



42 Sim Project Objectives

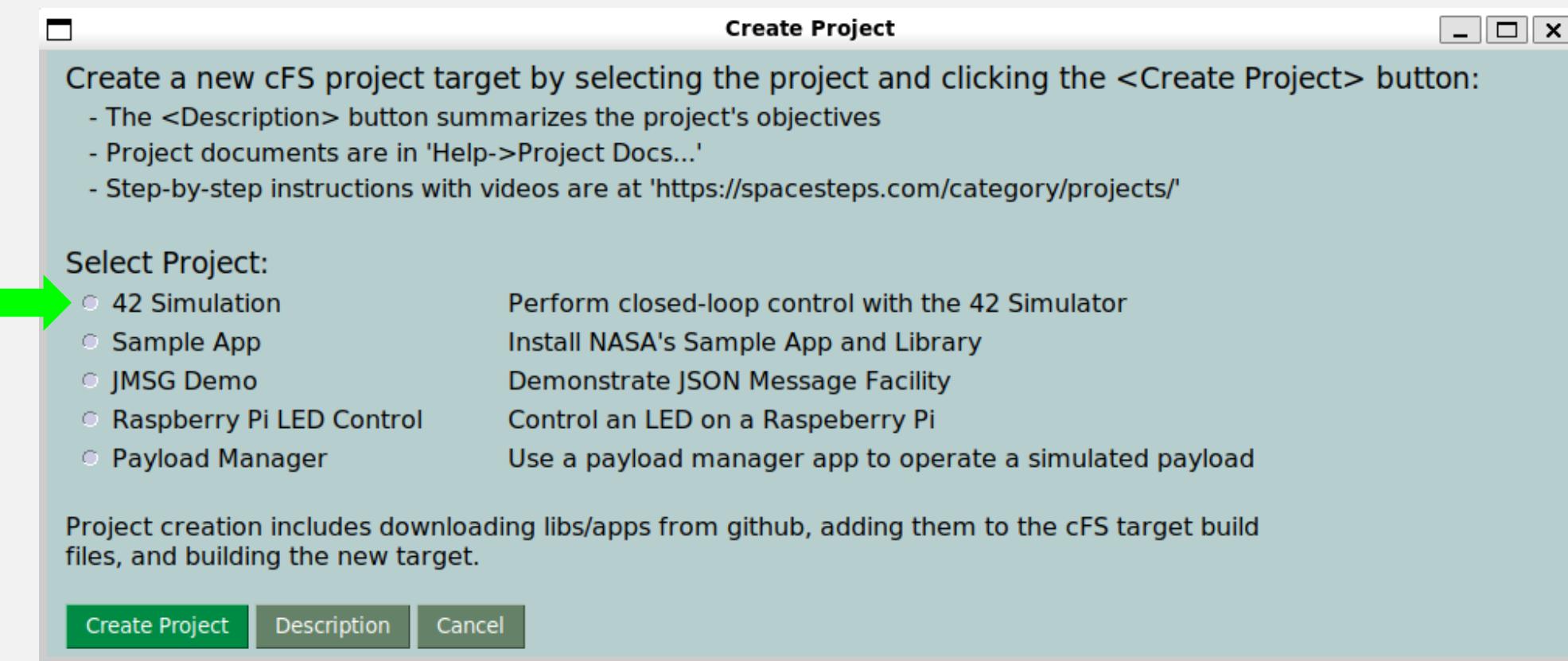
This project enables you to run a spacecraft attitude controller in a cFS app in a closed-loop simulation using the 42 simulator. Closed-loop simulation is a method of running a system by connecting a controller to a simulator that models the time-varying behavior of the spacecraft and its environment.

Detailed project instructions with videos can be found at

<https://spacesteps.com/TODO/>

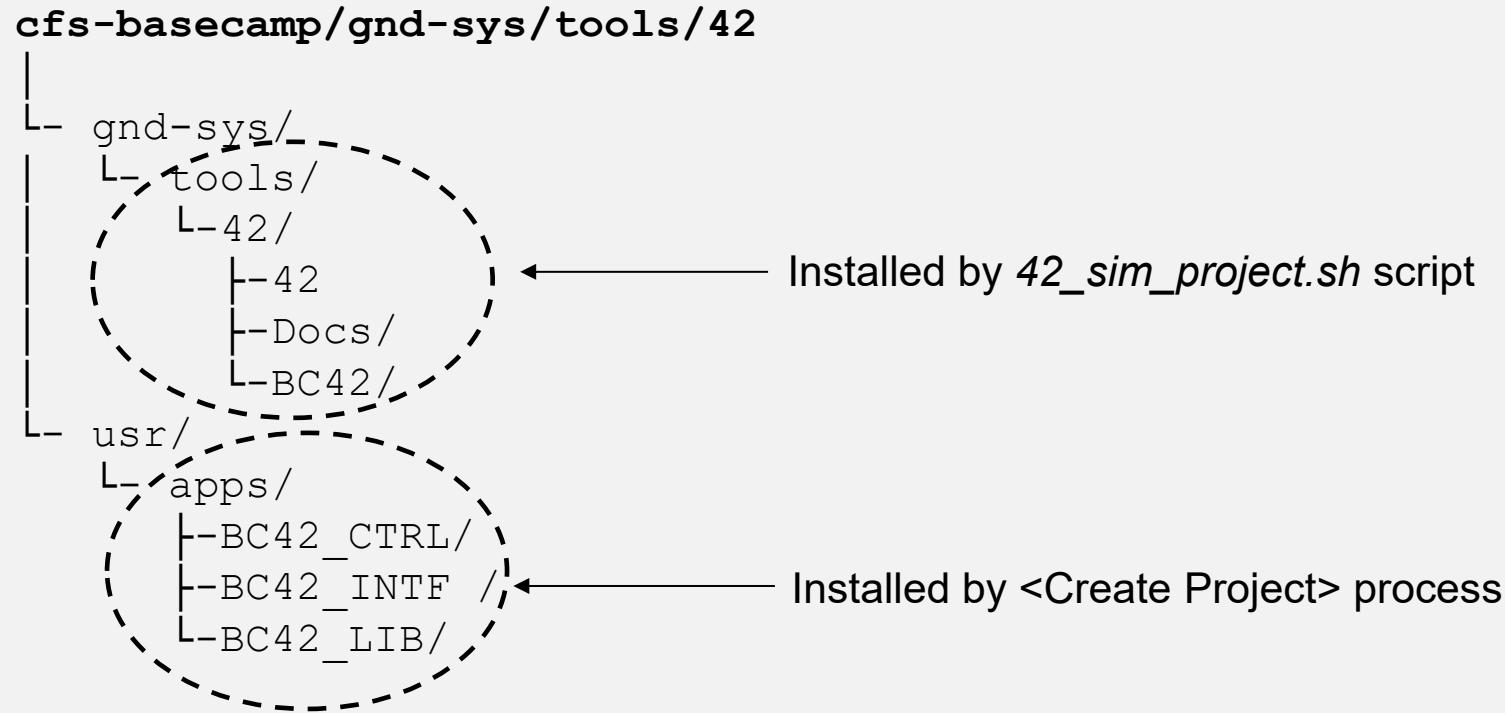
Software Installation (1 of 3)

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.



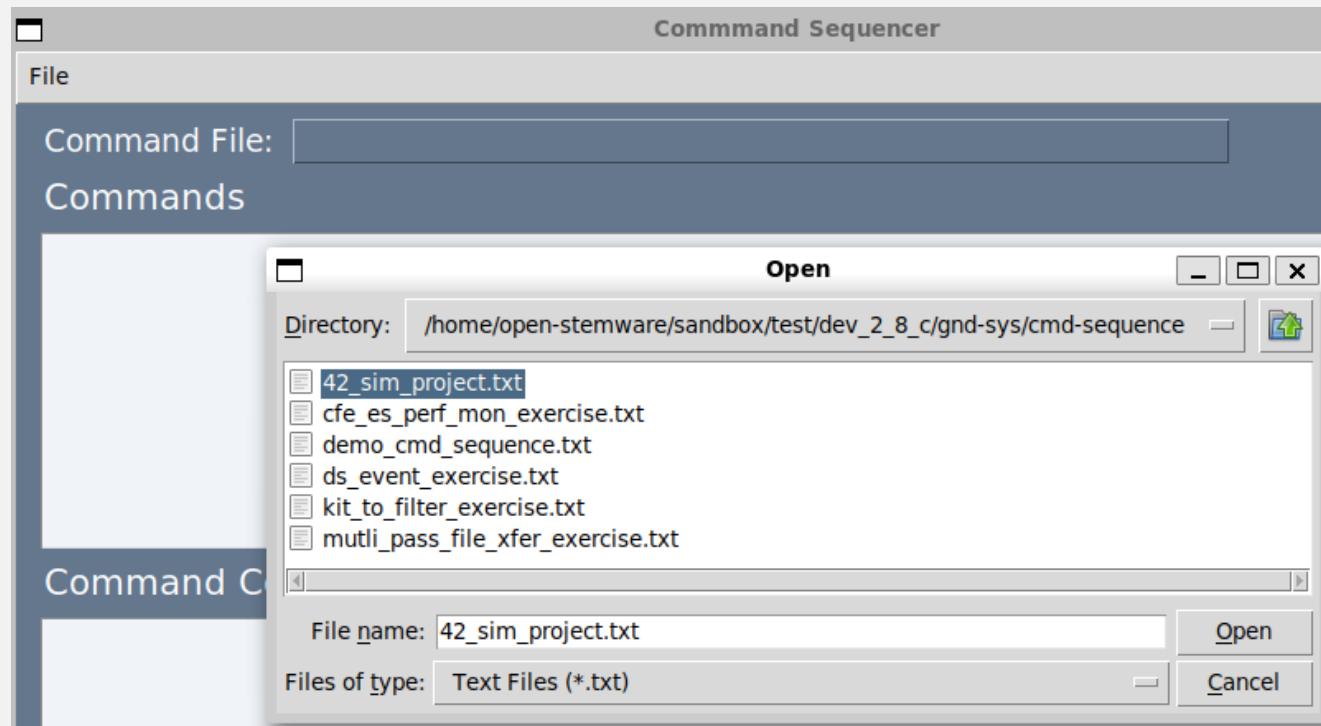
Running a Simulation (1 of 4)

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)

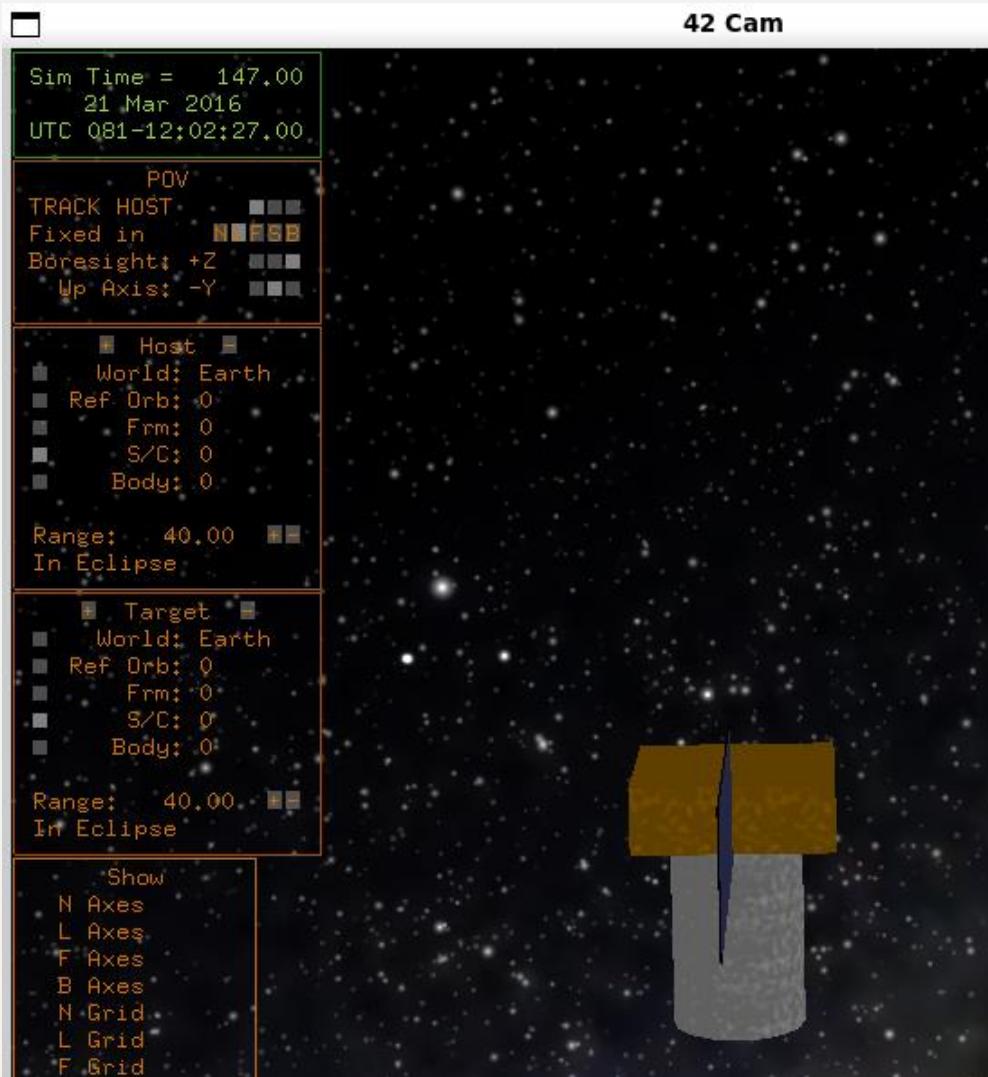
4. Send the BC42_INTF StartSim command
 - A. Highlight the StartSim command line
 - B. Right click and select Send

Commands

```
># See prologue for 42 installation requirements
># In a separate terminal window start 42: 42 BC42
'BC42_INTF', 'StartSim', {}           Send
'BC42_INTF', 'StopSim', {}
># ID 0 = Controller, Type 1 = Update
'BC42_CTRL', 'LoadTbl', {'Id': 0, 'Type': 1, 'Filename': '/cf/bc42_ctrl_k.json'}
'BC42_CTRL', 'LoadTbl', {'Id': 0, 'Type': 1, 'Filename': '/cf/bc42_ctrl_prm.json'}
'BC42_CTRL', 'SendCtrlGainsTlm', {}
'BC42_CTRL', 'RestoreDefaultCtrlGains', {}
```

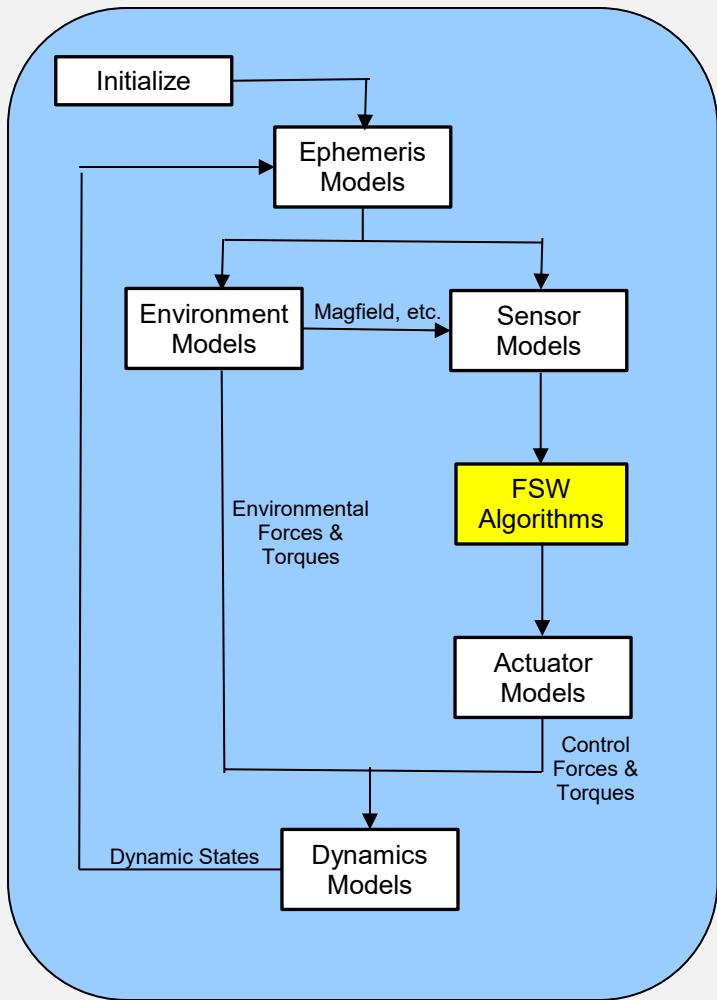
Running a Simulation (4 of 4)

The blank 42 screen should be populated





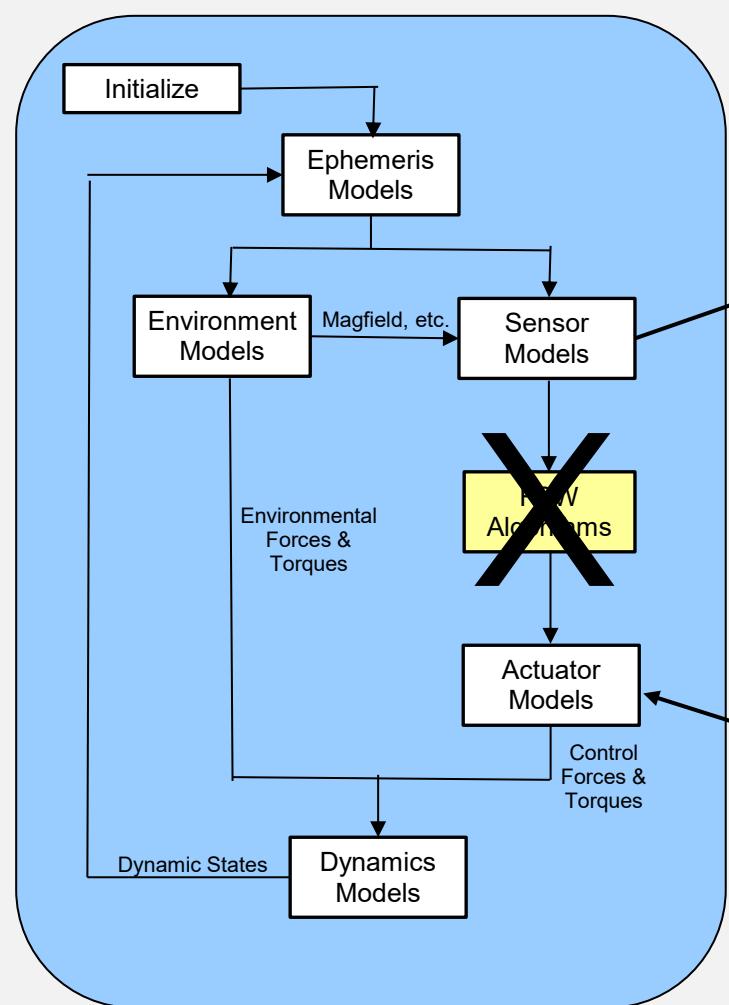
42 Sim Data Flow



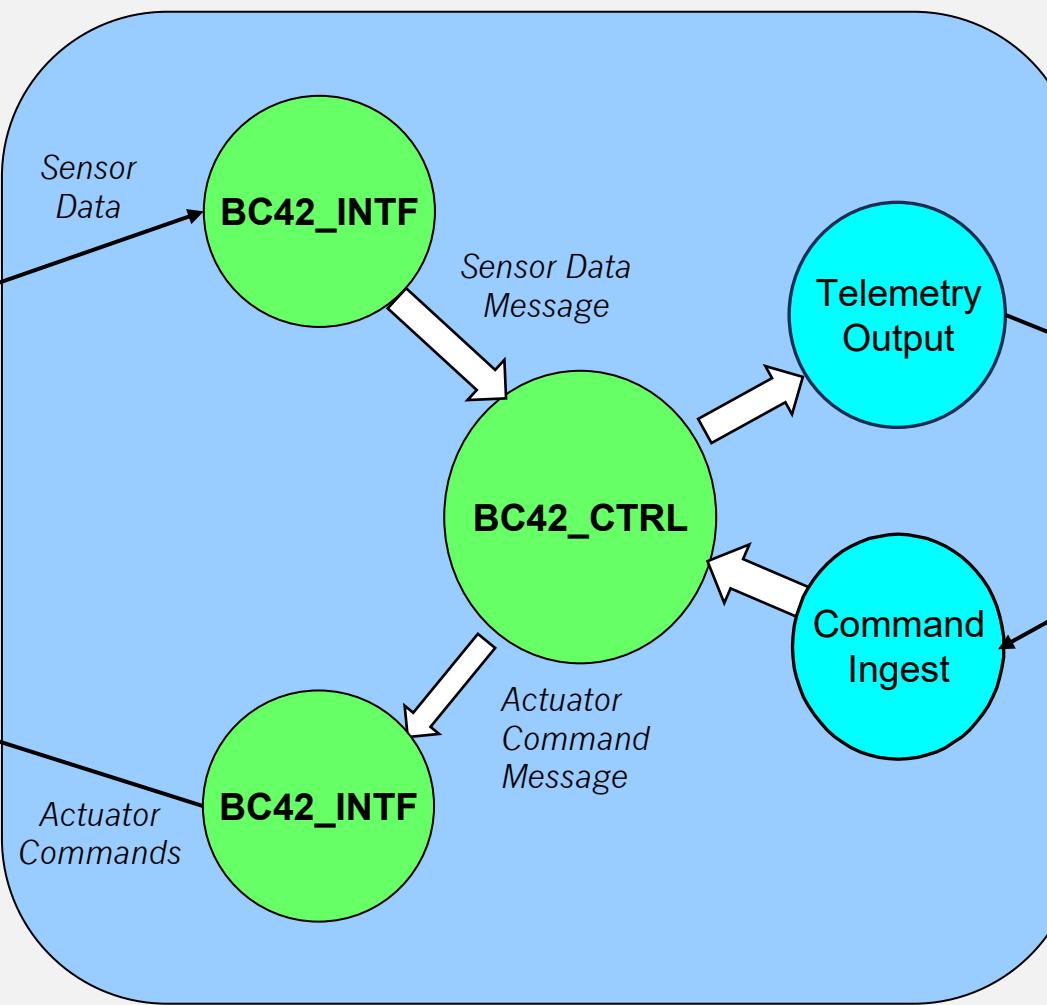


Closed-loop Control Data Flow

42 Simulator



cFS Target



Basecamp GUI

The screenshot shows the cFS Basecamp - v2.7 application window. At the top, there's a menu bar with File, Tools, Remote Ops, Tutorials, Help, and a toolbar with Build, Start, Stop buttons. The main area has tabs for Mission, basecamp, Target: cpul, Image, and Home. Below the tabs is a toolbar with Erase Tim, Browse Files, Quick Cmd, Send Cmd, View Tim, and Telemetry Topic buttons. A large arrow points to the 'Send Cmd' button.

cFS Target Process Window

Telemetry: Local | Time: 1003583

Port 110/FILE MGR 100: FILE MGR App Initialized. Version 4.0.0

Port 110/FILE SCHED 200: Scheduler Table loaded, updated 27 entries

Port 110/FILE SCHED 201: KIT SCH Initialized. Version 3.0.0

Port 110/FILE SCHED 202: Successfully loaded new table with 34 packets

Port 110/FILE SCHED 203: Child task initialization complete

Port 110/FILE MGR 531: Child task packet entry

Port 110/KIT TO 387: Removed 0 table packet entries

Port 110/KIT TO 388: Received 1 table packet entries message 0x0002 (2146)

Port 110/KIT TO 202: Successfully loaded new table with 34 packets

Port 110/KIT TO 203: Successfully replaced table 0 using file /cfkit/pkt/tbl.json

Port 110/KIT TO 389: KIT TO Initialized. Version 3.2.0

10000/PPS 012 14:35:55 CFE_EVS: Main entering PPS INT state

10000/PPS 012 14:35:55 CFE_EVS: Main: CFE_EVS_Main entering INTERNAL state

EVS Port 110/KIT TO 386: FSW Event 108537: Telemetry output enabled for IP 127.0.0.1

EVS Port 110/KIT SOC 404: Major Frame Sync too noisy (Stat 1). Disabling synchronization.

Ground Events

04-08-26 - Bascom version 2.7 initialized with mission 'basecamp', target 'cpul' on 07/31/2025 at 06:48:26

04-08-26 - Bascom Target host 127.0.0.1, command port 1234, telemetry port 1235

04-08-31 - CFE_EVS:Main entering INTERNAL state

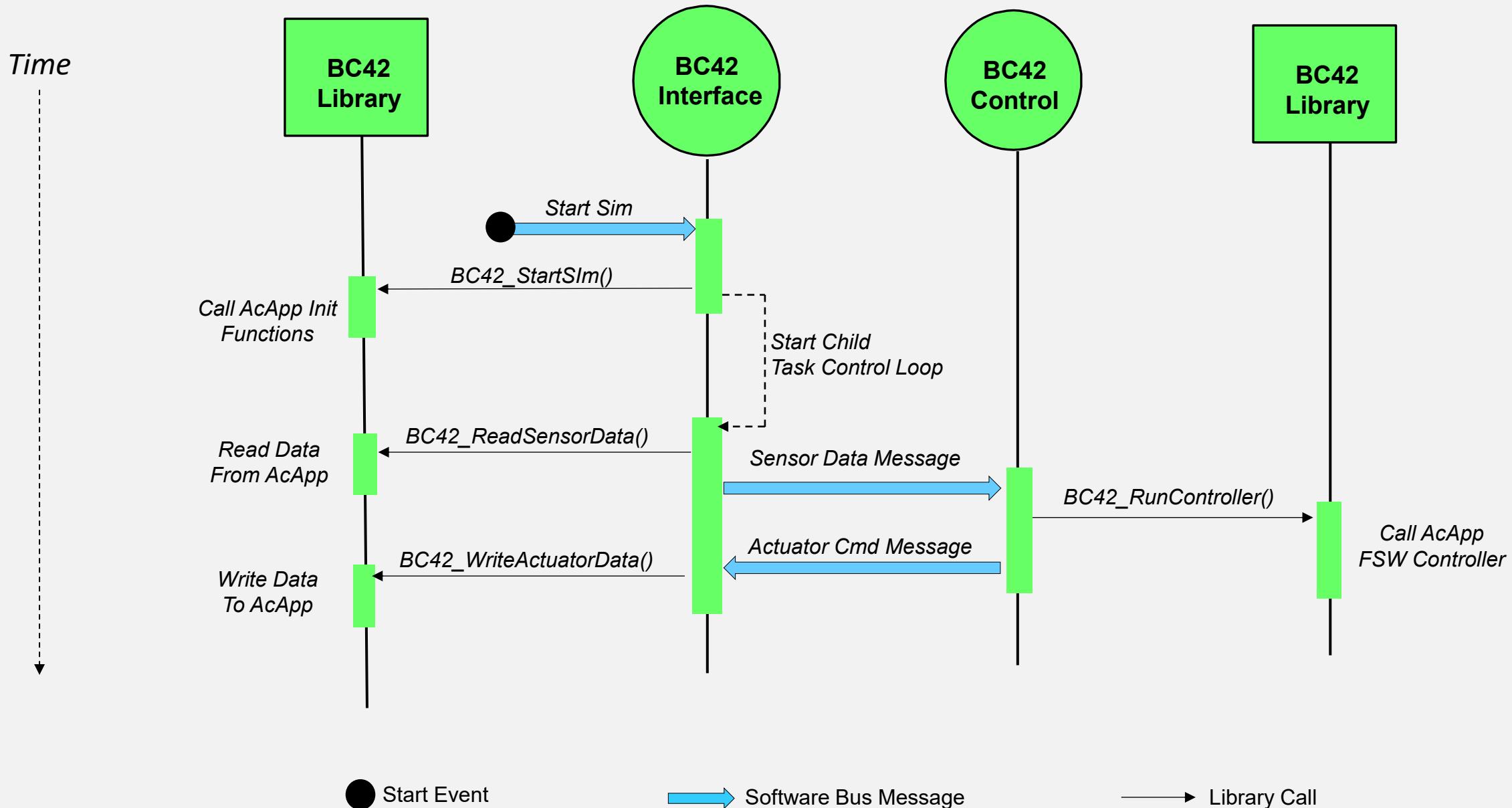
04-08-31 - Sent CFE_EVS:AddDeviceFilterCmd command

04-08-31 - CFE_EVS:Main exiting INTERNAL state

04-08-32 - FSW Event at 108537: KIT TO_2_Telemetry output enabled for IP 127.0.0.1

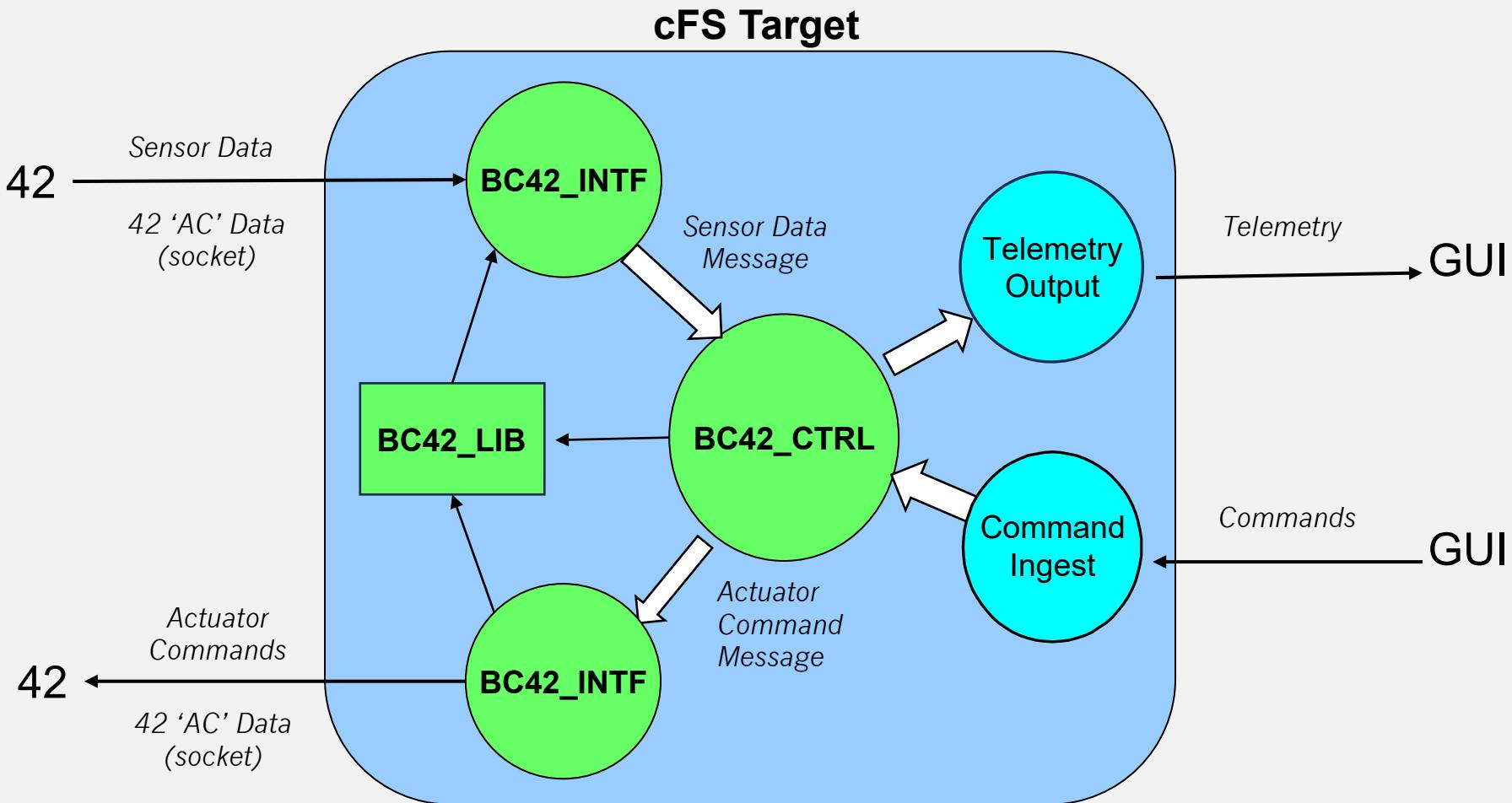
04-09-12 - FSW Event at 108557: KIT_SCH_3_Major Frame Sync too noisy (Stat 1). Disabling synchronization.

Start & Run Simulation





Detailed Library Flow

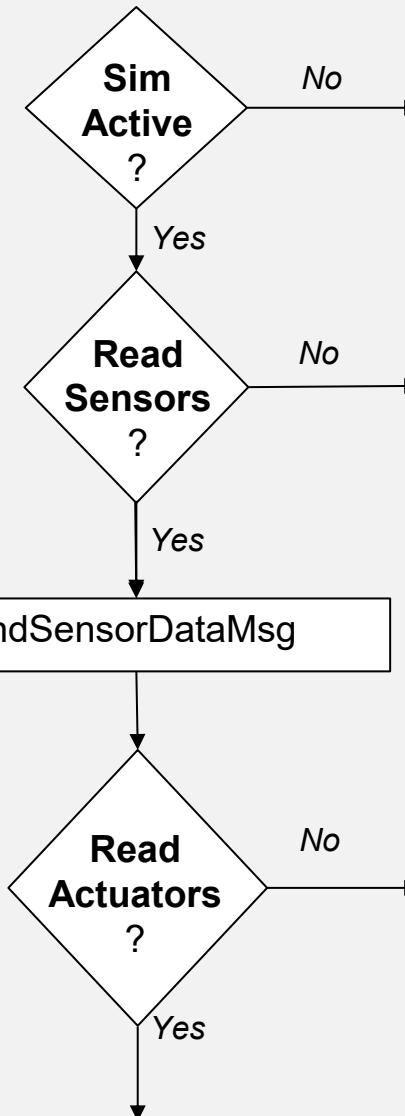
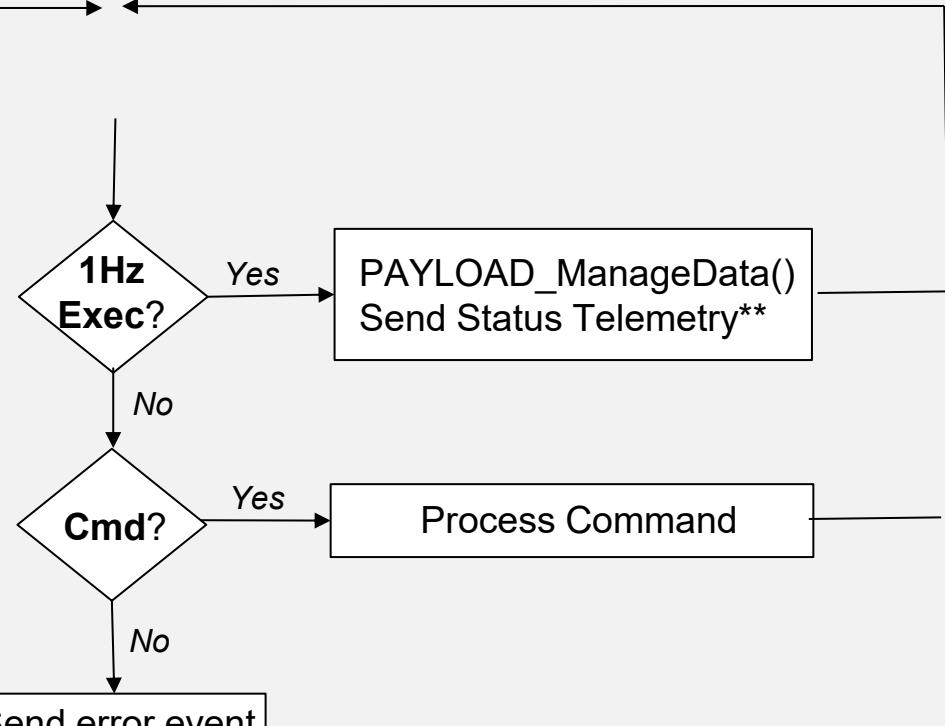




BC42_INTF::ControlLoopTask

Initialize App

Subscribe to 1Hz Exec,
Command messages





Detailed 42 Interface Flow

