

Sat-GPT

Investigating the performance of commercially available AI hardware in a radiation-intense lunar orbit

9th Mission Idea Contest

Lunar Orbit CubeSat Mission

UNISEC Global



THE UNIVERSITY OF
SYDNEY

Reliance on large-scale data transmission reduces satellite mission efficiency

Satellites largely rely on ground-based computation for data processing



Low-Level Processing

Essential tasks such as **data formatting** and **compression** are done locally



High-Capacity Computing

Majority of data processing occurs **on Earth**, including **image analysis** and **calibration**

Reliance on this model has two main limitations:



Bandwidth Constraints

The **distance** and **power constraints** of satellite missions severely restrict data transmission rates



Short Communication Windows

Satellites orbit out of line-of-sight with Earth, limiting communications to **brief periods when antennas are aligned**

NASA's MMS mission as a case study highlights these issues

NASA's Magnetospheric Multiscale mission relies on **Earth-based** computation; as a result, **much of this data is never processed**



Generates up to
100GB/day
of science data

Due to bandwidth limits, only
4% of data
is successfully sent to Earth

Sources: NASA, Google, AMD, Kendryte, NVIDIA

On-board data processing has clear upsides

On-board processing (OBP) overcomes key challenges by improving two key mission aspects:



Reduced Bandwidth Strain

Satellites must only transmit the most relevant results or compressed data, rather than raw sensor readings



Improved Storage Optimisation

Satellites can free up storage space quicker by storing only the most relevant findings and data

Continued development of COTS hardware is promising for SmallSats

Development of **commercial off-the-shelf (COTS)** components in recent years have made OBP feasible for **low budget missions**

Google Coral
Edge TPU

USD\$150



2019

AMD Xilinx
Kria K26 SOM

US\$349



2021

Kendryte
K510

US\$199



2022

NVIDIA Jetson
Orin Nano

US\$249



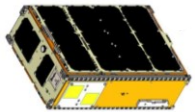
2024

COTS components may allow for affordable OBP on SmallSat missions

Use of COTS AI hardware for orbital missions is an ongoing investigation

Efficacy of COTS AI hardware in LEO has been tested and proven

Missions have **successfully** investigated the efficacy of **COTS components** in LEO for **onboard processing**



Phi-Sat-2 (2024 - present)

6U CubeSat to test the **use of AI** for Earth imaging in LEO
Built using Intel Movidius Myriad 2 VPUs



Spacebourne Computer-2 (2021 - present)

Successfully running **AI/ML algorithms** aboard the ISS for 4 years
Built using Intel Xeon CPUs, NVIDIA GPUs

Efficacy of COTS AI hardware beyond LEO remains untested

Radiation poses the largest threat to hardware beyond LEO

Intense **cosmic** and **solar radiation** degrades spacecraft electronics over long periods of time, with two dominant threats



Total Ionizing Dose

Continuous exposure to gamma rays, protons and electrons causes **cumulative** and **irreversible damage**



Single-Event Upsets

High-energy ions can deposit charge in semiconductors, causing **latch-ups** and **bit-flips**, resulting in **sudden logic errors**

Radiation on COTS AI hardware has been tested in lab conditions

Several studies have been conducted into the **effects of radiation on COTS AI hardware**, with **promising results**:



University of California Davis Cyclotron (2013)

Using the UCD cyclotron, Sinclair Interplanetary and Skybox Imaging demonstrated COTS components can survive up to **30 krad**



National Nuclear Laboratory UK (2021)

Found that a low-cost COTS microcontroller could remain operational up to approximately **35 krad**



Technical University of Delft (2018)

Demonstrated that COTS CPUs survived up to **45 krad** when powered and **60 krad** unpowered

Studies estimate the lunar-orbit to be exposed to **approx. 5 krad per year**, implying the **feasibility of COTS AI hardware for deep-space missions**

However, the true impact of radiation on COTS AI hardware beyond LEO remains unknown

Sources: ESA, Hewlett Packard Enterprise, Sinclair Interplanetary, NNLUK, TUD, Carnegie Mellon University

Sat-GPT aims to evaluate the performance of COTS AI hardware beyond LEO

Mission Summary

Sat-GPT is a **single 3U CubeSat** mission designed to evaluate the **performance and resilience** of a **COTS AI accelerator** in high-radiation conditions of **lunar orbit**

- Payload:** Hailo-8L, CNN, Camera, Dosimeter
- Timeline:** 12 months
- Scale:** 1 x 3U CubeSat
- Orbit:** Circular 100km altitude at 95° inclination



The satellite will run a **Convolutional Neural Network (CNN)** onboard using the COTS **Hailo-8L AI accelerator**

Ground Segment



Fault-Aware Training

Bit-flip errors simulated during training to harden the CNN against radiation

Space Segment



Crater Detection

CNN identifies craters, characterised by radius and frame position



Position Estimate

Craters are matched against database to estimate position

The output of this CNN will be used to validate COTS performance

Performance for both **crater detection** and **position estimation** will be compared against a **control CNN on Earth**



Satellite Output

- Crater radii and positions
- Estimated position
- Dosimeter readings

Earth Control Comparison

- Using known position, infers frame to compare craters to
- Compares known position with estimated position
- Dosimeter reading correlation

Sat-GPT will help validate feasibility of COTS AI hardware in deep-space

If successful in surviving the 12-month mission, Sat-GPT supports future space missions that hope to use affordable COTS AI hardware

Sat-GPT aims to achieve three key objectives

1. Crater Detection

High priority

Identify craters on the moon by classifying radius and relative position in the frame

Steps Taken:



Photograph the lunar surface with an onboard optical camera



Detect craters using CNN running on onboard COTS AI hardware

Desired Outputs:

1

Crater radii

2

Relative crater positions in frame

3

Total crater count

2. Location Determination

High priority

Compare detected crater features against database of known craters to determine location estimate

Steps Taken:



Compare the detected crater features to a database of known craters



Account for the possibility of **new** or **misidentified craters** not in the database



Estimate satellite's orbital location using a CNN based on crater best fits

Desired Outputs:

1

Orbital position estimate

2

Check of selected lunar surface portion

3. Performance against Radiation

Low priority

Quantify the impact of radiation on the system hardware by correlation with dosimeter readings

Steps Taken:



Run control CNN on Earth on the estimated image frame



Quantify the error rates of the CNN on board the satellite w.r.t Earth results



Evaluate the viability of using COTS AI hardware in high radiation environments

Desired Outputs:

1

Dosimeter readings

2

Performance of objectives 1 & 2

Sat-GPT will test affordable NPU hardware

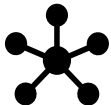
Hailo-8L Overview



Entry-level AI accelerator uses its SDK as a framework to deploy and run tested neural-networks.



Dataflow processor maps neural network directly into **Multiply-Accumulate (MAC) units**.



Specialised for acceleration of **neural-processing unit inference models**.

The Hailo-8L was selected for three key reasons:



Hardware Compatibility

Designed to be used with the selected OBC of a Raspberry Pi 5 (discussed in further detail later)



Software Compatibility

Compatible with a number of AI software platforms, including TensorFlow, PyTorch, ONNX



Specialised for Vision Processing

For the purposes of our mission, high-end image processing capabilities are essential to remove systematic error



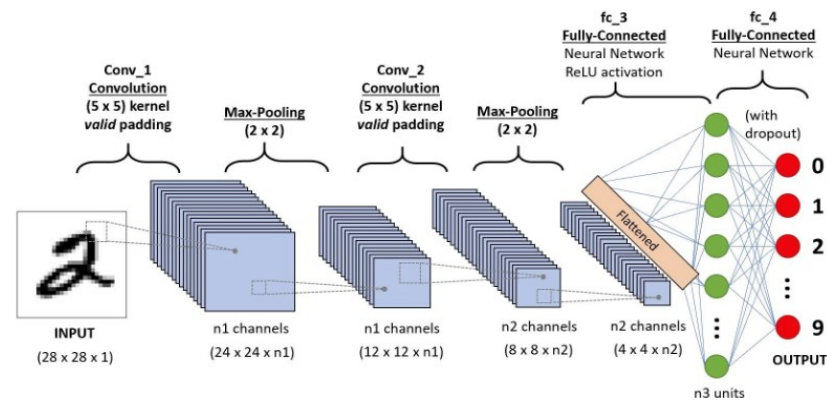
Performance specifications for Hailo-8L

Factor	Quantity
Inference Throughput	13 TOPS
Power Consumption	1.5W
Operating Temperature	-40°C — 85°C
Processing speed	Yolov8n: 430fps Yolov8s: 490fps Yolov8m: 31fps Yolov8l: 19fps

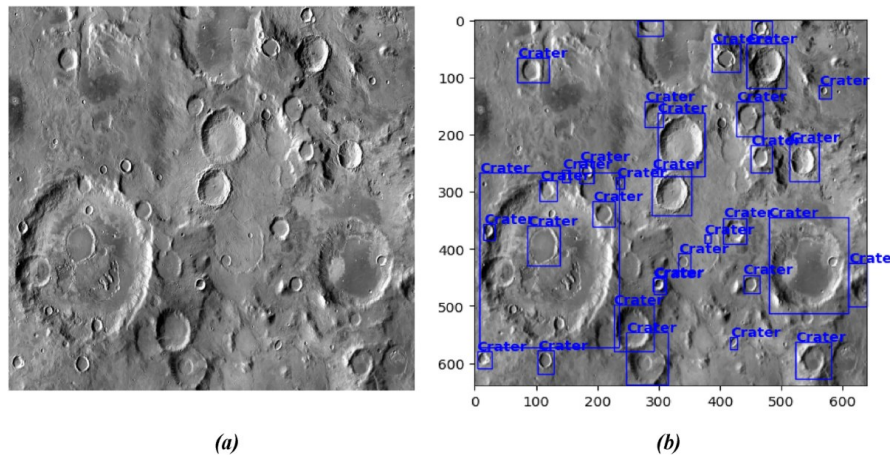
Sources: Hailo

To test the Hailo-8L, a CNN will be utilised

Convolutional Neural Network (CNN) Framework



Case Study: ISRO Chandrayaan 2 - Automated Lunar Crater Identification

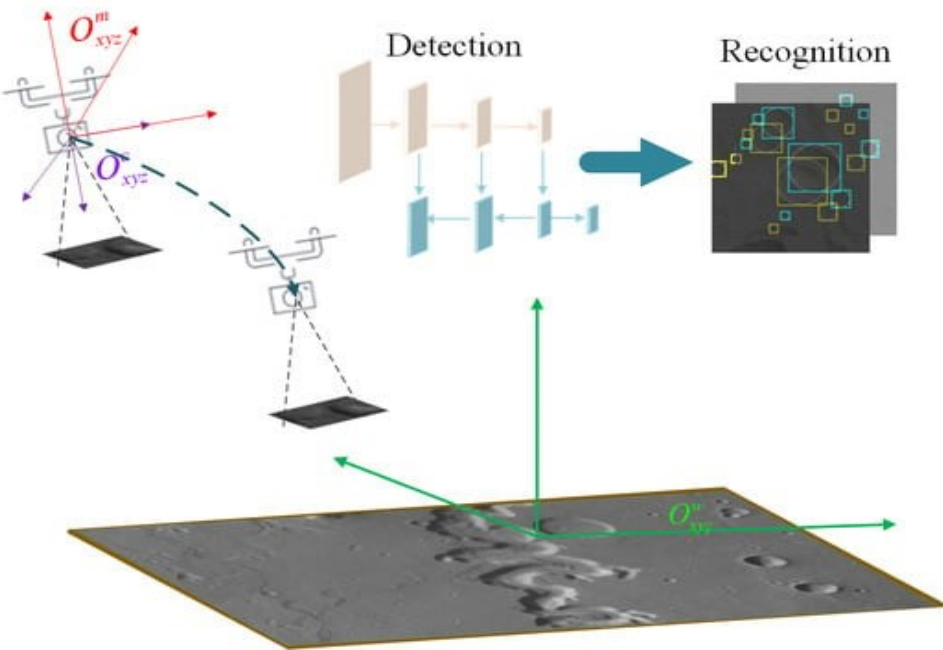


(a)

(b)

Sources: Beihang University, Birla Institute of Technology

Implementation Diagram

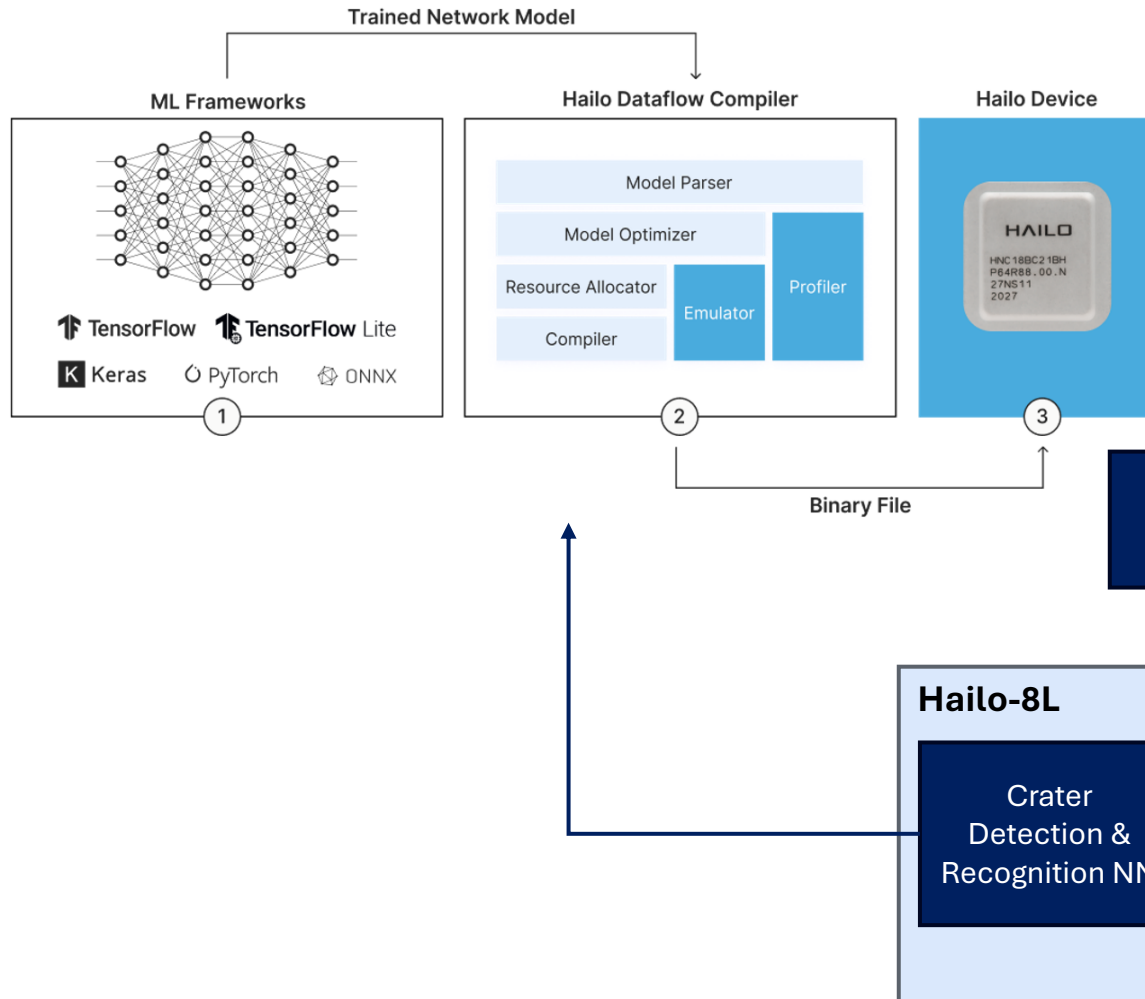


Key Features

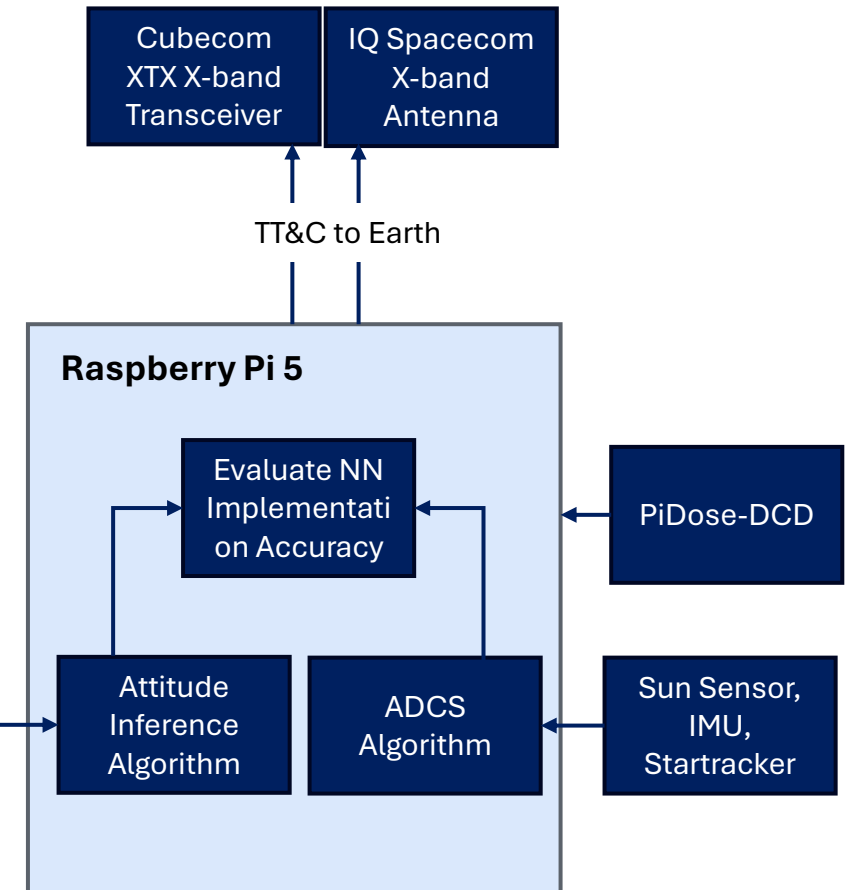
- | | | | |
|---|--------------|---|---------------------------------|
| 1 | Crater radii | 2 | Relative crater centre in frame |
|---|--------------|---|---------------------------------|

The Hailo-8L will rely on several sensor inputs

Deployment of Crater Recognition CNN



Hailo-8L Integration with Sensors



Sources: Hailo

To support Sat-GPT’s mission objectives, a camera and dosimeter will be used

Camera Selection



Arducam 477P High Quality Camera

The Arducam 477P was selected for the following reasons:

High Resolution

12.3 MP Sony IMX477 offers sufficient detail and clarity for crater detection

Compact Size

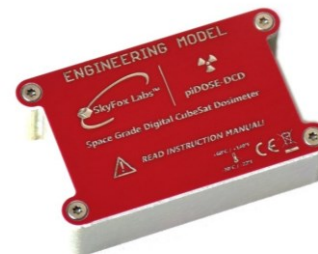
At 25mm x 24mm, the Arducam 477P fits within the constraints of the Sat-GPT mission

OBC Compatibility

Designed to be used with the selected OBC of a Raspberry Pi 5 (discussed in further detail later)

Achieves outcomes 1 & 2

Dosimeter selection



piDOSE-DCD CubeSat Dosimeter

The piDose DCD Dosimeter was selected for the following reasons:

Nominal and High-Dose Event Differentiation

Designed specifically for CubeSat missions, designed for differentiating between sudden high-dose events and nominal radiation

Compact Size

At 53mm x 32mm, the piDose DCD Dosimeter is significantly smaller than other dosimeters available (within the same price range)

Space Grade Design

Already used in CubeSat missions and designed for the exact outcomes Sat-GPT aims to achieve

Achieves outcome 3

Sources: ArduCam, SkyFox Labs

Four performance parameters are used to measure Sat-GPTs performance

6DOF Estimation Accuracy

How closely the satellite's estimated position matches known truth, using selenocentric coordinates.

$$PA = 1 - \left(\frac{\| E[P(x)] - P(x) \|}{\| P(x) \|} \right)$$

Estimated attitude & position = $(E(P(x)))$

Ground-truth attitude & position = $(P(x))$

Crater Identification Hit Rate

Measures the reliability of crater detection, scoring each crater based on identification accuracy

$$CIHR = \frac{\sum S_i}{N}$$

S_i = identification score (1 if correct, 0 if incorrect/unidentified)

N = expected number of craters in the expected field of view

Crater Recognition IoU

Calculates the average Intersection over Union (IoU) for all craters that should have been detected. Ranges from 0 to 1

$$\Pi = \frac{1}{N} \sum_{i=1}^N \pi$$

IoU ratio = π

Ground Station Interpretation

Overall performance of the system is computed by the average sum of the three key performance metrics outlined

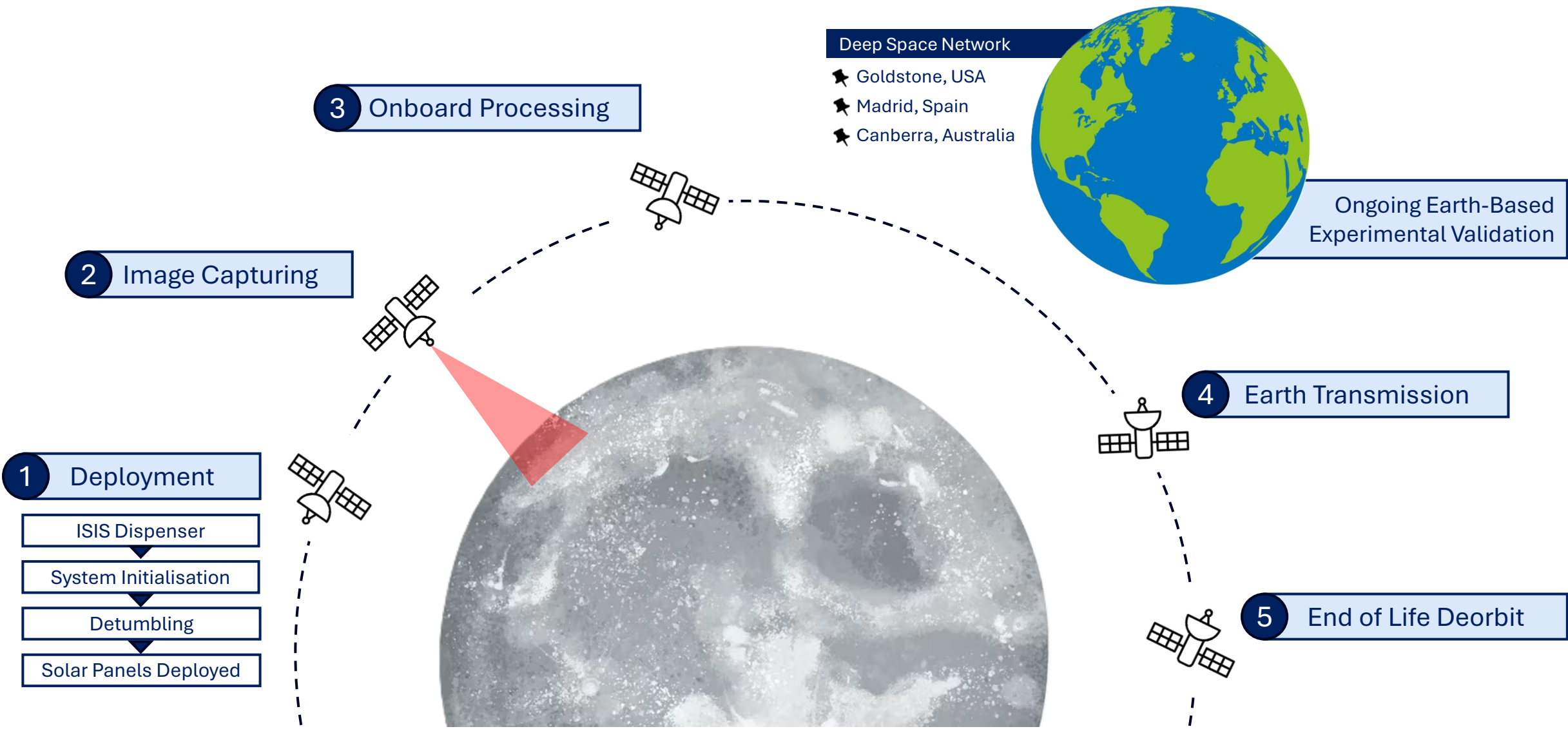
$$P(t) = \frac{PA(t) + CIHR(t) + \Pi(t)}{3}$$

Position Estimation Accuracy = $PA(t)$

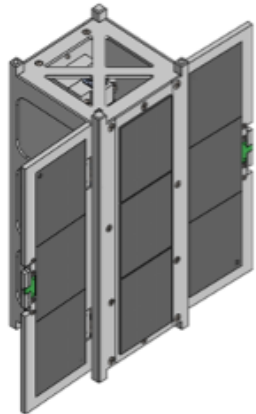
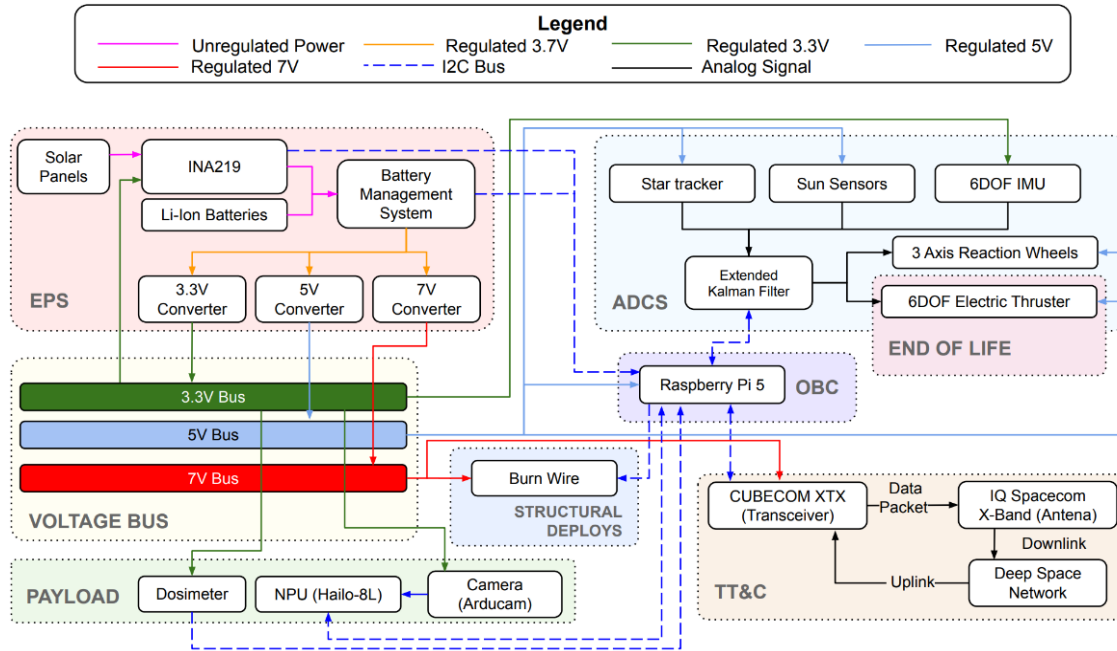
Crater Identification Hit Rate = $CIHR(t)$

Crater Recognition IoU = $\Pi(t)$

Concept of Operations



Satellite Design Architecture and Structure



Redundant and Modular:

Subsystems designed for independent operation to isolate failures

System-Level simulation and verification:

Ensure each objective's success criteria can be quantitatively measured and achieved.

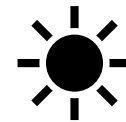
Thermal and structural design:

Maintain safe operations across -5 to 45°C thermal loads as well as all mechanical loads.

Chassis

- Housed by a 3U Aluminum 6061 chassis.
- The frame provides mechanical support for all internal and external components, maintaining the satellite's integrity during launch, deployment, and operation.
- Designed to withstand launch loads, vibration, and thermal stresses while minimising mass to meet CubeSat deployment standards.
- Includes dedicated mounting interfaces for subsystem integration and external connection points for the Deployable Solar Panel System.

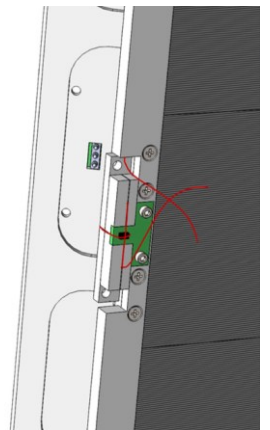
Solar Array



Deployable Solar Array allows for two extra panels to face sun at any given charge time



Pogo Pin Release Mechanism stows the deployable array during launch. Developed in-house, however will be outsourced COTS



Supporting Subsystems – OBC & ADCS

On-Board Computer (OBC)



Raspberry Pi 5 8GB RAM

The Raspberry Pi 5 was selected for the following reasons:

Computing Power

With 8GB RAM and four cores, the raspberry pi can run complex flight software and data IO simultaneously

Price

With 2 million units sold around the globe in 2024, this COTS component is priced at a very affordable 120 USD

Interfaces

A specialised M.2 PCIe cable allows for rapid data transfer to attached AI hardware, and 40 GPIO pins allow for many more connections under various communication protocols

Size

The entire board fits comfortably within a 1U satellite

Sources: Raspberry Pi

Attitude Determination and Control (ADCS)

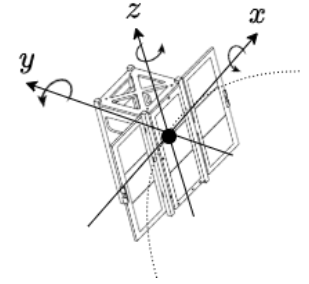
Requirements

Detumbling

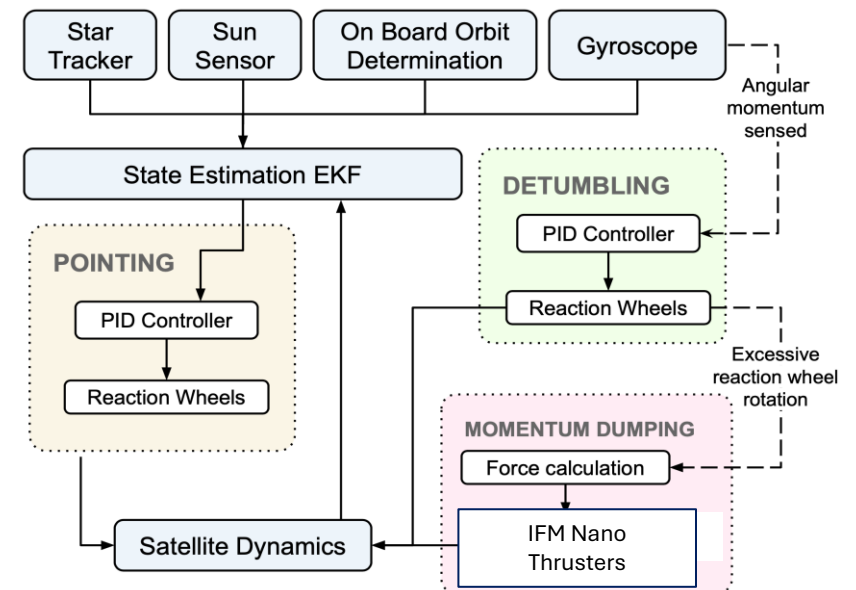
Pointing

Sun Pointing for Charging

Earth Pointing for Communications



ADCS integration and operations are visualised below:



Subsystem Design

Supporting Subsystems – EPS & TTC

Electrical Power System (EPS)



44.4 Wh Li-Poly Battery

Used to store power, supporting OBC, payload, camera and TT&C module

Parameter	Initialise	Detumble	Deploy	Standby	Point	Charge	Comms	NNP	Safe	EOL
Dosimeter (W)	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Thruster (W)	24	24	24	0	24	0	0	0	0	0
Camera (W)	0	0	1	1	1	0	0	0	0	0
Hailo-8L (W)	0	0	2	2	2	0	0	2	0	0
Raspberry Pi 5 (W)	5	5	5	2	5	2	5	2	2	2
Comms (W)	0	0	0	0	0	10	10	0	0	0
Total Consumed (W)	29.03	29.03	32.03	2.03	32.03	2.03	12.03	8.03	2.03	2.03
80% Efficiency (W)	36.29	36.29	40.04	2.54	40.04	2.54	15.04	10.04	2.54	2.54
Generated (W)	25.3	25.3	25.3	25.3	25.3	75.9	25.3	25.3	25.3	25.3
% Margin	-12.8	-12.8	-21	1147	-21	3641	110.3	215.1	1147	1147

All mission states after deployment observe a **positive power margin**, excluding **Point**

Demonstrates CNN can be run without concern of major battery drain

Sources: IQ Spacecom, Cubecom

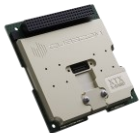
Telemetry, Tracking and Communications (TT&C)

Hardware:



IQ-Spacecom X-band Antenna

High performance X-band antenna for SmallSats



Cubecom XTX Transceiver

Designed for high-speed data downlinks for SmallSats

Freq Range

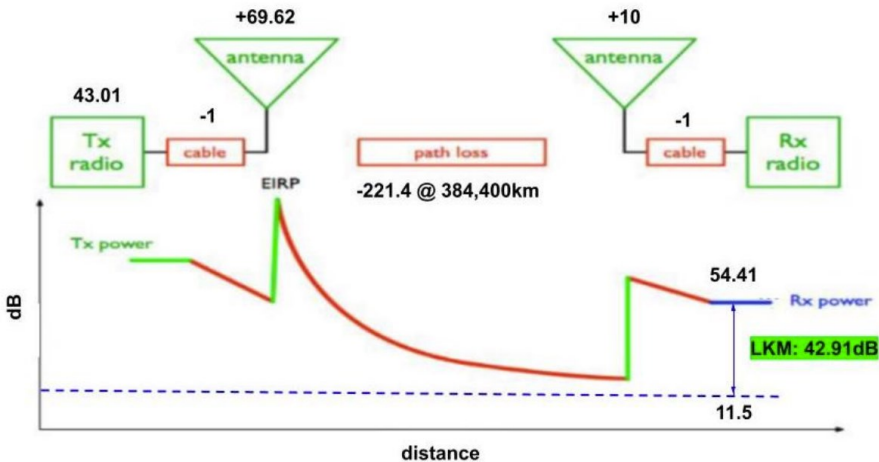
8-8.4GHz

Comms Relay

Deep Space Network

Data Rate

56kbps



With this setup, we can demonstrate the benefits of OBP:

Sending Processed Data

~ 7 seconds

Sending Raw Data

88 minutes

Organisational Approach & Timeline

Sat-GPT's Partnership with CUAVA

The Sat-GPT mission will be delivered through a **partnership** between **The University of Sydney** and **CUAVA**



USYD Student Team
CNN model development, subsystem prototyping, limited environmental testing, software development

Leadership: Mission Delivery, Payload, Software



CUAVA
Specialist testing facilities, Ground station infrastructure, Launch Heritage

Leadership: Bus Engineering, AIT, Mission Operations

Current Student Progress

Sat-GPT student team have already developed a low-cost **engineering model**.



Already Proven the CNN Concept
Although lacking a camera, the **crater detection CNN can run on the Hailo-8 and Raspberry Pi**, with limited power resources



Limited Resources
With a budget of only **\$1.3k USD**, the model proved **all software and ADCS requirements** for launch, with **in-house manufacturing**

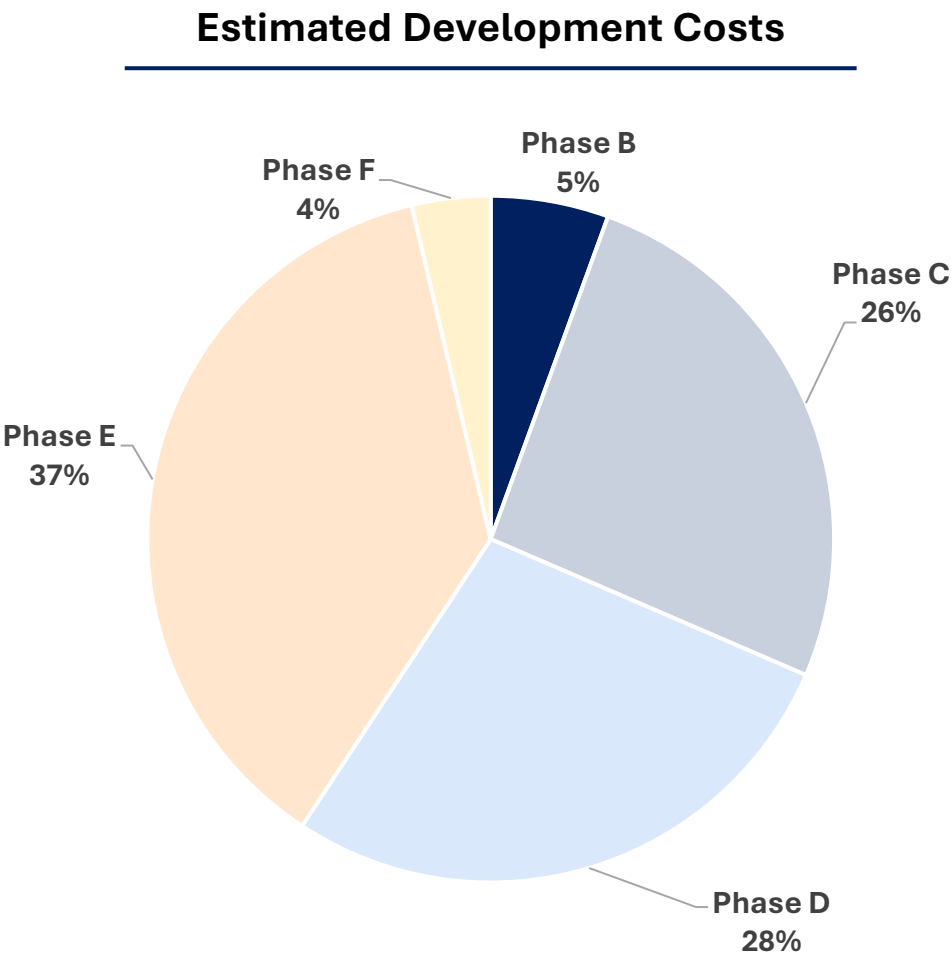


	2025				2026				2027			
Phases	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase A Concept & Prototype												
Phase B Preliminary Design & Team Expansion												
Phase C Detailed Design & Regulatory Prep.												
Phase D Assembly, Integration & Testing												
Phase E Launch & Operations												
Phase F Disposal & Close Out												

Implementation Plan

Estimated Budget

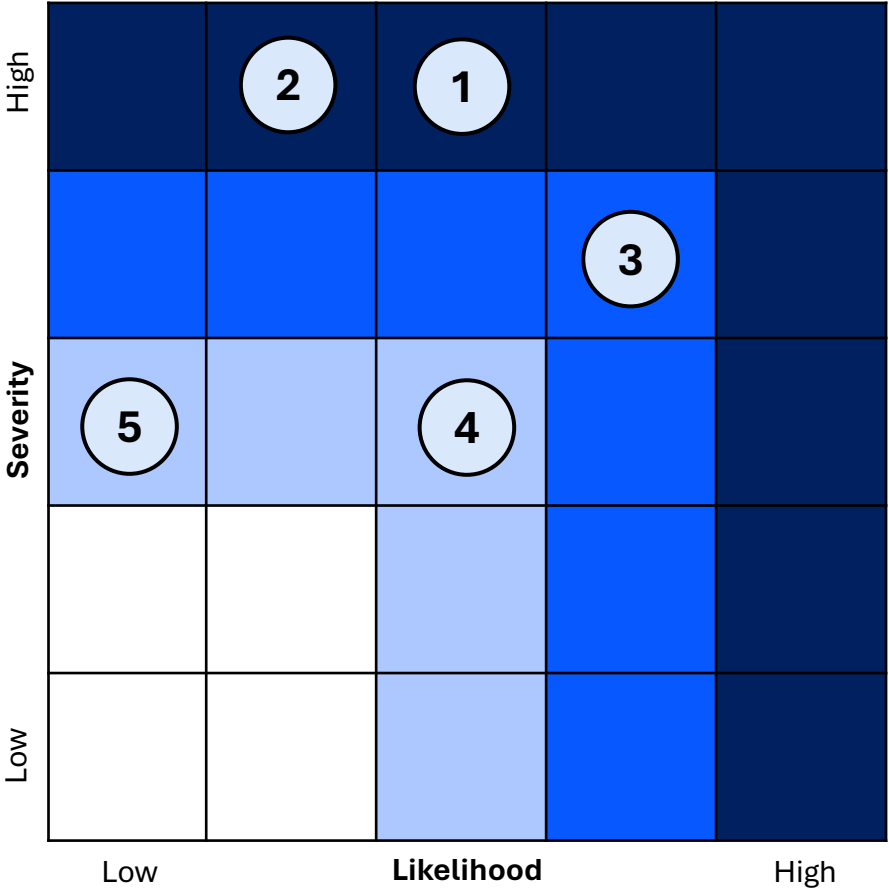
COSTING		
Phases	Scope	Est. Cost
Phase A Concept & Prototype	<i>Engineering Model – course funded</i>	\$1.3K
Phase B Preliminary Design & Team Expansion	Prototyping, simulation software, lab consumables, team expansion/consulting costs	\$100k – 200k
Phase C Detailed Design & Regulatory Prep.	COTS subsystem procurement (structure, OBC, payload, EPS, ADCS, propulsion, comms), spares	\$500k – 900k
Phase D Assembly, Integration & Testing	Environmental Testing (vibration, TVAC, radiation), cleanroom access, insurance & logistics	\$600k – 900k
Phase E Launch & Operations	Ground station use, licensing, logistics, student-led operations	\$1M per year + ~\$5M Launch
Phase F Disposal & Close Out	Controlled impact, passivation, reporting, dissemination	\$50k – 100k M
Total <i>(without Launch Costs)</i>		\$2 M
Total		\$7 M



Note: Launch Costs have been excluded as this is independent of development/team costs

Risk Matrix

	Threat	Mitigation
Technical	1 Radiation-induced failures in key operating infrastructure	Radiation hardening, use of error correcting code (ECC), watchdog timers and reset logic
	2 ADCS underperformance in lunar orbit	Hardware-in-the-loop testing, conservative control margins
Programmatic	3 Limited funding availability	Early grant applications, staged fundraising, industry partnerships
	4 Delays in hardware procurement or testing	Use of COTS components, multiple suppliers, schedule buffers
	5 Regulatory/licensing delays (frequency allocation, export control)	Early engagement with ACMA and ITU, leverage university heritage from past CubeSat missions



Appendix A

Link Budget

Parameters	Dist (km)	Data Rate (kbps)	Modulation	EIRP (dBW)	Gain (dBi)	Noise Temp (K)	FSPL (dB)	Eb/N0 Req (dB)	Eb/N0 (dB)	Link Margin (dB)
Uplink	388400	56	QPSK	111.6	9.81	580	-221.4	11.5	54.4	42.9
Downlink	388400	56	QPSK	11.8	72.6	280	-222.7	11.5	19.2	7.7

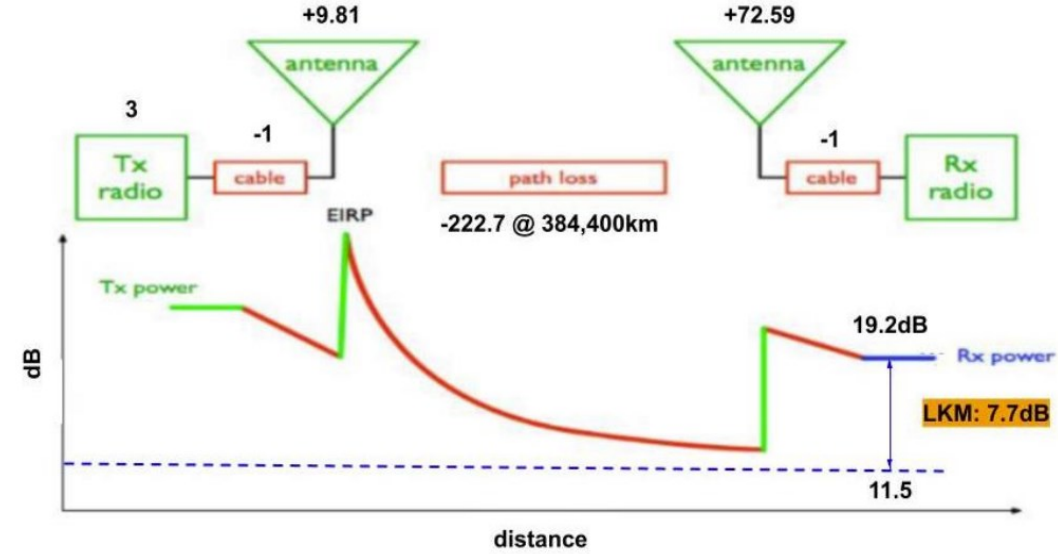
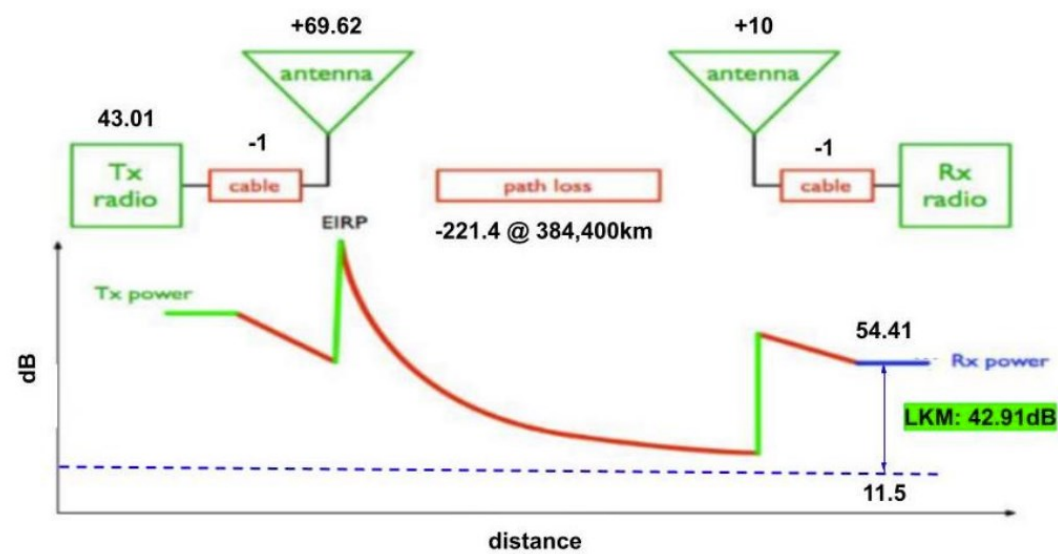


Image Transmission

Parameter	Value
Resolution	4056 x 3040
Bits / pixel	24 (8 . RGB)
Bits / image	295925760
Baud Rate (bits / second)	56000
Transmission (s)	5284

Payload Data

Parameter	Value
Performance Parameter	XX.XXXX% (20 bits)
Bits per performance param	20
# Performance parameters	4
Performance bits	80
Dosimeter Upper Bound	900,000
Bits Required	20
Total Bits	100
Baud Rate (bits / second)	56000
Transmission (s)	6.43

Orbit Description

Parameters

Parameters:

- Circular 100km low lunar orbit, inclined at 95°
- Right Ascension of Ascending Node of 200°
- 54% visibility during orbit from chosen ground stations
- 280 unique visibility periods averaging 1hr and 20 minutes

Mission Relevance

- Orbit maximises CubeSat lifetime (12 months) as lunar mascons can lead to rapid orbital decay and/or procession.
- Post-mission completion or in the event critical subsystem failure, an end-of-life plan shall be implemented.
- Thrusters shall be used to perform a controlled de-orbit maneuver, ultimately achieving impact at an optimum site on the lunar surface.
- CubeSat will otherwise naturally deorbit after approximately 12 months due to decay.

Determination

Establish the **quaternion attitude** of Sat-GPT at the **current** time.

COTS ADCS Sensor Suite

- 3 DOF IMU with an accelerometer and gyroscope, a sun sensor and an on-board star tracker.

Attitude Determination Algorithm Sequence

- QUEST algorithm for initial static attitude estimate.
- Continuous attitude estimates determined with an EKF which fuses sensor and gyroscopic data.

Control

Actuate **rotation** to align Sat-GPT's attitude with the **requirements** of the current mission phase.

Actuator Suite

- Three-axis reaction wheels (manufactured in house), electric propulsion thrusters (IFM Nano Thruster)

Pointing Control

- PID controller software induces reaction wheel rotation in response to quaternion attitude error .

Detumbling Control

- Detumbling PID controller counteracts angular rotation with reaction wheel rotation. Momentum offsetting via IFM Nano Thrusters.

Sources: Raspberry Pi 5 (2023)

Raspberry Pi 5 Specifications

Specification	Value
CPU	2.4GHz Quad-Core ARM
RAM	8GB
Storage	64GB
Operating Voltage	5V
Power Consumption	2.5-4.0W
Interfaces	40-pin IO: I2C/PWM/SPI
Dimensions	85.6mm x 56.5mm
Weight	46g
OS	Pi OS (Debian) / Ubuntu (Linux)
Price	120 USD

Telemetry, Tracking and Communications Specifics

Key Components

Cubecom XTX X-Band Transceiver
IQ Spacecom X-Band Antenna

Subsystem Analysis

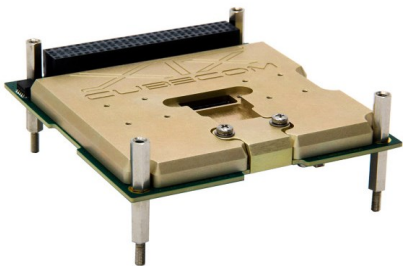
- Link budget demonstrates robust margins for both uplink and downlink
- High-gain DSN dishes and low-noise receivers enhance signal quality
- Ensures CubeSat maintains strong, uninterrupted communication with Earth during the 280 unique visibility periods averaging 1hr and 20 minutes

Component Usage

- Allow for reliable transmission of data to DSN stations over vast lunar distance.

Antenna Specifications

Specification	Value
Frequency	8.025-8.4 GHz 7.145-7.250 GHz
Max Gain	10dBi
Impedence	50 Ohm
RF Power Output	<2 W
Temp Range	-30 to 60 °C
Dimensions	60 x 40 x 1.8 mm^3



Transceiver Specifications

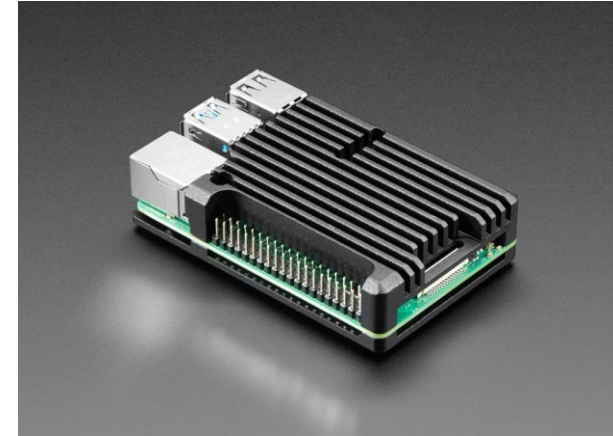
Specification	Value
Frequency	8.025-8.4 GHz
Input Voltage	7-20 V
Spurious Response	<-60 dBc
Channel Spacing	1 MHz
RF Power	<2 W
Dimensions	96 x 90 x 13 mm^3
Mass	120g
Symbol Rate	2.5 - 25 Msps

Sources: IQ spacecom X band antenna datasheet, CUBECOM Datasheet XTX

Thermal Specifics

Passive Control Methods

- Multilayer Insulation (MLI) reduces heat loss during eclipse.
- High-emissivity coatings & thermal tape assist heat radiation from the NPU and OBC.
- Battery insulation & heater patch prevent temperatures from dropping below 0 °C in long eclipses.
- NPU and Raspberry Pi thermally bonded to a radiator panel to dissipate excess heat.
- Thermal tape and aluminium heat sink on Pi 5 draw heat to the chassis.
- Thermal analysis confirms all components remain within operational limits.
- Lithium-ion batteries, the most temperature-sensitive, stay within –5 °C to 45 °C under both eclipse and sunlight conditions.



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Sources: <https://www.adafruit.com/product/4341?srsltid=AfmBOopbs8XnOz6hyup5e-cAGzaraUwOWF1CvgenK0td5ONrcolfowL8>, https://www.kaneka.co.jp/en/business/qualityoflife/eit_005.html

Crater Detection (CNN): Open-Source Solutions

Existing Open-Source Solutions:

1. [PyCDA](#) (Crater Detection Algorithm) - Michael Klear
2. [Craterpy](#) - Hawai'i Institute of Geophysics and Planetology
3. [DeepMoon](#) - Department of Astronomy & Astrophysics – University of Toronto

Appendix H

Power Budget

Component	Qty	V_{in} (V)	P_{max} (mW)	P_{nom} (mW)	Launch	Satellite Operating Modes (% of Nominal Power)						
						Detumble	Deploy	Standby	Point	Charge	Comms	Process
OBC												
Raspberry pi 5 8GB	1	5	5000	3500	0	100	100	100	100	100	100	100
3-Channel Voltage and Current Sensor INA3221	1	3.3	1.75	1.16	0	100	100	100	100	100	100	100
8-Channel ADC ADS7830	1	5	0.3	0.18	0	100	100	100	100	100	100	100
4-Channel ADC ADS1115	1	3.3	0.3	0.18	0	100	100	100	100	100	100	100
Thermistor NTCLE100E3	3	3.3		1.089	0	100	100	100	100	100	100	100
Payload												
Hailo 8L AI Accelerator	1	5	4000	2000	0	0	0	0	0	0	0	100
ADCS												
Geared Motor with Encoder FIT0483	3	7.5	2000	1020	0	0	0	0	100	0	0	0
Controlled Thrust	1	7.5	6000	4000	0	100	0	0	0	0	0	0
Motor Driver DRV8835	2	7.5		12.5	0	0	0	0	100	0	0	0
Photodiode BPW34	5	5		<0.01	0	100	0	0	100	0	0	0
IMU ISM330DHCX	1	3.3		<0.01	0	100	100	100	100	100	100	100
Structures												
Solar Panel Deploy Mechanism	2	7.5		11960	0	0	100	0	0	0	0	0
Comms												
Cubecom XTX Transceiver	1	7.5	15000	12500	0	0	0	0	0	0	100	0
IQ Spacecom X-Band Antenna	1	/		5	0	0	0	0	0	0	100	0
EPS												
3.3V Buck Converter D36V6F3	1	/		198	0	100	100	100	100	100	100	100
5V Boost Converter U1V10F5	1	/		150	100	100	100	100	100	100	100	100
7.5V Boost Converter U3V16F7	1	/	350		0	100	100	100	100	100	100	100
Battery Charger ADA259	1	/	10	0.75	100	100	100	100	100	100	100	100
Consumed Power (mW)					150.75	4373.86	15811.36	3851.36	4883.86	3851.36	16356.36	5851.36
Consumed Power at 80% Efficiency (mW)					188.44	5467.32	19764.20	4814.20	6104.82	4814.20	20445.45	7314.20
Power Generated (mW)					0	1564	1564	6255	3128	6255	3128	6255
Power Budget Margin (%)					0.00	-249.57	-1163.70	23.03	-95.17	23.03	-553.63	-16.93