Subsystem Description

1. Functional Architecture

The communications subsystem is responsible for telecommand reception and telemetry transmission. Being so that the functionality of the satellite's control from the Earth ground station completely relies on the COMMS subsystem. Therefore, it is imperative for the COMMS subsystem to fulfill specific requirements to facilitate accurate communication and seamless operation of the satellite.

It is opted for the utilization of LPWANs (Low Power Wide Area Networks), specifically employing the LoRa (Long Range) physical layer technology. COMMS hardware is located both in the OBC-COMMS board as well as in a lateral board (where the antenna is soldered or screwed). The subsystem can be divided into different blocks to identify their functionality.

The first one is the **power circuit**, tasked with ensuring the proper power supply and composed by passive components. The **transciever** is the key component of the SS, responsible of both the recepction as well as the transmission of information from and to the ground station. It communicates with the MCU through SPI, as a slave, and performs signal modulation and demodulation.

The transciever requires an stable reference signal in order to perform its tasks, this is provided by a **crystal oscillator**.

The **RX Line** transmits the received signal from the antenna to the transciever. The line is balanced by a balun and impendance matched. The **TX Line** transmits the transmitted signal from the transciever to the antenna and presents different filters and matchings. The line to be used at each instant is selected by the **switch**, controlled by the transciever, which is at the same time controlled by the MCU.

Finally, the **antenna**, connected to the switch through a line that boths filters and matches impedance, is responsible for physically receiving and transmitting electromagnetic waves.
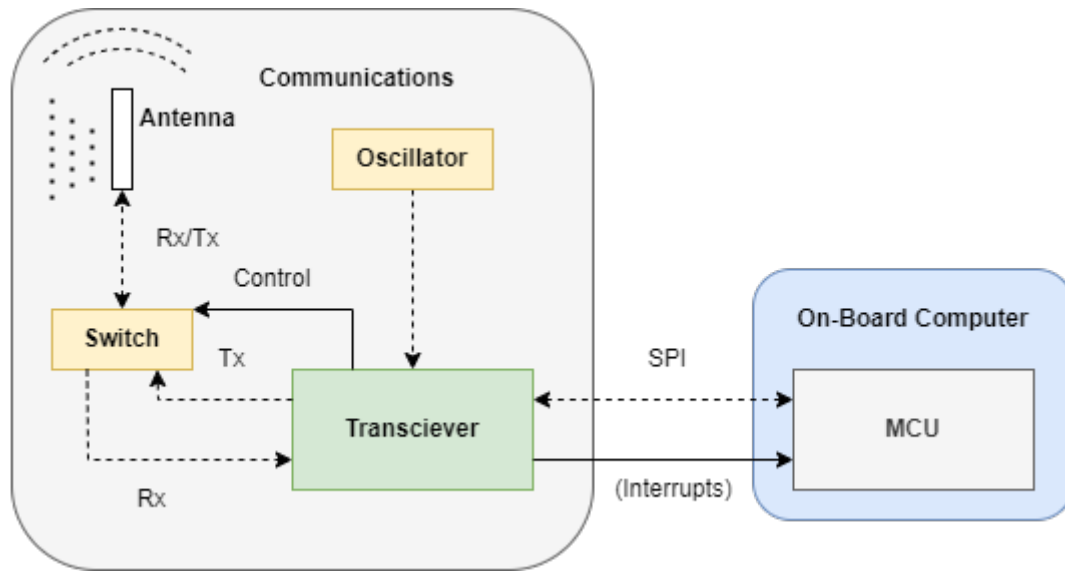
Figure 1: COMMS Functional Architecture Block Diagram

2. Requirements

Subsystem	ID	Requirement
COMMS	COMMS - 0000	The Communications Subsystem (COMMS) shall work in the ISM band via radio links.
COMMS	COMMS - 0010	The COMMS subsystem must transmit at a maximum power of 20 dBm.
COMMS	COMMS - 0020	The COMMS subsystem must support half-duplex communication, enabling both transmission and reception of data.
COMMS	COMMS - 0030	Be able to deploy the omnidirectional quarter wavelength antenna once the satellite is deployed in space.
COMMS	COMMS - 0040	The COMMS shall periodically transmit the telemetry of the spacecraft.
COMMS	COMMS - 0050	All packets shall be tagged with a timestamp.
COMMS	COMMS - 0060	The COMMS must be able to receive Telecommands from the ground segment and send a reception acknowledgement.
COMMS	COMMS - 0070	The COMMS shall have the capability to provide past telemetry housekeeping.

Subsystem	ID	Requirement
COMMS	COMMS - 0080	The transmitted beacon shall contain a subset of information from the whole satellite housekeeping.
COMMS	COMMS - 0090	OBC and COMMS subsystems must communicate through SPI.
COMMS	COMMS - 0100	The S/C shall be capable of changing the operating frequency using a telecommand.
COMMS	COMMS - 0110	The satellite must comply with European regulations.
COMMS	COMMS - 0120	Be able to distinguish between wanted packets and unwanted packets.

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