

Mission Software Systems Section 369

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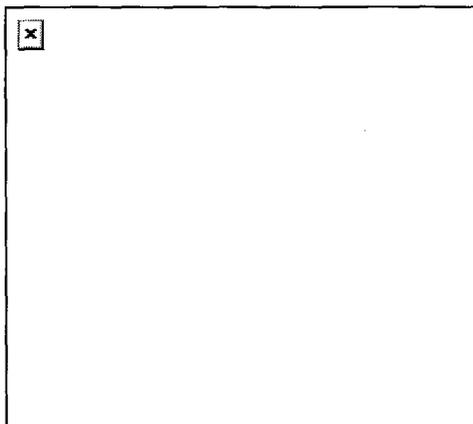
Mission Software Systems: Overview

- 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

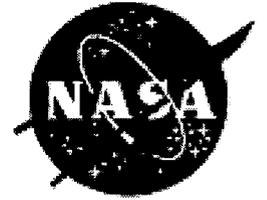
Technical Goals

- 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.



Section Product Lines and Skills

- 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).
 - Monitor and Control system for NASA's Deep Space Network (DSN).
 - 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



Section Product Lines and Skills (cont'd)

- 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

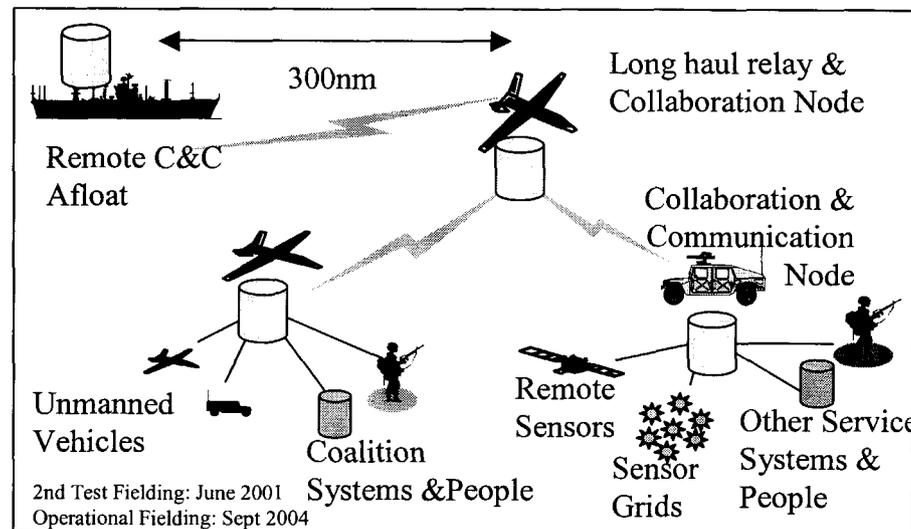
Section Technology Thrusts

- 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.



Sensor Grids
Rovers

Rovers &
Orbiters by
other Nations

Multi-tiered
Comms

Comms
Bottleneck

Common Approach:

- Based on an 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.

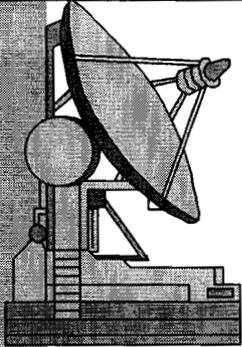
Jason 1 – A Mission Specific Example

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

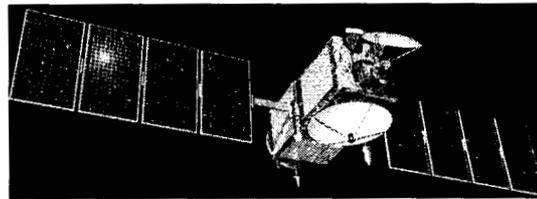


- Control and Monitor Earth Terminals
- Receive, Store, Process and Display Real-time and Recorded Telemetry Data.
- Command and Monitor Satellite Status
- Translate and Transmit Commands
- Decommutate and Distribute Telemetry Data
- Manage and Archive Data Files
- Platform Abstraction - “Ready to Run”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

Jason 1 - Characteristics

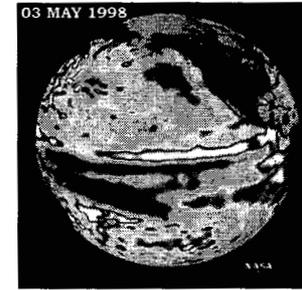


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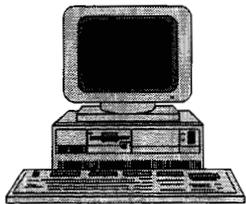
**JASON 1 Earth Orbiting
Spacecraft**

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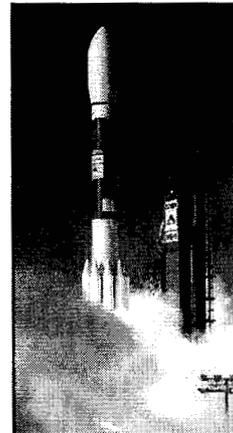
- Poker Flat, Alaska
- Wallops Island, Virginia
- Aussaguel, France

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

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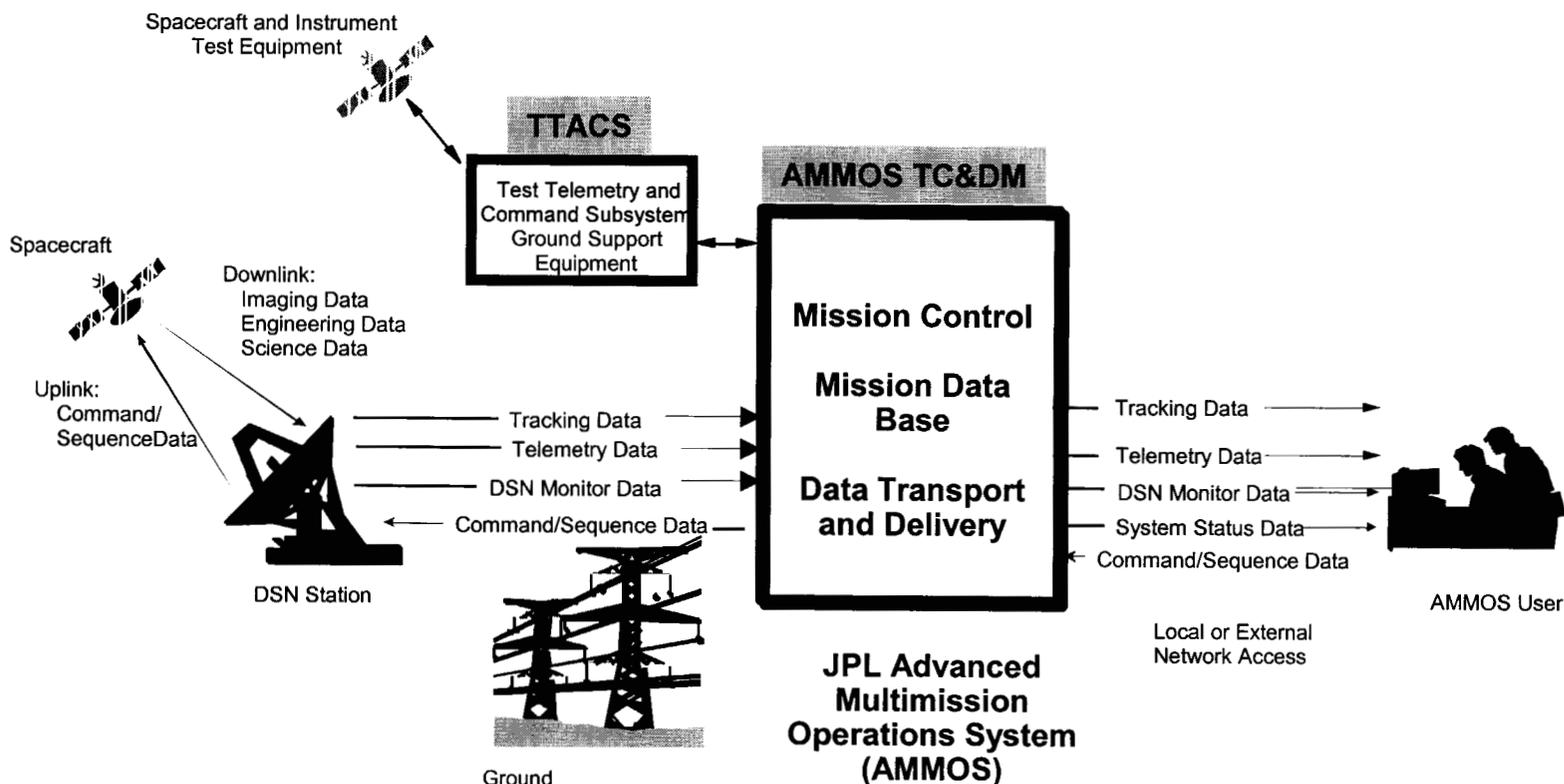
•Delta II from Vandenberg AFB

Mission Software Systems - 369

- 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

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

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





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