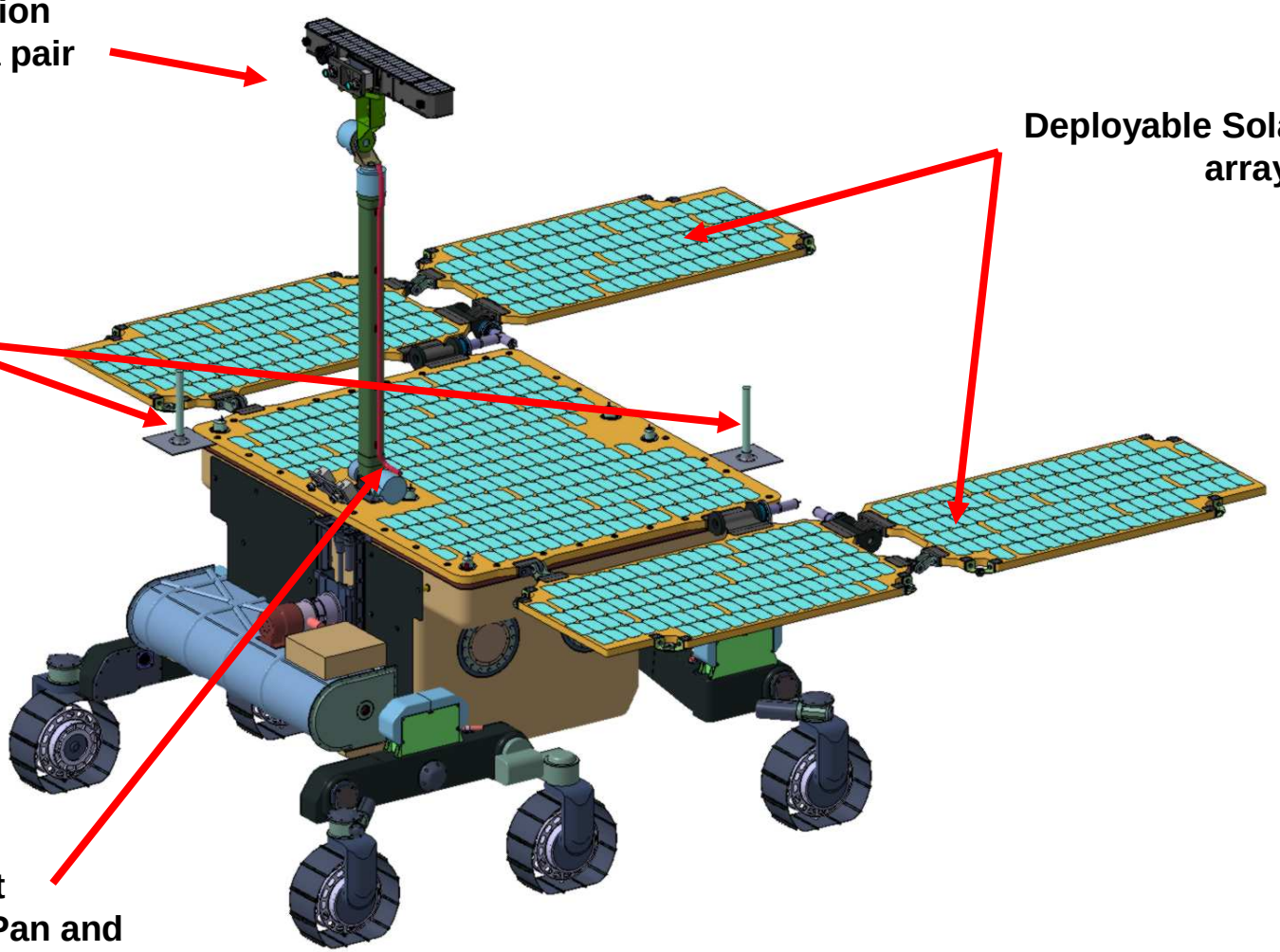
ExoMars Rover Vehicle

European Industry Day

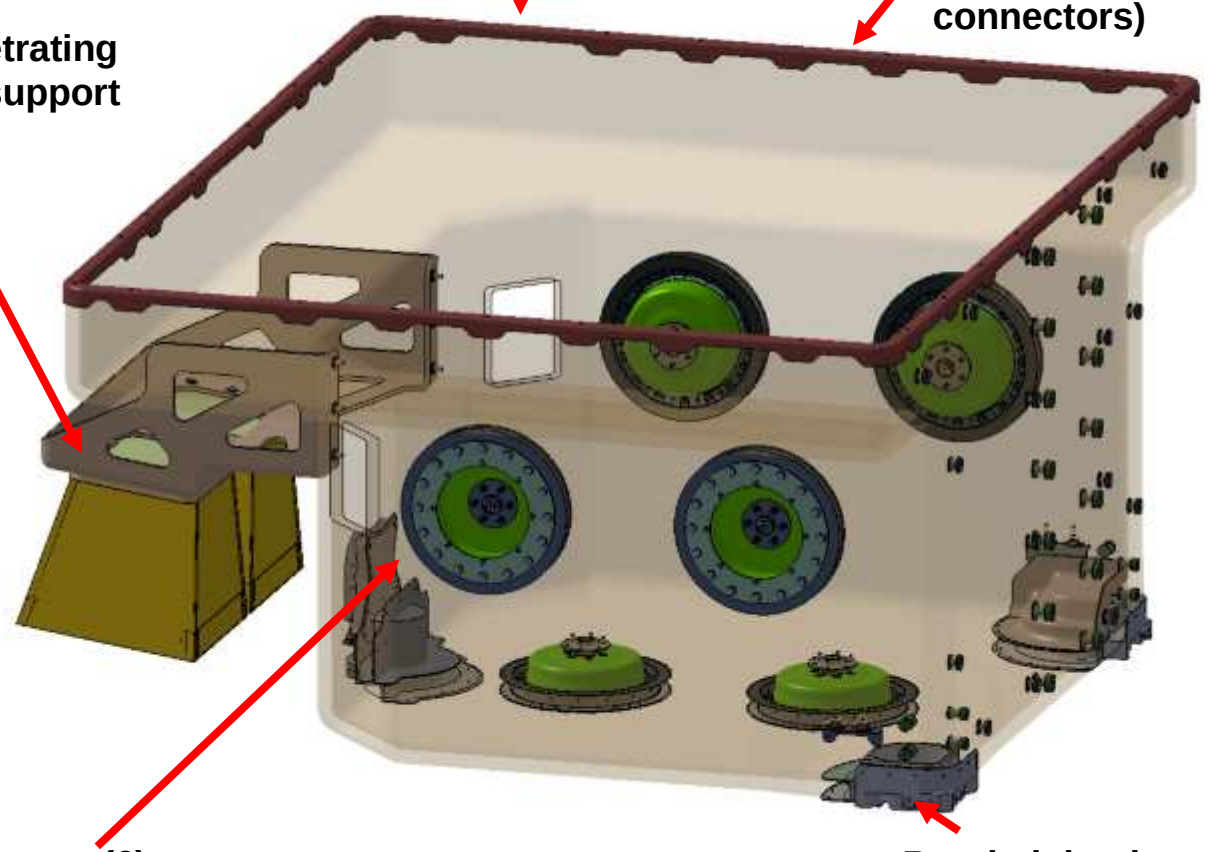
TAS-I, Turin

23rd September 2010

Rover Vehicle Configuration

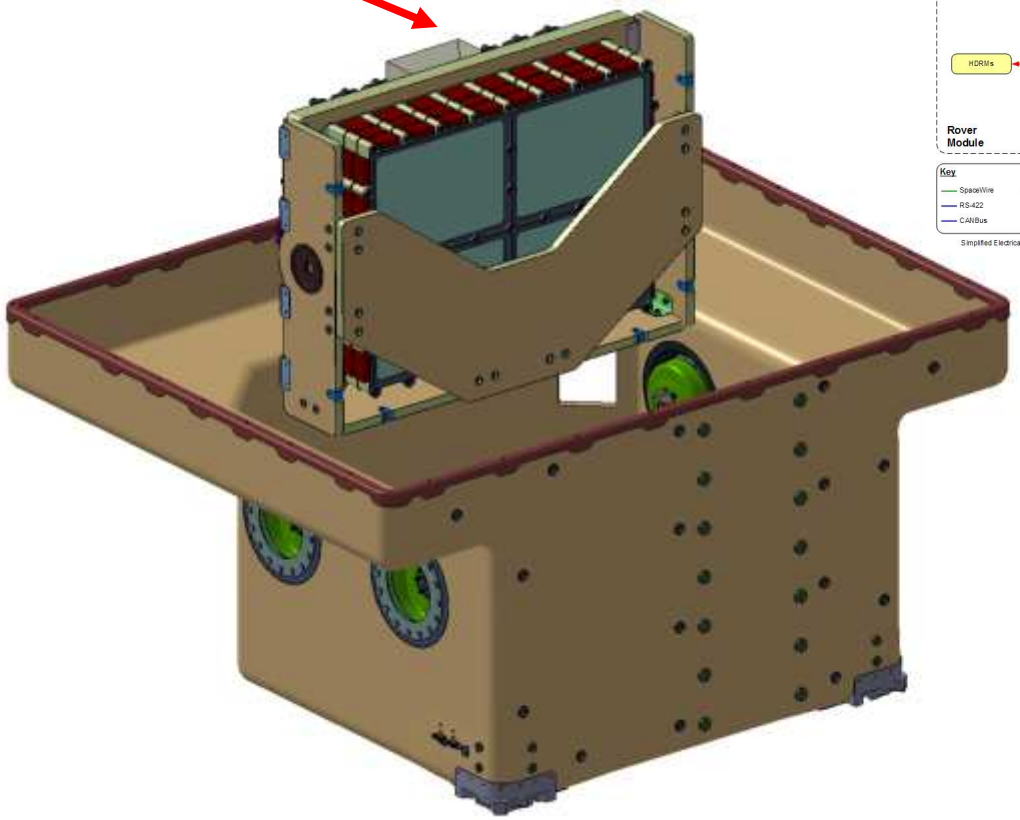


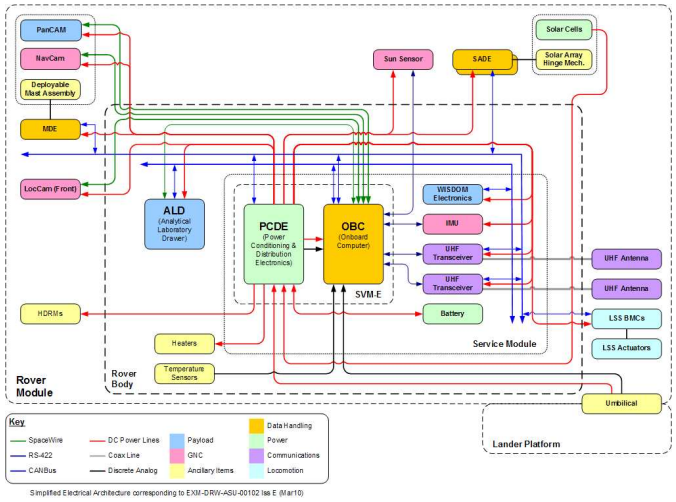
Body Structure



Rover Vehicle E-SVM Configuration

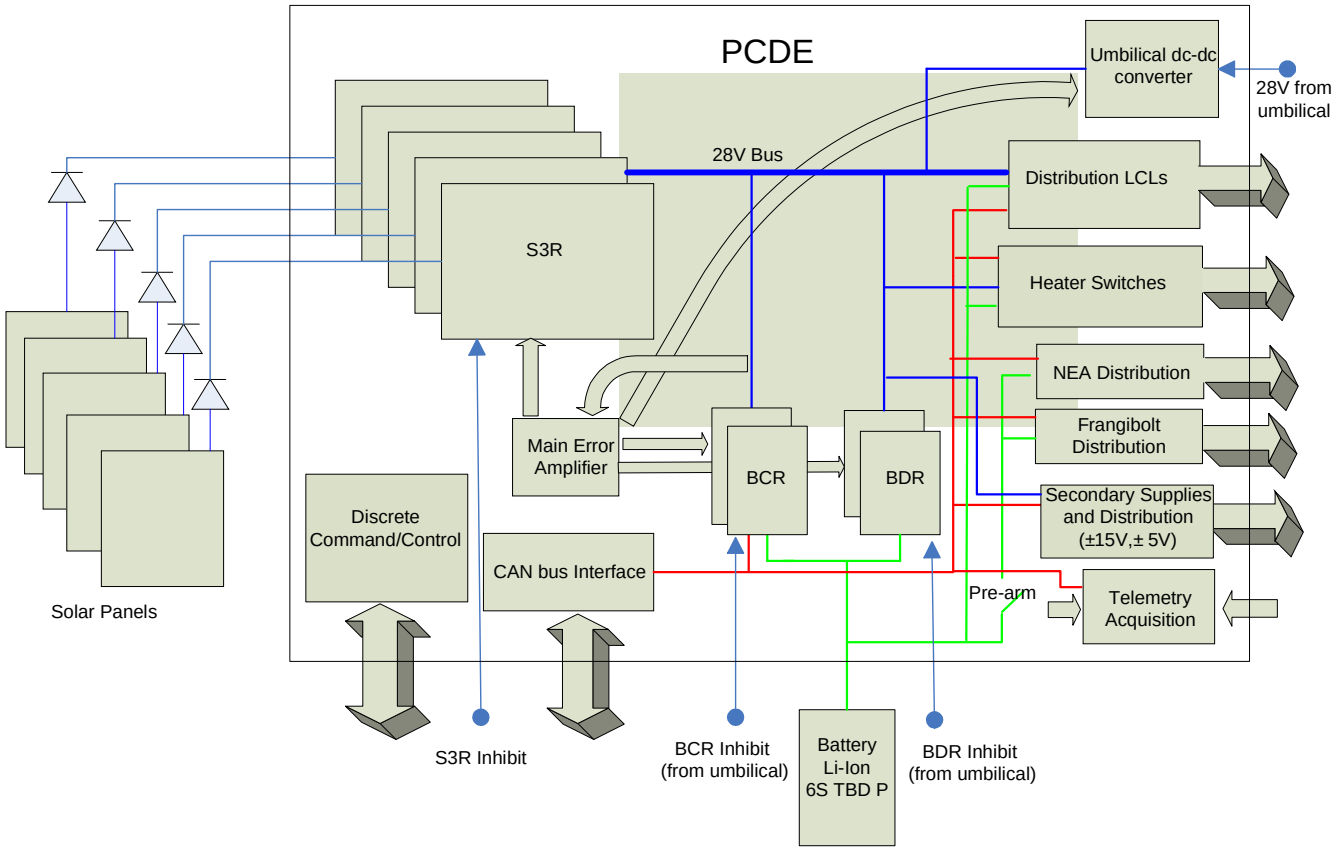
Electrical Service Module





Simplified Electrical Architecture corresponding to EXM-DRW-ASU-00102 Iss E (Mar10)

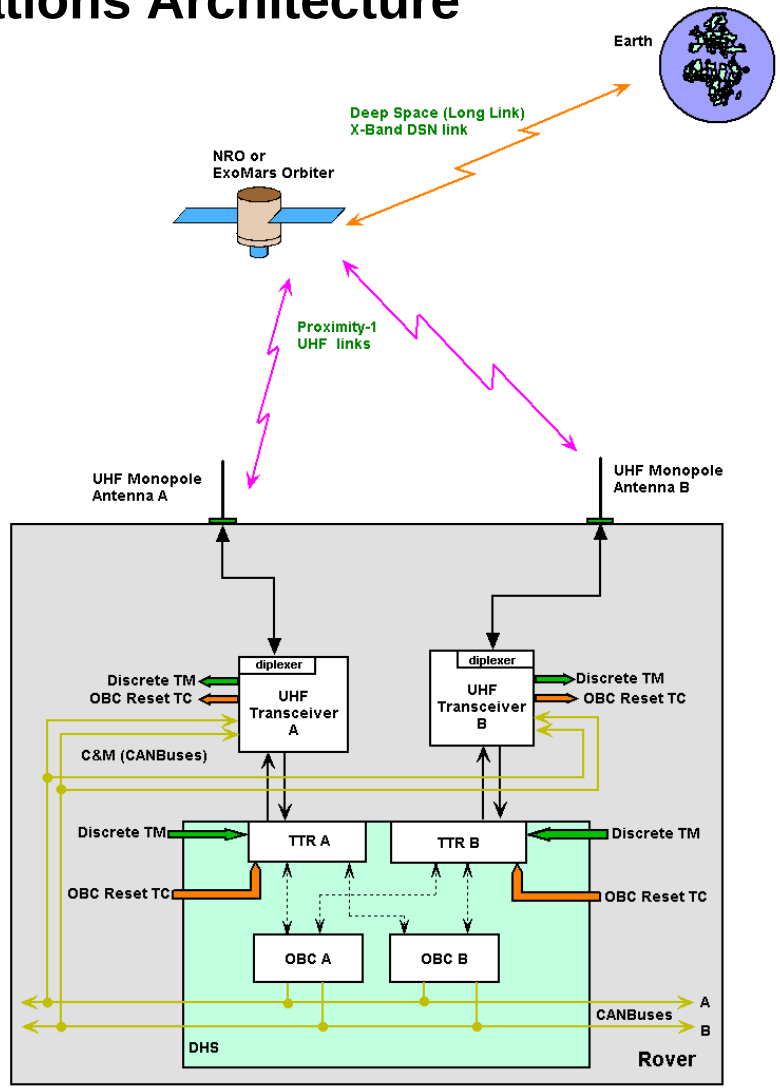
Power Sub-system Architecture



- **Battery**
  - li-Ion
  - Isolator Switch
  - Direct Negotiation
- **Solar Panels**
  - 2.5m^2 total area
  - Total of 5 panels
  - ~ 300watts
- **PCDE**
  - Direct Energy Transfer
  - LCL's 20+20

Communications Architecture

- **UHF**
  - Redundant UHF Transceiver
  - Redundant RF Path
  - Proximinty-1 standard
  - 2 Monopole UHF antennae
- **Status**
  - UHF Transceiver Supplier selected



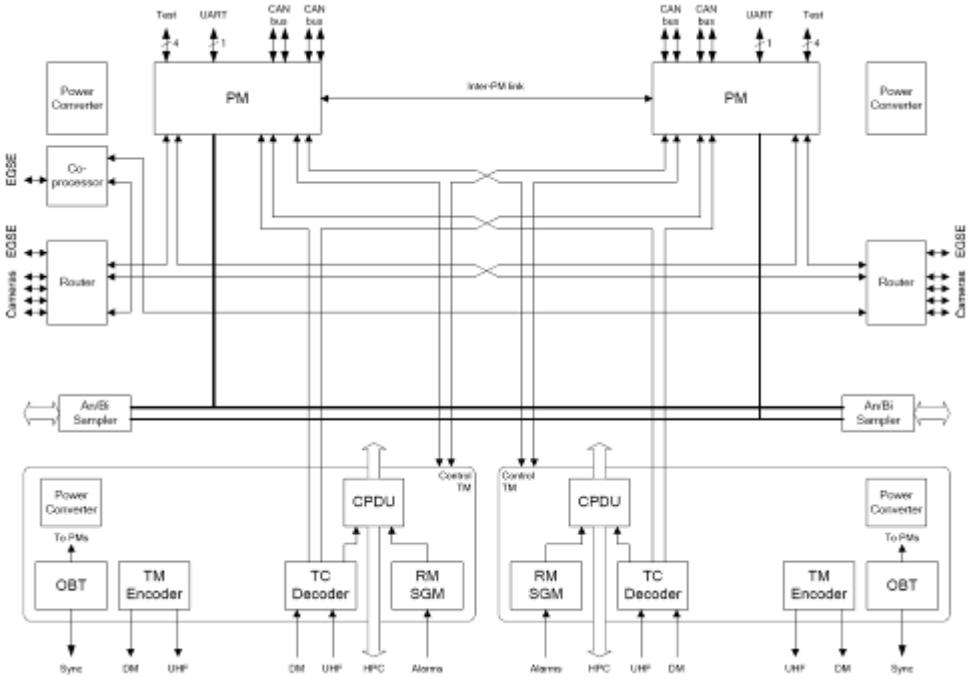
Communication System Architecture Block Diagram

Onboard computer

- **Core Module**
  - LEON based processor
  - 512MB SDRAM
  - CAN databus, RS 422 I/F
  - RTEMS O/S
  - OBC reconfiguration
  - On Board Time

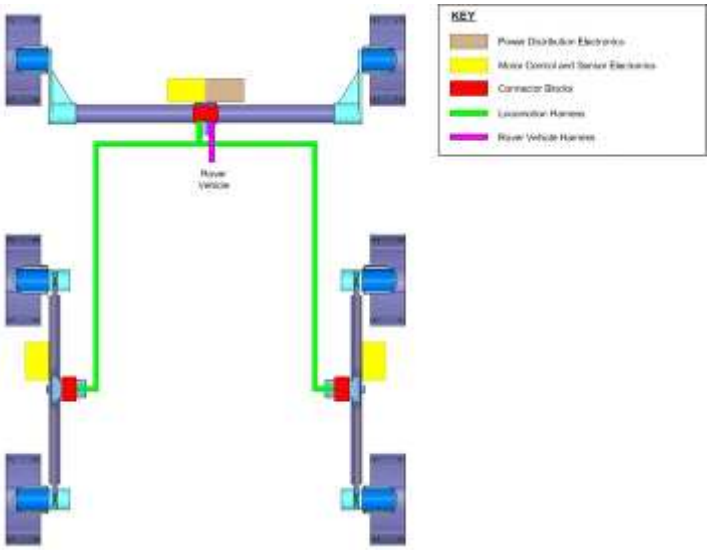
- **Navigation Computer & Mass Memory**
  - LEON based algorithm co-processo
  - 16GB of Flash Memory
  - 512MB SDRAM
  - EDAC protection
  - SpW for high speed instruments
  - SpW routing network

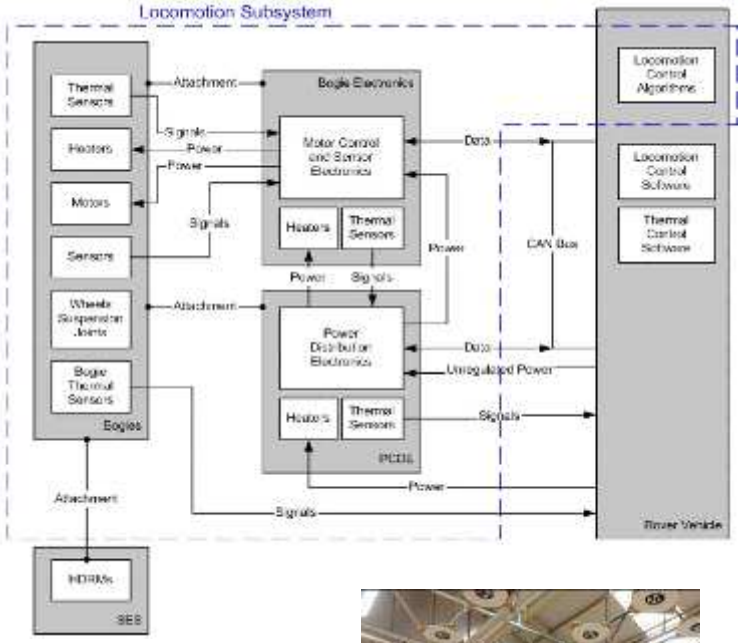
- **Power supply and Interface module**
  - High priority telecommand to PCDE
  - HKTM acquisition
  - Internal secondary voltages



Development Model delivered to Astrium

Locomotion Subsystem

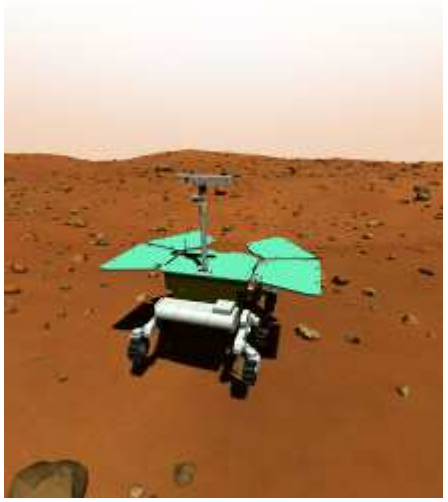




- 6 wheel, 21 DOF system
- Includes Electronics Drive system
- Flexible wheels baselined
- Building on existing BB activities

Traverse and Navigation

- **Navigation concept relies on a wide set of equipment consisting of:**
  - Navigation Cameras (mounted 2m above the surface at the top of the mast)
  - Visual Odometry
  - Inertial Measurement Unit
  - Sun Sensor
  - Mast and Pan & Tilt assembly



Pangu simulated image

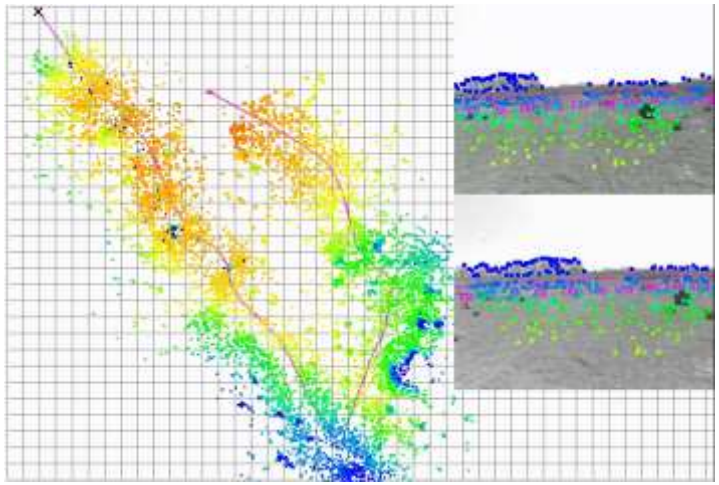


Image from Structure from Motion Localisation algorithms

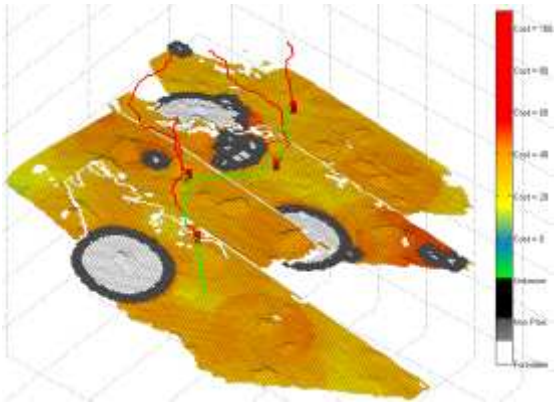
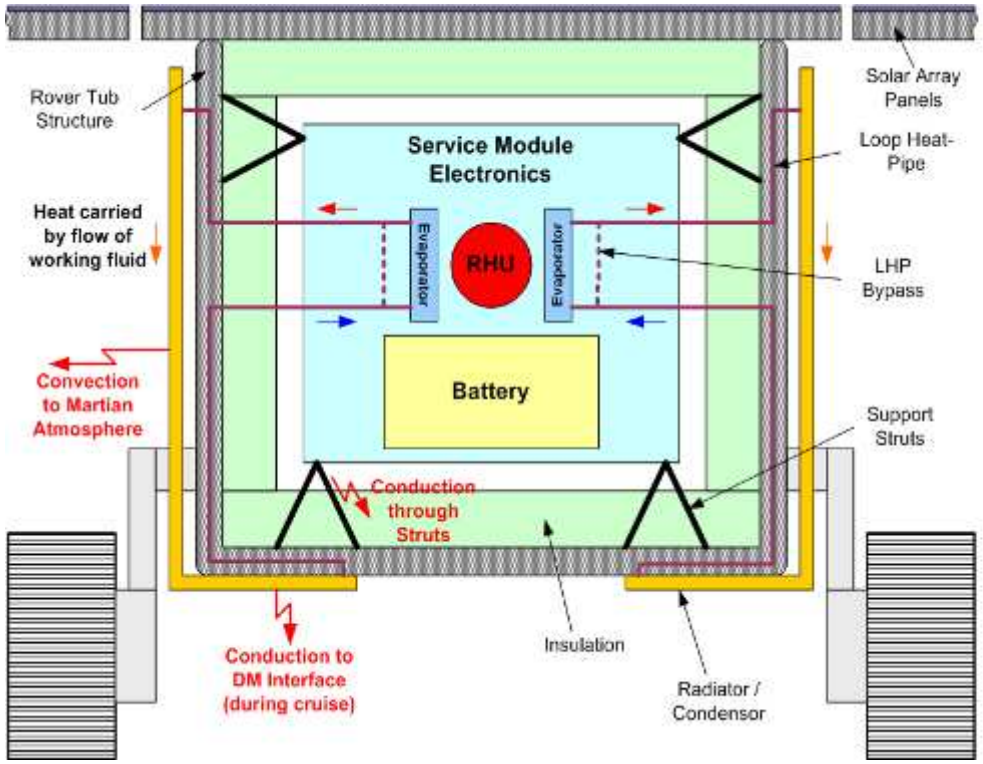
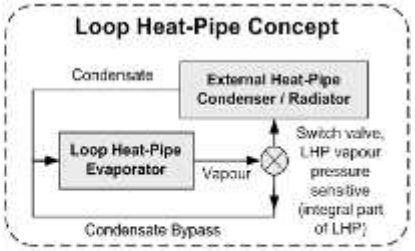


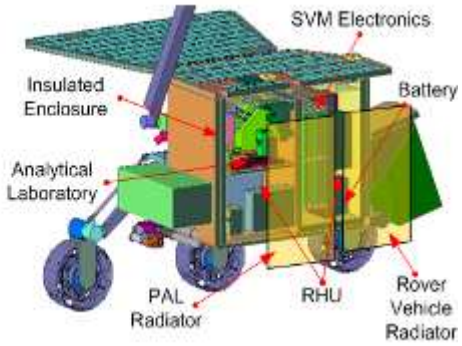
Image from Astrium Navigation simulator

Mars Yard Testing Facility at Astrium Stevenage

Thermal Subsystem







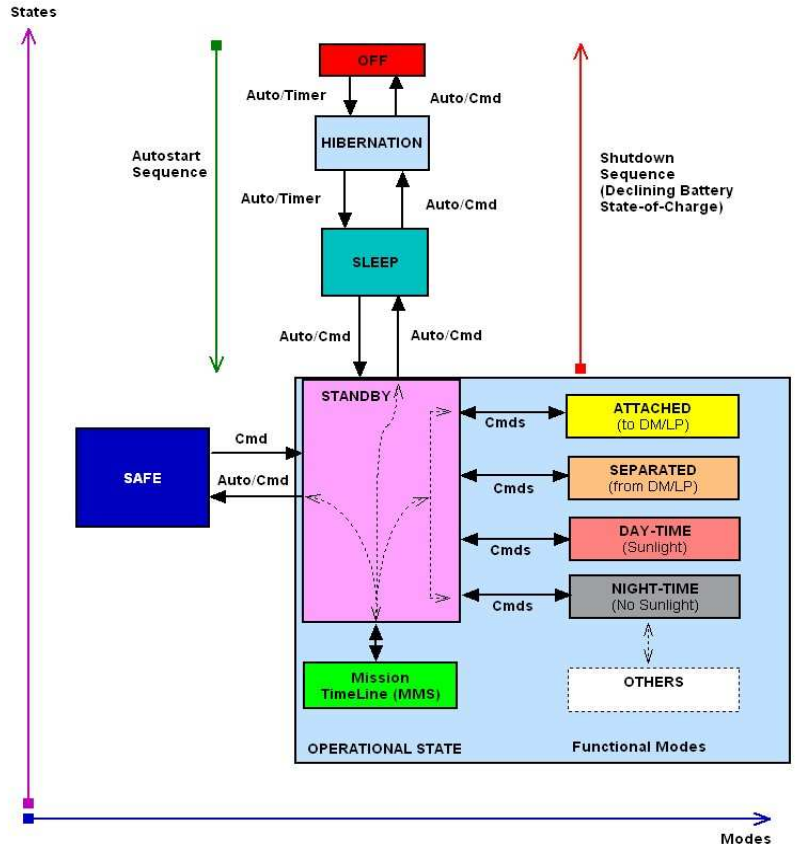
- **Loop Heat Pipe system (~15watt)**
- **Standard Heater elements (mats, etc) supporting electronic control loops**

Onboard SW and Operations

- **Software Requirement for Version 1 complete**
  - V1 Implementation about to commence
- **Architecture and Requirements Definition for V2**

- **Rover Vehicle Software Features:**
  - RTEMS OS
  - Data Handling Software (providing PUS TC/TM service functionality and some architectural services)
  - On-Board 'File Management' (image storage & retrieval etc)
  - OBCP Interpreter
  - Vehicle Application SW to perform vehicle locomotion control, localisation data processing, 'platform level' management (thermal, power etc)
  - 4 SW versions expected developed using the C language

- **Software subcontracting**
  - To be released as 3 separate Subcontracts (Tranches)
  - Sub-Contracting at System level and Code level
  - Subcontractor will be responsible for the code and unit test activities Integration support to Astrium
  - Co-Engineering development approach to maintain efficient risk managed process



Ground Support Equipment

- **MGSE**
  - Transport Containers (Asceptic)
  - Turn-over Trolley
  - Vertical Stands
  - Support structures for test benches

- **EGSE**
  - SCOEs (Power, TMTC, RF)
  - Bench harnessing
  - Central Check out System led by Prime contractor

RV Schedule challenges

- **Schedule driven by**
  - Launch window May 2018 (~2years cycle, but narrow window)
  - RV Integration sequence complexity (Many units and associated harnessing, small integration volume, PP and CCC requirements).
  - AIT activities at Prime level prior to releasing European Rover to NASA

- **Equipment delivery dates (approx):**
  - Mar 12 Development Models & GNC benches
  - Oct 12 RV Qualification Models
  - Sep 13 RV Flight Models

RV Procurement Schedule

ITEM	Status	RFQ/ITT Release date
Locomotion SS	Selected	
UHF Transceiver	Selected	
OBC	Selected	
PCDE	Under TEB	
Primary Structure	ITT Released	Aug-10
Camera System (Nav/Loc)	ITT Released	Aug-10
Visual Localisation Alg	RFQ release	Oct-10
TM/TC SCOE	ITT	Nov-10
RF SCOE	ITT	Dec-10
SW Contractor tranche A	ITT	Dec-10
Umbilical Connector	ITT	Jan-11
Power SCOE	ITT	Feb-11
Inertial Measurement Unit	ITT	Mar-11
Battery	ITT	Mar-11
Sun sensor	ITT	Apr-11
Harness	ITT	Apr-11
MGSE (handling Jigs)	ITT	May-11
Deployable Mast Assy	ITT	May-11
SVM frames	ITT	May-11
SA Assy (incl hinges + HDRM)	ITT	Jun-11
SW Coding contractor tranche B	ITT	Jun-11
SW Coding contractor tranche C	ITT	Jun-11
HDRM RV Body	ITT	Jul-11
UHF Antenna	ITT	Aug-11
Thermal H/W	ITT	Aug-11
MGSE support Structures	ITT	Aug-11
MGSE (transport containers)	ITT	Sep-11
Insulation and thermal (heating elements	ITT	Jan-12
Wheel release Mechanism	ITT	Jan-12
Test Adaptors	ITT	Jan-12
Mechanical Simulators	ITT	Feb-12
OGSE	ITT	Apr-12

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Rover Vehicle Progress

- **Industrial build up continues to be a major focus of the Rover Vehicle team**
  - OBC and UHF Transceiver selected and progressing well
  - Camera and Structure ITTs will be responded to in October
  - ITT releases prior to Christmas EGSE for test benches
  - ITT releases after Christmas further E-SVM units
- **The Rover Vehicle Team recognise that this is a difficult period for the Subcontractors.**

Thank you for your continued support