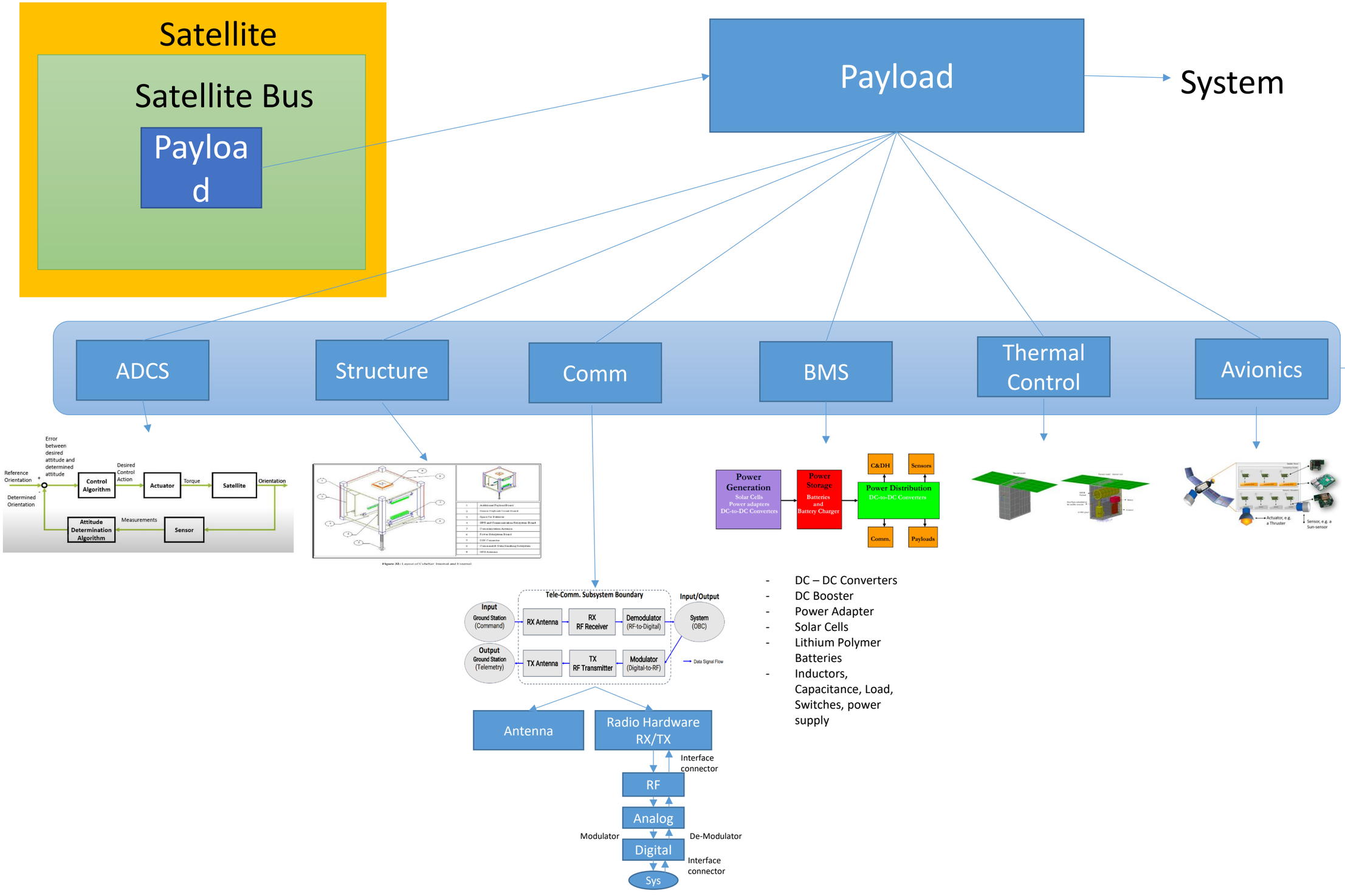


- DC – DC Converters
- DC Booster
- Power Adapter
- Solar Cells
- Lithium Polymer Batteries
- Inductors, Capacitance, Load, Switches, power supply

System

CubeSat System Design Hierarchy

Sub System

- Communication system
- Information System
- Material System
- BMS
- Thermal
- Avionics

Components

- Communication system
  - Transceiver
  - Antenna
  - SAW Filter
  - Modulator/ Demoulator
  - RF Switch
  - RF Front-end Power Amp
  - Power Supplies/Regulator
- Information System
  - Database & Algo
  - Computer Memory
  - Computer Controller
  - Debugger
  - Timing clock set up
- Material System
  - Satelite Casing
  - Mechanical SYstem
  - Actuators
  - Padding & Insulation
  - Shock Absorbers
- BMS
  - Power Generators
  - External Power Li-po
  - Voltage Regulator
  - Power Management IC
  - Current monitor & load Switching
  - Battery Charger
  - Solar power converter
  - Ideal diodes
  - Power load switch
- Thermal
  - Temperature sensing network
  - Heating/Cooling system
  - Passive heat removal sys
  - Iosaltion materials
  - Thermocouple
  - Resistance heater
  - MLI
- Avionics
  - MCU
  - Mag
  - Gyro
  - GPS
  - Sun Sensor
  - Oscillatosr
  - Debugger
  - Cantranceiver
  - External watchdog
  - Mram
  - SD card

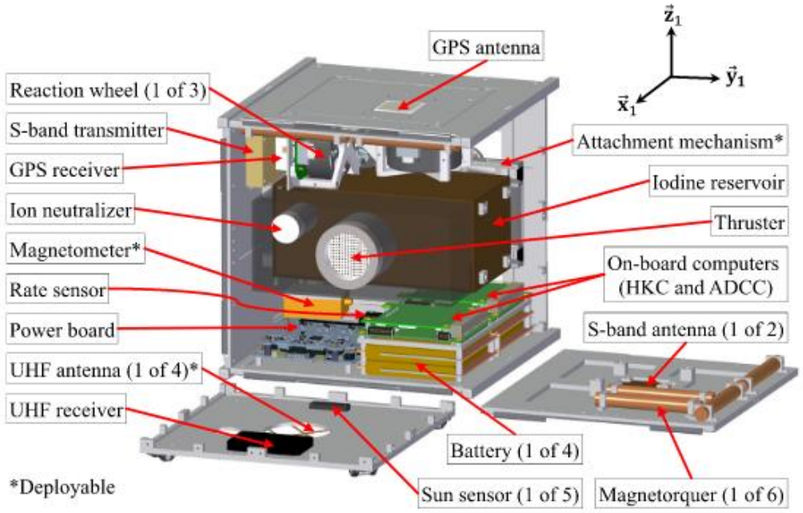
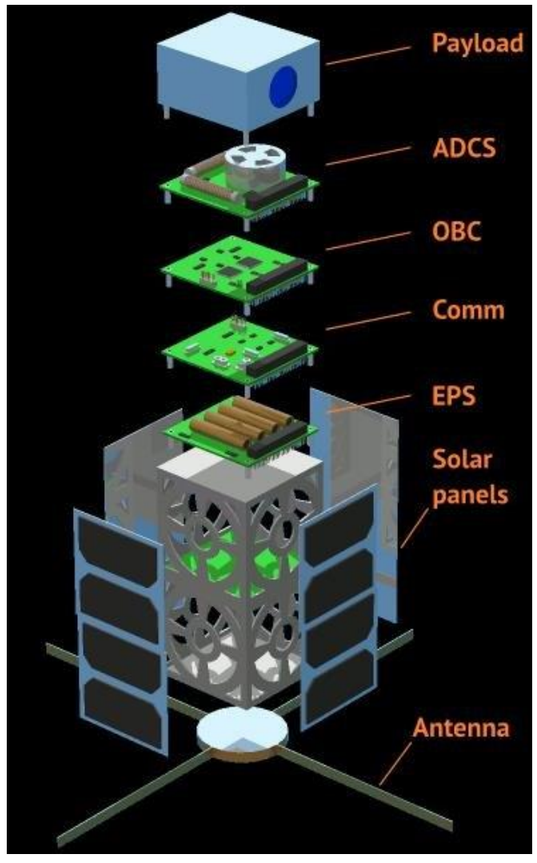
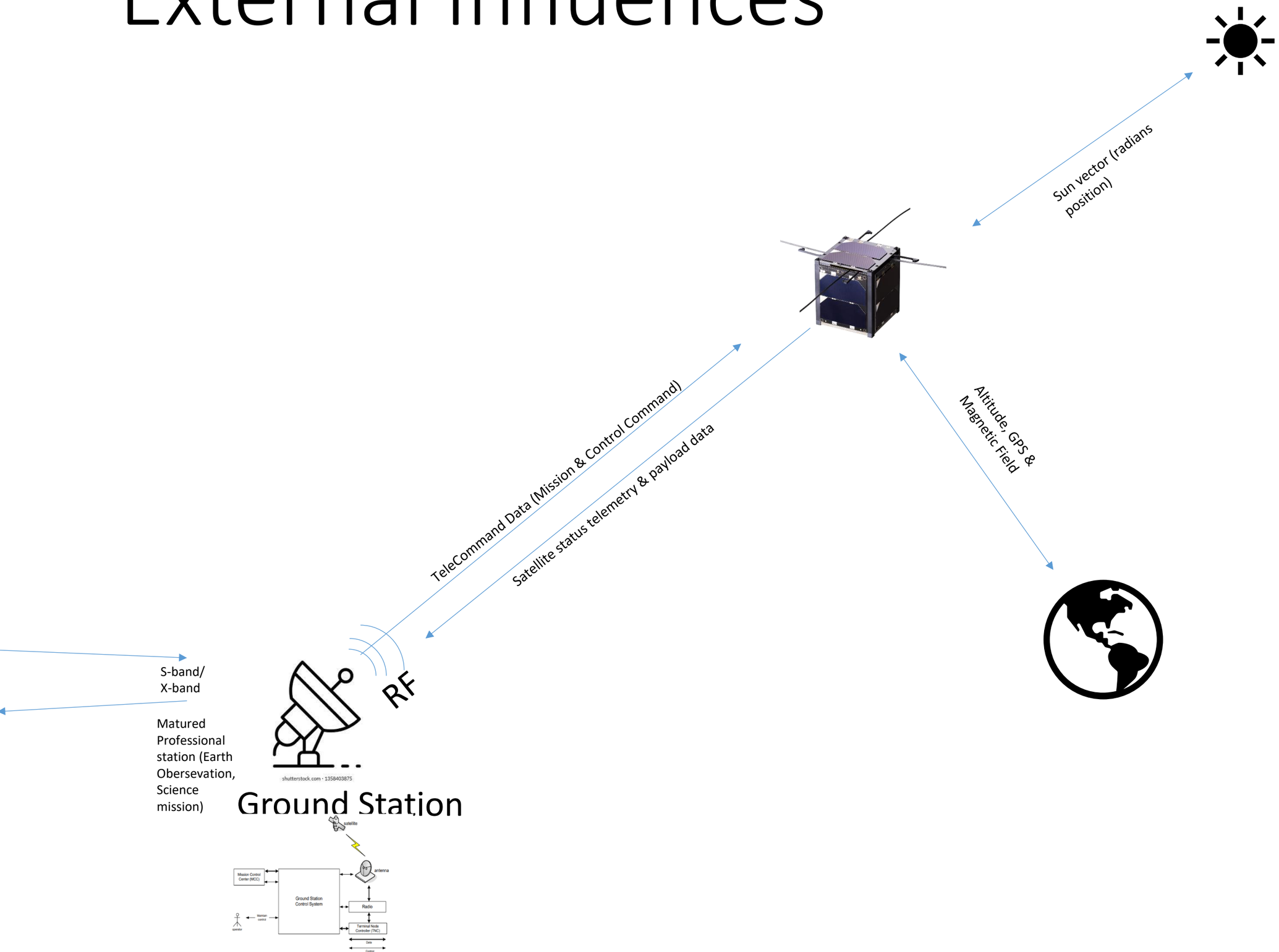


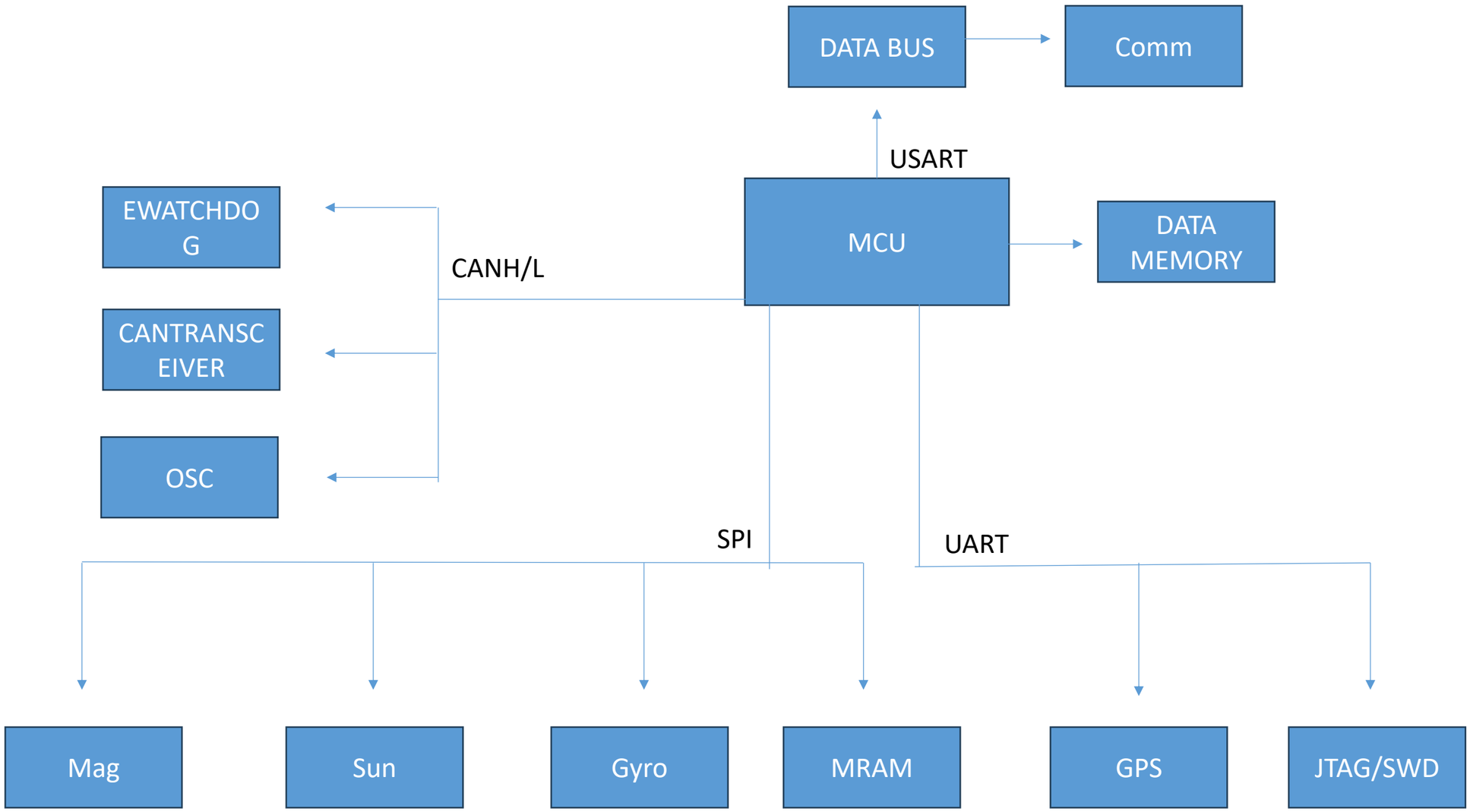
Fig. 4 Deorbiter CubeSat's engineering model. Deployable solar panels are not shown



External Influences



Functional Block Diagram



Material List for Cubesat:-

- Specifications and Upgrades
- - 10x10x10 cm chassis: constructed from laser-cut square aluminum bands and PCBs
- - Printed circuit boards (PCBs) (EPS[Emergency Power Supply], OBC[On-Board Charger], ADCS[Analog(different sensor data like temp, sound etc) to Digital converters, Comm[Communication RF Board])
- - Electronic components, 2x4 Mbits FRAM Memory, Atmega 2560 microcontroller, integrated micro-USB port
- - 9-degree-of-freedom inertial module (with
- magnetometer)
- - Extra solar power: 4 durable 1.37W solar cells
- - 4 Lithium Ion batteries (with holding clips and temperature sensors); longer life
- - Improved power-management and charging control
- - 1.5W high-efficiency radio transceiver with built-in amplifier
- - a ßy radiation sensor
- - Real-time Clock
- - Dipole communications antenna -Compatibility with Arduino IDE
- - 2 sub-miniature deployment switches
- - Launch to polar Low Earth Orbit: optional

Comm Sub-System

- Satellite Survival (Using Beacon/ CW morse code)
- Get Telemetry Data(Temp,current,voltage.status, attitude etc)
- Satellite Control (operational Mode, Camera Shooitng , Scheduling mission)
- Distance Information (GPS) and other info…

→ Why?

Primary Design Process for Tele-Comm.

- ❑ **Step 1: Identify Requirements**
  → Orbit, data amount and update period
- ❑ **Step 2: Select Frequency**
  → Amateur or experimental or commercial
- ❑ **Step 3: Select and Design Hardware (Antenna, Transmitter, Receiver,**
  → Power, gain, sensitivity, G/T
- ❑ **Step 4: Select Data Protocol**
- ❑ **Step 5: Identify Link Budget (Margin)**

Iteration is needed until all interface conditions and requirements are satisfied

Step	Information Required
1. Identify Requirements	Mission type and orbit (LEO or GEO), Data amount and update frequency
2. Select Frequency	Type: Amateur or experimental or commercial, bandwidth, modulation
3. Select and Design Hardware	Antenna spec. TX/RX spec.
4. Select Data Protocol	Data packet format Error correction method
5. Identify Link Budget	Link margin

→ How?

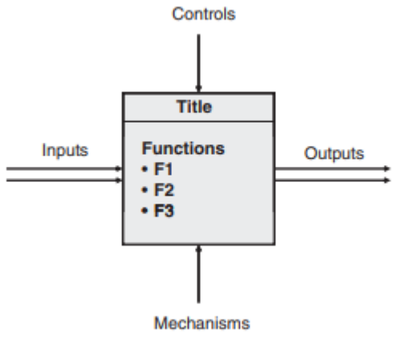
Internal Influences

Context Diagram

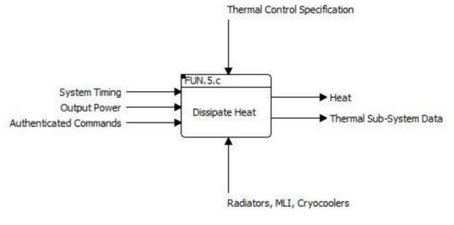
Functional analysis

- Functional Media:-
- Functional Elements:-
- Functional Interactions:-

/ Functional Flow Diagram (IDEF0) for System and individual sub-systems



Genralised Block Diagram



Example Block Diagram

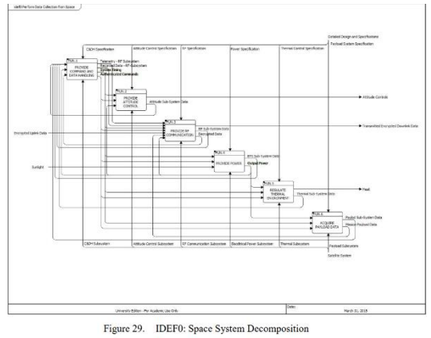


Figure 29. IDEF0: Space System Decomposition

Combined IDEF0 Block Diagram

Project & System Managemnet

- WBS
- SEMP (System Eng Management Plan)

Requirements on the Sys:-

Consideration:-

- Using SPI(SCK, MISO, MOSI) rather than I2C(SCK[Clock-Transistor], SDA[data] communication (faster rise time)
- Avoiding connecting all the componenets to a single can bus which will lead to problem(like shortcircuit will turn the whole system off).Connect the components to different busses with separate power lines bus for each
- Using 0 resistor to check current
- Multiple different test points
- High rang range of capcitance to handle maximum voltage

Avionics Board

Radio:-

Satellites

Gps for location and time

Attitude Control:-

Magnetorquer

Oritentationv – (Gyroscope, Sun sensor)

Command & Control:-

UART and CAN data busses Communication protocol

Temp Sensor

Real Time Clock & Schedule Keeping (clock switch and timing of data to other componenets)

Data Storage:-

MRAM

SD Card

Communication Protocol b/w Subsystems