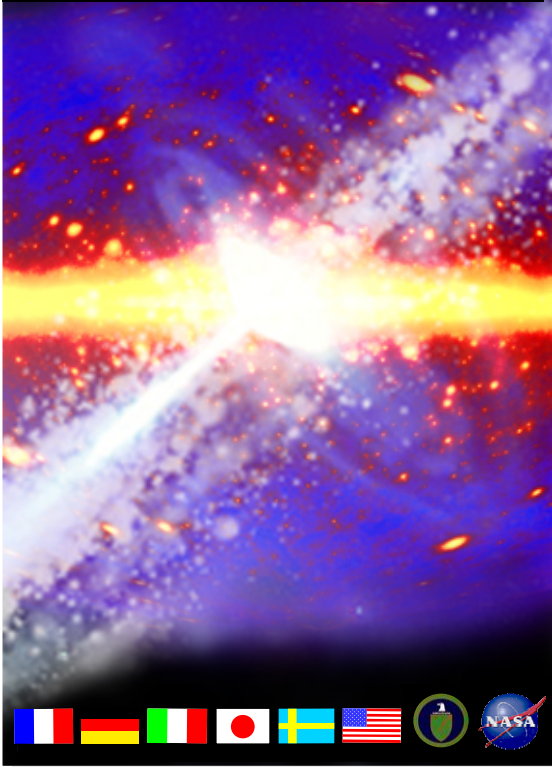


Gamma-ray Large
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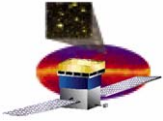
GLAST Large Area Telescope

LAT Flight Software
System Checkout TRR

FSW Overview

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FSW Overview

- **FSW Design Overview**
- **Design Changes Since Flight Unit Peer Review**



FSW Design: System Summary

- **FSW is a multi-CPU system that processes detector data delivered by the LAT T&DF 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

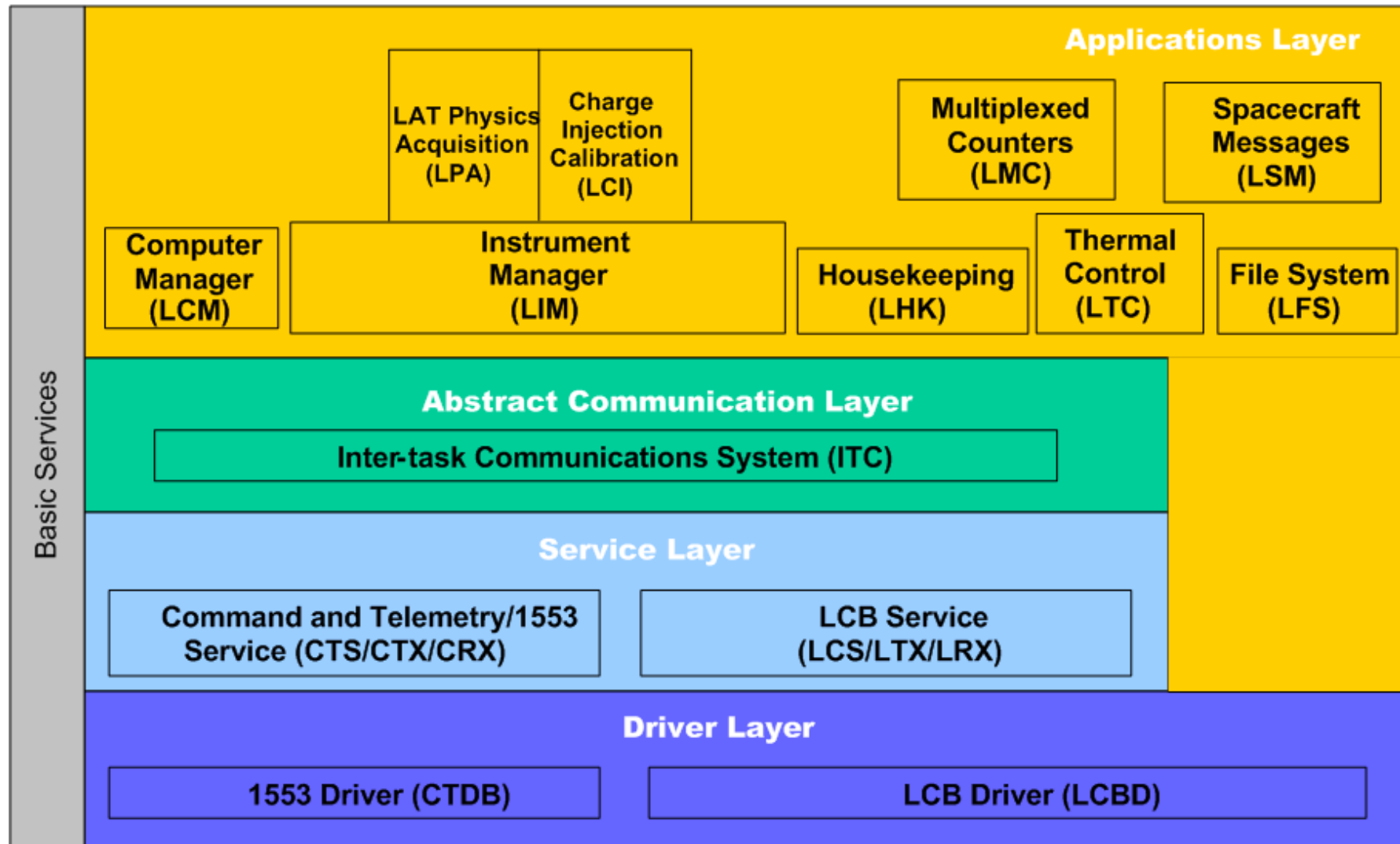


FSW Design: System Summary (2)

- **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 in 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 Flight Unit Peer Review


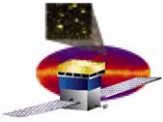
- A handful of design changes were made since the September 2004 Flight Unit Peer Review (FUPR):
 - **Some requirements-driven**
 - **Some development-driven**
 - **Minor test team impact**

FUPR Design	Post-FUPR Design Change
Single primary boot image	Redundant primary boot images
“Basic” App Mode startup sequence	“Enhanced” startup
CPU watchdog manager app w/ callbacks (LSW)	Simpler watchdog handling in MON package
N/A	Added LAT Computer Manager (LCM) package





Design Changes Since FUPR (2)

FUPR Design	Post-FUPR Design Change
N/A	Added LAT Multiplexed Counters (LMC) package
LAT Diagnostics Framework (LDF) application for instrument diagnostics	LDF descoped Instrument diagnostics to be handled by LPA
FSW to provide analyzed/reduced calibration and instrument diagnostic data set along with raw data	LCI and LPA provide raw data only. All data analysis performed on the ground.



**Gamma-ray Large
Area Space
Telescope**



A vertical banner on the left side of the slide. At the top is the GLAST logo, which consists of the word 'GLAST' in a stylized, metallic font with a satellite-like structure behind it. Below the logo is the text 'Gamma-ray Large Area Space Telescope' in blue. The middle section of the banner is a colorful image of the cosmic microwave background, showing a bright yellow and orange band across the center, with a white beam of light pointing towards the left. At the bottom of the banner is a row of flags representing the participating countries: France, Germany, Italy, Japan, Sweden, and the United States, followed by the European Space Agency and NASA logos.

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Backup

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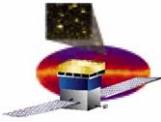
FSW Design: Tasks and Task Categories

- **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**