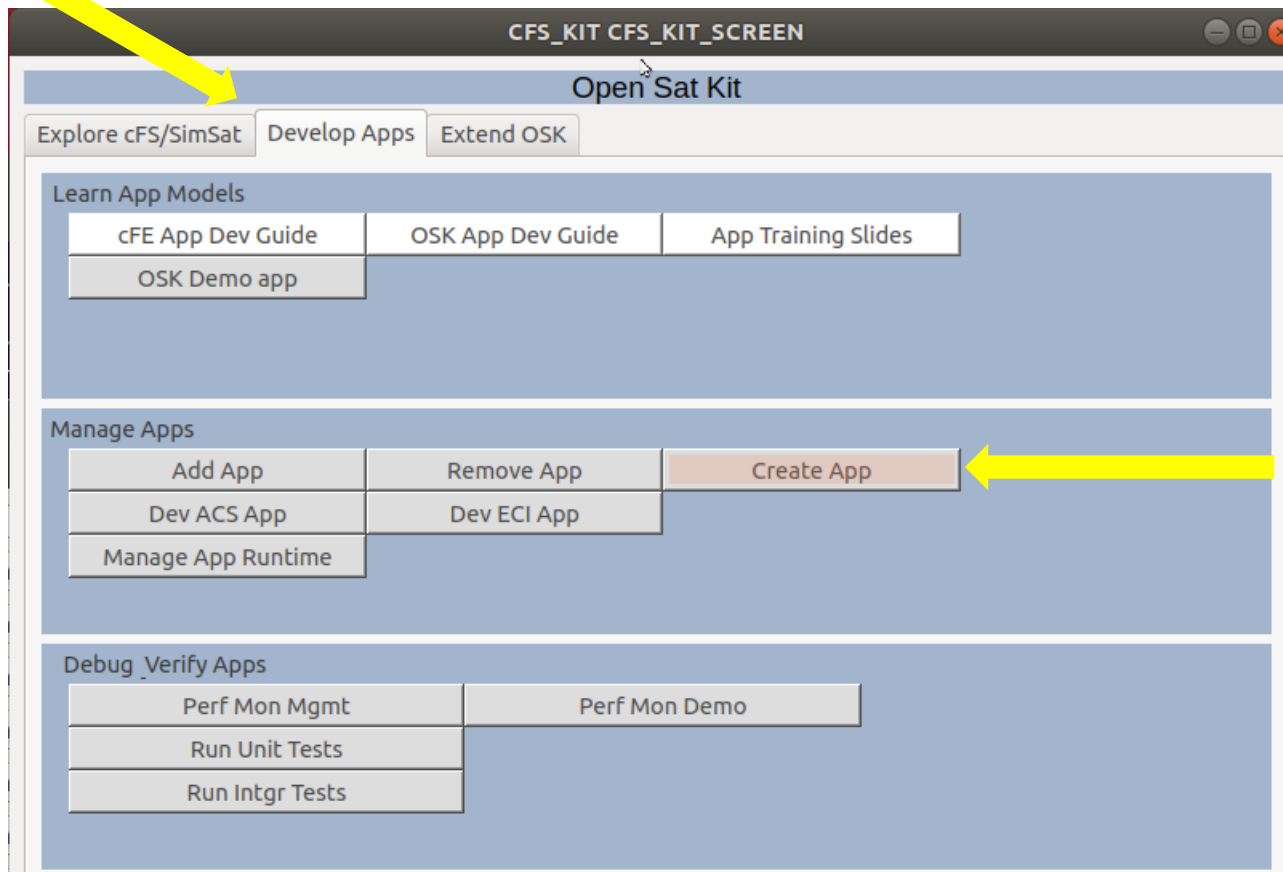


# core Flight Executive (cFE)

## Training Exercises

- **These slides contain exercises for the cFS core Flight Executive application development training module**
  1. Create a “Hello World” app
  2. Add a command
  3. Add a table
- **See “OSK Training – Intro.pptx” for an OpenSatKit introduction for running exercises**
- **Some of the cFS file standards/conventions are not followed to reduce the number of files that need editing to complete an exercise**
- **“~/” is used to indicate the OSK base directory**
  - “~/cfs” is equivalent to “/home/user/OpenSatKit-master/cfs” if OpenSatKit was installed in the home directory for an account named “user”

Select  
Develop App  
Tab



Launch  
“Create App”  
screen

- Follow the steps on the screen to create, build, and install the app
- In step 1 select the “*cFE App Training*” template
- When prompted, use “example” as the name of your app. The directories in the left figure assume “*example*” is used as the app name as do all of the exercises in this package.

CFS\_KIT MNG\_APP\_DEV\_SCREEN

Manage App Development

```

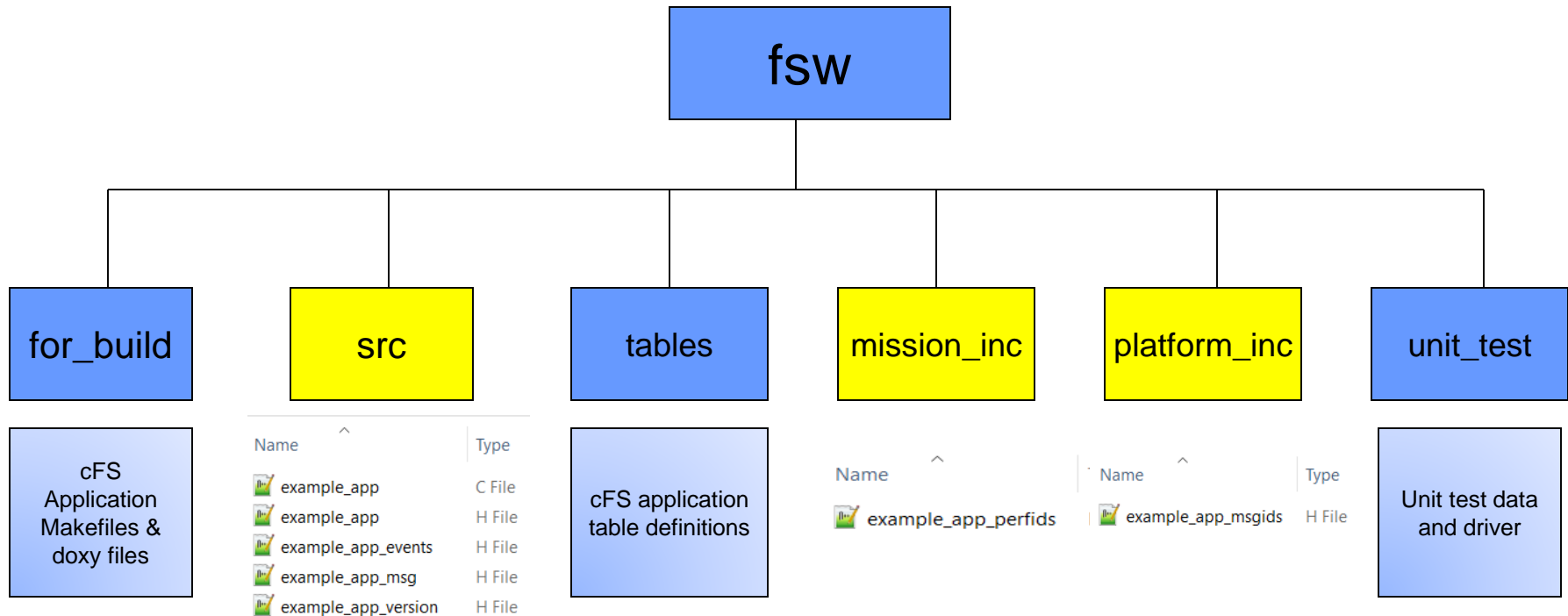
cfs
|- apps
|  |- example
|- osk def
|  |- cpul_cfe_es_startup.scr
|  |- targets.cmake
cosmos
|- config
|  |- targets
|   |- EXAMPLE
|   |- cmd_tlm
|- tools
|  |- cmd_tlm_server.txt
|- lib
|  |- message_ids.rb

Generated by APPGen
Manually edited by user
Definitions assumed by AppGen

```

- Create App** Launch tool to create new app/lib from a template
- Edit cmake** Add app file to cmake target list TGT1\_APPLIST
- Edit ES Startup** Add app to cFE Executive Service startup script
- Stop cFS/Server** Stop cFS and COSMOS cmd-tlm server
- Build cFS** Run cmake to build new app
- Start Server/cFS** Start cFS and COSMOS cmd-tlm server

The tool generated code in ~/cfs/apps/example/fsw and populated the yellow highlight boxes



Open ~/cfs/apps/example/fsw/example\_app.c in a text editor to review the code



- Using COSMOS “Command and Telemetry Server” open Command Sender with example’s command target

1

Target	Value or State	Units	Description
DS SET_FILTER_FILE	0		View Raw View in Command Sender
DS SET_FILTER_PARAM	0		View Raw View in Command Sender
DS SET_FILTER_TYPE	0		View Raw View in Command Sender
EXAMPLE NOOP	0		View Raw View in Command Sender
EXAMPLE RESET_CTRS	0		View Raw View in Command Sender
F42 CONFIG_DBG	0		View Raw View in Command Sender
F42 DUMP_TBL	0		View Raw View in Command Sender
F42 LOAD_TBL	0		View Raw View in Command Sender
F42 NOOP	0		View Raw View in Command Sender

2

File Mode Help

Target: EXAMPLE Command: NOOP Send

Description: Generate an info event message with app version

Parameters:

Name	Value or State	Units	Description
CCSDS_STREAMID:	6275		Packet Identification
CCSDS_SEQUENCE:	49152		Packet Sequence C...
CCSDS_LENGTH:	1		Packet Data Length
CCSDS_CHECKSUM:	0		CCSDS Command C...
CCSDS_FUNCICODE:	0		Command Function...

Command History: (Pressing Enter on the line re-executes the command)

- Using COSMOS “Command and Telemetry Server” open Telemetry Server with example’s housekeeping tlm target

The screenshot shows the COSMOS interface with the 'Tlm Packets' tab selected. The interface displays a list of telemetry packets and their details.

**Telemetry Packets List:**

Target	Packet	Count	View Raw	View in Packet Viewer
COSMOS	LIMITS_CHANGE	0	View Raw	View in Packet Viewer
COSMOS	VERSION	0	View Raw	View in Packet Viewer
CS	HK_TLM_PKT	39	View Raw	View in Packet Viewer
DS	FILE_INFO_PKT	0	View Raw	View in Packet Viewer
DS	HK_TLM_PKT	39	View Raw	View in Packet Viewer
EXAMPLE	HK_TLM_PKT	39	View Raw	View in Packet Viewer
F42	ACTUATOR_CMD_PKT	0	View Raw	View in Packet Viewer
F42	CONTROL_PKT	105	View Raw	View in Packet Viewer
F42	HK_TLM_PKT	39	View Raw	View in Packet Viewer

**Packet Details (EXAMPLE HK\_TLM\_PKT):**

Item	Value
*RECEIVED_TIMESECONDS:	1555090693.757620
*RECEIVED_TIMEFORMATTED:	2019/04/12 10:38:13.757
*RECEIVED_COUNT:	47
CCSDS_STREAMID:	0x0883
CCSDS_SEQUENCE:	49321
CCSDS_LENGTH:	9
CCSDS_SECONDS:	1001676
CCSDS_SUBSECS:	52516
CMD_VALID_COUNT:	1
CMD_ERROR_COUNT:	0

# Exercise #1 - Add a Command (1 of 3)

In this exercise you will add a command that sends an event message that reports the value of the 16-bit integer command parameter

## 1. **example\_app.h**

- a. Define event message ID and a new command code by uncommenting the following definitions (remove “//Ex#1”)

```
EXAMPLE_NEW_CMD_INF_EID
EXAMPLE_NEW_CMD_CC
```

- b. Locate `EXAMPLE_NoArgsCmd_t` and create a new command message structure next to it that defines one 16-bit unsigned command parameter. Easiest to copy, paste, and modify the `EXAMPLE_NoArgsCmd_t` function to

```
typedef struct {
    uint8  CmdHeader[CFE_SB_CMD_HDR_SIZE];
    uint16 Param;
}
EXAMPLE_NewCmd_t
```

## 2. **example\_app.c:** Add a function to process the new cmd and logic to call the function

- a. In `EXAMPLE_AppPipe()` uncomment (remove “//Ex#1”) the following case  
`case EXAMPLE_NEW_CMD_CC:`



## 2. **example\_app.c: Continued...**

- b. Locate `EXAMPLE_NoopCmd()` and create the following function next to it. Easiest to copy, paste, and modify the noop function

```
void EXAMPLE_NewCmd(CFE_SB_MsgPtr_t msg) {

    uint16 ExpectedLength = sizeof(EXAMPLE_NewCmd_t);
    EXAMPLE_NewCmd_t* Cmd = (EXAMPLE_NewCmd_t*)msg;

    if (EXAMPLE_VerifyCmdLength(msg, ExpectedLength)) {

        EXAMPLE_AppData.CmdCounter++;

        CFE_EVS_SendEvent(EXAMPLE_NEW_CMD_INF_EID, CFE_EVS_INFORMATION,
            "EXAMPLE: New command parameter %d", Cmd->Param);
    }
}
```

## 3. Note that when example app was initially created the COSMOS command definition for “NEW\_CMD” was created in

**~/cosmos/config/targets/EXAMPLE/cmd\_tlm/example\_cmd.txt**

- Each FSW command must have a corresponding COSMOS command definition
- See TBD for a description of OSK’s Embedded Ruby (ERB) extensions to COSMOS



**In this exercise we will add a table**

- 1. Copy example\_tbl.h from**  
     ~/cosmos/cfs\_kit/tutorials/cfe/training to  
     ~/cfs/apps/example/fsw/src
- 2. Create a new tables directory: ~/cfs/apps/example/fsw/tables**
- 3. Copy example\_tbl.c from**  
     ~/cosmos/cfs\_kit/tutorials/cfe/training to  
     ~/cfs/apps/example/fsw/tables
- 4. Open**  
     ~/cosmos/cfs\_kit/tutorials/cfe/training/example\_tbl\_code\_snippets.txt and  
     follow the instructions in the file to update example\_app.c and  
     cmakelist.txt
- 5. Repeat steps 4-6 on the *Manage App Development* page build/install the  
     updated example app in the FSW**
  - 4. Stop cFS/Server**
  - 5. Build cFS**
  - 6. Start Server/cFS**

## Verify the tables is functioning properly

1. Issue an EXAMPLE NEW\_CMD command and verify table data displayed in an event message
2. From OSK's main screen open the "Manage Table" screen
3. Select Dump Table
  1. EXAMPLE.MyFirstTbl
  2. Active buffer
4. After display table in Table Manager tool change the values of the table
5. Save file as osk\_tmp\_bin.dat
6. Load Table