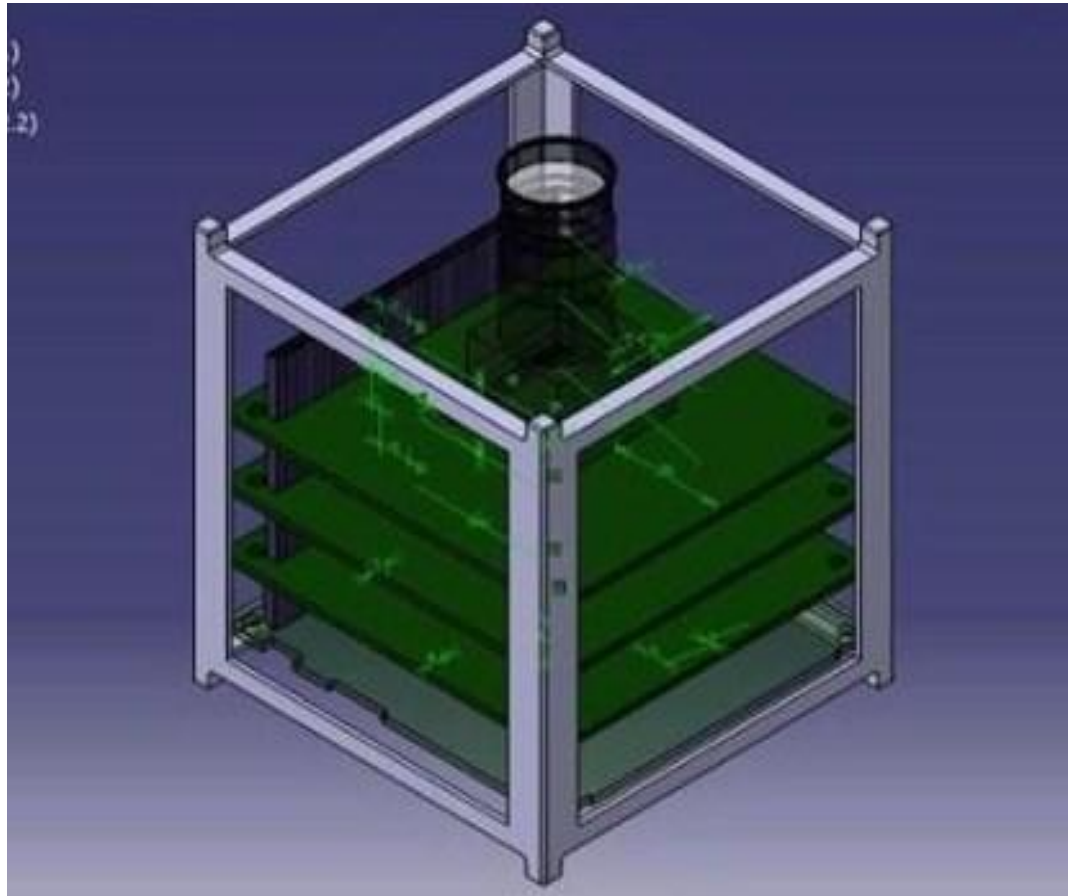


STUD SAT



STRUCTURE

- Mass : <250 Kg
- Dimension : 10 X 10 X 11.3 cm³

PAYLOADS

- Model : KAC 9618
- Imager : CMOS sensor
- Array size : 648 X 448
- Pixel size : 7.5 X 7.5 μm
- Mass : 150g
- Power : 168 mW
- Interface : UART
- Operating voltage : 3.3 V

Specification Table

PARAMETERS	VALUE
FOCAL LENGTH	50mm
RESOLUTION	94.65m
SWATH	61.33 km X 46.189 km
FOV	5.565°
FORMAT	2/3”
FNO.	4
APERTURE	12.5mm

POWER

- Solar panel : body mounted
- Solar cell : ITJ multifunction
- Generated power : 4 W
- Battery : Li ion

ON BOARD COMPUTER

- Processor : ATMEL ARM 9 (32 bit)
- Power : 0.19 mW / Mhz

ALTITUDE DETERMINATION AND CONTROL SYSTEM (ADCS)

- Accuracy : 2° in all 3 axes
- Power : 200 mW
- Weight : 150 gm
- Angular velocity : 0.1 rad /s
- Model : IGRF
- Sensors
 - Magneto meter : HMC 1001/1002
- Actuators : Torquers

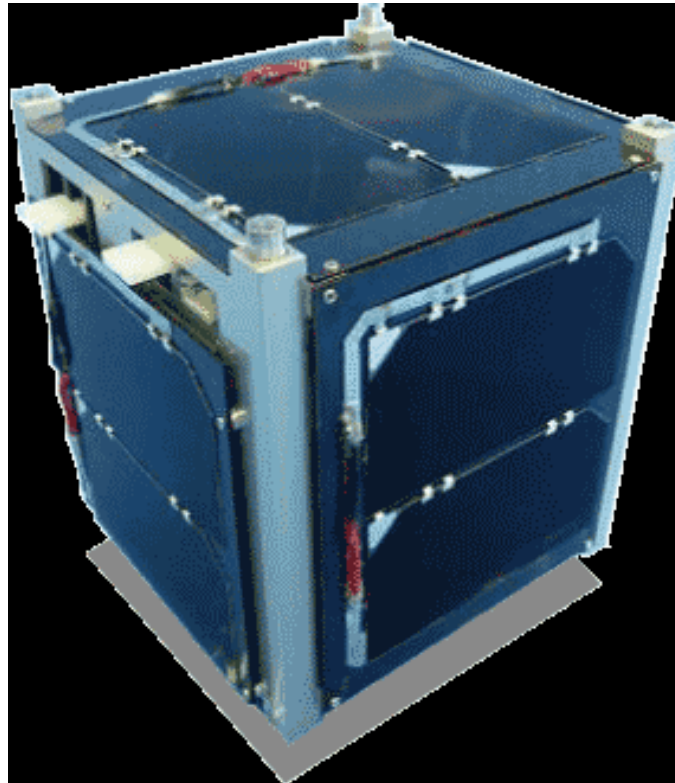
COMMUNICATION

- Frequency : Amateur
- Transceiver : CC1020
- Power : 500mW
- Dimension : 86 mm X 52.5 mm
- Protocol : AX.25
- Data rate : 9600 bps
- Interface : RS232
- Modulation : GMSK
- Antenna : monopole

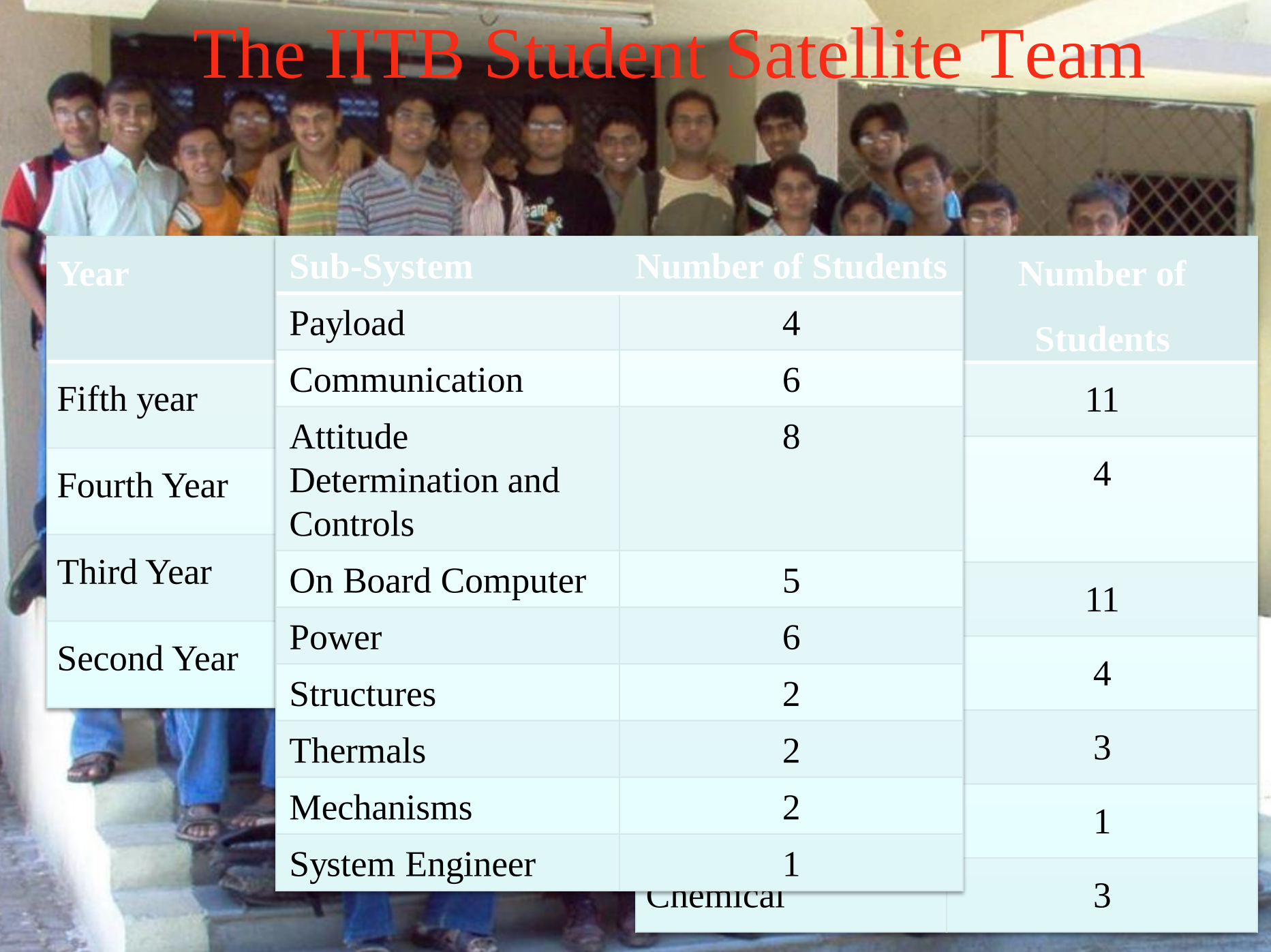
MECHANISMS

- Launcher interface : X-POD

PRATHAM



The IITB Student Satellite Team



Year	Sub-System	Number of Students	Number of Students
Fifth year	Payload	4	11
	Communication	6	
	Attitude	8	
Fourth Year	Determination and Controls		4
Third Year	On Board Computer	5	11
Second Year	Power	6	4
	Structures	2	
	Thermals	2	3
	Mechanisms	2	1
	System Engineer	1	3
	Chemical		

Success Criterion

Description	Success of Mission
Flight Model ready	55%
Beacon Signal received	65%
Communication link is established	75%
TEC measurements at IITB	85%
Satellite is functional for 4 months	100%

Need to know orientation → Magnetometers & Sun Sensors
Need to know position → GPS

Need to maintain orientation → Control Law → Magnetorquers

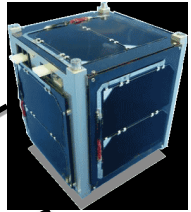
Onboard Processing → OBC

Beacon – I am alive

Ionosphere

Rotation of plane of polarization $\propto$ TEC

Power



STRUCTURE

- Mass : 7065 g
- Dimension : 230 X 230 X 230 mm³

PAYLOADS : TEC

- Technique : Faraday's rotation
- Mass : 798 g
- Power : 2W peak
- Operating voltage : 3.3V

POWER

- Solar panel : body mounted
- Solar cell : ITJ multifunction
- Generated power : 10.9 W (normal incidence)
- Battery : Li ion

ON BOARD COMPUTER

- Processor : Atmel AT91M40080 (32 bit)
- Scheduler : cyclic Scheduler
- Interface : UART
- Power : 5mV /Hz

ALTITUDE DETERMINATION AND CONTROL SYSTEM (ADCS)

- Accuracy : 5° in all 3 axes
- Sensors
 - Position sensor : GPS
 - Inertial sensor : GYRO
- four sun sensor
- Magneto meter : HMC 2300
- Actuators : Torquers

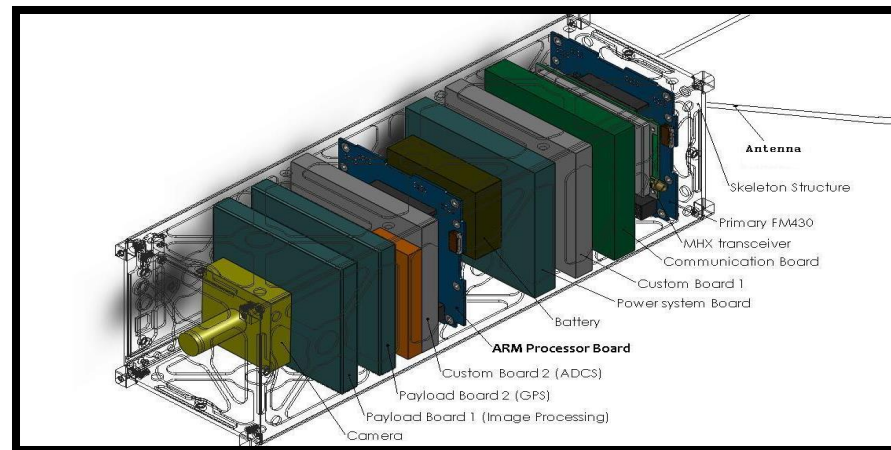
COMMUNICATION

- Frequency : Amateur – 437 MHz
- Model : CC1020
- Power : 89mW
- Protocol : AX.25
- Data rate : 1.2 Kbps
- Modulation : FSK
- Antenna : monopole

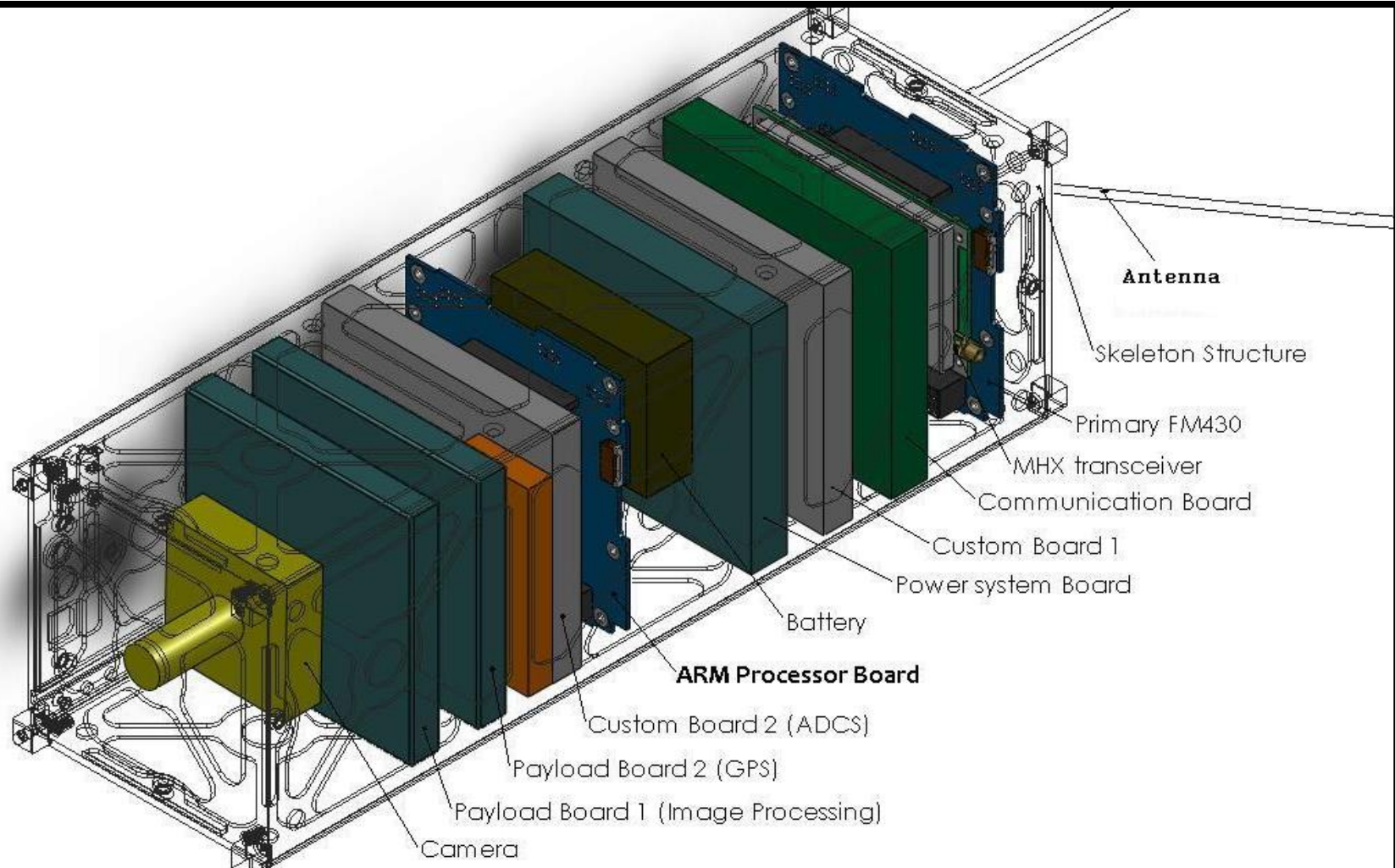
MECHANISMS

- Launcher interface : X-POD
- Mono pole deployment

IITK SAT

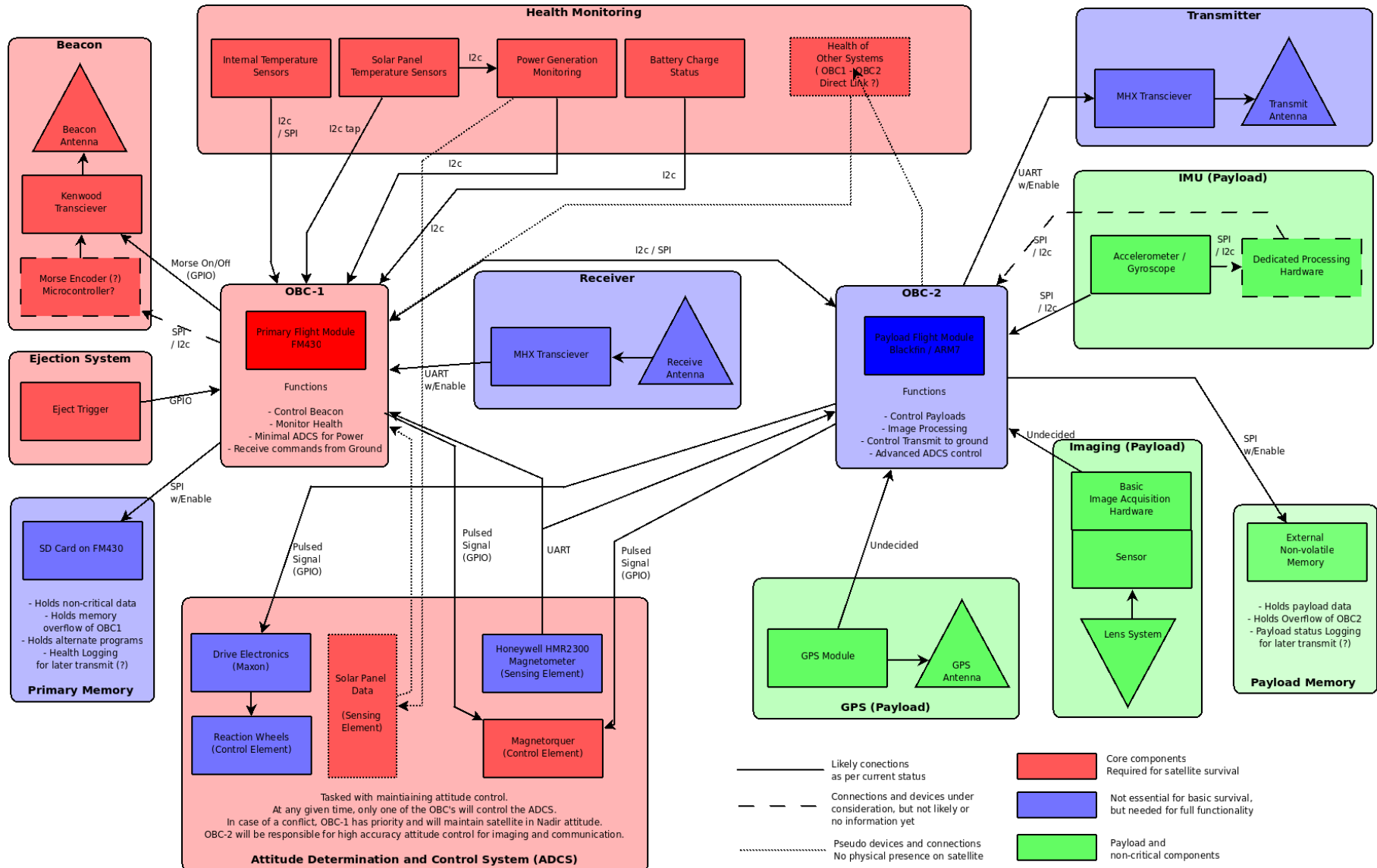


Proposed Model



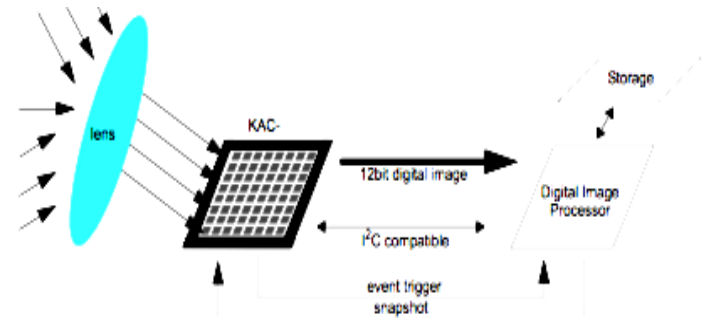
Functional Block Diagram

Based on Analysis & Design Activity done so far (since Dec 2007)



CMOS Sensor KAC-9619

- Pixel Size: 7.5 micro m * 7.5 micro m
- Output: 12 bit digital
- Data Rate: 13.5 MBps
- Dynamic Range: Linear 62 dB, Non-Linear 110 dB
- Electronic Shutter: Rolling Reset
- Sensitivity: 5 V/lux.s
- Sensitivity Range: 550 nm to 850 nm
- Quantum Efficiency: 27%
- Power Supply: 3.3 V +/- 10%
- Power Consumption: 168 mW
- Operating Temperature: -40 to 85 C

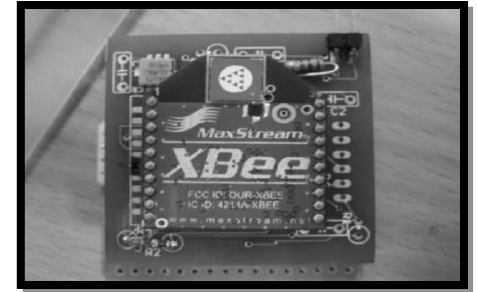


System Block Diagram

Inertial Measurement Unit (IMU)

Designed & developed at IITK

- Design and Development of **IMU** using MEMS angular rate sensor and MEMS accelerometer.
- Test of algorithms for using IMU for the future Attitude Determination applications
- Calibration of the unit for the small rate using rotary positioning tables



IMU developed for Railway Mission

The Team *Faculty*

Dr. S.G.Dhande Patron

No.	Name	Department	Sub-system
1	Dr. Hari Hablani	Aerospace Engineering	Space Dyn:Injection System ADCS
2	Dr. Sudhir Kamle	Aerospace Engineering	Structure
3	Dr. Ashish Tiwari	Aerospace Engineering	Satellite Control
4	Dr. A.R.Harish	Electrical Engineering	Antennas - Communication
5	Dr. K Vasudevan	Electrical Engineering	Communication
6	Dr. P.Sensarma	Electrical Engineering	Power
7	Dr. Ramprasad Potluri	Electrical Engineering	Controls-ADCS
8	Dr. Sumana Gupta	Electrical Engineering	Imaging-Payload
9	Dr. B.M. Shukla	Computer Science	On Board Computer
10	Dr. V Raghuram	Mechanical Engineering	System Integration
11	Dr. Pankaj Wahi	Mechanical Engineering	Dynamics - Satellite
12	Dr. Kamal Kar	Mechanical Engineering	Materials
13	Dr. Sameer Khandekar	Mechanical Engineering	Heat Flow Design
14	Mr. T.V.K. Gupta	Mechanical Engineering	Prototyping – Satellite

Dr. N.S.Vyas Project Coordinator

Project Execution

- Phase-I: Conceptual Phase
 - Literature Survey
 - Identification of the subsystem functions and Payload applications
- Phase-II Preliminary Design
 - Identification of the components for each subsystem
 - Design Calculations and decision making on the interfacing issues
- Phase-III: Detailed Design
 - Component procurement and Development of indigenous subsystems
 - Primary testing of the individual components
 - Work on the minute details of each subsystem

Project Execution..... contd

- Phase-IV Testing
 - Calibration of the subsystems
 - Testing of the subsystems- Thermo vacuum, Radiation, Vibration Testing
- Phase-V Post Launch Phase
 - Initialization phase (initial control, health monitor, communication link setup)
 - Characterization phase (attitude correction, clock correlation and drift, power)
 - Mission phase (Optimization, Payloads, Automation)
 - End of Life (Depending upon the component status, some are turned off)

STRUCTURE

- Mass : 4000 g
- Dimension : 10 X 10 X 30 cm³

PAYLOADS

- Micro GPS receiver : SGR-05
- MEMS IMU
- **Camera**
 - o Sensor resolution : 640 X 480
 - o Image format : 1/3"
 - o Frame rate : 13.5 fps
 - o Pixel pitch : 7.5 μm
 - o Data quantization : 12 Bit
 - o Power : 168mW

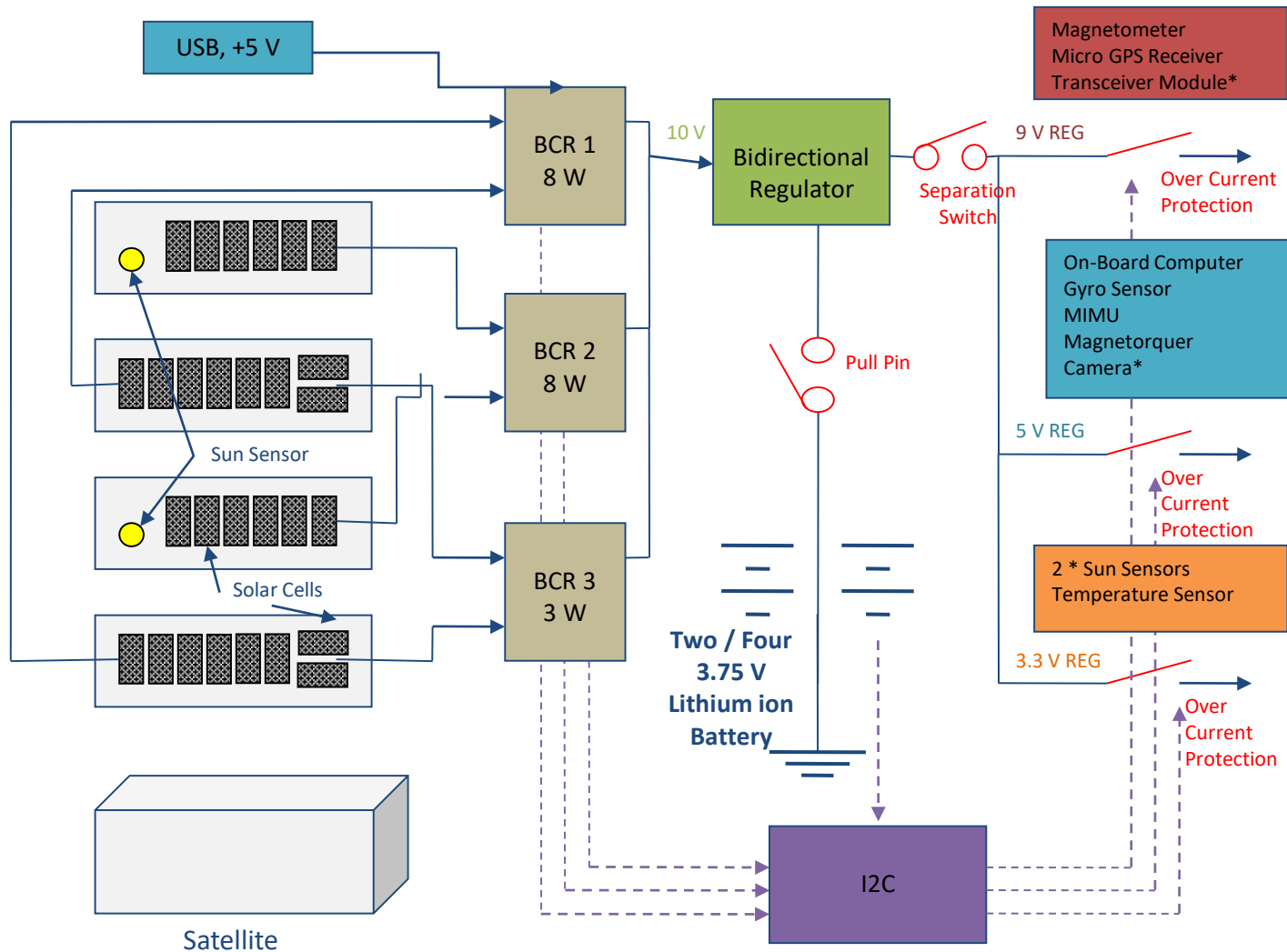
POWER

- Solar panel : body mounted
- Solar cell : ITJ multifunction
- Generated power : 5 W (normal incidence)
- Battery : Li ion (MP 174865)

ON BOARD COMPUTER

- Processor : ARM 9 processor
- Scheduler : Embedded LINUX
- Interface : UART
- Power : 5 mW

Power Management Board



3U EPS Power Management Board

ALTITUDE DETERMINATION AND CONTROL SYSTEM (ADCS)

- Accuracy : 2° in all 3 axes
- Sensors
 - Position sensor : GPS
 - Two sun sensor
- Magneto meter : HMR 2300
- Actuators : ZARM Technik's MT2-1

COMMUNICATION

- Frequency : Amateur – 437 MHz
- Transceiver : Alinco DJ-C7 Transceiver
- Data rate : 1200 / 9600 bps
- Power : 400mW
- Protocol : AX.25
- Dimension : 5.4 x 11.9 x 3.5 cm
- Weight : 380g (whole module)
- Modulation : FSK
- Antenna : monopole

MECHANISMS

- Launcher interface : Indegenous

COMMUNICATION SUB-SYSTEM

Onboard computer

Data :

1. Beacon (CW mode)
2. Satellite Health status
3. Image data

Modulator

Transceiver

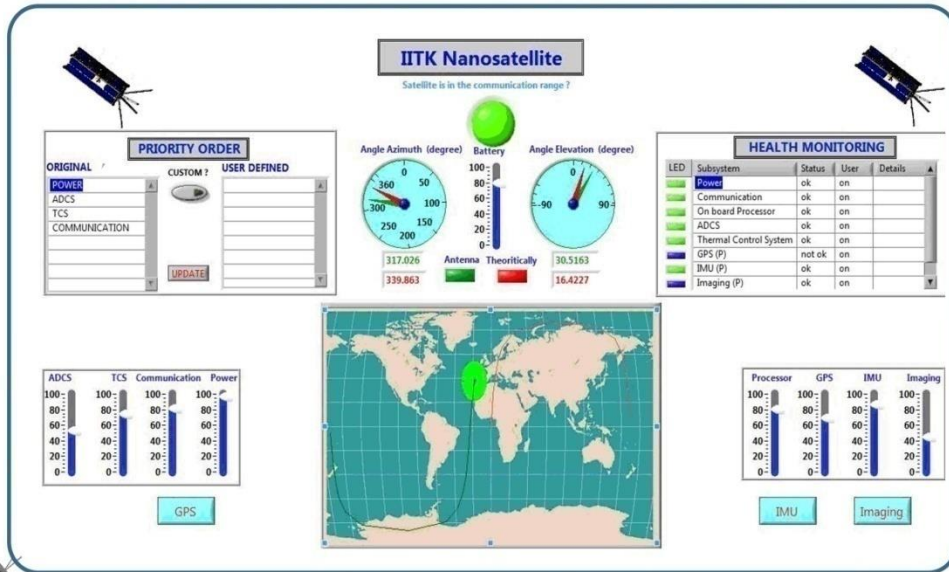
Frequency bands
430MHz.- 440MHz.
145MHz.

Antenna

Orbit details:

- Sun Synchronous polar orbit,
- 700Km from ground station,
- communication time: 12-15 minutes per pass
- Slant range: 3067.88km

Parameters	Uplink	Downlink (data)	Downlink
Frequency	144-146Mhz band	430-440MHz band	430-440MHz band
Data rate	1200 bps, FSK	9600bps, FSK	CW mode, 12-15 wpm
Antenna	Tx: Yagi-Uda12dB	Rx:parabolic antenna25dB	Rx: helix antenna 12dB
Expected margin	21.14	5.5	8.46



Ground station



LNA



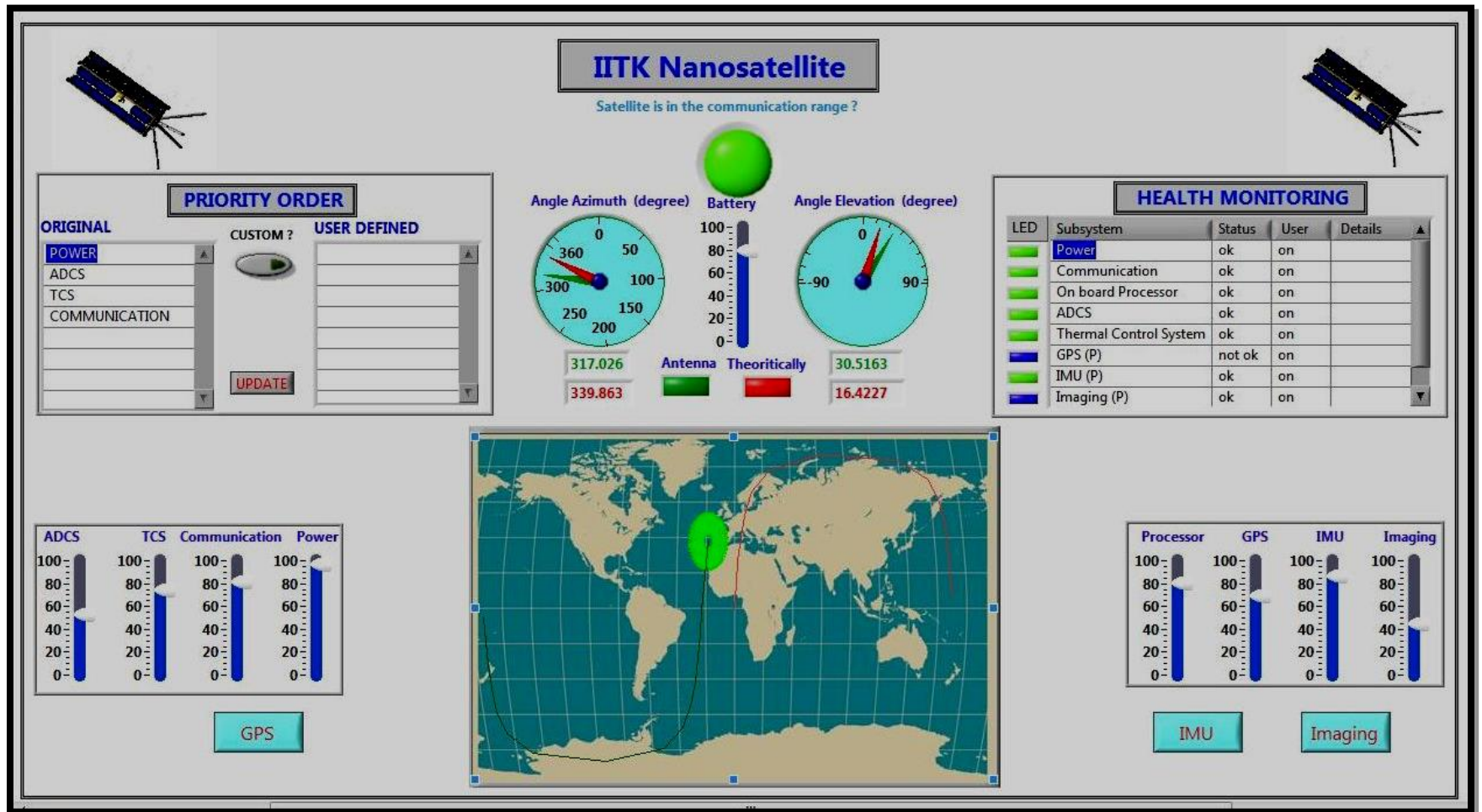
Transceiver



PC

Ground Station GUI

developed at IIT Kanpur



G-5500 Antenna azimuth elevation rotators & controller

Specifications

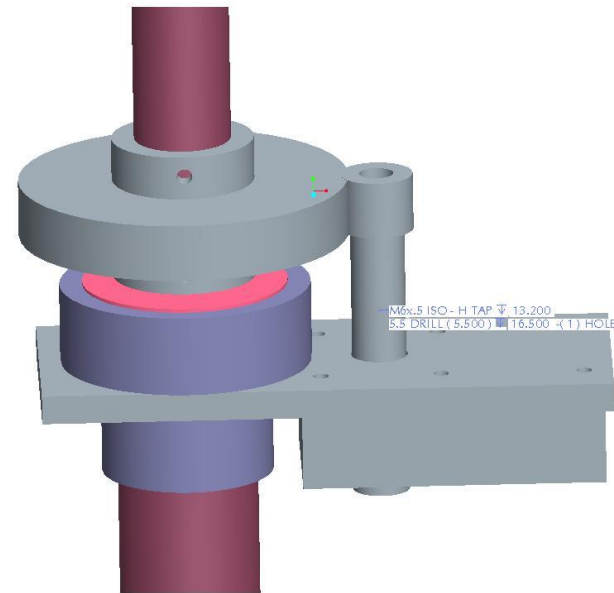
Voltage requirement	: 200-240 VAC
Motor Voltage	: 24 VAC
Rotation time @60 Hz	: Azimuth(360 degree) :58 sec Elevation(180 degree) :67sec
Maximum continuous Operation	: 5 minutes
Rotation Torque	: Azimuth: 6 kg-m (44ft-lbs) Elevation: 14kg-m (101 ft-lbs)
Braking Torque	: Azimuth: 40 kg-m (289 ft-lbs) Elevation: 40 g-m (289ft-lbs)
Vertical load	: 200 kg
Pointing accuracy	: 4%
Wind surface area	: 1 m ²
Control cables	: 2X6 conductors
Mast diameter	: 38-63 mm
Boom diameter	: 32-43 mm
Weight	: 9 kg



Rotary System (In-House Development)

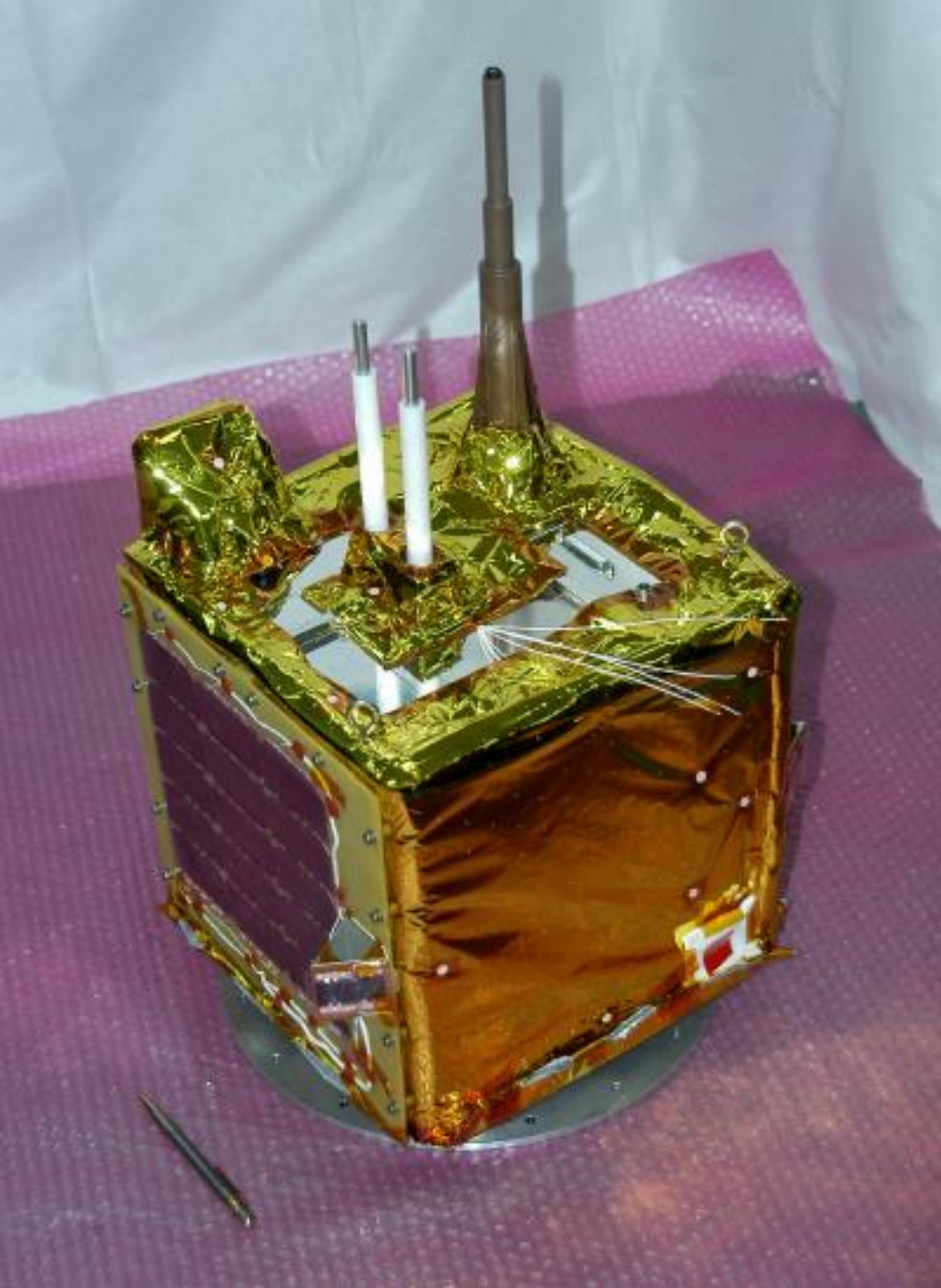
ELECTRONICS

- Microcontrollers
- Motor drivers
- DC Motors/Encoders
- Battery
- Serial Interface



ERRORS

- WIND affects
- ANGULAR TORSION while rotation
- BENDING due to the load
- BACKLASH IN MOTOR



SRM SAT

By SRM University, Chennai

Payload : Tracegas measurement
payload (CO₂, CO, OH)

Mass : 10.3 Kg

Power : ~16W (Generated)

Uplink : VHF

Down Link : UHF