

## **Background**

Satellites are a key component of our everyday life. From weather forecasting, telecommunication networks, to GPS navigation they are essential to many systems we use on a daily basis. In order to help keep up with the rising demand of earth observation capabilities there is a new five satellite constellation of imaging satellites that will be launched shortly into a sun-synchronous low-earth orbit. Each satellite is an identical copy of the other and will be placed into orbit equally spaced apart. These satellites will then be used to image the earth night and day based on the needs of a diverse set of users. Communication with satellites is typically done through large ground based antennas. While the new constellation of satellites does have a globally distributed network of stations this still means that there will only be certain times where the satellite is able to be commanded and data is able to be retrieved. Imaging activities are not the only commands that will need to be sent to the satellite. In order to ensure a healthy constellation, there are certain activities that may need to be performed periodically (i.e., battery calibration and/or orbital maneuvers). Each satellite will also have limits with respect to storage space for images, power to operate the imaging payload, and a variety of other constraints that will have to be accounted for when planning the activities.

## **Main Objectives**

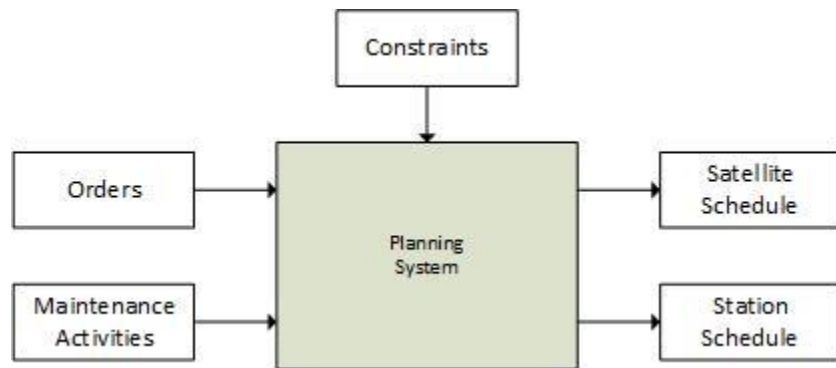
Your objective is to design and create a web-based software system capable of scheduling and downlinking images ordered by users amid a wide variety of constraints. The system should be configurable while also being largely automated, not requiring any user-intervention to carry out the nominal process. While automation is critical it is still important to allow users of the system to observe the state of the system and the status of the various submitted orders.

## **Project Deliverables**

Git repository containing project source code and documentation

## **System Description**

The system can be described at a high level as consisting of three inputs and two outputs as in the figure below. The system receives orders from the user community and maintenance activities from the satellite operators. It then must take those requests and plan them to be executed within the constraints of the satellite and station availabilities. It then outputs those plans in the form of two schedules, one for the spacecraft and one for the ground station.



## Inputs

*Image Orders* – An image order specifies the location, time constraints, and type of image that is requested. A single image order can consist of several individual images each with their own location, time constraints, and types.

*Satellite Maintenance Activities* – A Satellite maintenance activity is an action that must be performed onboard the satellite that prevents imaging while it is executed. The activity must be completed within a time window specified as part of the request.

*Constraints* - Each of the key components/units has its defined set of constraints, including the following.

Ground Station Constraints	<ul style="list-style-type: none"> <li>• Fixed locations on Earth</li> <li>• Uplink/downlink rates</li> </ul>
Satellite Constraints	<ul style="list-style-type: none"> <li>• Storage Capacity</li> <li>• Power capacity</li> <li>• Orbit, which defines its location at any time</li> </ul>
Order Constraints	<ul style="list-style-type: none"> <li>• Imaging location</li> <li>• Image type</li> <li>• Time to image by</li> <li>• Revisit frequency (could be a Single order or a pattern of revisit with time or spatial constraints)</li> </ul>
Maintenance Constraints:	<ul style="list-style-type: none"> <li>• Time window during which maintenance must be performed</li> <li>• Duration of maintenance</li> </ul>

## Outputs

*Satellite Schedule* – This is the list of actions that will be executed by a satellite. It should include when the list will be sent to the satellite to ensure that it is uploaded before the actions must be completed.

*Station Schedule* – This is the schedule of when each station is being used for uplinking and downlinking from the spacecraft and with which spacecraft from the constellation.