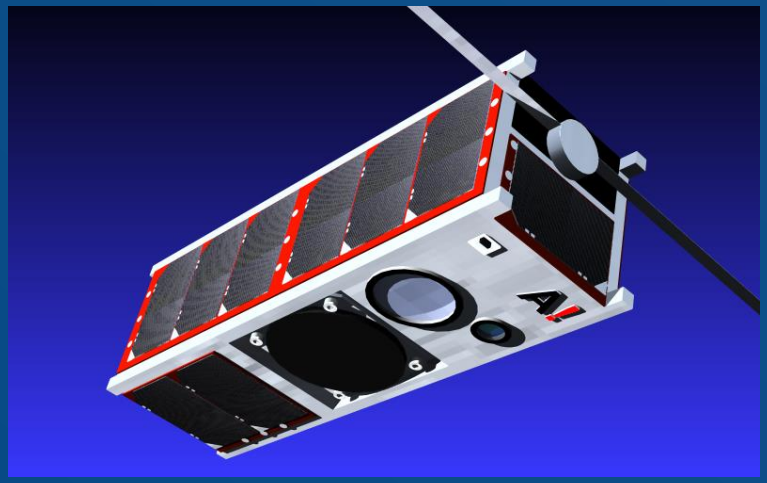
Viestintävirasto
Finnish Communications Regulatory Authority

ITU symposium and Workshop on Small Satellite Regulation and Communications Systems

Prague, Czech Republic, 2-4 March 2015

Experience on ITU Radio Regulatory procedures for small-satellites AALTO-1



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Pauli Huuhka, Finland
26.1.2015

Satellite

Satellite: AALTO-1
Operator: Aalto University, Finland

Satellite launch estimated in October 2015/beginning 2016

Non-geostationary orbit,

- altitude 590 km (460 - 720 km)
- inclination 98.7 deg (polar orbit)

Visible on average in Helsinki 1h45m/d = 7.2 % of time
at equator 0h41m/d = 2.8 % of time

Visible 2600 km from sub-satellite point on earth.

True distance when visible 600 – 2800 km (diff 13.5 dB)

Frequencies

Frequency up-link
437.22 MHz
Frequencies down-link
437.22 MHz
2402 MHz

The exact frequencies were given by the IARU.

The satellite is in the amateur-satellite service.

RR 5.282: In the frequency ranges 435-438 MHz and 2400-2450 MHz amateur-satellite service may operate subject not to causing harmful interference. Transmission has to be ceased immediately, if harmful interference is caused. **

** Note: In this presentation references to RR are shortened versions of the text, not copied.

Procedure for coordination or agreement Art 9

Article 9 of the Radio Regulation gives the procedure for coordination with or obtaining agreement of other administrations (of satellite networks or systems) .

Divided in 2 sections:

- Section I, advance publication of information
  - Sub-Section IA, not subject to Section II
  - Sub-Section IB, subject to Section II
- Section II, effecting coordination

•RR 5.282: In the frequency ranges 435-438 MHz and 2400-2450 MHz amateur-satellite service may operate subject not to causing harmful interference. Transmission has to be ceased immediately if harmful interference is caused.

•Sub-Section II A of RR Article 9 defines the cases where station in a satellite network needs coordination. Non-geostationary satellites in amateur-satellite service are not included in the definitions. Therefore Sub-Section IB is not applicable to those cases and Sub-Section IA is applied.

Sub-Section IA

API/A Publication

RR 9.1

- Administration (A) sends BR the advance publication information (API) as listed in Appendix 4.
- Administration may request the information to be also for coordination or notification.

Finland sent the information for API and notification 30.9.2013.

RR 9.2A

- The Bureau asks clarification if information is incomplete.

Finland sent the correction 16.10.2013.

RR 9.2B

- In three months the Bureau publishes the information in its Special Section of BR IFIC

AALTO-1 was published in API/A/8754 in IFIC 2760 dated 7.1.2014

Sub-Section IA

API/A Commenting

RR 9.3

- If any administration (B) believes that there may be unacceptable interference to its existing or planned satellite networks or systems it shall in 4 months:

  - Communicate comments to the administration (A)
  - Provide the particulars (=details) of the anticipated interference
  - Send a copy to the BR (= SpaceCom file)

- After that

  - Administrations (A and B) shall cooperate to solve difficulties
  - Administrations (A and B) shall exchange relevant information

    Note: It could be understood from the text in IA that interference should be evaluated only against satellite networks and satellite systems, not against other systems. (See conclusions)

- If comments are not received from administration (B) in 4 months, it may be assumed that it has no objections.

Sub-Section IA

API/A comments before dead-line

- Until the dead-line 7.5.2014 Finland had received comments from 3 administrations.
- None of the administrations had in their comments any details on the interference level or their requirements for protection.
- Two of the administrations gave in their comments the name of their interfered satellite, but no more information [(not even the frequency range)]
- Agreement was obtained from one administration after they received from Finland a clarification that there was no frequency overlapping.
- One administration was of opinion that there exists potential for unacceptable interference to existing and planned satellite networks. Administration asked for RR9.7 coordination. No answer was received from the administration to 3 further requests.
- Three letters were sent to the third administration, but there was no answer.

Sub-Section IA

API/A comments and resolving

RR 9.5

The Bureau shall publish a list of commented administrations and a summary of comments received. BR sends API/B special section for that.

The API/B/401 published in 27.5.2014 had 9 administrations in the list: the 3 previous ones and 6 new. Finland had not received comments from the 6 adms.

Comments had been sent to the BR in SpaceCom files

API/B had summary of 4 reasons for comments:

1. Excluding territory (from service area) (5 adms)
2. Interference to terrestrial services (4 adms)
3. Interference to the space services (6 adms)
4. Others (0 adms)

Finland interpreted that the 6 new administrations had failed in the process with their comments, as according to RR9.2 the comments should primarily be sent to the administration (A) in 4 months and in addition a copy to the BR. The process was however continued to avoid any discrepancies.

Sub-Section IA

API/A comments and resolving

RR 9.4

In the case of continuing difficulties administration (A) shall explore all possible means to resolve the difficulties by adjustments to its satellite network. If not possible, then administration (B) has to make all efforts by adjustments to its network.

RR 9.5A

The procedure is mainly to inform all administrations of development in space radiocommunications.

This statement was actually noticed only after all the work described before was done. After reading RR9.5A carefully, it looked like no actual agreement is needed, but was to find "mutually acceptable adjustments to their networks".

When checking Article 11 for BR examination of notices, no reference to the procedure in Sub-Section IA of Article 9 was found. That would mean, that missing agreements do not lead to unfavorable finding by the BR and does not prevent recording to Master Register.

An inquiry to BR confirmed that the interpretation was correct.

Sub-Section IA

API/A comments and resolving

Sub-Section IA
RR 9.4

Administration (A) shall inform the Bureau of progress made in resolving the difficulties.

The report was made and sent to the BR.

API/A comments and resolving

Results from the 3 (in deadline) administrations were:

- 1 acceptance
- 2 closed

Results with the 6 administrations were:

- 2 acceptances (1 was one-sided to exclude territory)
- 2 no answers to several request. FIN closed
- 1 asked to receive interference evaluation and exclusion. Finland agreed to exclusion, could not make evaluation. FIN closed.
- 1 received our request for more information. Response was that they need coordination and do not have enough information for assessing interference (was in API/A). They asked BR to keep them in coordination. FIN closed.

The reasons to "closed" cases were that either FIN received no answers or there seemed not to be a way forward. That seemed to be proper as (1) the procedure is only for information and (2) the satellite notification had already been published and (3) because the satellite operates on non-interference basis.

Sub-Section IA

API/A comments and resolving

ID number (SNS)	adm	ORG or Geo.area	Satellite name	Earth station	long_nom	Date of receipt	ssn_ref	ssn_no	ssn rev/ Sup	ssn rev no	Part/ Art.	WIC/IFIC (ific.mdb)	WIC/IFIC date
up down	up down	up down	up down	up down	up down	up down	up down	up down				up down	
113540604	FIN		AALTO-1		N-GSO	16.10.2013	API/A	8754				2760	07.01.2014
113540604	FIN		AALTO-1		N-GSO	16.10.2013	API/B	401				2770	27.05.2014
114500032	FIN		AALTO-1		N-GSO	07.07.2014	PART I-S					2774	22.07.2014
114500032	FIN		AALTO-1		N-GSO	07.07.2014	PART II-S					2788	17.02.2015

Conclusions

It is firstly good to recognize that the texts in the Radio Regulations has been written and approved in World Radio Conferences by administrations. Administrations can agree on required changes in the future WRCs.

Administrations may assume that unacceptable interference might be caused, but may not continue to resolve the difficulties. Reasons might be for example:

- Just to make sure for the case there appears to be interference
  - however, the satellites in ASS are operated on non interference basis
- They do not have easy means for interference calculations
- They have noticed the principle of "purpose of informing of development" and considered no need to continue

Conclusions

Text in RR Sub-Section IA is misleading as it looks like coordination process because of all dead-lines, objections ,solving difficulties and reporting to the BR. If the last paragraph (RR9.5A) had been noticed earlier, the work in the process could have been lightened.

- Text in RR IA reads: "...interference which may be unacceptable may be caused to its existing or planned satellite networks or systems ..."
- Text in RR IB (leading to coordination) reads: " ...considers its existing or planned satellite systems or networks or terrestrial stations..."

It is not clear in RR IA if it means: "satellite networks or (any) systems" or if it means: "satellite networks or satellite systems". The difference is if terrestrial systems should be included in IA-procedure or not.

On the basis of the results it could be questioned what are the real benefits in carrying out the API-procedure. Only one change was made in this case and it was to exclude one administration from the service area.

Additional observations

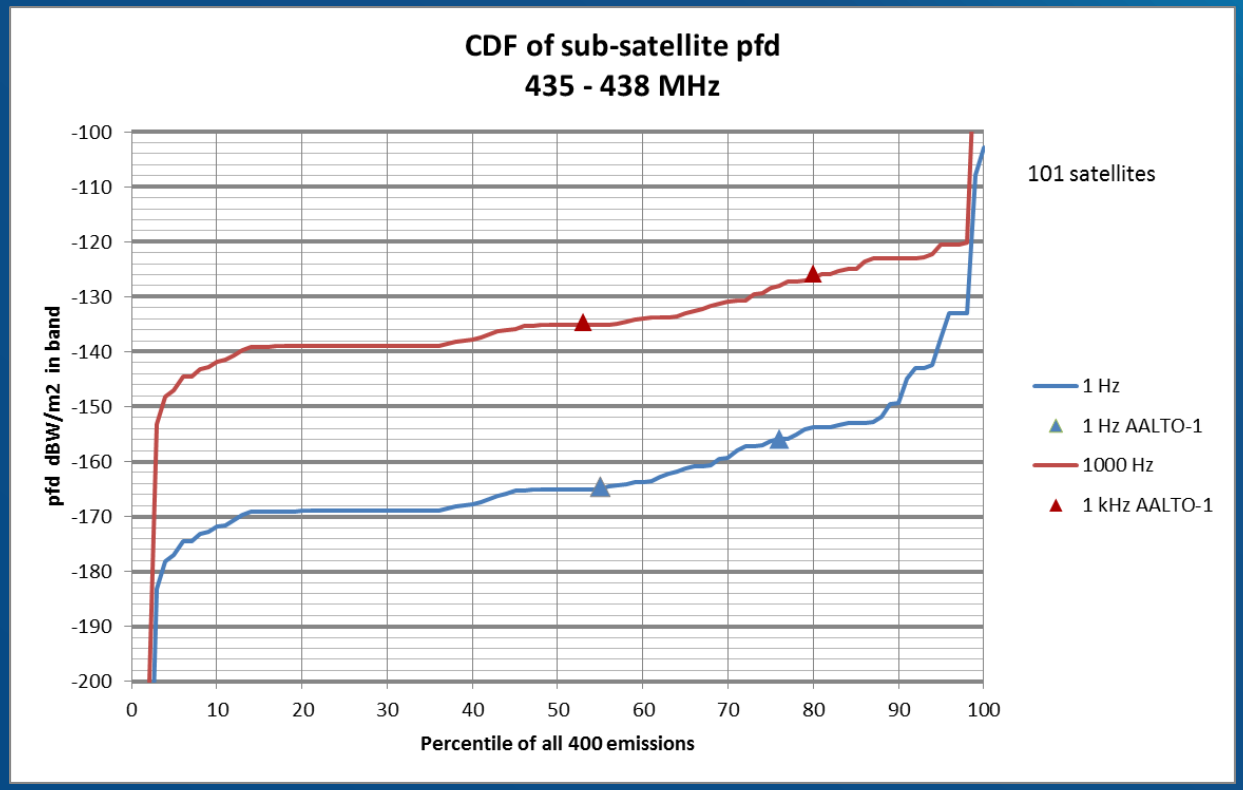
Some additional (preliminary) studies on the 435 – 438 MHz range showed that it would be reasonable generally to evaluate interference to terrestrial systems. Especially the increasing number of satellites should be taken into account.

The same way the interference between the small satellites should be considered and especially the high difference between the wanted and interfering signal levels.

An analysis on the present satellites (in process or registered) in 435 – 438 MHz band was made. There was 101 satellites with total 400 emissions. The pfd was calculated for the lowest satellite altitude for the sub-satellite point (point under satellite)

In 80 % of emissions the pfd spectral density values where spread in 25 dB range.

Additional observations



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