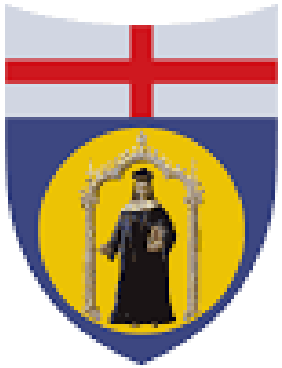
COGAR Assignment: Mars Topic



UNIVERSITÀ DEGLI STUDI
DI GENOVA

Author: Nicolas Bravi, 6402442

Supervisor: Fulvio Mastrogiovanni

Genova, 20/05/2024

MARS ROVER

In a context of space exploration on the planet Mars, a next-generation autonomous rover, named M-12, is tasked with conducting terrain analysis opera-ons to collect scien-fic data. Equipped with a series of advanced sensors (including spectrometers, multispectral cameras, and radar for analysis activities, and stereoscopic cameras and IMU for navigation and attitude control) and sophisticated data processing capabilities, M-12 is designed to explore Martian terrain and gather crucial mission information.

Suppositions:

1. Communication delay Earth-Mars is 5-20 minutes (as Mars rotates).
2. Rover is able to know perfectly its position (thanks to IMU and cameras). It is able to estimate it through the IMU sensors and it can adjust and correct it using orbiters around Mars and the position of the sun and costellation.
3. There are two orbiters around Mars called *Mars Reconnaissance Orbiter (MRO)*, used for more reasons included the comunication between the Rover and the Earth.
4. There is a fixed computing station on Mars.
5. The rover M-12, should process and compute low-level tasks. High-level tasks should be processed by the computing station on Mars or on Earth.
6. The rover has a speed of 110 m/h.

Communication:

The communication between M-12, the team on Earth and the computer station on Mars happends in different ways. The rover has 3 antennas, an Ultra-High Frequency Antenna (UHF), a X-band High Gain Antenna (XHG) and a RF antenna, moreover, also the computer station on Mars has these 3 antennas provided.

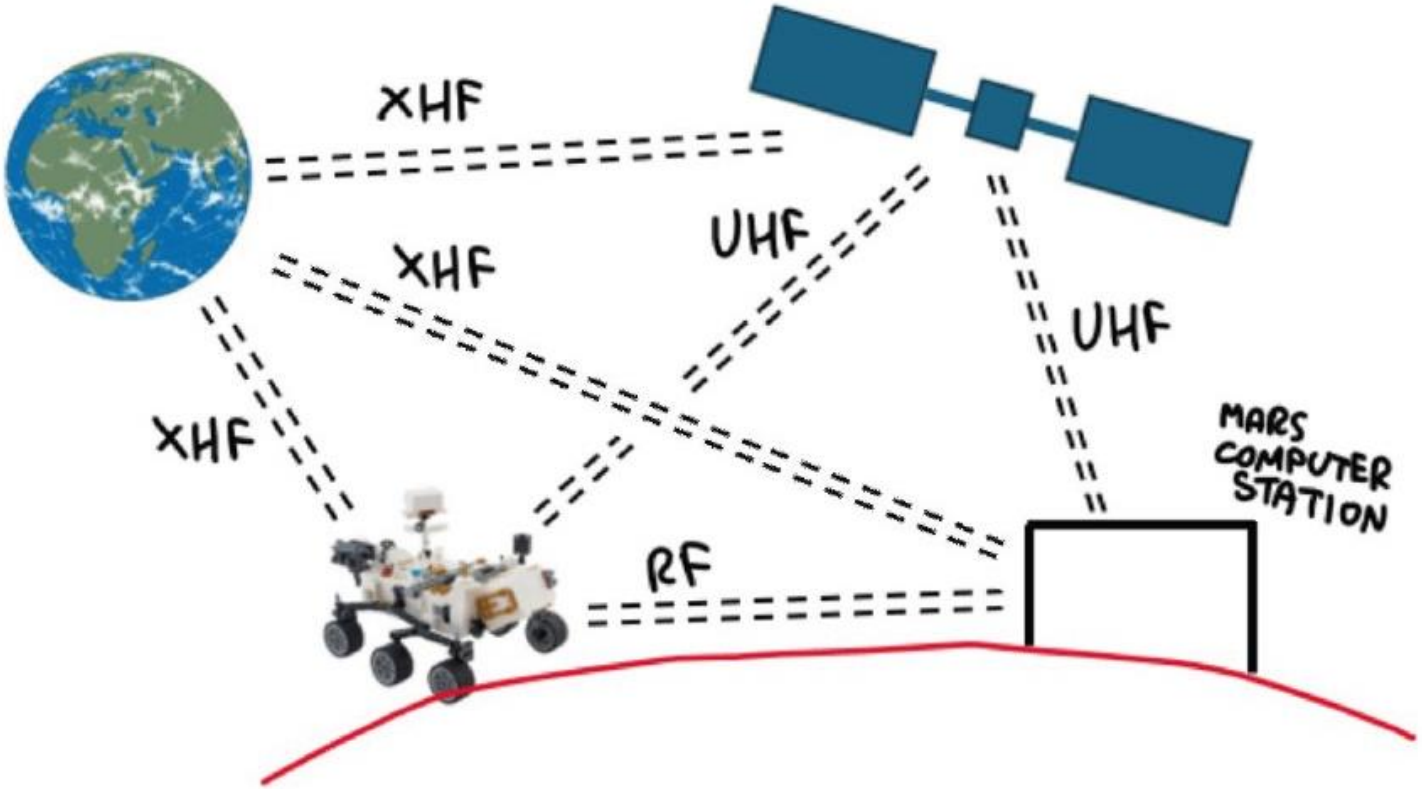
The RF antenna is used for the communication between the Rover and the computer station on Mars, which must process complex software components.

The UHF of the computer station does not transmit data to Earth directly, but instead, the data transmission is via the MRO, which relays information to Earth. With this communication path, the computer station on Mars sends to Earth data relatives to scientific analys. The rover uses the UHF with the purpose to compute its position in the space. Even though 3 orbiters are necessary for this algorithm, it is possible to use the 2 orbiters around mars and the other natural orbiters in the space, which are the sun and the costellations.

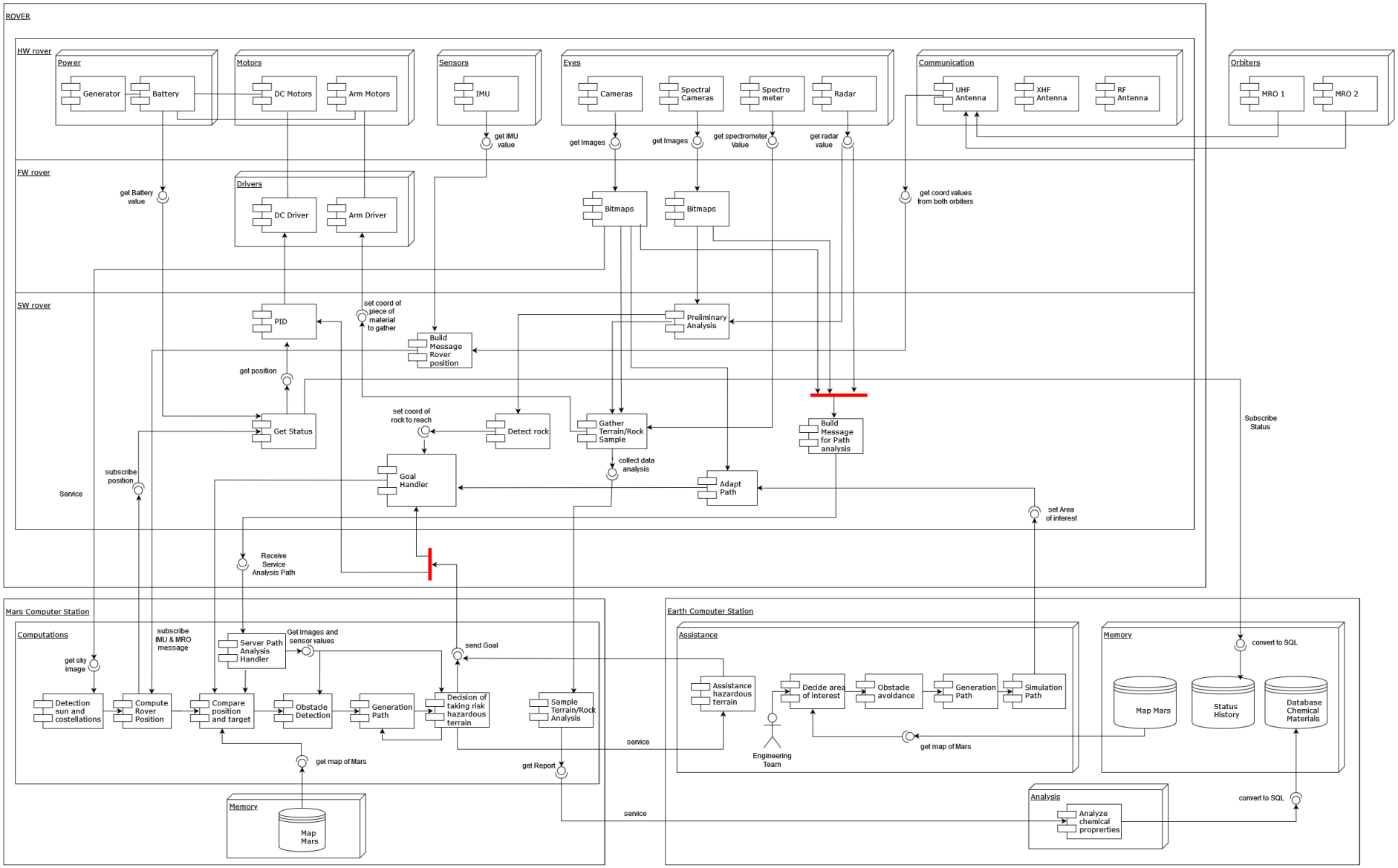
The XHG antenna permits to transmitting data directly to and from Earth, in the rover it is used for communication about its status, while the computer station on Mars uses it to send request of services to the engineering team on Earth.

Due to the huge distance, the transmission of data between the two planets has a 5-20 minutes delay (as Mars rotates). However, the communication with the RF antenna between the rover and the computing station on Mars, might be in real-time. Because the are in the same planet and it is possible to have an high-speed transmission of data, so it is possible to share big amount of data in few time. It is possible to neglette the few seconds of delay due to the low speed of the rover (110 m/h).

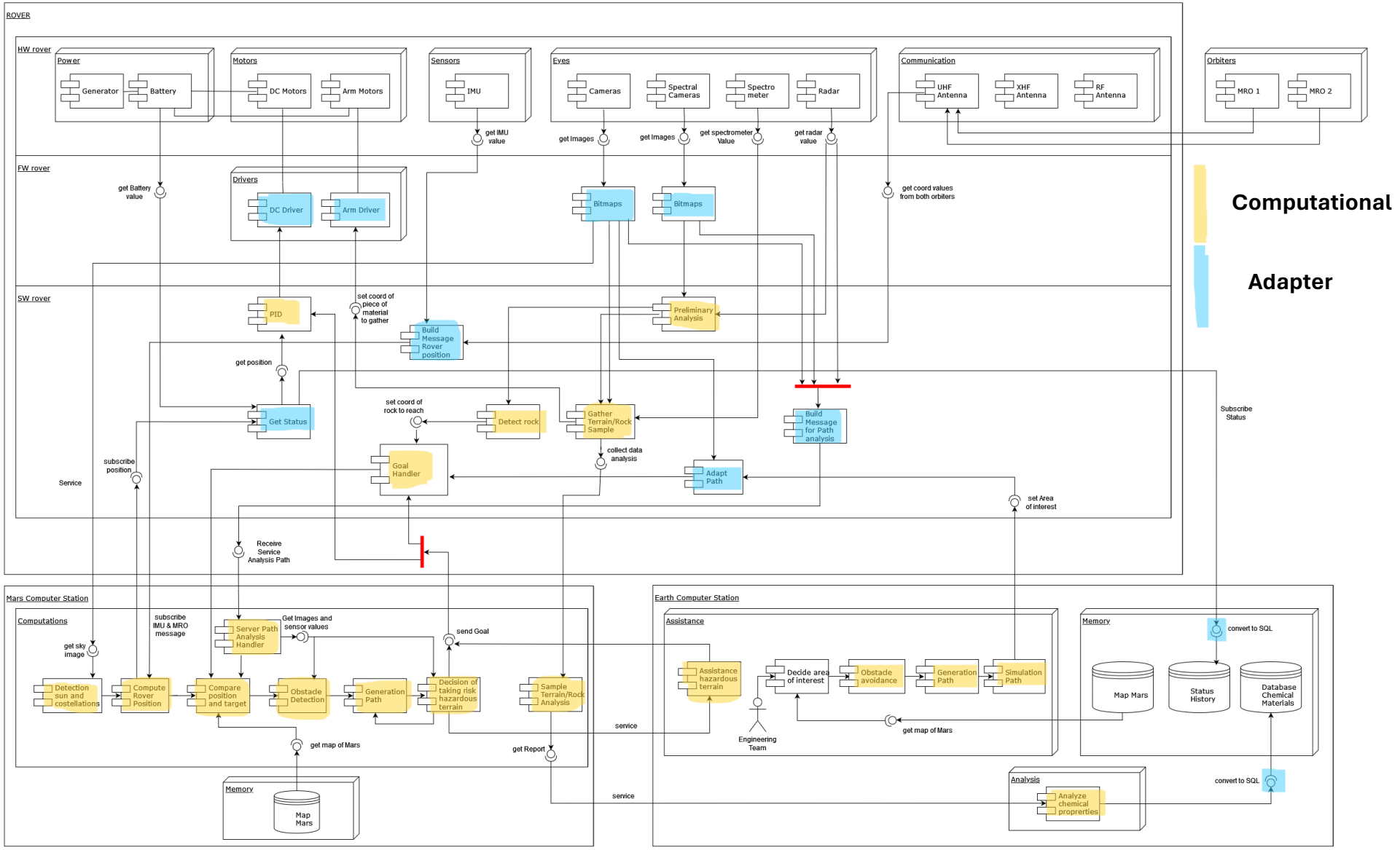
Antennas managment



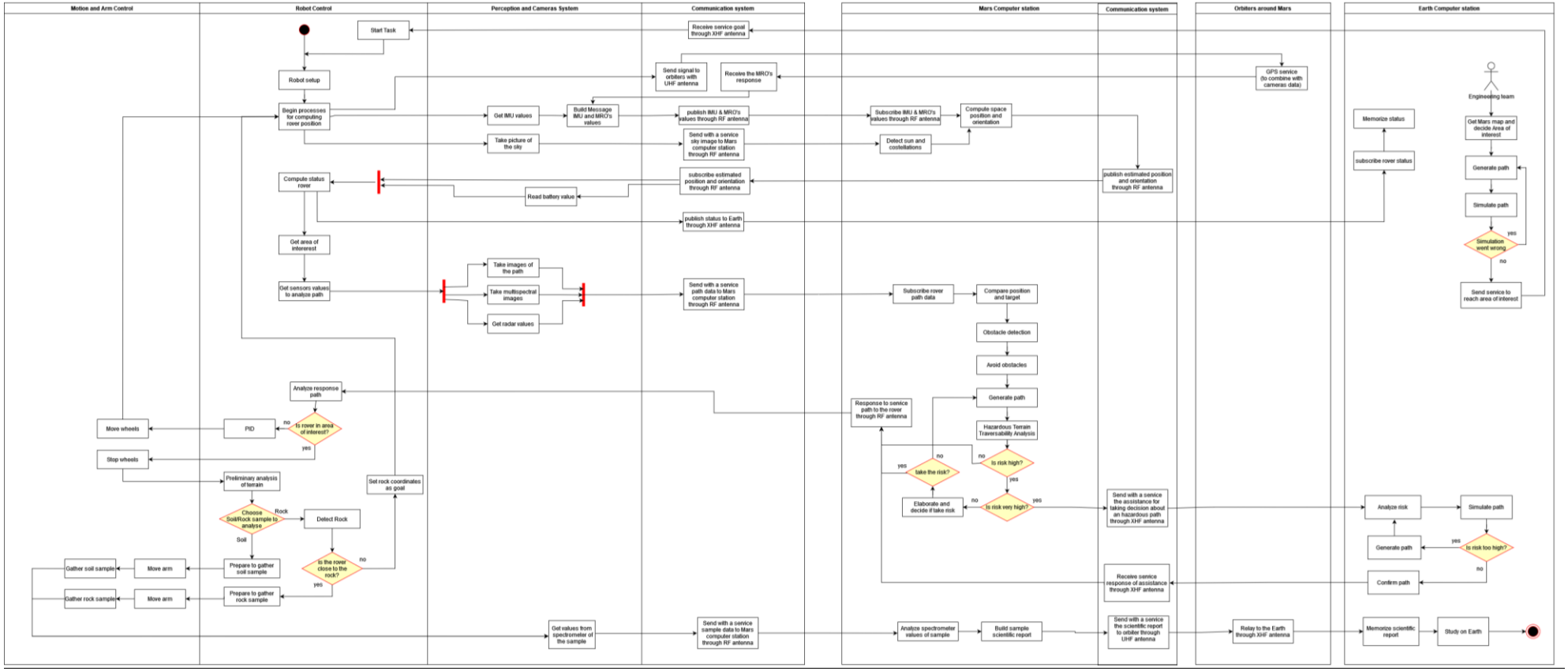
Component Diagram



Component Diagram (Computational or Adapters)

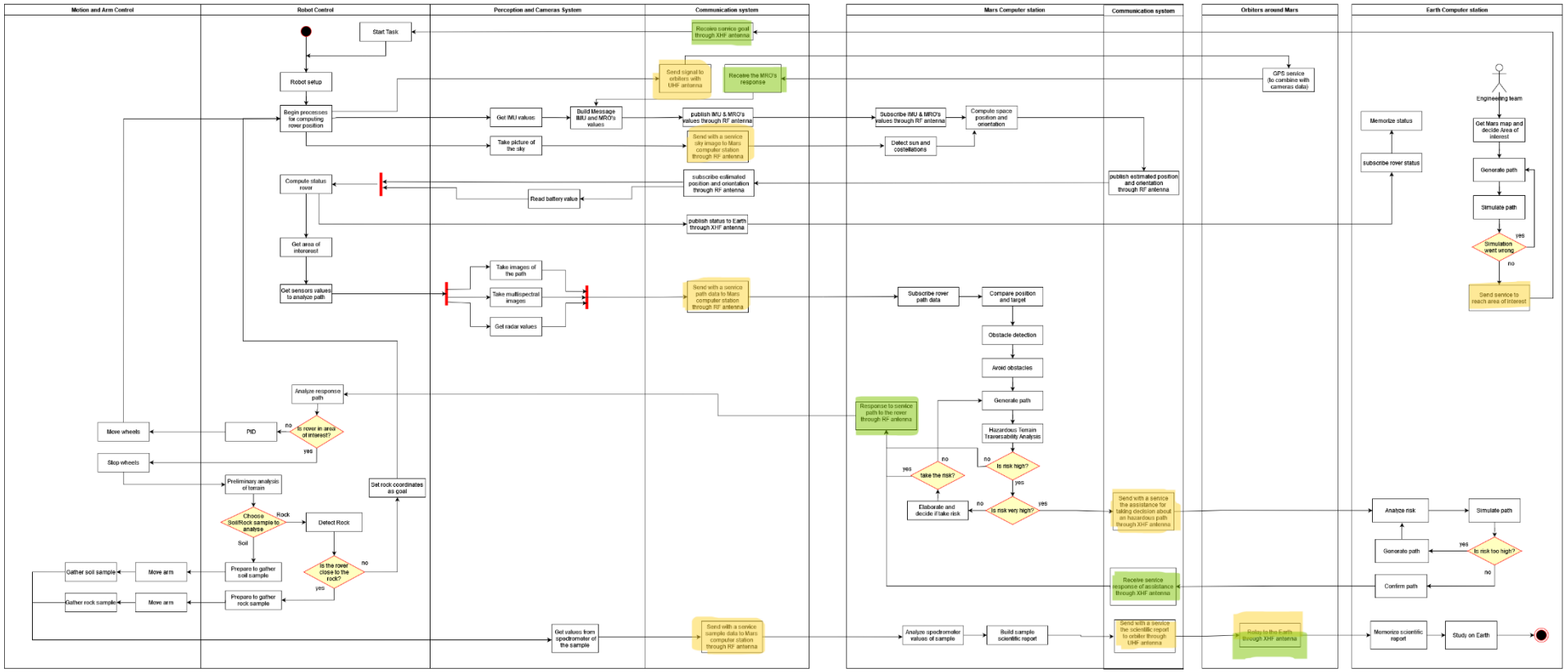


Activity Diagram



There are 4 main blocks. From left to right, we have the Rover, the Mars computer station, the orbiters around Mars and at the end the computer station on Earth.

Activity Diagram (Request-Process-Reply communication)



Service **request** are highlighted in Yellow and **response** are highlighted in Green.

State Machine (decision of taking risk hazardous terrain – Mars computer station)