.

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