

OASIS-CC

OASIS-CC PRESENTATION

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OASIS-CC OVERVIEW

Original requirements

Architecture overview

Evolution since 1986

OASIS-CC Origins

GSFC's MSOCC → SME POCC → OASIS-CC

Additional
requirements:

- Ease of use
- Portability between applications
- Portability between hosts
- Life-cycle use

OASIS-CC: Ease of use

- **A flexible user interface based on GSFC's Transportable Application Environment+ (TAE+)**
 - X-11 based, Motif compliant
 - User Interface workbench to design and test user interface
 - Data-driven objects
- **An upgraded test and operation language: Colorado System Test and Operations Language (CSTOL)**
 - Based on GSFC's STOL
 - English-like syntax: MOVE EXTENDER TO 100.0 MM
 - Command syntax modifiable by user
 - Supports engineering units
 - Includes database query

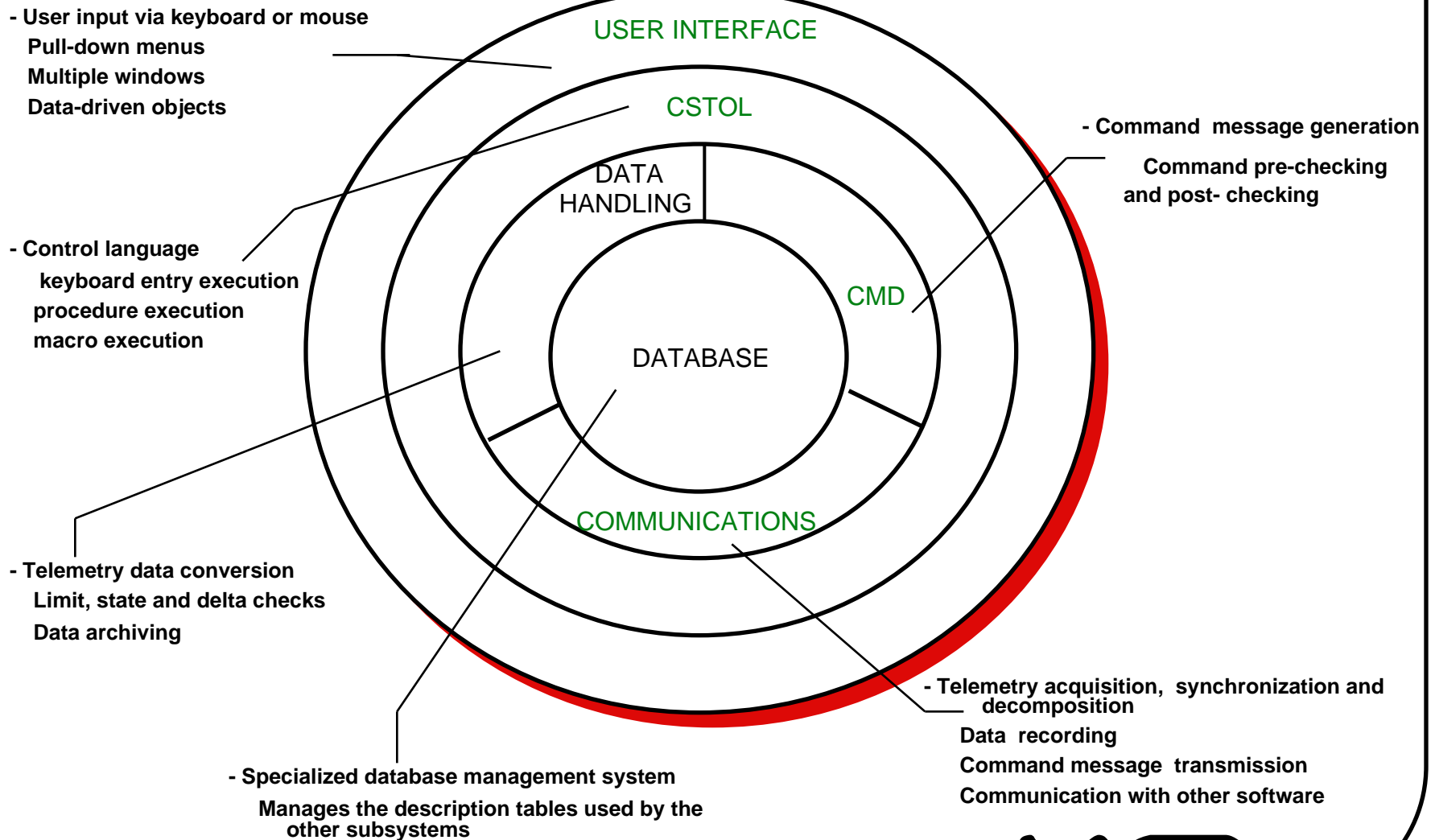
OASIS-CC: Portability

- **Portability from application to application**
 - Table-driven software (29 tables describing command format, telemetry format, data processing, etc.)
 - Built-in support for standard communication protocols (TCP/IP and RS232)
 - Extremely successful: all applications of OASIS-CC run the same code
- **Portability of the code to different computer environments**
 - Coded in Ada and user interface based on X-11/Motif
 - Sparc architecture under Solaris and HP 7xx architecture under hp_ux

OASIS-CC: Life cycle use

- **OASIS-CC can be used throughout the project life cycle:**
 - During functional test
 - During calibration
 - During systems integration and test
 - During on-orbit operation
- **This life cycle use is possible because:**
 - OASIS is a table-driven software
 - OASIS can handle simultaneously multiple out-going and incoming command and data streams
 - OASIS provides services to distribute data

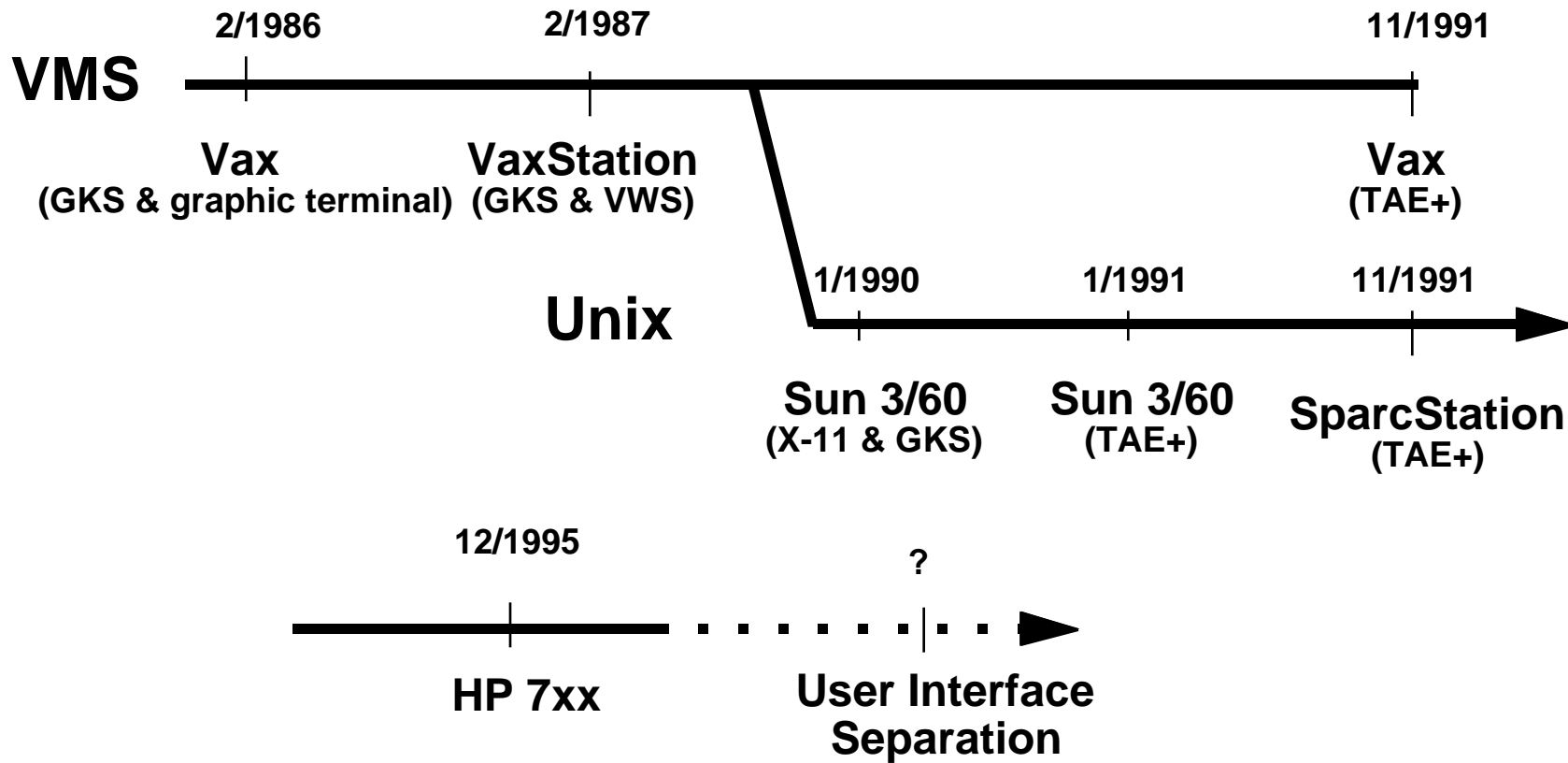
OASIS-CC: Architecture Overview



OASIS-CC: Architecture overview (cont.)

- **Mostly coded in Ada, with C code generated by the user interface workbench**
- **One process, with multitasking (Ada tasking).**
- **Users can also tailor OASIS-CC by complementing the generic processing with their own C code**

OASIS-CC Evolution



OASIS-CC FUNCTIONALITY DESCRIPTION

- **User Interface**
- **CSTOL**
- **Language processing**
- **Communications**
- **Data processing**
- **Data transfer**
- **Recording**
- **Command**
- **Thruput characterization**

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 (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.**

OASIS-CC: User interface (cont.)

- **User input is done via:**
 - push button
 - slider
 - form-filling
 - radio button
 - check box
 - menu selection
- **Actions on those input objects generate CSTOL statements and/or TAE+ events**
- **The user can also input CSTOL statements via keyboard entry**

OASIS-CC: User interface (cont.)

- **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
 - X-Y Plots
- **Displays can be send to remote workstations or X-11 terminals**

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 accomodates 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: CSTOL (cont.)

```
proc cal_lamp $mode
declare input $mode= off on,off
if ($mode = on ) and (instrument mode = stellar)
  write "Unsafe to turn on calibration lamps at this time"
  set calibration lamps with f off,g off,n off, bos off
  return
endif
set calibration lamps with f $mode,g $mode,n $mode, bos $mode
write "Turning all lamps", $mode
end proc
```

OASIS-CC: CSTOL (cont.)

- **Modifying the command sub-language can be accomplished by:**
 - Adding or removing transitions in the ASCII representation of the parser
 - Loading the new parser

```
;Following are application-specific directives for the command sublanguage.  
; These are for the initial test version of OASIS which uses our Laboratory  
; Spacecraft and Instrument Simulator (LSIS).
```

```
STATE  
  
TRAN 'ENABLE' ,NORMAL_CMD_STATE ,EXTENDED_DIRECTIVE_TOKEN,COMMAND  
TRAN 'CHANGE' ,NORMAL_CMD_STATE ,EXTENDED_DIRECTIVE_TOKEN,COMMAND  
TRAN 'CLOSE' ,NORMAL_CMD_STATE ,EXTENDED_DIRECTIVE_TOKEN,COMMAND  
TRAN 'DISABLE' ,NORMAL_CMD_STATE ,EXTENDED_DIRECTIVE_TOKEN,COMMAND  
TRAN 'HALT' ,NORMAL_CMD_STATE ,EXTENDED_DIRECTIVE_TOKEN,COMMAND  
TRAN 'MOVE' ,NORMAL_CMD_STATE ,EXTENDED_DIRECTIVE_TOKEN,COMMAND  
TRAN 'OPEN' ,NORMAL_CMD_STATE ,EXTENDED_DIRECTIVE_TOKEN,COMMAND  
TRAN 'SET' ,NORMAL_CMD_STATE ,EXTENDED_DIRECTIVE_TOKEN,COMMAND
```

OASIS-CC: Language processing

- **In OASIS-CC, CSTOL is run by Control Language Processors (CLPs)**
- **At least four CLPs are always present:**
 - One user CLP
 - Three specialized CLPs:
 - *Trigger-CLP: execute CSTOL procedures triggered by out-of-limit values*
 - *Equation-CLP: execute CSTOL procedures to calculate pseudo telemetry values*
 - *Command-CLP: execute CSTOL procedures to pre-check and post-check commands*
- **Additional CLPs (called sub-CLPs) can be started to handle background processing**
 - They are controlled from the user CLP

OASIS-CC: Communications

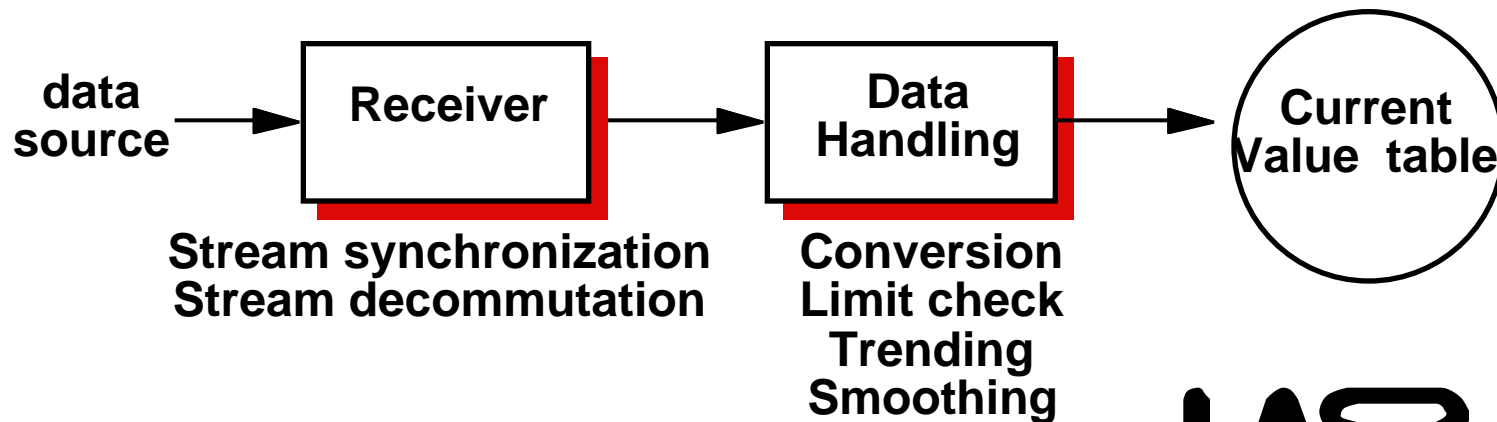
- **Generic protocol support is provided:**
 - TCP/IP and RS-232
- **Other protocol handlers can be developed if required by an application**
 - example: VME for GFOS
 - Most of the applications rely on TCP/IP. Users have build black boxes or software processes to go from the application protocol (e.g., 1153) to TCP/IP
- **Support for IEEE-488 exists in the Sparc version**

OASIS-CC: Data processing

- **Stream synchronization**
- **Stream decommutation (super-commutation, sub-commutation, packetized telemetry, TDM frame)**
 - 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
- **Unexpected event detection**

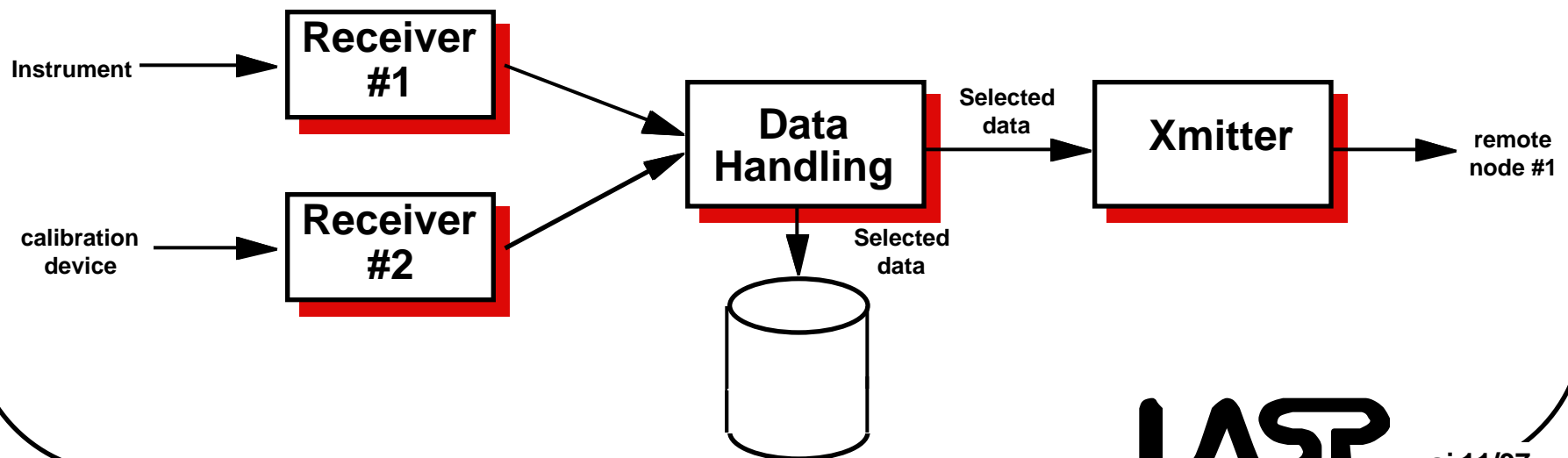
OASIS-CC: Data processing (cont.)

- Counter of out-of-limit measurements on per-subsystem basis
- Smoothing and trending
- Print-on-change
- Pseudo-measurement generation:
 - Generically via the execution of a CSTOL procedure by the equation-CLP
 - Heavy load of pseudo-measurements generation may be handled better by adding equation-solving code to OASIS-CC. It is possible to code the computation of the pseudo-measurements in C.



OASIS-CC: Data transfer

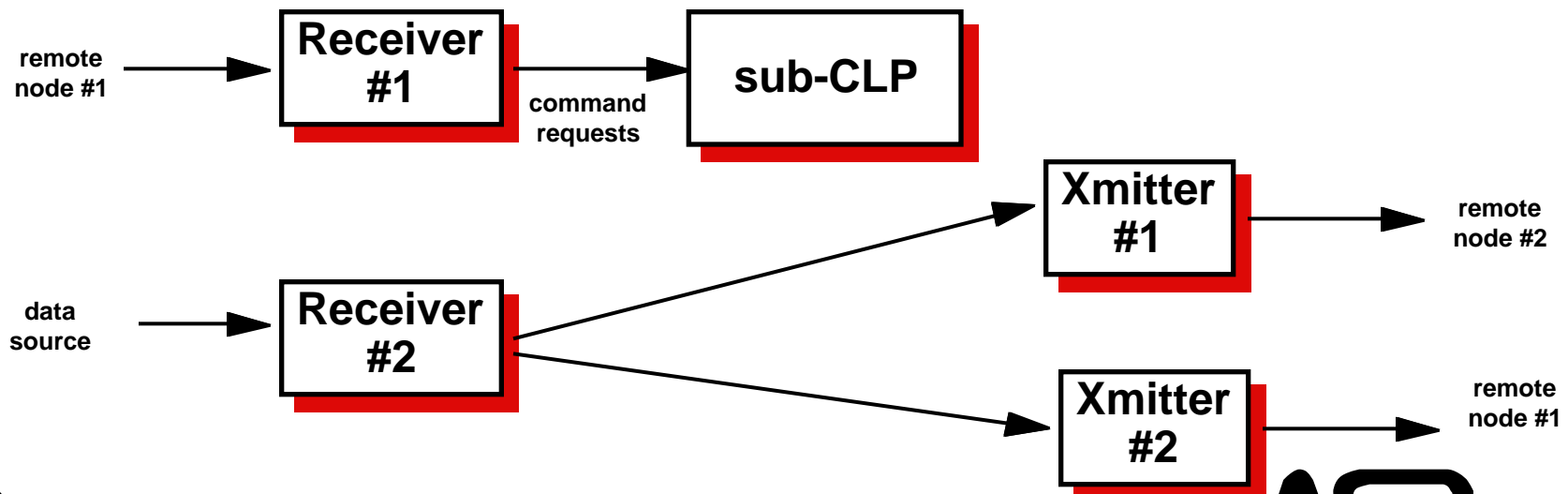
- **Three mechanisms are provided: Bridge, Router and Data Server**
- **Bridge and Router mechanisms use the communication services provided by OASIS-CC**
- **Bridge:**
 - Allows transfer via file or over communication links of processed data in a format defined by the user
 - Useful to transfer time-correlated science and engineering data for quick-look processing



OASIS-CC

OASIS-CC: Data transfer (cont.)

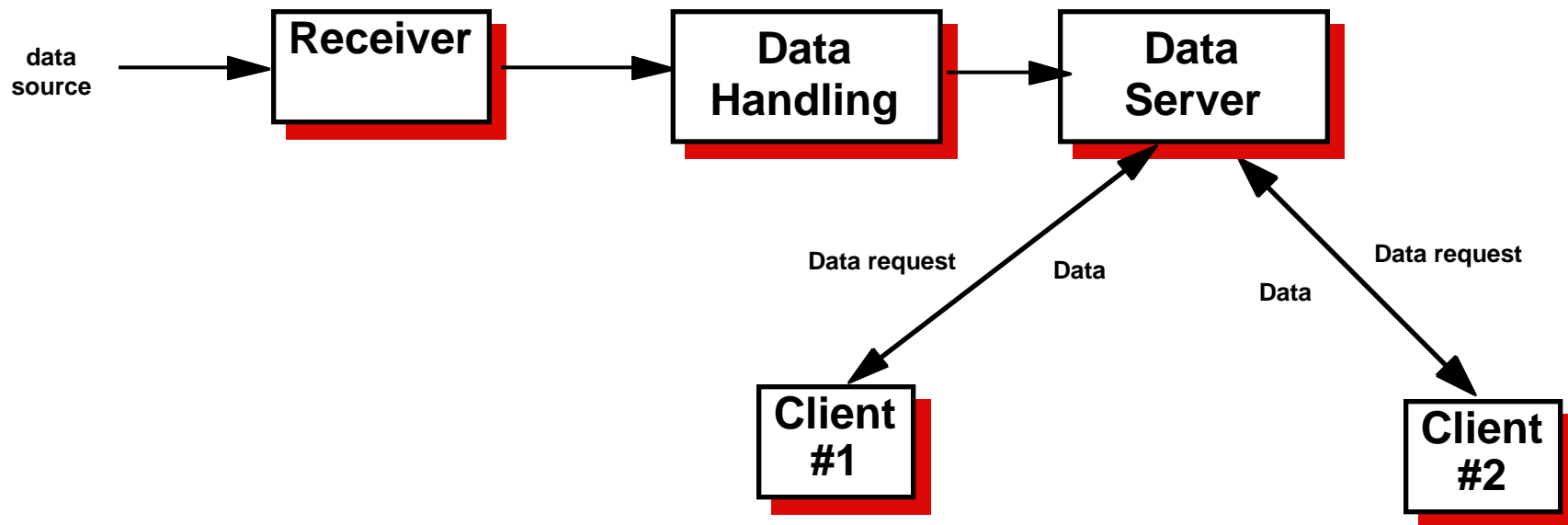
- **Router:**
 - **Bi-directional mechanism:**
 - *Allows the transfer of raw data over communication links*
 - *Allows the transfer to any sub-CLP of CSTOL statements received on communication links*
 - **Useful for distributing realtime data to remote nodes or executing command requests from remote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



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OASIS-CC: Data transfer (cont.)

- **Data Server:**
 - OASIS-CC acts as a data server to client processes
 - Client processes request group of data to be transferred
 - OASIS-CC transfers the data as a 32-bit tag and a 32-bit value



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**
- **Display pages can be snapped**
- **Commands hexadecimal pattern and command messages hexadecimal pattern can be recorded in the event message log file**

OASIS-CC: Command

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

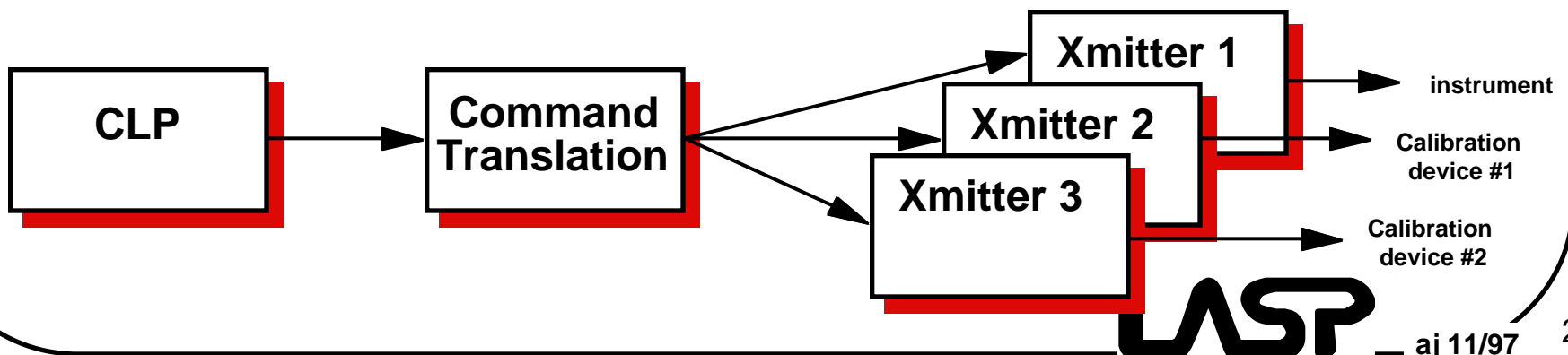
CSTOL	TRANSLATION
slew grating to 1800	=> CC229F08
slew grating to 1216.0 a	=> CC229F08
set observation list to 5	=> CC220605
set entrance slit to stellar	=> CC220780
move extender to 10.0 mm	=> 3FCC280C83
move extender to 1.0 cm	=> 3FCC280C83
close gripper	=> move gripper to 6.0 cm

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)
 - *Subfield values can be:*
 - Unit-less value
 - Unitized value
 - State value
- **Instrument microprocessor load support**

OASIS-CC: Command (cont.)

- **Protections provided:**
 - Commands can be declared as hazardous
 - Command subfields are checked for out-of-range values
 - Command subfield states can be declared as hazardous
 - Users can define CSTOL procedures to pre-check and post-check individual commands
 - Command uplink can be disabled
 - Check on the privilege of the user to command an instrument or an instrument subsystem (partially implemented)
 - Automatic command execution verification
- **From one CLP, commands can be directed to multiple targets over multiple communication lines**



OASIS-CC: Command (cont.)

- **User- developed C code can be added to:**
 - Modify the command bit pattern on per-command basis
 - Modify the command message bit pattern on per-target basis

OASIS-CC: Thruput characterization

- **Factors influencing OASIS-CC thruput:**
 - Frame rate (TDM frame or packet)
 - Number of telemetry measurements per frame
 - Average number of telemetry measurements with changing value per frame
 - Telemetry rate
 - Overall system load
- **Thruput measurements:**
 - Test application (data generator): variable frame rate and bit rate over using TCP/IP
 - EOS/am acceptance test: multiple input source (data generator) with pre-defined size, rate and constraints. Uses TCP/IP
 - *This test has been run continuously for 32 days*

OASIS-CC

OASIS-CC: Application thrupt measurement V020514 IP Protocol

Computer : Ultra Sparc 1/140 , 196 Mbyte, running SOLARIS 2.5.1

OASIS-CC :

- Release of v02.05.14(3). Compiled with run-time checks ON
- Application set up to decompose 128 measurements per packet.
Measurements are converted to engineering unit using the analog conversion table and are limit checked.
- Protocol used is Ip
- OASIS-CC verifies the sync pattern of each packet

Simulator: - Packet size set to 128 bytes
- Running on a remote workstation

measured packet rate	measured bit rate	# measurements decomposed per second	# measurements changing per second	# measur. xfered per second	measured- % of cpu
32/s	32kbps	4096	3968	0	12%
32/s	32kbps	4096	3968	3908	20%

OASIS-CC

OASIS-CC: EOS/am acceptance test V020514

Input

- 7 packetized streams	
- 2 16kb packets, one packet/sec each (each stream has 64 different packet ids)	32.0 kbp/se
- 5 1kb packets, one packet/sec each	5.0 kbp/sec
- 1 ascii message stream at 3 messages/s (with burst of 50 messages/sec)	1.9 kbp/sec

	38.9 kbp/sec

Processing

- Number of measurements extracted	1,109/sec
- Number of measurements changing (in telemetry)	113/sec
- Number of equations firing	110/sec
- Number of display (refresh rate of 2 sec)	2 with 75 items each
- Number of measurements bridged or xfered	200/sec
- Latest_Data and Limits tables checkpointing frequency	2/hour
- Run directive frequency	2/hour
- Switch recording file frequency	2/hour
- Clear and display frequency of one of the 75 items display	10/hour
- Snap frequency	10/hour
- Trigger activation	~1/hour (burst of 5 commands)
- Commanding rate	2 commands/sec
- All events are logged	
- Event messages are displayed (including the messages from the ascii message stream)	
- Cstol procedure lines in user clp are displayed	
- Cstol procedure running in the user clp with \$\$step_interval = 0.25	
- One measurement out-of-limit per second (with burst of 110 measurements going out-of-limit in the same packet for time to time)	
- Procedures running in 5 sub clps	

Sizing

Decomposition	: 70,406 records
Latest_Data	: 5,226 records
Equations	: 600 records (600 equations coded in C)
Limits	: 600 records
Analog_Conversions	: 1,106 records

TEST RESULTS

Ultra Sparc 1 (test duration: 22 hours)

With no data bridged	: 8.0%
With data bridged to file	: 10.4%
With data xfered via the data server	: 8.5%

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
- **Parser-related program:**
 - convert_table: from ASCII to internal representation

OASIS-CC: Documentation

- **CSTOL Reference Manual**
- **Database Guide**
- **System Manager's Guide**
- **Installation Guide**
- **Application Environment Reference Manual**
- **Quick Reference Manual**
- **Generic Communications User's Guide**

- **Up-to-date with the version 12 of OASIS-CC**
 - Current version of the code is 14(4)

OASIS-CC: Support office

- **Four types of support can be provided:**
 - Phone support for application developer
 - Applications developer class
 - Specific code development
 - Application development
- **Contact:**
 - Alain Jouchoux (303) 492 6792, alain.jouchoux@lasp.colorado.edu
 - Gail Tate (303) 492 6825, gail.tate@lasp.colorado.edu

OASIS-CC Anomaly reporting

- **Reporting mechanism exists on the internet:**
 - 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
- **Three parts in a report:**
 - User-provided description
 - Problem statement and solution description by the support office team
 - Disposition field

OASIS-CC VERSION V02.05.14(3) RELEASE NOTES

5/1/97

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Appendix A: oasis_data_server.h

Appendix B: MEASURED PERFORMANCES

<http://lasp.colorado.edu>

OASIS-CC

OASIS-CC: Some Current Projects

◆ In-house applications

- STRV 1A and 1B: Flight operations
- SNOE: Spacecraft I&T and flight operations
- Cassini/UVIS: Instrument bench testing, I&T and flight operations

◆ Outside applications

- ORBCOMM (OSC): Spacecraft I&T and flight operations
- GFO (Ball): Spacecraft I&T
- QuikBird (Ball): Spacecraft I&T
- QuikScat (Ball): Spacecraft I&T and flight operations
- EOS/am (Lockheed): Spacecraft I&T
- Landsat 7 (Lockheed): Spacecraft I&T
- Gravity Probe B (Lockheed/Stanford): Spacecraft I&T and flight operations
- Lunar Prospector (Lockheed): Spacecraft I&T
- CRSS (Lockheed): Spacecraft I&T and ground segment
- MOPITT (Comdev/U of Toronto): Instrument bench testing
- MODIST (SBRC): Instrument bench testing
- ARGOS (NRL): Instrument bench testing