VII.A GLAST Science Support Center Software

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Outline

- Overview & Documents
- Software definition
- Release Schedule & Drivers
- Release Process
- Change Control
- Resources & Schedules
- Summary

Software Overview

- Two types of software developed at GSSC
  - GSSC Internal Software
    - Data Archive and Support Software - Pipelines and Databases
    - User Interface - GI proposal and web interface tools
    - Operations - Planning and Scheduling Tools
    - General infrastructure software
  - GLAST Analysis Tools to analyze GLAST data
    - Strong participation in creation of LAT's Standard Analysis Environment

Relevant Documents

- GSSC Functional Requirements Document
- GLAST Project Data Management Plan (433-PLAN-0009)
- GSSC Software Management Plan - GSSC-0004
- GSSC Design Document - GSSC-0003
- GSSC Development Plan - GSSC-0001
- GSSC Test Plan - GSSC-0005

Software Definition

- GSSC software tool functionality and interfaces based on
  - Requirements
  - Good practices of other HEA missions
- Tool list vetted by GSSC members and documented in GSSC Design document.
- Already existing software with required functionality identified, e.g.,
  - Lab software (Tako for scheduling)
  - Software from other missions (e.g. XTE science operations center software)
- Detailed functionality captured in internal tool requirements documents (determines size of development task).

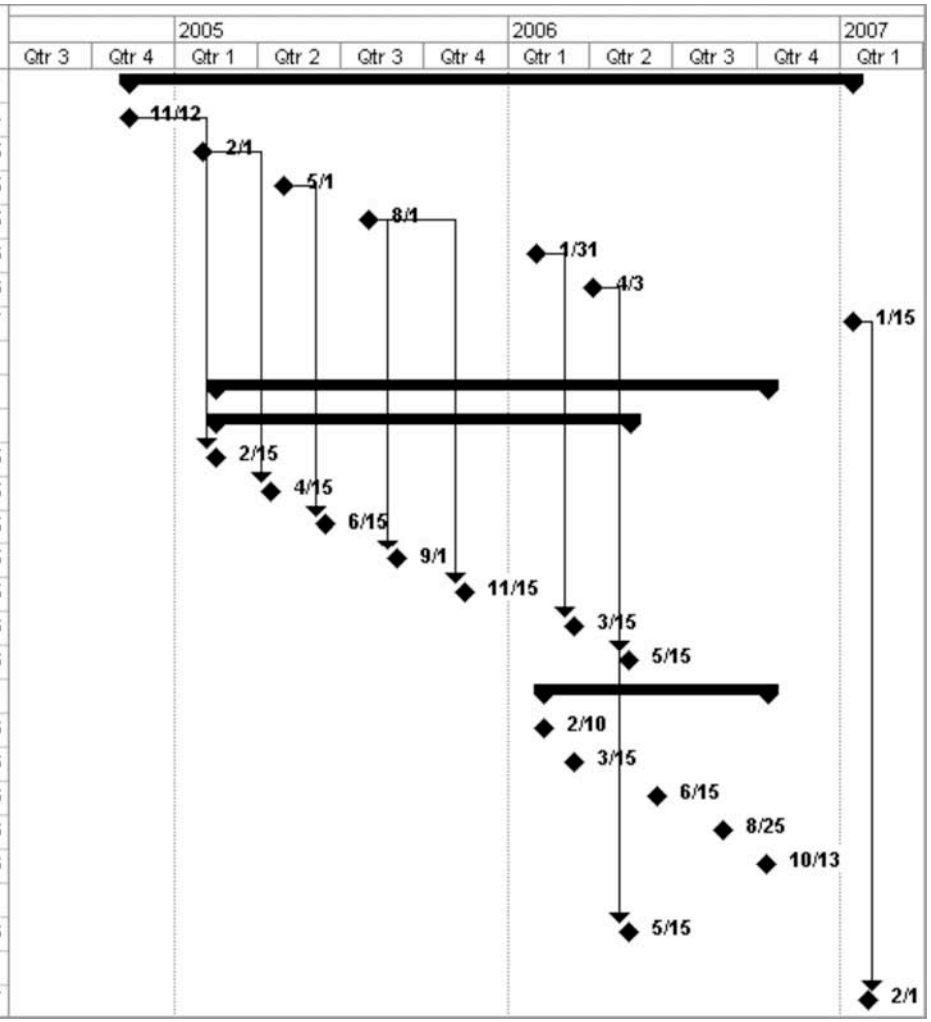
Software Development Schedule Drivers

- System Tests
  - GRTs
  - ETEs
  - Data Challenges
- NRA release
- Launch

External Schedule Events

- GRTs main drivers of GSSC software development priorities and software releases

ID		Task Name	Start	Finish
1		**GSSC RELEASES**	**Fri 11/12/04**	**Mon 1/15/07**
2		Release 1	Fri 11/12/04	Mon 11/15/04
3		Release 2	Tue 2/1/05	Tue 2/1/05
4		Release 3	Sun 5/1/05	Sun 5/1/05
5		Release 4	Mon 8/1/05	Mon 8/1/05
6		Release 5	Tue 1/31/06	Tue 1/31/06
7		Release 6	Mon 4/3/06	Mon 4/3/06
8		Release 7 (pre-launch cleanup release	Mon 1/15/07	Mon 1/15/07
9				
10		**GROUND TESTS**	**Tue 2/15/05**	**Fri 10/13/06**
11		**GRTs**	**Tue 2/15/05**	**Mon 5/15/06**
12		GRT1 Levl 0 Ingest	Tue 2/15/05	Tue 2/15/05
13		GRT2 Command & timeline	Fri 4/15/05	Fri 4/15/05
14		GRT3 command ephem & timelines	Wed 6/15/05	Wed 6/15/05
15		GRT4 regression	Thu 9/1/05	Thu 9/1/05
16		GRT5 Level 1&2	Tue 11/15/05	Tue 11/15/05
17		GRT6 TOO & Anomaly Reports	Wed 3/15/06	Wed 3/15/06
18		GRT7 cleanup/regression	Mon 5/15/06	Mon 5/15/06
19		**ETEs**	**Fri 2/10/06**	**Fri 10/13/06**
20		ETE1 Level 0 & 1 ingest	Fri 2/10/06	Fri 2/10/06
21		ETE2 commands	Wed 3/15/06	Wed 3/15/06
22		ETE3 TOO	Thu 6/15/06	Thu 6/15/06
23		ETE4	Fri 8/25/06	Fri 8/25/06
24		ETE5	Fri 10/13/06	Fri 10/13/06
25				
26		First NRA release	Mon 5/15/06	Mon 5/15/06
27				
28		Launch	Thu 2/1/07	Thu 2/1/07



SAE Software Release schedule

- LAT sponsored “Data Challenges” main drivers of SAE software priorities and release schedule (Note: LAT team manages SAE schedule in coordination with LAT development effort - these dates are estimates.)
- Release 1 (12/8/03) tied to Data Challenge 1 (12/9/03 - 2/9/04)
- Release 2 (~ 3/1/05) tied to Data Challenge 2 (spring 2005)
- Release 3 (~3/1/06) tied to Data Challenge 3 (spring 2006)

GSSC Software Release Process

- Releases occur 6-12 weeks before GRTs to allow ample time to do informal testing with other ground elements and correct faults.
- Releases preceded by 6-8 week code freezes
  - GSSC system tests are carried out during this time (see Test Plan)
  - Only bugs which prevent software from meeting its requirements are fixed during this time.
- Code which passes system tests given official release tag in our code repository (we use CVS - Concurrent Versions System).

Change Control

- All software will carry a 3 field CVS version (M.m.p): Major version number, Minor revision number, Patch number
- Pre-release software
  - Changes made to code by developers under supervision of section manager.
  - In prerelease testing - test team leader identifies problems and proper software behavior, software manager assigns resources to make fixes.
- Code which passes GSSC System testing submitted for official release to CCB, which may officially release it.
- Post release software
  - All bugs, functionality change proposals must be entered in issue tracking system (roundup - http://roundup.sourceforge.net)
  - All changes must be approved by CCB
  - CCB (Configuration Control Board) assigns software change tasks.
- CCB - contains 3 section managers, software manager, GSSC manager, and other cognizant scientists and programmers.

Schedule definition

- Tool development order and tool due dates defined by section managers.
- SAE tool functionality and due dates assigned by LAT team.
- Section development schedules put together by section managers with advice of software manager.
- Software schedules coordinated by software manager who identifies resources to meet development needs.

Resource Personnel

- Operations
  - Scientist: **Robin Corbet**
  - Programmers: Giuseppe Romeo, Marilyn Mix, Thomas Stephens, Sandhia Bansal
- User Support
  - Scientists: **David Band**, Jerry Bonnell
  - Programmers: JD Myers, New hire 1
- Data Archive & Software Support
  - Scientists: **Dave Davis**, Jim Chiang, Dirk Petry, Masa Hirayama, Jerry Bonnell, Jay Norris, Valerie Connaughton
  - Programmers: Bob Schaefer, James Peachey (SAE), Tom Stephens, Sandhia Bansal, New Hire 2

- Note: **Bold** indicates section manager

Operations Software Schedule

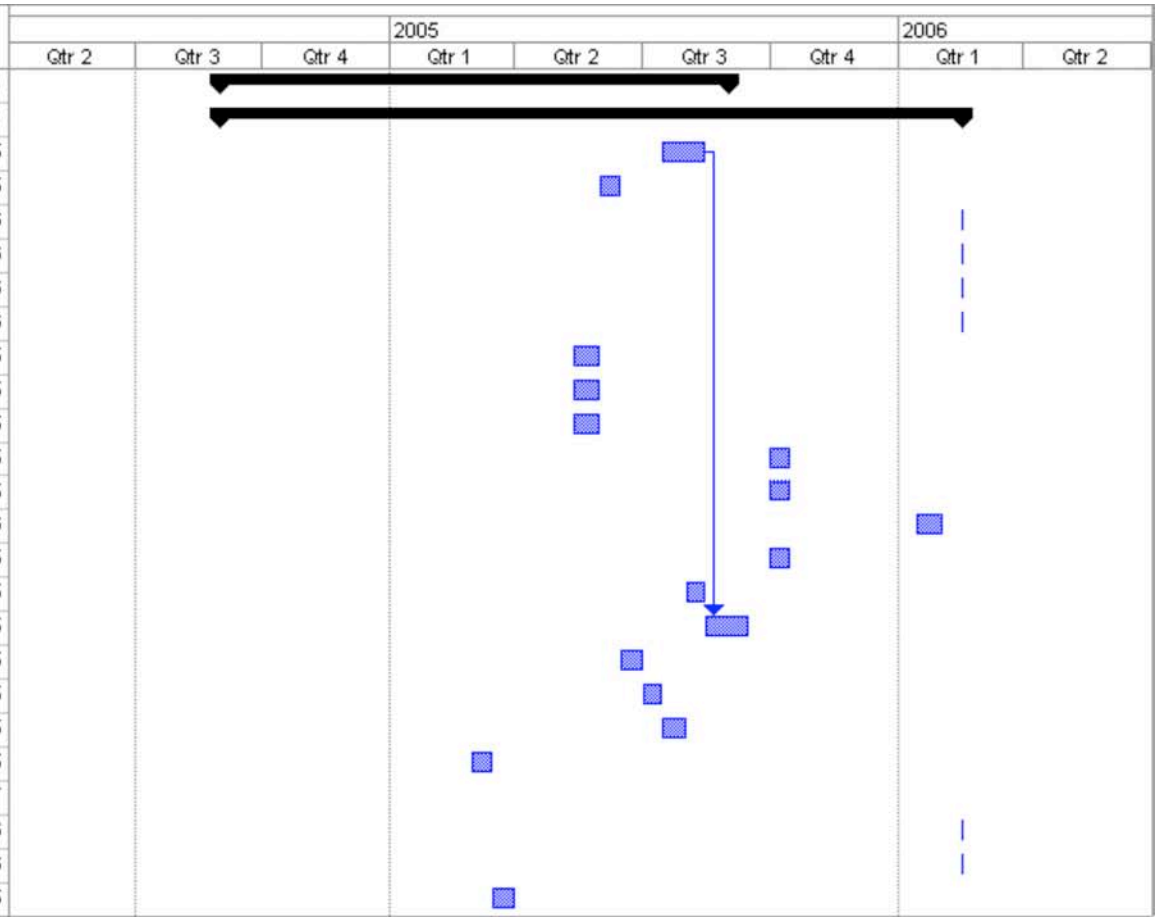
- ~2 half time programmers, both experts with scheduling tool (Tako)
- Development help from DASS programmers- first 7 tools are part of ingest pipeline

ID		Task Name	Start	Finish	Duration
1		**GSSC PLANNING AND SCHEDULING**	**Mon 12/22/03**	**Wed 12/21/05**	**516 days?**
2		Op 10 As Flown Timeline Ingest	Mon 7/26/04	Mon 6/20/05	231 days
3		Op 20 Integrated Observatory Timeline	Mon 7/26/04	Fri 3/25/05	170 days
4		Op 30 Anomaly Reports Ingest	Fri 4/1/05	Wed 12/21/05	189 days
5		Op 40 GLAST Ephemeris Ingest	Wed 9/8/04	Fri 12/17/04	69.5 days
6		Op 45 TDRSS Ephemeris Ingest	Wed 9/8/04	Fri 12/17/04	70 days?
7		Op 50 TDRSS contact Schedule Ingest	Fri 7/30/04	Fri 3/25/05	166 days
8		Op 60 Observatory Telemetry and Corr	Mon 8/2/04	Tue 12/21/04	98 days
9		Op 70 Command Ingest	Mon 6/21/04	Tue 12/21/04	127 days
10		Op 80 Command Submit	Mon 8/23/04	Fri 3/25/05	150 days?
11		Op 90 Planning Tool	Mon 3/22/04	Mon 6/20/05	319 days
12		**Op 100 Scheduling Tool**	**Mon 12/22/03**	**Tue 4/12/05**	**335 days**
13		Scheduling tool trade study	Mon 12/22/03	Tue 8/31/04	180 days
14		Scheduling Tool (alpha version)	Mon 5/17/04	Mon 12/20/04	150 days
15		Scheduling Tool	Tue 12/21/04	Tue 4/12/05	80 days
16		Op 110 Science Timeline Deliverer	Tue 8/24/04	Fri 12/17/04	80 days
17		Op 120 TOO Orderer	Wed 12/1/04	Tue 2/1/05	44 days
18		Op 140 Paging Tool	Tue 5/31/05	Tue 12/20/05	146 days
19		Op 150 TOO Evaluator	Mon 7/11/05	Tue 12/13/05	112 days?
20		Op 160 Proposal Ingestor	Mon 1/31/05	Sun 5/1/05	65 days
21		Op 170 ST2FT2	Mon 8/1/05	Mon 12/12/05	96 days

User Support Software Schedule

- 1 scientist, 2 half time programmers

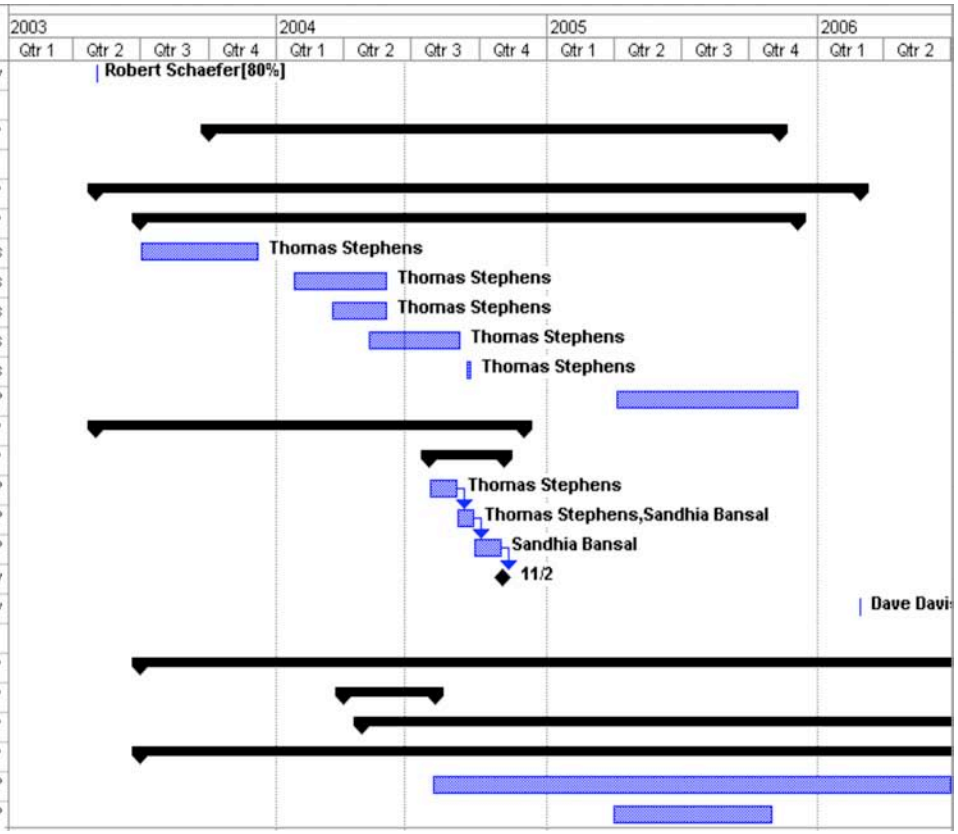
ID	Task Name	Start	Finish
6	**Calc. and Trade Studies**	**Wed 9/1/04**	**Thu 9/1/05**
11	**S-01 Source Sensitivity Cal**	**Wed 9/1/04**	**Wed 2/15/06**
17	S-02 Exposure Anal.	Fri 7/15/05	Mon 8/15/05
18	S-03 Orbit Sim.	Wed 6/1/05	Wed 6/15/05
19	S-04 Obs. Sim.	Wed 2/15/06	Wed 2/15/06
20	S-05 LAT 1D Sim.	Wed 2/15/06	Wed 2/15/06
21	S-06 LAT 3D Sim.	Wed 2/15/06	Wed 2/15/06
22	S-07 GBM Spec. Sim.	Wed 2/15/06	Wed 2/15/06
23	S-11 Wk. Timeline Post	Fri 5/13/05	Tue 5/31/05
24	S-12 Yr. Timeline Post	Fri 5/13/05	Tue 5/31/05
25	S-13 As-Flown Post	Fri 5/13/05	Tue 5/31/05
26	S-21 GI Prop. Submit	Fri 9/30/05	Fri 10/14/05
27	S-31 TOO Prop. Submit	Fri 9/30/05	Fri 10/14/05
28	S-32 TOO Display	Fri 1/13/06	Tue 1/31/06
29	S-41 LAT Obs. Req.	Fri 9/30/05	Fri 10/14/05
30	S-51 Ct Map	Mon 8/1/05	Mon 8/15/05
31	S-52 Exposure Map	Mon 8/15/05	Thu 9/15/05
32	S-53 Diffuse Emission	Wed 6/15/05	Fri 7/1/05
33	S-54 GRB Map	Fri 7/1/05	Fri 7/15/05
34	S-55 GRB Lightcurve	Fri 7/15/05	Mon 8/1/05
35	S-56 GCN Post	Tue 3/1/05	Tue 3/15/05
36	S-57 Pt. Source Mon.	Thu 2/1/07	Thu 2/1/07
37	S-61Helpdesk Submit	Wed 2/15/06	Wed 2/15/06
38	S-62 Helpdesk Admin.	Wed 2/15/06	Wed 2/15/06
39	S-63 FAQ	Tue 3/15/05	Fri 4/1/05



Data Archive and Support Software Schedule

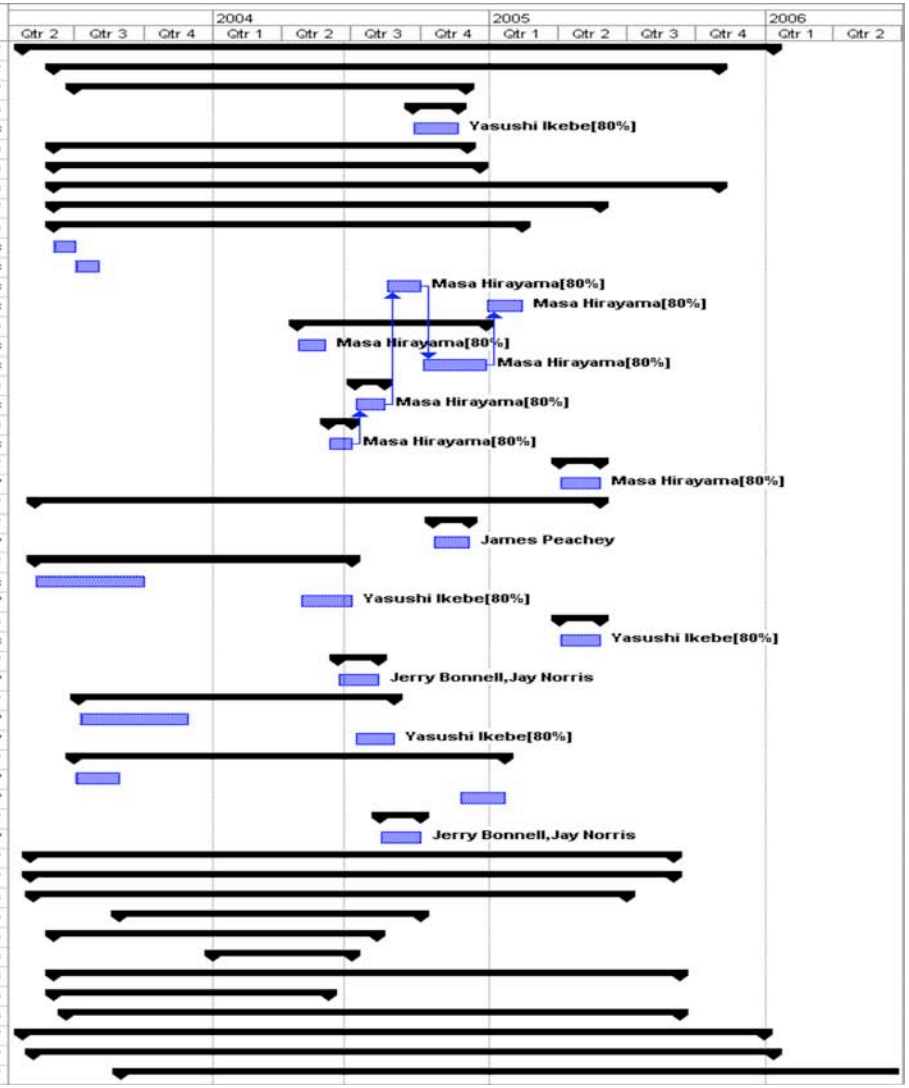
- Three programmers in non-SAE activities

ID	Task Name	Start	Finish	Duration
1	GSSC LOCAL SOFTWARE DEVELOPMENT :	Wed 4/30/03	Wed 4/30/03	1 day
2				
3	**DATA INGEST PIPELINE**	**Wed 10/1/03**	**Wed 11/9/05**	**544 days?**
21				
22	**DATABASES**	**Wed 4/30/03**	**Mon 2/27/06**	**732 days?**
23	**D1 photon, D2**	**Mon 6/30/03**	**Mon 12/5/05**	**629 days?**
24	D1,D2 prototypes	Mon 6/30/03	Fri 12/5/03	115 days
25	DB Architectures defined	Thu 1/22/04	Fri 5/28/04	92 days
26	DB Internal formats defined	Mon 3/15/04	Fri 5/28/04	55 days
27	D1,D2 production development	Mon 5/3/04	Fri 9/3/04	88 days
28	D1, D2 production delivered for te:	Mon 9/13/04	Fri 9/17/04	5 days
29	D1 Event	Mon 4/4/05	Mon 12/5/05	176 days?
30	**Queue Manager**	**Wed 4/30/03**	**Tue 11/30/04**	**409 days?**
36	**Level 0 DB**	**Mon 7/26/04**	**Tue 11/2/04**	**71 days?**
37	Level 0 DB specification	Mon 7/26/04	Tue 8/31/04	27 days?
38	Level 0 DB system design	Wed 9/1/04	Thu 9/23/04	16 days?
39	Level 0 DB implementation	Fri 9/24/04	Fri 10/29/04	26 days?
40	Level 0 DB delivered	Tue 11/2/04	Tue 11/2/04	1 day
41	DB backup system delivered	Mon 2/27/06	Mon 2/27/06	1 day
42				
43	**GSSC Software Development Infrastru**	**Tue 7/1/03**	**Mon 1/8/07**	**913 days?**
44	**Bug Tracking**	**Thu 4/1/04**	**Mon 8/2/04**	**86 days?**
47	**Software Build system**	**Mon 4/26/04**	**Mon 8/21/06**	**599 days?**
52	**CVS maintainence**	**Tue 7/1/03**	**Mon 1/8/07**	**913 days?**
55	Code Reviews	Fri 7/30/04	Mon 12/18/06	617 days?
56	Backup Pipeline	Thu 3/31/05	Mon 10/31/05	153 days?



GSSC Development Support for SAE

ID		Task Name	Start	Finish	Duration
3		**ANALYSIS TOOLS**	**Mon 4/21/03**	**Tue 1/10/06**	**705 days?**
4		**LIKELIHOOD ANALYSIS**	**Mon 6/2/03**	**Mon 10/31/05**	**624 days?**
5		**D3 CALDB for IRFs**	**Tue 7/1/03**	**Tue 11/30/04**	**365 days?**
15		**U8 Response function visualiz**	**Mon 9/20/04**	**Fri 11/19/04**	**44 days**
16		v0	Mon 9/20/04	Fri 11/19/04	44 days
17		**U4 Exposure calculator**	**Mon 6/2/03**	**Wed 12/1/04**	**387 days**
22		**U7 Source model definition**	**Mon 6/2/03**	**Fri 12/17/04**	**399 days**
28		**A1 Likelihood analysis**	**Mon 6/2/03**	**Mon 10/31/05**	**624 days**
41		**Pulsar analysis**	**Mon 6/2/03**	**Fri 5/27/05**	**513 days?**
42		**D4 & U11 Pulsar ephemeris da**	**Mon 6/2/03**	**Fri 2/11/05**	**438 days**
43		Define contents of ephemeris	Mon 6/2/03	Mon 6/30/03	21 days
44		Define interface to D4	Tue 7/1/03	Thu 7/31/03	23 days
45		U11 - v0	Mon 8/16/04	Fri 10/1/04	34 days
46		U11 - v1	Tue 12/28/04	Fri 2/11/05	34 days
47		**A3 Pulsar profiles, periodicity**	**Tue 4/20/04**	**Mon 12/27/04**	**173 days**
48		Select the periodicity test(s) t	Tue 4/20/04	Fri 5/28/04	29 days
49		v0	Mon 10/4/04	Mon 12/27/04	57 days
50		**U10 Barycenter arrival time co**	**Tue 7/6/04**	**Fri 8/13/04**	**29 days**
51		v0	Tue 7/6/04	Fri 8/13/04	29 days
52		**U12 Phase assignment**	**Tue 6/1/04**	**Fri 7/2/04**	**24 days**
53		v0	Tue 6/1/04	Fri 7/2/04	24 days
54		**A4 Pulsar period search**	**Mon 4/4/05**	**Fri 5/27/05**	**40 days?**
55		v0	Mon 4/4/05	Fri 5/27/05	40 days?
56		**GRB analysis**	**Thu 5/8/03**	**Fri 5/27/05**	**530 days?**
57		**U13 GRB visualization**	**Mon 10/18/04**	**Fri 12/3/04**	**32 days?**
58		v0	Mon 10/18/04	Fri 12/3/04	32 days?
59		**A5 GRB Event Binning**	**Thu 5/8/03**	**Fri 7/2/04**	**301 days?**
60		A5 DC1 version	Thu 5/8/03	Tue 9/30/03	104 days
61		Post DC1 Refactored version	Mon 4/26/04	Fri 7/2/04	49 days?
62		**A6 Event Rebinning**	**Mon 4/4/05**	**Fri 5/27/05**	**40 days**
63		v0	Mon 4/4/05	Fri 5/27/05	40 days
64		**A7 GRB temporal analysis**	**Mon 6/14/04**	**Fri 8/6/04**	**39 days?**
65		v0	Mon 6/14/04	Fri 8/6/04	39 days?
66		**U14 LAT GRB DRM generator**	**Mon 7/7/03**	**Fri 8/27/04**	**298 days?**
67		U14 DC1 version	Mon 7/7/03	Fri 11/28/03	105 days?
68		U14 post DC1 refactoring	Tue 7/6/04	Fri 8/27/04	39 days?
69		**A8 GRB binned spectral analys**	**Tue 7/1/03**	**Fri 1/21/05**	**402 days?**
70		DC1 version (XSPEC)	Tue 7/1/03	Fri 8/29/03	44 days?
71		DC2 version XSPEC + scripts	Mon 11/22/04	Fri 1/21/05	42 days?
72		**A10 GRB spectral-temporal ph**	**Mon 8/9/04**	**Fri 10/1/04**	**39 days?**
73		v0	Mon 8/9/04	Fri 10/1/04	39 days?
74		**Catalog analysis**	**Wed 4/30/03**	**Wed 8/31/05**	**604 days?**
75		**D6 & U9 Other high-level (incl.**	**Wed 4/30/03**	**Wed 8/31/05**	**604 days?**
84		**D5 & U9 LAT point source cata**	**Mon 5/5/03**	**Thu 6/30/05**	**557 days**
91		**U5 Interstellar emission mode**	**Fri 8/29/03**	**Thu 9/30/04**	**282 days**
94		**U6 Map generator**	**Mon 6/2/03**	**Tue 8/3/04**	**305 days**
100		**A2 Source identification**	**Thu 1/1/04**	**Thu 7/1/04**	**130 days**
104		**Observation Simulation**	**Mon 6/2/03**	**Fri 9/9/05**	**588 days**
105		**O1 Livetime/pointing simulato**	**Mon 6/2/03**	**Tue 6/1/04**	**261 days**
111		**O2 High-level observation sim**	**Fri 6/20/03**	**Fri 9/9/05**	**574 days**
117		**User Interface**	**Mon 4/21/03**	**Fri 12/30/05**	**698 days?**
134		**Other Tasks**	**Mon 5/5/03**	**Tue 1/10/06**	**695 days?**
156		**LAT System Tests**	**Mon 9/1/03**	**Mon 6/26/06**	**729 days?**



Standard Analysis Environment

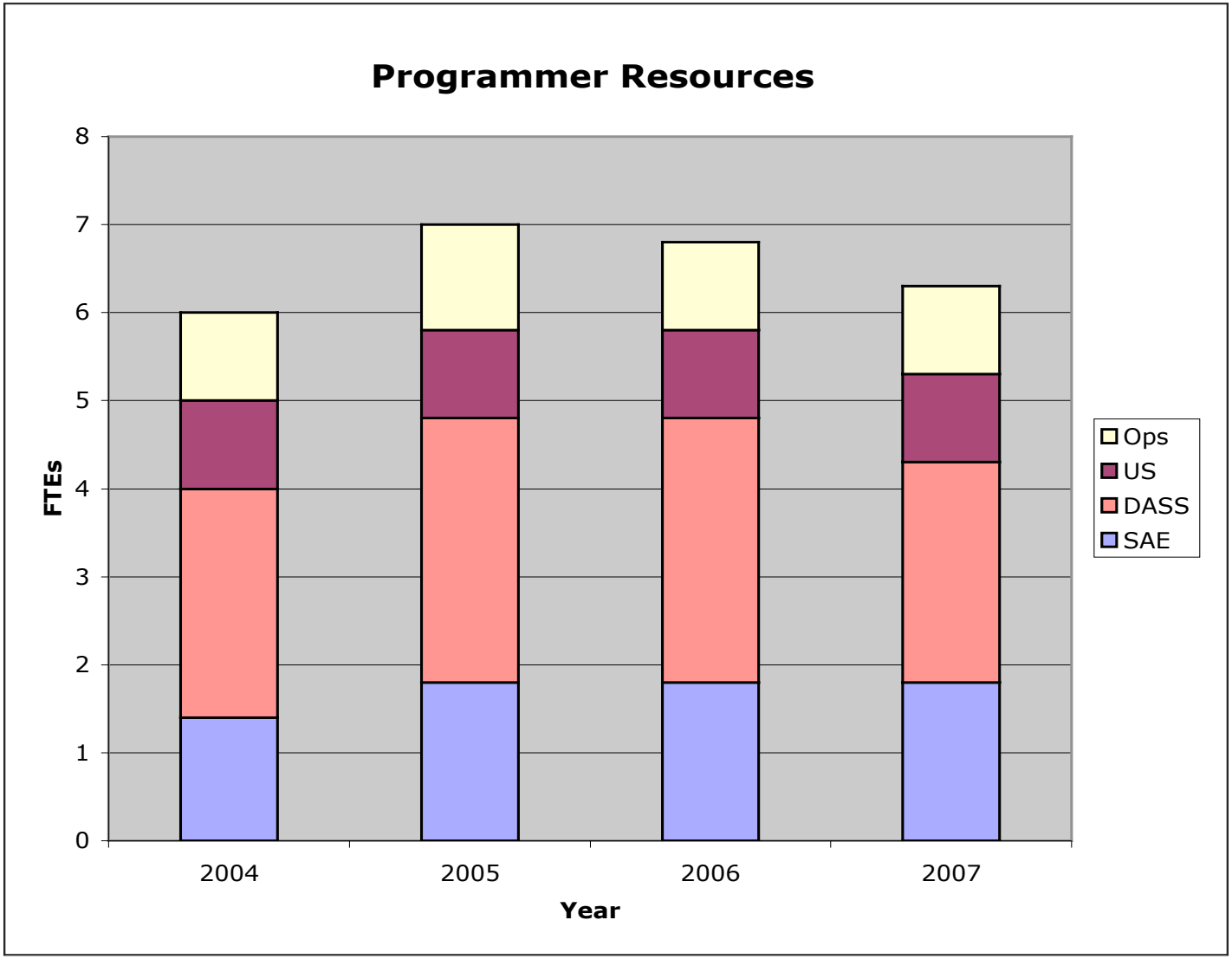
- SAE development managed by LAT team.
- SAE has two code co-architects
  - James Peachey - GSSC
  - Toby Burnett - LAT
- SAE resources at GSSC
  - 2 programmers.
  - 5 scientist developers.

Section Development in FTEs

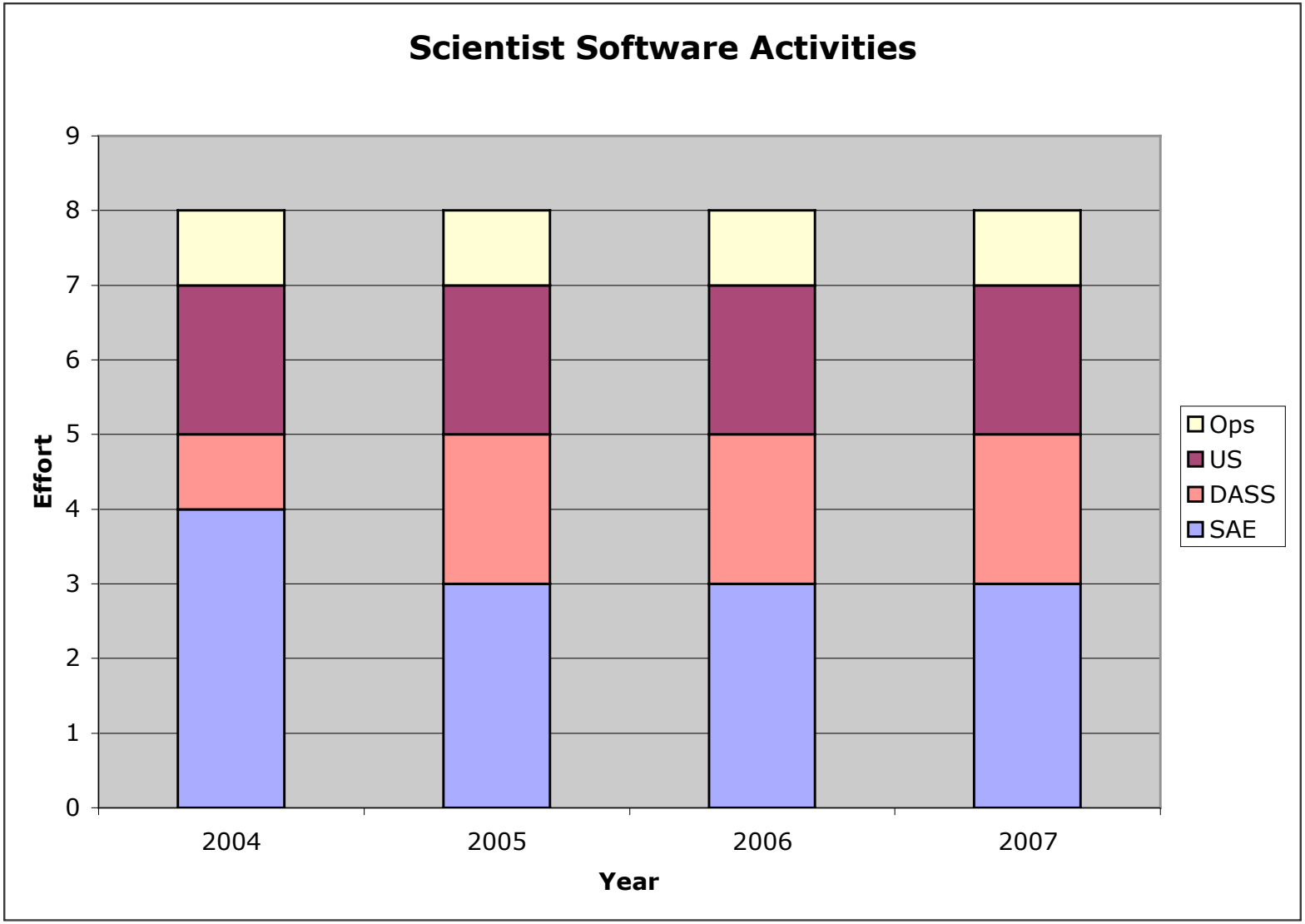
Estimated Resources Needed for Software Development Tasks (including management)

Section	2004	2005	2006	2007
US	3	3	3	3
Operations	2	2.2	2	2
DASS	3.6	5	5	4.5
LAT SAE	5.4	4.8	4.8	4.8

Projected Programming Staff Resources



Scientist Programming Effort



Summary

- Software development schedule and management structure defined
- Software release schedule and procedures defined.
- Software version control procedures defined.
- Resources allocated to meet expected development needs
- Procedures used successfully to create LAT photon database and query system.

Software Development Environment

Software issues (bugs, change proposals, requests for more documentation, etc.) tracked with web accessible tool - Roundup (http://roundup.sourceforge.net/)

Software Development Metrics

- Chose to use Functionality points as software management metric - why?
  - GSSC software a mixture of scripts and compiled code in different languages.
  - GSSC attempts to use existing tools and libraries where possible - size of task is then determined by specifying changes (in functionality) needed for GSSC
  - Development goals based on functionality.
- Example prototype photon database
  - 3 developers each using mixture of
    - perl (for web interface)
    - C++ (queue manager)
    - C (for search engine)
  - Development tracked by functionality across tools
  - Successfully completed 8 week development cycle as planned

e.g. Functionality Points for SAE tools

- http://lheawww.gsfc.nasa.gov/%7Eikebe/GLAST/SAE_functionality.html
- **Category A: Show Basic Information of the Observation**
  - **Display time history of the spacecraft status during the observation e.g. attitude, attitude stability, SAA passage**
  - **Display information of a data set and their time history if variable:**
    - **e.g. TSTART, TSTOP,**
    - **the total number of events,**
    - **the number of events in each detector (front and back?),**
    - **the calibration/reconstruction version,**
    - **the detector mode,**
    - **time resolutions,**
    - **time-assignment mode/reliability,**
    - **the number of events in each time resolution/reliability,**
    - **time span of the observation (visualization of GTI?)**
- **Category B: Making Histograms**
  - **1-d histogram with a column value in FT1 or FT0 event table**
  - **Frequently referred columns would be,**
    - **TIME' column for time history of counts,**
    - **ENERGY' column for energy spectrum,**
    - **THETA' (the inclination angle, i.e. the fit incoming direction with respect to the instrument z-axis),**
    - **'PHI',**
    - **'ZENITH_ANGLE',**
  - **2-d histogram with two column values in FT1 or FT0 event table Frequently used column pairs would be, 'RA' and 'DEC', 'CONVERSION_POINT[0]' and 'CONVERSION_POINT[1]' for the event distribution in the detector coordinate**
  - **Projected SKYX-SKYY counts map (in different energy bands)**
- **Category C: Data Selection**
  - **Apply the standard background rejection to remove particles and albedo gamma events**
  - **Select events with TIME (GTIs)**
  - **Select events with ENERGY, THETA, ZENITH_ANGLE, or other FT1 column parameters**
  - **Select events with count rate**
  - **Select events with instrument observation modes**
  - **Select events with time resolution/reliability**
  - **Select events with detectors (front and back)**

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