Mission Software Systems
Section 369

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Mission Software Systems: Overview

- Summary
- Section Charter
- Section Product Lines
- Technology Thrusts
- Application Examples
Mission Software Systems Section: A Summary

Products

- Telemetry, Command, Data Management for Deep Space and Earth Orbiting Missions
- CCSDS File Delivery Protocol (CFDP), and Space Link Extension (SLE) protocol
- Large Scale Distributed Information Systems

Technical Expertise

- Design, implementation and deployment expertise in CCSDS compatible space data systems for international cross support, interoperability, and science information interchange.
- Design, implementation and deployment expertise in deep space mission uplink and downlink data services and information systems for Mission Operations.
- Distributed Information Systems software engineering

Technical Goals

- Providing standard closed-loop autonomous end-to-end data delivery systems over deep space distances.
- Developing methods for fusing data sources and products to derive information needed by the mission community.
- Establishing an integrated flight-ground software product line with extensive re-use and inheritance that maximizes mission data quantity, quality and continuity.
Section Charter

- Our Thrust: Mission Information Systems
  - We provide seamless, flexible and reusable software intensive information systems for space missions
  - We maintain a broad information technology skill base to define, design, implement, and deliver integrated solutions for our customer needs.
  - In the area of software, we focus on the development of end-to-end software systems and architectures that contribute to the evolution of integrated multi-mission and mission-specific core components in the area of Telemetry, Command, Data Management, Monitor & Control.
  - For non-NASA customers the Section has vast experience in developing command and control information centers.
Our main product is integrated ground software information systems from large scale solutions to point solutions, depending on customers needs and constraints:

- Command, Telemetry and Data Management systems for Deep Space (e.g. Space Infrared Telescope Facility (SIRTF), Mars Explorer Rover (MER), Deep Impact (DI) and Earth Orbiting spacecrafts (TOPEX, JASON 1).


- Integrated Marine Multi-Agent Command & Control System (IMMACCS) for US Marine Corps Warfighting Laboratory

- Defense Information Infrastructure (DII) Common Operating Environment (COE) Kernel development for Defense Information Systems Agency
Main products (Continued)
- Integrated flight/ground Data Management and Data Transport for the Mission Data System (MDS) architecture.
- Communications engineering (Reliable Network Service for Deep Space Mission Systems).

Management, System Engineering and I&T Leadership
- Task management
- Ground data systems engineering
- Software implementation management
- System integration and test
- Deployment and training
Section Technology Thrusts

- International Consultative Committee for Space Data Systems (CCSDS) space communication protocols infused into deep space mission tracking, telemetry, command and data management systems
  - CCSDS File Delivery Protocol (CFDP)
  - Space Link Extension (SLE) Command Link Translation Unit (CLTU)

- [DoD] Management of distributed systems across unreliable/narrow-bandwidth communications and non-homogeneous hardware platforms (IMMACS)

- [DoD] Kernel level shared software infrastructures (DII COE)
Relevance of DoD Technology Thrusts to Space Mission Challenges

**Common Goals:**
- In-situ collaboration with instruments, systems, and people from multiple organizations and nations.
- Efficient use of very narrow communications links to exchange priority information.
- Command & Control supporting multiple simultaneous missions.
- Generic computer services protecting systems: security, fault tolerance, integrity, replication.
- Agent-based reasoning supporting autonomous operations & fault detection/correction.

**Common Approach:**
- Based on a rich information-centric model of the "world" - objects & relationships
- Information distribution based on priorities and subscriptions.
- Store and forward architecture supporting distributed servers on a variety of air, orbital, and ground platforms.
- Information-centric approach and open architecture provides excellent support for agents & opportunistic collaboration.
Jason 1 – A Mission Specific Example

Jason-1 Telemetry, Command and Communications Subsystem (JTCCS)

- Control and Monitor Earth Terminals
- Receive, Store, Process and Display Real-time and Recorded Telemetry Data.
- Command and Monitor Satellite Status
- Translate and Transmit Commands
- Decommutate and Distribute Telemetry Data
- Manage and Archive Data Files
- Platform Abstraction - “Ready to Run” on Other Many O/S Platforms (E.G., Windows NT, VMS, Unix)
Jason 1 - Characteristics

- Poker Flat, Alaska
- Wallops Island, Virginia
- Aussaguel, France

- Jason Earth Terminal running JTCCS
- 2 Project Ops Control Centers at JPL and CNES

- Delta II from Vandenberg AFB

JASON 1 Earth Orbiting spacecraft

- Open Architecture
- Easy to Use
- Easy to Learn (Low Cost Training)
- Ready for Lights Out Operation
- Very Low Cost
- Fully Operational
- Modular
- Plug and play
- Portable
- Distributable
- Designed for a Twenty Year Lifetime
- Designed to Support Multiple Spacecraft

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Advanced Multimission Operations System (AMMOS): A Multi-Mission Example

Telemetry, Command, and Data Management (TC&DM)
Test Telemetry and Command System (TTACS)

Spacecraft and Instrument Test Equipment

TTACS
Test Telemetry and Command Subsystem Ground Support Equipment

AMMOS TC&DM

Mission Control
Mission Data Base
Data Transport and Delivery

JPL Advanced Multimission Operations System (AMMOS)

Ground Communication Facilities (GCF)

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Advanced Multimission Operations System (AMMOS) (cont’d)

- Telemetry Frame, Packet, and Engineering Channel Services
  - Data Monitor and Control
  - Limit Checks, Derived Parameters
  - General processes support any type of channelized data (telemetry, station, tracking)
  - Plots and Alphanumeric Displays
- Test Telemetry and Command System (TTACS)
  - Spacecraft and Instrument Assembly and Test
  - Closed-Loop Telemetry and Command Data Flow
  - Integrated Ground Support Equipment (GSE) TTC Interface
  - Same software as TC&DM Flight System, with test tool and GSE interfaces added
- Command
  - Remote command request and simplified file transfer from Mission Control to station
  - Layered on new CCSDS CLTU SLE Services, enable use of non-DSN and 26m stations
Advanced Multimission Operations System (AMMOS) (cont’d)

- Distributed Object Management for Mission Files
  - General purpose object cataloging and file management
  - Wide-area file management with NFS or AFS distributed server
  - Lightweight adaptable catalog servers with query and web/JAVA access interfaces
  - Files on demand and automated subscription capabilities
  - Includes extensive set of tools for database management
  - Automated data security and access control as required with scalable storage for large and small mission data volumes

- End-to-End Data Accountability
  - Spacecraft-to-Ground Data Accountability
  - Data Gap Analysis, QQCL Metrics, and Pathological Data Recovery
  - Quick critical data recovery
  - Service performance verification