OASIS-CC PRESENTATION

Laboratory for Atmospheric and Space Physics
Operations and Information Systems Group

University of Colorado at Boulder

CU/LASP Organization

Laboratory for Atmospheric and Space Physics

Scientific Division

Engineering Division

Operations and Information Systems Division

CU/LASP employs 100 professional researchers and engineers and 60 undergraduate and graduate student researchers.
CU/LASP Flight Projects

LASP scientists and engineers have participated in the following NASA space flight missions:

- Orbiting Solar Observatory 5
- Orbiting Geophysical Observatory 4, 5 & 6
- Orbiting Astronomical Observatory 2
- Mariner Venus 5
- Mariner Mars 4 & 7
- Mariner Mars 9
- Orbiting Solar Observatory 8
- Atmosphere Explorer C & D
- Voyager 1 & 2
- Pioneer Venus Orbiter
- Solar Mesosphere Explorer
- Spartan Halley
- Galileo Jupiter Orbiter
- Hubble Space Telescope
- Upper Atmosphere Research Satellite
- Cassini Saturn Orbiter
- Earth Observing System
- 200 Sub-Orbital Rocket Experiments

Asterisks denote projects for which LASP built or is building one or more instruments.

What is the OASIS Project?

- The Operations and Science Instrument Support (OASIS) project is a long-term effort to help produce operations capabilities that can support space science missions of the next century.
  - Past funding from NASA Office of Space Science and Applications and Goddard Space Flight Center
  - By providing a comprehensive concept for future mission operations systems we can enable new kinds of missions by increasing flexibility and functionality while substantially reducing life-cycle costs and project development time.
- We have implemented portions of the OASIS concept in software under the general name OASIS-R/T.
  - OASIS-CC — OASIS Command and Control, for monitoring and controlling science instruments and spacecraft during test, integration, launch and on-orbit operations.
  - OASIS-PS — OASIS Planning and Scheduling, for scheduling instrument and spacecraft operations.
OASIS-CC

Fundamental User Requirements for OASIS-CC Software

- Usable by scientists and engineers who aren't programmers and who don't want to be programmers
  - Software must be easy to install, tailor for application, and operate
  - Must perform all primary functions without need for any additional software coding and without need for other costly software packages
- Applicable throughout the project life cycle:
  - Instrument development, test and integration, launch, and on-orbit operations
- Extremely flexible
  - Need to be able to modify data definitions and processing functions quickly and easily without writing new software
  - Built-in support for a wide variety of communications protocols
- Good user interface
  - Graphical user interface that can be tailored by users
  - Operations language that is more English-like and which eliminates the main deficiencies of STOL

OASIS-CC

OASIS-CC Evolution

<table>
<thead>
<tr>
<th>VMS</th>
<th>Vax (GKS &amp; graphic terminal)</th>
<th>VaxStation (GKS &amp; VWS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SunOS</td>
<td>Sun 3/60 (X-11 &amp; GKS)</td>
<td>Sun 3/60 (TAE+)</td>
</tr>
<tr>
<td>SparcStation (TAE+)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>USLTX</td>
<td>DecStation (TAE+)</td>
<td></td>
</tr>
</tbody>
</table>
OASIS-CC

FUNCTIONALITY DESCRIPTION

User Interface
CSTOL
Language processing
Communications
Data processing
Data transfer
Recording
Command

Something to remember

OASIS-CC is table driven. Most of what follows are generic capabilities of the system. Users only need to provide the contents of the tables.
OASIS-CC: User interface

- The interface uses the Transportable Application Environment Plus (TAE+)
  - TAE+ is a Motif-compliant, portable environment for developing and running interactive, window, text and graphical object-based application systems
  - TAE+ is developed and supported by GSFC
  - TAE+ includes a workbench, an intuitive tool that supports the design and layout of an application's user interface
  - Code (Ada or C) generated by the workbench is linked with the OASIS-CC code to generate the executable program
  - Using TAE+ a user can develop simple or extremely elaborated user interfaces.

- User input is done via:
  - push button
  - slider
  - form-filling
  - radio button
  - check box
  - menu selection
- The user can also input CSTOL statements via keyboard entry

- Data in the OASIS-CC current value table can be used to:
  - Drive alphanumeric display
  - Animate icons (rotation, distortion, translation)
  - Drive icons that represent a system's state
  - Drive stripchart-like plots
OASIS-CC: CSTOL

- The Colorado System Test and Operations Language (CSTOL) is derived from GSFC's STOL.
- Improvements over STOL:
  - A distinctly English-like syntax
  - The ability to access database tables through a query language
  - A mechanism for expanding the language through macros
  - Support of engineering units
- CSTOL is designed for scientists, engineers, ground controllers who develop, test and operate spacecraft and payloads
- CSTOL was built as a test for many of the requirements for the Space Station User Interface Language
- CSTOL accommodates people with little or no programming experience
- CSTOL's English-like syntax makes it readable and self-documenting

OASIS-CC: CSTOL (cont.)

CSTOL provides users with the means to perform the following functions:

- Evaluate expressions, where variables in the expression can be data from a spacecraft or instrument
- Make decisions based on information returned by the spacecraft or instrument
- Initiate and control procedures written in CSTOL
- Maintain the OASIS database
- Call up and terminate displays
- Make and break communication links
- Send commands to the spacecraft or instrument
OASIS-CC: Communications

- Generic protocol support is provided:
  - DECNET, mailbox and RS-232 for the VMS version
  - TCP/IP (stream socket) and RS-232 for the SunOS version
- Other protocol handlers can be developed if required by an application (example: NASCOM for the RHISE application and the LDBP application, DADS/ADS for the SSFP DMS testbed application, 16-bit parallel interface)
- The VMS version provides an IEEE-488 capability

Future developments:
- IEEE-488 for SunOS version
- 1153 for SunOS version

OASIS-CC: Data processing

- Stream synchronization
- Stream decommutation (super-commutation, sub-commutation, packetized telemetry)
  - Binary data
  - Floating point data
  - ASCII formatted data (I, F or A format)
  - Interfacing to a hardware decommutator may be done in the near future (concept already tested)
- Conversion from raw (unsigned integer) values to unitized real values
- Conversion from raw discrete values to state values (like ON, OFF)
- Limit checking
  - High/Low, Red/Yellow
  - Red limit can trigger the execution of a CSTOL procedure
  - State check
  - Unsafe state can trigger the execution of a CSTOL procedure
  - Delta check
OASIS-CC: Data processing (cont.)

- Smoothing and trending
- Print-on-change
- Pseudo-measurement generation:
  - Generically via the execution of a CSTOL procedure by the equation-CLP

OASIS-CC: Data transfer

- Two mechanisms are provided: Bridge and Router
- Both mechanisms use the communication services provided by OASIS-CC

Bridge:
- Allows transfer via file or over communication links of processed data in a format defined by the user
- Useful to transfer time-correlated science and engineering data for quick-look processing
OASIS-CC

OASIS-CC: Data transfer (cont.)

- Router:
  - Bi-directional mechanism:
    - Allows the transfer of raw data over communication links
    - Allows the transfer to a CSTOL processor of CSTOL statements received on communication links
  - Useful for distributing realtime data to remote nodes or executing command requests from remote nodes

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OASIS-CC: Recording

- Recording of downlink data
  - Raw data can be recorded and replayed
  - Processed data can be recorded (via the Bridge capability)
  - Comments can be added by the user at recording time to qualify the recorded data
  - Event messages can be recorded
OASIS-CC

OASIS-CC: Command

- Translation from an high-level (e.g., CSTOL) representation of a command into an instrument command

- Examples:

<table>
<thead>
<tr>
<th>CSTOL</th>
<th>TRANSLATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>slew grating to 1800</td>
<td>CC229F08</td>
</tr>
<tr>
<td>slew grating to 1216.0 s</td>
<td>CC229F08</td>
</tr>
<tr>
<td>set observation list to 5</td>
<td>CC220605</td>
</tr>
<tr>
<td>set entrance slit to stellar</td>
<td>CC220780</td>
</tr>
<tr>
<td>move extender to 10.0 mm</td>
<td>3FCC280C83</td>
</tr>
<tr>
<td>move extender to 1.0 cm</td>
<td>3FCC280C83</td>
</tr>
<tr>
<td>close gripper</td>
<td>move gripper to 6.0 cm</td>
</tr>
</tbody>
</table>

OASIS-CC

OASIS-CC: Command (cont.)

- Instrument commands can be:
  - Binary (when the natural representation of the instrument command is a bit pattern)
  - ASCII (when the natural representation is a character string)

- Instrument commands can be:
  - Discrete
  - Serial (i.e., a command containing subfields)

- Instrument microprocessor load support

- From one CLP, commands can be directed to multiple targets over multiple communication lines
OASIS-CC SUPPORT

Utility programs
Documentation
Support office
Anomaly reporting and configuration management
Release documentation

OASIS-CC: Utility programs

- Database-related programs:
  - Load Database: from ASCII to internal representation
  - Dump Database: from internal representation to ASCII
  - Report Database: from internal representation to report format
  - DDP (Database Development Package): a user-friendly database builder program, using TAE+ (in development)

- Parser-related program:
  - Convert Table: from ASCII to internal representation

- Event log file:
  - Dump Events: to search and create a printable file from the event log file
OASIS-CC

OASIS-CC: Documentation

- CSTOL Reference Manual
- Database Guide
- System Manager's Guide
- Installation Guide
- Graphics Editor User's Guide

- Up-to-date with the current version of OASIS-CC, with TAE+
  version-specific documentation:
  - Installation guide
  - Application developer's guide

OASIS-CC: Support office

Four types of support can be provided:

- Phone support for application developer
- Applications developer class
- Specific code development
- Application development
OASIS-CC

OASIS-CC Anomaly reporting and release documentation

- Reporting mechanism existing currently on the SPAN network:
  - Allows the users to report anomalies or request enhancements
  - Each report is automatically assigned a number
  - Users can refer to this number to track their reports
  - The reports are also used to support configuration management
- Each new release is documented in a release note:

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Release Notes for OASIS V02.05.02

This is the release notes for OASIS V02.05.02.

The following programs and source files have been released:

- OASIS V02.05.02
- OASIS-DEC.EXE (GFX version)
- PAUSERMOD
- PAUSER_INIT.DAT
- REPORT V02.05.02
- REPORT.COM

This version of OASIS is compiled using DecLinks 1.6 and has been tested under
the following configurations:

VXMS Dos/VIC VMS
4.7 3.1 3.2
4.8 4.0 4.9
4.1 3.9 4.9
5.1 3.1 4.1
6.3 4.1 4.2

LASP 04/02
```

OASIS-CC

OASIS-CC AS A TOOL

Examples of utilization
Support of instrument development
Support of spacecraft integration and test
Support of flight operations

LASP 04/02
OASIS-CC

OASIS-CC: Examples of utilization

- UARS/SOLSTICE instrument
  OASIS-CC is used to support instrument functional test, calibration, integration and flight operations

- JSC Space Station Freedom DMS testbed
  OASIS-CC was used in four nodes of the testbed (OMA, OMGA, APEM and POIC nodes) located at JSC and at MSFC

- ESA Astronaut training
  OASIS-CC is used to access MSFC's Payload Crew Training Complex from ESTEC in Noordwijk

- Long Duration Balloon Project
  OASIS-CC will be used along with OASIS-PS to acquire balloon experiment data, TDRSS ODM messages and issue GCM requests

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OASIS-CC: Examples of utilization (cont.)

- SOLCON flight operations
  From ESTEC in Noordwijk, OASIS-CC was used to monitor and control the SOLCON experiment aboard the last ATLAS flight

- DMSP and DSCS ground station demonstration
  OASIS-CC was used to demonstrate low-cost, transportable satellite operation and control systems

- EOS/SOLSTICE II and CASSINI/UVIS
  OASIS-CC will be used during the functional tests, calibration and integration of these two instruments
OASIS-CC

OASIS-CC: Instrument development support

OASIS-CC → S/C Simulator → Instrument

Instrument functional test

Quick-Look Processing

OASIS-CC → S/C Simulator → Instrument

Instrument calibration

Calibration devices

LasP