

UV_Sat - HyperSat Microsatellite Platform



KBKiS PAN

Tomasz Zawistowski, Creotech Instruments

12.10.2019

Project basics

- Sponsored by NCBiR
- To be concluded in 2020
- Deliverables: Engineering Qualification Model (TRL 7) of a universal satellite platform
- In order to qualify the platform a particular mission was picked up (UV-photometric mission)
- Mission assumptions based on the UV mission feasibility study
- Requirements of the platform reflect the needs of the UV photometric mission, although no particular payload is delivered

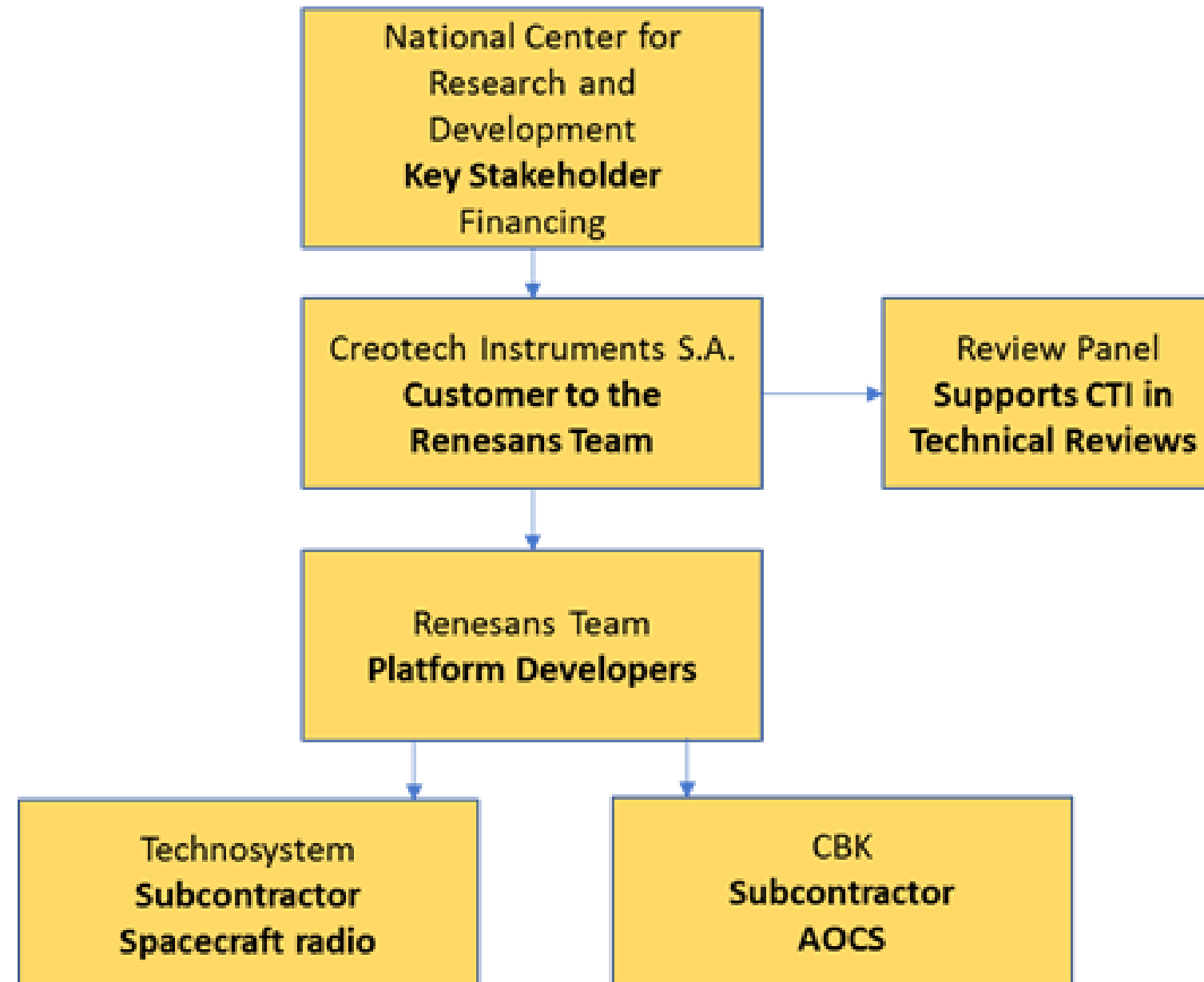


Project assumptions

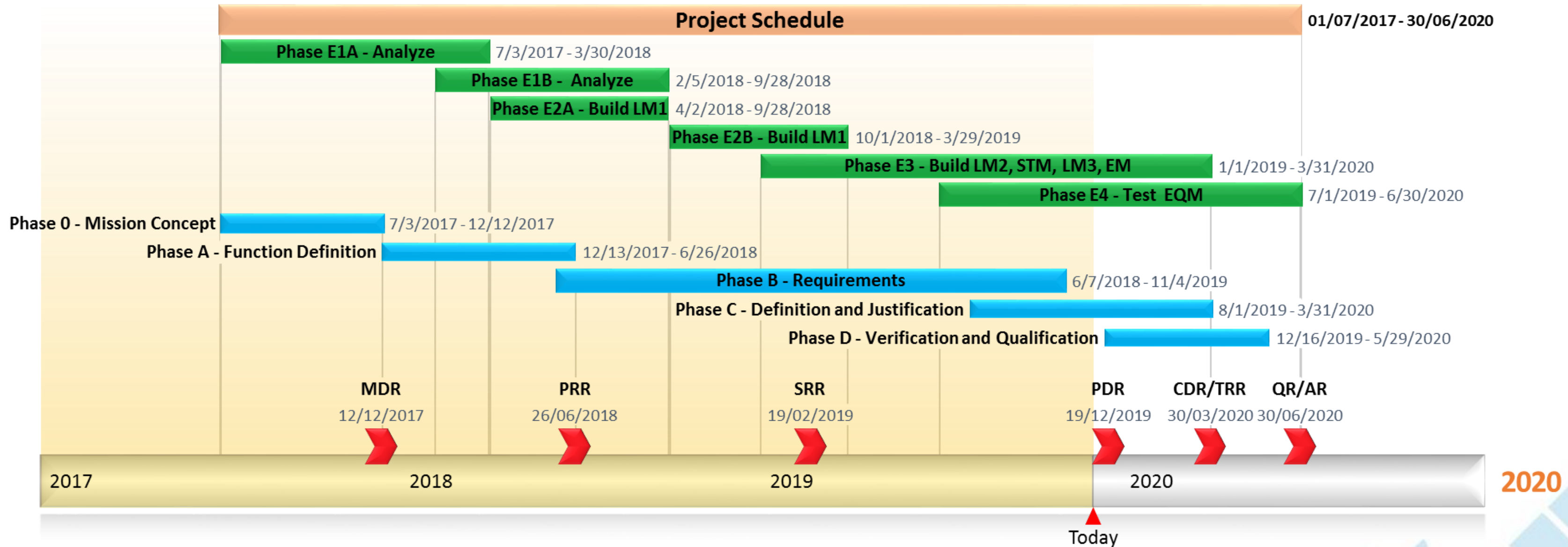
- Scalable architecture
- Open Software & Open Hardware
- Modular design
- Software reconfigurable in orbit
- Using COTS with space heritage, inexpensive, ITAR Free design
- Single Point of Failure Free
- Short Time To Market
- Compatibility:
 - ✓ CubeSat
 - ✓ SpaceVPX
 - ✓ Most of capable launch vehicles
 - ✓ CCSDSStandard
 - ✓ ESA Mission Control Software –SCOS2000



Project organization



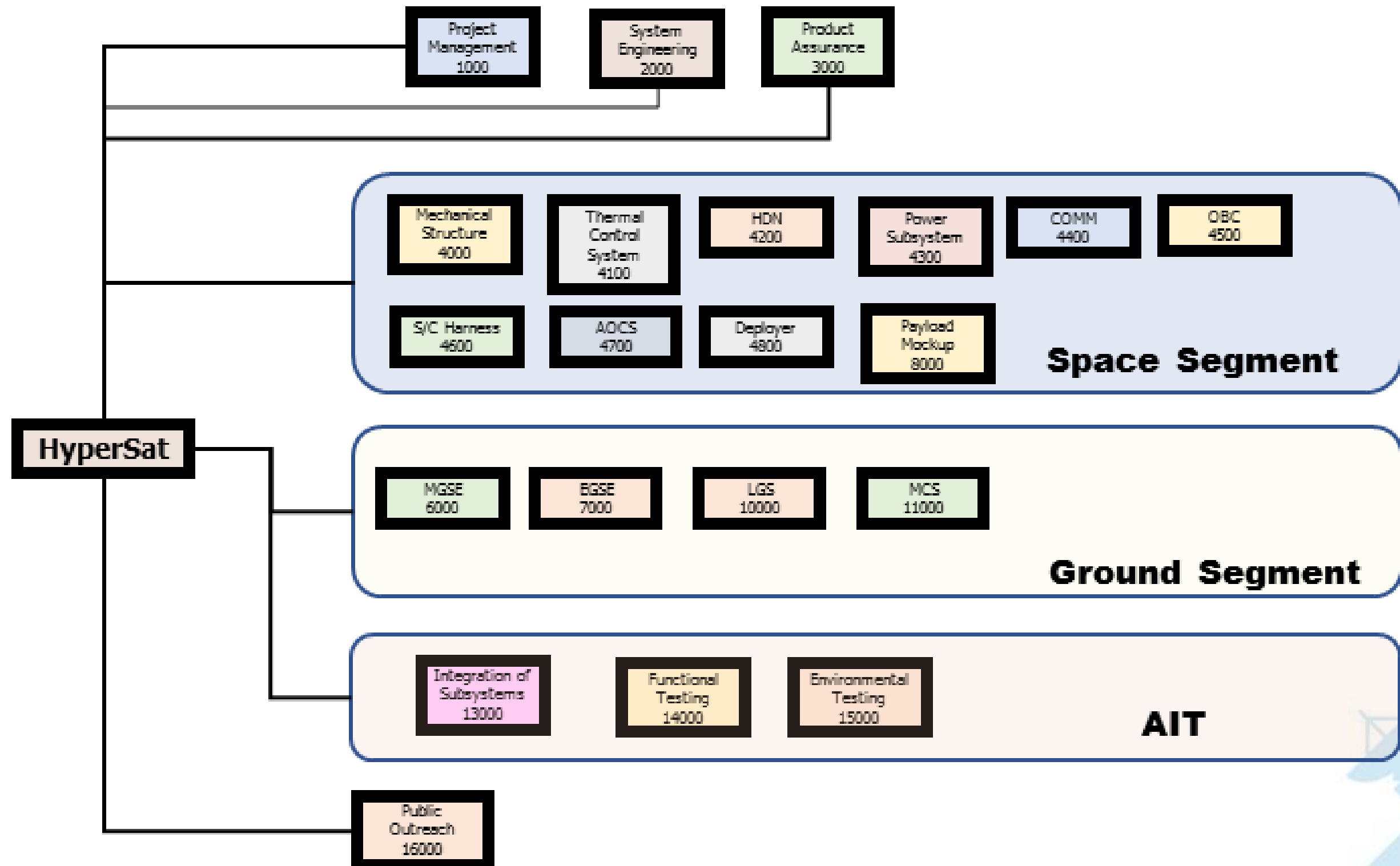
Project life cycle



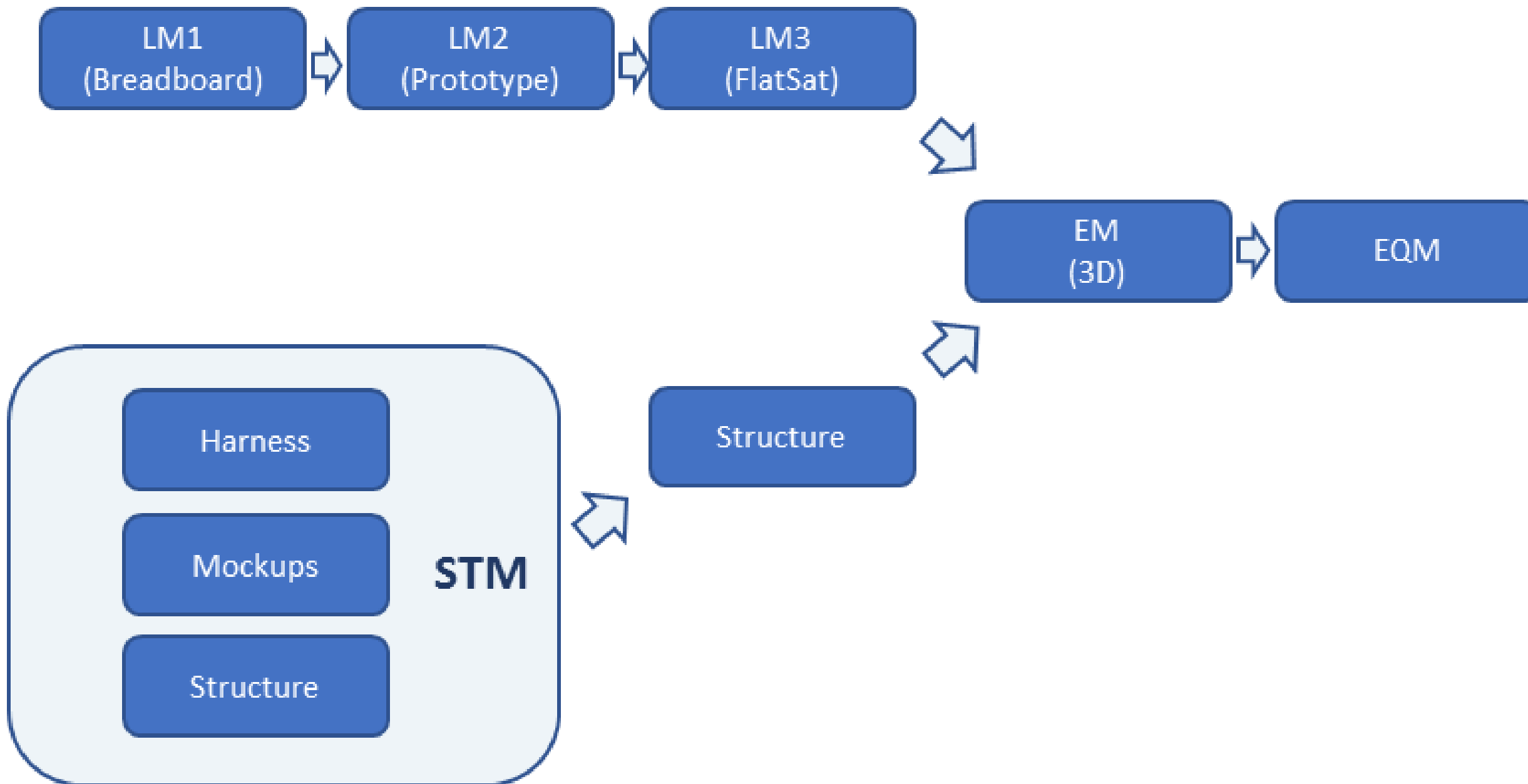
PDR preparation under way

Collocation meeting scheduled for next week

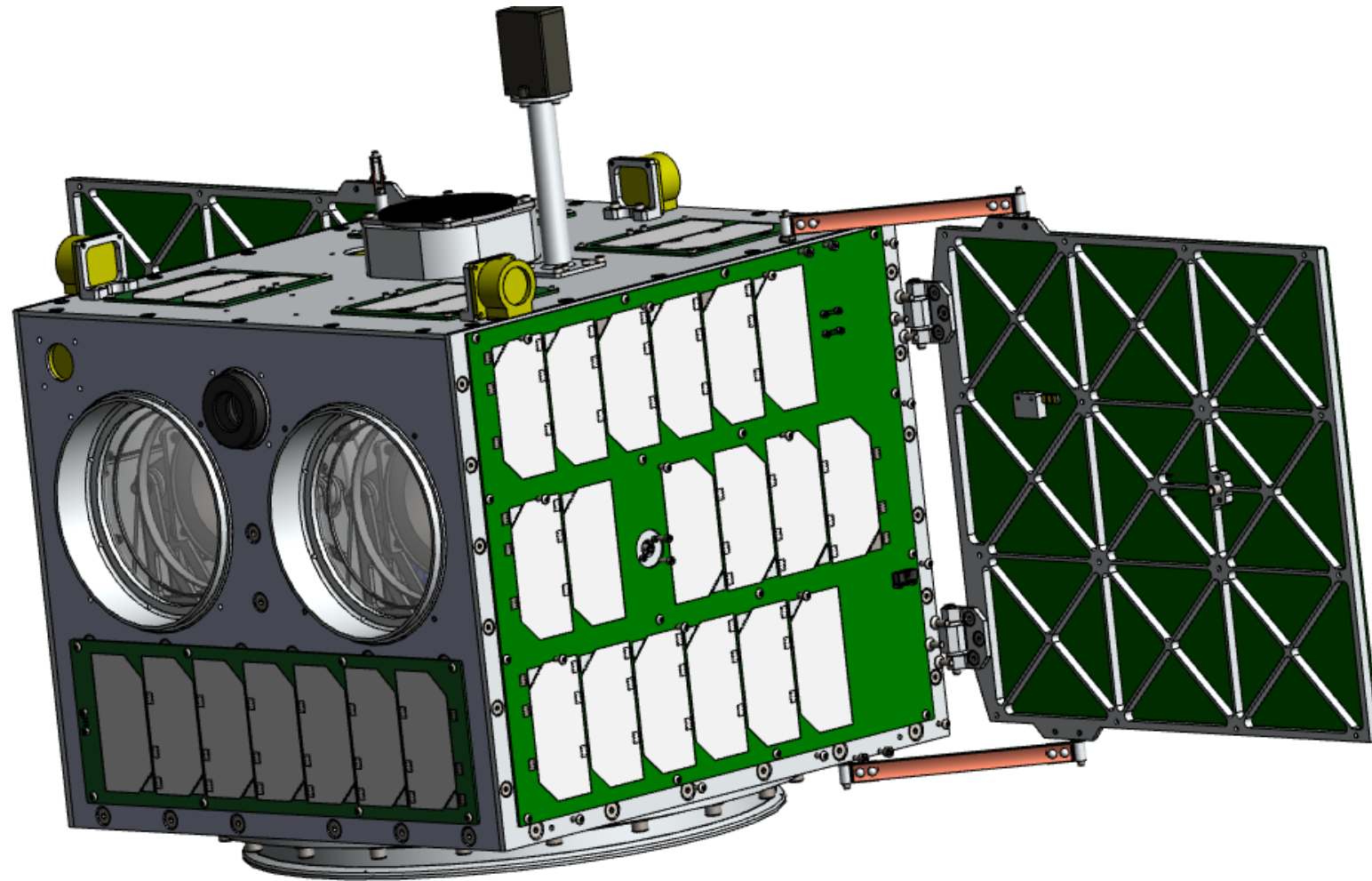
System classification



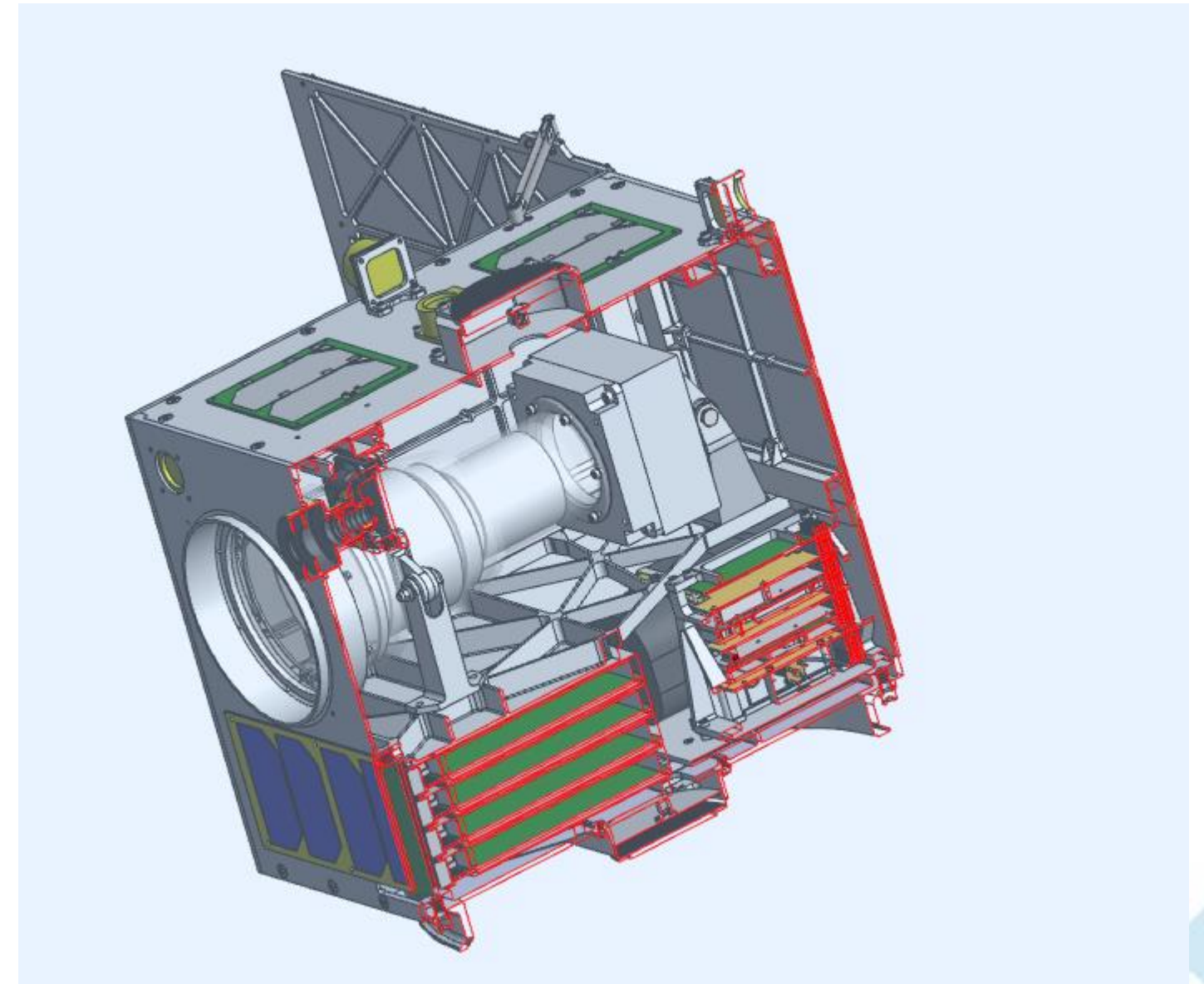
Model philosophy



Platform visualization

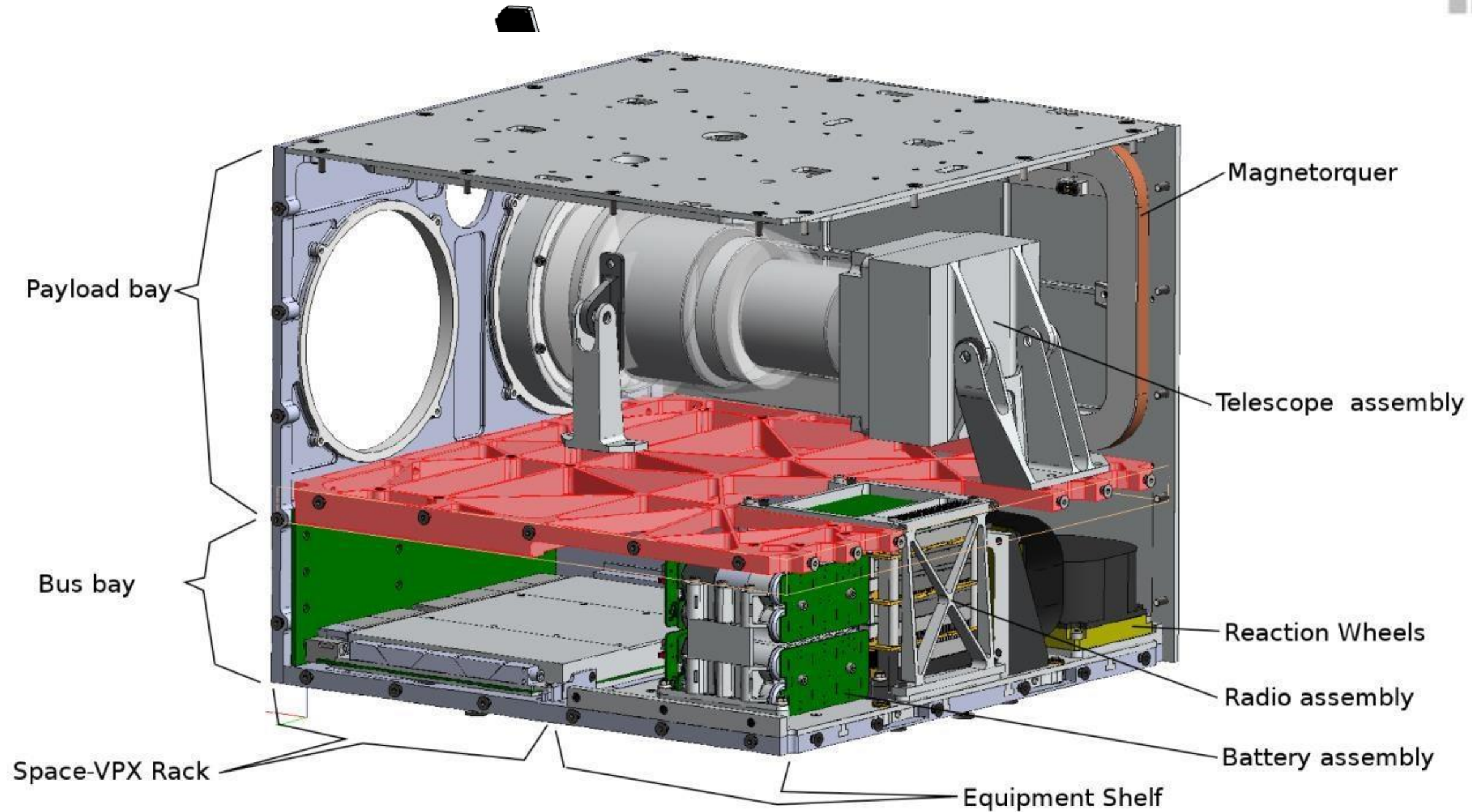


In –orbit configuration



Cross section

Subsystem description



Satellite subsystems:

In-house development:

- Structure
- Power Subsystem
- OBC
- OBDH
- MCS
- Ground Station
- MGS/EGSE

Outsourcing:

- AOCS
- RADIO
- DEPLOYER



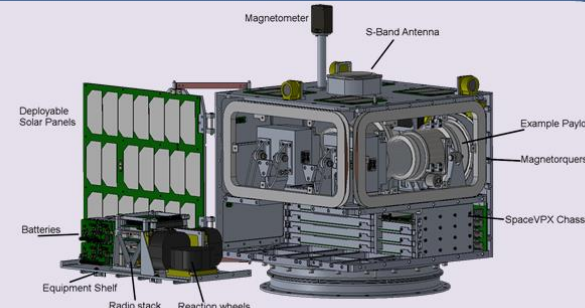
Space VPX Standard description

Open source SpaceVPX modules for HyperSat platform



HyperSat features:

- Scalable architecture
- Open Software & Open Hardware
- Modular design
- Software reconfigurable in orbit
- Using COTS with space heritage, inexpensive, ITAR Free design
- Single Point of Failure Free
- Short Time To Market
- Compatibility:
 - CubeSat
 - SpaceVPX
 - Most of capable launch vehicles
 - CCSDS Standard
 - ESA Mission Control Software – SCOS2000



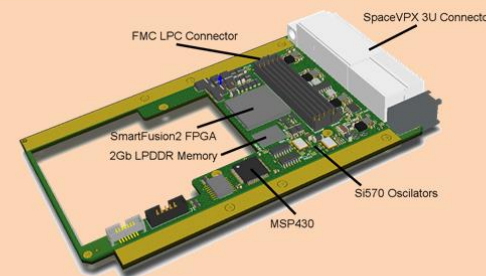
Technical:

- Mass: 10 - 100 kg (payload up to 50 kg)
- Size: 350x350x100 - 350x350x600 mm
- Power: up to 50W avg (3.3V, 12V, 28V)
- RF link:
 - S-Band - 256 kbps Uplink,
 - S-Band - 10 - 1000 kbps Downlink
 - X-band - 50 Mbps Downlink
- ADCS accuracy: 1 deg or 10" (with a star tracker)
- Main BUS architecture: Double-Star SpaceVPX
- Launch readiness: 6-12 months from mission definition to launch



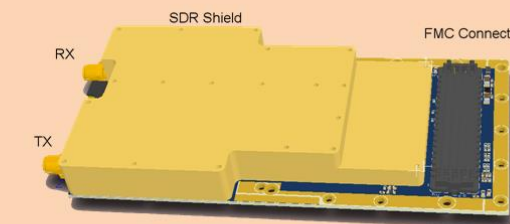
SpaceVPX-FMC-3U card:

- Microsemi SmartFusion2 FPGA
- Internal Cortex M3 and LPDDR memory for fast operations
- FMC LPC connector allows to connect any type of extension card (radio, FMC SDR, storage, non-standard payload connection)
- SLT3-PAY-1Q2T profile with additional I2C and PCIe x4 link
- Configurable transceivers
- Local Housekeeping with MSP430 over I2C
- Latch-up protections
- Two Silabs Si570 clock oscillators



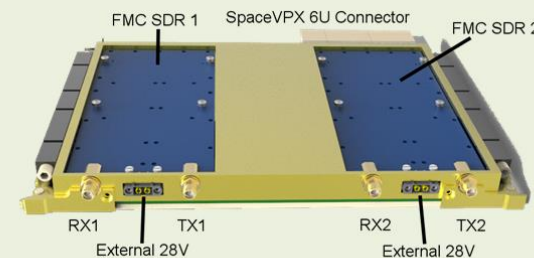
FMC-SDR card:

- AD9364 integrated transceiver
- two frontend configurations:
 - for VHF UHF L and S band, with coherent TX carrier generation
 - for X band with direct frequency conversion
- 33dBm TX power
- max. 2dB Rx noise figure
- TDD or FDD operation
- max. power consumption lower than 15W



SpaceVPX-FMC-6U:

- Two separate Microsemi PolarFire FPGAs with over 300k LE
- Two separate FMC HPC connectors allows to connect any type of FMC card (radio, FMC SDR, storage, non-standard payload connection)
- Double PCIe x4 links
- Multiple LPDDR Memories for fast operations
- Latch-up protections
- Local Housekeeping data with MSP430 over I2C

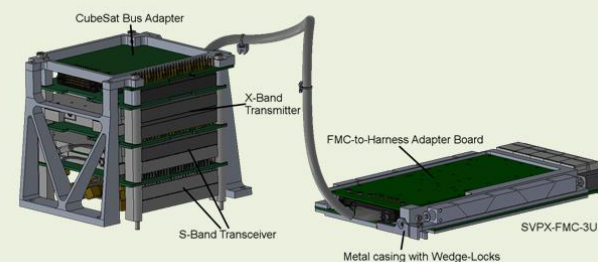
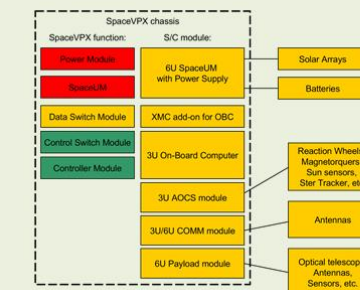


SpaceVPX-JETSON-6U features:

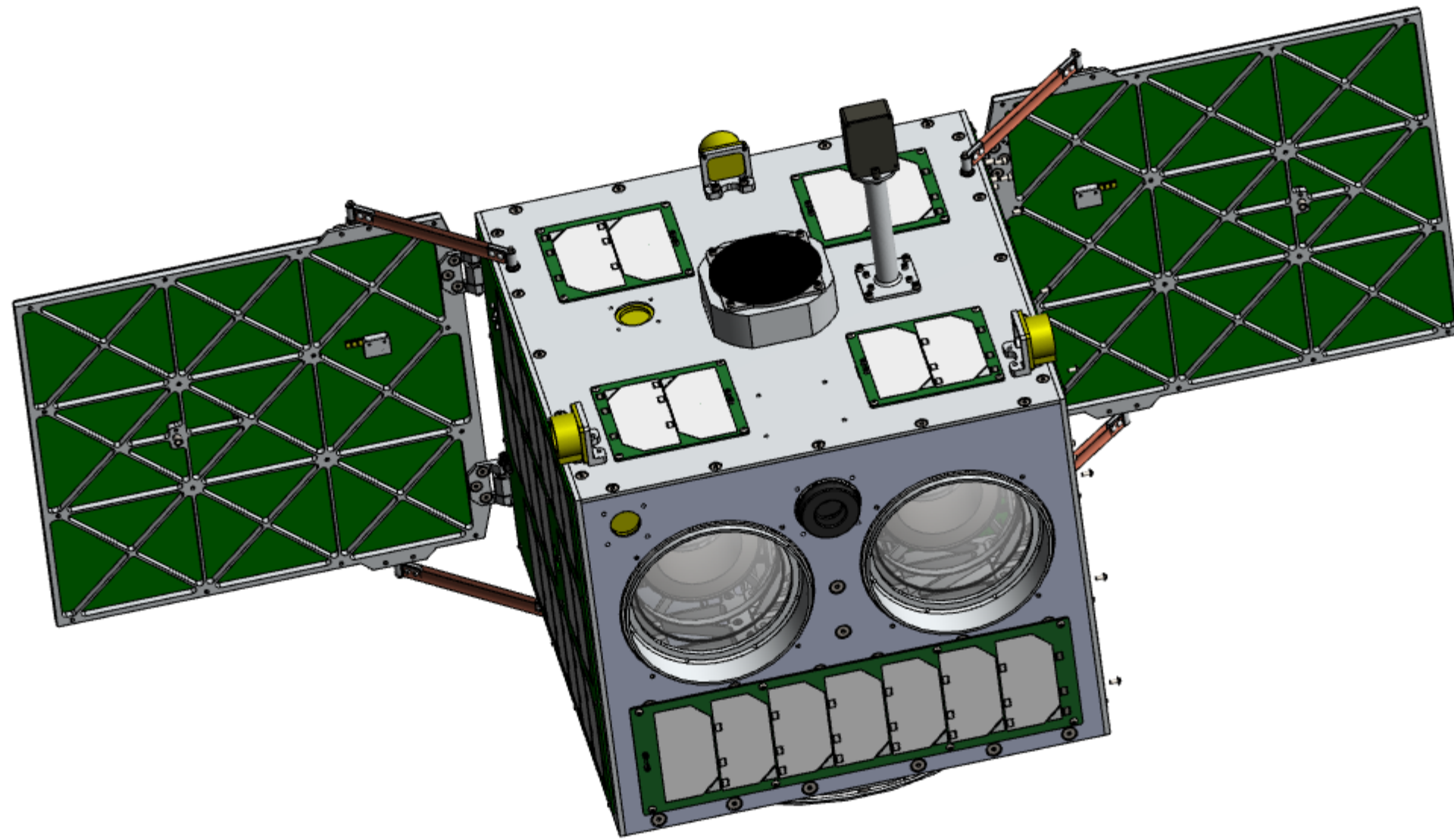
- Two Microsemi SmartFusion2 FPGAs
- Two NVIDIA Jetson modules in metal cases
- Two M2 SSD Memory for storage
- PCIe link connecting Jetson, M2 Memory and other parts of the satellite through backplane
- Additional External Data connectors (LVDS lines for sensors i.e. optical)
- SpaceVPX 6U configuration
- Direct connection to radio payload module
- Latch-up protections
- Local Housekeeping data with dual MSP430 over I2C

SpaceVPX tailoring:

- Hybrid 3U/6U backplane
- Single SpaceUM with integrated Power Supply and MPPT
- On-Board Computer as SpaceVPX controller
- Multiple 3U/6U slots available for AOCS, COMMM, Payload etc.
- Possible system extension with multiple interconnected backplanes
- Possible system bandwidth upgrade with SpaceFibre (multi Gb/s)



CAD Model

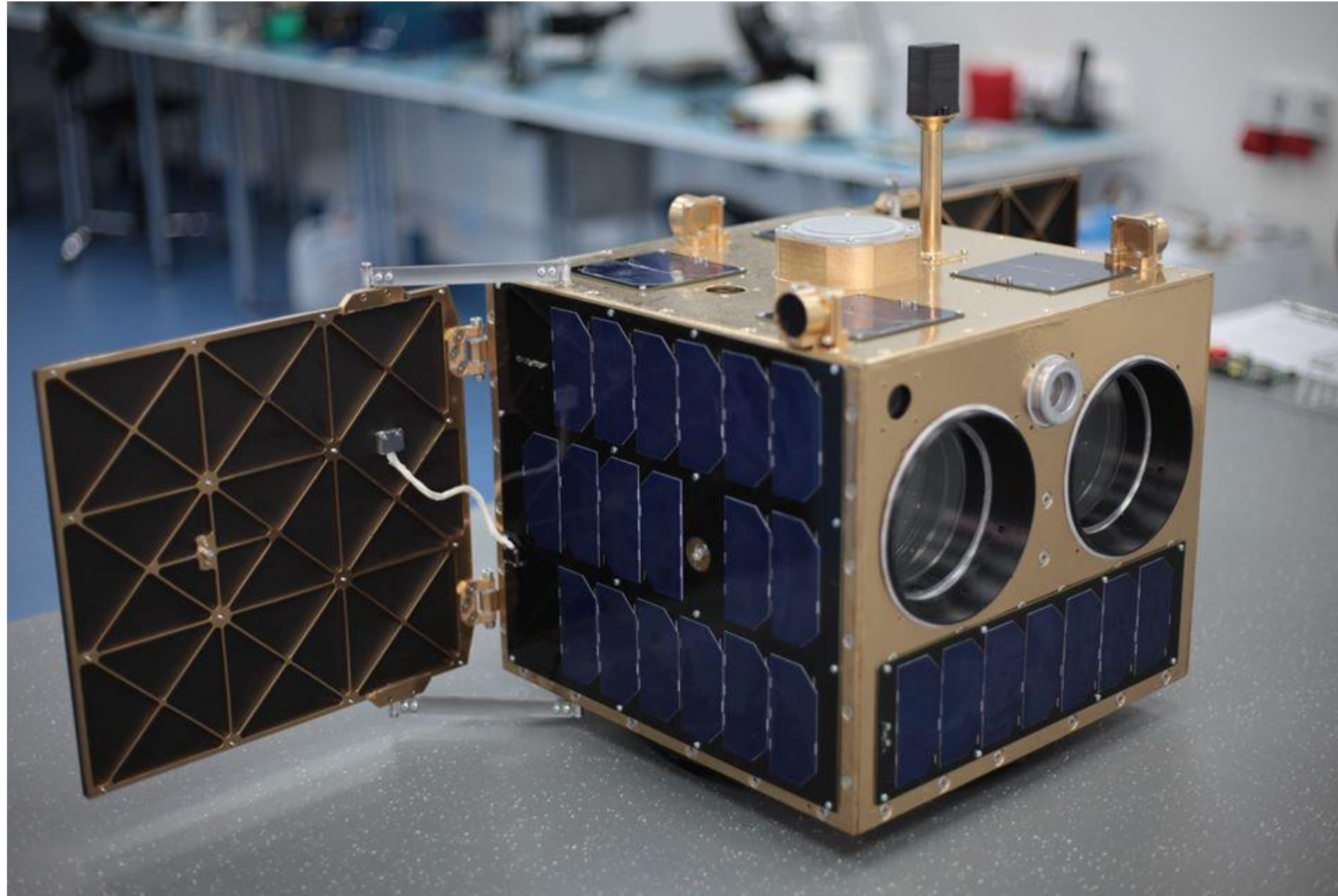


In –orbit configuration

RFP in progress – manufacturing drawings issued



Fit check model



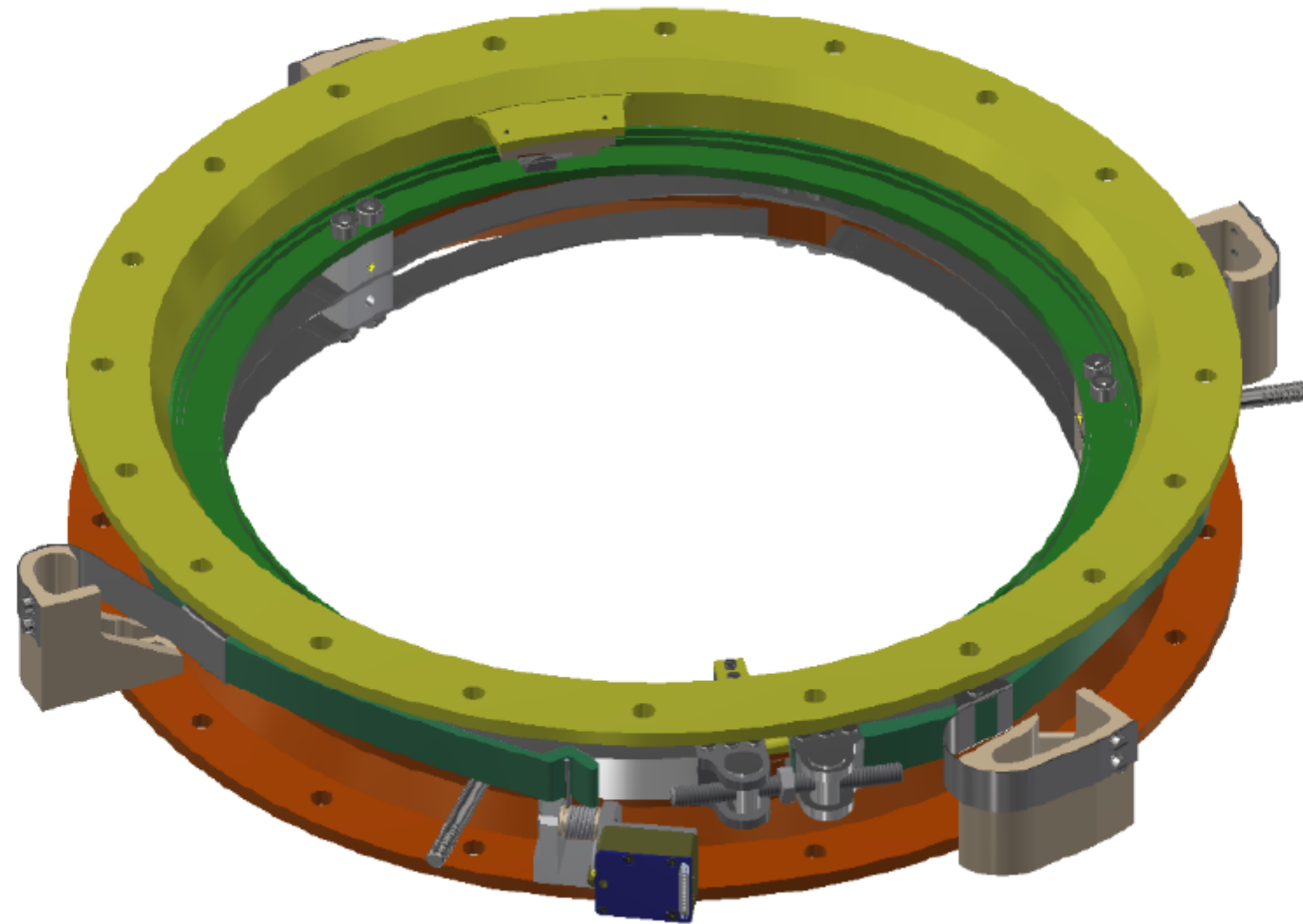
Fit check model



Separation system



Separation System 415/258/64 (13")



Satellite platform preparation



International cooperation

- ✓ Big support recorded from the international community
- ✓ Are we looking for partners (and external funding)?
- ✓ CTI was approached by the Chinese (an engineering company with experience in UV detectors)
- ✓ They are willing to contribute hardware with flight heritage
- ✓ We need a mechanism regulating the international cooperation (Ministry???)



