Rethinking Satellite Operations

OPSSAT, the experimental operations platform

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GSAW 2014 - February 2014
Overview

- Concepts of OPSSAT
- Experiments
- Conclusions
Technology Change

The World

Space Systems

Operations
A Vicious Circle of No-Change

It is not flight proven... We won’t fly it...
Goal

... and not just for operators
Concepts

- Provide a platform for testing new operational concepts
- Accept risks, expect failures, **ensure** recovery
- Do not judge
OPSSAT

- Triple Cube (10x10x30 cm)
- UHF, S-Band and X-Band (experimental)
- CCSDS Space Link
- Multiple FPGAs
- More processing power than all operational ESA satellites combined
- VM environment with Java
- Completely reconfigurable on ground and in space
ESA Experiments

- Automation; Goal-based plan generation, On-board analysis and event recognition

- CCSDS SM&C (MO) service; standard APIs for interaction, basic monitoring and control

- Compression; Packet and real-time compression

- File based operations; Exchange of files, file store, M&C of on-board systems

- XTX (Cubesat X-Band); Basic transmission
Industry Experiments

- Onboard (43)
- Radio and Coms (11)
- Schedule and Autonomy (11)
- Camera (10)
- Ground (9)
- ADCS (5)
- Protocol (3)
- Magnetic Field (1)
... from around the (western) world

From ... to

- Germany
- Austria
- ESA
- UK
- Spain
- Switzerland
- France
- Belgium
- Netherlands
- Italy
- Norway
- Greece
- Hungary
- Slovenia
- Bulgaria
- Czech Rep
- Ireland
- Poland
- Canada
- USA
- Egypt
- Canada
- Poland
- Ireland
- Slovenia
- Hungary
- Greece
- Czech Rep
- Bulgaria
- Italy
- Netherlands
- Belgium
- France
- Switzerland
- Spain
- UK
- ESA
- Austria
- Germany
Trend

• Harmonization of Space and Ground systems
  • Satellite just a piece of HW in space
  • Use of terrestrial software onboard

• Functions pushed from ground, to space
ADCS
Based on EO Observation
Ranging using retroreflector
Ground Applications

- Concurrent design through complete lifetime
- Modern Software Management
- Agent based system
- 3D

(the Ypsilon Generation Operator?)

Available on the App Store
Onboard Applications

Web server

Fault tolerance and detection techniques

Onboard image processing

Onboard SW Build

Onboard cloud

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THE #1 PROGRAMMER EXCUSE FOR LEGITIMATELY SLACKING OFF:

"MY CODE'S COMPILING."

HEY! GET BACK TO WORK!

COMPILING!

OH, CARRY ON.

operator
Radio and Coms

- Laser com
- Spectrum analyser in space
- IP in Space
- Positioning

Overlapping pseudo ranges provided by GPS satellites are used to establish the probable position of the aircraft.
Scheduling and Autonomy

Goal based operations

Onboard Autonomy

Onboard conjunction analysis

Formation Flying
Benefits for ESA

• Breaks the circle of no-change

• Facilitate capitalization of already performed investments

• Demonstrate what works… and what doesn’t
Benefits for Industry

• Freedom

• A platform

• A reference story

• Contacts

(Cube sized actually...)

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Conclusions

- Cubesats are not just toys
- If you want innovation, give freedom
- There are a lot of ideas out there
- There is a need for an experimental platform
- The new ideas will change how we operate satellites