ESAT
The Hands-On Training Satellite
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ESAT Objectives

• Teach space systems engineering.
• Teach how the different subsystems and architectures work and interact with each other.
• Teach how the integration and validation tests are performed.
• Possibility to work with the subsystems stand-alone or integrated.
• Easy to use and robust.
• Community oriented.
• Easy to build on it:
  • Open Source SW
  • Easy programming interface
  • Serial Interface
ESAT Subsystems (I)

**EPS**
- 2 solar panels
- 2 solar panel regulators: MPPT/DET
- Voltage/current telemetry
- 5V, 3.3V DC/DC converters and switches
- Battery management module with overcurrent/overvoltage/undervoltage protection
- Integrated battery charger
- Programmable MCU

**OBC**
- Fully programmable unit (preprogrammed with open source base software)
- Micro-SD card
- Real Time clock
- Wireless communication via WiFi module
ESAT Subsystems (II)

**ADCS**
- One reaction wheel
- Two magnetorquers
- One IMU with 9 degrees of freedom (3 accelerations, 3 gyros, 3 magnetic axis)
- 4 sun sensors
- Wheel tachometer
- Customizable control algorithms

**STR**
- 2 Aluminium frames
- 4 Aluminium rails
- 4 methacrylate side panels
- 2 Solar panels
- Spacers between the electronic boards
ESAT EGSE and MCS

EGSE
- Turning table
- Sun simulator
- Magnets to provide a useful magnetic field

MCS
- COSMOS SW
- Telemetry visualization:
  - Raw
  - Plots
  - Subsystems displays
  - Replay
- Telecomands
ESAT Data Management

- CCSDS and XTCE standards implemented
- A central server handles the TM sent by all the satellites and broadcasts it to the corresponding connected users (clients).
- The server forwards commands from the users to the corresponding satellites.
- The client interface helps the user interpreting the TM and sending TCs.
- Open-source code.
ESAT On-Board Software (I)

• Free/Libre/Open-Source Software, so users are welcome to:
  • Run the programs as they wish.
  • Study and modify the programs.
  • Share the programs (as they received them) with others.
  • Share the programs (as they modified them) with others.

• Available on GitHub:
  • Currently, the most popular software development platform.
  • Check our repositories at https://github.com/TheiaSpace

• Leverages the Arduino platform:
  • Popular among artists, hobbyists, students and educators.
  • Well-established community.
  • Lots of learning resources.
  • Quick, easy and simple setup.
  • Also Free/Libre/Open-Source Software.
ESAT On-Board Software (II)

- Designed with user-extensibility and user-modifiability in mind.
- Common utility library:
  - CCSDS Space Packets.
  - CCSDS-over-I2C transfer protocol.
  - Data conversions.
  - Timekeeping.
- Per-subsystem libraries/programs:
  - Subsystem programs are Arduino example programs/sketches.
  - Low-level details are handled by the libraries.
  - Plug-in architecture: the user can add new functionality (including low-level functionality) directly from the Arduino sketch.
Potential Users

• STEM education
• Universities
• Space Companies
• Space Agencies

• Training
• Fast prototyping
• Satellite programmes
• Outreach activities
• First step towards a real satellite

• We provide courses
Thank you!

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