
cFE
Time Service (TIME)
Tutorial
OSK v3.1

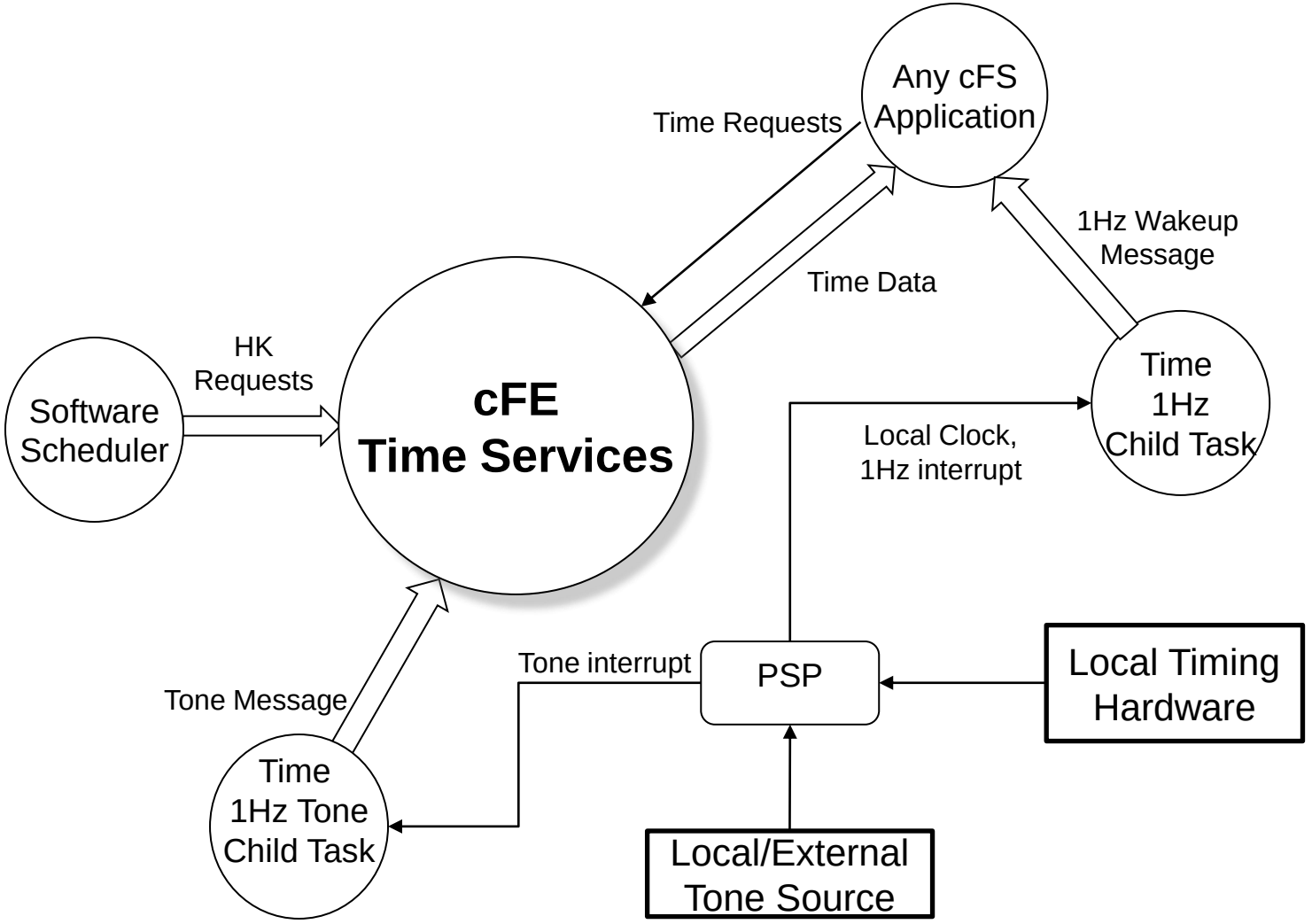
Time Services - Overview

- cFE Time Services provides time correlation, distribution and synchronization services
- Provides a user interface for correlation of spacecraft time to the ground reference time (epoch)
- Provides calculation of spacecraft time, derived from mission elapsed time (MET), a spacecraft time correlation factor (STCF), and optionally, leap seconds
- Provides a functional API for cFE applications to query the time
- Distributes a “time at the tone” command packet, containing the correct time at the moment of the 1Hz tone signal
- Distributes a “1Hz wakeup” command packet
- Forwards tone and time-at-the-tone packets
- Designing and configuring time is tightly coupled with the mission avionics design

Time Services – Time Formats

- **Supports two formats**
- **International Atomic Time (TAI)**
  - Number of seconds and sub-seconds elapsed since the ground epoch
  - TAI = MET + STCF
    - Mission Elapsed Counter (MET) time since powering on the hardware containing the counter
    - Spacecraft Time Correlation Factor (STCF) set by ground ops
    - Note STCF can correlate MET to any time epoch so TAI is mandated
- **Coordinated Universal Time (UTC)**
  - Synchronizes time with astronomical observations
  - UTC = TAI – Leap Seconds
  - Leap Seconds account for earth's slowing rotation

Time Services - Context



Performance Monitor Steps

1 **Apps call ES Performance functions to mark code execution entries/exits**

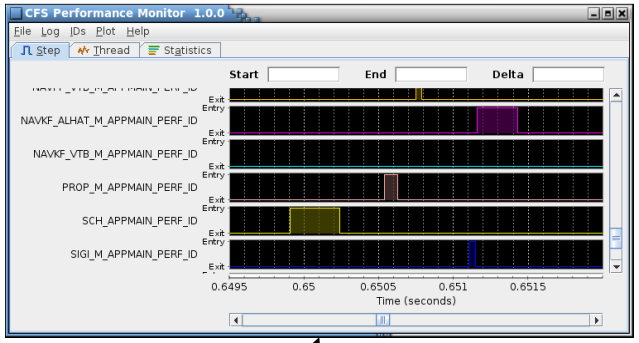
Any App

CFE_ES_PerfLogEntry(XXX_PERF_ID)
CFE_ES_PerfLogExit(XXX_PERF_ID)

Service API
Service Library

cFE Service App

2 **Operator configures ES Performance Monitor and collects data**



3 **Operator transfers the data file to the ground**

Log File

Log File

4 **Operator use CPM to display and analysis data**

cFS Performance Monitor

Time Services – “Flywheeling”

- ***Flywheeling*** **occurs when TIME is not getting a valid tone signal or external "time at the tone" message. While this has minimal impact on internal operations, it can result in the drifting apart of times being stored by different spacecraft systems.**

- **Flywheeling occurs when at least one of the following conditions is true:**
  - loss of tone signal
  - loss of "time at the tone" data packet
  - signal and packet not within valid window
  - commanded into fly-wheel mode

Time Services – Reset Behavior

- **Power-On-Reset**
  - Initializes all counters in housekeeping telemetry
  - Validity state set to Invalid
  - STCF, Leap Seconds, and 1 Hz Adjustment to zero set to zero

- **Processor reset, preserves:**
  - MET
  - STCF
  - Leap Seconds
  - Clock Signal Selection
  - Current Time Client Delay (if applicable)
  - Uses ‘signature’ to determine validity of saved time. If signature fails then power-on-reset initialization is performed

Time Services – Retrieving Onboard State

- **Telemetry**
  - Housekeeping Status
    - Clock state, Leap Seconds, MET, STCF 1Hz Adjust
- **Telemetry packets generated by command**
  - Diagnostic Packet
- **Files generated by command**
  - None

- **Packet time stamps**

Time Services – Configuration Parameters

- **List parameters that with higher probability of being tuned**
- System time is TAI or UTC

MET – Hardware register or software variable

Time Services APIs

Time Conversion Functions	Purpose
CFE_TIME_Sub2MicroSecs	Convert a sub-seconds count to an equivalent number of microseconds
CFE_TIME_Micro2SubSecs	Convert a number of microseconds to an equivalent sub-seconds count
CFE_TIME_CFE2FSSeconds	Convert cFE seconds to File System Seconds
CFE_TIME_FS2CFESeconds	Convert File System seconds to cFE seconds

Basic Clock Functions	Purpose
CFE_TIME_GetTime	Get the current spacecraft time
CFE_TIME_GetUTC	Get the current UTC time
CFE_TIME_GetTAI	Get the current TAI time
CFE_TIME_MET2SCTIME	Converts MET to Spacecraft time
CFE_TIME_GetMET	Get the current value of the mission-elapsed time
CFE_TIME_GetMETseconds	Get the current seconds count of the mission-elapsed time
CFE_TIME_GetMETsubsecs	Get the current sub-seconds count of the mission-elapsed time
CFE_TIME_GetSTCF	Get the current value of the spacecraft time correction factor (STCF)
CFE_TIME_GetLeapSeconds	Get the current value of the leap seconds counter
CFE_TIME_GetClockState	Get the current state of the spacecraft clock
CFE_TIME_GetClockInfo	Get clock information

Time Services APIs

Time Manipulation Functions	Purpose
CFE_TIME_Add	Add two time values
CFE_TIME_Subtract	Subtract one time value from another
CFE_TIME_Compare	Compare two time values
CFE_TIME_Print	Print a time value as a string

External Time Sources	Purpose
CFE_TIME_ExternalTone	Latch the local time at the 1Hz tone signal
CFE_TIME_ExternalMET	Provide the MET from an external source
CFE_TIME_ExternalGPS	Provide the time from an external source that has data common to GPS receiver
CFE_TIME_ExternalTime	Provide the time from an external source that measures time relative to a known epoch