



International Amateur Radio Union Region 1 2011 Regional Conference – Sun City, South Africa 12 to 19 August 2011



Subject	VHF Handbook Satellite Chapter		
Society	RSGB	Country:	Great Britain
Committee:	C5	Paper number:	SC11_C5_44
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Introduction

This paper brings to conference the new VHF Handbook chapter on Amateur Satellites, as commissioned by a series of recommendations at the 2008 Region 1 Conference at Cavtat

Background

At the Cavtat Conference, Paper 'CT08_C5_20 Amateur Satellite Handbook Chapter' resulted in a series of recommendations that gave a mandate for a thorough update of the Amateur Satellite chapter. (Chapter 9 in VHF Managers Handbook v5.42)

In addition, the information on the IARU-AC website, which is referenced, has also had a wide-ranging set of updates and additions by the IARU Satellite Advisor, including new advice with respect to ITU filing procedures.

Key points and proposal

The draft chapter attached updates the Handbook and strengthens the amount of information with regard to Satellite coordination, in order to provide a useful resource to managers and a firm foundation on which future activities or expansion can be based

Recommendation

That the draft chapter be adopted and incorporated in the VHF Managers Handbook

9 Amateur Satellites

9.1 Introduction

The Amateur Satellite Service is a radiocommunications service using spaceborne radio equipment for the same purposes as the Amateur Service. This includes amateur communications by earth orbiting satellites, interplanetary missions and contacts with astronauts on the International Space Station.

Starting with the launch of Oscar-1 in 1961, amateur satellites have become increasingly sophisticated. They have provided voice and data links, served school science groups, provided emergency communications, acted as technology demonstrators and transmitted Earth images. Construction and operation of any amateur satellite is subject to a range of ITU, IARU and other regulatory and coordination procedures.

9.2 IARU Region 1 and IARU Satellite Coordination

Satellite builders should make certain that their operating frequencies are coordinated to ensure that mutual interference between different spacecraft does not occur. More information about this process can be found here: <http://www.iaru.org/satellite/>

National VHF/Microwave Managers and Amsat organisations are encouraged to closely coordinate activities and monitor developments in their countries so that, for example, CubeSat projects are fully coordinated. Advice is available from IARU Satellite Advisor and Coordinators.

9.3 Amateur Satellite Names

Amateur Satellites are currently named within two generic groups, one is OSCAR, which is an acronym for Orbiting Satellite Carrying Amateur Radio and the other is RS, which is an acronym for Radio Sport, the description used for Amateur Radio in the former Soviet Union.

A nomenclature has been developed that includes a reference to either the group that built the satellite or a name that the builders would like assigned to their satellite e.g. UoSAT-OSCAR -22 that was built by the University of Surrey and Fuji-OSCAR -20 which was built in Japan. For simplicity, most Amateur Satellite names are abbreviated to XX-yy e.g. UoSAT-OSCAR-22 is known as UO-22 and Fuji-OSCAR-20 is known as FO-20. Most of the Russian-built Amateur Satellites are simply known as RS-yy.

The OSCAR designation is administered by Amsat-NA not IARU. There is no requirement for an OSCAR number to be assigned to an amateur satellite in order for it to be legitimately recognised and used in the amateur satellite service. However, OSCAR numbers are a proud tradition of amateur radio that should be supported and continued.

9.4 Amateur Satellite Band Plan Usage

In IARU Region 1 band plans, the following frequency segments are designated for use by satellites:-

- 145,800 - 146,000 MHz (out of the overall 144 - 146 MHz ITU allocation)
- 435,000 - 438,000 MHz
- 1260 - 1270 MHz (uplink only)
- 2400 - 2450 MHz
- 3400 - 3410 MHz (only available in a few Region 1 countries)
- 5650 - 5670 MHz (uplink only)
- 5830 - 5850 MHz (downlink only)
- 10,450 - 10,500 GHz
- 24,000 - 24,050 GHz
- 47,000 - 47,200 GHz
- 76,000 - 81,000 GHz
- 134,00 - 136,00 GHz
- 136,00 - 141,00 GHz
- 241,000 - 248,00 GHz
- 248,000 - 250,00 GHz

In addition, for information, the Amateur Satellite Service also has the following HF allocations:

- 7,000 – 7,100 MHz
- 14,000 – 14,250 MHz
- 18,068 – 18,168 MHz
- 21,000 – 21,450 MHz
- 24,890 – 24,990 MHz
- 28,000 – 29,700 MHz

9,5 Satellite Transponder Designations

Apart from beacons and telemetry transmissions, amateur satellites often carry transponders. There are two methods of designating operation modes and frequencies. The original method specified by operational mode type was as per the table below:-

MODE	Uplink between	Downlink between
A	145,8 - 146,0 MHz	29,3 - 29,5 MHz
B	435 – 438 MHz,	145,8 - 146,0 MHz
J	145,8 - 146,0 MHz	435 - 438 MHz
K	21,26 - 21,30 MHz	29,40 - 29,50 MHz
L	1260 - 1270 MHz	435 - 438 MHz,
S	435 - 438 MHz	2400 - 2450 MHz
T	21,26 - 21,30 MHz	145,8 - 146,0 MHz

Subsequently a more flexible alternative method has been developed where the input (uplink) is always specified first, A slash is used to separate input and output:-,

Band	Wavelength	Designator
21 MHz	15 m	H

29 MHz	10 m	T
144 MHz	2 m	V
435 MHz	70 cm	U
1260 MHz	24 cm	L
2400 MHz	13 cm	S
5650 MHz	6 cm	C
10 GHz	3 cm	X
24 GHz	1,5 cm	K

When this newer method is used for transponder modes, the older designations become:-

Old Name	New Name
A	V/T
B	U/V
J	V/U
K	H/T
KA	H,V/T
KT	H/T,V
L	L/U
S	U/S
T	H/V

9,6 ITU Notification Requirements for Amateur Satellites

Background

In recent years there has been a dramatic increase in the number of satellites being launched which operate on frequencies in the Amateur Satellite Service,

The Amateur Satellite Service has different and less onerous notification and registration requirements than most other Satellite services, However it has been noted that many satellites have not actually been notified to the ITU at all, This has led to their records of frequency usage, which are often examined by other services, providing an incomplete picture to our possible detriment, This section shows the correct procedure which should be followed for all such projects,

It should be noted that this ITU procedure should proceed in parallel with the IARU Frequency Coordination process which is still required, All member societies are requested to familiarise themselves with this procedure and to encourage/ensure that satellite builders in their country follow the process,

Procedure

The Potential Amateur Satellite Builder

- A potential amateur satellite builder is required to inform their National Telecommunications Regulatory Authority about their planned satellite project,

The Regulatory Authority

- Verifies that the project is in accordance of Article-25 and other provision of the Radio Regulations (RR)
- Checks if the satellite, telemetry and command ground station(s) will be operating under valid amateur licenses
- In cooperation with the responsible amateur licence holder, submits the required API (Advanced Publication Information) information to the ITU (Bureau) – see the required data in the wizard at:
<http://www.itu.int/ITU-R/space/support/ARS/ARS-APIhelp.pdf>
It is only necessary to send general orbital characteristics, frequency bands (not exact frequencies), emissions, service area, antenna diagrams and some other data – see the wizard,
- The Bureau will publish, based on the API data from the Regulatory Authority, an API/A special section to inform all administrations about the project
- At the same time (as submitting the API to the Bureau), or preferably earlier, the responsible amateur license holder should contact the IARU Satellite Adviser and submit all required information for the IARU amateur satellite frequency coordination process, See the information at <http://www.iaru.org/satellite/>
- The National Regulatory Authority (with help of the Bureau) has to solve any API potential problems (for example exclusion of country from the service area of the satellite) and the Bureau will publish it in API/B publication,
- When the IARU amateur satellite frequency coordination is completed the IARU Satellite Frequency Coordinator informs the responsible amateur license holder of the coordinated frequencies and some other (if necessary) conditions/restrictions,
- If all is in order, the National Regulatory Authority, in cooperation with the Satellite builder, submits the required notification data to the Bureau using SpaceCap software (see CR/303 for details) – more detailed data, including EXACT frequency assignments (notification wizard is under preparation)
- The Satellite has to be operational within 7 years from the date of the receipt of the API information, Notification shall reach the Bureau not earlier than 3 years before the satellite is operational, The Bureau will publish, based on the notification data, a PART I-S publication – acknowledgment
- The Bureau will publish the result, in its technical and regulatory examinations and findings, in PART II-S publication – resulting in INTERNATIONAL RECOGNITION and RECORDING of the satellite in the Space Master Register following all regulatory requirements of the Radio Regulations

9,7 IARU-AC RESOLUTION 89-3 - CONCERNING AMATEUR SATELLITE USAGE

The IARU Administrative Council, Orlando, September 1989, recognised the important contributions made by amateur societies in the following areas:

- demonstration to the professional community that radio amateurs contribute to the development of state-of-the-art technology and techniques

- provision of new and challenging operational opportunities and training ground for radio amateurs to acquire new skills
- providing opportunities for training in an exciting technological field by direct participation, in schools, universities and professional organisations, and
- stimulating the interest of young people in a worthwhile activity, and encouraging the pursuit of a technological career to provide the next generation of industrial and research engineers,

Wishing to stimulate the growth of the Amateur Satellite Service in an orderly manner, the Administrative Council strongly supports the following goals:

- the encouragement of a wide dynamic range of activities stimulating training through increasing intellectual challenge
- the stimulation of young people in schools and universities to develop an interest in amateur radio through participation in amateur satellite activities
- where allowed, the provision of emergency services, especially to parts of the world that are less technologically developed, and
- the adoption of a "code of practice" that ensures the use of amateur frequency allocations by satellites in accordance with the spirit and ethos of amateur radio,

The Administrative Council resolved that:

- 1) Member societies shall make Administrations more aware of the value and achievements of the Amateur Satellite Service,
- 2) Satellites operating within amateur frequency allocations shall carry payloads and experiments that are relevant to, of interest to and available for participation by radio-amateurs worldwide,
- 3) Operational frequencies of amateur satellites shall be in accordance with all applicable IARU band plans
- 4) The use of higher frequency bands by amateur satellites shall be encouraged,

9,8 TERMS OF REFERENCE OF THE IARU SATELLITE ADVISER

General: An advisory and representational role, requiring technical knowledge and good interpersonal skills,

Function: To keep the Administrative Council informed on all technical and operational aspects of the amateur-satellite service, and to provide advice and assistance to enable the Council to adopt appropriate policies, and also to better inform the satellite community of the IARU,

Appointment: The IARU Satellite Adviser shall be appointed by the Administrative Council and the position, the appointment and these terms of reference shall continue until the next meeting of the Administrative Council, which may or may not reconfirm this position, the appointment and these terms of reference,

Tasks: Report to the Administrative Council, providing information as to all developments in the satellite area, including all planned amateur satellites,

At the request of the Administrative Council, provide technical and operational advice to assist the representation of the amateur-satellite service to the ITU,

And attend such meetings of the satellite community as are appropriate,

Represent generally the IARU to the satellite community and particularly to new or non-AMSAT satellite groups,

To consult with and liaise with the satellite community as appropriate,

To appoint any assistants that may be required,

9,9 TERMS OF REFERENCE OF THE IARU AMSAT SATELLITE FREQUENCY COORDINATOR

General: The IARU AMSAT (Amateur Satellite) Frequency Coordinator (IAFC) is an operational role, requiring high technical competence and a detailed knowledge of amateur satellites, frequency management as well as of IARU band plans,

Function: The IAFC shall assist the IARU Satellite Adviser and provide a service to enable any group to coordinate frequencies and emissions of a planned satellite intended to operate on Amateur Frequencies, under the license from the group's national administration, with existing and other planned amateur satellites,

Appointment: The IAFC is appointed jointly by the IARU Satellite Adviser (ISA) in consultation with the consensus of the recognized AMSAT Groups. The necessary liaison for this purpose with and among AMSAT Groups is to be conducted at the Annual IARU International Satellite Forum and, between Forum meetings, via Internet (amsat-international@amsat.org). The IAFC shall report both to the ISA and to the AMSAT Groups,

The appointment is to last until the next Annual IARU International Satellite Forum, at which it may be reconfirmed or a new appointment made. The ISA after obtaining the concurrence of the AMSAT Groups as above, may revoke the appointment at any time, and the appointment shall thereupon cease. Any vacancy in this position, whether by resignation or revocation, shall be filled as soon as possible in the manner set

forth above,

Tasks: Maintain a data base of all operating and planned satellites on Amateur Frequencies including frequencies, emissions and orbits,

Upon request of an individual or group proposing to build a satellite to operate on Amateur Frequencies, provide information and advice to assist that prospective builder in the choice of frequencies and modes with the view of minimizing interference,

Through publicity and direct communication, seek out prospective satellite builders and to encourage them to make use of this service, This function is jointly shared with the ISA,

Promptly provide all information required by the ISA,

After taking into account the input from various experts, it is the IAFC's task to make appropriate recommendations to the satellite builder(s), The IAFC is supported in this task by the ISA,

Publish quarterly reports for distribution to the ISA, IARU national Societies and AMSAT Groups, Distribution to the AMSAT Groups will be considered fulfilled if said reports are posted on the amsat-international@amsat.org Internet distribution,

While this position is a technical position, the IAFC has an important role in assisting in the protection of bands allocated to the amateur satellite service,

To this end the IAFC is tasked to work with the AMSAT Groups to develop a protection plan which should be submitted to the IARU Satellite Adviser who's task it is to achieve endorsement from the IARU Regions and incorporation in band plans,

It is also important that the role of the IAFC is not confused with that of the ISA, To this end:-

- The role of the IAFC is restricted to providing advice as set out above, and in particular shall not make any statement(s) that could be understood to be expressing IARU policy, which will be the role of the ISA,
- The IAFC shall promptly inform the ISA of any matters that may affect bands allocated to the amateur services, particularly the amateur satellite service,
- The IAFC shall work closely with the AMSAT Groups and national IARU Societies as appropriate while maintaining consistent contact with the ISA and the AMSAT Groups, via Internet,
- The IAFC will be expected to attend the Annual IARU International Satellite Forum and such other meetings as agreed to, or directed by, the ISA from

time to time, However all travel and other expenses associated with such meeting attendance must be budgeted for in advance and is subject to approval of the ISA who is responsible for the budget,

9,10 RELEVANT IARU REGION-1 RECOMMENDATIONS

Recommendation CT08_C5_Rec01

(Paper CT08_C5_03 Support for Satellite Frequency Coordination)

Member Societies are recommended to work closely with the IARU Satellite Adviser and his Advisory Panel, and with their national administrations, with respect to requests for satellite frequency coordination originating in their respective countries,

Recommendation CT08_C5_Rec02

(Paper CT08_C5_03 Support for Satellite Frequency Coordination)

Member Societies are recommended to promote the proper use of amateur frequencies consistent with the international Radio Regulations, with a view toward maintaining the integrity of the amateur service and its frequencies,

Recommendation CT08_C5_Rec22

(Paper CT08_C5_16 Increased Amateur Satellite Service 2 Metre Usage)

The presence of interfering non-amateur signals in the 145,80-146,00MHz part of this band, in many parts of the world, is well documented, To prevent the retransmission of interfering terrestrial signals, satellites in the Amateur Satellite Service that plan to use the 145MHz Amateur band for transponders, are encouraged to use this band for downlink (satellite to ground) modes only, regardless of modulation type

Recommendation CT08_C5_Rec25

(Paper CT08_C5_17 3400 MHz Amateur Satellite Allocation)

- 1) National Societies should take all necessary steps in seeking 3400-3410MHz allocations on a Secondary non-interference basis as quickly as possible,
- 2) All Societies should explicitly include the Amateur Satellite Service (both S-E and E-S) in such requests on the basis that many years of terrestrial and EME operations (notably in the CEPT area) have not resulted in interference reports from other users,
- 3) National Societies and IARU-R1 should collaborate more closely to assist those Societies who in the past have not been able to achieve such allocations,
- 4) Societies should collectively obtain a critical mass of national allocations so that footnotes in regional allocation tables can be extended or acquired that include the Amateur Satellite Service
- 5) IARU-R1 to prioritise this band and to take active steps in support of these goals

Recommendation CT08_C5_Rec37

(Paper CT08_C5_37 Amateur Satellite Service Spectrum - Vienna 2007)

It is recommended that all IARU Region 1 societies request that the following additional Amateur Satellite Service bands be studied and considered, perhaps as a package, for a future WRC agenda item:-

50-51 MHz
1240-1250 MHz
2300-2330 MHz
2390-2400 MHz

3400-3410 MHz
5650-5670 MHz (Currently Earth-To-Space only)
10350-10400 MHz

9,11 Historical Overview of Amateur Satellite Developments

For up to date information visit:

<http://www.amsat.org/amsat-new/satellites/>

9,12 Amateur Satellite Organisations

For up to date information visit:

<http://www.amsat.org/amsat-new/links/index.php>

9,13 Current Satellites

For current operational information check these sites:

<http://www.amsat.org/amsat-new/satellites/status.php>

<http://www.dk3wn.info/satellites.shtml>

<http://oscar.dcarr.org/>