Aalto-3

The Open Source Student Satellite

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A Brief Introduction 1/2

- The Aalto-3 is an Open Source Student Satellite
- Designed and built at Aalto University in Finland by undergraduate and graduate level students
- The primary payload is an in-house built, reconfigurable Software-Defined Radio (SDR) platform to demonstrate deploying and utilizing complex SDR and signal analysis software on a CubeSat
- A variety of secondary payloads, including a Bluetooth communication experiment to demonstrate wireless intra-satellite communication, a camera, and a novel magnetometer payload

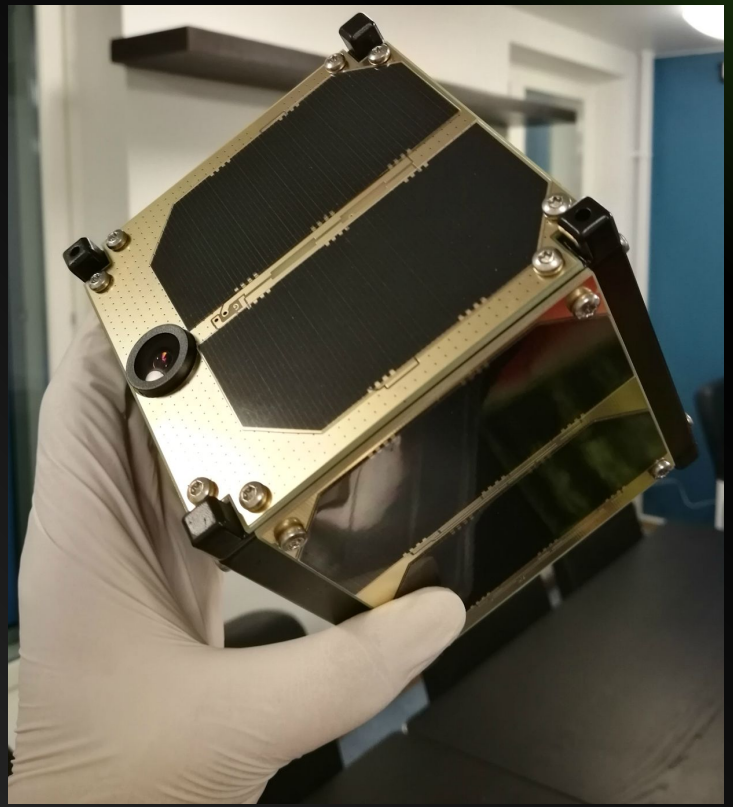


Fig. 1. Credit A. Binios

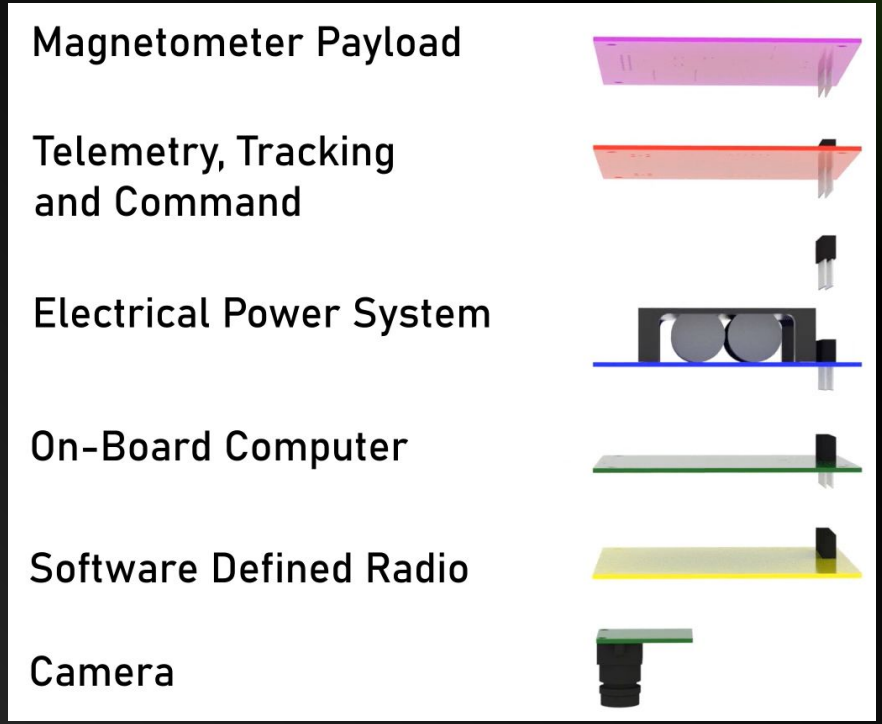
A Brief Introduction 2/2

- The Aalto-3 is the third member of the Aalto family of satellites
- The project aims to open the satellite design as an Open Source project
- The main mission objectives and goals
  - Support space engineering education and teach students how to develop a CubeSat
  - Build a complete satellite inhouse and launch
  - Demonstrate in-orbit payload operations and results to the community
  - Technology demonstration of in-house built Software-Defined Radio
  - Promote interest in space-related activities in Finland
  - Promote STEAM education in Finland

Fig. 2. Credit A. Binios

Subsystems

- Teams are divided at subsystem level
  - Software-Defined Radio (SDR)
  - On-Board Computer (OBC)
  - Electrical Power System (EPS)
  - Telemetry, Tracking and Command (TT&C)
  - Solar Panels (SP)
  - Software (SW)
  - Magnetometer Payload (MAG)
  - Mechanical structure (MEC)
  - Systems Engineer (SYS)
  - Quality Assurance (QA)
  - Project Management (MNG)



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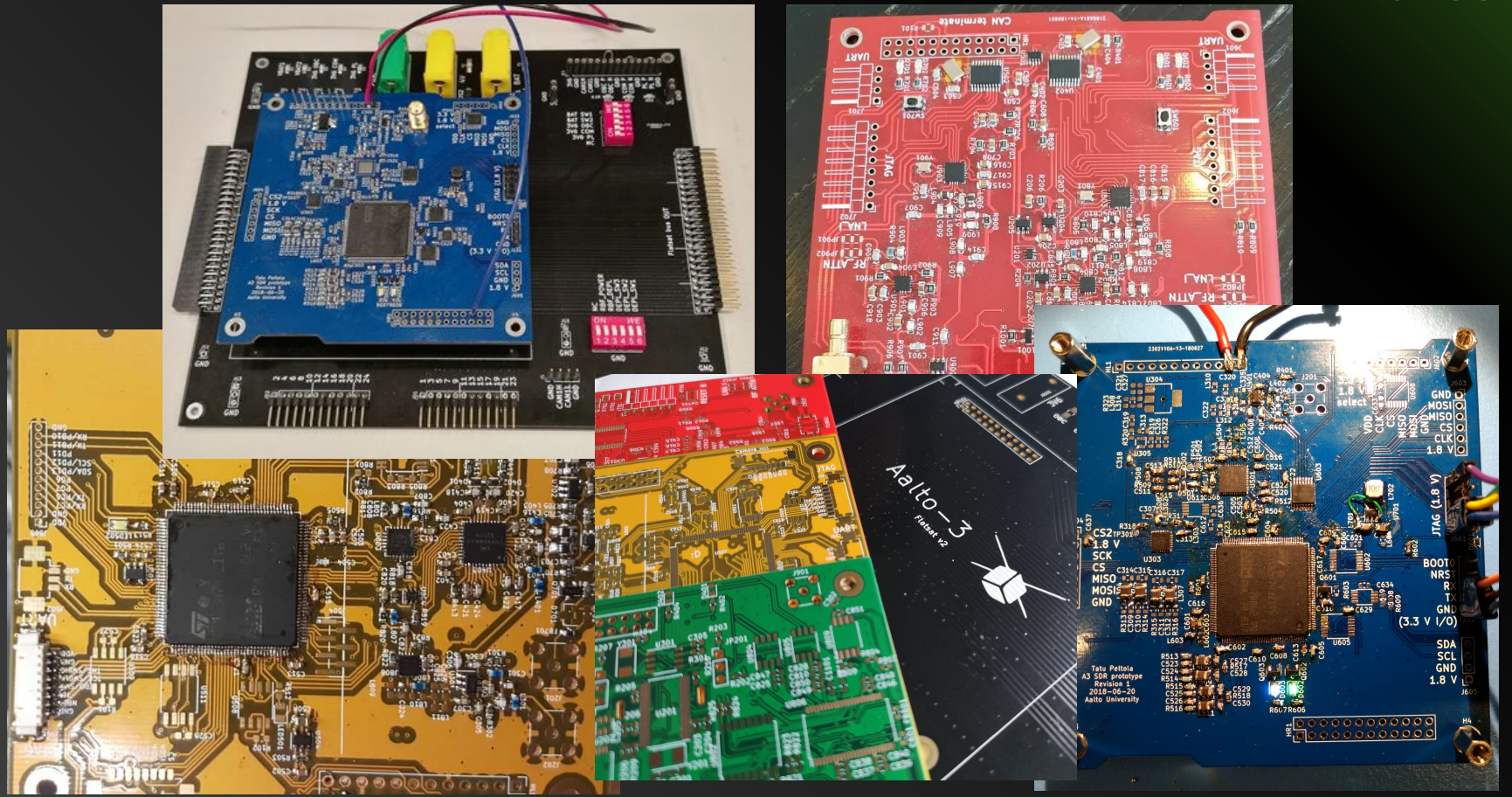
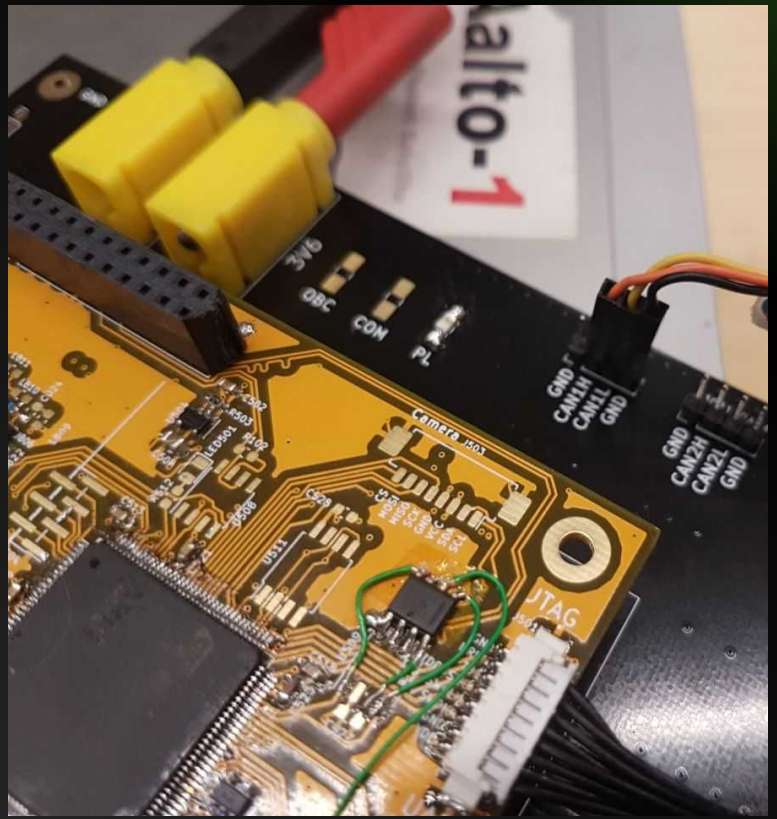


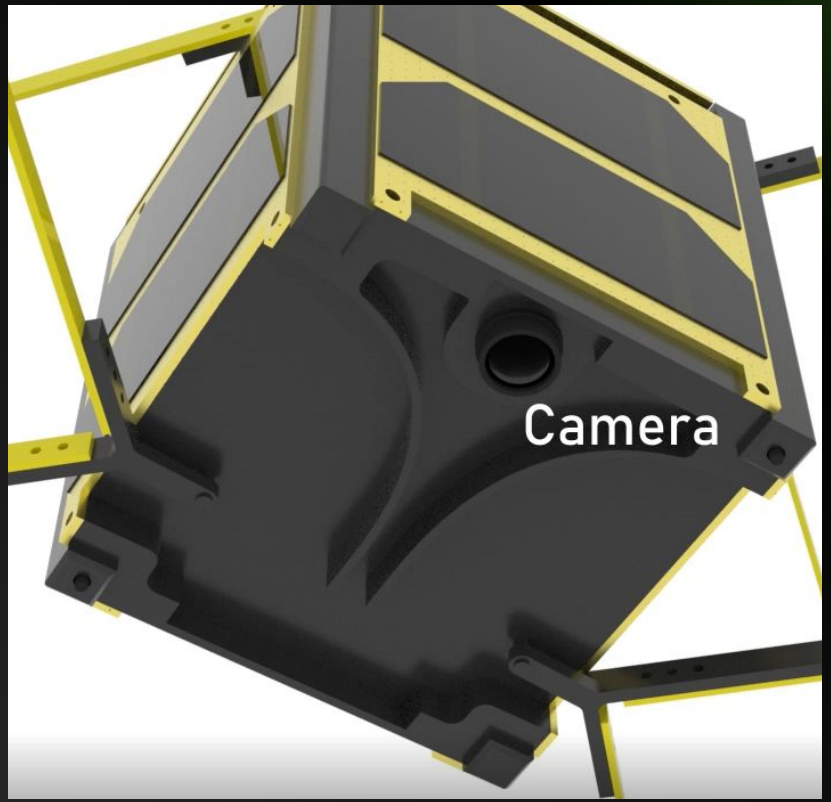
Primary Payload

- Software-Defined Radio (SDR)
  - In-house developed and built
- Selectable modulation and frequency during flight
- Bluetooth experiment with the OBC
- Software development
  - Successful transmission
  - Initial application loading with limited API
- Planned SDR experiments include the development of an advanced small satellite radio link protocol, reception of amateur radio Automatic Packet Reporting System messages, and transmitter locationing by using radio signals



Secondary Payloads

- Magnetometer payload (MAG)
  - In-house built
  - HMC2003
  - Technology demonstration
- Camera
  - Sensor OV5642
  - Resolution 5 Mpx (2592 px × 1944 px)
  - Image format 4:3
  - Field of View 46°
  - Aperture f/2.5
- Bluetooth
  - Wireless intra-satellite communication between the subsystems
  - Proof of concept



Mechanical Structure

- Frame manufactured from anodized 7075-T6 aluminium
- Manufactured using 3-axis CNC mill, two side panels cut from sheet
- Design is rigid and heavy
  - Structure complies with mass budget
- PCB stack is supported by four AISI 316 M3 threaded rods, spacers in between PCBs
  - Tolerance > ± 0.5 mm. Top end of stack supported by bracket which is fastened to the frame
- Structure supports VHF and UHF antenna deployment

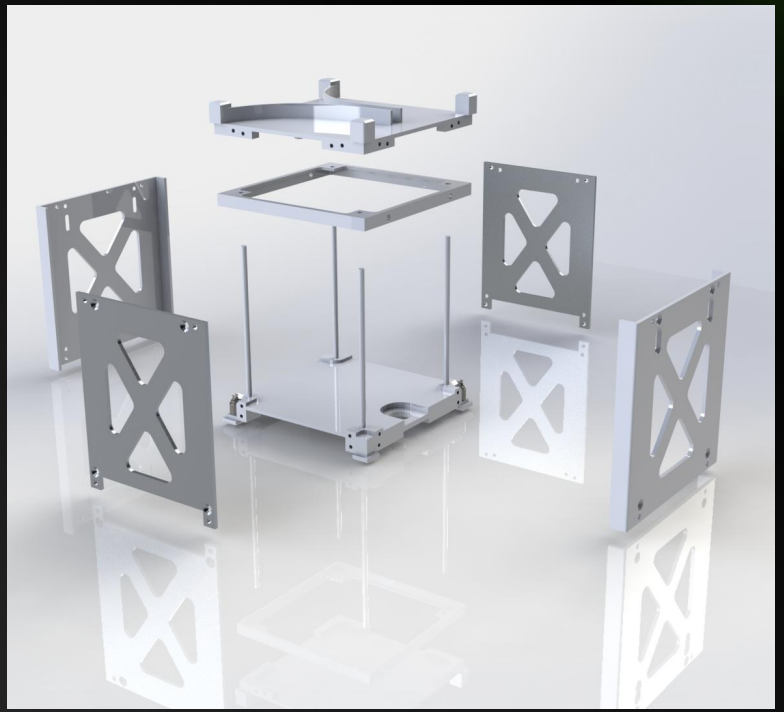
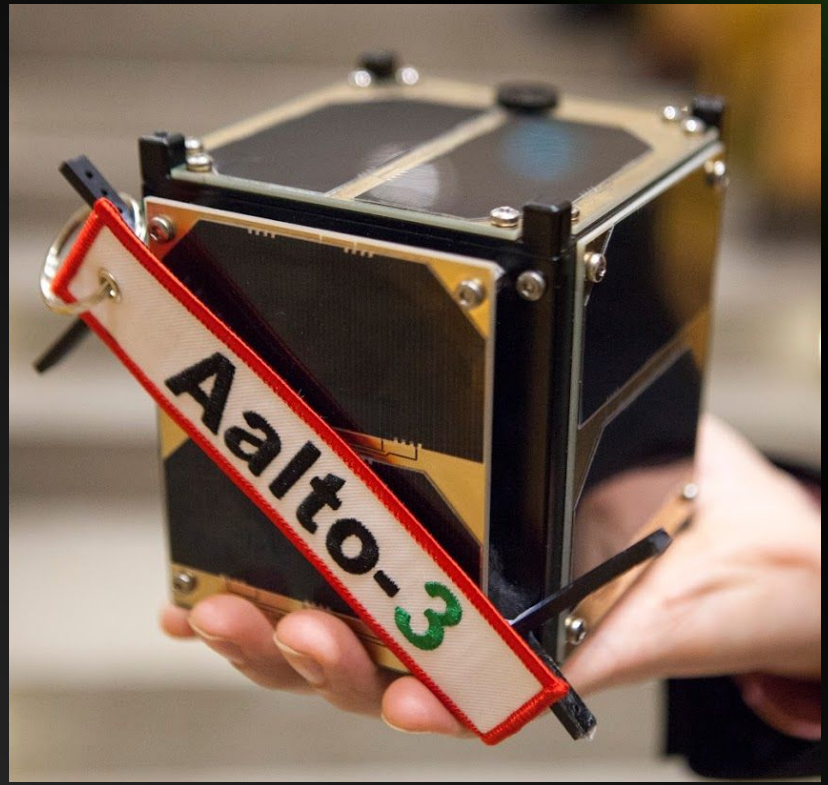


Fig. 3. Credit M. Simenius

Challenges

- Student dedication of time to the project, while simultaneously progressing with their Bachelor and Master level studies
- Communication between the subsystem teams and their documentation
- Overall steady progress and keeping necessary deadlines
- Lack of experience often leading to a slower decision process



Credit V. Piaulokaite

Outreach and Social Media

- Updates in social media channels
  - Twitter
  - Facebook
  - Instagram
  - LinkedIn

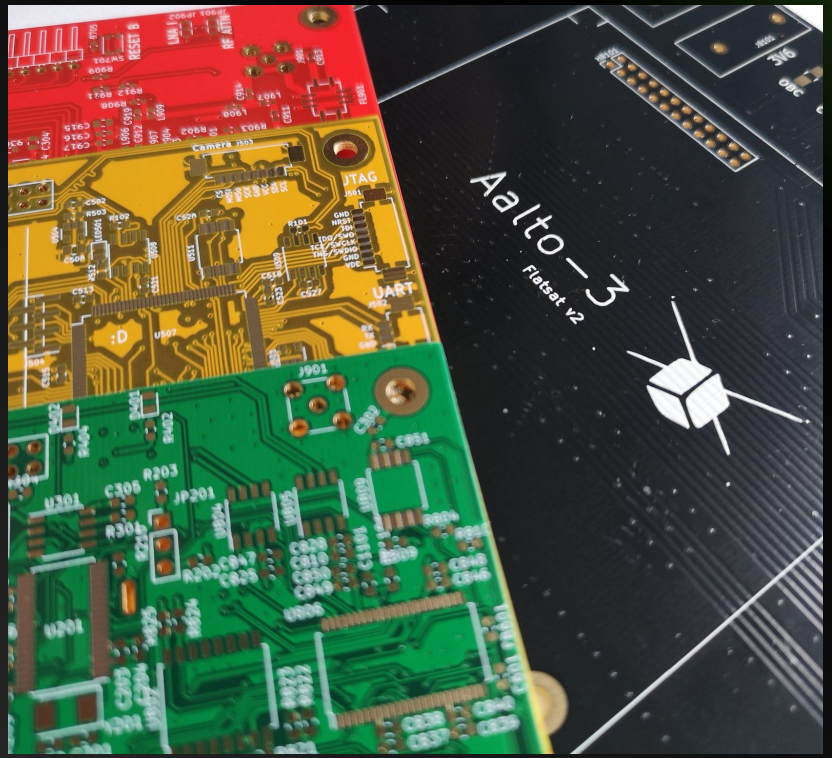
  → @AaltoSatellites

- Outreach to schools, visits to our Space laboratory with presentations given by students related to Space, Satellites and Technology

- Aalto Space Technology Association
  - Bringing together space professionals with enthusiasts and hobbyists

What's Next?

- Recently participated in ESA's Fly Your Satellite 3! Selection Workshop
  - Unfortunately not selected
- Aalto-3 mission paper to be written and published in 2020
- Subsystems in their third iteration phase
  - Soldering
  - Testing
  - Programming
- Structure
  - MEC team has been developing a concept for the structure and engineering a prototype of the structure
  - Next step includes manufacturing a full prototype, and carrying out vibration tests in mid-2020



Thank You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