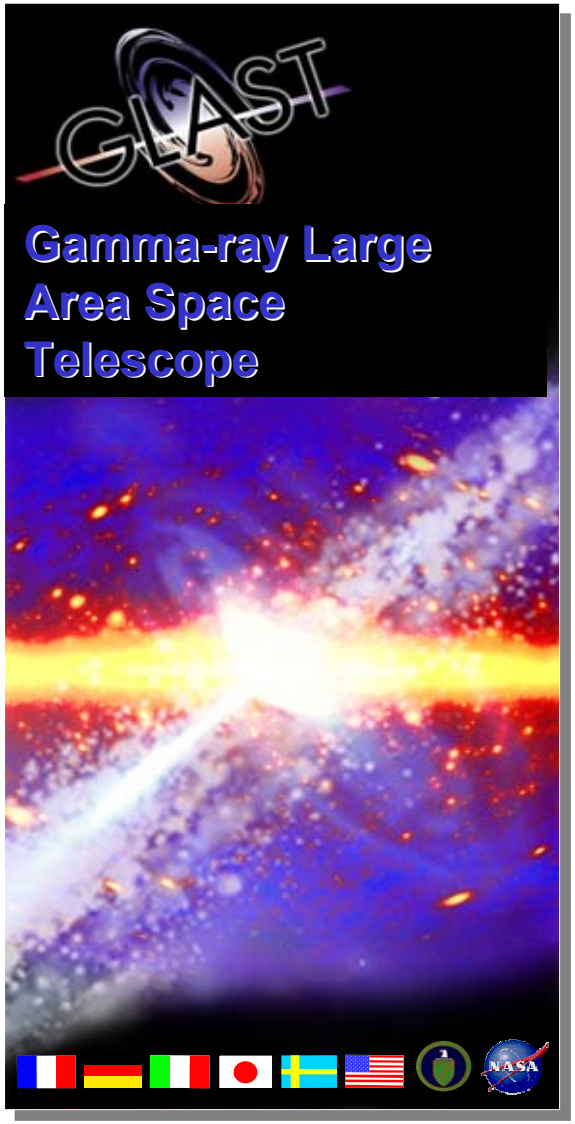

GLAST Large Area Telescope:

4.1.7 Engineering Models

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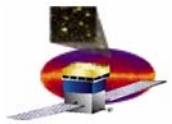
Outline

- Categorize deliverables in terms of components and systems
- Define scope of presentation
- Enumerate and characterize *components*
- Enumerate and characterize *systems*



Components and systems

- As defined in this presentation:
  - A *component* is a single identifiable design or function
  - *Systems* are simply ensembles of one or more components
- Systems and components come in generations
  - Measure of maturity of both implementation and interface definitions
- May be more then one *instance* of a system or component
  - More then one component in a system
  - More systems in order to maximize productivity through parallel activity
- *All* Systems and components come bundled with software
  - Hardware is *delivered* to FSW
  - Hardware and software is *shipped* to clients
- Dates are in months/ years

What's *not* discussed

- *So*-called "Qual" or "flight" articles
- Front-End Electronics
  - Deliverability is the responsibility of respective sub-systems
  - However, all the components and systems described here depend on the robust operation, timely delivery, and interface fidelity of their respective Front-End Electronics
- *Purely* software components
  - For example, L3 filter or housekeeping
  - Simply not enough time to get all the players together and agree on "buy-in"
  - However, all components and systems have related software and this is implied by the difference between delivered and shipped dates in the following slides…

Tower Electronics Board (TEM)

- Aggregates event data from one tower
  - Front-end electronics
    - Calorimeter (4 AFEE boards)
    - Tracker (8 flex cables and 32 MCMs)
- Manages Front-End Electronics
  - Power and registers

generation	description	delivered	shipped	instances	comments
V0	Prototype	JAN/2001	MAR/2002	4	XLINIX FPGAs
V1	Engineering I	JUN/2002	OCT/2002	18	Interface mature + enclosure
V2	Engineering II	MAR/2003	APR/2002	18	ASIC + ACTEL

Power Supply Assembly (PSA)

- Provides power to a single tower
  - TEM
  - Front-End Electronics (Analog/Digital)
  - Bias (HV) for calorimeter and tracker
- Derived from 28 V (spacecraft)

generation	description	delivered	shipped	instances	comments
V0	Prototype	OCT/2001	OCT/2002	2	
V1	Engineering I	NOV/2002	DEC/2002	18	+ enclosure
V2	Engineering II	OCT/2003	NOV/2003	2	Vendor supplied

GASU

- Contains LAT's 4 single objects
  - Global Trigger (GLT)
  - Event Builder (EB)
  - Fan-In/Fan-Out Unit
  - ACD Electronics Module (AEM)
  - Engineering module separates AEM from GASU
    - Uncouples system from subsystem deliverables

generation	description	delivered	shipped	instances	comments
V0	Comm board + VHDL	NOV/2001	FEB/2002	6	
V1	Transition board	SEP/2002	OCT/2002	18	
V2	Prototype	JAN/2002	FEB/2003	2	
V3	Engineering I	MAR/2003	APR/2003	4	

AEM

- Performs same function for ACD as TEM for Tower
  - Manages 12 FREE boards
  - LAT has only one
  - Will ultimately reside in GASU space

generation	description	delivered	shipped	instances	comments
V0	Comm board + VHDL	NOV/2001	JAN/2002	3	Pseudo AEM (1 FREE)
V1	Prototype	JAN/2002	FEB/2003	4	12 FREE boards
V2	Engineering I	MAR/2003	MAR/2003	6	

Single Board Computer

- Execution environment for Flight Software
  - Includes processor, memory and external bus interface
  - FSW operates under VxWorks real-time kernel
  - For risk mitigation pursuing two designs:
    - Vendor (BAE 750)
    - In-house (NRL 603)

generation	description	delivered	shipped	instances	comments
V0	Motorola 2306	JAN/2001	JAN/2002	25	VME + PMC
V1	Motorola 750	NOV/2002	JAN/2003	4	cPCI
V2a	Engineering I	MAR/2002	JUL/2003	1	BAE (cPCI)
V2b	Engineering I	JAN/2003	FEB/2003	1	NRL (cPCI)

Spacecraft Interface Board (SIB)

- Provides:
  - 1553 Interface to spacecraft
  - SSR interface to interface
  - Digital discrete interface to spacecraft
  - EEPROM
- Delivered by NRL

generation	description	delivered	shipped	instances	comments
V0	VME summit board	JUN/2001	JAN/2002	1	
V1	Prototype	OCT/2002	DEC/2002	1	Only 1553 interface (cPCI)
V2	Engineering I	APR/2003	MAY/2003	2	SSR and discrete

LAT Communication Board (LCB)

- Gateway between flight processor and instrument
  - Allows:
    - Register access
    - Event reception
    - Crate/Crate communication
  - One per crate

generation	description	delivered	shipped	instances	comments
V0	Comm board + VHDL	OCT/2001	JAN/2002	4	
V1	Prototype	JAN/2002	FEB/2003	2	PMC form factor
V2	Engineering I	FEB/2003	MAR/2003	18	
V3	Engineering II	FEB/2003	MAR/2003	4	cPCI form factor

Backplane/Crate

- Supports:
  - SBC, LCB, SIB

generation	description	delivered	shipped	instances	comments
V0	VME	JAN/2001	JAN/2002	25	commercial
V1	cPCI	AUG/2002	AUG/2002	4	commercial
V2	prototype	FEB/2003	MAR/2003	1	Mechanical dependencies
V3	Engineering I	APR/2003	JUN/2003	6	NRL (cPCI)

Spacecraft Interface Simulator (SIS)

- Used to commission:
  - SIB
  - I & T interface

generation	description	delivered	shipped	instances	comments
V0	VME summit board	JAN/2001	SEP/2002	1	1553 BM interface only
V1	Logic Analyzer	FEB/2003	MAR/2003	1	SSR and discrete
V2	Spectrum Astro	APR/2003	JUN/2003	1	

Power Distribution Unit (PDU)

- Monitors LAT temperatures, voltages and currents
- Switches 28 V to LAT modules and crates

generation	description	delivered	shipped	instances	comments
V0	Transition board	OCT/2002	NOV/2002	2	one tower
V1	Prototype	FEB/2003	MAR/2003	1	
V2	Engineering I	APR/2003	JUN/2003	4	

Thermal Control (TC)

- 250 Watt survival heaters
- 50 watt survival/operational heater (VCHP)

generation	description	delivered	shipped	instances	comments
V1	Prototype	JUN/2003	JUL/2003	1	
V2	Engineering I	JUL/2003	AUG/2003	4	

Instrument Simulator (ISIM)

Emulates *some* of the function of the Front-End Electronics

- Triggering and Event Support
- No Command/Response or monitoring

- Physically incompatible with a tower
- Principal functions is to commission and validate:
  - Flight Software event handling
  - Trigger (both L1 and L3)

generation	description	delivered	shipped	instances	comments
V0	prototype	APR/2002	JUN/2003	1	1 tower
V1	Engineering I	DEC/2003	JAN/2004	16	16 towers + ACD

Teststand

- Used to debug and commission Front-End Electronics
- Emulates the LAT populated with only one tower or AEM
  - Baseline:
    - SBC(0)
    - Crate(0)
    - TEM(V0)/AEM(V0)
    - LCB(V0)
    - GASU(V0)

generation	description	delivered	shipped	instances	comments
V0	Baseline	4/2001	1/2002	6	
V1	V0 -> GASU(1) + PSA(1)	4/2002	4/2002	18	TEM only
V2a	V1 -> LCB(2)	1/2003	1/2003	18	LCB prototype
V2b	V2a -> AEM(2)	2/2003	2/2003	4	TEM/AEM
V3	Engineering II	3/2003	3/2003	2-4	cPCI form factor

Spacecraft Test-Bed (STB)

- Constructed at NRL
- Commission interface between LAT and spacecraft
  - Baseline:
    - SBC(1)
    - Crate(1)
    - SIB(1)
    - SIS(1)

generation	description	delivered	shipped	instances	comments
V0	Baseline	NOV/2002	DEC/2002	1	
V1	V0 -> (SIB(2) + SIS(2))	?	4/2002	1	Astro emulator
V2	V1 + LCB(2)	1/2003	1/2003	1	Emulate SIU

Single-Tower test

- Satisfies requirements for I & T “EM test”
- Simply an instance of the teststand

generation	description	delivered	shipped	instances	comments
V0	Teststand V1	JAN/ 2003	JAN/2003	1	backup for V1
V1	Teststand V2a	JAN/2003	JAN/2003	1	

LAT Test-Bed (LTB)

- Used to debug and commission FSW
- Baseline is simply teststand 2a
- Home of the ISIM

generation	description	delivered	shipped	instances	comments
V0	Baseline	DEC/2001	JAN/2003	1	
V1	V0 -> GASU(2)	FEB/2003	MAR/2003	1	Multi tower/crate support
V2	V1 + ISIM(0)	APR/2003	JUN/2003	1	
V4	V1 + PDU(1)	JUN/2003	AUG/2004	1	Power management
V4	V1 + AEM(2)	JUN/2003	AUG/2004	1	ACD support
V5	V1 -> ISIM(1)	DEC/2003	JAN/2004	1	Full ISIM support
V6	V2 -> LCB(3) +STB()	JAN/2004	MAR/2004	1	Spacecraft view

Beam test

- Satisfies requirements for I & T “CU test”
- Simply an instance of the LAT testbed
  - Baseline is V1 of testbed
- Assumes *no* participation by ACD

generation	description	delivered	shipped	instances	comments
V0	Testbed V1	JUN/ 2003	JUL/2003	1	

ACD Test-Bed (ATB)

- To be discussed
- Depends on ACD planning (currently being reworked)

Summary

- Schedule is defined such that:
  - Hardware/software deliverables will *not* impact testing schedule
  - at CDR time:
    - All Engineering models are in hand and under test
    - Schematics and parts list for Flight Articles are available