42 Sim Project Objectives

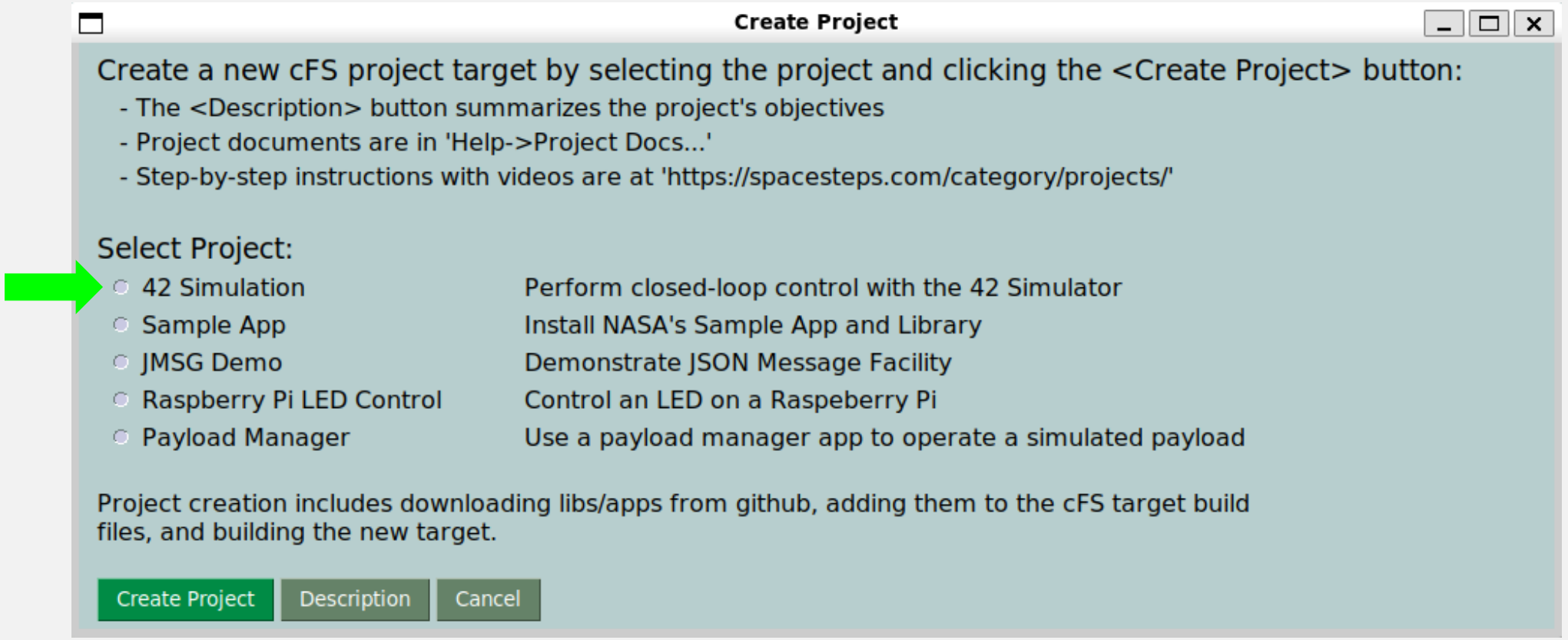
This project enables you to run a spacecraft attitude controller in a cFS app in a closed-loop simulation using the 42 simulator. Closed-loop simulation is a method of running a system by connecting a controller to a simulator that models the time-varying behavior of the spacecraft and its environment.

Detailed project instructions with videos can be found at

https://spacesteps.com/TODO/

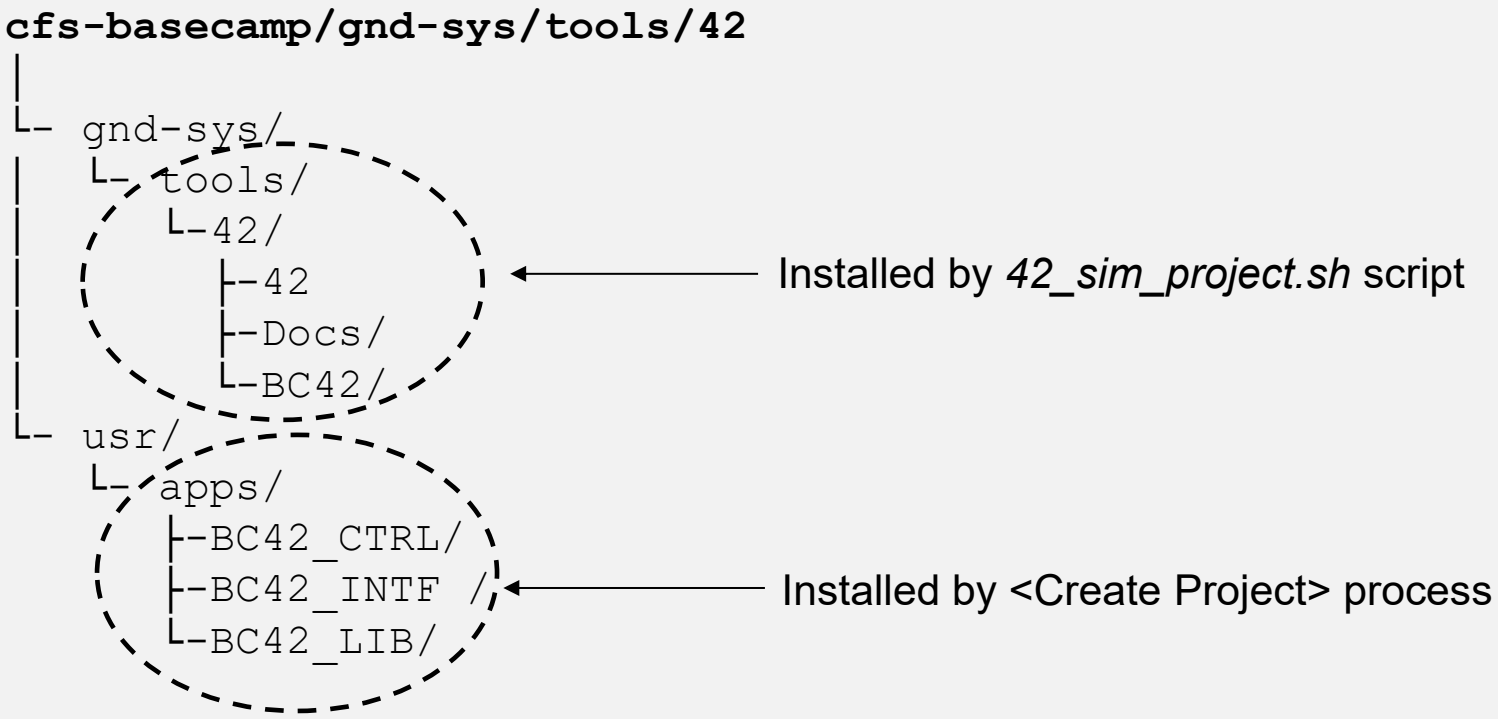
Software Installation (1 of 3)

This project requires a library and two apps to be installed into the cFS target. It also requires the 42 Simulator to be downloaded from github, configured and built in its “Standalone” mode. The Basecamp Create Project should be used to performs both of these activities.



Software Installation (2 of 3)

42 is installed Basecamp's ground system tools directory.



Notes:

1. Basecamp's Create Project runs the *42_sim_project.sh* script to download, configure and build 42 and it serves as documentation for this process
2. In Basecamp 2.8 this shell script must be manually run. It will be automated in 2.9.

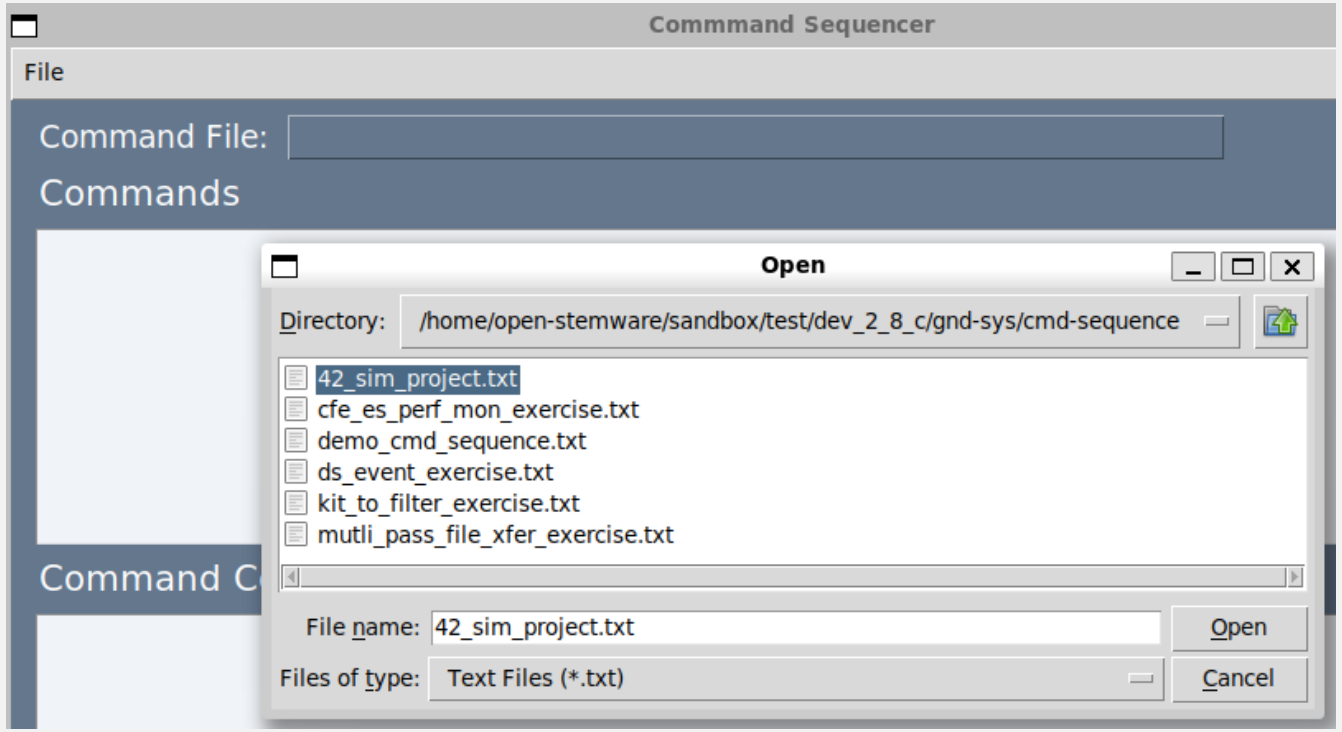
Running a Simulation (1 of 4)

1. Start 42
   A. Open a terminal window
   B. Changed directory to /gnd-sys/tools/42
   C. Start 42 ‘./42 BC42’
   D. Multiple blank windows should appear and you should see the follow output in the terminal window

```
open-stemware@Open-STEMware:~/sandbox/42$ ./42 BC42
0.0 SC[0] qrl = [0.0  0.0  0.0  1.0]
Reached CmdScript EOF at Time = 0.000000
Initializing GLUT
Initializing Cam Window
Loading Cam Shaders
Loading Cam Textures
Loading 3D Noise
Loading Cam Lists
Cam Window Width = 800
Cam Window Height = 800
Cam Screen Width = 1600
Cam Screen Height = 900
Done Initializing Cam Window
Server is listening on port 10001
```

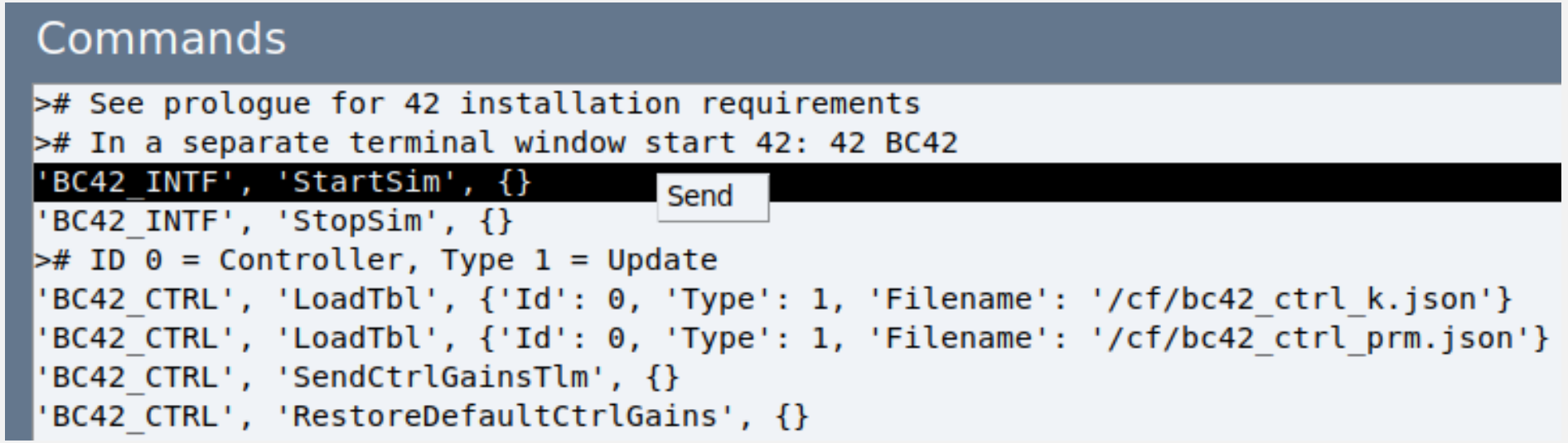
Running a Simulation (2 of 4)

2. Start Basecamp and then start the cFS
3. Launch the *Command Sequencer* from the Tools menu and open the 42-sim_project.txt file



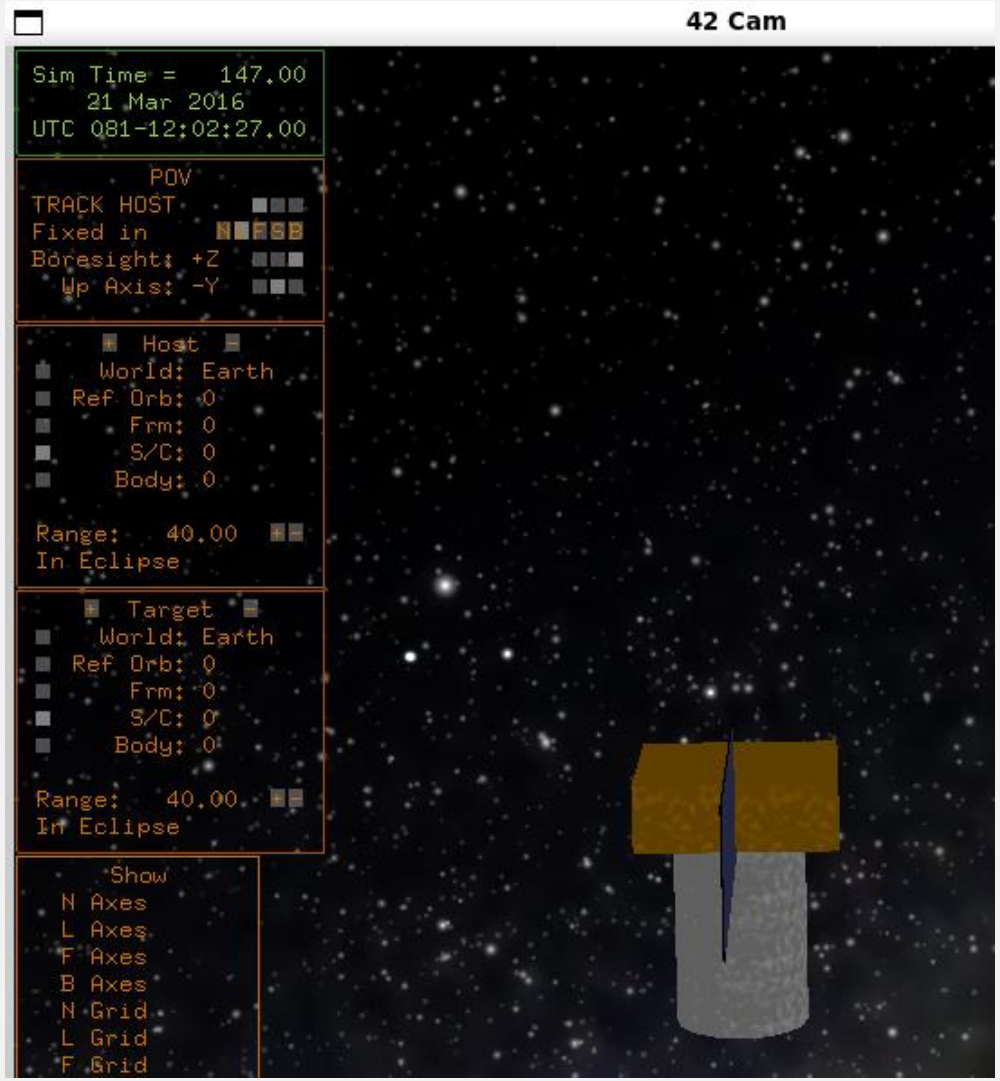
Running a Simulation (3 of 4)

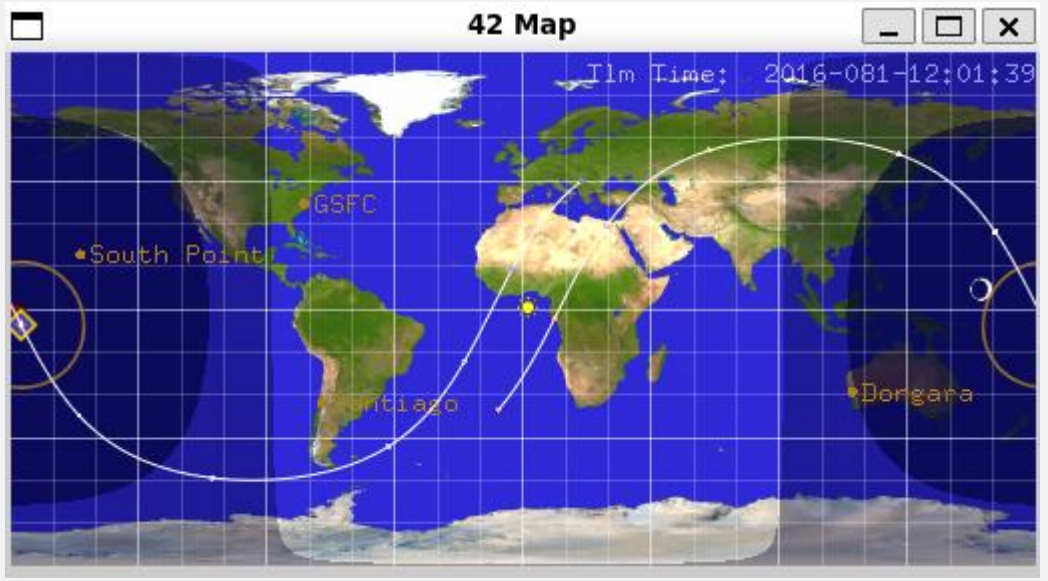
4. Send the BC42_INTF StartSim command
   A. Highlight the StartSim command line
   B. Right click and select Send



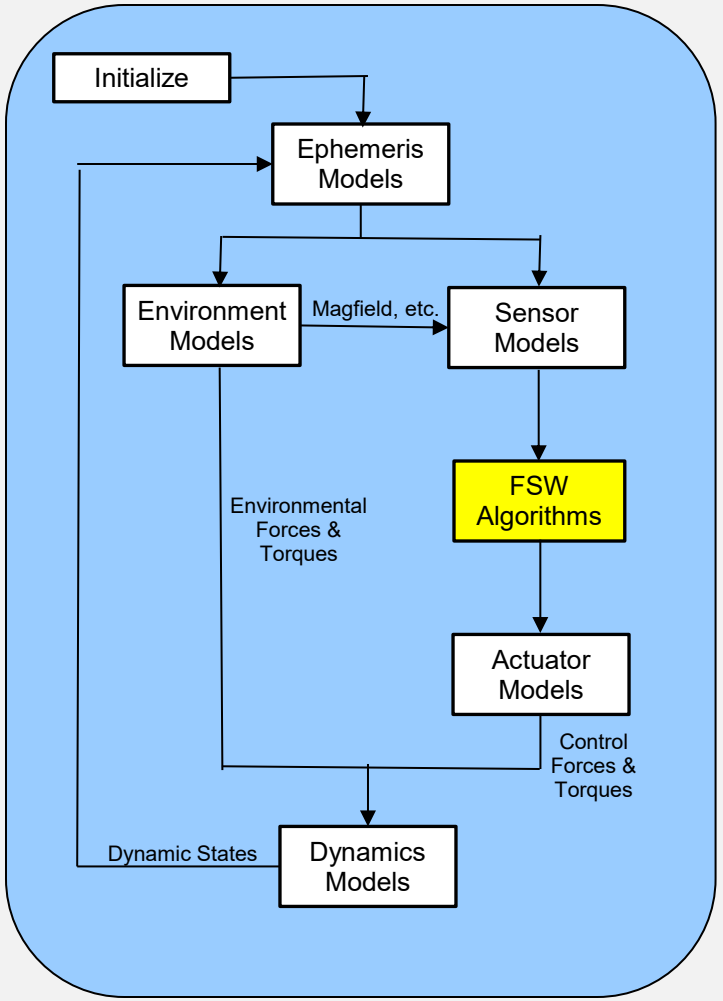
Running a Simulation (4 of 4)

The blank 42 screen should be populated





42 Sim Data Flow



Closed-loop Control Data Flow

42 Simulator

Initialize

Ephemeris Models

Environment Models

Magfield, etc.

Sensor Models

Environmental Forces & Torques

Actuator Models

Control Forces & Torques

Dynamic States

Dynamics Models

cFS Target

Sensor Data

BC42_INTF

Sensor Data Message

BC42_CTRL

Telemetry Output

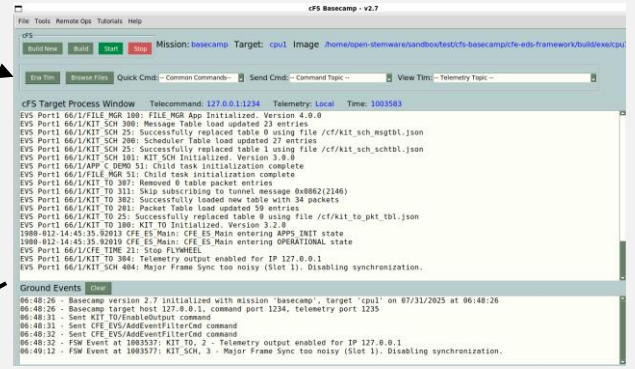
Command Ingest

Actuator Command Message

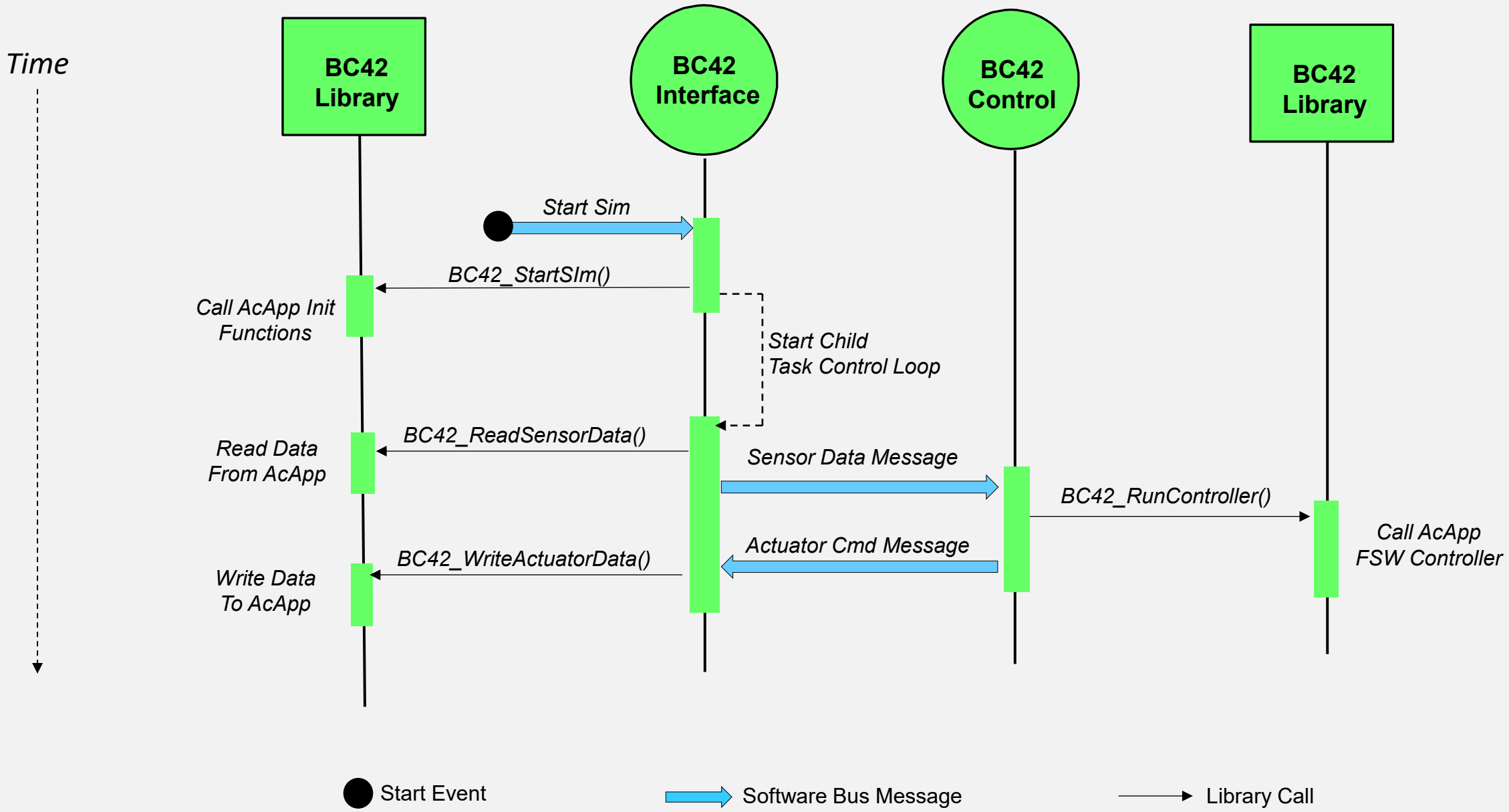
Actuator Commands

BC42_INTF

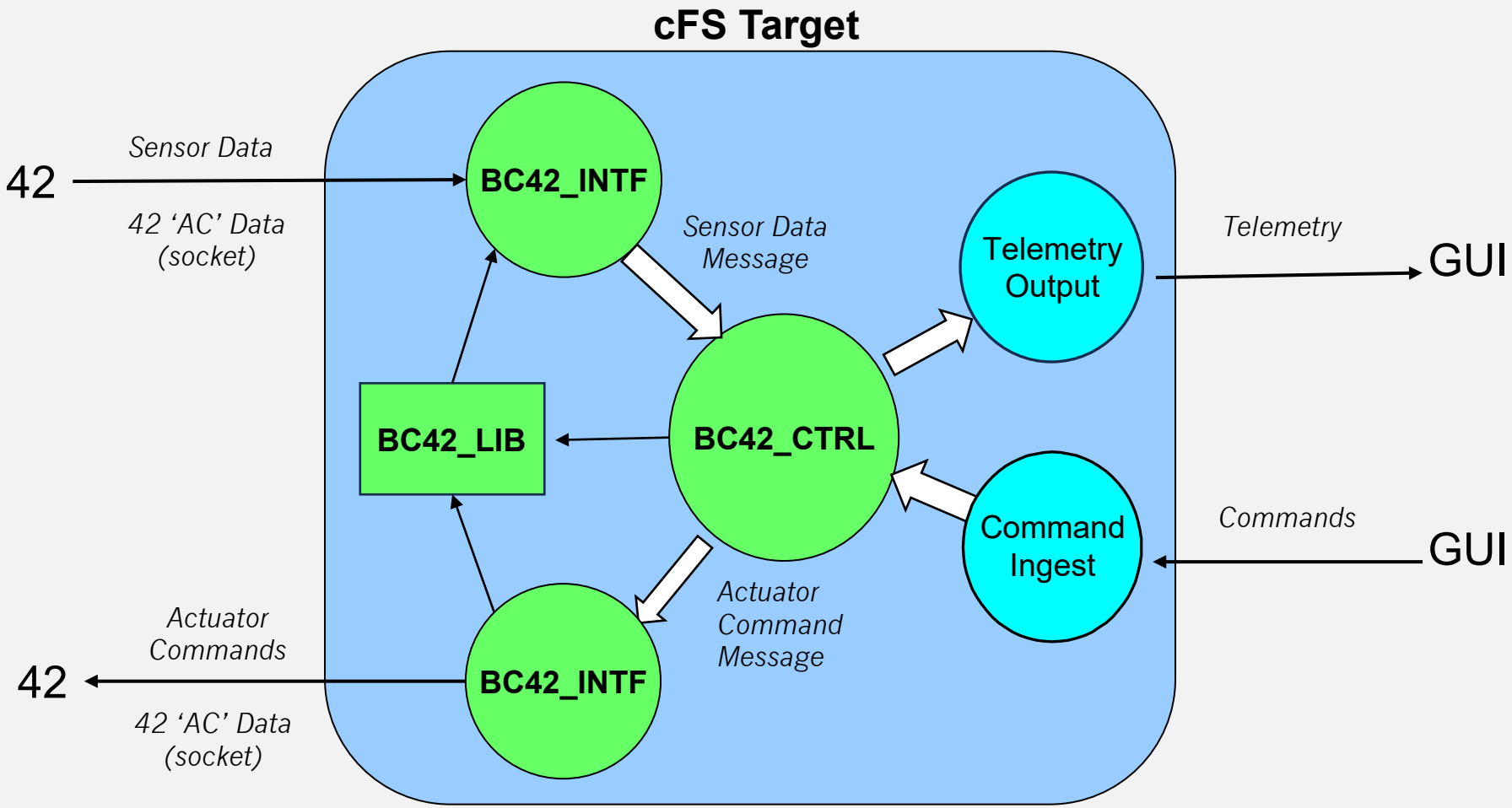
Basecamp GUI



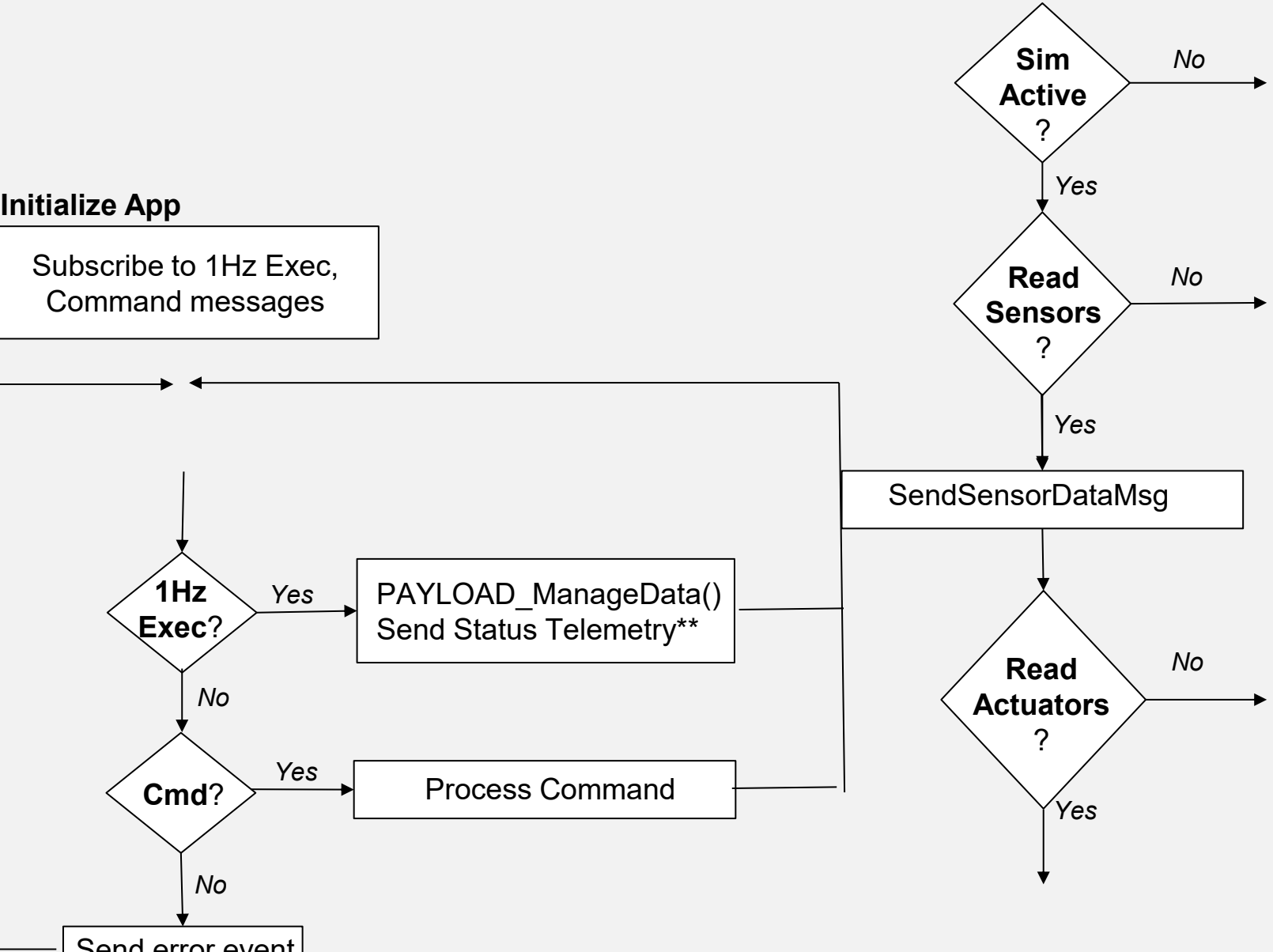
Start & Run Simulation



Detailed Library Flow



BC42_INTF::ControlLoopTask



Detailed 42 Interface Flow