Design of the On-Board Computer of the Belgian OUFTI-1 CubeSat

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Outline

1. OUFTI-1
2. Two OBCs for OUFTI-1
3. Real Time Operating System
4. Software architecture
5. Conclusion
OUFTI-1

CubeSat standard

Three payloads

Subsystems developed by students

1 kg liter watt
1. OUFTI-1
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Two OBCs for OUFTI-1

Backup OBC + Default OBC
Two OBCs for OUFTI-1
Two OBCs for OUFTI-1

- Redundancy management through I²C bus.
1. OUFTI-1
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Real-Time Operating System

- Multi-tasking

Task 2 – High Priority
Task 1 – Low Priority
Real-Time Operating System

- Deterministic

Diagram:
- Interrupt Routine
- Task 1
- Asynchronous event
Real-Time Operating System

• Why FreeRTOS?
  – Free
  – Open Source
  – Lightweight
  – Known to be reliable
  – MSP430 compatibility

www.freeRTOS.org
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Software architecture

Timer

Tasks

COM Rx
Sequencer
Measurement
Monitor
Log
COM Tx

Temporal reference

Roles

AX.25 decoding
Commands execution
Measuring
Antenna deployment
Log updating
AX.25 encoding

Commands storing
Payloads config.
Meas. storing
SS & PL (de)act.
Log retrieval

Meas. retrieval
Redund. Manag.
Software architecture

- COM Rx task:
  - AX.25 bits reception
  - BUFFER Rx
  - COM Rx
    - Waiting for AX.25 frame
    - Decoding of AX.25 frames
    - Commands interpretation
    - Recording of the received commands
    - DEMOD configuration
  - SCHEDULER
  - DEMOD
Software architecture

• Sequencer task:

  Time reference

  SCHEDULER

  Sequencer

    Looking for a command to execute

    Doppler Correction

    Change subsystems status

    Log & Meas. retrieval

    Modification of meas. configuration

    Measurement & sampling frequencies

    UART
Software architecture

• Measurement task:
Software architecture

- Measurement task:
Software architecture

Monitor
- Redundancy management & waiting for a FAULT or a status change

Subsystem or payload ON/OFF
- Subsystem or payload reset
- Antennas Deployment

Subsystems
- Event to log

ADCs
- Required status
- FAULTs
- I²C
Software architecture

- Monitor task:
Software architecture

• Log task:
Software architecture

• COM Tx task:
• Two is better than one…

• Task distribution and priority definition have to be carefully chosen
Thank you for your attention!