FLY YOUR SATELLITE!
The ESA Academy CubeSats programme

Attracting, inspiring, and preparing the next generation
of space engineers and scientists

Joost Vanreusel

ITU Symposium & Workshop on Small Satellite Regulation and Communication Systems
Santiago de Chile, Chile
7-9 November 2016
Presentation Outline

1. The ESA Education Programme
2. Fly Your Satellite! (FYS)
3. FYS Legal and Regulatory Matters
ESA education objectives

1. Motivate, engage and enable young people to enhance their literacy & competence in sciences and technology (STEM disciplines)

2. Inspire and enable young people to consider pursuing a career in the STEM field, in the space domain in particular

3. Contribute to increase youngsters’ awareness of the importance of space research, exploration and applications in modern society and economy
The ESA Education Programme
A diversified approach

**School pupils & teachers**

**Space is the context**

**Formal education,** right into the schools, with teacher training and resources to support the curriculum in an innovative way (**ESERO**)

**Hands-on:** learning to think, learning to do, as classroom project or extracurricular activity

**Informal education,** learning while having fun

**Universities**

**Space is the subject**

**Hands-on:**
- Satellite projects
- Scientific instrumentation and experimentation
- Technology demonstration experiments

**Academic support:**
- Courses, schools and workshops
- Participation to conferences
- Lectures and seminars of ESA experts
ESA Academy - Concept

- Help to prepare a **talented and skilled workforce** for ESA and the European space industry

- Enhance the **motivation** of university students to work in the fields of space engineering, technology and science, by:
  - Providing them with **practical experience** in real space projects
  - Enabling transfer of know-how and **direct interaction with space professionals**
  - Offering access to **state-of-the-art facilities**
ESA Academy - Concept

- The objective is to have a transfer of space expertise, know-how and standard professional practice from ESA to European university students
- Complement academic education
- Work in close coordination with European academic institutions and, whenever possible, in partnership with European space industry and other organisations involved in space activities
- ESA Academy is the combination of two components:
  - Hands-on Programmes
  - Training and Learning programme
ESA Academy
The Education Programme for university students

Hands-on ‘Space’ Projects
+ Fly a Rocket!

Training and Learning Programme
Portfolio of courses:
• Space Systems Engineering
• Project and Risk Management
• QA/PA; Standardization
• Concurrent Engineering
• Mission Design and Operations
• ...

Internal & External Facilities
CubeSat Education Centre

University Students Community

Training and Learning Centre
CDF
Presentation Outline

1. The ESA Education Programme
2. Fly Your Satellite! (FYS)
3. FYS Legal and Regulatory Matters
Objectives:

- Host end-to-end educational CubeSat activities
- Support periodical/recurrent cycles of FYS programme opportunities
- Focus on satellite design, integration, verification, testing and operations
- Offer opportunities to a maximum of university students' teams
- Complete academic education with initial training
- Transfer of experience and know-how from experienced professionals to students
- Apply professional space standards and ESA best practices
- Technology but also laws and regulations
- Through careful verification and proper documentation aiming to increase chances for mission success
- Enhance enthusiasm and professional motivation
- Better prepare students for careers in ESA and in European space industry
PHASE 1: BUILD YOUR SATELLITE!
Focus on satellite integration & functional tests

PHASE 2: TEST YOUR SATELLITE!
Focus on environmental test campaign

PHASE 3: TICKET TO ORBIT!
Three CubeSat teams selected for integration & launch campaign
PHASE 4: CUBESATS IN SPACE!

- Auxiliary passenger with **Sentinel-1B** on Soyuz VS14
- Launched on **25 April 2016**
- Orbit compatible with **space debris mitigation** requirements
- **Frequencies** coordinated and notified
- National **authorisations** granted
- **Early Operations Phase** controlled by students after deployment
- Operational phase using **university Ground Stations**, supported also by ESA and by enthusiastic radio amateur volunteers
Fly Your Satellite from the ISS! Pilot Edition

- **AAUSAT5** built by University of Aalborg, Denmark
- March – June 2015: Verification/Testing & Delivery of the FM
- Freq. & mission registered & authorised at national level
- Complex set of stakeholders / Launching States
- **17 August 2015**: Launch to ISS on board HTV-5 / HII-B (Japan)
- **05 October 2015**: Deployed into orbit with GomX-3 **from ISS**
- **Re-entered** the atmosphere on 15th March 2016
Fly Your Satellite! Second edition 2017

• **Call for Proposals** to be published in 2016
• **Differentiated opportunities** for CubeSat teams at different levels of experience and development maturity
• **Multiple entry levels**

Dedicated facilities at ESA-REDU Centre in Belgium:

• **Training and Learning Centre** for a new set of courses and learning opportunities;
• **Concurrent Design Facility** (CDF) for training purposes;
• **CubeSat Laboratory** to support students in their verification campaigns.
Presentation Outline

1. The ESA Education Programme
2. Fly Your Satellite! (FYS)
3. FYS Legal and Regulatory Matters
Legal & Regulatory

- Frequency Registration
- Licensing
- Authorisation
- Domestic and international coordination
- Export control

Lessons Learned – prior FYS

- Risk of **frequency conflicts** when last-minute co-passengers are added to the mission
- **Lack of awareness among the university teams** regarding legal aspects of space activities
- CubeSat sometimes first national space object; **paving the way**
Frequency & Space Object Registration within «Fly Your Satellite!»

- Participating CubeSats making use of radio-amateur frequencies
- Participating CubeSats considered national space activities
- All involved States:
  - ITU Member States that have ratified the ITU Constitution and Convention;
  - Shall commit to register CubeSats in their National Space Object Register and in the United Nations Register of Objects Launched into Outer Space
- Guidelines about satellite registration prepared for the good information of the student teams
Proposed Preparatory Steps For Frequency and Space Object Registration

Participating CubeSat teams are invited to:

• **Check the list of the international treaties** ratified by their state for space activities and satellite missions (e.g. ITU Constitution and Convention, UN space-related treaties, etc.)

• **Identify the appropriate governmental entity** of their state responsible for the communication with the relevant international organisations (e.g. national telecommunication regulatory authority, national space agency, Ministry of Foreign Affairs, or any other dedicated office)

• **Contact the appropriate telecommunication governmental entity** and **inform** them about the CubeSat mission

• **Identify the appropriate radio amateur organisation** in their state in order to inform them about the CubeSat mission (if using radio-amateur frequencies)

• **Create an overview** tailored to their state summarising the **space law practices and required administrative procedures** relating to legal and regulatory aspects of satellite missions
Frequency allocation: Step-by-step Approach

**STEP 1**
- **NATIONAL TELECOM ADMINISTRATION**
  - Frequency Licence
  - Satellite Call Sign
  - Ground Station Call Sign

- **IARU SATELLITE ADVISOR**
  - Identify suitable frequency band

- **ITU SPACE SERVICE DEPARTMENT**
  - Preliminary (informal) contact

**STEP 2**
- **ITU**
  - Submit API Information to ITU
    - [ITU RR Art. 9.1]

**STEP 3**
- **IARU**
  - File official Frequency Coordination with IARU

**STEP 4**
- **ITU**
  - Submit Notification to ITU
    - [ITU RR Art. 11]

**Launch**
- Bringing into use of satellite frequency

Regulatory Clock Starts

Preferably minimum 2 years
Maximum 7 years

3 months for treatment by Bureau

4 months for comments from other administrations

>2 months for coordination on comments

(Considered) not earlier than 6 months after Publication

Not earlier than 3 years before launch
Lessons learned & conclusions

• **Awareness of and ensuring compliance to laws and regulations** is an important part of the project task **to be considered in project planning** also for CubeSat projects.

• Guidelines prepared for “Fly Your Satellite!” **allowed to raise the awareness among the university teams** on legal and regulatory requirements.

• Following ITU RR for frequency registration provides **protection and international recognition**.

• **Proper and timely** consideration of the frequency regulations **may allow to identify earlier technical problems** (thus possibly reducing the impacts), which may be drivers for the mission design, e.g.:
  - Include telecommand to allow cessation of transmission;
  - Avoid that commands are uplinked from unregistered ground stations;
  - Limit the risk of frequency compatibility conflicts.

• **Open and timely information** at appropriate level: limited effort with high gain

  ➢ **Radio frequency planning early in a satellite project may help to avoid last-minute complications** before launch and it may contribute to a **responsible usage of radio frequency bands**. This is in the interest of the entire small-satellite sector.
Would you like to know more?

Visit

www.esa.int/education