ITASAT-2 Mission Overview

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ABSTRACT

The ITASAT-2 project is part of a progressive development of CubeSat space missions at the Instituto Tecnológico de Aeronáutica (ITA). Focused simultaneously on space weather and on the development of new technological solutions, the ITASAT-2 mission is based on the previous developments of the ITASAT-1 and SPORT missions. Consisting of three 12U CubeSats in a formation flight, the mission expands on the study of ionospheric plasma movements and density, small-scale ionospheric structures, magnetic field, and radiation environment. On the development of technological solutions, the mission proposes to test a baseline option at LEO to understand the influence of ionospheric phenomena and signal deterioration on geolocation/aviation-related services. While it allows for the development of support technologies closely related to airworthiness and flight safety, the formation flight arrangement is expected to provide novel (temporal) insights on the evolution of ionospheric events. This paper presents an overview of the ITASAT-2 mission with the main mission objectives, the concept of operation, initial Systems Engineering analysis, and expected work for the next phases of the project.

INTRODUCTION

ITASAT-2 is a mission to study space weather and to develop and demonstrate capabilities in geolocation. In space weather [1], the mission continues the developments from SPORT (Scintillation Prediction Observations Research Task) mission [2, 3], bringing new attributes to the study of the ionosphere such as spatiotemporal variations of interactions and phenomena as well as radiation in orbit. On geolocation, the mission proposes to demonstrate key technologies to locate and identify radio-frequency sources in the national territory. Additionally, the geolocation side of the mission aims to understand the influence of space weather on augmentation systems to support aviation location and communication. Therefore, the mission is part of an evolutionary process of Centro Espacial ITA (CEI) [4], with consecutive missions of incremental complexity.

The ITASAT 2 project is not the first orbiting Observatory to study the ionospheric structures known as plasma bubbles. Four other missions collected in-situ data: (1) San Marco, (2) Communications/Navigation Outage Forecasting System (C/NOFS), (3) Republic of China Satellite 1 (ROCSAT-1), and (4) Defense Meteorological Satellite Program (DMSP). San Marco and C/NOFS experienced aliasing due to low inclination orbits. ROCSAT-1 and DMSP experienced infrequent plasma bubble occurrences due to the high-altitude orbits, and a scintillation correlation was difficult due to the convolution of longitude and local time. Figure 1 presents an artistic representation of the ITASAT-2 conceptual design.

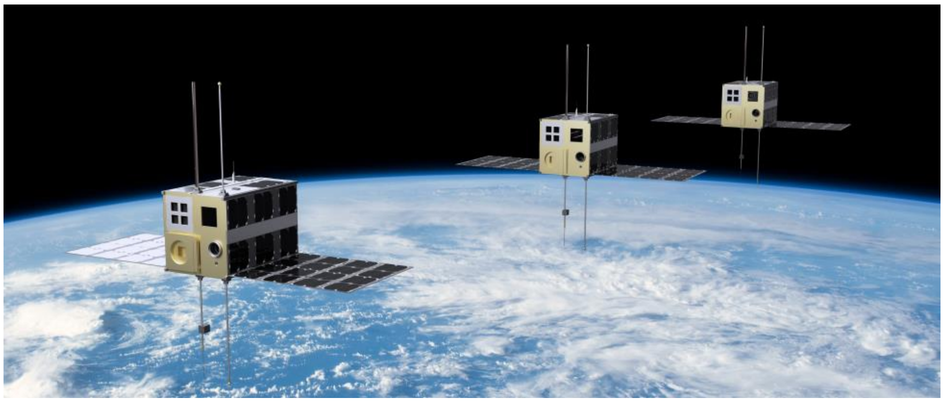


Figure 1: ITASAT-2 Conceptual Design (Artistic Representation)

MISSION OBJECTIVES

The ITASAT-2 Mission Statement is presented as follows:

"ITASAT-2: a formation flight mission to provide a tailored source of data for the understanding of space weather spatiotemporal events and interactions; and to provide a baseline geolocation option based on national needs."

The top-level Mission Objectives are defined as follow:

1. To measure ionospheric plasma movements.
2. To measure ionospheric plasma density and temperature.
3. To measure ionospheric plasma impedance.
4. To measure small-scale ionospheric structures.
5. To measure the magnetic field.
6. To measure the electric field.
7. To measure the electron density.
8. To measure in orbit radiation levels.
9. To geolocate RF emitting objects.
10. To perform formation flying.

Considering that ITASAT-2 is part of an evolutionary development of missions, there are similarities in the objectives for this current mission and the previous mission SPORT [3], especially considering the commonality of space weather stakeholders. From a technical perspective, ITASAT-2 serves as a pathfinder for potential missions in discussion and expected by agency-level stakeholders.

The minimum mission success criteria defined for the ITASAT-2 mission are presented as follow:

- Operate for at least two years.
- Perform spatiotemporal measurements of the ionospheric environment.
- Perform measurements of the orbit radiation.
- Perform the geolocation of a RF emitting source.
- Demonstrate formation flight and topology control.
- Demonstrate propulsive maneuvers.

Further discussions and iterations of the project with science stakeholders are expected to define the specific metrics for the Mission Success Criteria. To support the current Mission Minimum Success Criteria, the following points are presented:

- The project is based on lessons learned from previous missions such as ITASAT [5] and SPORT, with up-to-date items developed, incorporated, resolved, and adapted through phases B, C, D, and E of these previous missions.
- The project utilizes an established and sound process for the allocation and control of requirements throughout all levels, and a plan has been defined to complete the definition activity within schedule constraints.
- Requirements definition is complete with respect to top-level mission and science requirements, and interfaces with external entities and between major internal elements have been defined.
- Requirements initial allocation and flow down of key driving requirements have been defined down to the systems level.
- Preliminary approaches have been determined for how requirements will be verified and validated down to the subsystem level.
- Major risks have been identified and technically assessed, and viable mitigation strategies have been defined.

CONCEPT OF OPERATION

The CONOPS presented herein is an initial assessment of the current possibilities and is expected to mature through the next phases of the project. The main phases of the CONOPS are:

Handover and integration: The Observatories are delivered to the launch/rideshare/deployment provider based on the timeline agreed/defined by the entities. All the Observatories are integrated into the respective deployment hardware following the deployment provider guidelines.

Launch and deployment: The Observatories are launched on a specified date and deployed based on agreed conditions for orbital parameters, and deployment cadency among other operational factors. May the deployment occur from the International Space Station, there will be an additional step including the delivery and handling prior to the deployment.

Commissioning: The Observatories start the initial check-ups for the health status and operation of the main Platform equipment. This phase may include initial tests/checkups of payload instruments as well as initial tests of subsystems (e.g. Propulsion Subsystem). This phase includes the initial detumbling and pointing activities that might be required for the Observatories.

Operations – Geolocation tasks: The Observatories start the geolocation tasks, initially acquiring a given formation/topology followed by the operation using initially a known RF source for the initial geolocation tests. Further tests are expected to be performed during this phase, either as the commissioning of the geolocation instrument or as an on-demand operation defined by the stakeholder. For the case of the Observatories to be deployed from the ISS or other similar orbit, the Observatories are expected to undergo a natural and controlled decay from the deployment orbit (e.g. 400 km) down to the planned operational orbit (e.g. 370 km). During this phase, space weather tasks can be accommodated depending on the requirements and operational capabilities of the Observatories.

Operations – Space weather tasks: The Observatories start the space weather tasks. Once the satellites reach the planned operational orbit, they will acquire the relevant formation/topology for such tasks, with the satellites likely to perform such corrections/changes as they transition from geolocation tasks to space weather tasks. Any payload instrument for space weather that had not been tested/initialized up to this stage will start such a process. The Observatories will perform the complete on-orbit operations until they reach the intended mission lifetime of 2 years. At this stage, further decisions and analysis will define the necessity, intention, and possibility of continuing the operation up to the desired lifetime of 3 years. During the space weather tasks, the Observatories are expected to maintain the operational orbit (e.g. 370 km). During the space weather tasks, on-demand operation of geolocation instrument can be accommodated depending on the requirements and operational capabilities of the Observatories.

End Of Life – Decommissioning: The Observatories undergo the formal process of decommissioning, specifically focusing on the depletion of consumables (e.g. batteries, propellant). This phase is expected to follow the relevant guidelines for space debris mitigation.

End Of Life – Reentry: The Observatories start the atmospheric reentry at an altitude to be analyzed, with the total reentry expected to occur in a time not greater than 25 years (TBS).

A scenario encompassing the Geolocation and Space Weather tasks is presented in the Mission Analysis for initial estimates and analysis. Other relevant points to the presented CONOPS as well as potential concerns and requirements anticipation are discussed later in the paper. Figure 2 presents a general schematic for the ITASAT-2 CONOPS.

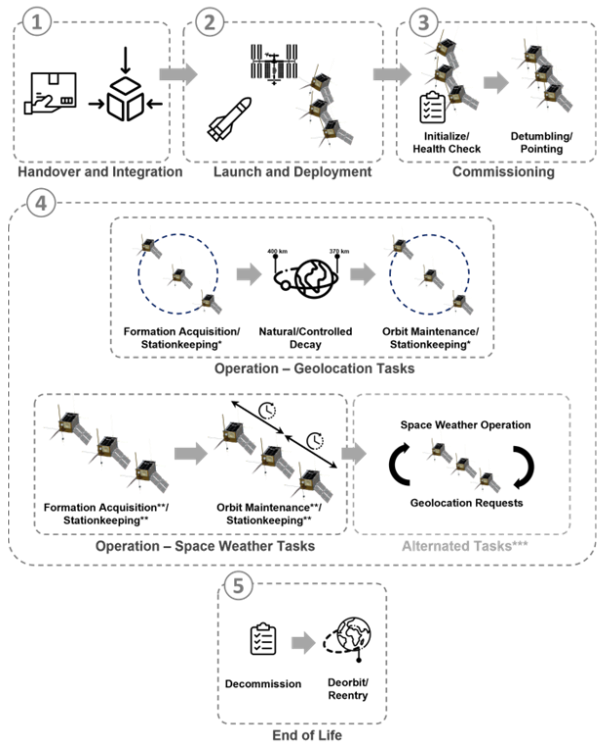


Figure 2 – ITASAT-2 CONOPS

* Depending on the formation flight option selected for the Geolocation Tasks.
** Depending on the performance requirements for Space Weather Tasks.
*** Depending on stakeholder requests and available system resources

SYSTEMS ENGINEERING

Functional Baseline

The ITASAT-2 Observatory is divided into two parts: Spacecraft Bus (Platform) and Payload. The ITASAT-2 Spacecraft Bus (Platform) is formed by the following subsystems:

1. On-Board Data Handling Subsystem (OBDH).

2. Attitude Determination and Control Subsystem (ADCS).

3. Communication Subsystem – Telemetry, Tracking, and Command (TT&C).

4. Electrical Power Subsystem (EPS).

5. Structure and Thermal Subsystem (STM).

6. Propulsion Subsystem (PROP).

The ITASAT-2 Payload is formed by the following science instrument:

1. Ion Velocity Meter (University of Texas at Dallas).

2. GPS Occultation Receiver (Aerospace Corporation).

3. Langmuir, E-field, and Impedance Probe (Utah State University).

4. Fluxgate Magnetometer (NASA Goddard).

5. Charge Analyzer Responsive to Local Oscillations – CARLO (NASA Marshall).

6. Radiation Sensor (ITA).

7. Geolocation Front-end (ITA).

At the current stage, the high-level functions are separated between Payload Functions and Spacecraft Functions. Such functions are expected to be refined with a more detailed description of each activity. The high-level functions for ITASAT-2 are presented in Figure 3.

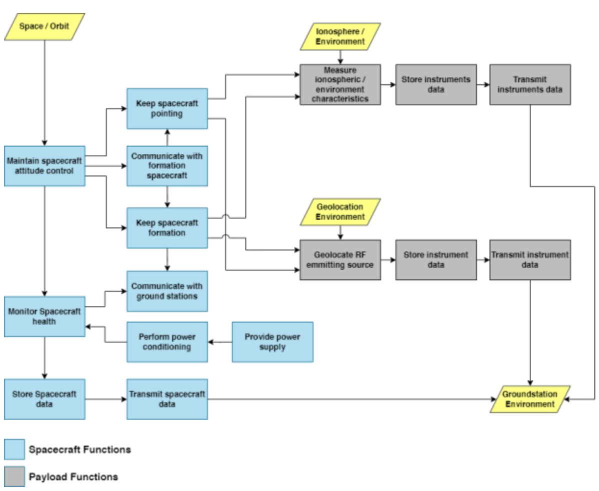


Figure 3 – ITASAT-2 High-level functional baseline

Payload and Measurements

The following instruments and their respective measurements are expected to be part of ITASAT-2 payload.

Ion Velocity Meter: The equipment uses a technique with extensive heritage in space to measure the velocity of the ion component of the ionospheric plasma at the location of the sensor. ITASAT-2 will make use of the CubeSat Ion Velocity Meter (cs-IVM) produced by the University of Texas at Dallas. The IVM is mounted to view approximately along the Spacecraft velocity vector in the ram direction and performs two functions. The first function is a planar retarding potential analyzer (RPA), which determines the energy distribution of the thermal plasma along the sensor look direction and the second is a planar ion RDift meter (IDM).

Impedance Probe: The Swept Impedance Probe (SIP) is intended to be used to determine the absolute electron density, irrespective of the payload charging, by monitoring the changing impedance of a short cylindrical probe excited over a range of RF frequencies. This data will be applied to compute Ne which will be employed to understand the state of the ionosphere and the nature of the density structures observed. Impedance probe techniques have been used for over thirty years to probe electron density in the ionosphere.

Langmuir Probe: The Langmuir probe is used to primarily measure plasma density, Ne and Ni, and temperature, Te. It also provides measurements of the floating potential, Vf, and space potential, Vs. The measurements are based on the current-voltage (I-V) response characteristics of a conductor immersed in plasma at a Debye length or greater from surrounding structures.

E-Field Probe: The electric field probe is used to measure only one component of both DC and AC electric fields to identify disturbed regions of the ionosphere. It is an implementation of the double-probe class of in-situ electric field instruments that have been used for decades to observe electric fields in the space environment. It operates by making measurements of the potential difference between two isolated, separate conductive sensors immersed in the plasma that are electrically isolated from the Spacecraft electronics.

GPS Radio Occultation: The GPS radio occultation technique is a rather simple and inexpensive tool for getting information about the global characteristics of the vertical electron density distribution. The ionosphere is a dispersive medium, which delays the two GPS frequencies, L1 and L2, differently as they traverse it. The timing difference is used to determine the integrated electron density along the slanted line-of-site between the Low-Earth-Orbiting (LEO) satellite and the GPS transmitters. Electron density profiles are then generated from slant Total Electron Content (TEC) observations using various inversion techniques.

Magnetometer: A magnetic field measurement is required for the post-processing of electric field data and for attitude determination. The Utah State University magneto-resistive magnetometer produces both observations of the ambient field and of δB, the fluctuations from the ambient field. This instrument was first flown on the DICE CubeSat mission and is constructed from a commercial Anisotropic Magneto Resistance sensor produced by Honeywell. The magnetometer electronics are implemented on the same printed circuit board as the electric field probe with the sensor head being deployed away via a ribbon cable. It makes use of low noise instrumentation amplifiers and a higher precision (24 bit) delta-sigma A to D converter to achieve <0.5 nT sensitivity. The magno-resistive magnetometer will be located on a 20 cm fixed boom. This is one of two science-grade magnetometer systems on SPORT, which together will be used in advanced algorithms to identify and reject magnetic field signatures of payload origin in the data. The magneto-resistive magnetometer will be sampled at the same rate as the electric field probe and telemetered to the ground to be used in the reduction of the electric field data and computation of δB. Similar to the electric field probe, a 16-channel spectrometer (20 Hz – 15 kHz) is implemented to detect smaller-scale features in the plasma.

Charge Analyzer Responsive to Local Oscillations – CARLO: CARLO is a rugged instrument consisting of four miniature retarding potential analyzers (RPAs) connected with electronic feedback circuitry to make measurements of plasma ion density and temperature at measurement sample rates from 1 Hz to 10 kHz. The instrument is designed for operation in Low Earth Orbit (LEO) at any inclination. CARLO was designed with students in mind. There are no delicate parts and no high voltage supplies. It was designed for integration into CubeSats according to the CubeSat design standards. CARLO has been tested in three different laboratory plasmas, two of which included oscillations up to 10 kHz. Tests show that CARLO can provide measurements in the form of time-domain waveforms up to ~10 Hz oscillations, frequency power spectra up to 2.4 kHz, and transient events up to 10 kHz.

Radiation Sensor: The Charged Particle Detector (Radiation Sensor) will investigate the characteristics, time, and space variations of the ionizing radiation field (protons, electrons, X, and gamma rays) at low earth orbit, including measurements carried over the South Atlantic Anomaly (SAA). It is expected to generate a continuous time series of radiation counts (particles and photons) discriminated by type and energy of the particle and photon, collection time, and geographical location of the measurement. The measurement time interval should be as small as possible so that the mapping of the radiation field will have enough resolution to show "locations of interest" in the orbit such as the South Atlantic Anomaly.

Geolocation Instrument: Radiofrequency frontend able to receive a set of different frequency bands using software-defined radio. The complete frequency spectrum is still to be defined by the stakeholder, with the main driver being Search and Rescue frequencies. The suit is expected to be composed of the main electronics boards encapsulated in a volume not greater than 1U (10X10X10 cm) with additional sensors/antennas to be arranged around the Observatory depending on the operational requirements.

Figure 4 presents part of the instruments listed previously. Those are instruments previously developed for other missions, representing the baseline for the instruments to be used for the ITASAT-2 Mission. Figure 5 presents the relation between the desired measurements and the instruments generating such data.

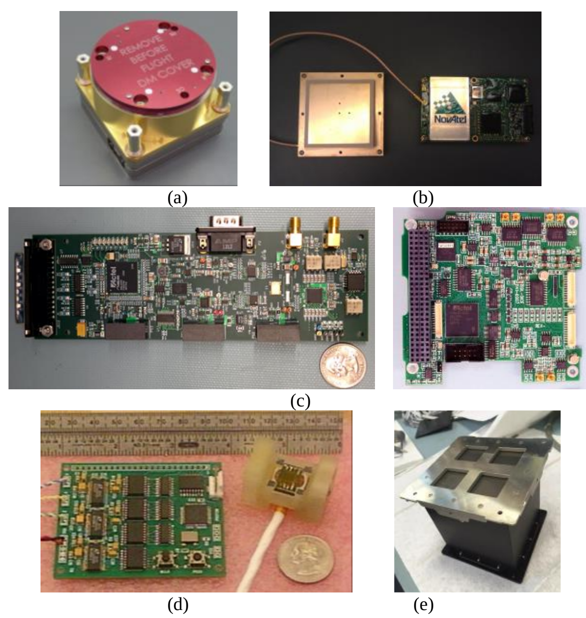


Figure 4 – ITASAT-2 Instruments (partial) – (a) Ion Velocity Meter, (b) GPS Radio Occultation Receiver, (c) Langmuir, E-field, Impedance Probe, (d) Fluxgate Magnetometer, (e) Charge Analyzer Responsive to Local Oscillations

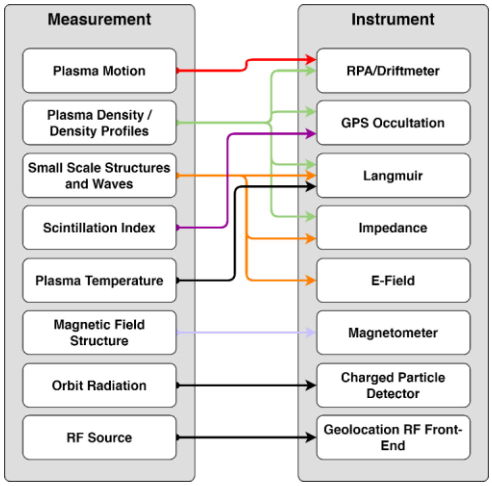


Figure 5 – Measurements and Instrumentation

Mission Analysis

Preliminary mission analysis for the initial phases of the mission were performed to estimate the natural decay from different initial orbits.

According to the CONOPS, ITASAT-2 is expected to perform geolocation and space weather tasks. The formation flying topology considered for the Observatories in this mission is the co-orbital string of beads (SOB) (Figure 6) since it meets the requirements for both tasks and it offers possibilities of reconfiguration maneuvers with lower risks and lower energy consumption, comparing to other topology options such as non-coplanar oscillator, project circular orbit and natural motion circumnavigation.

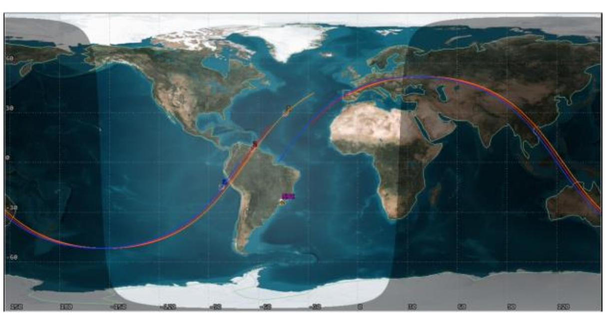


Figure 6 – ITASAT-2 Orbital Plane

The planned operational orbit of ITASAT-2 is assumed to be 370 km and based on the CONOPS presented, a natural controlled decay is assumed from an initial orbit. Therefore, early analysis of potential scenarios explored initial conditions for operations starting at different orbits and inclinations having as main driver the decay time from the initial deployment orbit down to the operational orbit (370 km). Table 1 presents the orbital decay (average for the three satellites) for a period of two years for four different scenarios.

Table 1 – Assessment Scenarios – Orbit decay for a period of two years

	Orbit Decay [km]
Scenario 1: 400 km – 45° incl.	98.00
Scenario 2: 400 km – 52°incl.	95.33
Scenario 3: 500 km – 45° incl.	15.00
Scenario 4: 500 km – 52° incl.	9.66

Considering the requirement of two years of operation, with most of this time expected to be at the operational orbit (370 km), the scenarios starting at 400 km offer a more suitable condition for this with the satellites reaching the operational orbit in a shorter time. The consideration of the different inclinations relates to different deployment options in analysis or expected to be analyzed. However, considering the current uncertainties of such services (capabilities, expected dates), Scenario 2 is considered the reference for the analysis presented herein since it presents more similarities to the International Space Station (ISS) orbital condition, which maintains an almost-circular orbit with an average altitude of 400 km and an inclination of 51.64°. Thus, at this altitude range, ITASAT-2 is expected to undergo a natural and controlled decay to keep the formation flying down to the operational orbit. The Observatories may perform geolocation tasks during this decay and space weather tasks can also be accommodated, as mentioned previously in the CONOPS.

In order to estimate the orbit decay time between 400 km and 370 km of altitude without propulsion control for (SOB) topology, the orbital motion was propagated for initial conditions shown in Table 2. Table 3 shows the results of the decay time for each Observatory.

Table 2 – Orbital initial conditions for preliminary ITASAT-2 formation flight simulations.

Orbital Elements	Value
Semimajor Axis	6,778.14 km
Eccentricity	0 deg
Inclination	51.64°
Right Ascension of the Ascending Node	0 deg
Argument of Perigee	0 deg
Mean Anomaly - Satellite 1	0 deg
Mean Anomaly - Satellite 2	351.54 deg
Mean Anomaly - Satellite 3	343.08 deg

Table 3 – Final epoch for ITASAT-2 formation flight and decay time from deployment to operational orbit.

Observatories	Date	Decay Time (30 km)
Satellite 1	11/08/2026	7 months and 13 days
Satellite 2	11/11/2026	7 months and 16 days
Satellite 3	11/20/2026	7 months and 25 days

Further analysis of the mission topology must be carried out on the mitigation of natural perturbation on the orbital motion to achieve the optimal relative motion among the Observatories according to the concerns presented here. The formation topology determined by stakeholders must directly impact power and fuel mission consumption since their choice will define the orbital correction and phasing maneuvers needed to orbit lifetime.

At the moment more interaction with the geolocation and science stakeholders as well as the propulsion coordination will help to outline appropriate parameters for DeltaV analysis for the operation. However, initial DeltaV analysis for potential topologies are in progress and are expected to be considered in the Mission Analysis for the next phase of the project.

Mass Budget

This section presents the overall mass budget for the Observatory. The values presented herein come from the SPORT mission for the Payload and from subsystem assessments of COTS for the Platform. The data presented herein is expected to be iterated and updated throughout the following phases of the project. The mass budget is based on:

- Current instruments (SPORT Heritage).
- Plans and estimates for instruments in development.
- Plans and estimates for subsystems in development.
- References of subsystems commercially available.

Table 4 – Observatory Total Estimate

Segment	Mass [kg]
Platform	14.53
Instruments	5.15
Observatory	19.68
Observatory w/ margin*	24.59

*Margin: 25%

Power Budget

An overall power budget for the Observatory is presented based on the preliminary analysis. The values presented herein come from SPORT mission for the Payload and from subsystem assessments of COTS for the Platform. The data presented herein is expected to be iterated and updated throughout the following phases of the project. The power budget is based on:

- Current instruments (SPORT Heritage).
- Plans and estimates for instruments in development.
- Plans and estimates for subsystems in development.
- References of subsystems commercially available.

Different operational modes (considered with margin) are analyzed and compared. Table 5 presents a summary of the maximum values for total consumed power of each of the operational modes considered. Such values are compared with a reference value of total power available coming from four 2X3U solar panels, with an average capacity of 20 W for each panel (80 W total). This reference value is considered based on the current 12U platforms commercially available [6] and their expected configuration for Solar Panels and capabilities.

This comparison is presented for assessment purposes and does not represent any constraint or formal definition of a solution for the Power Subsystem.

Table 5 – Observatory Additional Power Margin (Based on Solar Panels)

Operational Modes	Total Consumed Max [W]	Observatory Additional Power Margin*
Safe Mode	14.89	79.32%
Detumbling and Pointing Modes	23.06	67.97%
Nominal Modes	81.16	**-12.72%**

*Considering a total of 80W from solar panels (4X 2X3U of 20W each) and a margin of 10% for solar panel losses

Regarding to the Observatory not having an additional power margin with the system in Maneuvering Mode, as presented in Table 5, the following points must be considered for further analysis:

- The current margins considered are defined based on the level of knowledge of the subsystem and the respective TRL. As the development progresses, the TRL and the respective margin are expected to be updated as well as revisions of the total peak power.]
- At the current stage of the analysis, the Propulsion is expected to be the most demanding subsystem and will likely be the most demanding through the whole design process. Understanding the proper modes of operation for this subsystem such as the capability of adjusting the total impulse, and nominal ISP among other factors is expected to reflect directly on the power consumption of this subsystem.
- Understanding the types and the frequency of maneuvers is a key factor to identify more

refined duty cycles for the Maneuvering Mode, therefore reflecting in a more detailed version of the analysis presented herein.

The analysis presented up to this stage considers only the use of the assumed solar panels. Other factors such as additional panels around the satellite structure and the further analysis of the batteries to be used are the next step for the Power Budget analysis in the following phases of the project. Lastly, their iteration and results coming from Mission Analysis are also part of the refinement process for the Power Budget analysis.

Observatory Concept

This section presents the exploratory analysis of the Observatory with the main objectives listed as follow:

- To analyze the feasibility of accommodating the expected Payload and the required Platform equipment.
- To analyze the feasibility of SPORT solutions and the applicability to the ITASAT-2 Mission.
- To generate technical data for the interaction with science stakeholders.
- To provide feedback to the stakeholders based on their expectations and requirements for the mission.
- To consider at early stages part of the lessons learned from the SPORT mission.
- To anticipate potential risks and issues.
- To anticipate Systems, Subsystems, and Operation requirements.

It is important to note that this analysis does not constraint neither define solutions for the Observatory nor the overall Mission.

The information presented herein is expected to be iterated through the next phases of the project until the stage of critical definition.

A conceptual view of the ITASAT-2 Observatory is presented in Figure 7 and Figure 8. The detailed views of each of the Observatory's faces are presented in Figure 9 and Figure 10.

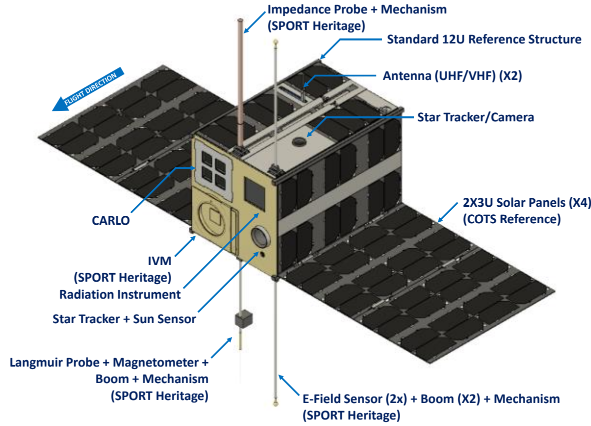


Figure 7 – ITASAT-2 Observatory Concept

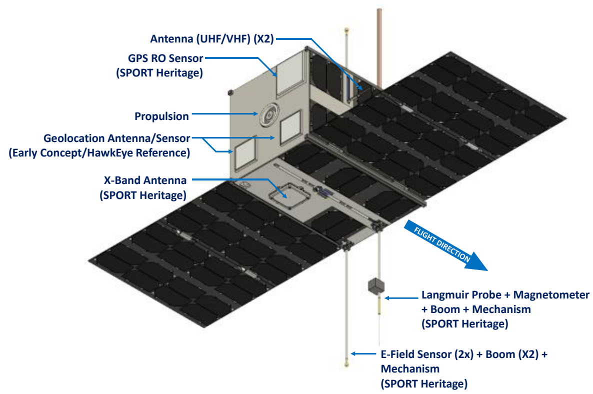
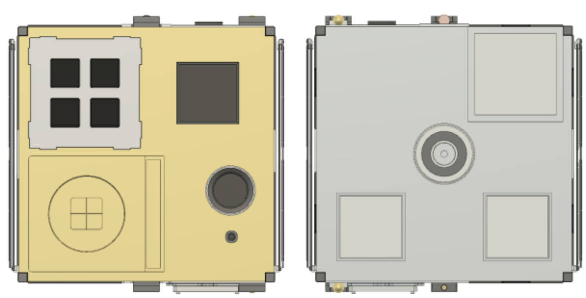
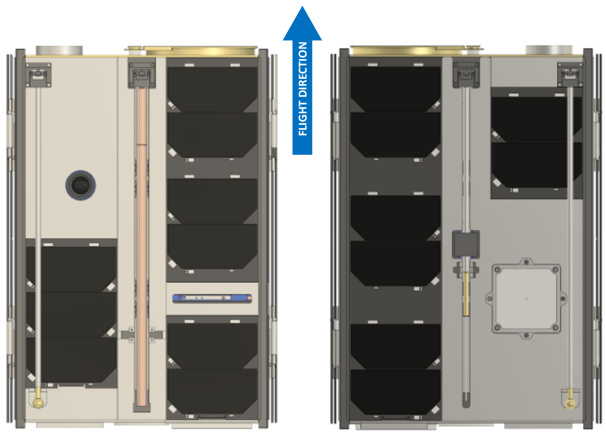


Figure 8 – ITASAT-2 Observatory Concept



(a) **(b)**

Figure 9 – ITASAT-2 Observatory Concept – Stowed sensors and panels – (a) Ram Face (b) Anti-ram Face



(a) (b)

Figure 10 – ITASAT-2 Observatory Concept – Stowed sensors and panels – (a) Zenith Face (b) Nadir Face

The instrument and subsystems allocation are presented based on the following assumptions:

- Possibility of stacking the main electronic boards of instruments (SPORT Heritage).
- Science requirements for instruments pointing to the ram-direction.
- Science requirements for instruments pointing to the anti-ram direction.
- Deployable sensors (SPORT Heritage).
- The use of mechanisms solutions/lessons-learned from SPORT (SPORT Heritage).
- Platform requirements for attitude control and maneuvers.
- Platform requirements for communication (downlink + inter-satellite).
- Standard 12U form-factor and structure.
- Protruding limits for 12U form-factor.
- Consideration of monolithic units (CubeSat form-factor) for instruments based on the general description provided by the scientists and by datasheet.

FURTHER WORK

Over the last phase, the project has been discussed with the different stakeholders and different perspectives and relevant points have been identified. Based on the analysis and discussions, the points presented herein aim to:

- Clarify assumptions and hypotheses
- Inform about current concerns
- Raise potential risks
- Anticipate requirements
- Drive the next round of analysis and discussions

At the current stage, all the analysis considers mainly the use of ITA's ground station (in development). More discussions and interactions with stakeholders are necessary to outline additional ground stations (e.g. COPE ground station) to expand the capabilities of the ITASAT-2 Missions. By experience, it is highly recommended that the project considers backup stations and expand the network, particularly for data reception.

Potential requirements anticipated for ground station interaction raised concerns on the capability of the ground station to process downlink of multiple satellites at the same time. This concern can reflect on the planning and definition of the formation/topology and the definition of appropriate subsystems. The consideration of additional ground stations as part of the main network for the, can represent a potential response to this concern.

In depth discussions with the geolocation stakeholder are necessary to outline the main modes of operation, the expected accuracy, the complete range of frequencies and the proper plans to test the instrument on ground and in orbit.

The use of topologies compatible with both space weather and geolocation tasks/objectives must be a driver for the next phase. While the use of different topologies allows for the theoretical exploration of the best scenarios in the two main lines of operation for this mission, it imposes a significant technical and operational challenge to the Mission. In addition to the points presented here.

The work on Mission Analysis is expected to be refined with more discussions with the relevant stakeholders and responsible parts (geolocation and science stakeholders, geolocation technical coordination and propulsion technical coordination).

Based on lessons-learned from SPORT, AIT activities can be time-consuming and technically demanding. Considering that ITASAT-2 is expected to deal with multiple satellites, preliminary plans must be considered and discussed still at early stages to anticipate further requirements leading to appropriate plans.

Additional discussions from Space Weather stakeholders are expected to clarify about any expected updates/changes on the planned instrument, originally based on SPORT mission. Considering that the next phase of the project aligns with the beginning of operations for the SPORT mission, further iterations on science objectives are expected to explore the attributes of the ITASAT-2 mission (e.g. multiple satellites, spatiotemporal measurements)

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