



The GLAST Science Support Center Software

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Outline

- **Overview**
- **Build Environment**
- **QA**
- **Software list**
- **Build Schedule**



Software Overview

- **Two types of software developed at GSSC**
 - **Science Tools (FRD 5.5) Analyze GLAST data**
 - LAT tools (jointly developed by LAT and GSSC)
 - GBM tools (supplied by GBM team)
 - **GSSC Internal Software (allows investigators to propose high quality observations and provides easy access to data)**
 - Pipelines and Databases (FRD 5.6 and 5.7)
 - GI Preparation Tools (FRD 5.3.2.1)
 - Miscellaneous tools (Software installers, etc. to facilitate a variety of requirements)
 - Planning and Scheduling Tools (FRD 5.3.2.9)

- **FRD = GSSC Functional Requirements Document**



Software Development Environment

- **Configuration Management: CVS (concurrent versioning systems) with repositories at SLAC (LAT science tools) and GSSC (GSSC specific software)**
 - **Eventually LAT science tools will be moved to GSSC for support by GSSC and HEASARC.**
 - **CVS repository available (read only) on the web.**
- **Build management tool: CMT**
- **Coding Standards:**
 - **C++ coding standards**
 - **Scripting coding standards (under development)**
- **Documentation fo C and C++ code - doxygen makes web accessible and LaTeX documentation**
 - **Code documentation recommendations**



Software Development Environment (con't)

- Integrated Development Environment: Unix - Eclipse CDT using gcc/gdb, Windows - VC++)
- Supported Platforms (other UNIX flavors, time permitting):
 - Linux
 - Windows (LAT Science tools)
- Software issues (bugs, change proposals, requests for more documentation, etc.) tracked with web accessible tool - Looking at:
 - Roundup (<http://roundup.sourceforge.net/>)
 - Bugzilla (<http://www.bugzilla.org/>)



Software development documents

- **Software Management Plan**
- **GSSC Functional Requirements Document**
- **GLAST Project Data Management Plan**
- **GSSC Development Plan**
- **Database Architecture document**
- **LAT Event Database Requirements**
- **LAT Science Databases Requirements document**
- **GSSC Software Testing Plan**



Design

- **Design Process**
 - **Use Cases formulated - to focus design on functionality**
 - **Requirements derived from Use Cases**
 - **Software architecture derived from requirements**
 - **Test cases taken directly from Use Cases**



Status of Development

- **Currently, most (60%) of software development is spent on LAT analysis software tools. The development effort will gradually transition to developing SSC software over the next two years.**
- **LAT & GSSC development environments similar to minimize effort of programmers**



Quality Assurance

- **Testing: All software will be tested extensively (see next talk) including unit, system, and regression tests,**
- **Code Reviews - software packages will be peer reviewed by internal groups**
 - **Reviewers taken from GSSC pool of programmers and cognizant scientists.**
 - **Reviews will be done periodically, with a rotating review schedule.**
 - **Reviewers will be checking code structure and checking adherence to coding and documentation standards in files chosen at random**
 - **Review concludes with an informal report containing action items for improving code and documentation, and for improving GSSC software development**
 - **Action items will be reviewed at next code review.**



Quality Assurance Table

Risk	Mitigation
Software Delivered Late	Tests and milestones set well before launch to allow time for development delays.
Software Not Functional	Nightly build tests, many official tests, internal tests to ensure functionality
Software hard to use/badly designed	Extensive testing by the GLAST collaboration team (data challenges) to ensure tools meet users needs
Software doesn't install	Leverage HEASARC FTOOLS experience with multi-platform support.



Quality Assurance - Bug Fixes

- **Bugs reported for all GSSC software and web pages will be tracked with a bug reporting system such as Bugzilla or Roundup.**
- **Problems will be investigated by persons assigned by the software manager or his designee.**
- **The GSSC Configuration Control Board will meet regularly (weekly) to approve changes to software that has been included in an official GSSC release.**
- **Programmers will be assigned to make the changes and to supply a test plan for exercising the changed code to test the fix.**



Software Release Schedule

- **Development schedule driven by:**
 - **Ground Readiness Tests**
 - **End-To-End Tests**
 - **LAT Data Challenges**
 - **Launch**



LAT Science Tools Releases

- **Release 1 (12/15/03)—Prototypes of basic tools: data extraction from databases, likelihood tool, basic burst tools**
- **Release 2 (9/30/04)—Completion of basic tools. Prototypes of advanced tools: pulsar tools, graphic displays**
- **Release 3 (2/28/06)—Completion of all tools**
 - **The release schedule is determined by the LAT ISOC as they are responsible for delivery of the tools.**



GSSC Software Release Schedule (1)

- **Software—Driven by Ground Readiness Tests (GRTs)**
 - **Release 1 (6/30/04), tied to GRT1 (11/1/04)—ingest of Level 0 data from MOC:**
 - a) scripts to move data from MOC to GSSC;
 - b) creation of GSSC database;
 - c) scripts to ingest data into GSSC database
 - **Release 2 (1/15/05), tied to GRT2 (4/1/05)—preliminary command and schedule tools:**
 - a) command passing from IOCs to GSSC, and from GSSC to MOC
 - b) timeline creation and passing to MOC
 - c) ToO order creation and passing to MOC
 - **[No GSSC functionality tested in GRT3]**
 - **Release 3 (5/1/05), tied to GRT4 (9/1/05)—ingest of Level 1 data from IOCs:**
 - a) scripts to move data from IOCs to GSSC
 - b) creation of GSSC databases
 - c) software to ingest data into GSSC databases
 - **Release 4 (8/1/05), tied to GRT5 (11/15/05)—completion of command and schedule tools**

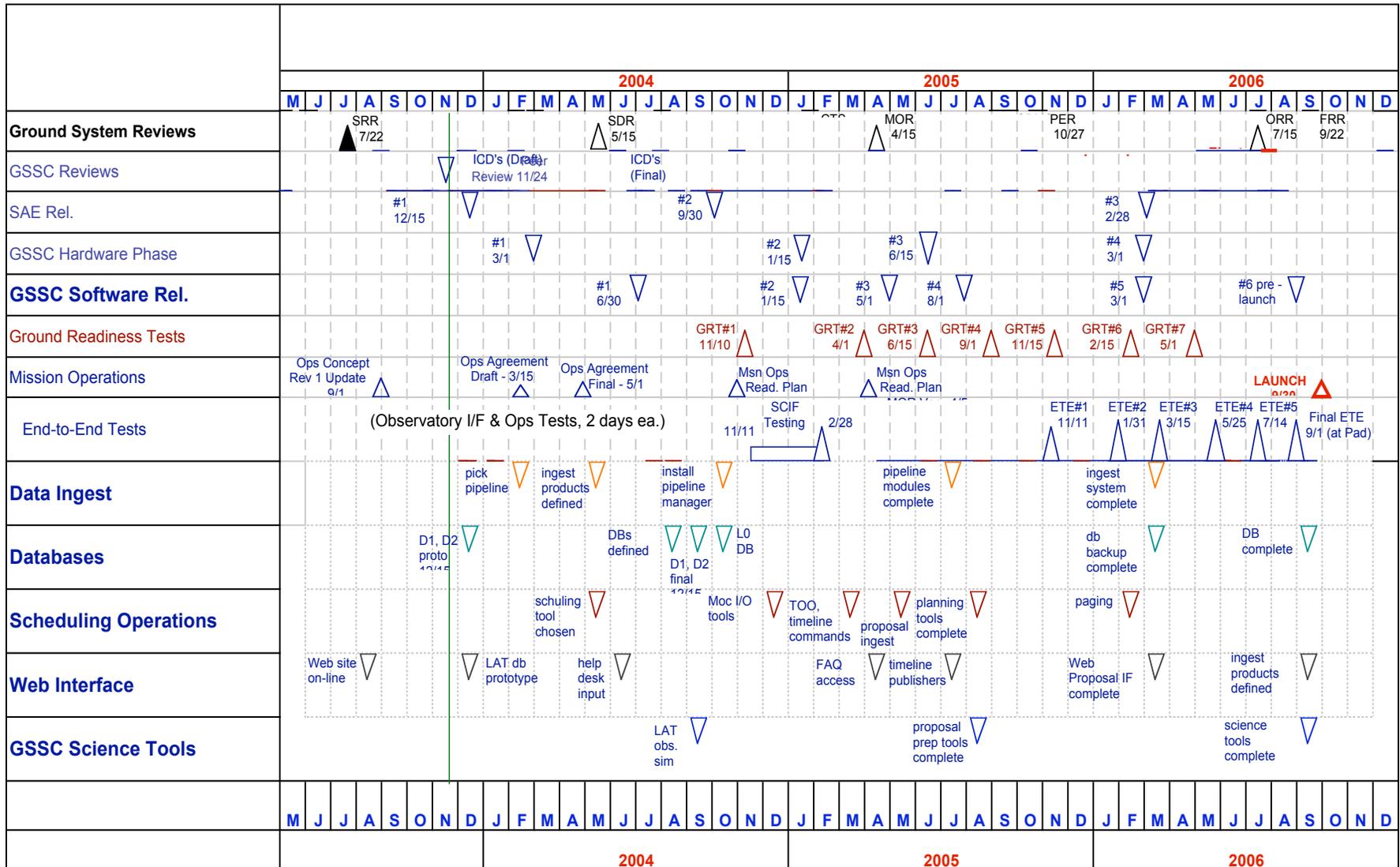


GSSC Release Schedule (2)

- **Software driven by Launch Readiness**
 - **Release 5 (3/1/06), tied to first NRA release---GSSC internal operations tools complete**
 - a) Ingest system complete for all data products.
 - b) GSSC web site able to serve observation simulator tools
 - c) Production databases and data backup system operational.
 - **Release 6 (9/1/06) Tied to Launch (9/30/06)--GSSC Web site ready to for business**
 - a) GSSC Web site able to distribute analysis tools
 - b) GSSC web site ready for timelines
 - c) GSSC website fully ready to display information about data products
 - d) Archive system complete
 - e) LAT and GBM backup pipelines operational



GSSC Software Development Milestones





Subsystem Development in FTEs

Estimated Resources Needed for Software Development Tasks

Subsystem	2003	2004	2005	2006	2007
Data Ingest	0	0.75	1.25	1.25	0.75
Databases	2.5	2	1.5	1.5	1.5
Web	0.25	0.5	1.25	2	1.75
Operations	0.1	1.5	1.25	1.25	1.25
GSSC Scienc	0.3	0.25	1	1	1.5
LAT SAE	3.75	2.75	2.5	2	2

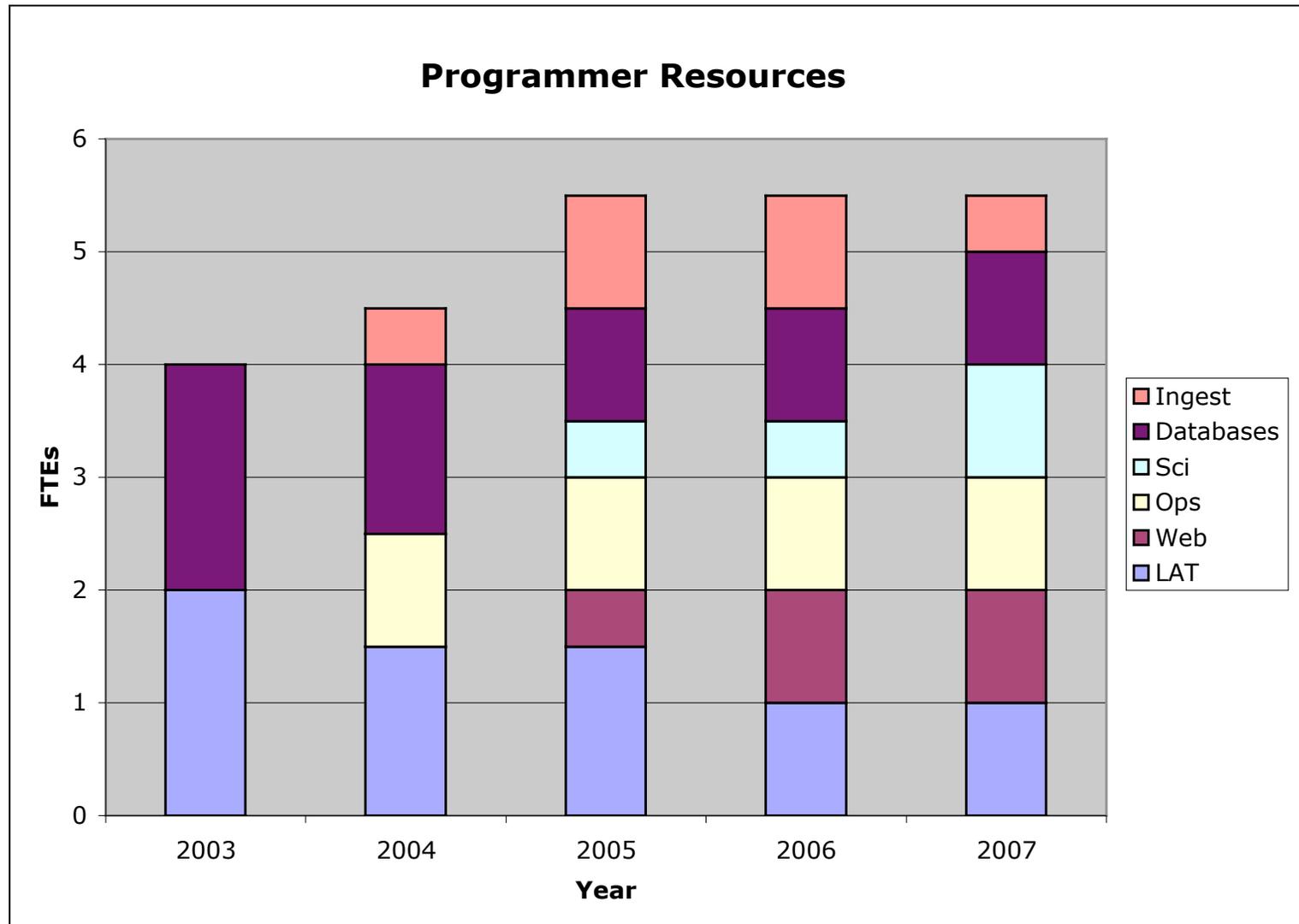


Programming Resource Assignment

- **Two types of programming resources**
 - **Programmers**
 - **Scientists - count on average as 1/2 programming FTE**
- **Science Tools**
 - **LAT Tools: GSSC involved in LAT Science Tools development so ambassador to LAT counted in scientist programming resources**
 - **GBM tools: GSSC NOT involved in science tool development, so GBM ambassador is not listed as a scientist programmer resource**
- **Legend**
 - **Ingest = Data Ingest Pipeline software and modules.**
 - **Databases = Database development and interface code**
 - **Sci = GSSC specific Science Software**
 - **Ops = Scheduling and Planning Operations Tools**
 - **Web = Web Interface Tools**
 - **LAT = LAT Science Analysis Tools**

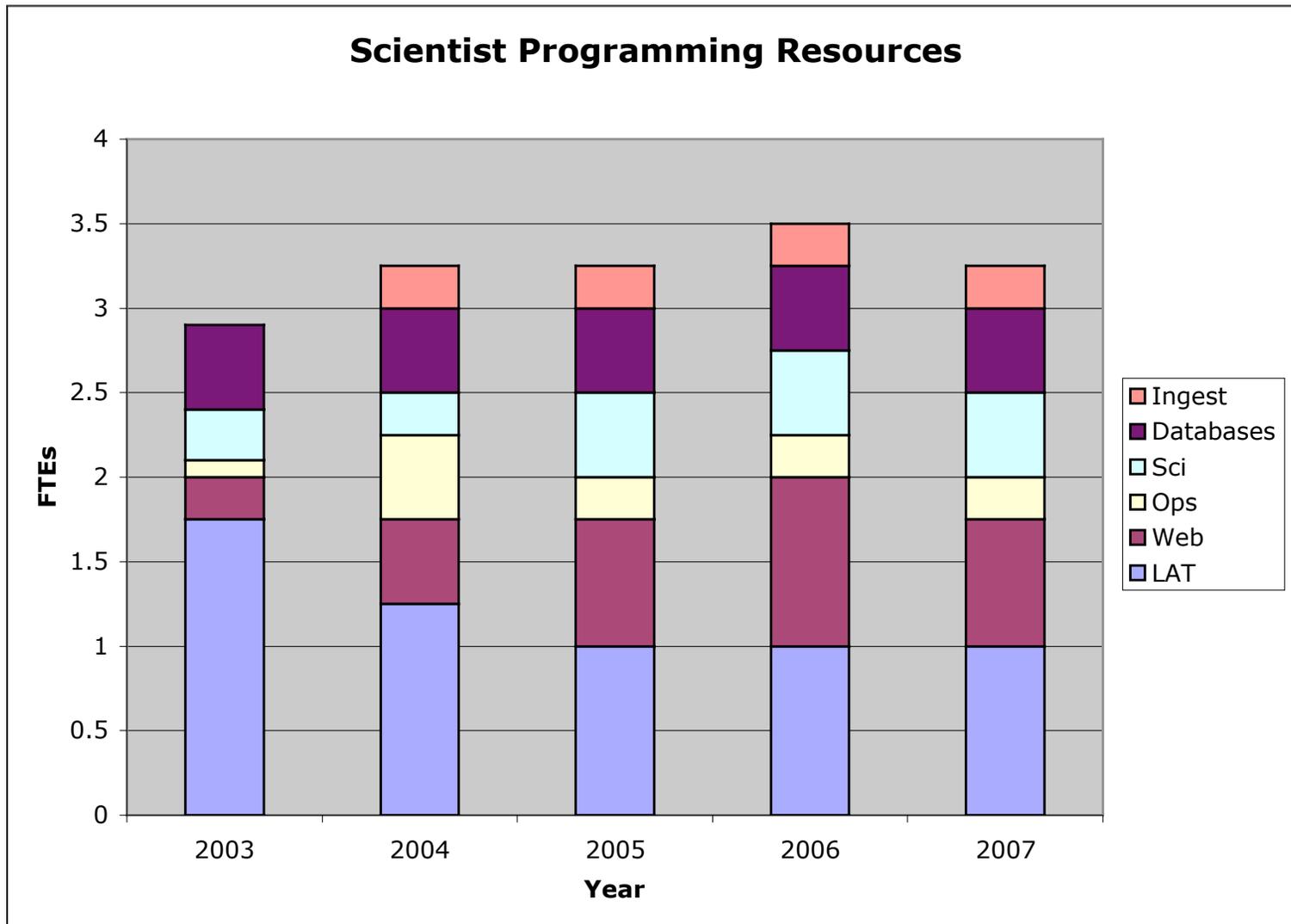


Projected Programming Staff Resources





Scientist Programming Effort





GSSC Software List - Ingest Pipeline Tools

GSSC Ingest Pipeline Tools			
Tool Name	Description	Source	Release
Data transfer program	To transfer data from the IOCs and the MOC to GSSC	DTS from LHEA and locally developed scripts.	GSSC 1 (MOC) GSSC 3 (IOCs)
Backup programs	To backup incoming data, and other important data in use.	Open source tool (e.g. Amanda)	GSSC4
Pipeline Manager	Handles queuing for ingest programs handling the 21 types of data from the MOC and IOCs, checking resources, and notification of errors, and tracking processing of data through the system.	OPUS or co-opt RXTE SOF pipeline software	GSSC5
Validation, Reformatting , and metadata extraction tools	Takes incoming data, validates it, and formats it for databases or distribution from the GSSC, collects metadata for databases and web scripts.	Custom built scripts.	GSSC5
Database Feeders	Ingest programs specifically for SSC databases, whether they be flat files, a relational database, or the custom built LAT databases.	Custom built combination of compiled code with script wrappers.	GSSC5
Archive tools	Program to prepare data for archiving and send to physical archive media	Based on HEASARC software for other missions	GSSC6



GSSC Software List - Planning I/O Tools

GSSC Planning & Scheduling Operations I/O Tools			
Tool Name	Description	Source	Release
TOO Orderer.	Sends TOO request to MOC	Custom software + DTS	GSSC2
Schedule Deliverer	Delivers new or updated schedule to MOC.	DTS together with custom scripts	GSSC2
MOC Products Receiver	Processes regularly received MOC products (e.g., as-flown timelines)	Custom software, scripts, and DTS?	GSSC 1
MOC Alert Receiver	Similar to MOC products category but for "exceptional" events. e.g., auto repoints)	Custom software, scripts	GSSC2
IOC Command Ingestor	Processes commands from the IOCs. May page staff.	DTS + Custom designed software. + Paging tool	GSSC2
General Archive Processor	General archive access to products such as timelines.	Modify software developed for XTE	GSSC4
Proposal Ingestor	Process proposals submitted by GIs	Recycle XTE software including RPS?	GSSC 3
External TOO Requester.	Method for general community to request a TOO observation	Web based submission process. Possibly reuse XTE software that uses RPS.	GSSC3
GCN Receiver	Receives and archives GCN notices produced by BAP	Custom scripts.	GSSC4
Paging Tool	Alert relevant GSSC personnel of urgent actions required. (e.g. command load from IOC)	COTS + custom scripts (e.g. telamon's telalert + RXTE scripts.)	GSSC5



GSSC Software List - Planning Operations

GSSC Planning & Scheduling Operations Tools			
Tool Name	Description	Source	Release
Planning Tool.	Design schedules for optimum coverage,	Modifications to Eric Stoneking's simulator	GSSC3
Scheduling Tool	Generation of observation schedule for transmission to the MOC.	Modified version of TAKO. (Other candidates would be Spike and STK tools)	GSSC2
Sky Coverage Monitor	monitor "as flown" timeline to check uniformity of sky coverage, Interacts with Planning tool.	Custom software.	GSSC 4



Software List - Proposal and Science Tools

Proposal Preparation and GSSC Science Tools			
Tool Name	Description	Source	Release
Observation simulation	Tool to simulate observations to understand observing constraints	LAT SAE – perhaps using simplified response functions	LAT SAE 2
Orbit Simulation	Tool to simulate GLAST orbit for studying observing strategy	Part of Scheduling Operations Tools below	LAT SAE 2
Point-source Lightcurve Monitor	Runs analysis tool (from SAE) on a set of bright sources (e.g., 3C279)	Script wrapping LAT SAE tools	GSSC6
LAT exposure map generator	Calculates exposure maps over a specified time range, posts maps on SSC website	Script wrapping LAT exposure tool.	GSSC6
LAT Proposal count rate and exposure estimators	Estimates the source photon count rate and expected exposure.	GSSC, count rate possibly based on PIMMS	GSSC 4
LAT all-sky sensitivity map generator	Calculates an all-sky map of the minimum point source flux which can be detected with more than 5 sigma	GSSC, based on LAT SAE	GSSC 6
LAT currently available exposure calculator	program to access pointing database and calculate the existing exposure available	GSSC, based on LAT SAE	GSSC 6
GRB map generator	Parses the official GRB list and produces all-sky Aitoff plot of the locations as gif file	GSSC, GBM team	GSSC 6
GRB lightcurve plotter	Plots LAT and GBM GRB data.	GSSC, GBM team	GSSC 6



GSSC Software List - Web Proposal Tools

GSSC Web Proposal-Related Software			
Tool Name	Description	Source	Release
Short-term and long-term timeline publisher	posts the latest weekly and yearly timelines	GSSC (using RXTE experience)	GSSC 5
LAT sensitivity, count rate, and observability proposal tools web interface	Cgi-scripts to take user input and run LAT proposal tools	GSSC, count rate estimator may be HEASARC's W3PIMMS	GSSC 4
Observation and TOO publisher	Adds approved TOOs and non-TOOs proposal information to the website.	GSSC	GSSC 6
Proposal (TOO and non-TOO) submission web interfaces	cgi scripts and web forms for submission of LAT proposals	GSSC, uses RPS	GSSC 4
Proposal submission web interface	cgi scripts and web form for submission of LAT proposals	GSSC, uses RPS	GSSC 4
ToO proposal submission web interface	cgi scripts and web form for the submission of ToO proposals	GSSC, uses RPS	GSSC 6



GSSC software - Web Science Programs

GSSC Web Science Interface			
Tool Name	Description	Source	Release
Database searching	Scripts to search through all publicly accessible GSSC databases,	Custom made scripts	GSSC5
GRB publishers	Add new GRB observations to the website, publish lightcurves and all-sky GRB map	GSSC	GSSC 6
LAT all-sky map publishers	Runs the all-sky map (sensitivity, exposure) generators and publishes the result on the web	GSSC	GSSC 6
LAT Light curve publisher	Updates web LAT point source light curves.	LAT team, GSSC, possibly examples from RXTE ASM team	GSSC 6
GBM data packager	Packages GBM and LAT data belonging to a given GRB into a compressed file with defined name for later download by GIs	GSSC	GSSC 6
Help Desk question submission	cgi script and web form to receive questions from GIs	GSSC, based on HEASARC scripts	GSSC 1
FAQ access	cgi script/ or javascript webpage to search the FAQ list by keyword	GSSC	GSSC 3



Software List - Science Tools

Science Analysis Tools			
Tool Name	Description	Source	Release
LAT Science Analysis Tools			
LAT Standard Analysis Environment (SAE)	Suite of science analysis tools defined jointly by the LAT team and the SSC, development managed by the LAT team with SSC participation. The tools are described in other documents	Custom Built – development managed by LAT ground software team, but with resources provided by SSC.	LAT SAE 3
GBM Science Analysis Tools			
LAT tools	tools for burst analysis (e.g., event binning, spectral fitting) that are part of the LAT SAE will also be able to analyze GBM data (separately or jointly with LAT data)	See LAT SAE	LAT SAE3
DRM generator	creates the DRM for the GBM data, to be supplied by the GBM team	Built by GBM instrument team.	11/2006
Background creation	calculates a background for the GBM data	Built by GBM instrument team.	11/2006



Summary

- **Software Development Environment defined.**
- **Software development team composed of scientists and programmers with previous mission support experience.**
- **GSSC heavily involved in LAT Science tool development, since GSSC is expected to provide these tools with support for users.**
- **Attention given to design and testing of software to ensure quality products. (see next talk for testing)**