Satellite Operational Modes

The operational modes for the satellite and its subsystems are:

Init: This mode is directly associated with the LEOP. The LEOP phase is the most critical, as it begins when the satellite is deployed and concludes when the Communications (COMMS) antenna is deployed and contact with the ground segment is established. For the ᴾᵒCat mission, it includes the following steps in this order:

1. **Standby:** To comply with the requirements, after injection in orbit the spacecraft must wait a minimum of 30 minutes before beginning operations or deploying appendages, specifically the COMMS and payload antenna. At the same time, no radio emissions are permitted after the spacecraft has been integrated into the PocketQube deployer, and this restriction remains in effect for 45 minutes following deployment. Therefore, no beacon transmissions are allowed. This precaution is necessary to prevent interference with other satellites being deployed or with other systems on the rocket. To meet these requirements, the satellite will wait 45 minutes before commencing operations and communications.
2. **Deployment of the LoRa Antenna:** As mentioned, it is necessary to deploy the COMMS antenna to begin transmitting beacons, which will facilitate the first contact with the GS (Ground Station).
3. **First Contact with the Ground Station:** The satellite will remain in this state until it receives confirmation from the GS that everything is functioning correctly, at which point nominal operations can begin.
4. **Nominal:** If all the performance criteria and actions of the **Init** phase are successfully completed, the satellite enters into nominal mode. This mode serves as the default operating state in the best-case scenario, and the satellite remains in this mode as long as the batteries are above a certain threshold value. While in nominal mode, payload-related operations can be conducted, including the mission experiments, and the FSS.

Contingency: The satellite enters this mode when the batteries fall below a certain value. In this mode, some functionalities of the flight software are disabled, including the experiments conducted by the payload and the FSS. Also, the ADCS subsystems stop performing nadir pointing to reduce power consumption.

Sunsafe: This mode is associated with a critical condition of the satellite and is activated when the batteries drop below an even lower threshold. More restrictions are applied in this mode to further conserve energy. The Electrical Power Subsystem (EPS) and ADCS subsystems cease all activities, such as heating the batteries in the case of the EPS or dumping and detumbling in the case of the ADCS. These subsystems enter a passive

Survival: This final state is the most critical, occurring when the satellite lacks sufficient energy to perform any vital actions. It may also arise if a significant error occurs in the code, making it safer

to remain in this state until operators determine the best course of action. In this state, all subsystems remain active but are only polling information from the sensors. At the same time, transmissions are ceased, and no beacons are transmitted to prolong battery life; the COMMS subsystem is only in reception mode.

The Figure 1.1 illustrates the transitions between the states. From the **Init** state, which is the first state the satellite enters after being released by the deployer or after a reboot, the satellite will transit to the Nominal state following the first contact with the ground segment. Once the satellite exits this state, it can only re-enter if a reboot event occurs.

All other states can transition up or down to the adjacent state. Transitioning to a state with more restrictions can occur automatically if the satellite does not have enough energy to remain in the current state, or it can be triggered by operators through the reception of a telecommand. Conversely, to transition to a less restrictive state, two conditions must be met: the battery level must be appropriate, and the satellite must receive a telecommand requesting the change of state.

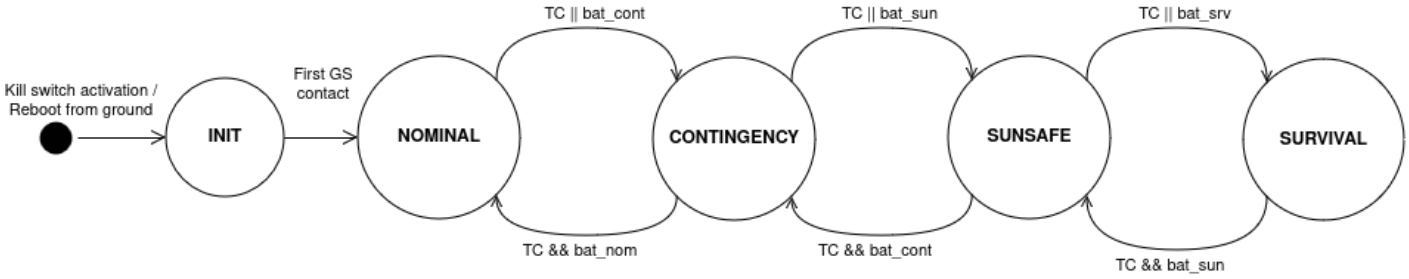

Figure 1.1: PoCat Operational Modes and Transitions

Revision #1
Created 15 November 2024 17:46:08 by roger.almirall
Updated 15 November 2024 17:46:19 by roger.almirall