



GLAST LAT Flight Software Demonstration

SLAC Campus
Building 84, Central Lab Annex

December 3, 2004
Overview Presentation 10:30 AM (Room B-259)
Demonstrations 10:45 AM

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1 Demonstration Overview

1.1 Agenda for the Demonstrations

The demonstration will take place in the Central Laboratory Annex (Building 84), Room B-101.

Demo Agenda Item	Presenter(s)
1. Overview of the Demonstration (in Group C Conference Room, B-288)	Lawrence Jeung
2. Memory Management Demo	Lawrence Jeung
3. Questions from Attendees	NA

Feel free to jot questions and comments down in the margins of this document or in the space provided on page 19.

1.2 Goals of the Demonstration

The November 2004 FSW Demonstration (actually held on December 3) covers:

Memory Management. This demo uses the Spacecraft Data Interface Simulator (SDIS) to represent the Spacecraft and the Instrument to Spacecraft Interface Simulator (ISIS) to represent the LAT. The demonstration shows the full range of memory management operations, including memory dumps and loads.

6 of 7 memory management requirements from Section 5.3.7 of the SRS will meet full progress with this demonstration.

1.3 Verification of Requirements

The following table cites the software requirements scheduled to be demonstrated today. Where entries in this table refer to other documents, consult the SRS for the list of citations.

FSW Requirements Demonstrated	Description	Completion Status
5.2.1.3.1: Science Data Rate	The FSW shall accommodate LAT science data interface data transfer rates up to 40 Mbps to SC storage via the Event Builder.	Rescheduled
5.3.3.1: SC Command Processing by SIU	The SIU FSW shall process LAT commands from the SC, received via the CTDB, in the order that they are received.	Rescheduled

FSW Requirements Demonstrated	Description	Completion Status
5.3.3.2: Command Execution Notification	For all LAT commands from the SC, the FSW shall be capable of generating time-tagged telemetry notification of their dispatch for execution.	Rescheduled
5.3.3.3: Command Completion Status	The FSW shall be capable of generating time-tagged telemetry notification of command completion status (success or general cause of failure) for ground-initiated commands at the time such information becomes available. As a goal, in addition to completion status, each successful command should result in a modification of a telemetry parameter (e.g., Off to On, Open to Closed, etc.) to further confirm success.	Rescheduled
5.3.3.8: Multiple Block Commands	The FSW shall execute block commands for uploads or dumps serially (i.e., not simultaneously, not interleaved with other block commands).	Rescheduled
5.3.3.9.1: Data Integrity Errors	To reduce the chance of executing a corrupted command, the FSW shall validate commands prior to execution.	Rescheduled
5.3.3.9.2: Parameter Validation	The SIU FSW shall validate command parameters prior to execution.	Rescheduled
5.3.4.1: GPS Time Hack from SC	The LAT shall receive and process a 1 Hz GPS "time hack" on a discrete signal line, generating a correlation between the GPS time hack and the LAT internal 20 MHz clock.	Rescheduled
5.3.4.2: GPS Time Hack Integrity Check	The LAT FSW shall perform an internal integrity check of the input GPS time hack to verify consistency with the expected internal clock behavior, reporting inconsistency to the ground.	Rescheduled
5.3.4.4: LAT Clock Correlation	The SIU FSW processing shall generate a mapping of external time to the LAT internal 20 MHz clock, in order to accurately time stamp event data.	Rescheduled
5.3.4.5: Time Stamp Accuracy	The accuracy of event timestamps shall be better than 10 μ sec relative to spacecraft time. The goal is to achieve time accuracy of better than 2 μ sec relative to spacecraft time.	Rescheduled.
5.3.7.1: Directory Create	In order to create a directory, the FSW shall receive as input, from the spacecraft via the CTDB, a command that includes directory identifier, device identifier, and unit identifier.	Rescheduled

FSW Requirements Demonstrated	Description	Completion Status
5.3.7.2: Directory Delete	In order to delete a directory, the FSW shall receive as input, from the spacecraft via the CTDB, a command that includes directory identifier, device identifier, and unit identifier.	Rescheduled
5.3.7.3: File Delete	In order to delete a file, the FSW shall receive as input, from the spacecraft via the CTDB, a command that includes file identifier, directory identifier, device identifier, and unit identifier.	Rescheduled
5.3.7.4: File Copy within a Processor	In order to copy a file within a processor, the FSW shall receive as input, from the spacecraft via the CTDB, a command that includes source file identifier, source directory identifier, source device identifier, unit identifier, destination file identifier, destination directory identifier, and destination device identifier.	Rescheduled
5.3.7.5: File Copy from SIU to EPU	In order to copy a file from the SIU to an EPU processor, the FSW shall receive as input, from the spacecraft via the CTDB, a command that includes source file identifier, source directory identifier, source device identifier, and destination unit identifier. Note that a separate commit command is sent to the EPU to move the file from EPU RAM into the file system.	Rescheduled
5.3.7.6.1.1: File Dump Command	In order to dump a file, the FSW shall receive as input, from the spacecraft via the CTDB, a command that includes file identifier, directory identifier, device identifier, and unit identifier.	Rescheduled
5.3.7.6.1.2: File Dump Data	In response to receiving a File Dump command, the FSW shall transmit the requested file data to the spacecraft.	Rescheduled
5.3.7.6.2: File Dump Cancel	The FSW shall receive as input, from the spacecraft via the CTDB, a command to cancel the dump of a file based on unit identifier.	Rescheduled
5.3.7.7.1.1: File Directory Dump Command	In order to dump a file directory, the FSW shall receive as input, from the spacecraft via the CTDB, a command that includes directory identifier, device identifier, and unit identifier.	Rescheduled

FSW Requirements Demonstrated	Description	Completion Status
5.3.7.7.1.2: File Directory Dump Data	In response to receiving a File Directory Dump command, the FSW shall transmit the requested data to the spacecraft, including: device identifier, directory identifier, file identifier, setting of read-only flag, archive flag setting, most recent update time, byte size, and number of blocks for each file and subdirectory in the requested directory.	Rescheduled
5.3.7.8.1.1: File System Status Dump Command	The FSW shall receive as input, from the spacecraft via the CTDB, a command to dump the file system status for a specific unit.	Rescheduled
5.3.7.8.1.2: File System Status Dump Data	In response to receiving a File System Status Dump command, the FSW shall transmit the requested data to the spacecraft, including: total block size, blocks used, and blocks free for the requested unit.	Rescheduled
5.3.7.9: File Loads	After entering the boot shell, the FSW processors shall be commandable by the SIU to perform file loads. Further design details are provided in [12].	Rescheduled
5.3.7.10: Upload Cancellation	The FSW shall be commandable to cancel an active file load.	Rescheduled
5.3.7.11: Memory Pool Status Dump	The FSW shall receive as input, from the spacecraft via the CTDB, a command to return information on the memory pool for a specified unit and memory pool.	Full
5.3.7.12.1.1: EPU Memory Dumps	After entering the boot shell, the EPU shall be commandable by the SIU to perform memory dumps.	Rescheduled
5.3.7.12.1.2: SIU Memory Dumps	After entering the boot shell, the SIU shall be commandable from the ground to perform memory dumps.	Full
5.3.7.12.1.3: Memory Dump Data	Upon receipt of a command to perform a memory dump, the FSW shall transmit the requested data to the spacecraft via the CTDB.	Full
5.3.7.12.1.4: Memory Dump Cancel	The FSW shall process a command to cancel a memory dump.	Full

FSW Requirements Demonstrated	Description	Completion Status
5.3.7.12.1.5: Memory Loads	In order to perform memory writes, the SIU FSW shall process commands, from the SC via the CTDB, that include unit identifier, memory address, memory size, and memory data.	Full
5.3.7.12.1.6: Memory Load Data	Load data shall consist of telecommand packet sequences that contain configuration tables, software loads, and command scripts.	Full

2 Demonstration Procedure

2.1 Context of the Demonstration

2.1.1 Hardware Context for the Memory Management Demonstration

The Memory Management demonstration is carried out using the Spacecraft Data Interface Simulator (SDIS) from Spectrum Astro and the Instrument to Spacecraft Interface Simulator (ISIS) built at SLAC.

2.1.1.1 The Spacecraft Data Interface Simulator (SDIS)

The SDIS represents significant portions of the interface between the LAT and the Spacecraft. The SDIS comprises one side of the SC C&DH system with a 1553 bus, LVDS Science Interface, and Discrete monitors and controls.

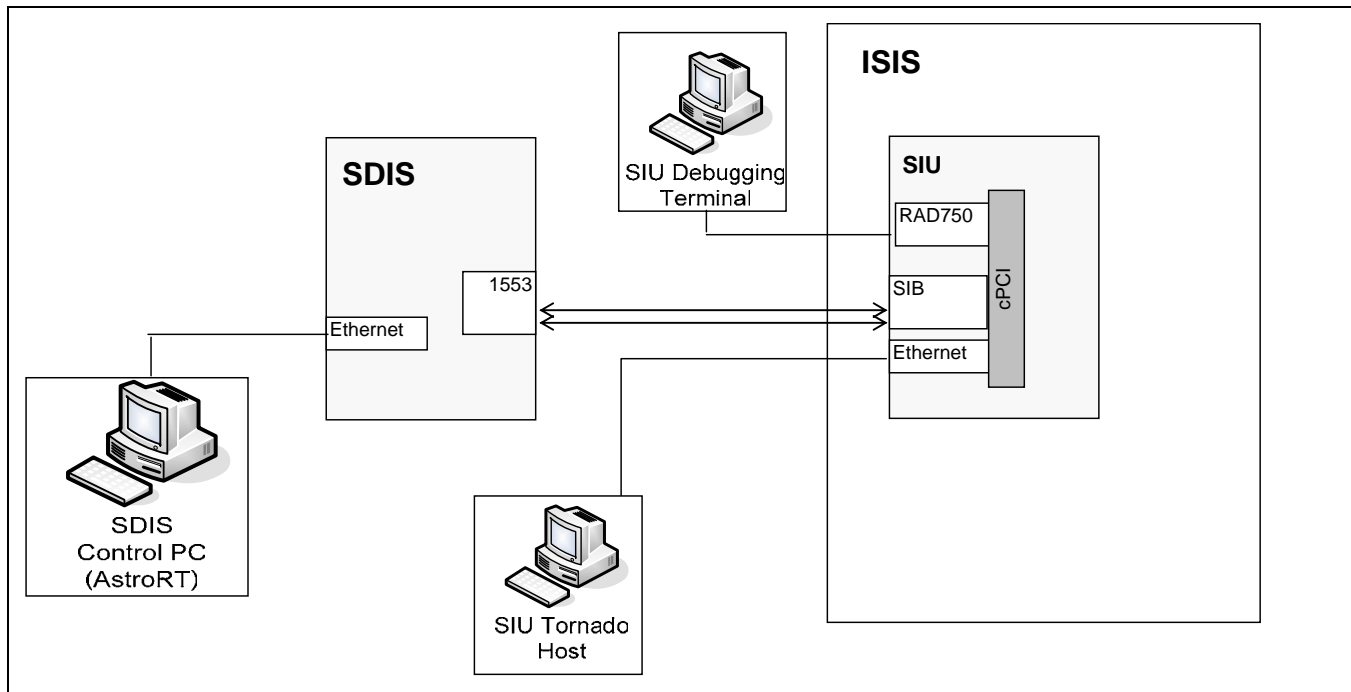
A PC, connected to the SDIS via Ethernet, is used to control the Simulator. The PC runs Spectrum Astro's proprietary Spacecraft command and control package, AstroRT.

2.1.1.2 The Instrument to Spacecraft Interface Simulator (ISIS)

The ISIS is made up of engineering models of flight hardware. The distinctions between the ISIS SIU, PDU, and GASU hardware and flight-qualified parts are very few. With the exception of the sole SIU, the remaining pieces of the core LAT hardware are fully redundant.

Today's demo makes use primarily of the ISIS SIU and its 1553 connection with the SDIS.

Figure 1: Hardware Setup for December 3, 2004 FSW Demonstration



2.1.2 Context for the Demonstrations

The following software libraries are loaded on the ISIS SIU during the course of the memory management demonstration. Unless otherwise indicated, these packages are production versions of FSW as of December 3, 2004:

```

/RAD750/prod/librad750_reboot.o, /CMX/prod/libcmx_asBuiltSpy.o, /PBS/prod/ libpbs.o,
/MSG/prod/libmsg_mt.o, /MSG/prod/libmsg_print.o, /ZLIB/prod/ libzlib_inflate.o,
/CCSDS/prod/libccsds_pkt.o, /CCSDS/prod/libccsds_dump.o,
/CCSDS/prod/libccsds_swap.o, /SIB/prod/liblibsib.o, /CTDB/prod/libsumt_rt_sib.o,
/ITC/prod/libitc_dump.o, /ITC/prod/libitc.o, /CTS/prod/libctx_lcp_sumt.o,
/CTS/prod/libcts_lcp.o, /PBC/prod/ pbc_lcp/libpbc_lcp.o,
/LSM/prod/lsm_dump/liblsm_dump.o, /LSM/prod/liblsm.o, /MEM/prod/libmem.o, ???
/MEM/prod/libmem_unit_test.o, /FILE/prod/libfile_hdr.o, /FILE/prod/libfile_path.o,
/FILE/prod/libfile_sys.o, /FILE/prod/libfile_upl.o, /FILE/prod/ libfile_lcp.o,
/FILE/prod/libfile_dump.o, /LCM/prod/liblcm.o, /LFS/prod/liblfs_lcp.o, /LCBD/dev/liblcbd.o,
/LEM/prod/liblem.o, /LEM/prod/liblem_cli.o, /PIG/prod/libpig_power.o,
/PIG/prod/libpig_flying.o, /PIG/prod/libpig_rooting.o, /LHK/prod/liblhk_cfg.o,
/LHK/prod/liblhk_slv.o, /LHK/prod/liblhk_sim.o, /LHK/prod/liblhk_scp.o,
/LHK/prod/libLAT_sumt.o, /LIMP/dev/libfft_sim.o, /LIMP/dev/ liblimp.o,
/LIMP/dev/libfsw_cfg.o, /LIMP/dev/libfsw_start.o, /LIMP/dev/libfsw_load.o, /LCP/prod/
liblcp.o

```

2.2 Memory Management Demonstration

The memory management demonstration proceeds in the following 4 major steps:

- Step 1: Boot Memory Dump and Dump Cancel
- Step 2: Boot Memory Load, and Dump to Confirm
- Step 3: Memory Pool Dump
- Step 4: Memory Dumps, Cancels, and Loads at the Application Level

Before the demonstration begins, the demonstrator has opened terminal windows to control VxWorks sessions and has launched the AstroRT software on the SDIS Control PC.

2.2.1 Step 1: Boot Memory Dump and Dump Cancel

Step 1 of the memory management demo proceeds as follows:

1. The demonstrator powers on the ISIS.
 - a. The SIU enters primary boot. After a few minutes, primary boot is complete and the boot shell is available for commands.
2. At the SDIS Control PC, the demonstrator opens the AstroRT BootMemoryDump window to display boot memory-related telemetry.
3. The demonstrator uses AstroRT to issue the LMEMDUMPMEM telecommand, specifying in the LMEMSIZELO field that 512 words of memory should be dumped. See Figure 2 on page 14.
4. In the BootMemoryDump display, the LPBCMEMPADDR field increments from 0 to 2048 as the memory dump proceeds. See Figure 3 on page 15.
5. The demonstrator issues the LMEMDUMPMEM telecommand again, this time specifying an LMEMSIZEHI value of 1 and LMEMSIZELO value of 512 to instruct the PBC to dump a larger amount of memory over 1553 to the SDIS.
6. Once again, in the BootMemoryDump display, the LPBCMEMPADDR increments from 0 as the memory dump proceeds. See Figure 3 on page 15 for an illustration.
7. While the large memory dump is proceeding, the demonstrator issues the LMEMDUMPCANCEL telecommand. The memory dump is cancelled, and the LPBCMEMPADDR field in the BootMemoryDump display ceases to increment.

This part of the demonstration shows that FSW provides functionality to satisfy the following requirements from Version 4 of the LAT Flight Software Specification – Level III:

FSW Requirements Demonstrated	Description	Monitor Verification
5.3.7.12.1.2: SIU Memory Dumps	After entering the boot shell, the SIU shall be commandable from the ground to perform memory dumps.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.
5.3.7.12.1.3: Memory Dump Data	Upon receipt of a command to perform a memory dump, the FSW shall transmit the requested data to the spacecraft via the CTDB.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.
5.3.7.12.1.4: Memory Dump Cancel	The FSW shall process a command to cancel a memory dump.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.

2.2.2 Step 2: Boot Memory Load, and Dump to Confirm

In Step 2 of the demo, with the ISIS SIU still in the boot shell, the demonstrator loads a boot memory region, then dumps that region out again to confirm the load was successful. Step 2 proceeds as follows:

1. Using AstroRT, the demonstrator issues the LMEMLOADMEM command with a particular starting address (4), number of words to load (11), and value to write in those words (65535) as shown in Figure 4 on page 16.
2. The demonstrator then issues the LMEMDUMPMEM command to dump the region at the same starting address, and confirms in the BootMemoryDump display window that the value 65535 is contained in the memory regions that were designated for load. See Figure 5 on page 16.

This part of the demonstration shows that FSW provides functionality to satisfy the following requirements from Version 4 of the LAT Flight Software Specification – Level III:

FSW Requirements Demonstrated	Description	Monitor Verification
5.3.7.12.1.5: Memory Loads	In order to perform memory writes, the SIU FSW shall process commands, from the SC via the CTDB, that include unit identifier, memory address, memory size, and memory data.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.
5.3.7.12.1.6: Memory Load Data	Load data shall consist of telecommand packet sequences that contain configuration tables, software loads, and command scripts.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.

2.2.3 Step 3: Memory Pool Status Dump

Step 3 of the memory management demo proceeds as follows:

1. The demonstrator uses AstroRT to issue the LBTRTOSEXEC telecommand to kick the boot code out of the boot shell and into secondary boot.
2. When secondary boot is complete, the demonstrator opens a VxWorks WindSh to the ISIS SIU and executes the **demo.vx** script to load the FSW libraries listed in Section 2.1.2 on page 8.
3. In AstroRT, the demonstrator opens a new telemetry display, the MemPoolData window.
4. The demonstrator uses AstroRT to issue the LMEMDUMPPPOOL command, specifying a pool ID of 0. See Figure 6 on page 17.
5. The corresponding memory pool statistics are shown in the MemPoolData window. See Figure 7 on page 17.
6. The demonstrator repeats the memory pool dump with a pool ID of 1 and confirms the new memory pool statistics in the MemPoolData window.

This part of the demonstration shows that FSW provides functionality to satisfy the following requirements from Version 4 of the LAT Flight Software Specification – Level III:

FSW Requirements Demonstrated	Description	Monitor Verification
5.3.7.11: Memory Pool Status Dump	The FSW shall receive as input, from the spacecraft via the CTDB, a command to return information on the memory pool for a specified unit and memory pool.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.

2.2.4 Step 4: Memory Dumps, Cancels, and Loads at the Application Level

In this step, now that the boot process is complete, the demonstrator shows that the application-level tools for memory management can supply the same dump, dump cancel, and load capabilities as the boot-level tools.

The demonstrator runs essentially the same sequence of commands used in Step 1. However, the display used to show the output telemetry is changed in AstroRT to the MemSiuData window. See Figure 8 on page 18.

This part of the demonstration shows that FSW provides functionality to satisfy the following requirements from Version 4 of the LAT Flight Software Specification – Level III:

FSW Requirements Demonstrated	Description	Monitor Verification
5.3.7.12.1.2: SIU Memory Dumps	After entering the boot shell, the SIU shall be commandable from the ground to perform memory dumps.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.
5.3.7.12.1.3: Memory Dump Data	Upon receipt of a command to perform a memory dump, the FSW shall transmit the requested data to the spacecraft via the CTDB.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.

FSW Requirements Demonstrated	Description	Monitor Verification
5.3.7.12.1.4: Memory Dump Cancel	The FSW shall process a command to cancel a memory dump.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.
5.3.7.12.1.5: Memory Loads	In order to perform memory writes, the SIU FSW shall process commands, from the SC via the CTDB, that include unit identifier, memory address, memory size, and memory data.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.
5.3.7.12.1.6: Memory Load Data	Load data shall consist of telecommand packet sequences that contain configuration tables, software loads, and command scripts.	This requirement was successfully demonstrated _____ Monitor Initials If only partially successful, record deviations on page 19.

3 Outputs of the Demonstration

This section contains the screen captures, terminal outputs, and other raw results of the demonstrations run today. These figures are provided to assist monitors in verifying that the FSW successfully demonstrated compliance with the software requirements cited above.

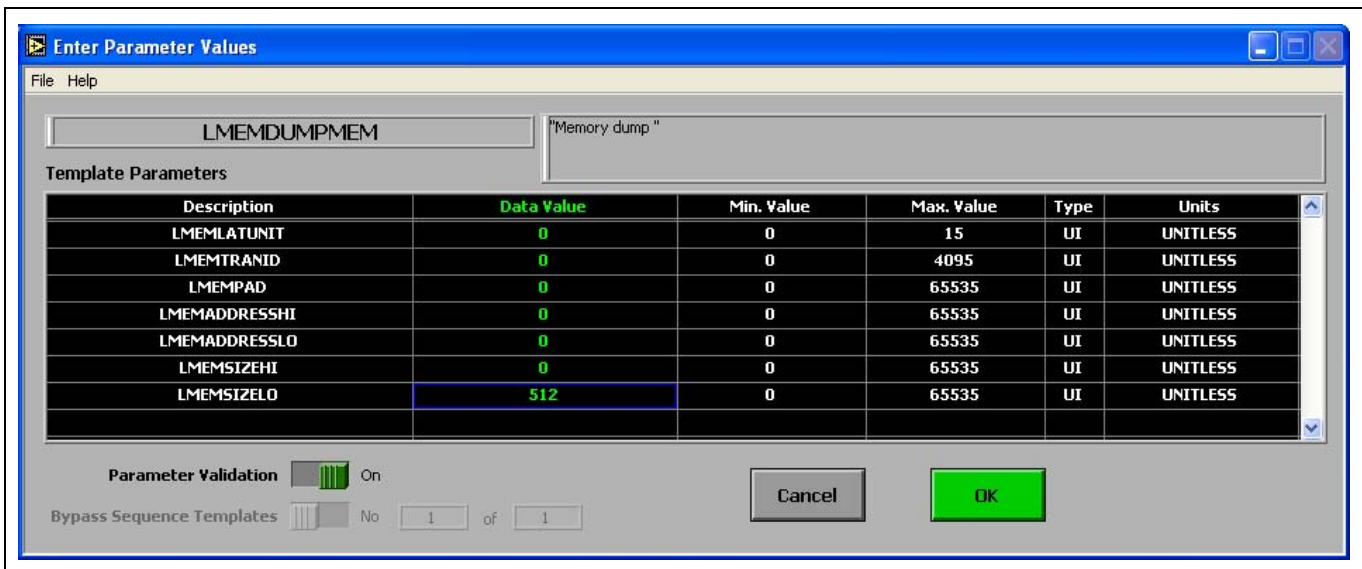
3.1 Outputs of Memory Management Demonstration

In Steps 1 through 4 of the memory management demonstration, several AstroRT windows are used to set memory management telecommand parameters and display the contents of memory dumps and memory pool status dumps. These outputs are presented below in order of the Steps followed during the demo.

3.1.1 Outputs of Memory Management Demo Step 1

While the SIU is holding in the boot shell, the demonstrator uses the SDIS to send the LMEMDUMPMEM telecommand to instruct the primary boot code memory management functions to dump a memory region that is 512 32-bit words in length (the LMEMSIZELO field is set to 512). The AstroRT window used to set parameters for this command is shown in Figure 2 below.

Figure 2: Parameters Set for LMEMDUMPMEM Command in Memory Management Demo Step 1



The AstroRT BootMemoryDump display is used to display the progress of the memory dumped in response to the above command, as shown in Figure 3 below. The LPBCMEMDUMPADDR field increments as the memory is being dumped.

Figure 3: BootMemoryDump Display Results for Memory Management Demo Step 1

LAT BOOT MEM DUMP				
H05125EQCNT	3731		LPBCMEMDUMPDAT09	804
H0512APID	512		LPBCMEMDUMPDAT10	808
H0512PKTTYPE	0		LPBCMEMDUMPDAT11	812
H0512PKTVNO	0		LPBCMEMDUMPDAT12	816
H0512SHDRFLG	1		LPBCMEMDUMPDAT13	820
LPBCMEMDUMPWC	16		LPBCMEMDUMPDAT14	824
LPBCMEMDUMPADDR	768		LPBCMEMDUMPDAT15	828
LPBCMEMDUMPDAT00	2097676966			
LPBCMEMDUMPDAT01	1207959827			
LPBCMEMDUMPDAT02	776			
LPBCMEMDUMPDAT03	780			
LPBCMEMDUMPDAT04	784			
LPBCMEMDUMPDAT05	788			
LPBCMEMDUMPDAT06	792			
LPBCMEMDUMPDAT07	796			
LPBCMEMDUMPDAT08	800			

Display File Path `c:\astrort\source\Glast\displays\user_def\Display_BootMemoryDump.txt`

To demonstrate the memory dump cancel command, the demonstrator repeats this process, now setting LMEMSIZEHI to 1 and LMEMSIZELO to 512 to dump a large amount of memory. The LPBCMEMDUMPADDR field shown in the LAT BOOT MEM DUMP display window increments as before. However, once the demonstrator issues the LMEMDUMPCANCEL cancel, the incrementing halts.

3.1.2 Outputs of Memory Management Demo Step 2

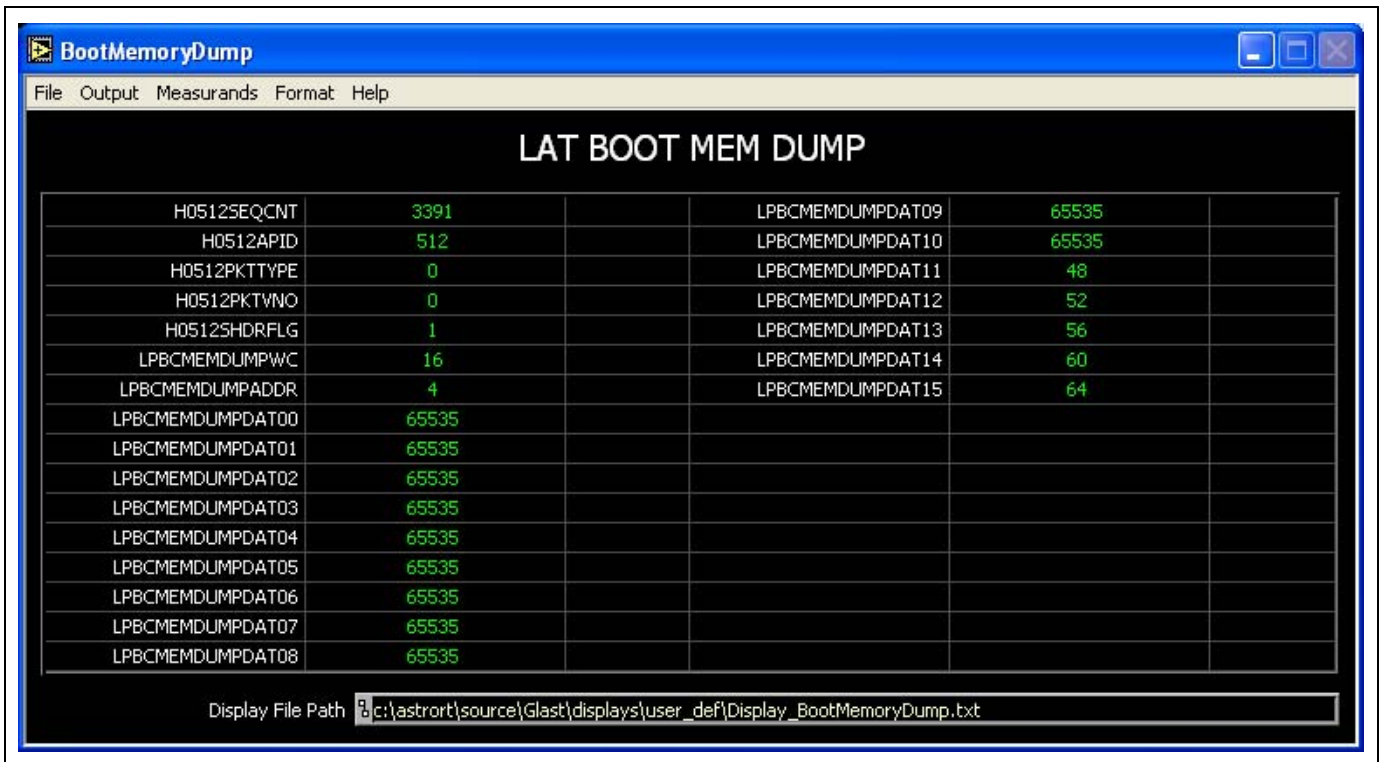
While the SIU is still holding in the boot shell, the demonstrator uses the SDIS to send the LMEMLOADMEM command with the parameters shown in Figure 4 below. 11 memory words are written (to keep the size of the figure small, only the first of the words, LMEMDATA00LO, is shown; note it has been assigned a value to be written of 65535).

Figure 4: Parameters Set for LMEMLOADMEM Command in Memory Management Demo Step 2



Once the demonstrator issues the LMEMDUMPMEM command at the same starting address, the BootMemoryDump display is updated, with the fields corresponding to the 11 data words now containing the value 65535, as shown below.

Figure 5: Memory Write Values Confirmed in the BootMemoryDump Display for Demo Step 2



3.1.3 Outputs of the Memory Management Demo Step 3

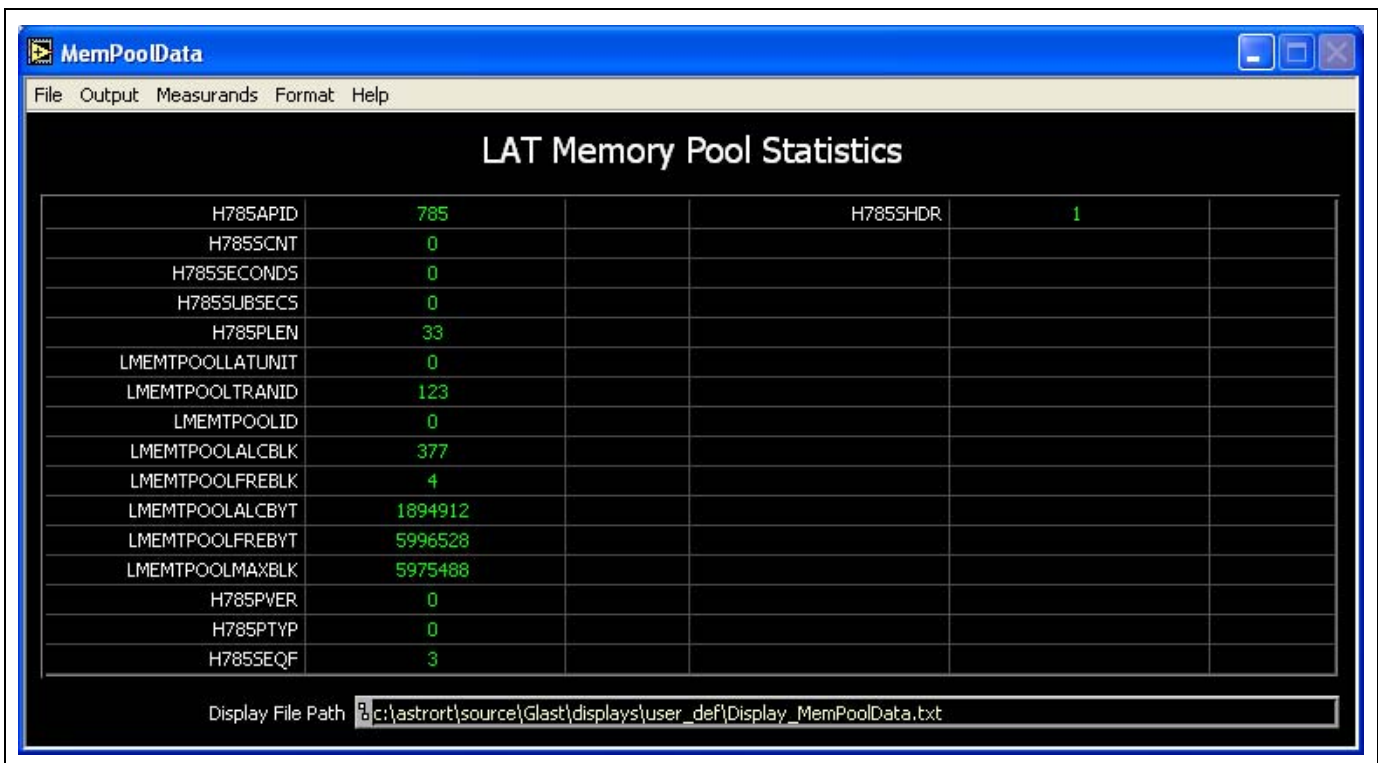
After secondary boot is complete, the demonstrator issues the LMEMDUMPPPOOL command with LMEMPOOLID set to 0. See Figure 6 below.

Figure 6: Parameters Set for LMEMDUMPPPOOL Command for Memory Management Demo Step 3



The MemPoolData telemetry display is used to show the results of the memory pool dump, as shown in Figure 7 below.

Figure 7: Memory Pool Statistics Displayed in the MemPoolData Window for Demo Step 3



5 Glossary

1553 – MIL-STD-1553B. Serial data bus specification; in particular, the serial data bus and data protocol implemented for the GLAST mission.

APID. CCSDS packet application identifier. A numerical code indicating the general type of data in a CCSDS packet.

Crate. Fond, generic term for development versions of Spacecraft Interface Units (SIUs) or Event-Processor Units (EPUs): custom-built, standalone on-board FSW processors and communications hardware units that control the LAT and communicate with the spacecraft (SIU), and process/filter instrument events (EPU). Crates are used for development purposes and will be replaced in the flight unit with single board computers with the same functionality.

GASU (Global-Trigger/ACD-EM/Signal-Distribution Unit). Portion of the FSW hardware suite that serves as the major hardware interface between data acquisition electronics on the LAT and other hardware and electronics that make up the FSW hardware package. The GASU contains the GEM, EBM, AEM, and CRU.

HKP. Real-time housekeeping telemetry data; telemetry data which relates to the health and safety of the LAT instrument.

LCB – The LAT Communications Board. A cPCI board that allows the internal components of the LAT to communicate with one another.

PID – Programmable Discrete. The RAD750 CPU board contains 32 channels of digital I/O. The primary boot code uses two channels configured as outputs.

PDU (Power Distribution Unit). Portion of the FSW hardware suite that manages power distribution from the spacecraft and monitors the health of other FSW hardware.

RTOS – Real Time Operating System. In particular the VxWorks 5.4 operating system used by the LAT.

SC – The GLAST Spacecraft. As built by Spectrum Astro. Refer to the GLAST LAT Instrument – Spacecraft Interface Control Document for the formal specifications of the SC as seen by the LAT.

SDIS – Spacecraft Data Interface Simulator. The SDIS represents significant portions of the interface between the LAT and the Spacecraft. The SDIS comprises one side of the SC C&DH system with a 1553 bus, LVDS Science Interface, and Discrete monitors and controls.

SDRAM. The RAD750 CPU board 128 MB of synchronous DRAM; the SDRAM serves as the RAD750 main memory.

SIB – Spacecraft Interface Board. The board in the SIU crates that contains the LAT 1553 remote terminal hardware.

SIU – Spacecraft Interface Unit. A type of single board computer (SBC) in the FSW hardware suite that acts as an interface between the spacecraft and the LAT.

SUROM – Startup ROM. 256 KB of EEPROM memory on the RAD750 CPU boards that holds the primary boot code; the SUROM is only programmable on the bench through the PPCI JTAG interface.

T&DF (Trigger and Dataflow System). Large LAT subsystem that provides gamma-ray identification, readout of the detector measurements, assembly of gamma-ray source location and energy measurements, and the streaming of data to the spacecraft. The T&DF subsystem contains the TKR, CAL, and ACD front-end electronics, Tower Electronics Modules (TEMs), ACD Electronics Modules (AEMs), Event Builder Module (EBM), Global Trigger (GLT), Global Trigger Electronics Module (GEM), and CPUs used for instrument configuration and data processing.

VxWorks. Computer operating system used on board the RAD750 processor.