



AMPCS

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Overview

- AMPCS: AMMOS Mission Data Processing and Control System
- OpenMCT: Open Mission Control Technologies
- Demonstration
- Future

AMPCS

(Scheduled for Open Source June 2023)

Telemetry Processing

- XTCE (XML Telemetric and Command Exchange)
 - Processing of CCSDS formatted Advanced Orbiting System (AOS) transfer frames or TM transfer frames containing Space Packets or file Protocol Data Units (PDUs)
- Extracting telemetry channels from packets using decommutation maps
- Constructing ground-derived channels
- Calculating Engineering Units for channels using a table, polynomial, or custom algorithm
- Alarm computations (high value, low value, inclusive range, exclusive range, mask, state, change, delta, digital, and combination alarm types)
- Extracting Event Records (EVRs) from packets
- File reconstruction from PDUs
- Processing of received files of recorded telemetry

AMPCS Downlink

AMPCS FSW Downlink Control: docker_session (8) on tcp://ampcs:10010/

File Control Advanced Help

Running Connected Flowing Processing

FSW

Message Type	Receive Time	Message
Telemetry Input Summary	2022-258T21:35:49.084	Info: (Raw Input Summary) (8) Data source connected, data flowing, last input data seen at 2022-258T21:
Performance Summary	2022-258T21:35:51.660	Info: (Performance) (8) Heap: Health=GREEN, Used=478Mb, Max=3641Mb, High Water=1121Mb, Percent:
Performance Summary	2022-258T21:35:51.660	Info: (Performance) (8) Overall health of the application is GREEN
Performance Summary	2022-258T21:36:01.660	Info: (Performance) (8) Heap: Health=GREEN, Used=480Mb, Max=3641Mb, High Water=1121Mb, Percent:
Performance Summary	2022-258T21:36:01.661	Info: (Performance) (8) Overall health of the application is GREEN
Telemetry Input Summary	2022-258T21:36:04.084	Info: (Raw Input Summary) (8) Data source connected, data flowing, last input data seen at 2022-258T21:
Performance Summary	2022-258T21:36:11.660	Info: (Performance) (8) Heap: Health=GREEN, Used=491Mb, Max=3641Mb, High Water=1121Mb, Percent:
Performance Summary	2022-258T21:36:11.660	Info: (Performance) (8) Overall health of the application is GREEN
Telemetry Input Summary	2022-258T21:36:19.084	Info: (Raw Input Summary) (8) Data source connected, data flowing, last input data seen at 2022-258T21:
Performance Summary	2022-258T21:36:21.660	Info: (Performance) (8) Heap: Health=GREEN, Used=493Mb, Max=3641Mb, High Water=1121Mb, Percent:
Performance Summary	2022-258T21:36:21.661	Info: (Performance) (8) Overall health of the application is GREEN

In Sync Frames: 0 Out-of-Sync Byte Count: 0 Invalid Frames: 0 Idle Frames: 0
Dead Frames: 0 Repeat Frames: 0 Frame Gaps: 0 Bitrate: 0
Valid Packets: 9990 Invalid Packets: 0 Fill Packets: 0 Station Packets: 0
CTDP Packets: 0

Click for Details
Performance

Copy

Information Monitoring, Storage, and Query

- Real-time displays with lists, plots, alarms, and messages
- All received and processed information is stored and can be queried, for both testbed and operations scenarios
- Historical lists and plots; standardized data reports and summary reports

AMPCS

1.0.13 (055e98f)

Dashboard

FSW Ingestor

FSW Processor

SSE Ingestor

SSE Processor

> CFDP

FWS TM Ingestor

<http://localhost:8081/ingest>

Online

Server Context Key: 2/MT-305865

Sessions

29/MT-305865/2

Open

FWS TM Processor

<http://localhost:8082/process>

Online

Server Context Key: 3/MT-305865

Sessions

Open

SSE TM Ingestor

Not available

Offline

Open

SSE TM Processor

Not available

Offline

Open

Session 29

2021-299T00:50:17.253

Expand

CFDP Processor

offline

localhost:8069

Open

CFDP Processor

online

Mnemonic

Context ID

Instance ID

PRIME

Entity ID

1

localhost:8070

Open

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AMPCS

1.0.13 (055e98f)

Dashboard

FSW Ingestor

FSW Processor

SSE Ingestor

SSE Processor

CFDP

FSW Ingestor

http://localhost:8081/ingest

Online

Server Context Key: 2/MT-305865

Number of Ingestors: 1

+ New Session

+ New Ingestor

Select Ingestor

Ingestor

29/MT-305865/2

29/MT-305865/2

Configuration

Start

Abort

Connected

Flowing

In Sync

Statistics

In Sync Frames: 0

Dead Frames: 0

Idle Frames: 0

Bad Frames: 0

Repeated Frames: 0

Frame Gaps: 0

Valid Packets: 0

Invalid Packets: 0

Bad Packets: 0

Product Packets: 0

Fill Packets: 0

Station Packets: 0

Frame Regressions: 0

CFDP Packets: 0

Out-of-Sync Data : 0

Out-of-Sync Count: 0

Bitrate: 0

Time	Level	Message
2021-299T00:50:17.698	Info	{29:2} TelemetryIngest [INITIALIZING]: {29/MT-305865/0/2/2/0} is now in READY state
2021-299T00:50:17.384	Info	{29:2} Publishing to topic mpcs.generic.mt-305865.ftudor.station
2021-299T00:50:17.377	Info	{29:2} Publishing to topic mpcs.generic.mt-305865.ftudor.alarm
2021-299T00:50:17.370	Info	{29:2} Publishing to topic mpcs.generic.mt-305865.ftudor.cfdp
2021-299T00:50:17.364	Info	{29:2} Publishing to topic mpcs.generic.mt-305865.ftudor.pdu
2021-299T00:50:17.358	Info	{29:2} Publishing to topic mpcs.generic.mt-305865.ftudor.frame
2021-299T00:50:17.352	Info	{29:2} Publishing to topic mpcs.generic.mt-305865.ftudor.packet

Automation Support

- Script access to telemetry via Python
- Alarm notification via email
- Automated antenna station connections/disconnections and telemetry processing according to schedule

Commanding Support

- User interface for building spacecraft commands, controlling the uplink of commands and command files, and archiving command logs primarily in the spacecraft test environment

AMPCS Commanding

AMPCS FSW/SSE Uplink Control: docker_session (3)

File Window Help

Venue: TESTSET Mission: EUROM Spacecraft ID: 159

Immediate Command Command Builder Send File CDDP Send SCMP Send Raw Data File Fault Injection Wizard

Search By: Stem

APPENDFILE
CANCEL
CMD_CLEAR_TRACKING
CMD_NO_OP
CMD_NO_OP_STRING
CMD_TEST_1
CREATEDIRECTORY
CS_AUTO
CS_CANCEL
CS_JOIN_WAIT
CS_MANUAL
CS_RUN
CS_START
CS_STEP
CS_VALIDATE
DUMP_RISER_STATE

Command Information

Stem: CMD_NO_OP
Opcode (16 bits): 0x0079
Module:
Description: cmdDisp No-op command

Preview Validate Clear

Bit Rates (bps): N/A

Send

Local Request History Console

Source	Status	Data
Immediate Command	Radiated	CMD_NO_OP

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acknowledged.

AMPCS CONFIGURATION WIZARD

RESTORE DEFAULTS

DOWNLOAD CONFIGURATION FILES

HOME PAGE ✓

AMPCS FEATURES ✓

MISSION SETTINGS ✓

VENUE SETTINGS ✓

UPLINK SETTINGS

DOWNLINK SETTINGS ✓

SSE SETTINGS

CONNECTIONS SETTINGS

DATABASE SETTINGS

MESSAGING SETTINGS

CHANNELIZED TELEMETRY SETTINGS

DICTIONARY SETTINGS

TIME SETTINGS

PREVIEW

UPLINK SETTINGS ?

General Uplink Settings

☒ Enable Command Validation

☐ Show String ID Selector

☒ Enable Command Modules

Capabilities in Test Venues

☒ Immediate Commanding

☒ Flight File Upload

☒ CFDP File Uplink

☐ Raw Data Uplink

☒ SCMF File Uplink

☐ Fault Injection

Capabilities in Operational Venues

☒ Immediate Commanding

☒ Flight File Upload

☒ CFDP File Uplink

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Open MCT

<https://github.com/nasa/openmct>

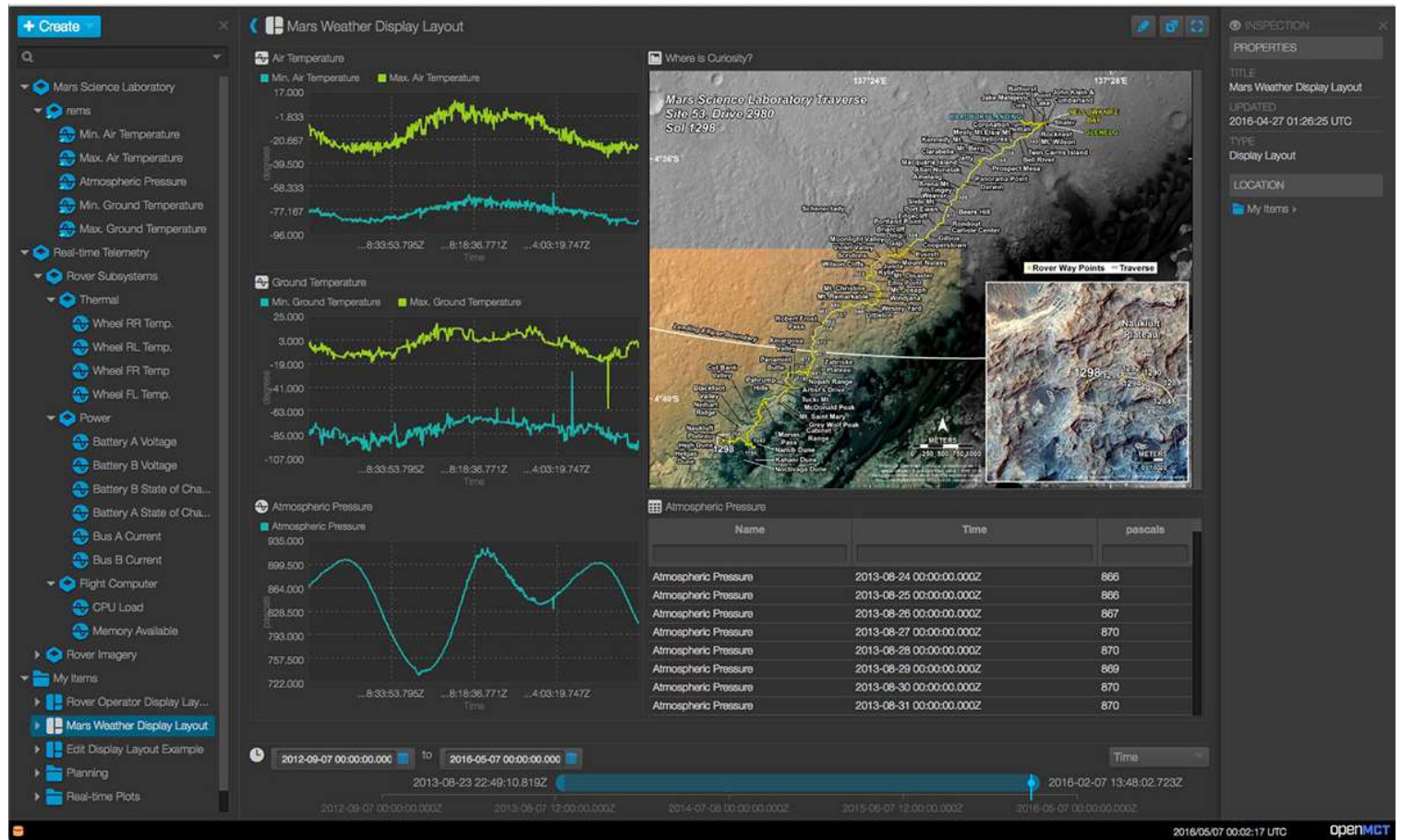
<https://nasa.github.io/openmct/documentation/>

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Open MCT

- Client software designed to work with various telemetry sources to enable flexible interactive display and analysis of telemetry information
- Composable displays specialized for telemetry information including historical and real-time data for Channels, Event Records, Data Products, and Dictionaries
- Users can create and save layouts developed during analysis as well as shared subsystem displays pre-configured for operations

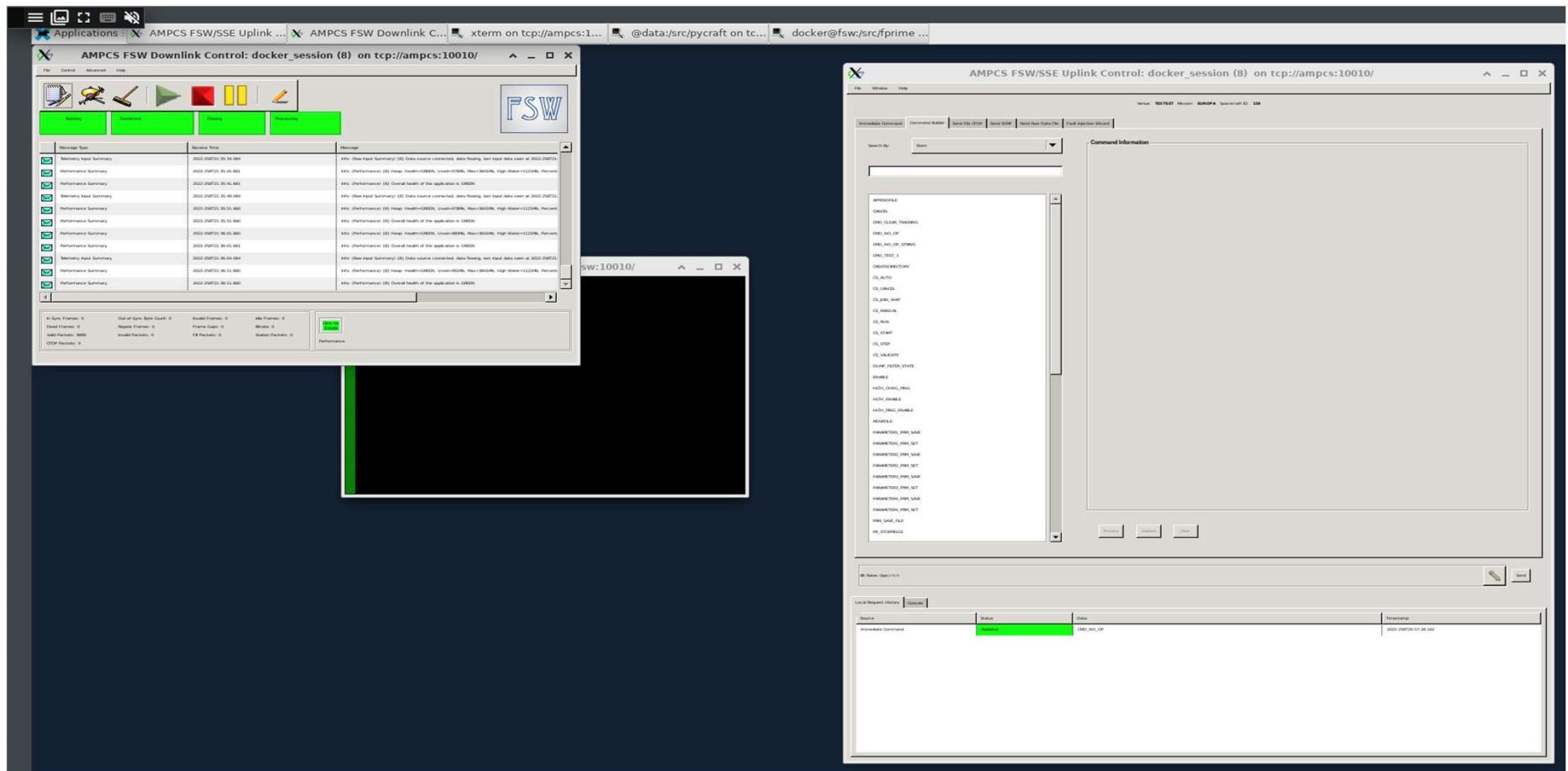
OpenMCT



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Demonstration

Demonstration



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Configuration

- Fprime FSW
 - Fprime v2.x Reference build for generic implementation/demo
- Fprime-gds
 - Modified for AMPCS uplink/downlink
- AMPCS
 - Europa Clipper Configuration readily available for integration

Integration Runtime

- Fprime-util automated build
- Dictionary conversion
- Launch AMPCS
- Launch modified fprime-gds
- Launch fprime FSW

Future

Future

- **AMPCS Open Source is scheduled for 6/15/2023**
- Cubesat Support
 - AMPCS compatibility for future cubesat missions
- NEAScout (Artemis 1)
- LunarFlashlight (SpaceX Mid-November)
- FPrime --> SRL MCFSW + SRL HELO
 - AMPCS compatibility for Mars Sample Return/Sample Return Lander + HELO
- Rolled back into FPrime as enhanced capability
 - To be Built into future FPrime releases
- Incorporate as AMPCS Adaptation
 - To be built into future AMPCS releases
- UART Serial --> TCP for Sphinx/SSDT
 - Serial middleware for AMPCS + FPrime testbed support for Sphinx