

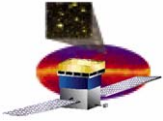
GLAST Large Area Telescope

LAT Flight Software
TRR

FSW Overview

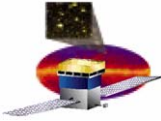
Sergio Maldonado
FSW Test Team Lead

Stanford Linear Accelerator Center



FSW Overview

- **FSW Design Overview**
- **Design Changes Since System Checkout TRR**



FSW Design: System Summary

- **FSW is a multi-CPU system that processes detector data delivered by the LAT Trigger and Dataflow System. Two classes of CPU are employed:**
 - **On the Spacecraft Interface Unit (SIU), FSW provides the command, control and configuration functions and:**
 - Supports 1553 and discrete line hardware interfaces with the spacecraft
 - Manages collection and delivery of all instrument health and safety data
 - Makes adjustments to LAT thermal control
 - Performs transient monitoring and processes/responds to transient alerts
 - Manages operational modes
 - Manages the charge injection calibration process
 - **On the Event Processing Units, FSW:**
 - Filters data produced by the T&DF system
 - Collects EPU health and performance data

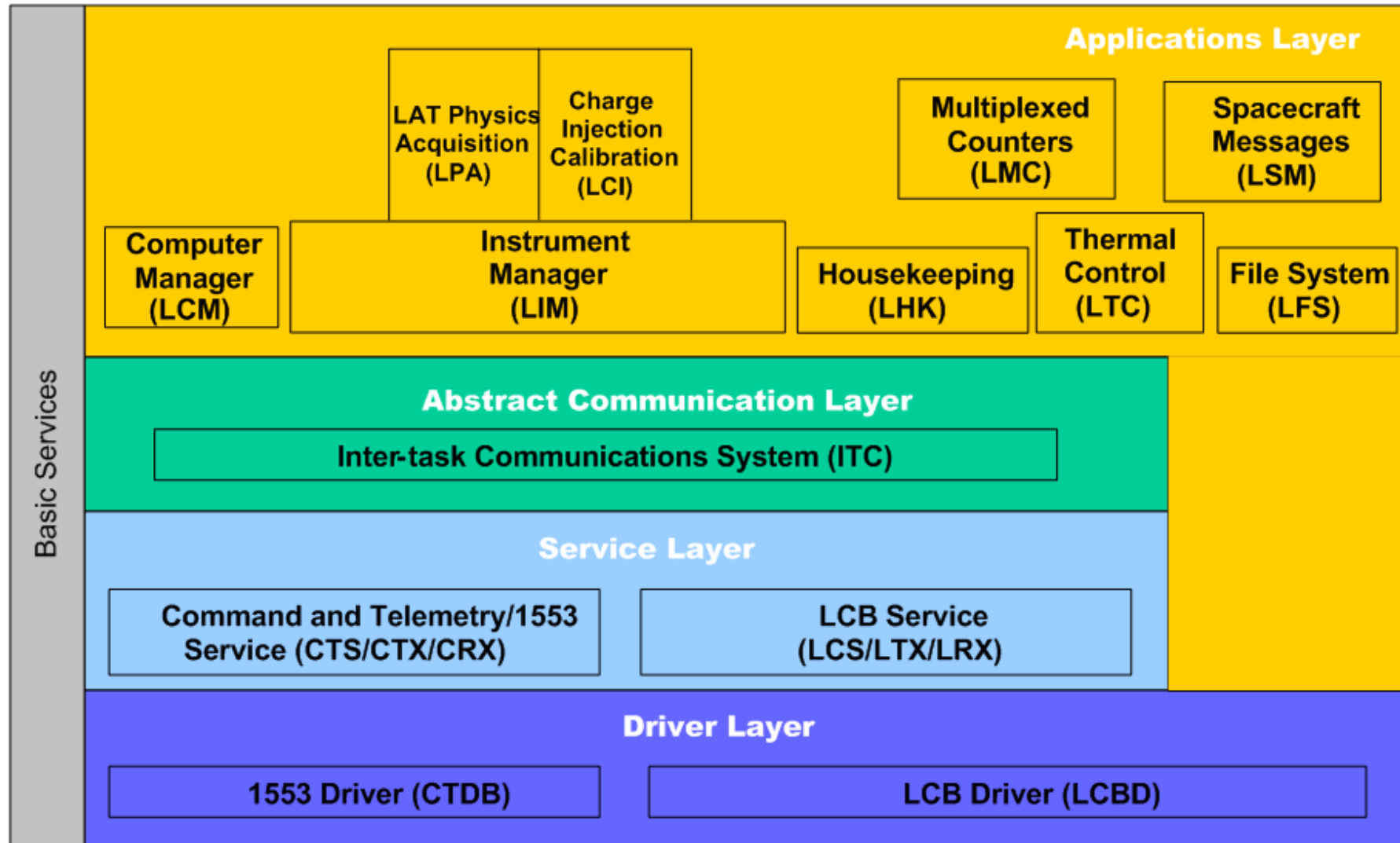


FSW Design: System Summary (2)

- **Primary Boot**
 - Initialize CPU, cPCI bus, and other hardware in each crate
 - Provide boot shell interface for file and memory loads and reads
 - Send boot housekeeping telemetry
- **Secondary Boot**
 - Load RTOS, FSW application code libraries, and initialize
 - Once the SIU and EPU's have completed secondary boot, various Operational Modes are supported (e.g., PHYSICS, CALIBRATION, etc.)
- **Once secondary boot is complete, FSW operates under the VxWorks 5.5 RTOS:**
 - FSW runs as a collection of VxWork “tasks”, which are analogous to Unix processes, but share a common address space
 - Master and slave tasks
 - Tasks communicate within a CPU and between CPUs through a custom-built inter-task communications system
 - Task scheduling is performed using standard priority-based preemptive scheduling



FSW Design: Layer Architecture for Application Mode FSW

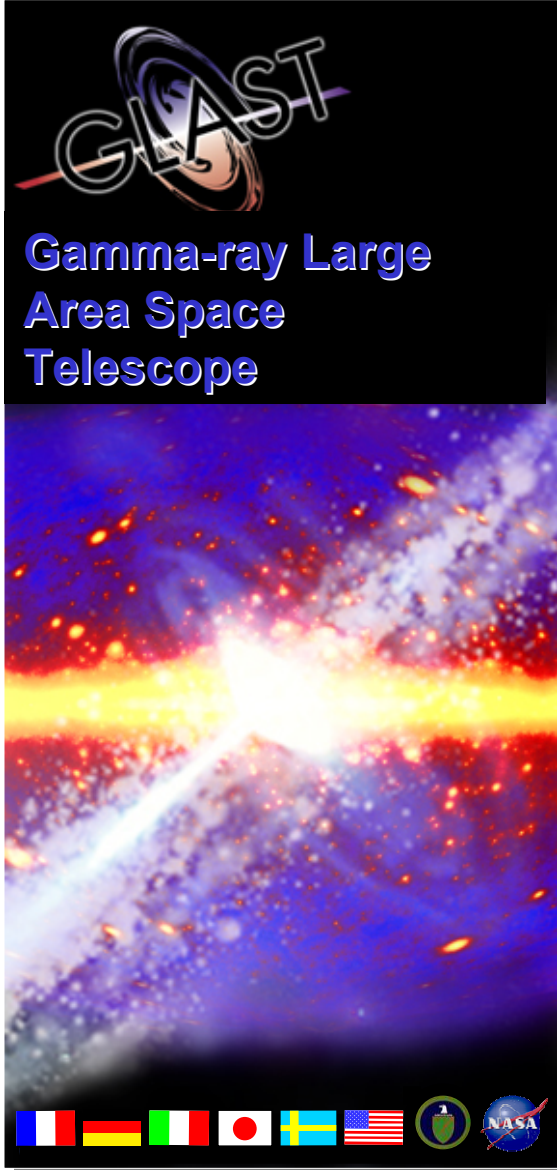
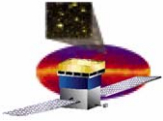




Design Changes Since System Checkout TRR

- A handful of design changes were made since the September 2005 System Checkout TRR:
 - Temporary simplification of GRB handling to meet schedule for delivery to NRL
 - Other changes were development-driven

C/O-TRR Design	Post- C/O-TRR Design Change
Full GRB detection and response for FQT	Full GRB handling for Δ FQT
EEPROM file system corruption potentially prevents successful secondary boot	Added EBC package, an emergency secondary boot system that allows operators to upload a monolithic secondary boot image, reformat the file system, and reload FSW libraries
Only event data (physics, diagnostics, calibration) written to the SSR over the Science Data Interface	Added additional types of “high-volume” diagnostic data to science data telemetry (file dumps, memory dumps, instrument configuration, LATp comm. statistics)

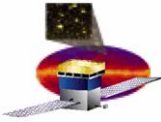


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Backup

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FSW Design: Tasks and Task Categories

- **Master and slave tasks**
 - Some functions are divided between master and slaves tasks operating on the SIU and EPUs
 - Master tasks receive telecommands, perform higher level verification, and queue commands. Slave tasks actually do much of the data collection and processing work
- **FSW libraries and tasks can be grouped into three rough categories:**
 - Drivers, such as the Command and Telemetry Data Bus/1553 (CTDB) driver, control operation of interface/communications hardware.
 - Services, such as the Command and Telemetry/1553 Service (CTS), are used by many other tasks throughout the system. In most cases, services act as interfaces to hardware, either directly or through driver software.
 - CTS, for instance, interfaces with the CTDB driver.
 - Services are not concerned with the types of data they process; instead, they are defined by the source or destination of the data they process.
 - Application tasks such as the Housekeeping (LHK) tasks, perform specialized functions.
 - Special-purpose tasks are defined by the type of data they process.
 - In the case of Housekeeping, LHK tasks collect health and safety data from a set of hardware registers and software counters on all CPUs, and assemble the data into CCSDS packets for transmission to the ground.



FSW Design: Applications Layer

- Applications perform the work required to operate and monitor the instrument, and collect science data
- LAT Housekeeping (LHK)
 - Housekeeping interrogates the instrument housekeeping systems (currents, voltages, counters, ...) and gathers CPU metrics, then places this data into housekeeping 1553 stream
- LAT Instrument Manager (LIM)
 - Responsible for instrument mode control (e.g., Safe Mode)
 - Therefore, controls power up and power down sequence as well
 - Controls access to and control over a related set of applications:
 - LAT Physics Acquisition (LPA)
 - Collect and filter data, detect GRBs, and monitor instrument deadtime
 - Charge Injection Calibration (LCI)
 - Injects charge and assembles data for analysis on the ground
- LAT Spacecraft Messages (LSM)
 - Receive and process attitude, time tone, and ancillary messages from the Spacecraft. This data allows all data from the LAT to be time stamped.
 - Attitude data to support Gamma-ray burst tracking and notification
 - Detects signals on discrete lines



FSW Design: Applications Layer (2)

- **LAT File System (LFS) and Memory Manager (MEM)**
 - **LFS receives requests for operations on the RAM and EEPROM based file systems (file upload, dump, copy, delete, ...), interrogates the file system (directory dumps, directory status, ...)**
 - **MEM software provides a telecommand and telemetry interface to write and dump memory contents**
 - **File and memory dumps can be sent over 1553 or to the SSR**
- **LAT Computer Manager (LCM)**
 - **Provides interface for running CPU troubleshooting and diagnostics**
- **LAT Thermal Control (LTC)**
 - **Read instrument temperature sensors and, based on a set of configurable parameters, apply a Lockheed algorithm to determine whether to activate heaters**
- **LAT Multiplexed Counters (LMC)**
 - **Provides on-demand low-rate science counters**