

BIRDS Bus Open Source #16

AN OVERVIEW OF THE GUARANISAT-2 PROJECT




Date: July 12th, 2023

Meeting: via ZOOM

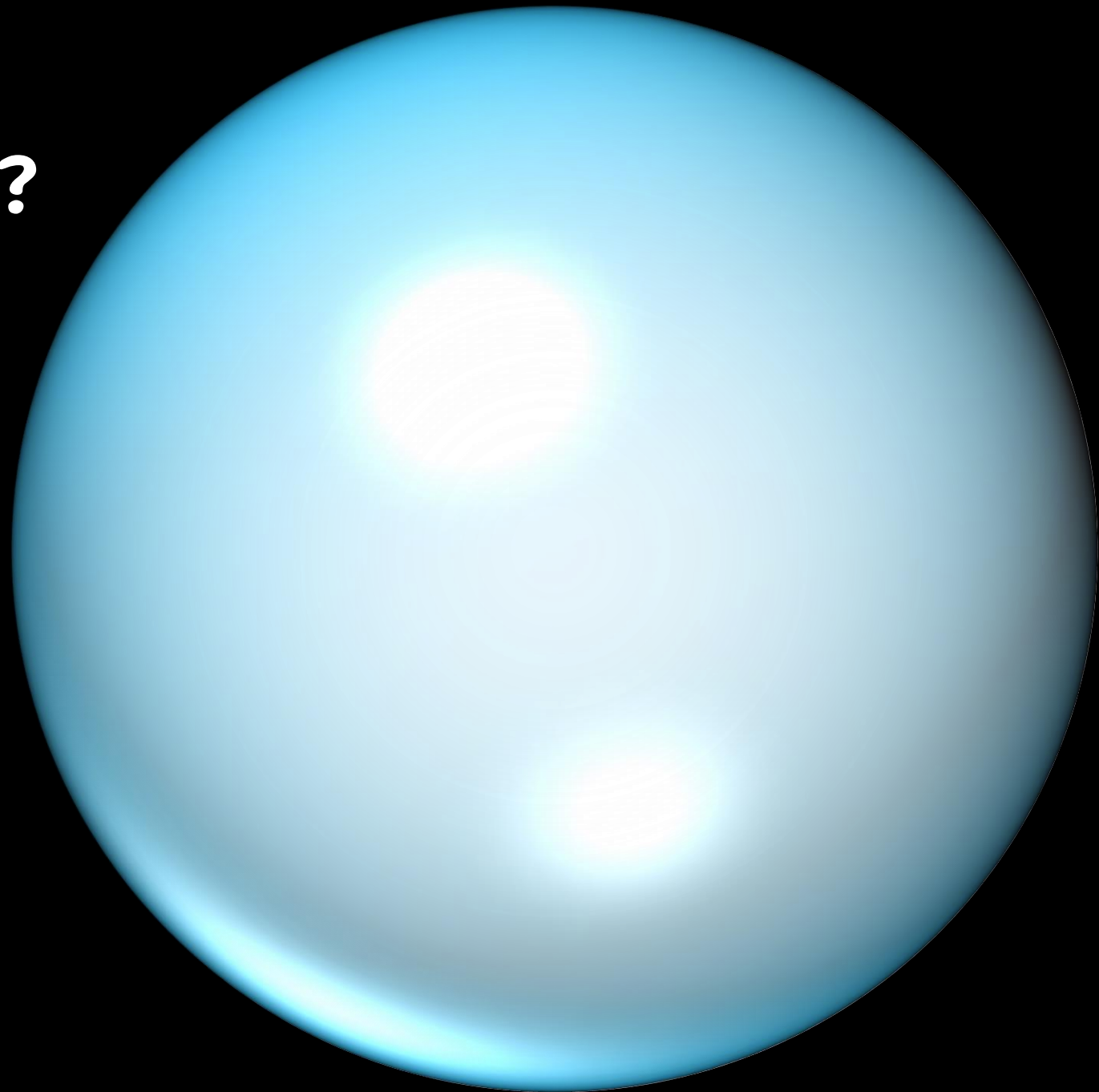
Time: 22:00 (JST) / 09:00 (UTC-4)



Outline

-  Paraguay – brief presentation
-  SPACElab
-  GuaraniSat-2 project overview

Where's
Paraguay?



Where's
Paraguay?



Where's
Paraguay?



AFRICA

Where's
Paraguay?



South
America

Where's
Paraguay?



At the
heart of
South America

Where's
Paraguay?

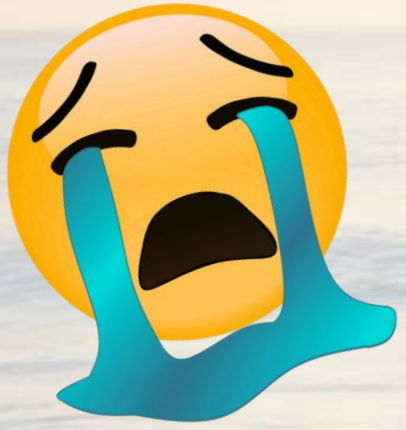


At the
heart of
South America

Where's
Paraguay?



At the
heart of
South America



HUG ME.
I NEED TO GO TO
THE BEACH.



One of the biggest natural
freshwater reservoir

Area: ~ 1.196.755 km²



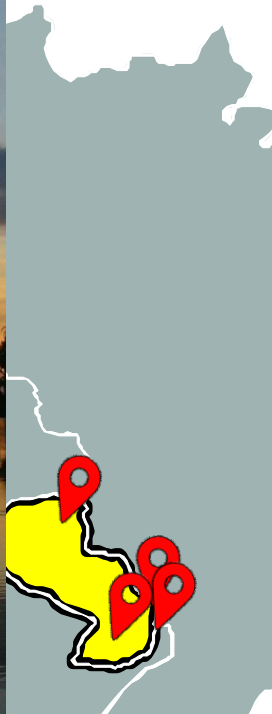
Paraguay: 72.540 km² of 406.752 km² (~18%)

CHACO-PANTANAL RESERVE, PARAGUAY



Wetland of International Importance

© Saul Arias



Itaipú Dam

(ita ipu = stone + [that] sounds)



3 Kandú Hill

Kandu = bump

(842 m – highest peak)



BienvenidoaParaguay.com

Iguazú Falls
(y guasu = water + big)

Fun fact: different emblems on the front & back sides

Front



Back



The only one in the world?





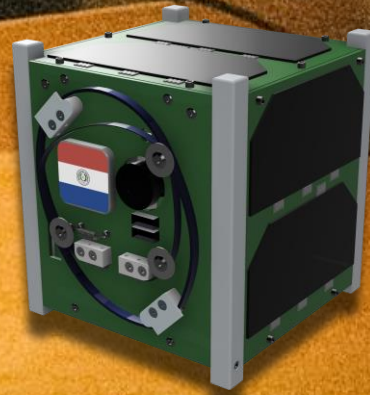
What is the story about?

OCTOBER 2018

Adolfo



Anibal





GuaraniSat-1



Tsuru



Maya-2

BIRDS-4 Project:

Build the first satellite for Paraguay while improving standardized bus system for future missions and giving continuity to the development of satellites for Japan and the Philippines.

BIRDS program Statement



Make the first step towards creating an indigenous space program by designing, building, testing, launching and operating, the first satellites for participating nations



Therefore, the mission success criterion is to have *the second satellite built by the former BIRDS graduates* after their return to the home countries.



**We packed as
much as we could!**

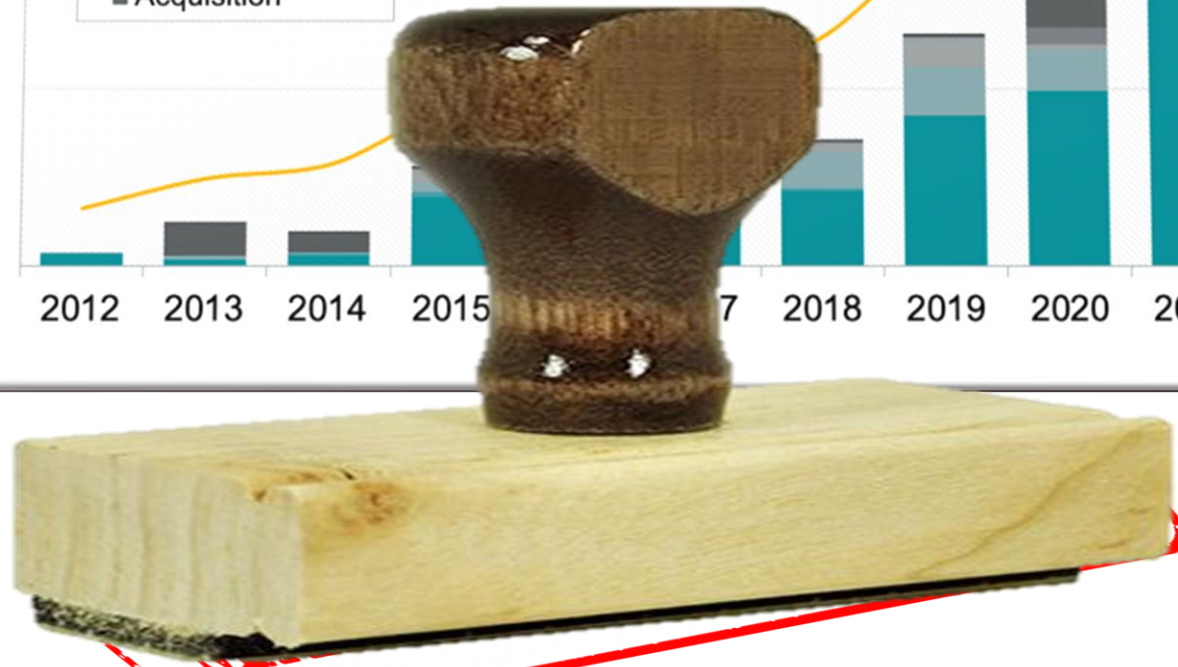
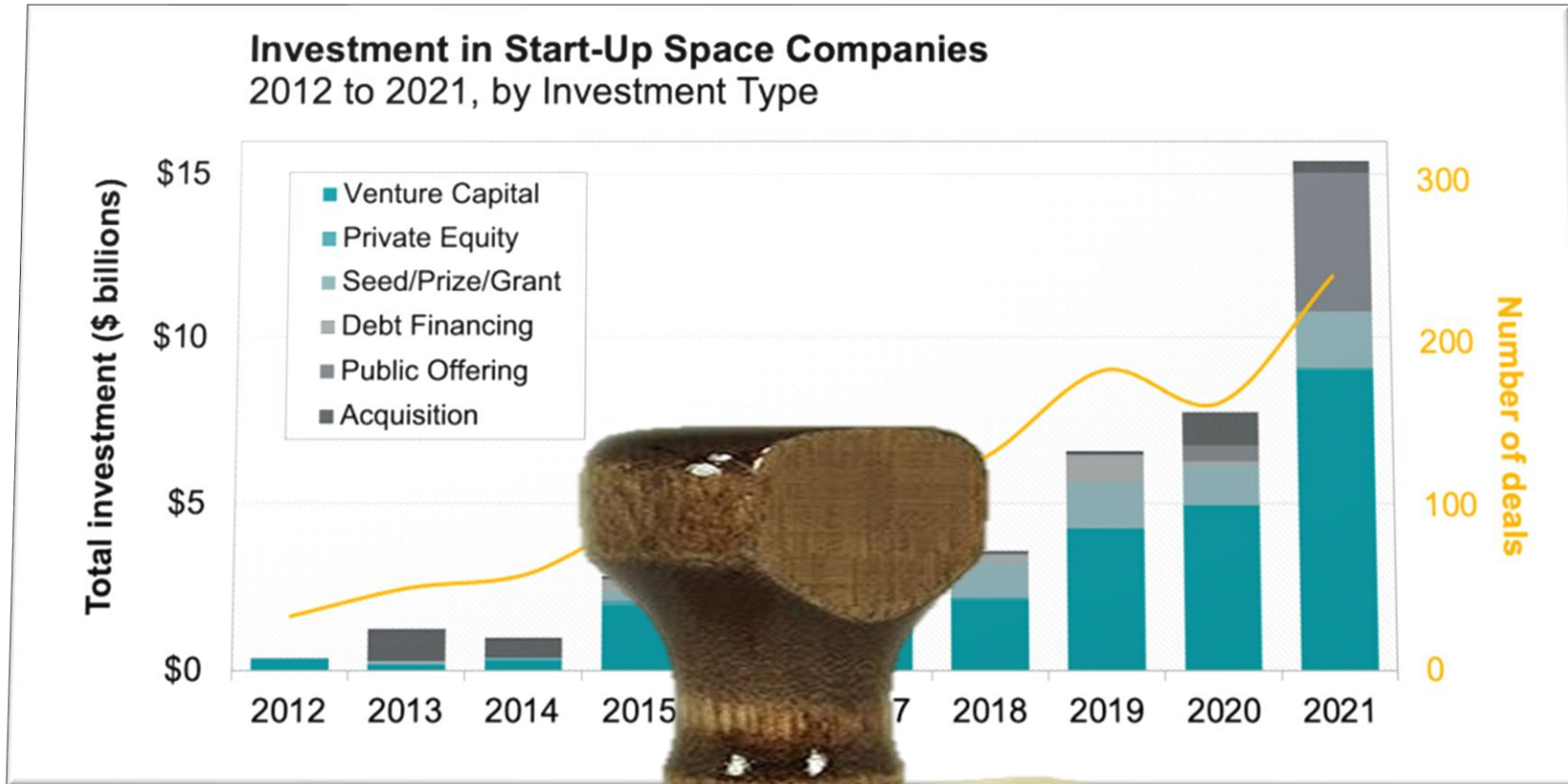
*(The friends we made,
The most valuable!)*

Alone is a big challenge!

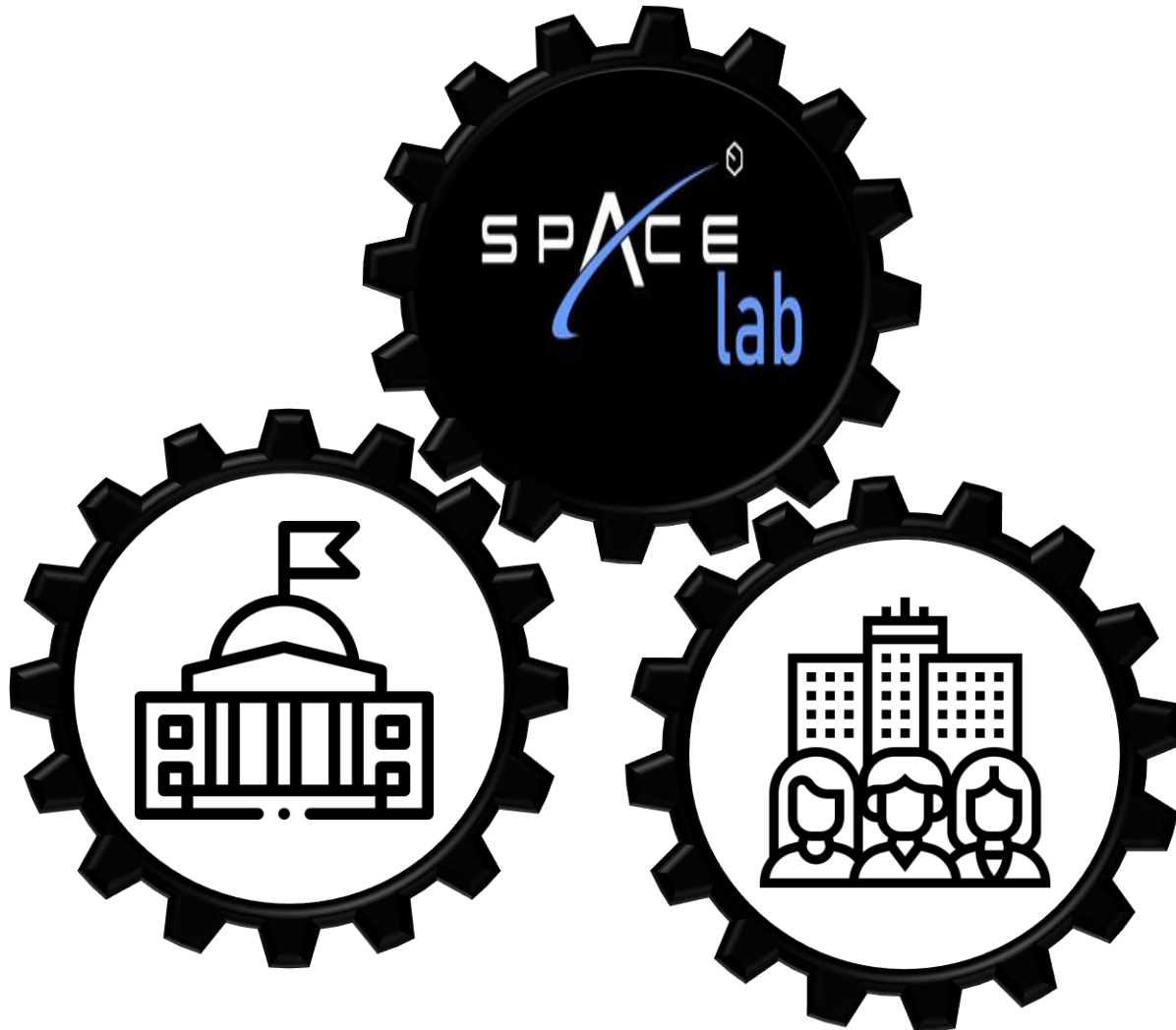
- **Regulations**
- **Politics**
- **Logistics**
- **Market**
- **And So on!**



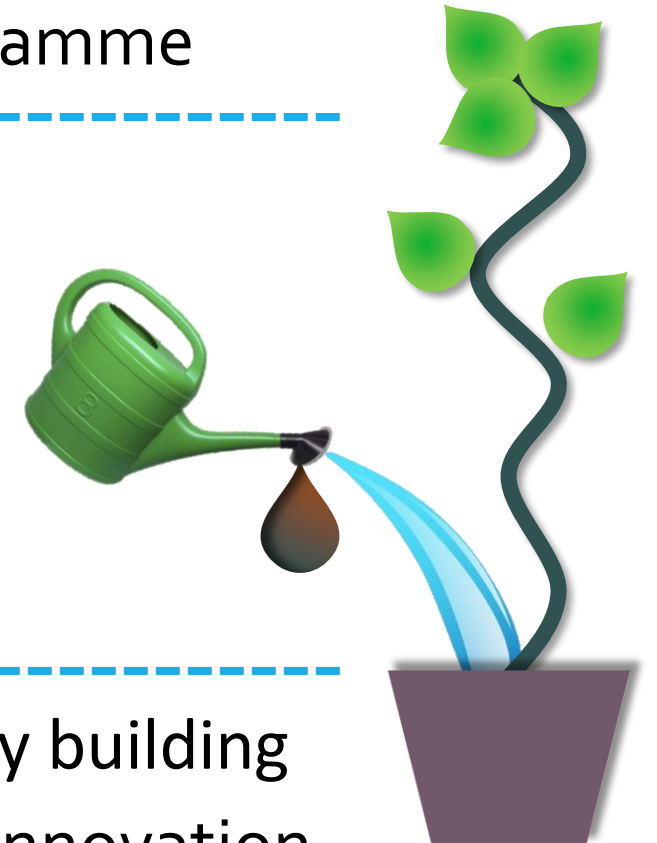
There is a big market out there!



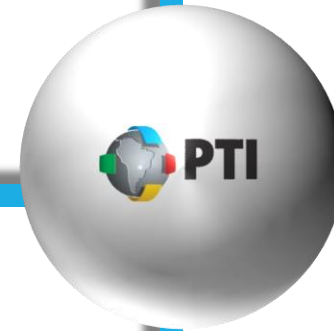
Encourage **synergy** among Universities, Companies, and the State.
(International collaboration)



Sustainable programme



- Capacity building
- R&D + innovation



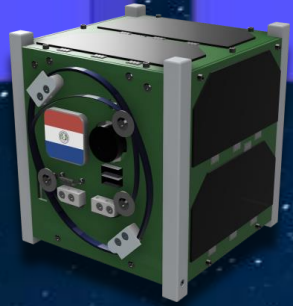
To address future initiatives collaboratively while avoiding duplication of efforts and infrastructure to maximize human, technical, and financial resources...



Space Systems Laboratory Network

Roadmap

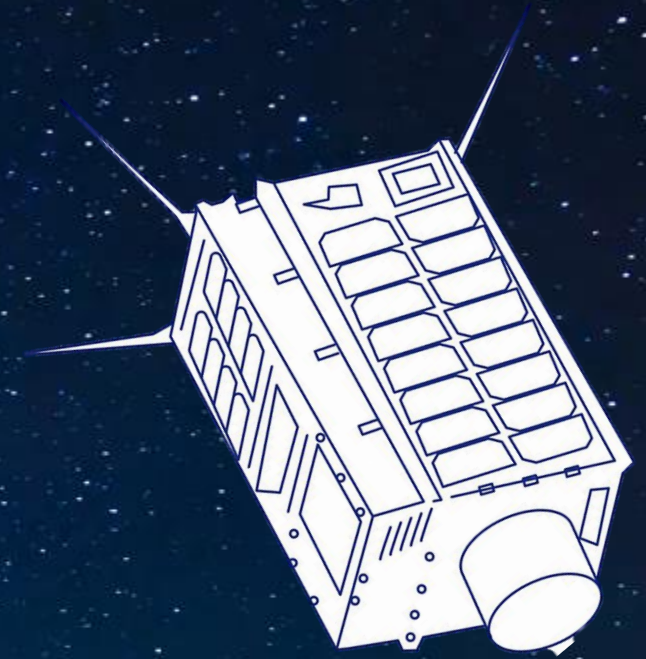
3U and 6U



2020~



3U
GSD = 70m



Microsatellites
GSD = 1m

PAST

PRESENT

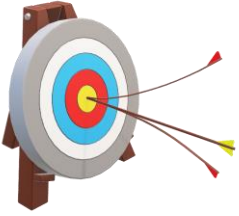
FUTURE

GuaraniSat-2

A GENERAL OVERVIEW

Project Timeline

- Official Kick off: May 2023
- Mission design review (MDR): July 2023
- Preliminary design review (PDR): December 2023
- Critical design review (CDR): June 2024
- Flight Readiness Review (FRR): February 2025
- Satellite delivery: May 2025
- Launch: August 2025
- Deployment: November 2025
- Operation: December 2025



Main objectives:

1

Promote space capacity-building through a Project Based Learning approach

2

To design, build, test, launch and operate Paraguay's second satellite

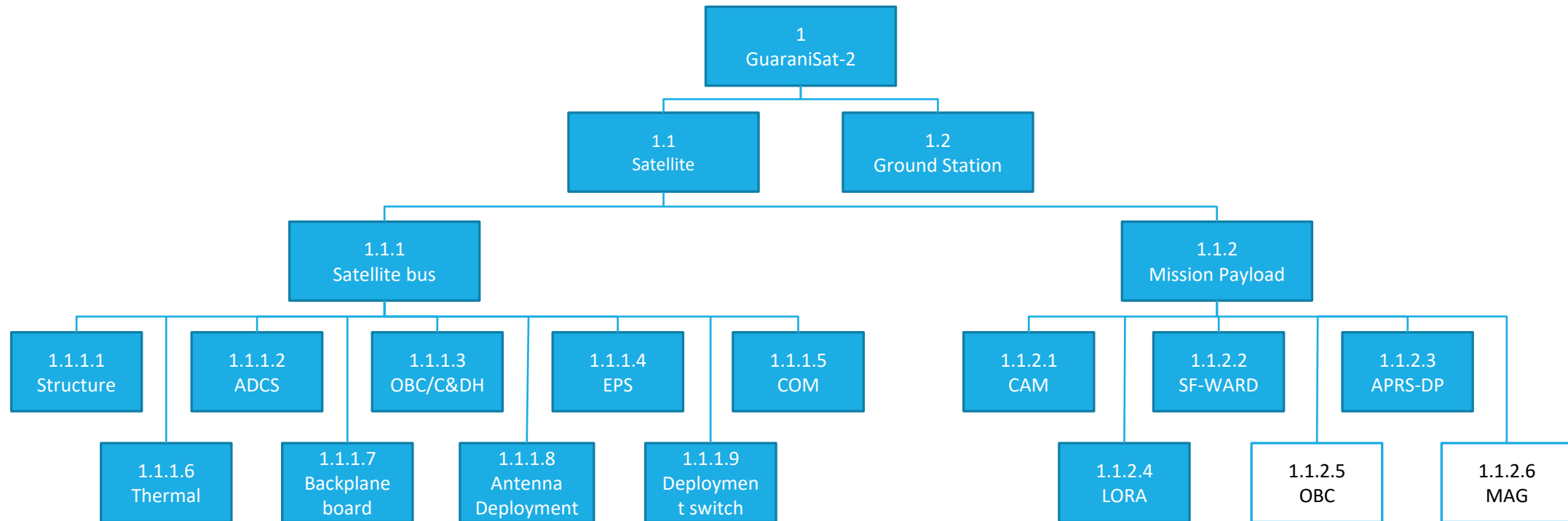
3

To give continuity to two missions; Store & Forward (SF-WARD) and Imaging Mission (CAM)

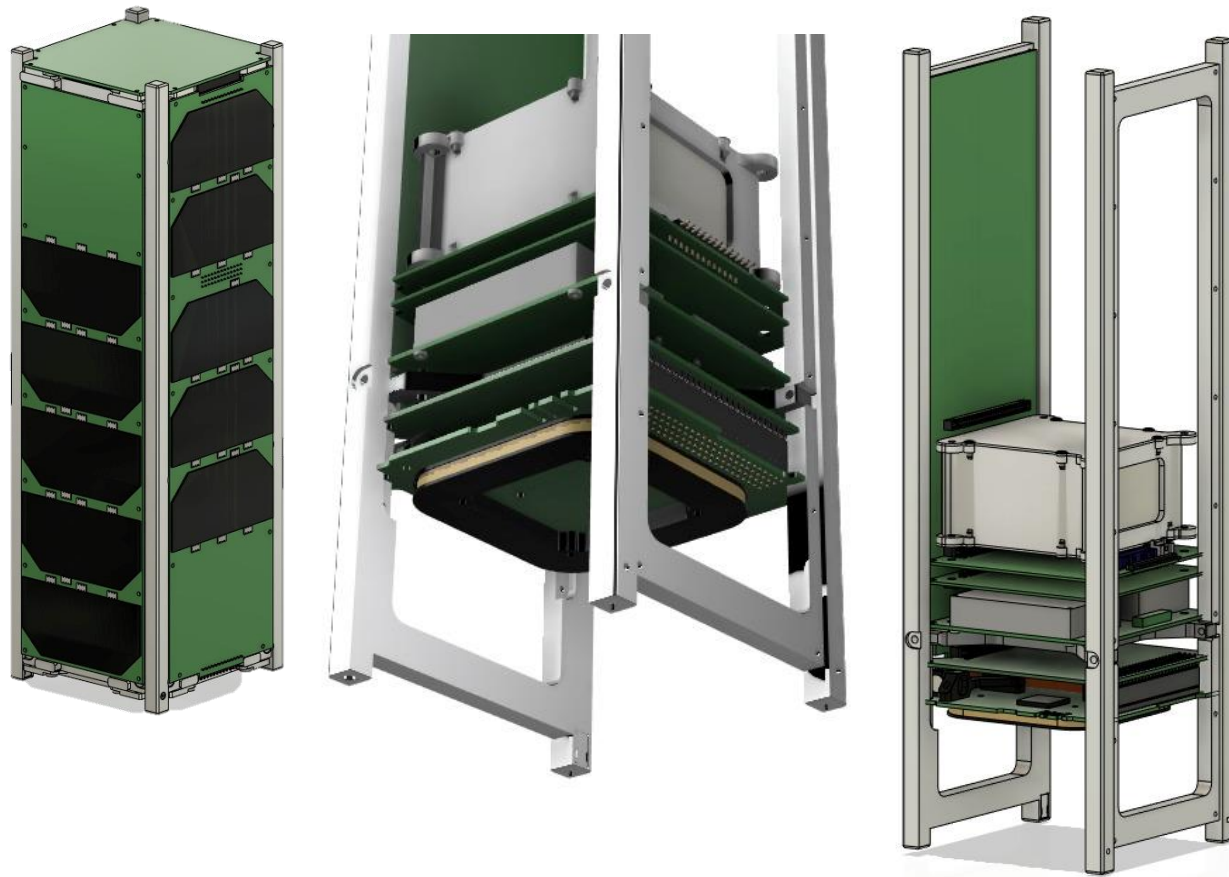
4

To serve the Amateur radio community with APRS-Digipeater mission (APRS-DP)

Product Breakdown Structure



Satellite Main Bus: BIRDS Open-Source

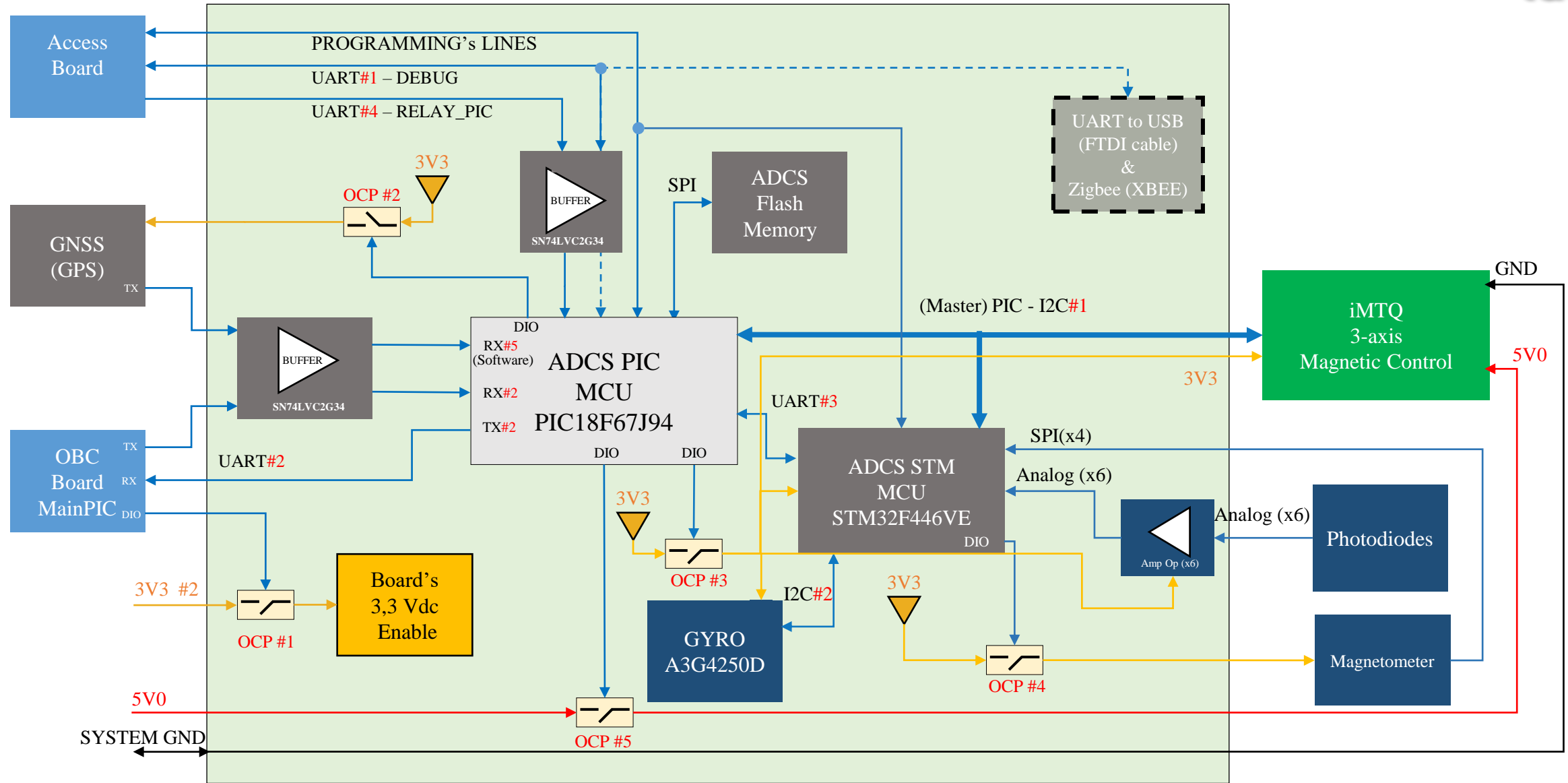


Main Bus will be provided by AEP

- OBC/EPS board
- EPS₁
- COM Transceiver
- iMTQ 3-axis magnetorquers

- Structure
- Adapter boards
- Backplane

ADCS Adapter Board



You might consider:

- Use just one value for bulk capacitors and then make associations (series or parallel).
- Always check capacitor voltage derating before purchasing.

Use SimSurfing >

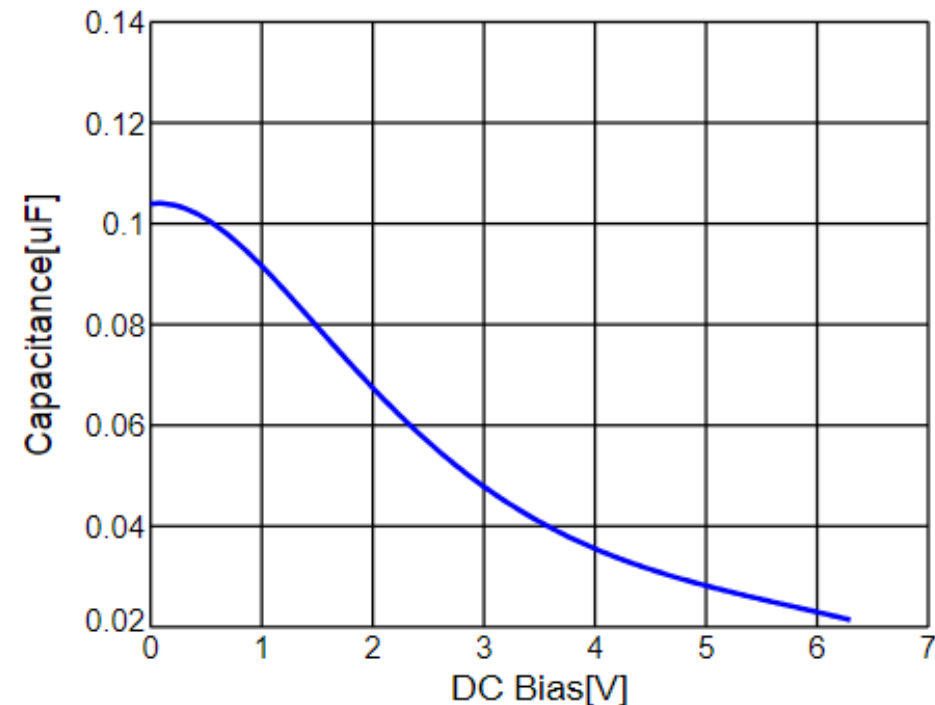


> **SimSurfing online version**

Go to the online version of SimSurfing.

> **SimSurfing downloadable version**

Learn about the downloadable version of SimSurfing you can use offline.



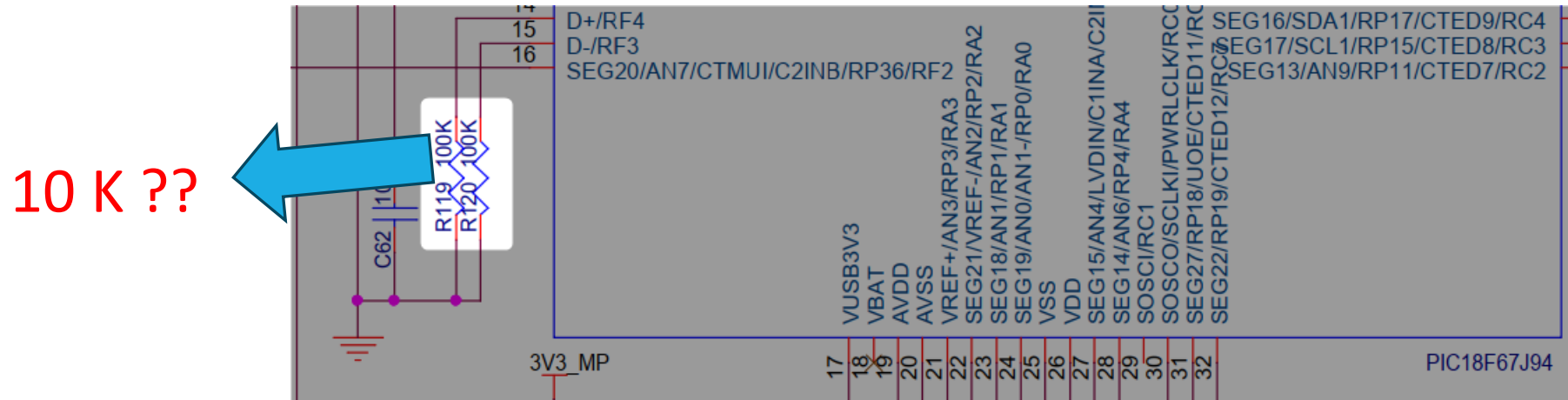
<https://www.murata.com/en-us/tool/simsurfing>

In Production

GRM022R60J104KE15, C-DC bias, capacitance, 25.0degC, AC0.5Vrms

You might consider:

- Replace these two pull-down resistors for a more common value.



Helps in keeping a consolidated BOM (*bill of materials*) !!

You might consider :

- Follow Micron's flash memory guidelines.

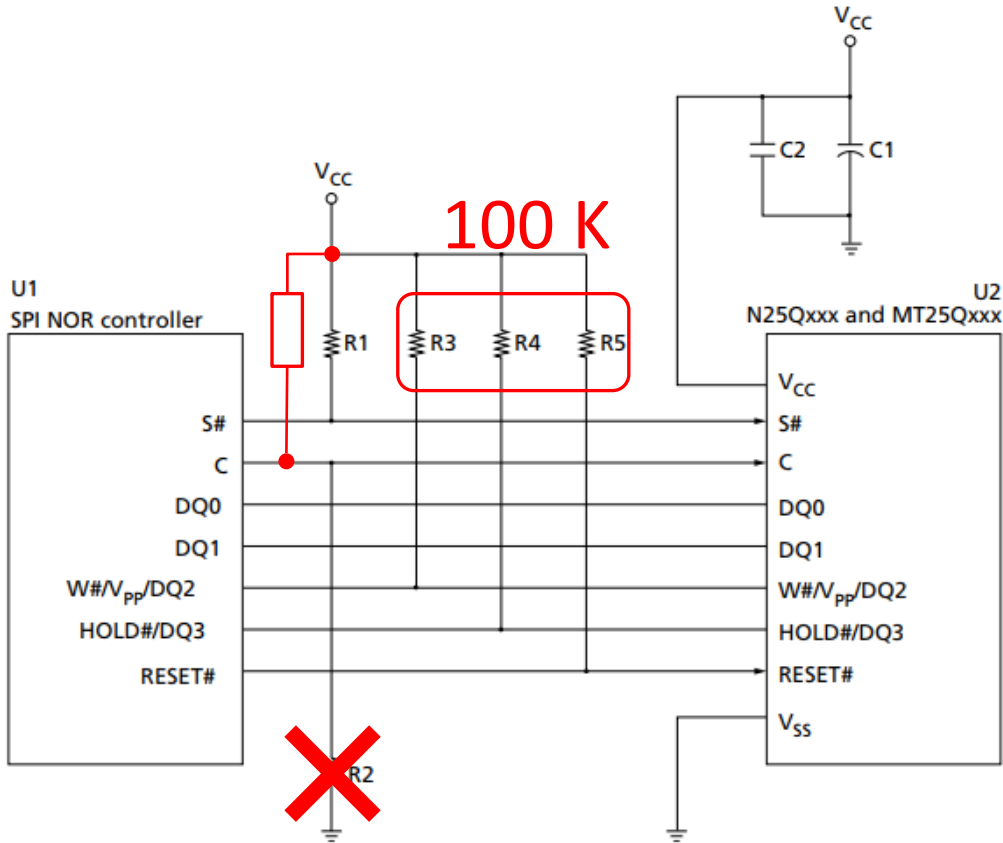
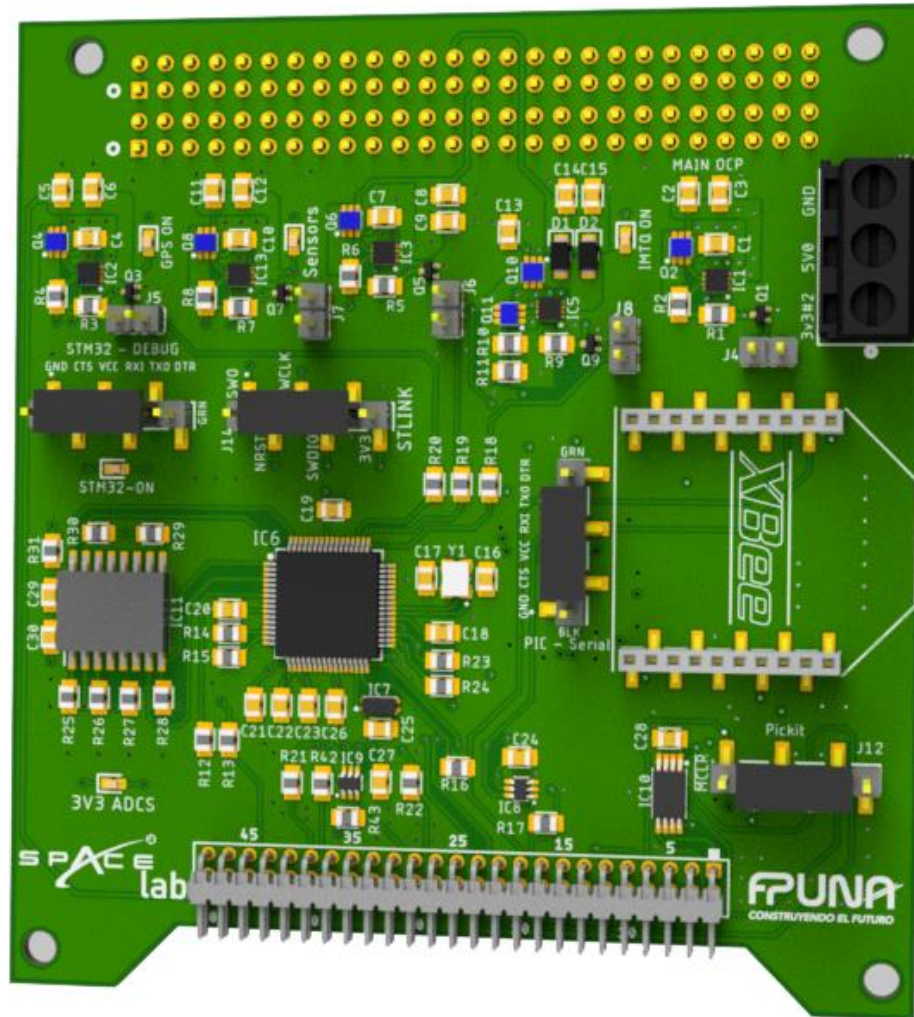


Table 1: Recommended Resistor Terminations

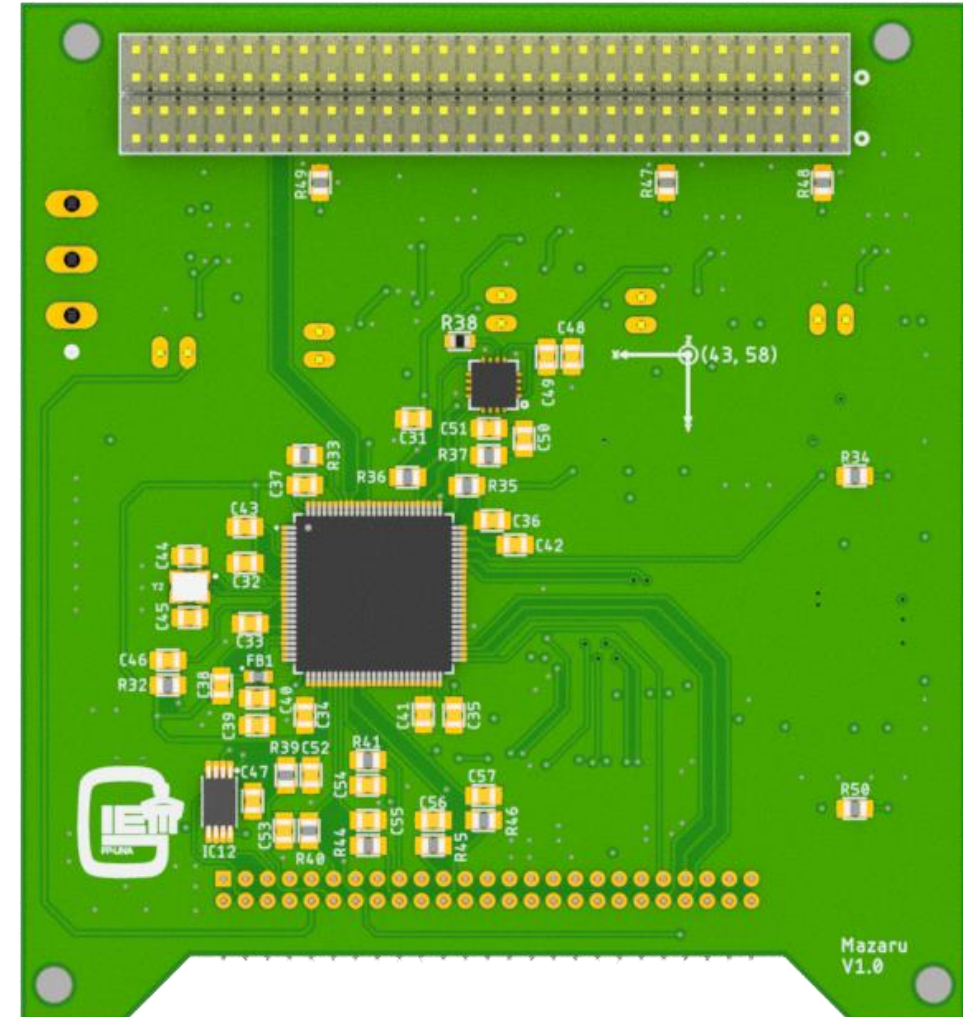
Parameter	Symbol	Min	Max	Recommended	Unit	Description
S# pull-up resistor	R1	4.7	50	10	KΩ	Prevents bus floating
CLK pull-down resistor	R2	47	500	100 50 K	KΩ	Ensures that S# and CLK are not HIGH simultaneously and that ^t SHCH is met.
W# pull-up resistor	R3	4.7	50	10	KΩ	Prevents bus floating
HOLD# pull-up resistor	R4	4.7	50	10	KΩ	Prevents bus floating
RESET# pull-up resistor	R5	4.7	50	10	KΩ	Prevents bus floating
CLK/Control/DAT impedance	-	45	55	50	Ω	Impedance match: Final manufacturing value
V _{CC} capacitor value	C1, C2	3.3 + 0.01	10 + 0.22	4.7 + 0.1	μF	Decoupling capacitor should be connected as closely as possible to V _{CC} and V _{SS}

ADCS Adapter Board

TOP VIEW



BOTTOM VIEW

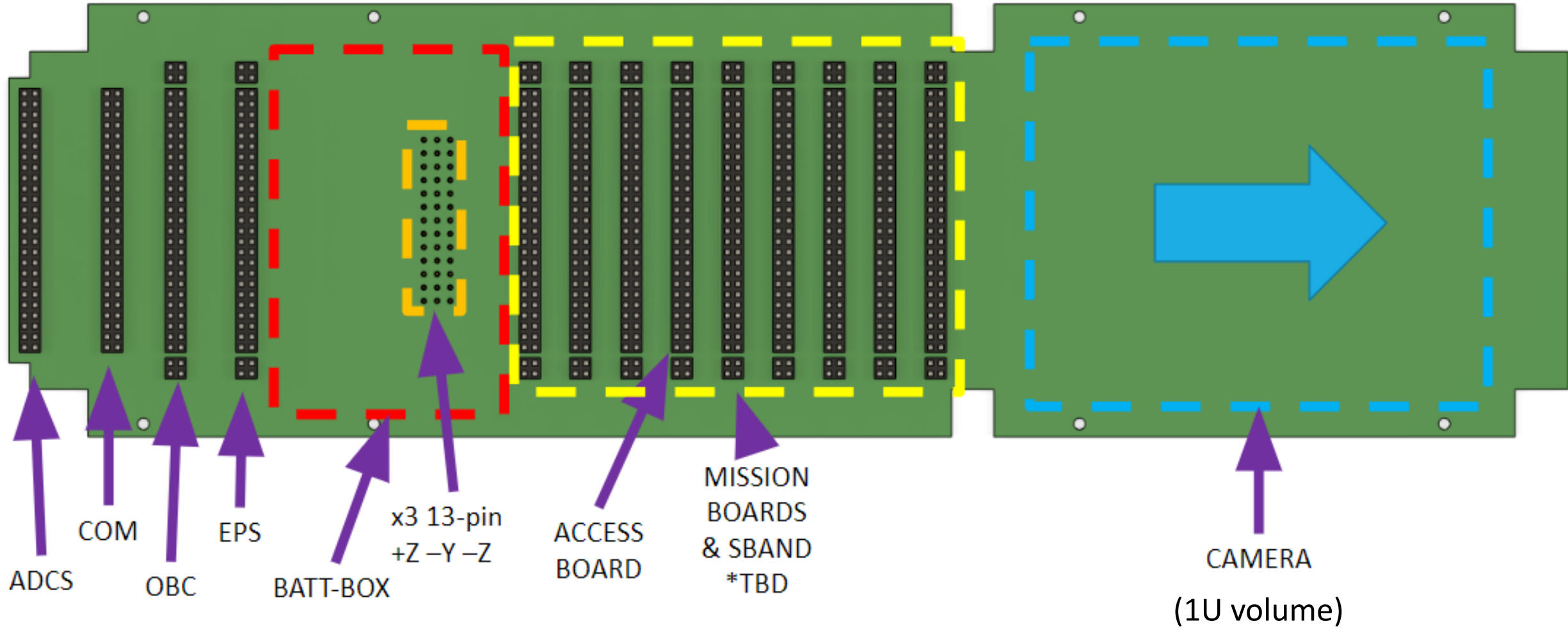


Final recommendations → peripherals' flexibility (SPI, USART by hardware)

GuaraniSat-2

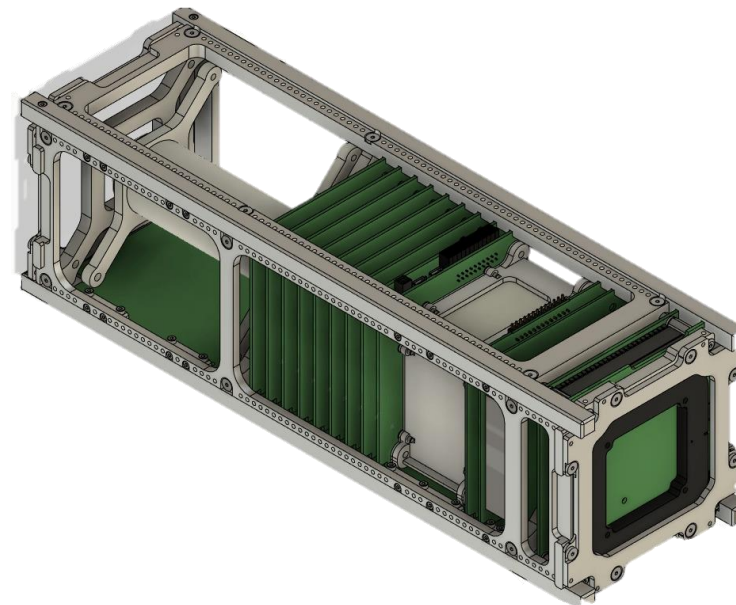
A SUMMARY OF MISSIONS

BACKPLANE (BPB)



MISSIONS

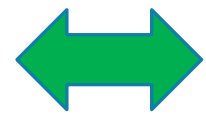
- Camera
- APRS-LoRa (*checking regulations*)
- On-board Computer testing (*AEM*)
- Image Classification Unit
- Meteorological mission
- Others



CAM MISSION - Background

“ Design and development of the **camera mission** for the **GuaraniSat-2** applied to **forest observation** promoting the **creation of capacities** in **space systems** ”

(Southern Cone University of the Americas)



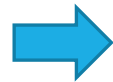
(National Council of Science and Technology)



(Considerable amount Can be obtained)

CAM MISSION - Background

During 7th International BIRDS Workshop (PhilSA - KYUTECH), we met Prof Juang.



The aim is to jointly develop the camera payload.



Jyh-Ching Juang  

Also published under: J. C. Juang, Jyh Ching Juang, J. -C. Juang, Jyh-Chin Juang

Affiliation

Department of Electrical Engineering
National Cheng Kung University
Tainan, Taiwan



<https://ieeexplore.ieee.org/author/37339750400>

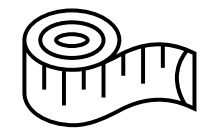
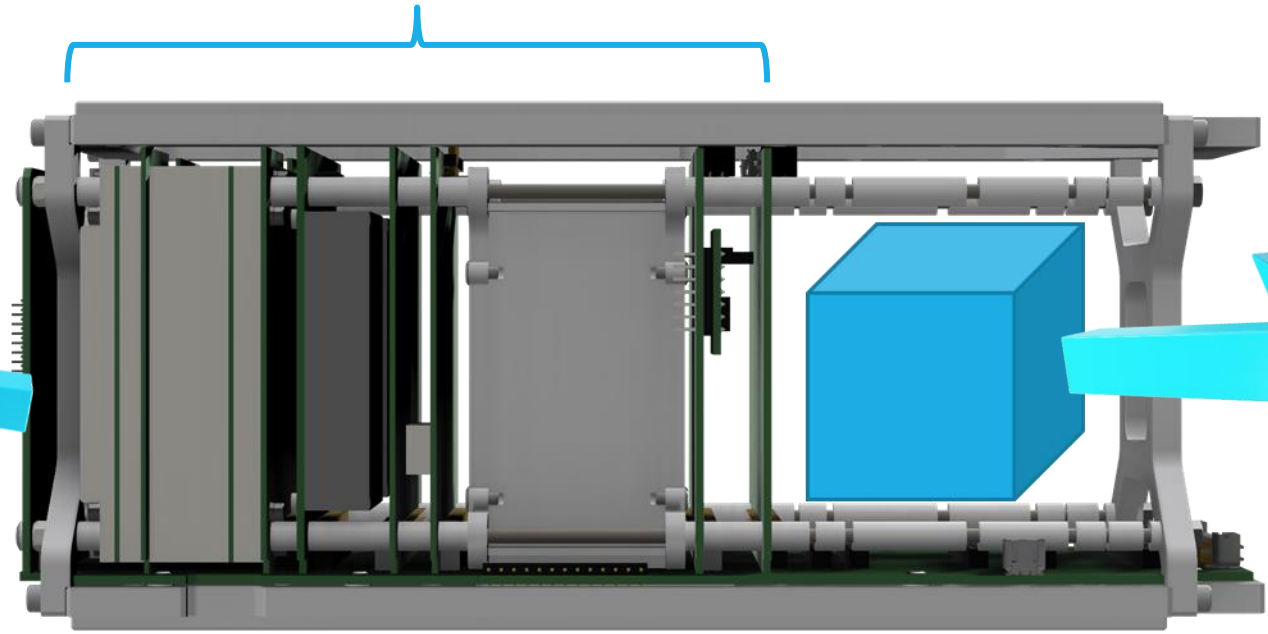
CAM Mission - Overview

Main Bus: **EPS**, COMM (VHF/UHF), **OBC** (confirmed)

3-axis Magnetic Control (confirmed)



(1)

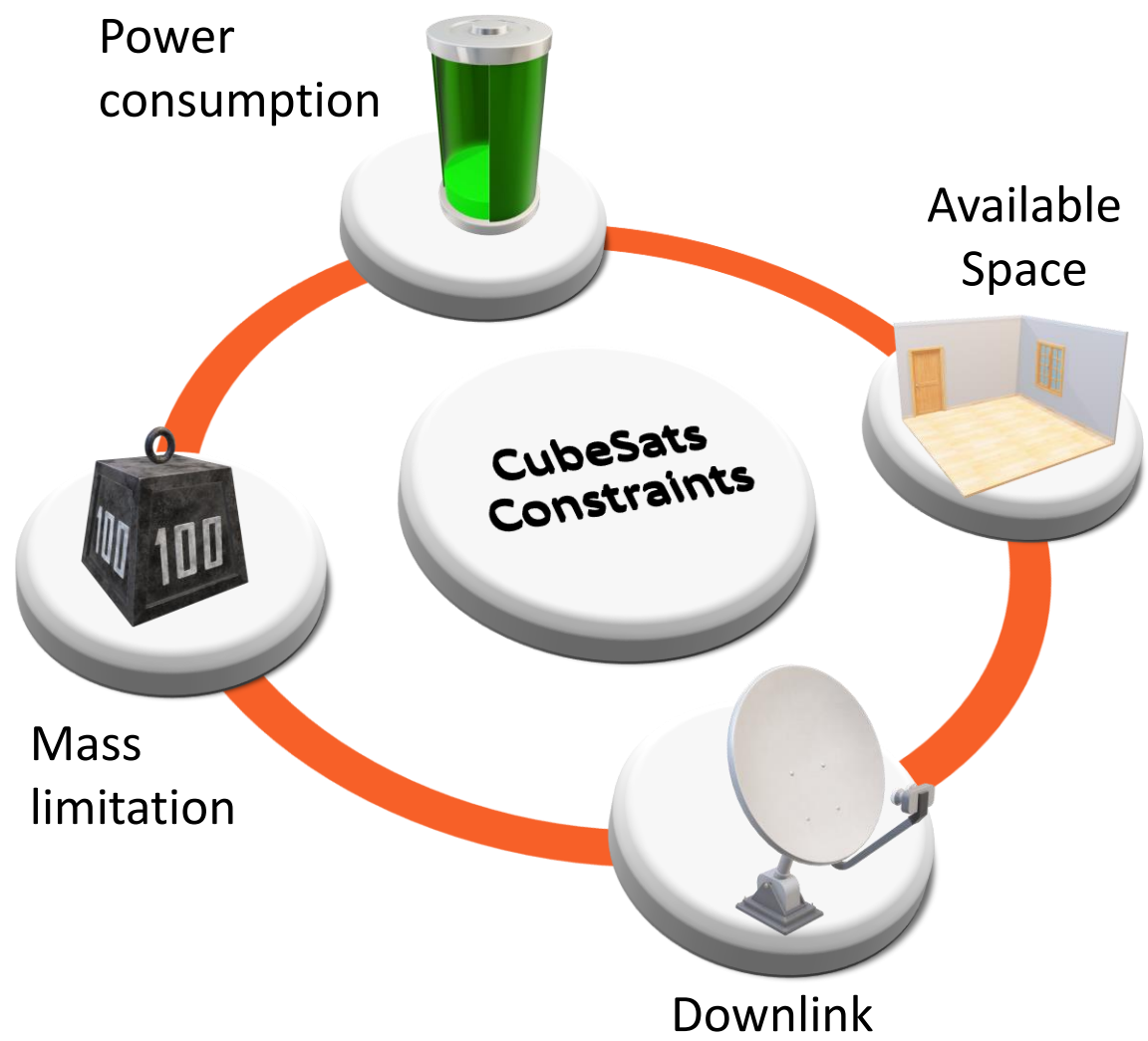


1U - volume Reserved




COMM S-BAND ??
(not confirmed)

(1) <https://www.isispace.nl/product/isis-magnetorquer-board/>

CAM MISSION- Considerations



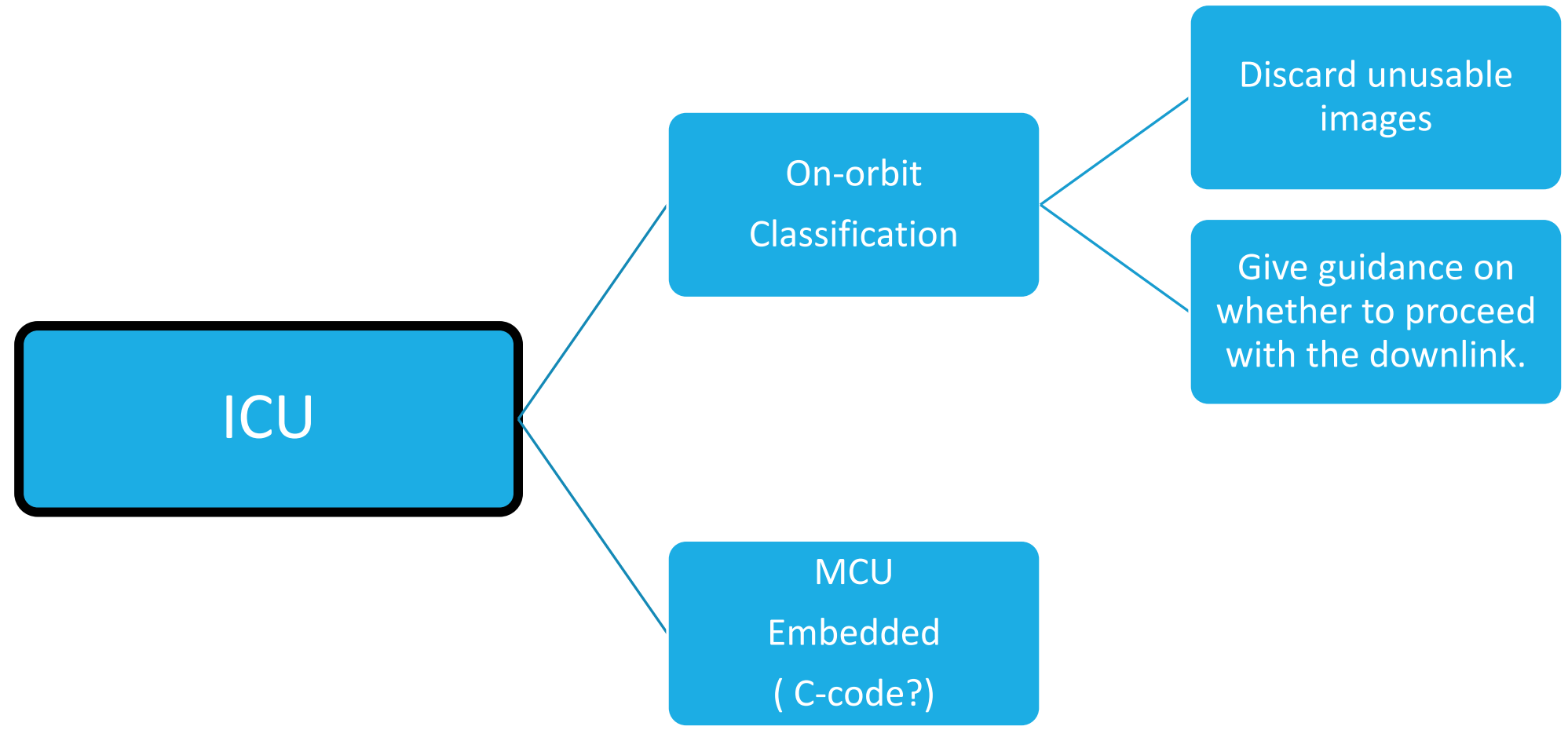
Basic flow for image's acquisition

-  Large amount of data
-  Compression algorithm
-  Low downlink rate using Amateur UHF band



Use of S-band, C-band, etc.
Usually more complicated !!

CAM – ICU (Image Classification Unit)

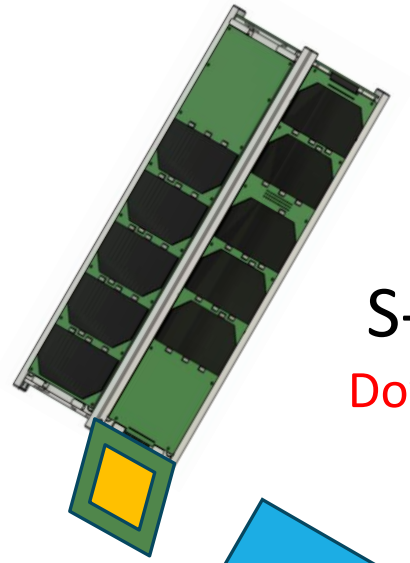
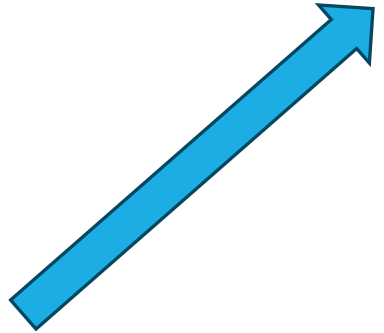


S-BAND Communication

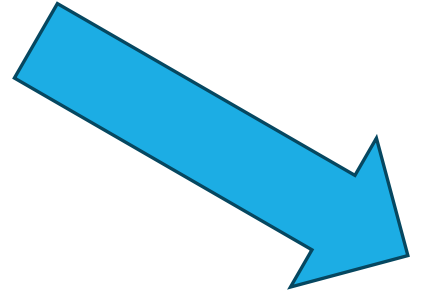
- License/Regulations
- Amateur S-band
- Mobile GS for S-band (Final project work)
- DIY (TESTS)



VHF/UHF
Command



S-band
Downloading
Only??



[S-band Ground Station \(satlab.com\)](http://satlab.com)



Aguyje!!
(Thank you)

Ariel Manabe, MSc.

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