

# The First Chilean Satellite Swarm: Approach and Lessons Learned

Cristobal Garrido

[cristobal.Garrido@ug.uchile.cl](mailto:cristobal.Garrido@ug.uchile.cl) or [garridoc@usc.edu](mailto:garridoc@usc.edu)

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Logan, UT  
August 6<sup>th</sup>, 2023

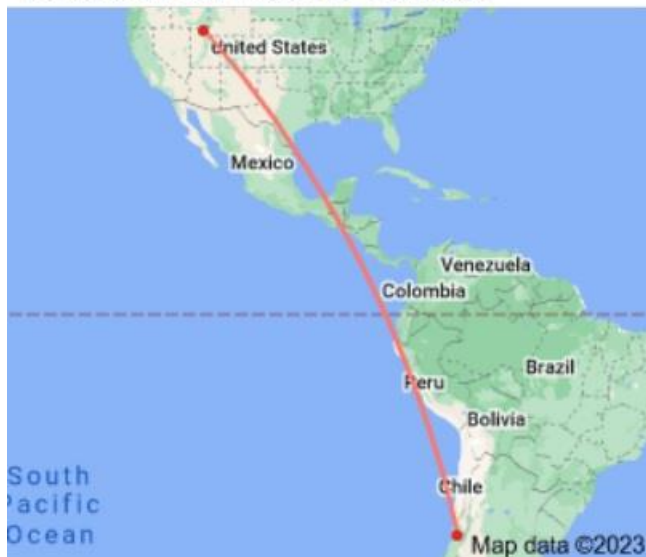
# Context

## Chile:

- Far, far, away (9,352 Km from here)
- No Space Agency
- No (Significant) experience doing satellites

5,811 mi

Distance from Logan to Santiago



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SUCAI  
(2017)



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FÍSICAS Y MATEMÁTICAS  
UNIVERSIDAD DE CHILE

# Context

## Chile:

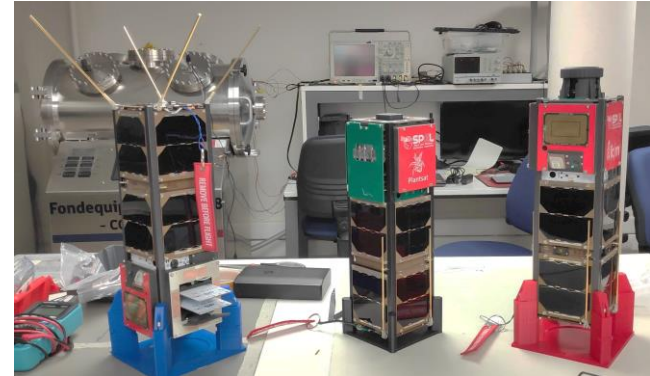
- Far, far, away (9,352 Km from here)
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- **How to expand a small space program?**



SUCHAI  
(2017)

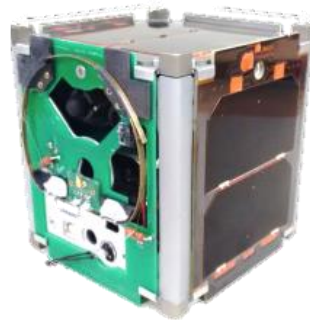


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UNIVERSIDAD DE CHILE



SUCHAI 2, SUCHAI 3  
and PlantSat (2022)

# Context

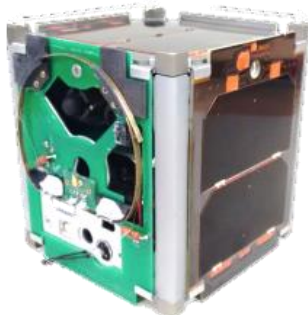


SUCHAI  
(2017)

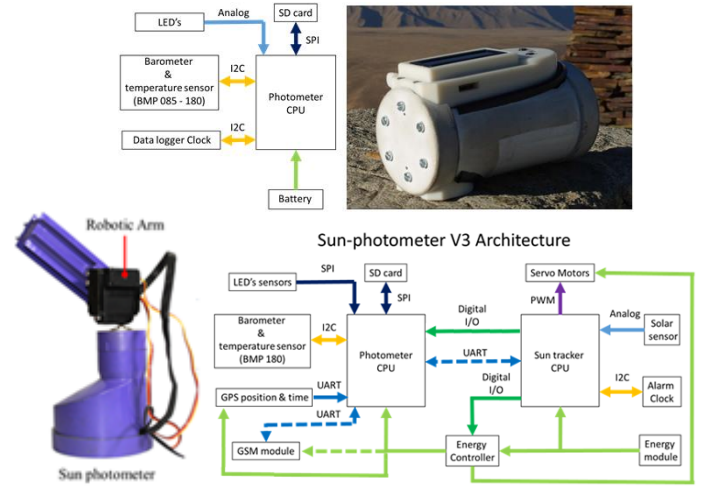
# Context



Sounding Probes  
(2018)

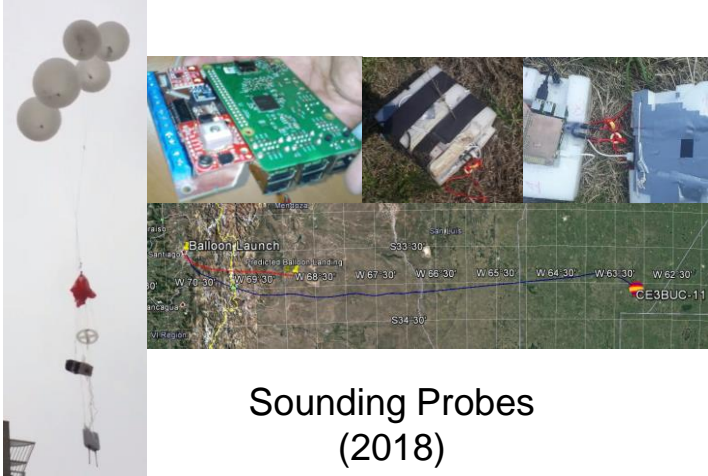


SUCHAI  
(2017)

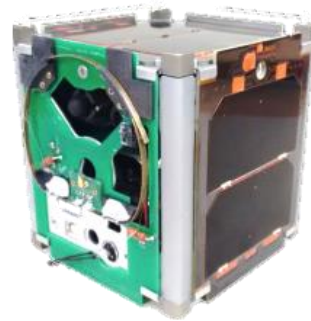


Sun Photometer  
(2015-2020)

# Context

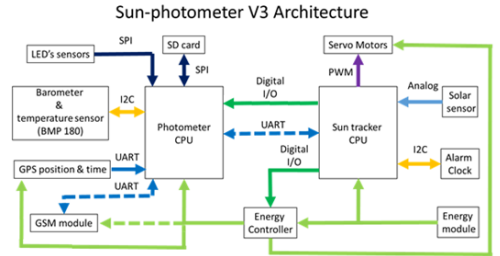
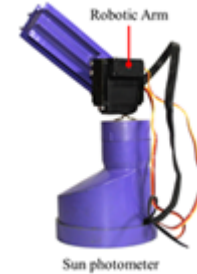
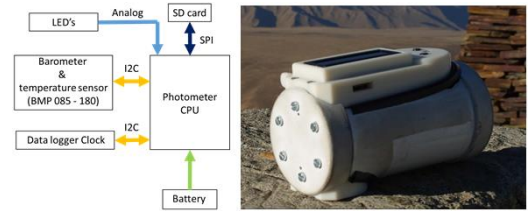


Sounding Probes (2018)



SUCHAI (2017)

- Space mission background.



Sun Photometer (2015-2020)

- Time Constrain mission.
- Satellite software testing.

- Upgrade from a previous device
- System Architecting definition

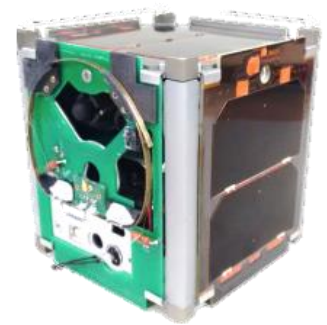
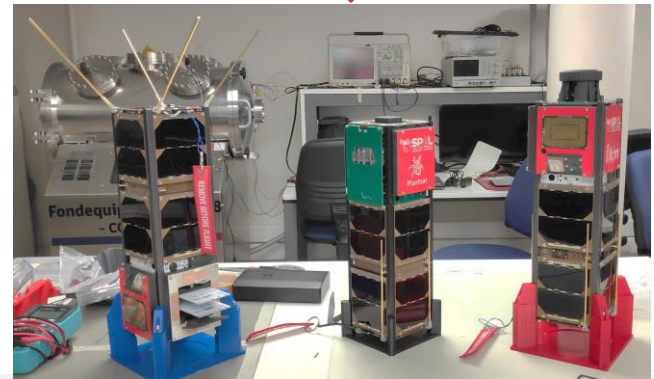
# Context



Sounding Probes  
(2018)



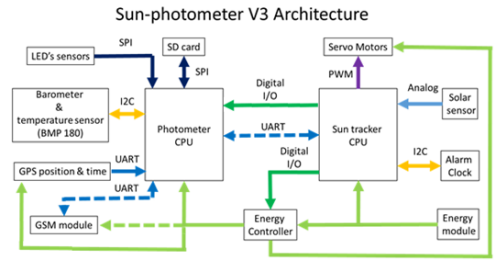
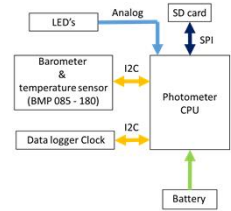
SUCHAI 2, SUCHAI 3  
and PlantSat (2022)



SUCHAI  
(2017)



Sun photometer



Sun Photometer  
(2015-2020)





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# Mission Payloads Summary

## SUCHAI 2



### Optical Experiments

UV-Visible PCO®  
Hyperspectral Camera

## SUCHAI 3



### Communication Experiments

(FEMTOSats & IoT)

## PlantSat



### Biological Experiments

(Plant and Extremophiles Chambers)

Graphene Transistor

Main Payload

Other Science Payloads

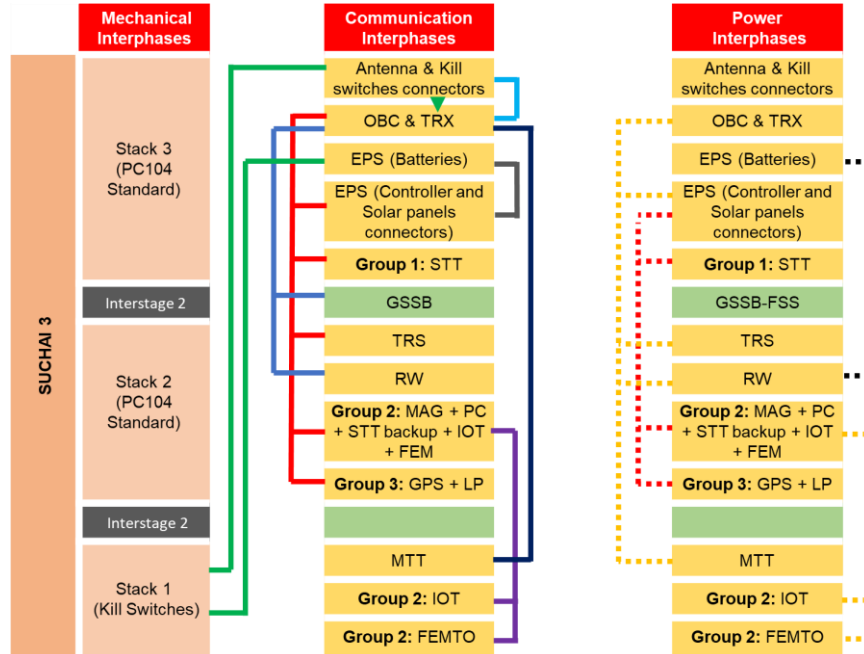
Technical Payloads

Magnetometers, Langmuir Probes, GPS TEC

Magnetometers

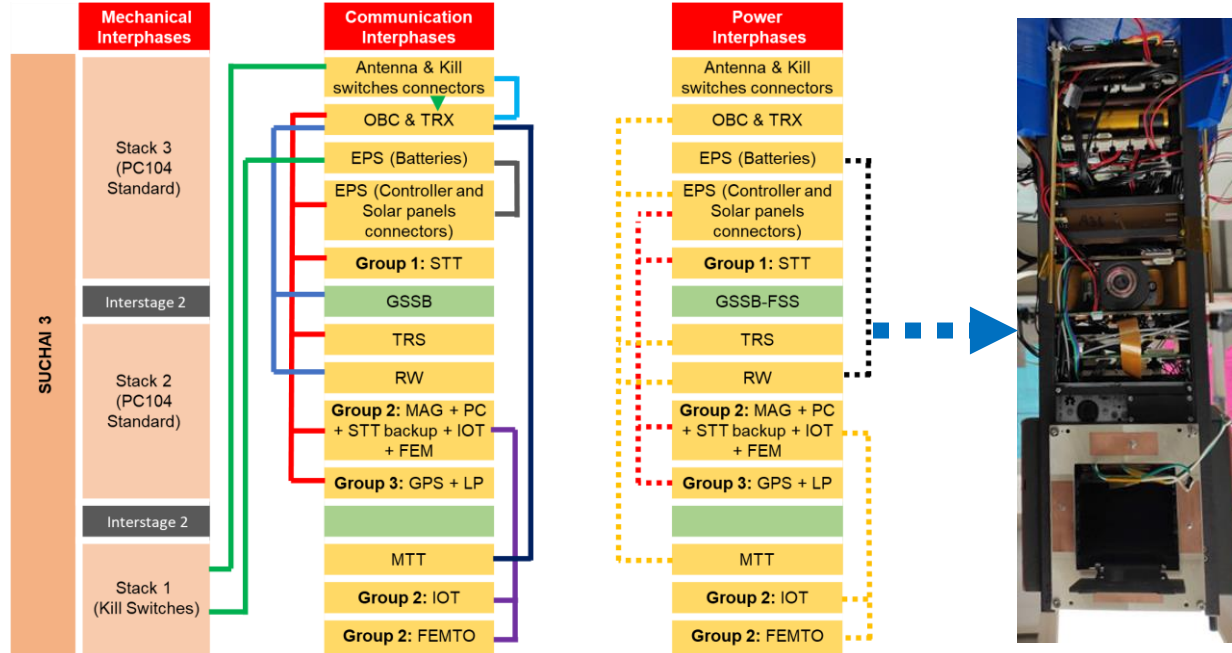
Star Tracker, Reaction Wheels

# Design, Integration and Testing Process



Subsystem Grouping Definition  
Common Flight Software

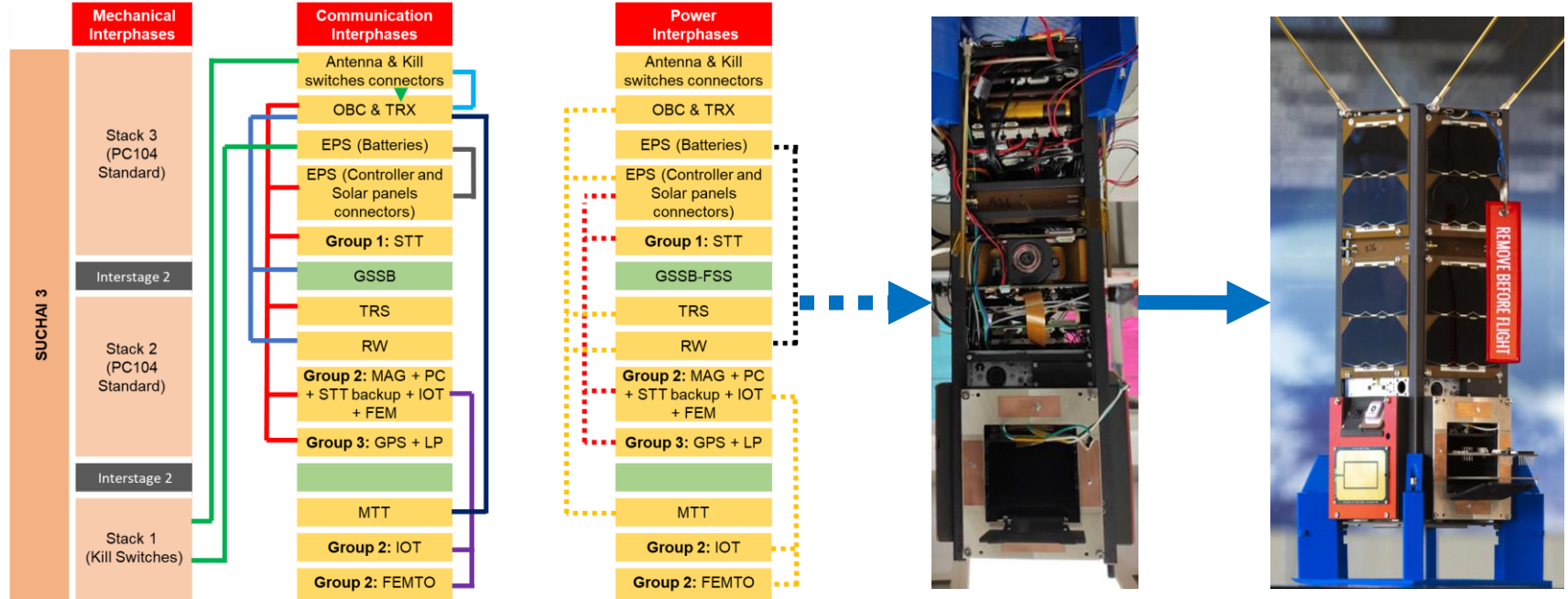
# Design, Integration and Testing Process



Subsystem Grouping Definition  
Common Flight Software

Satellite Integration, testing

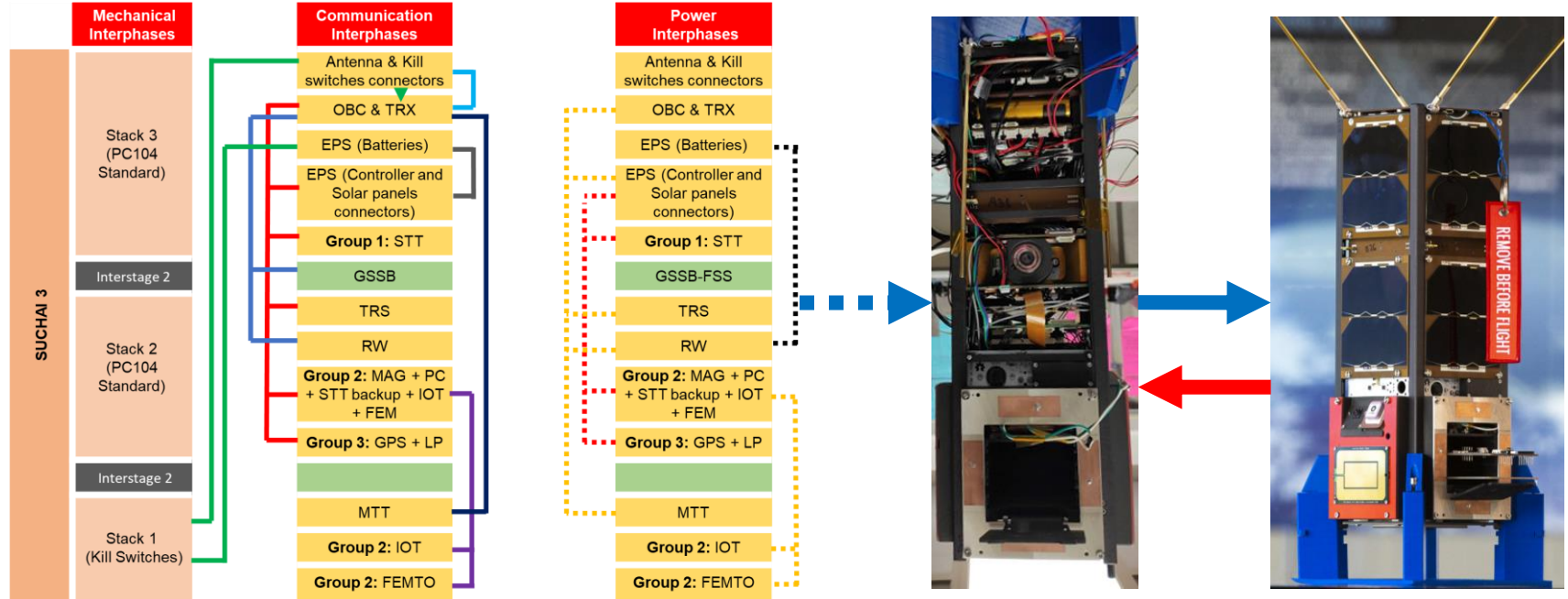
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Subsystem Grouping Definition  
Common Flight Software

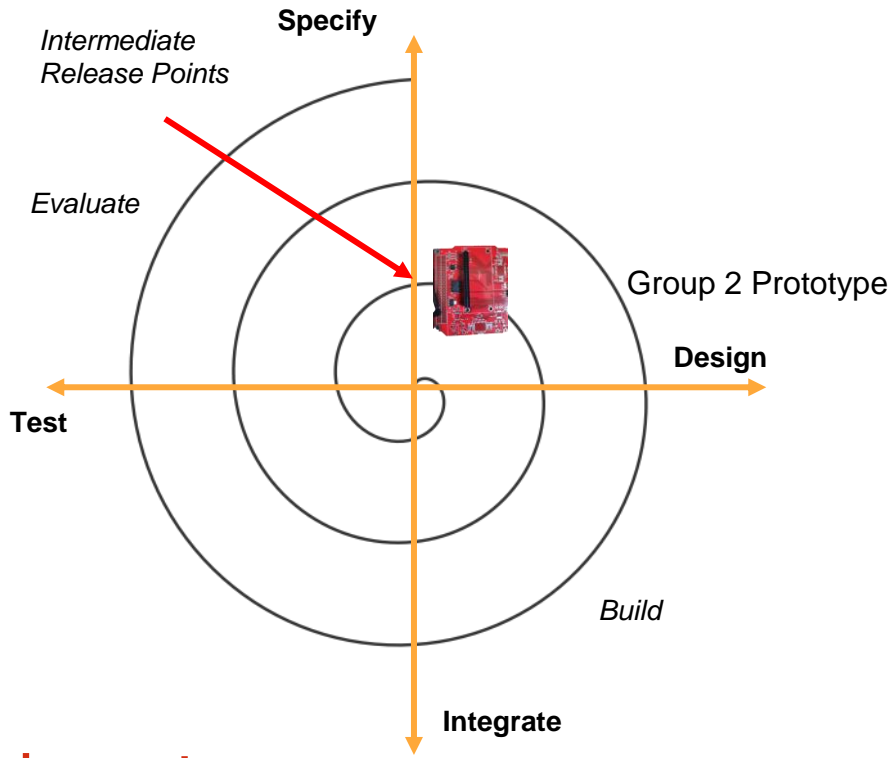
Satellite Integration and Testing

# Design, Integration and Testing Process



Subsystem Grouping Definition  
Common Flight Software

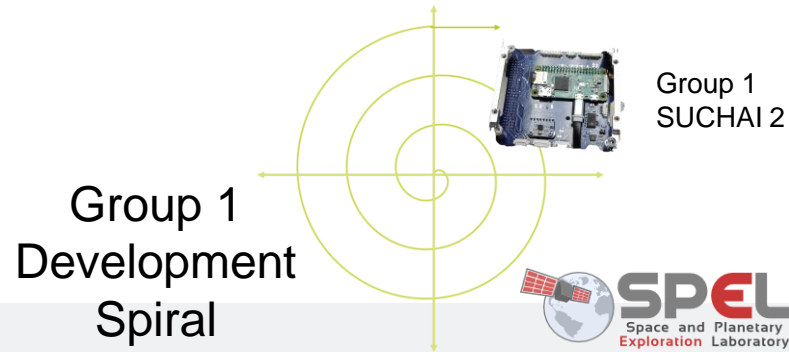
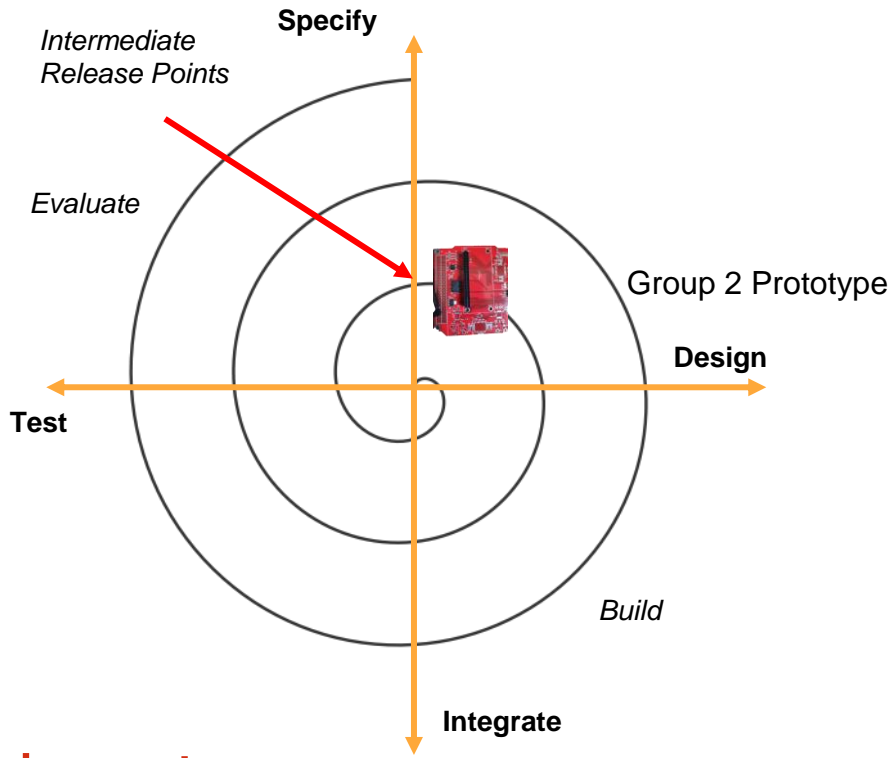
Satellite Integration, Testing and  
Subsystems Iteration



# Subsystem Iteration

Group 2  
Development  
Spiral

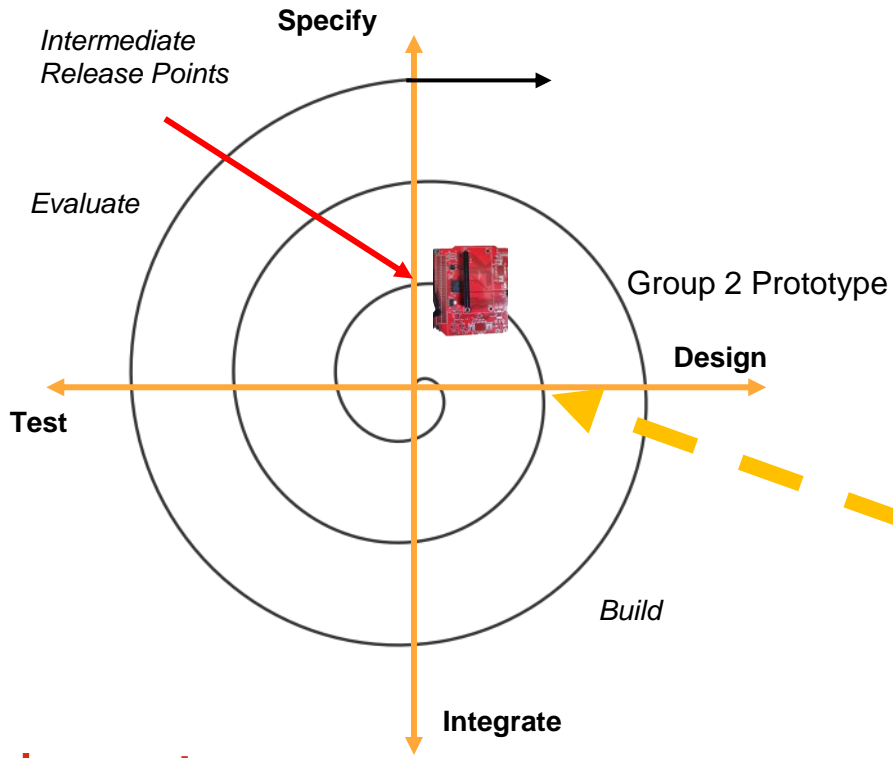




# Subsystem Iteration

Group 2 Development Spiral

Group 1 Development Spiral

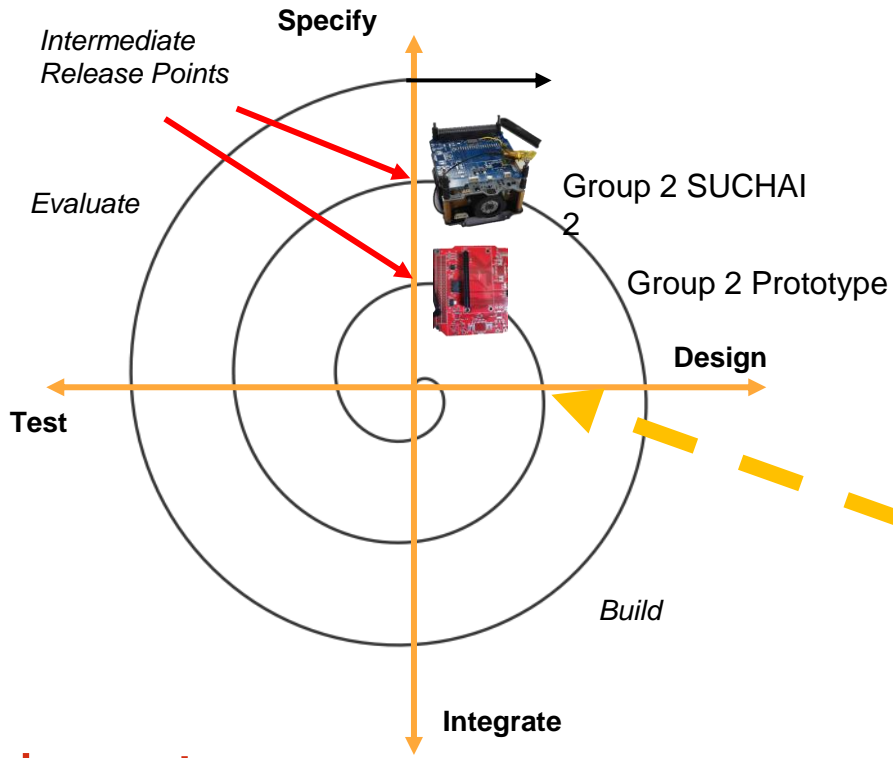


# Subsystem Iteration

Group 2 Development Spiral

Group 1 Development Spiral

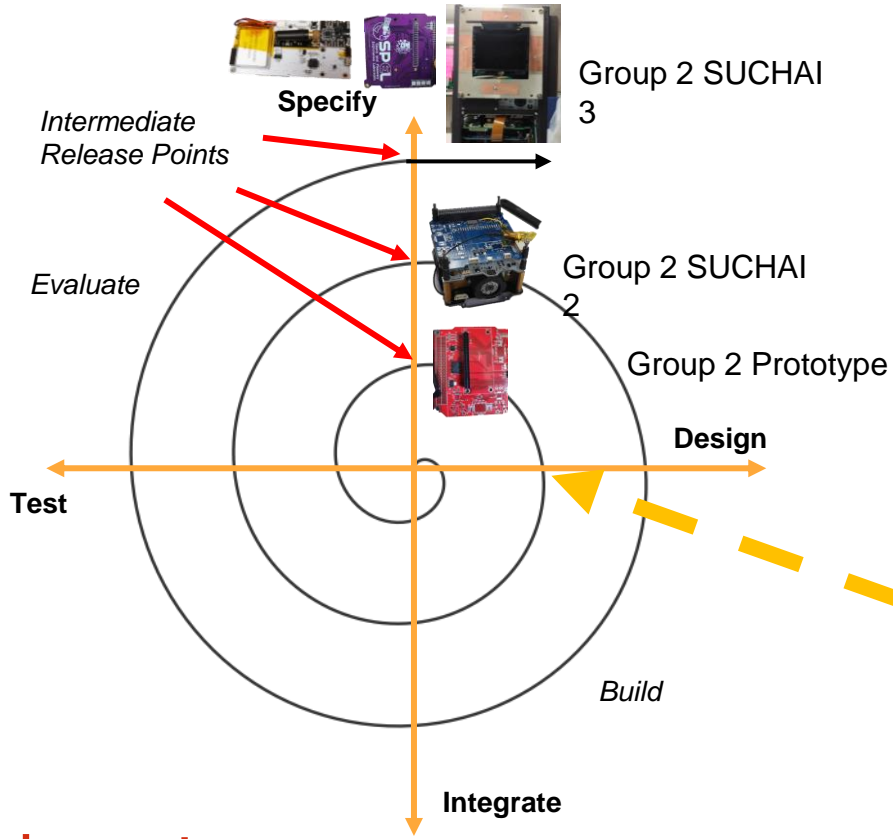




# Subsystem Iteration

Group 2 Development Spiral

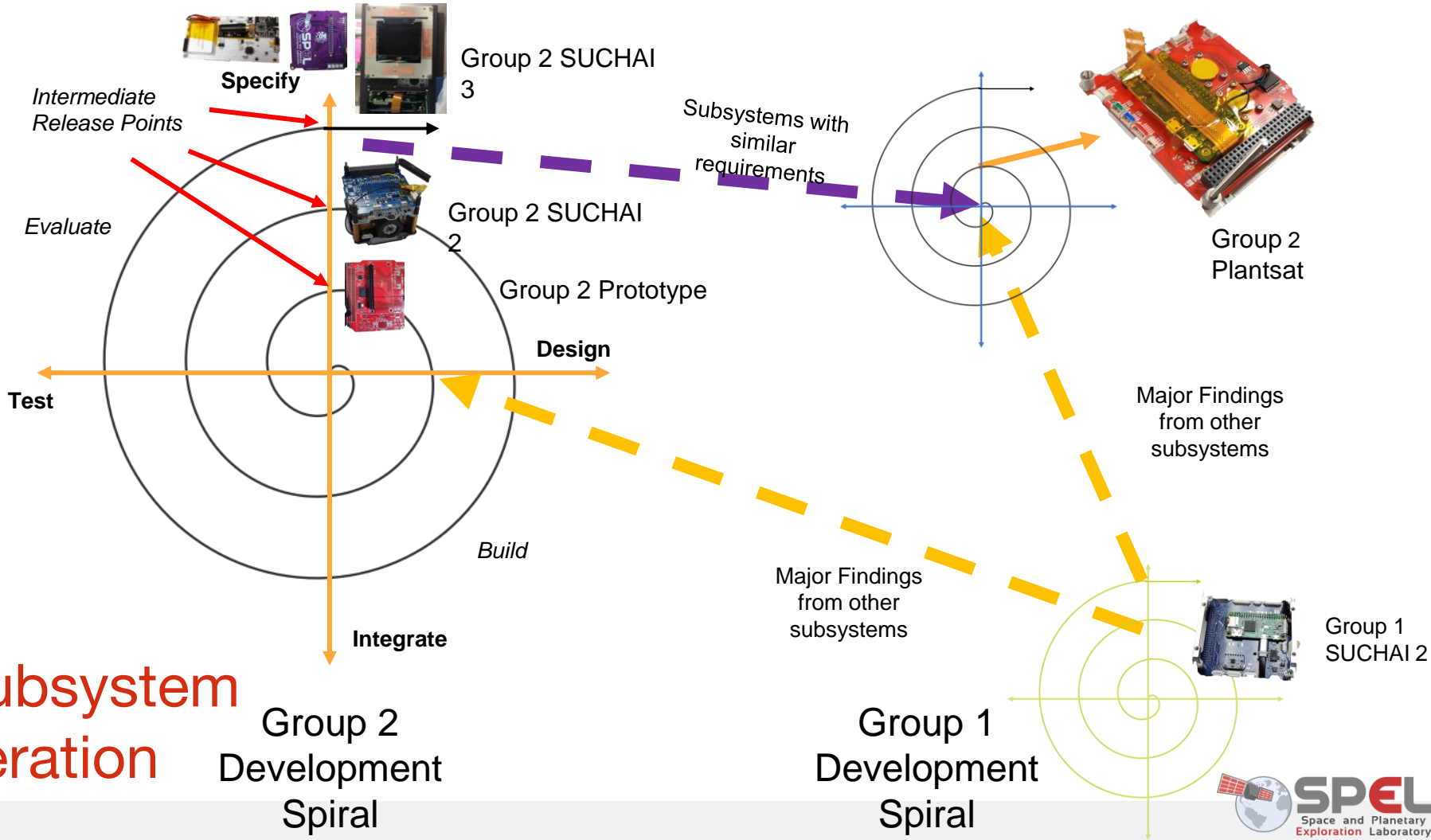
Group 1 Development Spiral



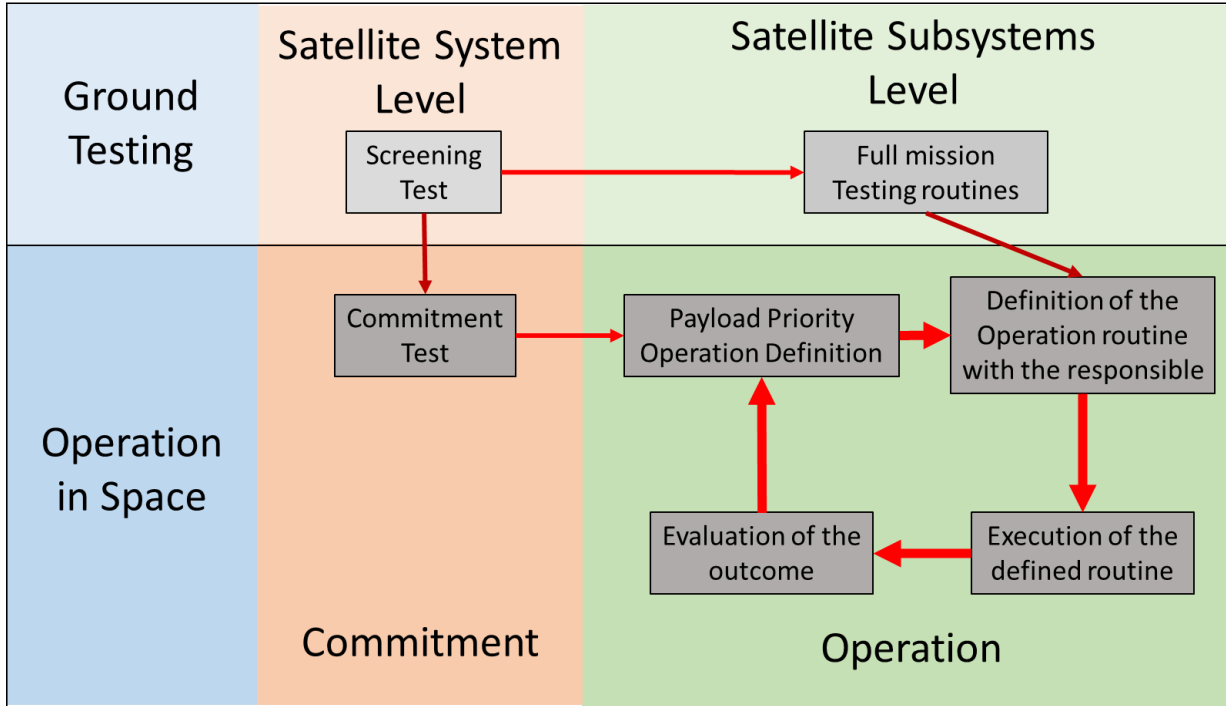
# Subsystem Iteration

Group 2 Development Spiral

Group 1 Development Spiral



# Operation Design Process



# The Results

## Some Results



## Key Decisions

- Subsystem division
- Common Flight Software
- System Overview

## Lessons Learned

- Use smaller projects to train the team
- Isolate every subsystem failure from the others
- Focusing on Testing
- Operate as it was tested on the ground

# The First Chilean Satellite Swarm: Approach and Lessons Learned

Thank You!

*Thanks to Embry Riddle Aeronautical University (ERAU) and the Space and Atmospheric Instrumentation Lab (SAIL) for their help in the integration process.*

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