

## **Bachelor's Aerospace Engineering Project (EP) or Thesis (BT)**

### **Master's Aerospace Semester Thesis (ST)**

#### **Amateur Radio Options for EventSat**

**Start date:** Summer Semester 2026

**Duration:** max. 6 months, adaptable

#### **Topic**

*This project is embedded within the EventSat satellite mission at the Chair of Spacecraft Systems (TUM SPS): <https://www.asg.ed.tum.de/en/sps/eventsat-mission/>*

The analysis of how to integrate amateur radio services into a CubeSat mission with a primary non-amateur payload is a recurring challenge in the small satellite community. Many CubeSat missions use amateur spectrum but struggle to define a meaningful amateur radio contribution beyond basic telemetry beacons. This work produces a structured assessment framework — covering regulatory expectations, architectural integration patterns, and trade-off criteria — that is applicable to any CubeSat mission seeking IARU coordination. The regulatory analysis, the catalogue of amateur radio service options for CubeSats, and the evaluation methodology should be documented for independent release.

#### **Goals**

The goals of this project are the following:

- Investigate the ITU and IARU regulatory framework for amateur radio satellite operations. Produce a concise description of the coordination process, the expectations placed on missions using amateur spectrum, and the criteria by which IARU (and national societies such as DARC) evaluate whether a mission's amateur radio contribution is sufficient. Assess whether EventSat's current baseline represents a compliance risk or is already adequate
- Assess the EventSat COM and CDH architecture with respect to its compatibility with amateur radio satellite operations, identifying what the current baseline already provides to the amateur radio community and where gaps exist relative to the identified IARU expectations
- Propose either software-defined methods implementable within the existing OBC/CDH architecture that add amateur radio functionality (e.g. digipeater, telemetry beacon in standard amateur formats, store-and-forward messaging) or identify candidate small secondary payloads that could complement the primary mission with amateur radio services
- Evaluate the proposed options against mission constraints: available mass, power, volume, OBC processing budget, and operational complexity — and recommend a preferred approach with a justified rationale
- Provide a preliminary implementation concept or interface specification for the recommended option, sufficient for integration assessment by the COM and CDH sub-teams

## Extension Points

**EP scope boundary:** At Engineering Project level, the scope is limited to: (1) the regulatory framework investigation — a concise document describing the ITU/IARU/DARC coordination process and what is expected of amateur radio satellite missions, including an assessment of whether EventSat's current baseline is at risk, (2) a catalogue of candidate amateur radio services with a qualitative assessment of feasibility within the EventSat architecture, and (3) a written recommendation with rationale. The EP does not include a detailed implementation design, simulation, or prototype. The deliverable is a regulatory assessment plus trade study report, not a design document. The architecture assessment at EP level is a desktop review of available documentation, not a deep technical analysis requiring OBC resource modelling.

**EP → BT elevation:** To elevate from the EP trade study to a Bachelor Thesis:

- Require a detailed implementation design for the recommended option, not just an interface concept. For a software-defined option, this means a software architecture with defined modules, interfaces, and resource estimates. For a hardware option, this means a component selection with interface design and integration concept
- Add a simulation or prototype demonstration of the recommended amateur radio service (e.g. a software prototype running on a development board, or a GNU Radio simulation of the proposed service)
- Require a proper literature survey of amateur radio satellite services and regulatory frameworks, positioned as a research contribution
- The thesis must include a methodology discussion justifying the trade-off approach and criteria selection

**BT → ST elevation:** To elevate from Bachelor Thesis to Semester Thesis:

- Require quantitative analysis of the proposed amateur radio service's performance (e.g. coverage analysis, expected user throughput, link margin for the amateur service)
- Add an operational concept: how would the amateur radio service be operated alongside the primary mission? What are the duty cycle implications, scheduling conflicts, and ground station compatibility requirements?
- Expect a more rigorous systems engineering framing: the amateur radio enhancement as a subsystem-level design decision with traced requirements and interface definitions, not just a feasibility study

## Tasks

The tasks of the project are the following. Time to completion is given in full-time work dedication:

1. **Regulatory and Community Context:** - Research IARU frequency coordination requirements and expectations for amateur satellite operations. Identify what IARU typically considers sufficient amateur radio contribution for coordination approval (~1–2 weeks)
2. **Survey existing amateur radio CubeSat missions** (e.g. AMSAT satellites, FUNcube, university missions with amateur payloads) and catalogue the amateur radio services they provide (~2 week)
3. **Architecture Assessment:** - Review the EventSat COM architecture (UHF transceiver capabilities, modulation, data rates) and CDH architecture (OBC processing capacity, available interfaces, software framework) to establish what is

technically feasible within the existing platform (~1–2 weeks) - Identify constraints: remaining mass/volume/power margins, OBC duty cycle availability for amateur services, ground station compatibility requirements (~2 week)

4. **Option Development:** - Develop a set of candidate amateur radio enhancements. For software-defined options: define the functional concept, required OBC resources, and interface to the UHF transceiver. For hardware options: identify candidate payloads, mass/volume/power requirements, and interface needs (~2–3 weeks)
5. **Evaluate each option against mission constraints and IARU expectations.** Use a structured trade-off (e.g. weighted criteria matrix) to rank options (~2 weeks)
6. **Recommendation and Interface Concept:** - Select and document the recommended approach. Produce a preliminary implementation concept or interface specification sufficient for the COM and CDH sub-teams to assess integration feasibility (~2 weeks)
7. **Documentation:** - Compile the full analysis into a report, clearly separating the reusable framework (general component) from EventSat-specific design decisions (~2 weeks)



### Expected results

- A regulatory context summary: what IARU expects for amateur satellite coordination
- An assessment of the EventSat baseline architecture's amateur radio capabilities and gaps
- A catalogue and trade-off of candidate amateur radio enhancement options
- A recommended approach with preliminary implementation concept or interface specification
- A report structured with separable general and mission-specific sections

### Prerequisites / Required Background

- Basic understanding of amateur radio concepts and satellite communication
- Familiarity with CubeSat architectures (or willingness to learn quickly)
- For software-defined options: basic understanding of embedded software concepts
- Interest in regulatory and community aspects of amateur radio

### Advisors

	<p>Ramón García Alarcia  COM System Lead  Phone: +49 89 289 – 55752  E-Mail: <a href="mailto:ramon.garcia-alarcia@tum.de">ramon.garcia-alarcia@tum.de</a></p>
	<p>Jaspar Sindermann  Project Manager  Phone: +49 89 289 – 55753  E-Mail: <a href="mailto:jaspar.sindermann@tum.de">jaspar.sindermann@tum.de</a></p>