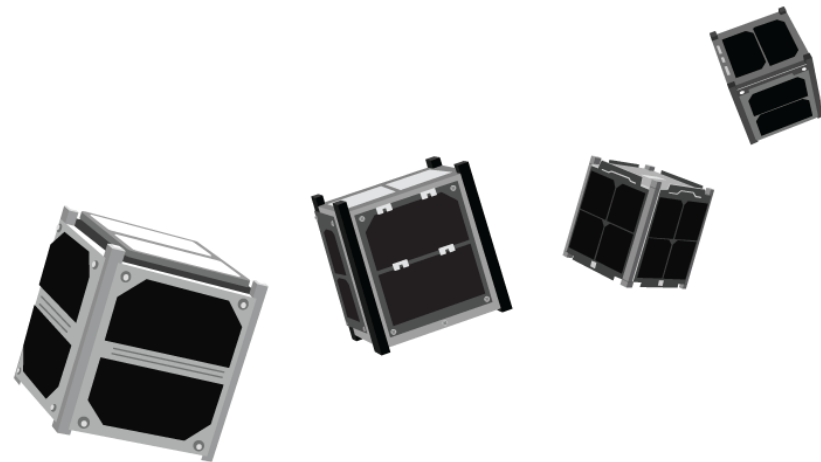


The Approach to Frequency Registration within the “Fly Your Satellite!” CubeSat Programme

Piero Galeone, Joost Vanreusel, Daniel Sagath

ITU Symposium on Small Satellite Regulation
Prague, 2-4 March 2015

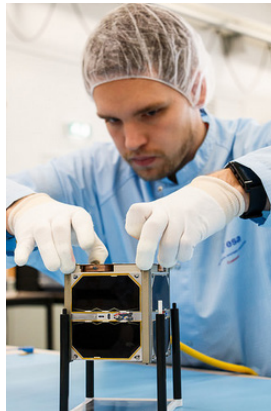
1. The ESA Education Office
2. “Fly Your Satellite!”
3. Frequency and Space Object Registration in “Fly Your Satellite!”
4. Conclusions



- **The Education and Knowledge Management Office is engaged in:**
 - a. Knowledge Management
 - b. Communication and Outreach
 - c. Primary/Secondary Education projects
 - d. Tertiary Education activities**
 - Contribute to better prepare the **next generation of the European space professionals.**
 - Students are engaged in **real hands-on space programmes**, conducted in collaboration with ESA specialists.



ITU Symposium | 02/03/2015 | Slide 3



«Fly Your Satellite!»



○ Programme approach:

- Focus on satellite **integration & verification**
- **Methodologies** similar to professional ESA missions
- From satellite integration **to mission operations**
- Engineering but **also laws and regulations**

○ CubeSat teams participating in the programme:

- Receive direct support from **ESA technical specialists**
- Learn the **importance of verification** and of **good documentation**
- Have **access to state-of-the-art environmental test facilities**
- The teams that demonstrate the **flight readiness** of their CubeSat can benefit from the ESA support for the procurement of the **launch opportunity**



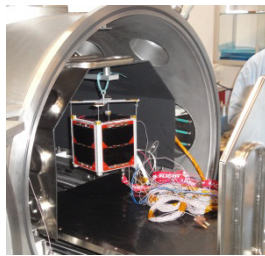
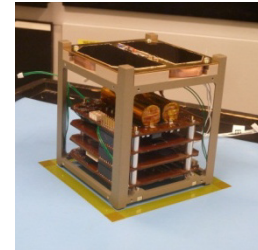
«Fly Your Satellite!»: Programme Breakdown



Phase 1 – Build your Satellite!

Phase 1A: Satellite integration

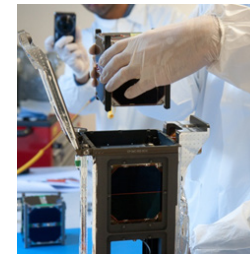
Phase 1B: Functional tests – Ambient



Phase 2 – Test Your Satellite!

Phase 2A: Environmental Tests Preparation

Phase 2B: Environmental Tests Execution



Phase 3 – Ticket to Orbit!

Phase 3A: Acceptance tests campaign

Phase 3B: Launch Preparation campaign



Phase 4 – CubeSats in Space!

Phase 4A: Launch and Early Operations Phase

Phase 4B: CubeSats Operations Results Feedback

«Fly Your Satellite!»: CubeSats



- **Three CubeSat teams** participating in the current “Fly Your Satellite!” Phase 2:



AAUSAT4, Aalborg University

Test AIS receiver

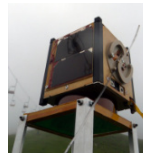
ADCS technology demonstration



E-St@r-II, Politecnico di Torino

Attitude Determination

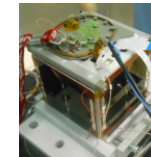
technology demonstration



OUFIT-1, Université de Liège

Test D-STAR amateur radio

protocol in space

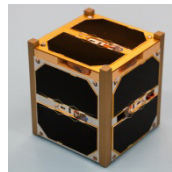


- **One CubeSat team** participating in the current “Fly Your Satellite! from ISS”:



AAUSAT5, Aalborg University

Test AIS receiver



Former Lessons Learned

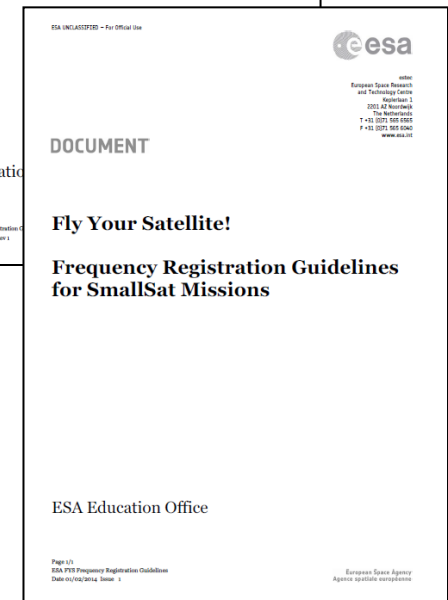
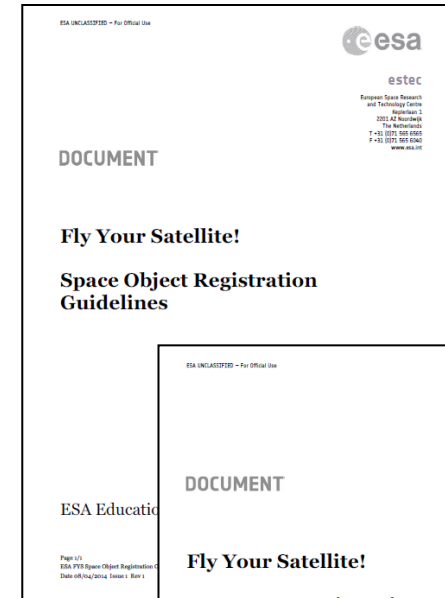
- **First ESA CubeSat mission:
CubeSats for the Vega Maiden Flight (2012)**
 - The ESA Education Office coordinated and supported **CubeSat student teams** for the integration on Vega
 - 12 university teams were supported, and finally **7 CubeSats were launched** (national space objects)
 - All CubeSats using **radio-amateur frequencies**
- **Issues:**
 - Risk of **frequency conflicts** when last-minute co-passengers are added to the mission
 - **Lack of awareness among the university teams** regarding law and regulatory aspects of space activities



Frequency & Space Object Registration within «Fly Your Satellite!»



- The participating CubeSats use **radio-amateur frequencies**
- The participating CubeSats are considered **national space activities**
- All involved States:
 - are **ITU Member States** and have ratified the ITU Constitution and Convention;
 - committed 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



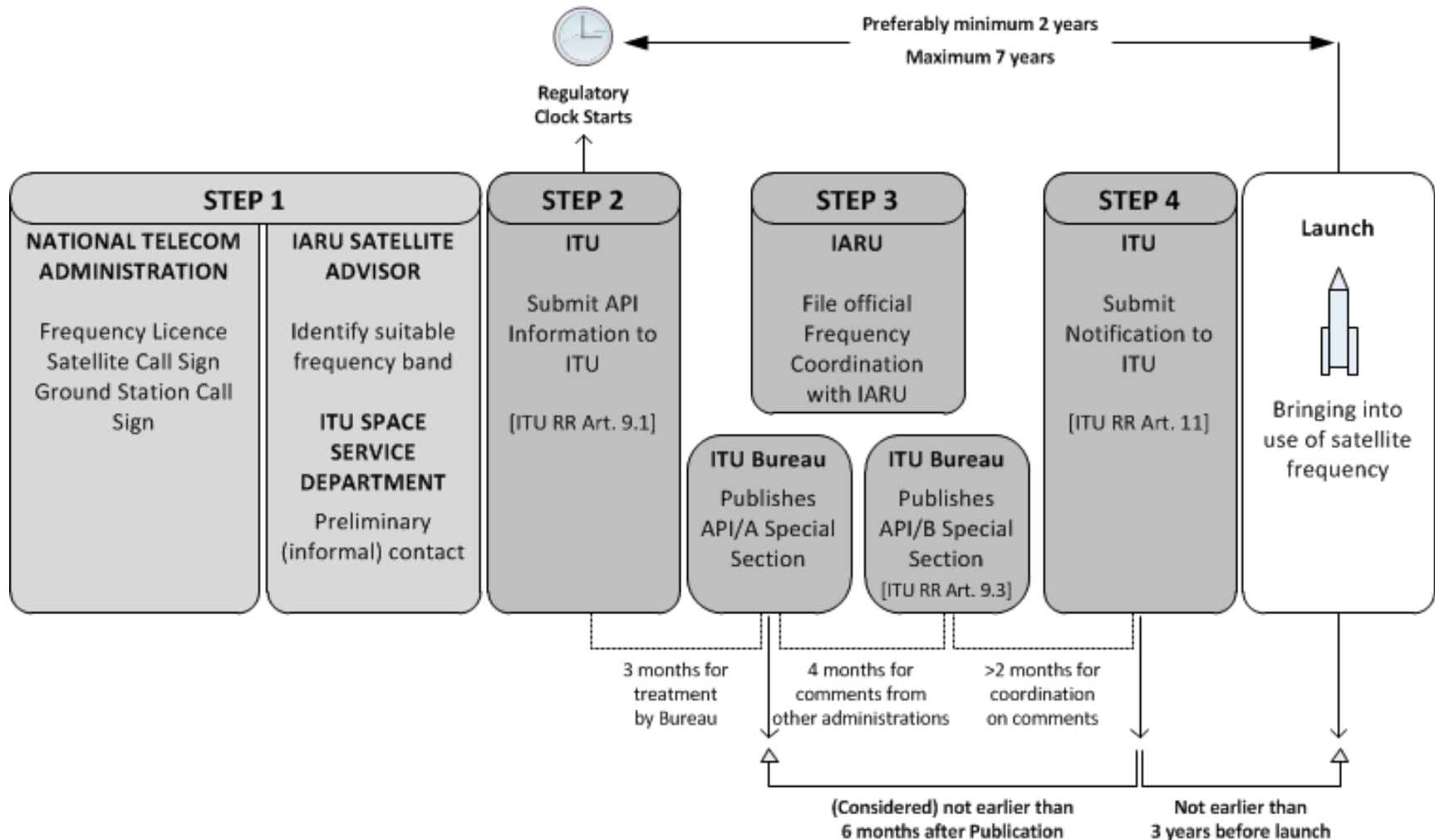
Proposed Preparatory Steps For Frequency and Space Object Registration



Participating CubeSat teams are invited to:

- 1. 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.)
- 2. 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)
- 3. Contact the appropriate telecommunication governmental entity** and **inform** them about the CubeSat mission
- 4. Identify the appropriate radio amateur organisation** in their state in order to inform them about the CubeSat mission (if using radio-amateur frequencies)
- 5. 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

Step-by-step Approach



1. **Awareness of and ensuring compliance to laws and regulations** is an important part of the project task, and it has **to be considered in project planning** also for CubeSat projects.
 2. The guidelines prepared for “Fly Your Satellite!” **allowed to raise the awareness among the university student teams** regarding legal and regulatory requirements.
 3. Following ITU RR for frequency registration provides **protection and international recognition**.
 4. **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.
- **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 the radio frequency bands.**

THANK YOU!



Piero Galeone
Head of the Tertiary Education Unit
ESA Education & Knowledge Management Office
Piero.Galeone@esa.int

Joost Vanreusel
CubeSats Project Coordinator
ESA Education & Knowledge Management Office
Joost.Vanreusel@esa.int

Daniel Sagath
Former ESA International Research Fellow
PhD Candidate at Vrije Universiteit Amsterdam
D.Sagath@vu.nl

