Small satellite developments in ESA satellite telecommunications group

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What do we do?

1. We fund research and development in the field of satellite communications, using a program called **ARTES** (Advanced Research in Telecommunications Systems)

2. Satellite communications is a very commercial business – so products need to be **competitive**

3. We issue tenders for **long-term developments** – we fund **100%**

4. **You** can always submit a proposal for a mid-term development you see a market opportunity for – **we co-fund 75 to 50%, you bring 25 to 50%**

5. We fund developments or studies in **ground segment, space segment, payload and system** – **including in-orbit validation**
Sample of outcomes of our contracts

...and many, many prototypes and systems studies
Smallsat and commercial telecom – what is missing?

1. Technical
   - **Baseband and RF equipment** using commercial telecom frequency bands which would allow higher data rates (i.e. C or Ka-band)
   - Ability to increase the **gain** of antenna’s and allow **pointing**
   - Ability to have a **low-cost inter-satellite link** (optical or RF) to GEO to receive or send data to smallsats
   - Ability to implement **simple ISL** between multiple smallsats

2. Regulatory issues (filing & coordination process at ITU)
   - Is being addressed and will supported also by us for WRC-19

3. Other issues (AOCS, power, propulsion, new launcher methods, space debris mitigation, QA/PA...) are also important but **seem to be taken care of** by a community outside of telecom (science, EO missions, weather)
Four mission topologies where we see gaps in communication capabilities
Our plans for closing gaps

1. **Technical** – we issue this year a number of tenders for smaller satellite payload developments:
   a. Miniaturised **Ka-band FSS** transponder
   b. C-band transceiver
   c. LEO-LEO ISL RF (60 GHz or Ka-band ISL? Fully transparent? Only intra-plane?)
   d. Network and link layer solutions for **inter-satellite** links between small satellites
   e. **Ka-band** Medium-gain antenna and pointing mechanism for smallsats
   f. Deployable antenna structure
   g. Small receive-only inter-satellite link **Ka-band 23 GHz** antenna and demodulator for use on smaller satellites

\[ \Sigma = 3.5 \text{ M€} \]

2. **Regulatory** – some support to opportunities for smaller satellites, more support for WRC-19 small satellite issues planned
What more is happening – 1a

1. We tendered a small satellite or hosted payload for the so-called VDES (VHF Data Exchange System)
ITU reparations – before any filing....

1. Many, many hours made before general support for a new satellite allocation (~ 5€/Hz)

2. Regular preparatory technical teleconferences

3. Only after some time, industry buys into the concept and supports

4. Initial spectrum request without clear application requirements

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Radiocommunication Study Groups

Subject: WRC-15 agenda item 1.16 Resolution 360 (WRC-12)

Working Party 5A
(Working Group 5A-4)

LIAISON STATEMENT TO WORKING PARTY 5B
WRC-15 AGENDA ITEM 1.16

In addition to the response (Document 5B/479) to your request on WRC-15 agenda item 1.16 on the proposed VHF data exchange system (VDES) (Document 5A/302), Working Party 5A (WP 5A) defined the following power flux density mask at the Earth’s surface from the MSS space systems, which provides protection to the MS for which the concerned frequency band in the agenda item is allocated on a primary basis.

\[
PSFD(\theta) \text{ (dBW/(m}^2\text{*kHz}) = \begin{cases} 
-149 + 0.16 \times \theta^\circ & 0^\circ \leq \theta < 45^\circ; \\
-142 + 0.53 \times (\theta^\circ - 45^\circ) & 45^\circ \leq \theta < 60^\circ; \\
-134 + 0.1 \times (\theta^\circ - 60^\circ) & 60^\circ \leq \theta \leq 90^\circ.
\end{cases}
\]

That mask shall be used for elaboration of necessary regulatory proposals in the CPM text with regard to possible new allocation to MSS downlink around 160 MHz.

WP 5A would like to be kept informed of any development related to mobile service under this agenda item.

Status: For action
Contact: Evgeny Tonkikh E-mail: et@nir.ru

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European Space Agency
More awareness and lobbying is required......

At the World Radiocommunication Conference (WRC-15) only administrations have decisive power

Besides operators: teleports, equipment manufacturers, downstream services

National preparation meetings

Large national stakeholders

ESA National Delegate

National space industry

International bodies

You
2. In 2015 we will tender a **Cubesat for W-band** (70/80 GHz) channel measurement. Any ideas on requirements or how to enhance such a mission very welcome!

**W-band workshop 8 April ESTEC**
http://congrexprojects.com/2015-events/15m17/introduction

3. We are running a study contract to make an inventory of what is missing more for small/nano satellite in order to offer **commercially sustainable communication services**.

4. We will soon tender a **smallsat mission study** for monitoring of the radiation environment between **LEO and GEO** in order to support an accurate solar generator sizing for the orbit raising of future GEO satellites using electric propulsion
What more is happening – 3

5. Satcom Module for Google ARA project - spin off from mobile industries – development in 2015
1. We support further work towards favourable position for smaller satellites at WRC-19

2. Modifications to ITU filing and coordination mechanisms (Art 9 and 11) are unlikely. Other ways to facilitate coordination among small satellites could be investigated in ITU. Ideally, studies to see if it is possible to identify a dedicated spectrum range and an agreed access mechanism.

3. ESA satellite communications group would be interest to support also the GEO-LEO data relay component

4. This is already in place for e.g. ATV with spread-spectrum access method
1. A GEO-LEO data relay can contribute to a future TT&C solution for small satellites

2. We are actively looking for demonstrations of such concepts with smaller satellites to prove technical feasibility and collect requirements

3. In case of interest and you have a small satellite which supports:
   a. S-band Rx/Tx in 2 GHz or
   b. Ka-band Rx/Tx on 22.55-23.55 GHz/25.25-27.5 GHz (EESS/SRS only 5.536) → Contact us!
Summary

1. ESA’s satellite telecommunications group will fund various payload developments to stimulate telecommunication applications of smaller satellites.

2. We seek requirements to make these developments useful for you.

3. If you want to go faster – put some of your own money and we go at your speed.

4. We believe data relay via GEO can enhance various smallsat missions and ease coordination burden. There is a need to experiment and test. We seek candidates.

5. We propose to support any WRC-19 studies, for example by funding a study on future TT&C concepts for smaller satellites, including the LEO-GEO relay component.
6. We **also fund smallsat** developments – as long as they address a telecommunications service

7. We are collecting ideas for our **next work plan activities in 2016**
   - More **optical** for smallsat ?
   - **Optical space communication workshop** X April ESTEC
   - Demonstration mission linking up two smallsats with ISL’s at high speed?
   - System studies for TT&C concepts, constellation management ?
   - Any specifics on ground segment (multiple satellites in view?)
   - More open source developments (HackRF alike, GNU Radio based?)

8. Contact:
   
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