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M2 Digital Sciences 23-24
Flight Software Developer
Supervisor: Ricardo Colpari
Period: 11/23 to 02/24

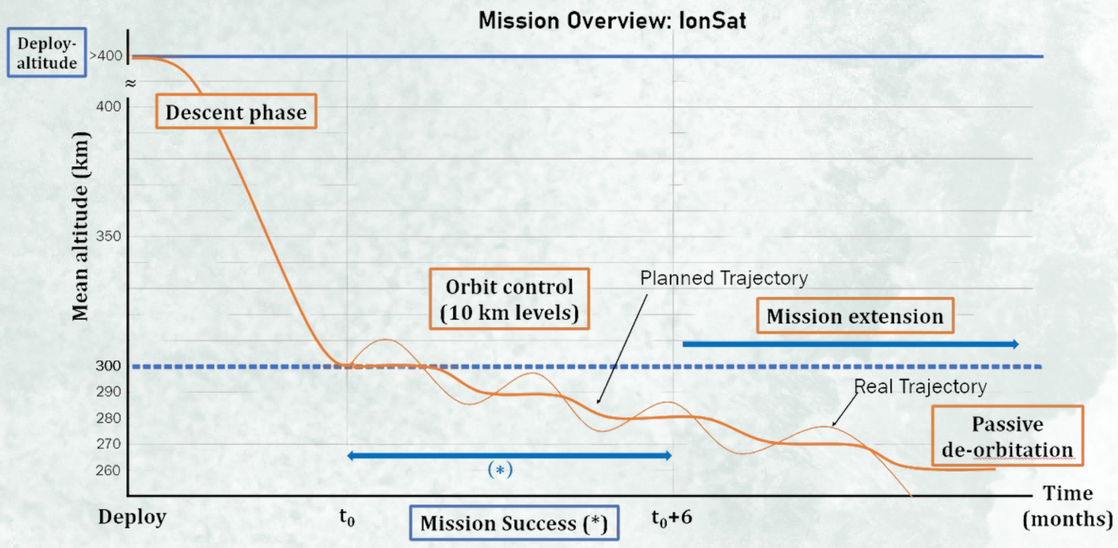
Centre Spatial de L'École Polytechnique

IonSat - Bus communication

Summary

IonSat, a collaborative **6U propelled cube satellite** initiative led by students from CSEP in partnership with CNES, ThrustMe, and École Polytechnique.

Throughout my internship, I actively engaged in various tasks within IonSat, with a specific focus on enhancing **I2C and CAN communication protocols** with subsystems such as thrusters and ADCS. Additionally, I played a pivotal role in contributing to the software architecture and logic of the project. My contributions significantly bolstered communication capabilities and overall progress within IonSat.



Missions

To establish the data link layer communication between the micro-controller (on-board computer) and the subsystems like ADCS and Thruster engineering model via CAN and I2C.

Challenges

1. Adapting to the STM32 Micro-controller Interface presented a noteworthy learning curve.
2. In the absence of a dedicated software engineer at CSEP, addressing questions posed a significant challenge.
3. Understanding the partitioning and intricacies of the FPGA proved to be a complex task.

Software

ARDUINO · STM32 · Visual Studio Code · GitHub

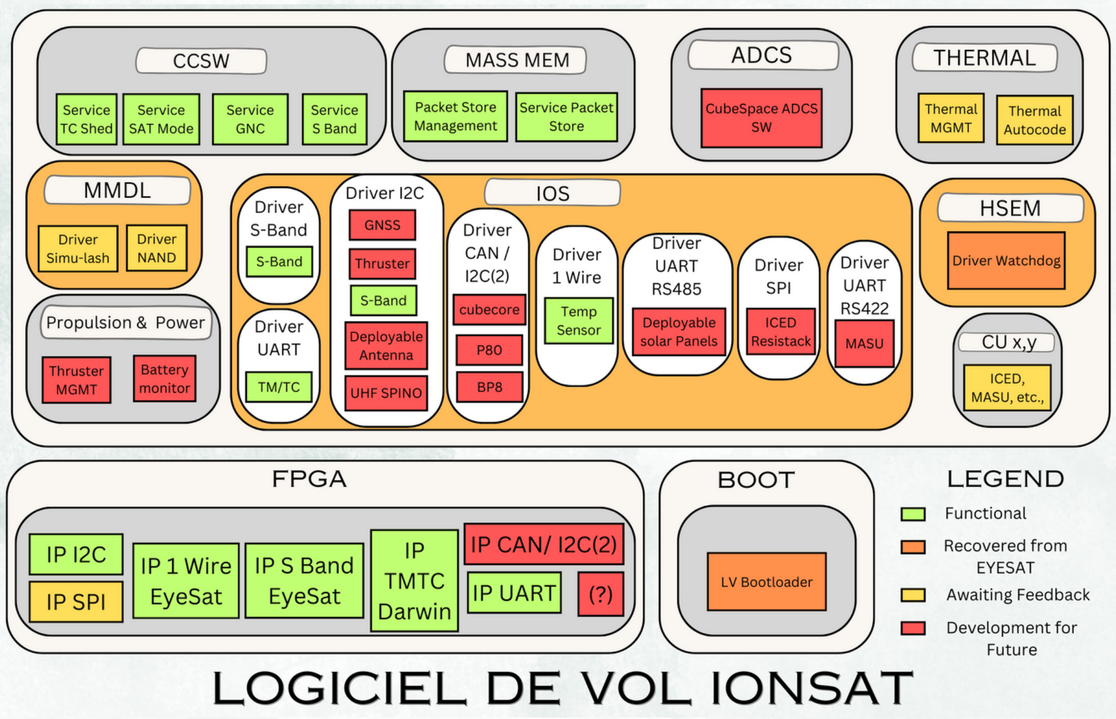
Learning Curve

1. **Comprehensive Knowledge of Cubesats:** Through my involvement with IonSat, I gained a thorough understanding of how cubesats work, exploring their various subsystems and how they are partitioned for efficient functionality.
2. **Improved Skills in Microcontrollers:** I now have a better grasp of microcontroller operations with transceivers like MCP2565, specifically in understanding how they communicate through buses. My experience with STM32 boards has added a new dimension to this knowledge.
3. **Exposure to Communication Protocols:** I have gained significant experience in communication protocols, especially in the layers between Data Link and Network. This has given me a broad understanding of how communication takes place in these systems.

Objectives

The IonSat project aims to deploy a cube satellite into VLEO (Very Low Earth Orbit) at an altitude ranging from 300 to 450 kilometers.

Software Architecture



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Execution

1. Successfully **implemented I2C bus communication** between the thruster and STM32F429I DISCO microcontroller, which serves as the on-board test computer. Initiated communication between the ADCS and the on-board computer using Arduino. Currently adapting and refining the thruster algorithm for improved functionality.
2. Contributed to the **comprehensive functional analysis** of the thruster propulsion system, specifically focusing on the NPT30I2.
3. Actively participated in software logic and architecture contributions under the guidance of CNES.
4. Engaged in the E4C challenge, actively contributing to the development and exhibition of an innovative energy demand forecasting model. This reflects a commitment to addressing contemporary challenges in the field.

Conclusion

My engagement with the Centre Spatial of École Polytechnique has provided a hands-on learning experience, encompassing both software development and the management and functionality aspects of the cube satellite. While the ongoing expansion of the algorithm and further advancements in software architecture are in progress, I am enthusiastic about continuing to broaden my knowledge in nano-satellites development. and contribute towards the successful deployment of IonSat.

References

- **CSEP:** Tavant, A. (2020, May 30). IonSat. CSEP. https://centrespatial-polytechnique.fr/ionsat/
- **GitHub:** https://github.com/Romaric1331/Flight-Software-Developer-at-Ecole-Polytechnique-Space-Center-

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