# Subsystem Description

## 1. Functional Architecture

Conceptually, the **On-board Computer** (OBC) acts as the brain governing the spacecraft, serving as the central component within the overall architecture of this system. It plays a pivotal role in a complex system that accommodates the following five distinct sub-modules: Electrical Power Supply (EPS), Communication System (COMMS), Attitude Determination and Control System (ADCS), and the payload (P/L).

In other words, the main purpose of the subsystem is to perform the housekeeping of the overall satellite. In this regard, performing both data processing and storage in a timely manner while maintaining a low power consumption is crucial so as to guarantee an efficient and robust performance of the PocketQube. In light of this, the **Flight Software** (FSW) running on the OBC needs then to be carefully designed by the application writter in order to meet the time requirements linked to the varied tasks that the satellite is expected to perform. A common technique used in embedded systems in order to fix this time constraint is implementing **Real-Time Operating Systems** (RTOS). In the PoCat project, **FreeRTOS** has been the open-source RTOS selected to manage the on-board FSW.

On the other hand, the OBC hardware needs to accommodate the FSW by providing enough resources for a correct execution. In summary, the breakdown of the OBC from the hardware perspective consists of a low-power but high-performance ARM Cortex M4 microprocessor, volatile and non-volatile memory banks for data storage, interfaces that reach out to peripherals and data buses interconnecting the whole system architecture.

To ensure the desired behaviour of the PocketQube, it is necessary for both software and hardware to converge seamlessly. This will enable the OBC to efficiently manage various tasks that play a critical role in determining the behavior of the picosatellite. In summary, the tasks that are performed by the On-Board Computer for the PoCat space mission are listed below:

- Task scheduling.
- Inter-task communication.
- Power management.
- Telecommand processing.
- Telemetry data handling.
- Payload data acquisition.
- Attitude determination and control.
- Error handling.

# 2. Requirements

| Subsystem | ID | Requirement |
|---|---|---|
| OBC | OBC-0010 | The OBC shall monitor all spacecraft subsystems. |
| OBC | OBC-0020 | The OBC shall have a Scheduler which determines the execution of different tasks through time. |
| OBC | OBC-0030 | The OBC shall provide and store the following housekeeping data: Satellite mode, Boot count, OBC error events, Internal satellite communication error events, RAM memory usage. |
| OBC | OBC-0040 | The OBC shall retrieve and store housekeeping data for all spacecraft subsystems. |
| OBC | OBC-0050 | The OBC shall monitor all satellite subsystems in order to verify their nominal behavior. |
| OBC | OBC-0060 | The OBC shall execute TC received from the GSeg. |
| OBC | OBC-0070 | The OBC shall be able to control and command all subsystems via its interfaces. |
| OBC | OBC-0080 | The OBC shall retrieve and store scientific data from the Payload. |
| OBC | OBC-0090 | The OBC shall have data interfaces with all subsystems. |
| OBC | OBC-0100 | The OBC power supply voltage shall be 3.3 V. |
| OBC | OBC-0110 | The OBC shall enable the manual transition between satellite modes if a TC from the ground is received. |
| OBC | OBC-0120 | The OBC shall automatically transition between satellite modes based on battery levels. |
| OBC | OBC-0130 | The OBC should allow in-orbit changes of its configuration. |
| OBC | OBC-0140 | The OBC shall implement a command-less timer that triggers a recovery routine if a telecommand from the GS is not received after a certain period. |

| Subsystem | ID | Requirement |
|---|---|---|
| OBC | OBC-0150 | The spacecraft shall allow modifications to the OBC Software after the satellite assembly is complete and while on ground. |
| OBC | OBC-0160 | The spacecraft shall have a timer, set to a minimum of 30 minutes, before operations or deployment of the antennas. |
| OBC | OBC-0170 | No radio emission shall be allowed after the spacecraft has been integrated within the PocketQube deployer until 45 minutes after deployment. |

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