DEVELOPMENT AND TESTING OF THE ON-BOARD SOFTWARE FOR QB50 NANOSATELLITE IP²SAT

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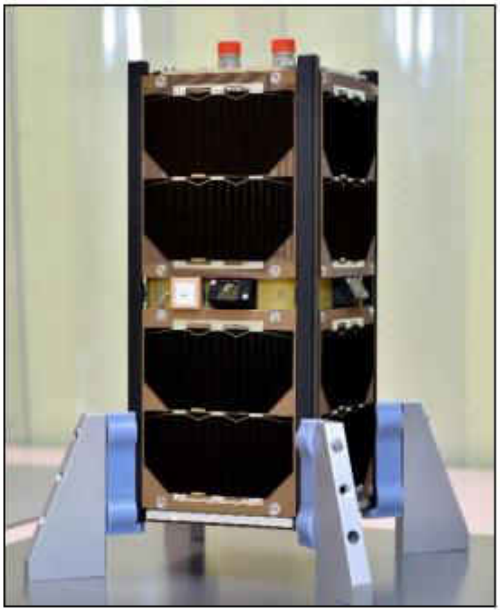
SUMMARY

- Introduction
- QB50 project
- IP²SAT
- On-Board Computer
  - Operating system
  - Functional test
- Telecommunication Card
  - Master DSP
  - Uplink/Downlink
  - Protection
- Conclusion



UPJV - INSSET

INSSET – INSTITUTE SUPÉRIEUR DES SCIENCES ET TECHNIQUES

- SAINT-QUENTIN (PICARDIE)
- UNIVERSITÈ DE PICARDIE JULES VERNE
- 350 STUDENTS
- **EMBEDDED SYSTEMS**, LOGISTIC ENGINEERING, CLOUD COMPUTING & MOBILITY, INDUSTRIAL PRODUCT DESIGN
- **SATPICARD**

SATPICARD

GROUP OF SATELLITE SYSTEMS R&D IN THE EMBEDDED SYSTEMS DEPARTMENT

1 PROFESSOR, 2 ENGINEERS, 1 PHD + MASTER STUDENTS

2 PROJECTS, 3 PRODUCTS

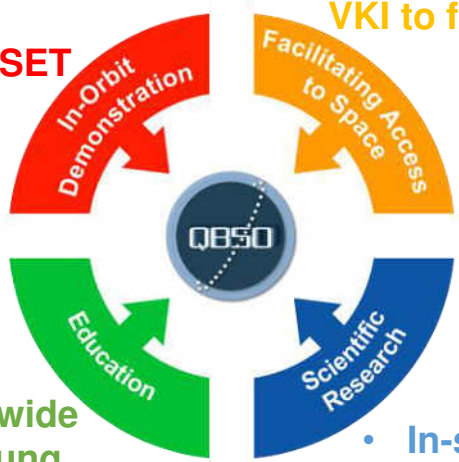
genso

Matra Électronique
SOLUTIONS PROVIDER
SEICER Solutions électroniques

QB50

- Launch cost: €20k (funded by EC)
- Launch date: July 2016 to ISS
- 50 CubeSat
- Guided framework coordinate by VKI to facilitate newcomers

- IOD: QARMAN, DelFFI, InflateSail
- Telecom card by INSSET

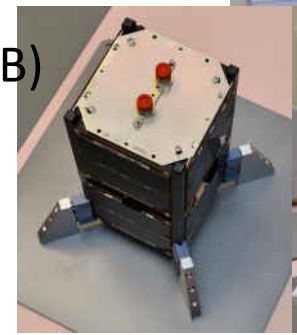


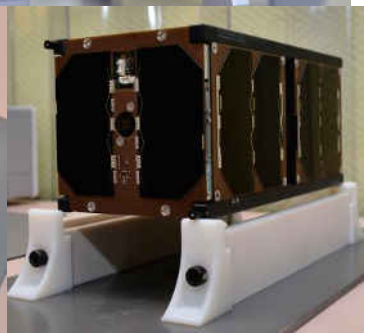
- 50 Universities worldwide
- Train and educate young engineers with hand-on activities
- Learn how to conduct sat projects

- In-situ measurements in the lower thermosphere (380 km – 90 km)
- FIPEX, INMS, m-NLP

IP²SAT

- Electrical Power Unit (EPS): Nanopower p31u
- On-Board computer: NanoMind 712D
- Solar Panels: NanoPower P110 series
- ADCS: NanoMind A3200
- Structure: ISIS
- **TT&C: WallCom v1.0 (INSSET)**
- Antenna: ISIS Deployable UHF/VHF 2-monopole Antenna
- Payloads: FIPEX, STM, (Secure-ODB)

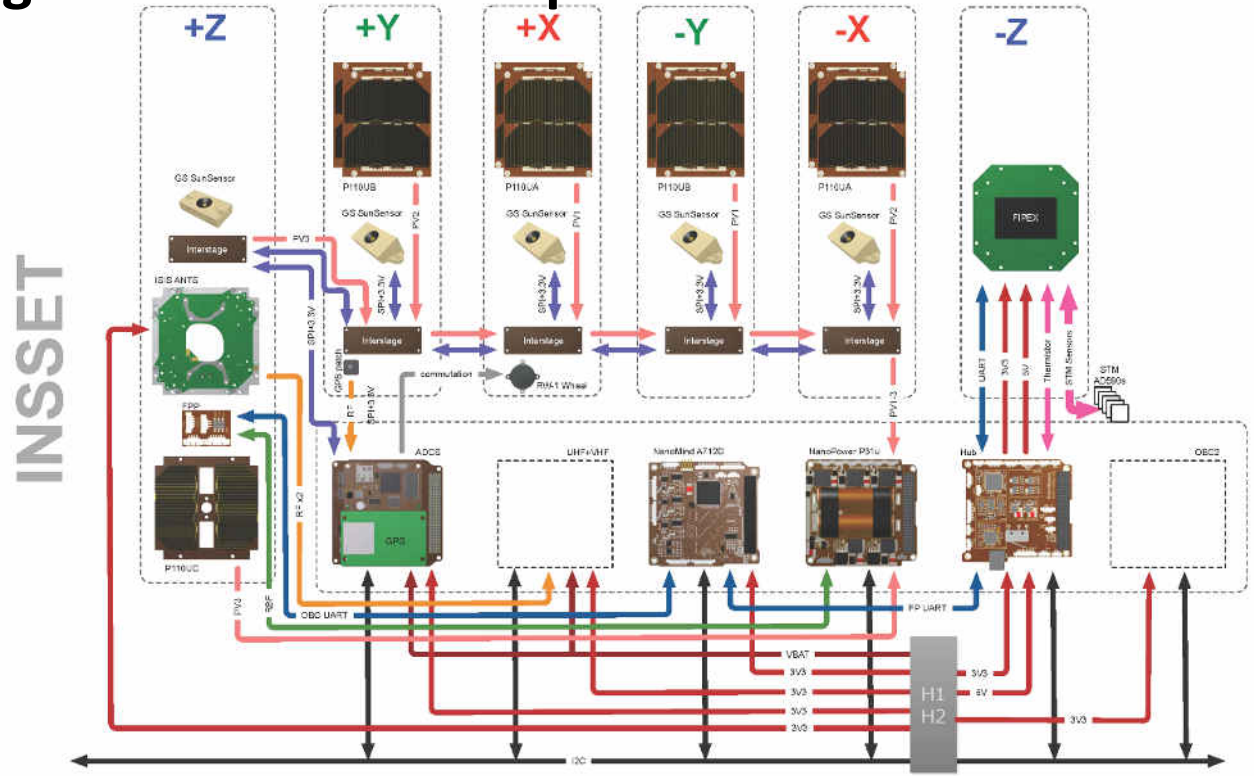




GOMSPACE ISIS

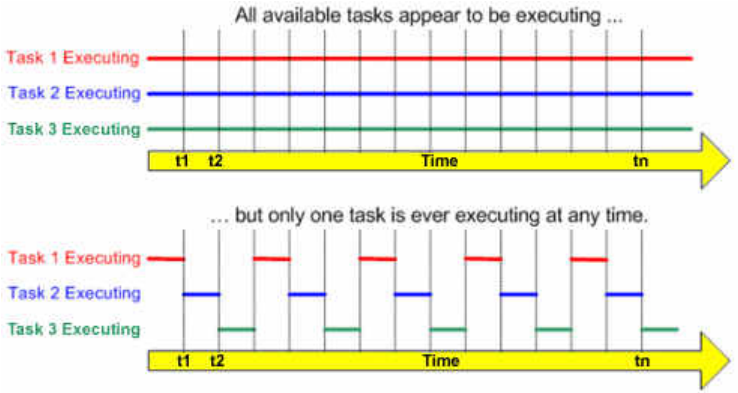
IP²SAT

Flight Software Development



On-Board Software

- OS in FreeRTOS (Linux or others also possible)



- Software with different tasks

- SCS ⟷ CubeSat Protocol (CSP)

- Encapsulation/Decapsulation

On-Board Software

- OS in FreeRTOS (Linux or others also possible)

```
typedef union {
        uint8_t tab[31];
        struct __attribute__((__packed__)) {
                uint8_t var1;
                uint8_t tab1[8];
                uint32_t var2;
                uint16_t var3;
                uint32_t tab2[4];
        };
} strucTest_t;
```

- Software with different tasks

- SCS ⟷ CSP

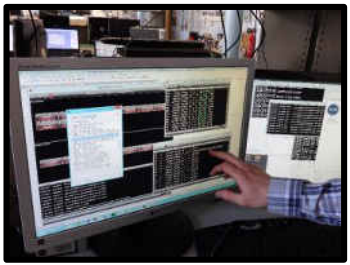
- Encapsulation/Decapsulation

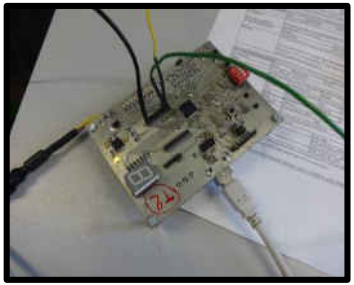
Functional Tests

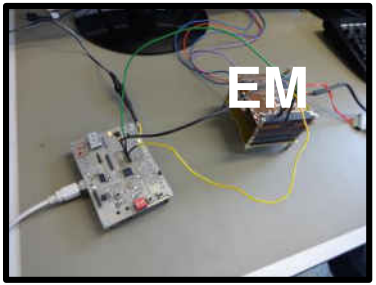
- Before and After Environmental tests to identify failures

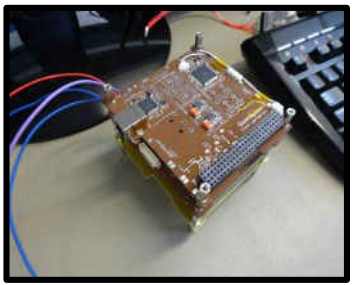
- End-to-End test

swiss space center



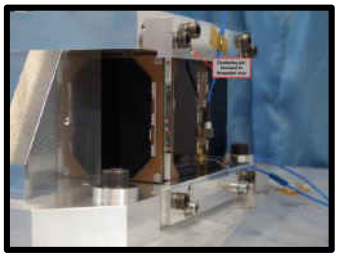


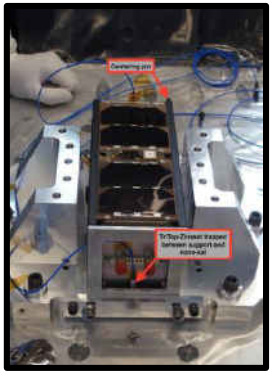




Enviromental tests

- Vibration (Quasi-Static and G-Loads, Natural Frequencies / Resonance Survey, Sinusoidal, Random)
- Shock



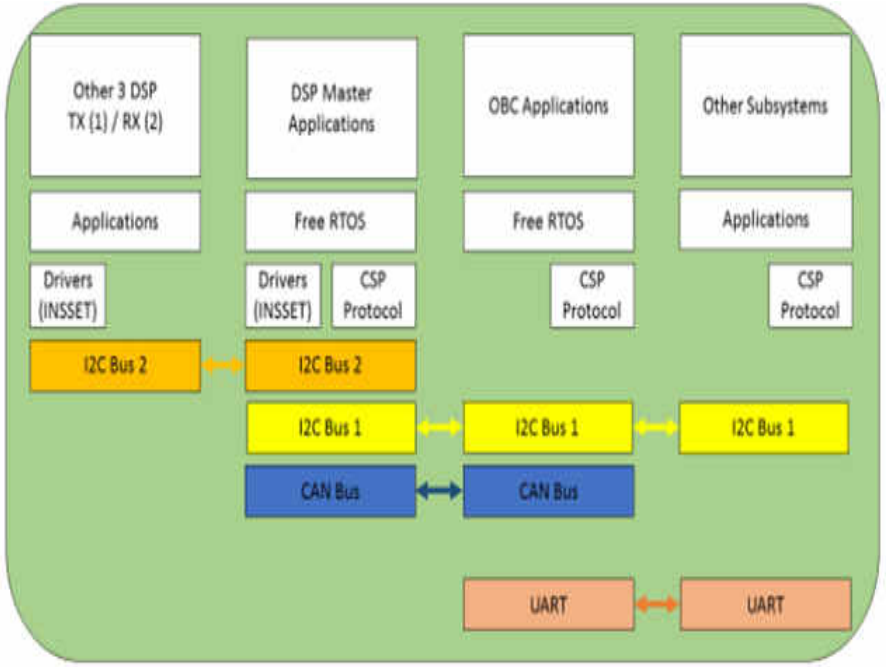


PIT PLATEFORME INTEGRATION TESTS OVSQ

MECANO I&D

WallCom V1.0

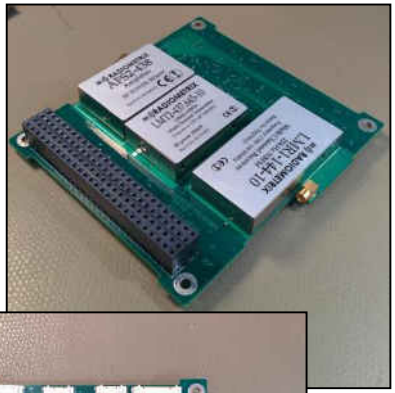
- Developed at INSSET
- Modularity
- General design
- 4 DSP

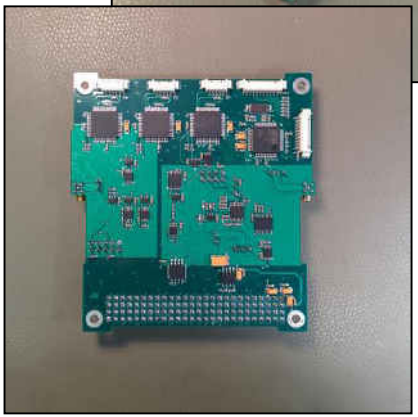


Master DSP

- Data exchange between the telecom subsystem and OBC

- Integrate FreeRTOS (also other OS possible)





Uplink/Downlink

Uplink

2 DSP for AX.25 and DTMF

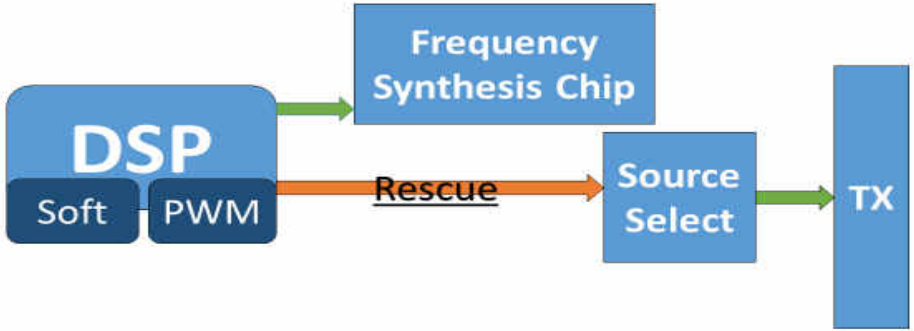
Inter-changeability

Downlink

1 DSP (Morse code, AX.25)

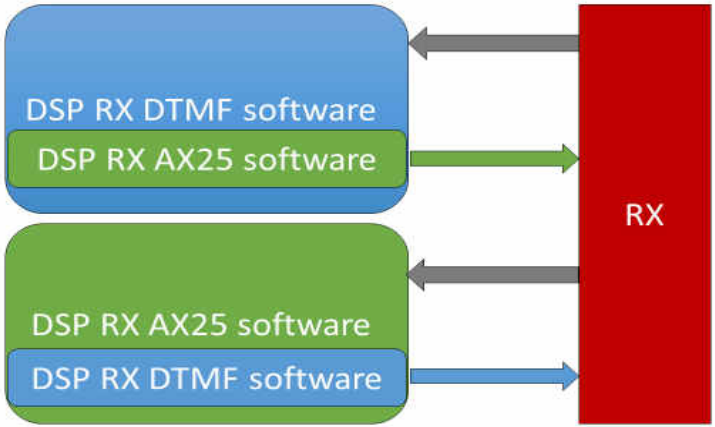
Modulation G3RUH via software

Protection



Double Protection

Dynamic Functional Redundancy



Conclusion

- Demonstrate the capacity of building a nanosat "Picard" from scratch
- IP²SAT is the basis for the development of other satellite subsystems
  - Modularity concept
  - Dynamic Functional Redundancy

Questions?

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