Basecamp Introduction Tutorial

Objectives

- Introduce Basecamp features so users can quickly be productive
- Provide guidance on what to do next based on your goals

Lesson 1 Objectives

- Describe Basecamp’s objectives, components, and terminology

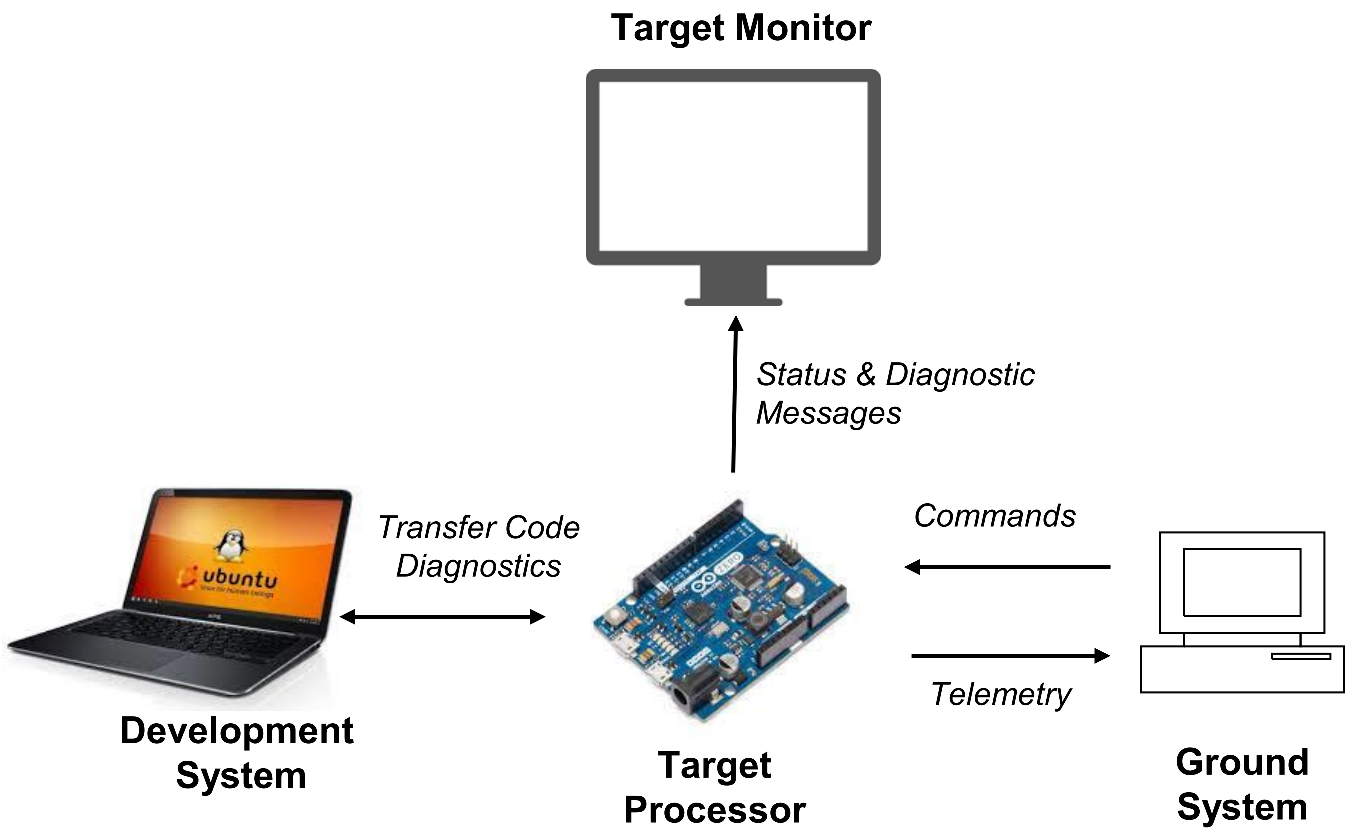
Notes

- This tutorial describes what is available. Other tutorials and documents provide details on workflows and how to accomplish goals.

Why Basecamp?

- Basecamp provides a cFS architectural framework, build/runtime tools, and a lightweight GUI that simplify creating, integrating, testing, and deploying cFS applications
- Provides a foundation for users and educators to create cFS-based projects
- Command and telemetry routing design supports interfacing to external systems
- Supports the following application activities
  - Learn the cFS application architectural model
  - Learn Basecamp's application framework (heritage from OpenSatKit)
  - Develop new applications
  - Download apps from the github cfs-apps repositories
  - Integrate apps into Basecamp's cFS target
  - [future] Learn Basecamp's application packaging specification
  - [future] Certify new apps comply with Basecamp's packaging specification
- <u>Not</u> intended to be a fully functional ground system
- Basic command and telemetry GUI/script interfaces provide app development and runtime support
- [future]cFS build tools can be customized to generate command and telemetry definitions for different ground systems

Embedded Flight Systems Context



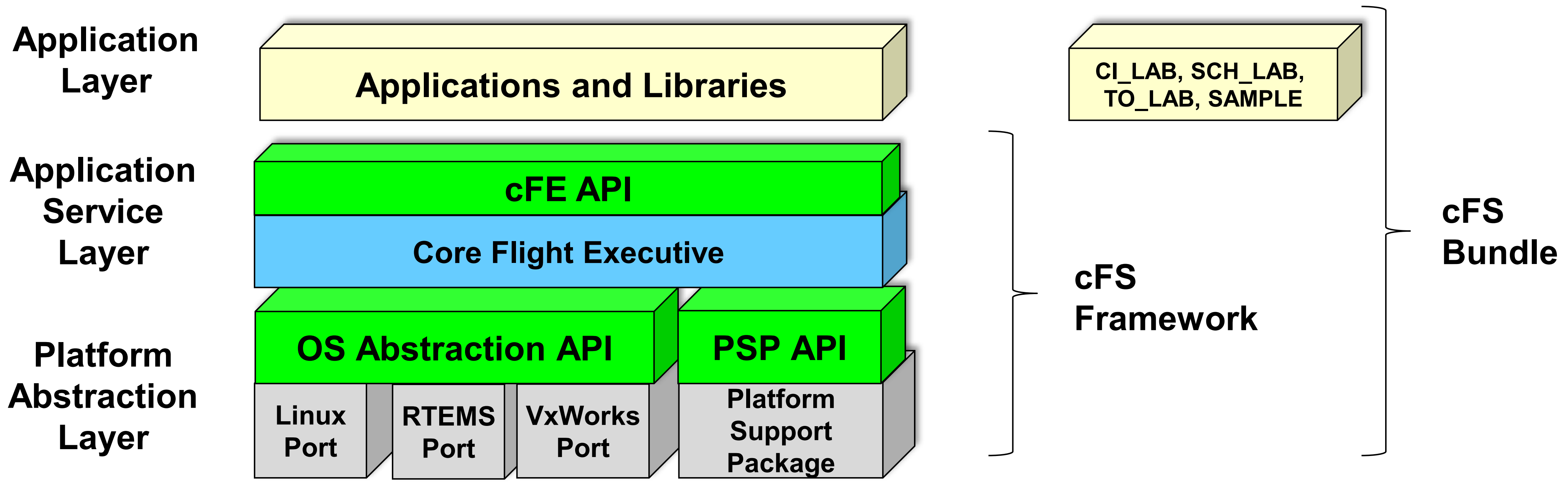
Target Processor
- A processor that runs the cFS target image

Development System
- Used to build and transfer the cFS target image to the target processor
- Requires a 'cross compiler' if the target process is different than the development system
- May include runtime diagnostic tools

Target Monitor
- A common diagnostic tool used to help verify the embedded system is operating correctly
- Often a monitor connected over a serial port

Ground System
- An application that sends command messages to the target and receives telemetry messages from the target
- The command & telemetry communications link may vary between test configurations and operations

core Flight System Context



- Platform Abstraction Layer ports to different operating systems (OS) / processor combinations
  - Contains the Operating System Abstraction Layer (OSAL) and the Platform Support Package (PSP)
- Application and libraries that only use the cFS APIs are portable across platforms
- The cFS Framework managed by NASA at https://github.com/nasa/cFE/
- The cFS bundle provides a starter system with a minimal runtime app suite, https://github.com/nasa/cFS

Basecamp Ecosystem

Learning Resources

https://www.youtube.com/channel/UC2wfvAIkrrgyC4ITwL3zokg

https://openmissionstack.com/

cFS App Repos

https://github.com/orgs/cfs-apps/repositories

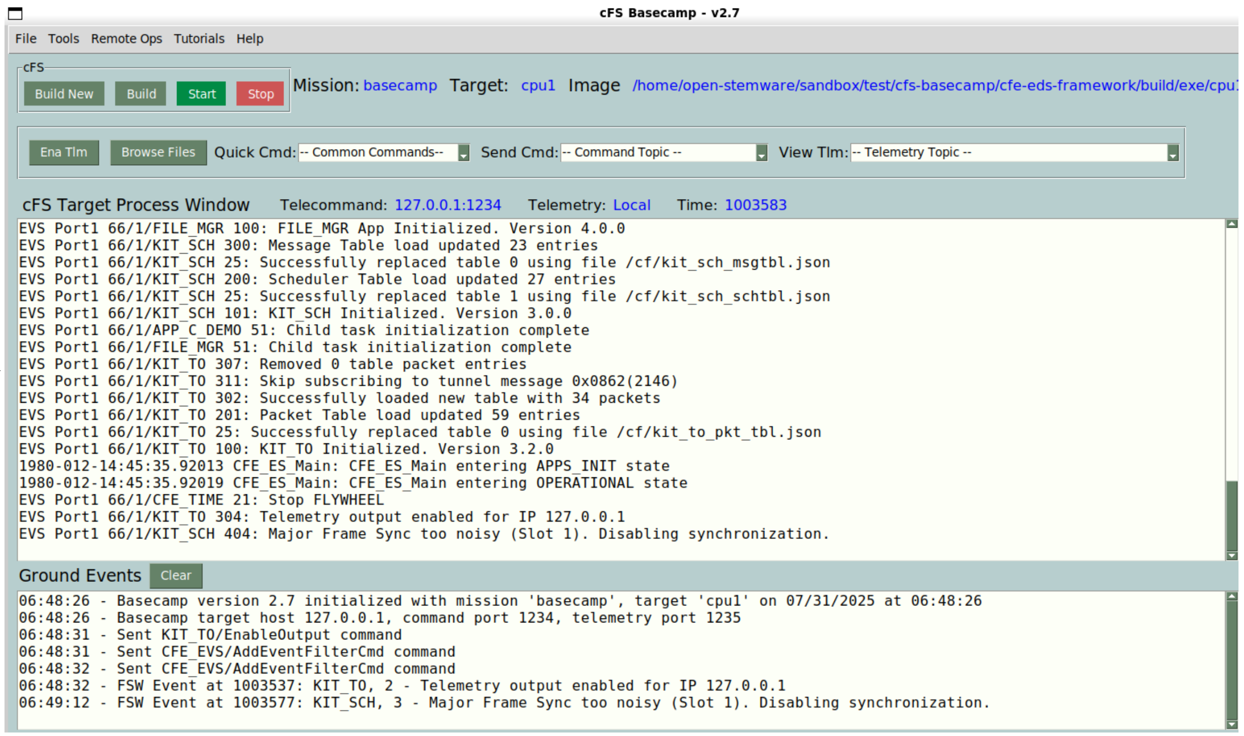
cFS target runs as a Linux Process

Telecommands

Telemetry

Status & Diagnostic Messages

Ground System


cFS Basecamp - v2.7
File Tools Remote Ops Tutorials Help
cFS
Build New
Build
Start
Stop
Ena Tlm
Browse Files
Quick Cmd: -- Common Commands--
Send Cmd: -- Command Topic --
View Tlm: -- Telemetry Topic --
Ground Events
Clear

Mission: basecamp Target: cpu1 Image /home/open-stemware/sandbox/test/cfs-basecamp/cfe-eds-framework/build/exe/cpu

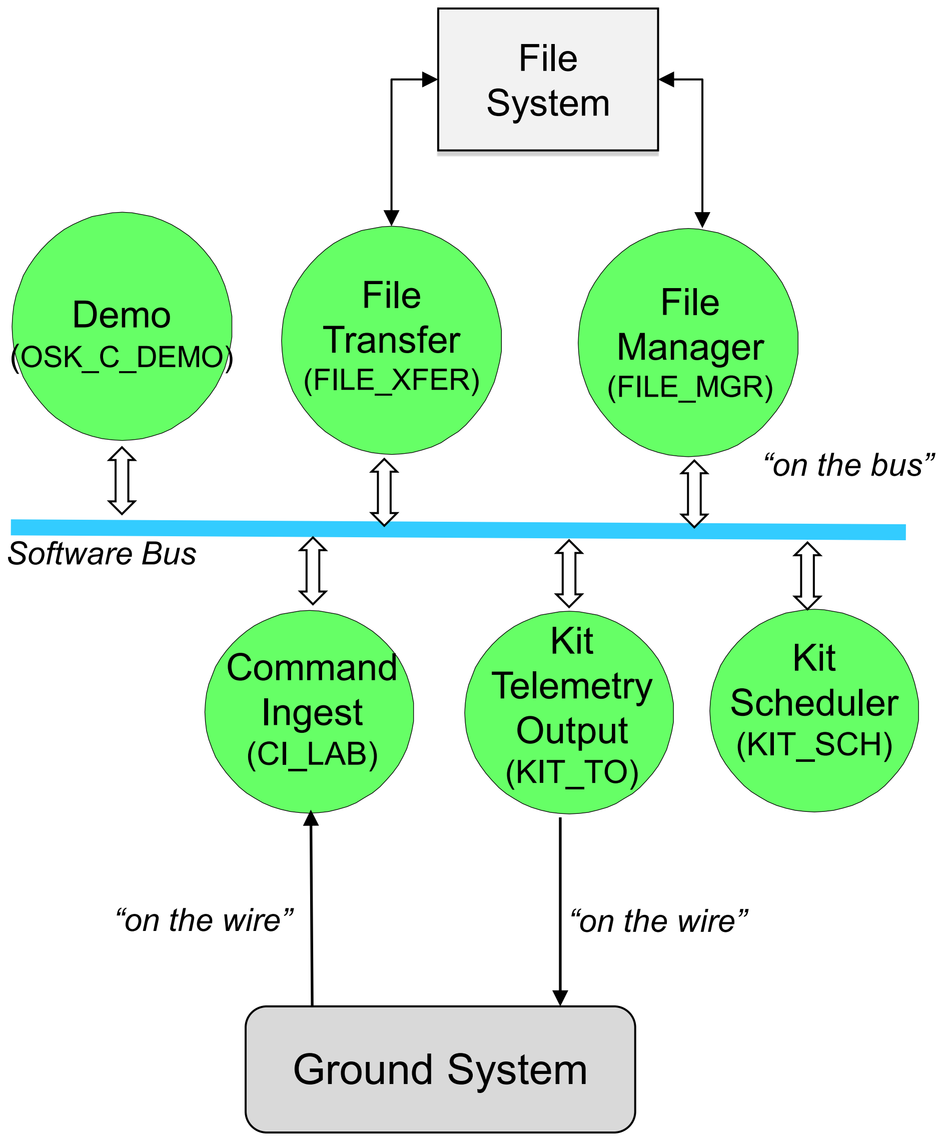
cFS Target Process Window Telecommand: 127.0.0.1:1234 Telemetry: Local Time: 1003583

```
EVS Port1 66/1/FILE_MGR 100: FILE_MGR App Initialized. Version 4.0.0
EVS Port1 66/1/KIT_SCH 300: Message Table load updated 23 entries
EVS Port1 66/1/KIT_SCH 25: Successfully replaced table 0 using file /cf/kit_sch_msgtbl.json
EVS Port1 66/1/KIT_SCH 200: Scheduler Table load updated 27 entries
EVS Port1 66/1/KIT_SCH 25: Successfully replaced table 1 using file /cf/kit_sch_schtbl.json
EVS Port1 66/1/KIT_SCH 101: KIT_SCH Initialized. Version 3.0.0
EVS Port1 66/1/APP_C_DEMO 51: Child task initialization complete
EVS Port1 66/1/FILE_MGR 51: Child task initialization complete
EVS Port1 66/1/KIT_TO 307: Removed 0 table packet entries
EVS Port1 66/1/KIT_TO 311: Skip subscribing to tunnel message 0x0862(2146)
EVS Port1 66/1/KIT_TO 302: Successfully loaded new table with 34 packets
EVS Port1 66/1/KIT_TO 201: Packet Table load updated 59 entries
EVS Port1 66/1/KIT_TO 25: Successfully replaced table 0 using file /cf/kit_to_pkt_tbl.json
EVS Port1 66/1/KIT_TO 100: KIT_TO Initialized. Version 3.2.0
1980-012-14:45:35.92013 CFE_ES_Main: CFE_ES_Main entering APPS_INIT state
1980-012-14:45:35.92019 CFE_ES_Main: CFE_ES_Main entering OPERATIONAL state
EVS Port1 66/1/CFE_TIME 21: Stop FLYWHEEL
EVS Port1 66/1/KIT_TO 304: Telemetry output enabled for IP 127.0.0.1
EVS Port1 66/1/KIT_SCH 404: Major Frame Sync too noisy (Slot 1). Disabling synchronization.
```

```
06:48:26 - Basecamp version 2.7 initialized with mission 'basecamp', target 'cpu1' on 07/31/2025 at 06:48:26
06:48:26 - Basecamp target host 127.0.0.1, command port 1234, telemetry port 1235
06:48:31 - Sent KIT_TO/EnableOutput command
06:48:31 - Sent CFE_EVS/AddEventFilterCmd command
06:48:32 - Sent CFE_EVS/AddEventFilterCmd command
06:48:32 - FSW Event at 1003537: KIT_TO, 2 - Telemetry output enabled for IP 127.0.0.1
06:49:12 - FSW Event at 1003577: KIT_SCH, 3 - Major Frame Sync too noisy (Slot 1). Disabling synchronization.
```

Target Monitor Display

Basecamp cFS Target Apps



- **Electronic Data Sheets (EDS) specs define command and telemetry messages**
  - *"on the wire"* ⟶ are off card interfaces
  - *"on the bus"* ⟺ are native host definitions

- **Basecamp comes preconfigured with 6 apps**
  - *CI_LAB* and *KIT_TO* manage external-to-internal message bus translations
  - *KIT_SCH* coordinates synchronous application functionality
  - *FILE_MGR* provides onboard directory and file management services
  - *FILE_XFER* manage file transfers between flight and ground
  - *APP_C_DEMO* is used for educational purposes

Basecamp Directory Structure

```
cfs-basecamp
│
├─apps/                  ← Preinstalled apps and libs providing essential functionality
│
├─cfe-eds-framework/     ← cFS Framework with Electronic Data Sheet build toolchain
│
├─docs/                  ← Basecamp system scope documentation
│
├─gnd-sys/               ← Python GUI & runtime tools
│
└─usr/                   ← User artifacts including apps and scripts
```