

FLY YOUR SATELLITE!

The ESA Academy CubeSats programme

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

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ITU Symposium & Workshop on Small Satellite Regulation and Communication Systems
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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



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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

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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**



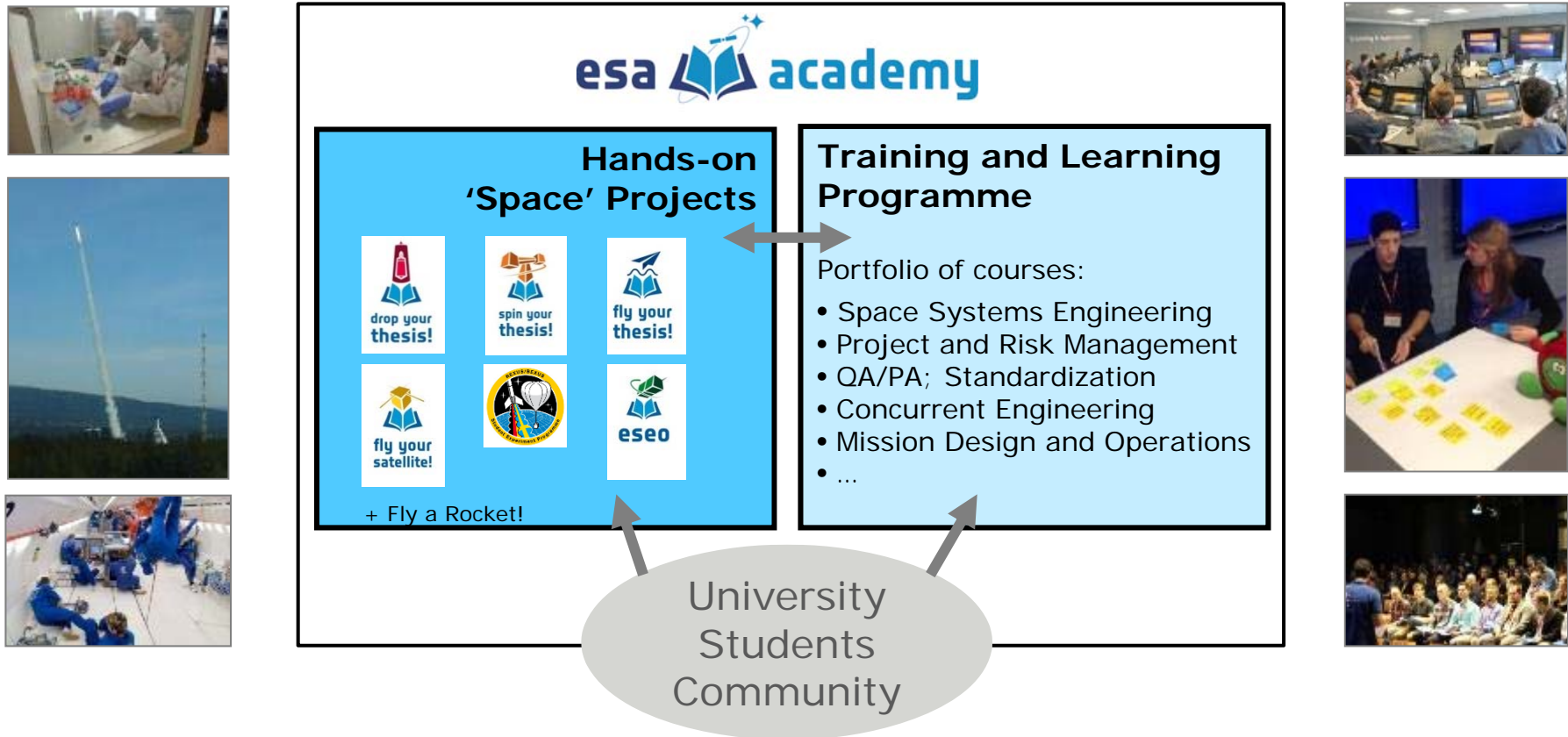
ESA Academy - Concept

- 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



Internal & External Facilities

CubeSat Education Centre

Training and Learning Centre

CDF

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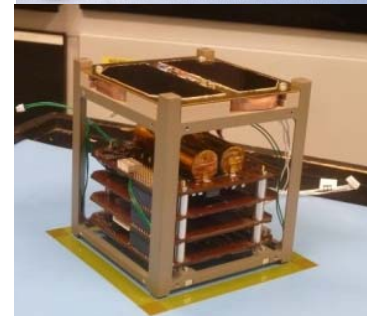
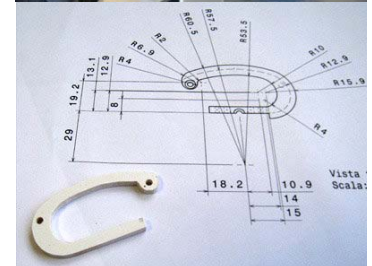


Fly Your Satellite!

The ESA Academy CubeSat Programme

Objectives:

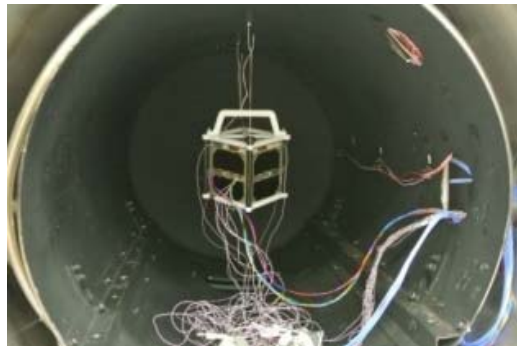
- Host **end-to-end** educational CubeSat activities
- Support **periodical/recurrent cycles** of FYS programme opportunities
- Focus on satellite **design, integration, verification, testing and operations**
- Offer **opportunities** to a maximum of university students' teams
- Complete academic education 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



Fly Your Satellite! First Edition 2013-2016

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

AAUSAT4



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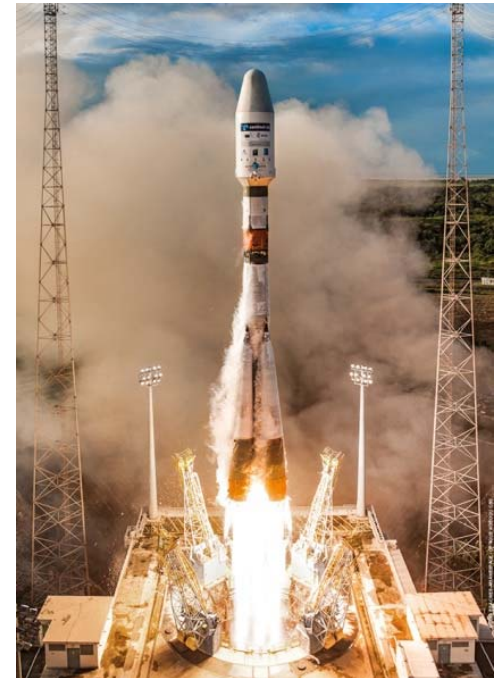


Fly Your Satellite! First Edition 2013-2016



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



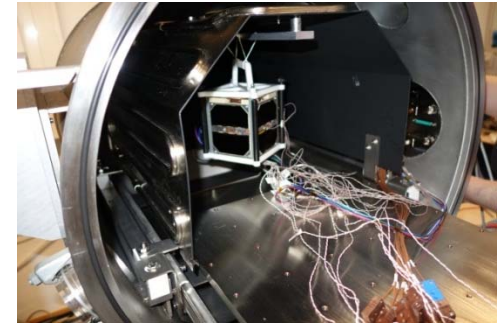
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Fly Your Satellite from the ISS! Pilot Edition



- **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



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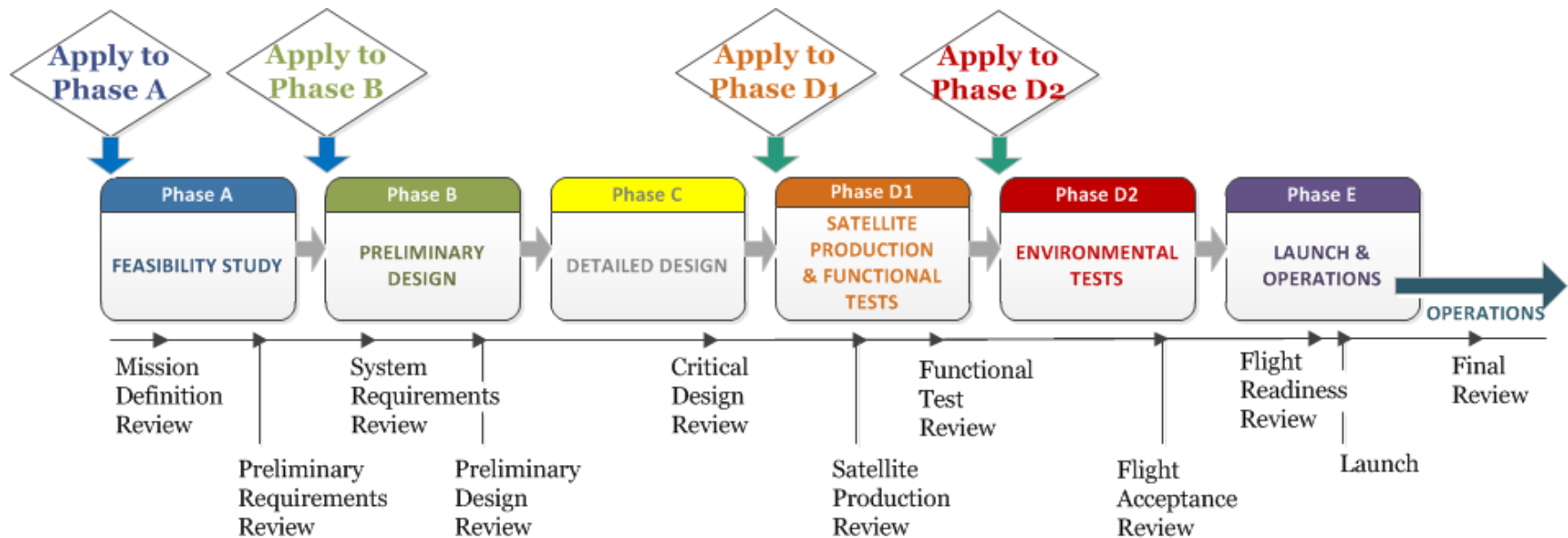




Fly Your Satellite! Second edition 2017



- **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.

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European Space Agency

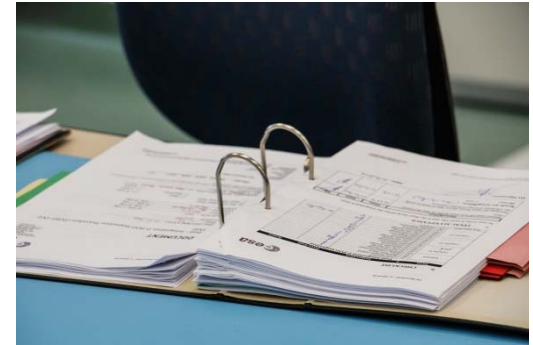
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Legal & Regulatory

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



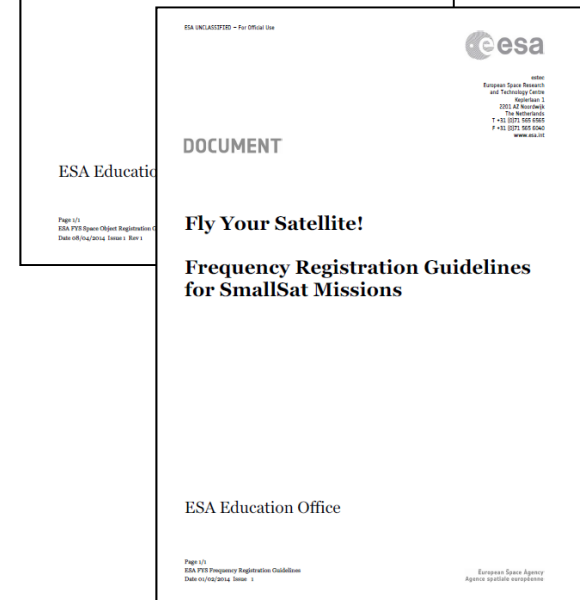
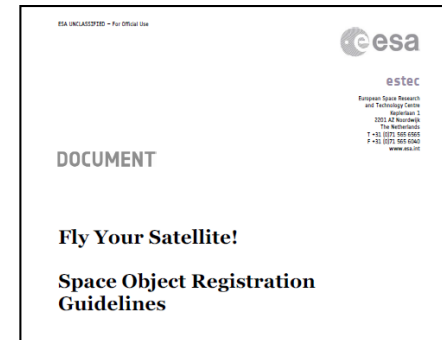
Lessons Learned – prior FYS

- 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

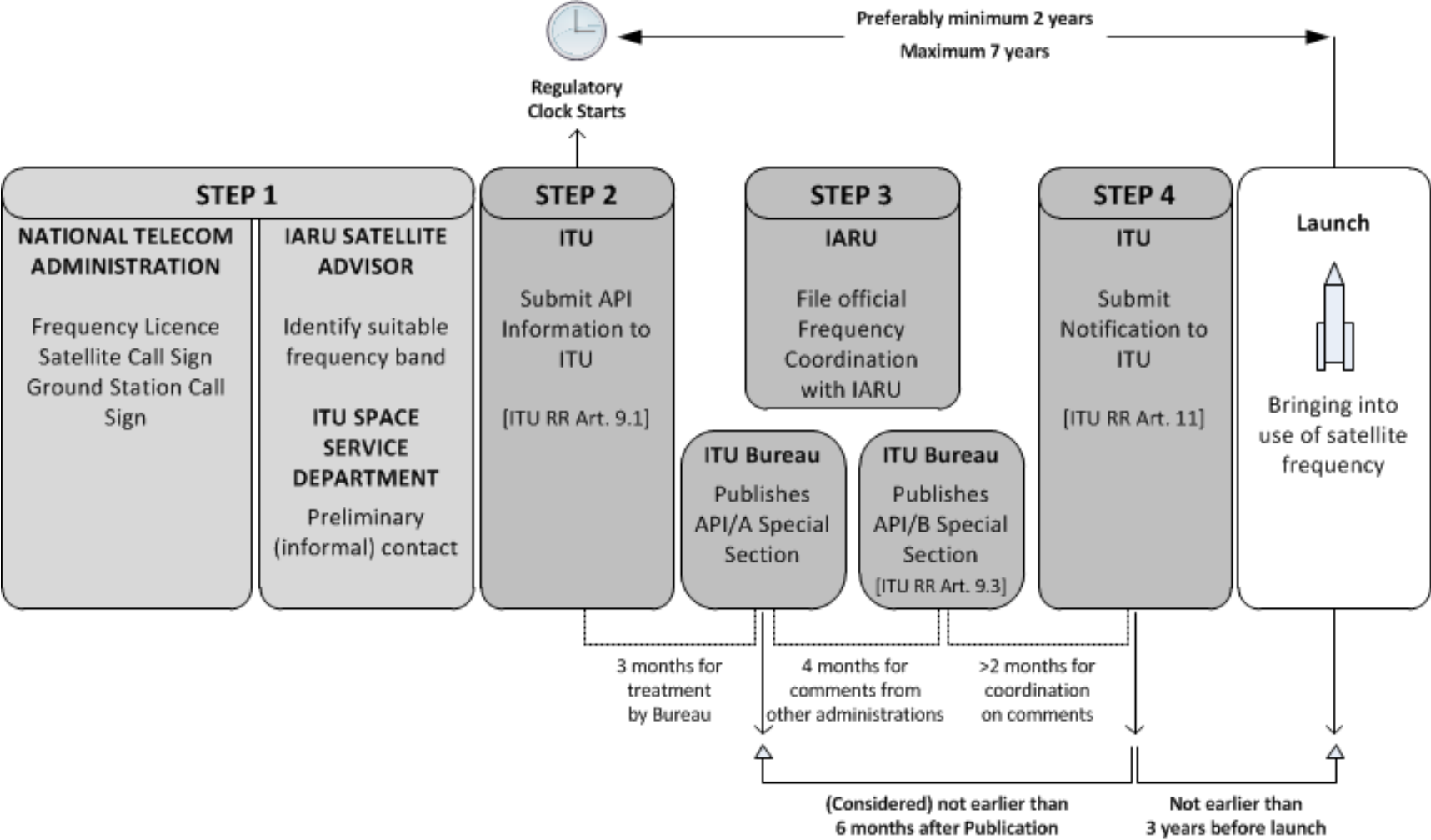


Proposed Preparatory Steps For Frequency and Space Object Registration

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



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