

## Bachelor's Aerospace Engineering Project (EP)

### Net Data Budget Analysis 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 methodology of decomposing gross-to-net throughput across a multi-layer protocol stack is broadly applicable to any CubeSat mission using standard amateur radio or commercial protocol stacks. The analysis framework — identifying overhead sources per layer and quantifying their impact on usable throughput — is a direct contribution to the EventSat's Communication System work. Students will perform analysis and produce a report so that the framework and methodology sections are publishable independently of EventSat-specific protocol configurations.

#### Goals

The goals of this EP are the following:

- Analyze the possible protocol stack options used for EventSat telemetry and science data transfer on both UHF and S-Band links, identifying all protocol layers and their associated overhead (headers, framing, error correction, acknowledgement traffic)
- Select the protocol stack based on requirements and input from the EventSat's Communication System team
- Quantify the net user data throughput as a function of gross data rate for each link, accounting for at least the physical layer framing, data link layer protocol (e.g. AX.25, AirMAC), and the telemetry file transfer overhead
- Provide a parameterized data budget model that allows operations planning to calculate achievable science data volume per ground station pass under varying assumptions (pass duration, elevation profile, protocol configuration)

#### Tasks

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

1. Identify and document the full protocol stack for both UHF and S-Band links as currently baselined or planned, from physical layer framing through to application-layer file transfer. Consult COM sub-team documentation and EnduroSat technical references (~2 weeks)
2. For each protocol layer, determine the overhead: header sizes, framing bytes, error correction redundancy, retransmission probability (if applicable), and

- acknowledgement traffic. Distinguish between fixed overhead per frame and variable overhead dependent on payload size (~2 weeks)
3. Calculate the net throughput as a fraction of gross data rate for representative configurations. Present results as overhead breakdown tables and net-vs-gross throughput curves (~2 weeks)
  4. Build a simple spreadsheet or script-based model that takes pass duration, gross data rate, and protocol configuration as inputs and outputs expected net data volume transferred. Validate with at least one worked example against manual calculation (~2 weeks)
  5. Document assumptions, results, and the data budget model in a project report. Include a clear statement of which protocol configuration assumptions are firm and which are still subject to change (~2 week)

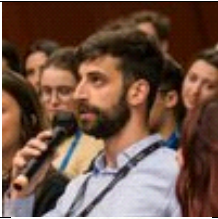

### Expected results

- A protocol stack decomposition document for UHF and S-Band links showing all overhead sources per layer
- Net throughput figures (as percentage of gross rate) for the baseline protocol configurations
- A parameterized data budget model (spreadsheet or Python script) for pass-level science data return estimation
- A project report documenting methodology, assumptions, and results

### Prerequisites / Required Background

- Understanding of communication protocols and layered network models (OSI or equivalent)
- Basic familiarity with data framing concepts (headers, CRC, packet structure)
- Spreadsheet or basic Python scripting ability for the data budget model

### Advisors

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