Software Project

SpaceZ industries is in the business of launching rockets and satellites in space for their customers. Every **SpaceZ** space-craft launch has two parts a launch vehicle or the "Rocket" and the payload which could be a satellite. **SpaceZ** has a Deep Space Network (**DSN**) facility containing a Mission-Control system and communication system from which they launch and communicate with their spacecrafts.

SpaceZ wants you to design a software system to run their operations. This software system can be classified as follows:

1) DSN Software ComponentFeatures:

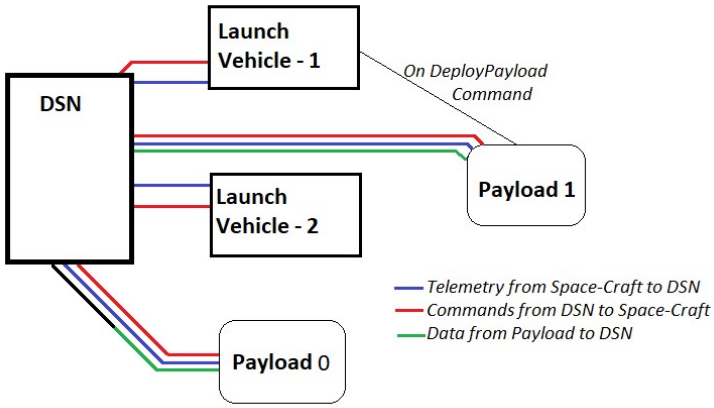
1. Able to show dashboard for
    1. All current active spacecrafts.
    2. All spacecrafts waiting to be launched.
2. Able to select a specific active spacecraft and look at its data.
3. Able to send command to a specific spacecraft.
4. Able to launch a new spacecraft.

2) Launch-Vehicle Software ComponentFeatures:

1. Able to receive and process commands from DSN.
2. Able to send real-time telemetry of itself back to DSN.

3) Payload/Satellite Software ComponentFeatures:

1. Able to receive and process commands from DSN.
2. Able to send real-time telemetry of itself back to DSN.
3. Able to send its Data back to DSN.



Example software components and communication interfaces between them:
DSN launched LV-1 and Deployed its Payload, DSN launched LV-2 and not yet deployed its Payload and DSN has Payload 0with its LV-0 already Deorbited

Design Rules:

Configuration:

- A **Launch-Vehicle** configuration should be defined in a config-file with following information
    1. Name: Name of launch vehicle.
    2. Orbit Info: Radius of orbit in (km).
    3. Payload Config-File: Pointer to the configuration file for payload.

- A **Payload** configuration should be defined in a config-file with following information
    1. Name: Name of payload
    2. Type: Type of payload (Possible Values: Scientific, Communication, Spy)

Data sent by actual "Payload" can be modeled randomly as follows:

Scientific: Periodic scientific data of your choice and format

Example,
Solar-Activity in solar-flares per second every 3 seconds*or*
Weather-data (%Rain, %Humidity, %Snow) every 1 min.

Communication: Periodic communication utilization data of your choice and format

Example,
Bandwidth utilization (Uplink and downlink data rates) every 5 seconds.

Spy: Periodic image data of your choice and format

Example:
An image every 10 seconds.

Launch Sequence:

DSNlaunches a **Launch-Vehicle** as follows:

- User should be able to select a **Launch-Vehicle** configuration file and launch.
- **DSN** software should then start the program/executable for Launch-Vehicle with the selected configuration-file.
- Using the orbit info in the configuration Launch-Vehicle will "fly" till the orbit is reached. This needs to be simulated as follows:
    - Using orbit info launch vehicle will calculate time-to orbit as follows:

        t = (Orbit Radius in km / 3600 + 10) seconds

- After t seconds have elapsed only then **Launch-Vehicle** can then accept "***DeployPayload***" command from **DSN**.
- After t seconds have elapsed **Launch-Vehicle** needs to "update" **DSN** that it has reached its orbit.

Commands:

Launch-Vehicle software should accept following Commands from **DSN**:

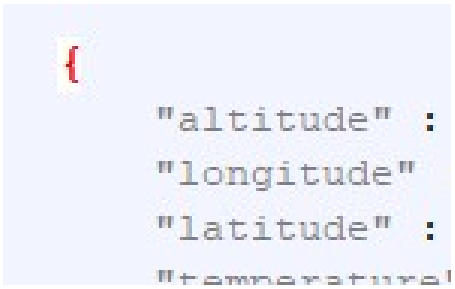
- ***DeployPayload***: Start the **Payload** software program/executable with the configured **Payload** Config-File.
- ***Deorbit***: End the **Launch-Vehicle** software program to simulate that **Launch-Vehicle** has been de-orbited.
- ***StartTelemetry***: Start sending (random/realistic up to you) telemetry data every second to **DSN**.
- ***StopTelemetry***: Stop sending telemetry data to **DSN**.

Payload software should accept following Commands from DSN:

- ***StartData***: Start sending data configured according to "*Type*" in **Payload** Config-File to **DSN**.
- ***StopData***: Stop sending data to **DSN**
- ***Decommission***: End **Payload** software program to simulate that **Payload** has ended its mission.
- ***StartTelemetry***: Start sending (random/realistic up to you) telemetry data every second to **DSN**.
- ***StopTelemetry***: Stop sending telemetry data to **DSN**.

Telemetry:

- Telemetry data sent by either Launch-Vehicle or Payload can be random or realistic.
- Each piece of telemetry can include following information
    - Altitude: in km
    - Longitude: in degrees (-90 deg (South) to +90 deg (North))
    - Latitude: in degrees (-180 deg (West) to 180 deg (East))
    - Temperature: in kelvin
    - **Time to Orbit**: in seconds counting down to 0(This must be the from above t calculation)
- Example:



Example guidelines:

Configuration for a Launch-Vehicle and its payload can be as follows:

```
*Launch Vehicle Config*
    Name: Bird-9              // Name of Launch-Vehicle
    Orbit: 600                // Low-earth orbit of 600
    PayloadConfig: <path to Payload Config defined be

*Payload Config*
    Name: GPM             // Name of Satellite (Global
    Type: Scientific      // Weather data
```

```
*Launch Vehicle Config*
    Name: Bird-Heavy          // Name of Launch-Vehicle
    Orbit: 36000              // Geostationary orbit of
    PayloadConfig: <path to Payload Config defined bel

*Payload Config*
    Name: TDRS-11             // Name of Satellite (Trac
    Type: Communication       // Bandwidth data
```

```
*Launch Vehicle Config*
    Name: Hawk-Heavy          // Name of Launch-Vehi
    Orbit: 3000               // Polar orbit of 3000
    PayloadConfig: <path to Payload Config defined

*Payload Config*
    Name: RO-245              // Name of Satellite (
    Type: Spy                 // Image data
```

Submission Criteria:

- Implementation can be done in any choice of language/platform provided it can be run and tested easily on a Windows Machine.
    - Preferred option is .NET platform with C# language and Visual Studio for solution. WPF for UI side, WCF for inter-process communication.
- Please provide a **complete working solution** and instructions on how to run.
- If you are using any third-party dependencies or libraries, please provide instructions on how to set them up before we can run and test your submission. Please include them in your submission as well.
- Your submission must have ***distinct programs/executables*** for DSN, Launch-Vehicle and Payload and demonstrate the required communication between them.
- Your submission must include **complete source-code** and instructions on how to compile and build it.
- Only the DSN software component has some user-interface requirements, the other two components need not have user-interface.