

ATV EXPERIMENT

ON THE

INTERNATIONAL SPACE STATION

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1 INTRODUCTION

1.1 Purpose of the document

2 REFERENCES

2.1 Applicable Documents

2.2 Reference Documents

[XX] - ITU Radio Regulations

[XY] – European Common Allocations Table

3 FREQUENCY BAND SELECTION

3.1 INTRODUCTION

The following discussion aims at selecting the proper frequency band for the ATV experiment from the International Space Station.

A preliminary investigation has restricted the selection of the frequency bands candidate for the ATV Experiment, to the L-Band and the S-Band because of the required bandwidth for the transmission of a digital or analogue television signal. It is also worth mentioning that in the UHF Band the Amateur satellite service is restricted to the band 435-438 MHz which implies that the ATV experiment is only possible with digital modulation emissions.

3.2 SELECTION OF THE APPROPRIATE FREQUENCY BAND FOR THE ISS ATV EXPERIMENT

The frequency bands allocated to the Amateur Satellite Service reported below, are taken from the ERO website (www.ero.dk) and indicate the ITU Radio Regulations allocations and the European Common Allocations (ECA). All these frequency bands are allocated to the ASS on a secondary basis, which implies that in case of harmful interference to other services that share the same frequency bands on a primary basis, the Amateur service shall switch off its emissions in order to protect the services with higher status.

It has to be noted that the frequency allocations to the amateur satellite service are generally allocated to both directions (earth-to-space and space-to-earth) leaving the amateur organizations (i.e. IARU) to decide on the proper use within their band plans.

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The only restriction to this general rule, concerning the direction of transmission, can be found in footnote n. 5.282 of the ITU Radio Regulations. Because of this, the frequency band 1260-1270 MHz is allocated to the amateur satellite service on a secondary basis in the Earth-to-space direction only.

During the technical discussions it appeared that the L-Band could have some operational advantages with respect to the S-Band, therefore it was assumed to ask for a possible waiver to the IARU Band Plan. The consideration that the L-Band is also allocated on a primary basis to the Radionavigation Service, which is a safety service, in the Space-to-Earth direction, has convinced the participants that this use is not compatible with the Amateur Satellite Service in the Space-to-Earth direction. In addition it was considered that the waiver should have been asked to all the ITU administrations (about 200) and not to IARU only.

As far as the S-Band is concerned, it is very close to both the frequency bands allocated to the Space Operations Service (i.e. 2025-2100 MHz ↑ and 2200-2290 MHz ↓). In addition it seems that there is a Wi-Fi activity onboard the ISS whose frequency bands are not known, at present. If this activity is carried out in the ISM band (i.e. 2400-2500 MHz), then there could be a complete overlapping with the ATV frequencies (2400-2450 MHz).

However the S-Band could be compatible with the Space Operation Service of the ISS if an appropriate filtering of the ISS receiver and of the ATV transmitter is present, which need to be checked. In addition if the Band used for Wi-Fi applications is the band 2400-2483.5 MHz then a complete overlapping exists. It has to be noted that Wi-Fi terminals are able to operate in an interfering environment (ISM Bands) but in order to minimize the potential for interference it is suggested to adopt an ATV modulation scheme which requires less power and less bandwidth. A trial is suggested in order to assess their compatibility. No problem could arise if the Wi-Fi use is on different frequency bands.

Footnote 5.282 is reported below for the reader benefit:

5.282 *In the bands 435-438 MHz, 1 260-1 270 MHz, 2 400-2 450 MHz, 3 400-3 410 MHz (in Regions 2 and 3 only) and 5 650-5 670 MHz, the amateur-satellite service may operate subject to not causing harmful interference to other services operating in accordance with the Table (see No. 5.43). Administrations authorizing such use shall ensure that any harmful interference caused by emissions from a station in the amateur-satellite service is immediately eliminated in accordance with the provisions of No. 25.11. The use of the bands 1 260-1 270 MHz and 5 650-5 670 MHz by the amateur-satellite service is limited to the Earth-to-space direction.*

3.3 CONCLUSIONS

- 435-438 MHz Frequency Band permits digital ATV experiment only, because of the limited bandwidth;
- Both L-Band and S-Band have enough bandwidth for a digital or analogue ATV experiment;

- L-Band is not compatible with the Radionavigation satellite service and in addition the need for requesting a waiver to the 200 ITU administrations for its space-to-earth use is a very lengthy and unpredictable process;
- S-Band can be compatible with the Space Operations Service carried out by the ISS assuming that appropriate filtering is implemented. The compatibility with the Wi-Fi use onboard the ISS needs to be checked, if the 2400-2500 MHz band is used.

3.4 ACTIONS

- Check the characteristics of the front-end filtering (2025-2100 MHz) on board the ISS;
- Check the frequency-band used for Wi-Fi ISS onboard activity;
- Plan a compatibility analysis, if the band 2400-2500 MHz is used for Wi-Fi activity.

4 LINK BUDGET

5 PAYLOAD

6 RECEIVING EARTH STATION

6.1 Receiving Antenna

6.2 Receiving Terminal

7 CONCLUSIONS

8 LIST OF ACRONIMS

ECA – European Common Allocations

ASS – Amateur Satellite Service