Open STEM ware

cFS

App Specification Guide

Version 1.16

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Audience & Prerequisites

- **Objectives**
  - Teach developers how to create an app specification so it can be used in Basecamp's *App Exchange*
- **Intended audience**
  - Software engineers
- **Prerequisites**
  - Experience developing apps and integrating them with a cFS target

App Specification Overview

- **From a cFS architectural component context the term app is used to mean either an app or a library**
  - There are important detailed design distinctions and these will be highlighted and explained within the context of the details

- **App naming consistency is very important**
  - [app] is used to represent an app's name and it must be exactly the same for each instance

- **An app specification defines an app's external interface that facilitates Basecamp's automated app integration process**

- **The following files are used by Basecamp**
  - [app].json – App metadata spec
  - [app.].xml - Electronic Data Sheet (EDS) spec
  - [app]_ini.json – App initialization configuration file (not applicable to libraries)

[app].json Metadata Spec

- **Located in an app's top-level directory**
- **Payload Manager App Example:**

```
{ "app": {

   "title": "Payload Manager",
   "version": "1.0.0",
   "supplier": "Open STEMware",
   "copyright": "bitValence",
   "url": "https://github.com/cfs-apps/pl

   "description": [
      "Example payload manager"
   ],

   "cfs": {
      "cfe-type": "CFE_APP",
      "obj-file": "pl_mgr",
      "entry-symbol": "PL_MGR_AppMain",
      "name": "PL_MGR",
      "priority": 70,
      "stack": 16384,
      "load_addr": 0,
      "exception-action": 0,
      "app-framework": "osk",
      "tables": ["pl_mgr_ini.json"]
   },

   "requires": ["app_c_fw", "pl_sim_lib"]

}}
```

App Programmatic Information

- Descriptive information that is not part of the automated integration of an app into a cFS Target
- Note *version* is manually kept in synch with the app's version number in the code
- *description* is an array of strings to help readability for long descriptions

cFS Object

- Information required by the automated integration of an app into a cFS Target
- The first 8 parameters map directly to what is required in cfe_es_startup.scr
- *app-framework* is either "osk" or "cfs" to identify the app's architectural style (currently unused and may be deprecated)
- *tables* identifies tables that need to be copied from /basecamp_defs to the cFS CPU target

Identifies libraries and apps required by the app

- Currently users must ensure required components are installed (plan is to add automated assistance)

[app].xml Electronic Data Sheet Spec

- **This document briefly describes aspects of EDS from an application integration perspective**
  - Please refer to NASA's TBD guide and to Basecamp's App Developer's Guide for more information on Electronic Data Sheets
- **EDS specs are used to define Library and Application external interfaces**
- **EDS <*DataTypeSets*> contain definitions for constants, enumerations, containers, etc.**
  - These types are used to define telecommand and telemetry messages
- **EDS <*ComponentSet*> define <*RequiredInterfaceSet*> and the their <*Implementation*>**
  - Payload Manager's <*ComponentSet*> is shown on the next slide

Payload Manager EDS *ComponentSet* Example

```
<ComponentSet>
  <Component name="Application">
    <RequiredInterfaceSet>
      <Interface name="CMD" shortDescription="Software bus telecommand interface" type="CFE_SB/Telecommand">
        <GenericTypeMapSet>
          <GenericTypeMap name="TelecommandDataType" type="CommandBase" />
        </GenericTypeMapSet>
      </Interface>
      <Interface name="STATUS_TLM" shortDescription="Software bus status telemetry interface" type="CFE_SB/Telemetry">
        <GenericTypeMapSet>
          <GenericTypeMap name="TelemetryDataType" type="StatusTlm" />
        </GenericTypeMapSet>
      </Interface>
    </RequiredInterfaceSet>
    <Implementation>
      <VariableSet>
        <Variable type="BASE_TYPES/uint16" readOnly="true" name="CmdTopicId"       initialValue="${CFE_MISSION/PL_MGR_CMD_TOPICID}" />
        <Variable type="BASE_TYPES/uint16" readOnly="true" name="StatusTlmTopicId" initialValue="${CFE_MISSION/PL_MGR_STATUS_TLM_TOPICID}" />
      </VariableSet>
      <!-- Assign fixed numbers to the "TopicId" parameter of each interface -->
      <ParameterMapSet>
        <ParameterMap interface="CMD"        parameter="TopicId" variableRef="CmdTopicId" />
        <ParameterMap interface="STATUS_TLM" parameter="TopicId" variableRef="StatusTlmTopicId" />
      </ParameterMapSet>
    </Implementation>
  </Component>
</ComponentSet>
```

Telecommand Definition

Telemetry Definition

cfe-topicids.xml

- cfe-topicids.xml is an EDS file that defines all of the Topic Ids for a target
- The EDS package name is CFE_MISSION

```
<DesignParameters>
    <Package name="CFE_MISSION"
```

- Here are Payload Manager's Telecommand and Telemetry definitions

```
<Define name="PL_MGR_CMD_TOPICID" value="${CFE_MISSION/TELECOMMAND_BASE_TOPICID} + 35/>
<Define name="PL_MGR_STATUS_TLM_TOPICID" value="${CFE_MISSION/TELEMETRY_BASE_TOPICID} + 45"/>
```

- Basecamp's app integration tools updates this file using the TopicIds defined in an app's EDS spec
- Basecamp's "make topicids" using these definitions to update topic ID values in each target app's JSON initialization file

[app]_ini.json Initialization Configuration

- **JSON initialization file are only used by apps and not libraries**

- **Interface configurations in the JSON *config* object include:**
  - App Name
    - Note this name is manually kept in synch with the Metadata spec app name
  - Performance Identifiers
    - Note creating unique IDs across all of the apps is up to the developer (i.e. no tool support)
  - Software Bus pipe names and queue depths
  - TopicIds subscribed to and published by the App
    - These names must match the names defined in EDS specs
    - Basecamp's "make topicids" tools sets the topicid values

- **The JSON config object also contains parameters that define a default configuration**

Payload Manager Initialization Configuration Example

```
{
    "title": "Payload Manager(PL_MGR) initialization file",
    "description": [ "Define runtime configurations",
                     "SCI_FILE_EXTENSION must be 8 characters or less"],
    "config": {

       "APP_CFE_NAME": "PL_MGR",
       "APP_PERF_ID" : 127,

       "PL_MGR_CMD_TOPICID"          : 0,
       "BC_SCH_1_HZ_TOPICID"         : 0,
       "PL_MGR_STATUS_TLM_TOPICID"   : 0,
       "TLM_SLOW_RATE": 4,

       "CMD_PIPE_DEPTH": 10,
       "CMD_PIPE_NAME":  "PL_MGR_CMD_PIPE",

       "SCI_FILE_PATH_BASE": "/cf/pl_sci_",
       "SCI_FILE_EXTENSION": ".txt",
       "SCI_FILE_IMAGE_CNT": 3

    }
}
```

Topid IDs

- Names must match the EDS spec names
- Values are set by the “make topicids” tool

Default configurations

- These types of parameters are often part of an external interface, however they are not required by Basecamp’s automated app integration processes