Youthsat-1 (IMS-1A)
Hand Out

India Space Research Organisation (ISRO)
Department of Space
Government of India

YOUTHSAT is second in the Indian Mini Satellite Series, carrying three payloads namely SOLRAD, LiVHySI and RaBIT. It is planned to be launched along with Resourcesat-2 into 817 kms – sun synchronous orbit at a nominal local time of 10:30 hrs. The payload data collected is planned to be used for scientific studies like research of solar activity, mapping the Total Electron Content (TEC) of the Ionosphere and performing airglow measurements of the earth's atmosphere. Youthsat configuration is same as IMS-1 with few changes like addition of Null Filling Antenna, Onboard HK storage at SSR end, Telemetry Transmitter for receiving Real time Telemetry. Payload details are:

1. LiVHySI by VSSC & SAC (Limb Viewing Hyper Spectral Imager)

- The main objective of the instrument is to perform airglow measurements of the earth's atmosphere (80 to 600 km) in a spectral range of 450 nm to 950 nm with a spatial resolution of 2 km and a spectral resolution of 25 nm.
- The observations would aid in understanding and modeling the earth's atmosphere as a whole in general and the upper atmosphere in particular.

2. RaBIT by SPL-VSSC (Radio Beacon for Ionosphere Tomography)

- For mapping the Total Electron Content (TEC) of the Ionosphere.
- The TEC is derived from the phase difference between two electromagnetic waves as it propagates from onboard beacon through the ionosphere to ground receiver.

3. SOLRAD by Moscow University (Solar Radiation Experiment)

- Research of solar flare activity
- Involvement of young researchers, i.e students and post graduate students in all stages of preparation and realization of the space experiment.

The SOLRAD payload onboard Youthsat would be continuously monitoring the Solar activities (like flare and CME events) through hard X-rays, γ-rays and particle (mostly electrons and protons) detectors. The effects of these solar activities on ionosphere would be studied by RABIT and the effects on the thermosphere, which co-exists with the ionosphere, by LiVHySI. All the three payloads put together form a unique and comprehensive package of experiment for the investigation of the composition, energetic and dynamics of upper atmosphere. The combination of LiVHySI and RaBIT would provide excellent simultaneous measurements of neutral and plasma parameters respectively, complementing each other and also the solar radiation measurements through SOLRAD. Both these Indian experiments are the, first of its kind indigenously built experiments onboard an Indian satellite.

Mission Objectives

· To build, launch and operate a 3 axis stabilized Micro Satellite for launch onboard PSLV as an auxiliary satellite with scientific payloads that are useful for observing solar flares and also for study of their impact on atmosphere.

· To involve the youth consisting of students, research scholars etc., for the development and use of payloads mentioned above, in order to inculcate interest and participation in space related activities and also to participate in the data analysis.

Orbit

As it is planned to launch Youthsat along with Resourcesat-2, the orbit details are applicable for Youthsat and the same are listed below. The nominal orbital parameters are:

Semi Major Axis	**:**	**7195.12 Kms**
Altitude	**:**	**817 Kms**
Eccentricity	**:**	**0.001**
Inclination	**:**	**98.731 deg**
Argument of Perigee (frozen)	**:**	**90.0**
No of orbits per day	**:**	**14 5/24**
No of orbits / cycle	**:**	**341**
Orbit Period	**:**	**101.35 minutes**
Local time @ descending node	**:**	**10.30 AM**
Repeativity	**:**	**24 days**
Ground track maintenance	**:**	**+/- 10 km**

It is planned to phase out Youthsat with respect to Resourcesat-2 to avoid visibility clash between them. For ground track maintenance of +/- 10 km, the frequency of maneuver is once in 150 days approximately.

Launch Vehicle

Youthsat is launched along with Resourcesat-2 on PSLV-16 on 20th April 2011. The launcher injects satellite into 817 km orbit with the required inclination of 98.731 deg. The orbit is sun synchronous with 10.30 am local time at descending node. The injection rate requirement is less than 2.0 deg/sec. The spacecraft lift of mass is 93 kg (including balance mass and fuel mass). The launch is planned from First Launch Pad, SDSC.

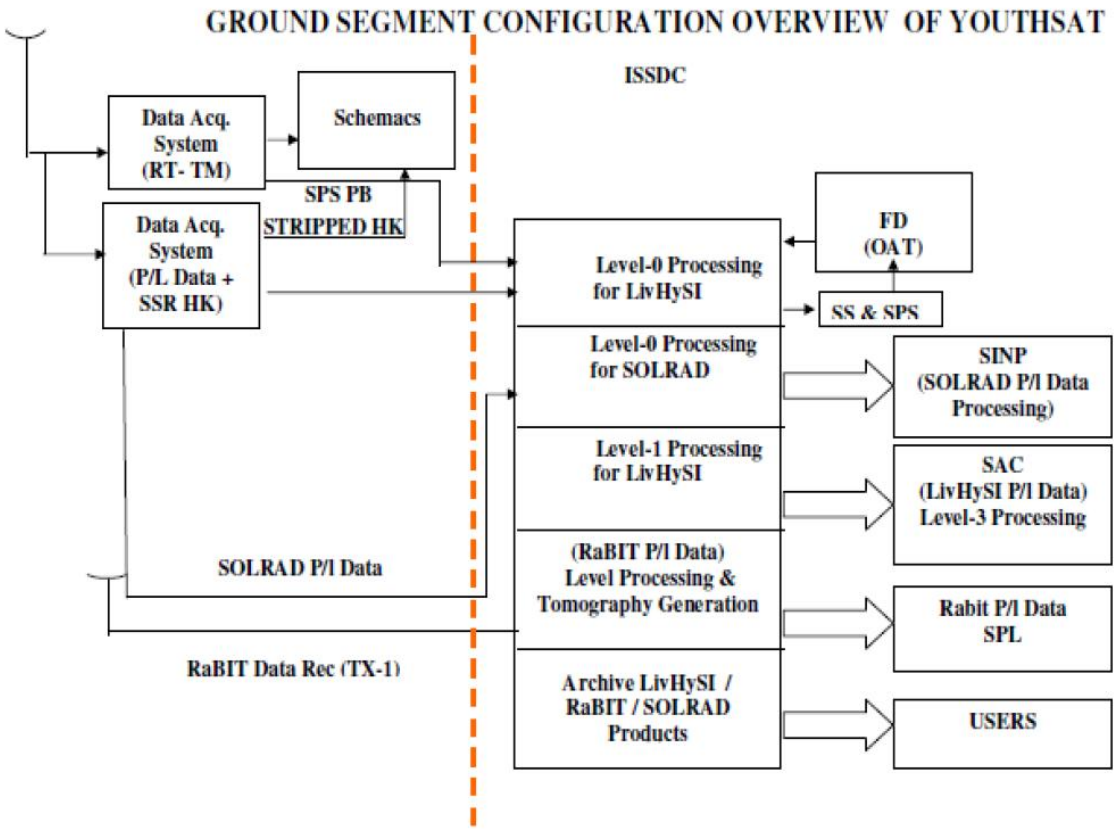
Pointing and Drift Rate Specification

The pointing requirement of Youthsat spacecraft has been mainly derived form LiVHySI and SOLRAD Payloads.

Pointing specification	**:**	**0.1 ° (3s)**
Drift Rates	**:**	**5.0 e-4 °/sec (3s)**

Ground Segment

The ground segment elements are spacecraft control center, payload operations, data reception & payload data acquisition, Level-0 operations, data processing facility, data products generation, archival and dissemination to meet the mission requirements. The RaBIT data will be collected by intended set of stations and the data transferred to ISSDC. The data from other two payloads, along with HK-PB will be received at Bangalore station and moved to ISSDC. Youthsat will be controlled through Bangalore ISTRAC Network station. This is also the station identified for the reception of instrument data. However support from other stations may be availed based on the mission requirements and for contingency recovery/special operations. The ground station transfers the TTC data to control center and instrument data to Science Data Center, after due conditioning. At the control center, the satellite health is monitored, tele-command up-linked towards payload operations programming and necessary change in onboard configurations, attitude determination, orbit determination, visibilities generation and all types of TTC data archived. This centre also facilitates offline analysis. The Science Data Center is bestowed with the responsibility of processing the instrument data for Level-0 and Level-1 and archives the same.



It also receives and stores the higher-level products, generated at payload operation centers. The dissemination of payload data is also governed from this centre. Payload Operation Centers interact with the control center for payload configuration and operations. POCs receive the processed data from Science Data Center and return the higher-level products generated at POC for dissemination.

Spacecraft Axis Definition

The axis definition during various regions of the orbit is as follows:

Sun-Pointing Geometry for SOLRAD payload operation or during normal sun pointing

-Yaw axis : towards Sun
+Roll axis : Normal to Sun and S/C Position vector
Pitch axis : Normal to Yaw and Roll
In this Geometry -Pitch axis lines on Earth viewing side and solar panel normal is towards the Sun

Limb (or Albedo) viewing Geometry for LiVHySI payload operation

- Pitch axis : Along Horizon vector (which joins S/C to Earth's Limb)
-Yaw axis : Along Local radial (ie radial normal to Horizon) vector
Roll axis : Normal to Pitch and Yaw.

Station Viewing Geometry used for RaBIT payload operation.

+Yaw axis : Towards the Look direction of Station from the Spacecraft
+ Roll axis : Normal to Look Vector and –ive Orbit Normal
Pitch axis : Normal to Yaw and Roll
In this Geometry, if the angle between –Pitch axis and Sun becomes less than 60°, yaw bias is applied by BMU automatically to maintain the Sun Angle separation of LiVHySI payload.

Earth-Pointing Geometry (The spacecraft biases for Orbit Maneuver are applied in this frame) .

+ Yaw axis : Towards Earth Centre
+ Roll axis : along velocity vector
+ Pitch axis : towards –Orbit Normal