GLAST Large Area Telescope (LAT) Flight Software Flight Unit Design Peer Review
Committee Report

Introduction:

The GLAST LAT Flight Software (FSW) Flight Unit Design Peer Review was conducted on Thursday September 16, 2004. The review team was asked to ensure that the FSW team has a clear understanding of functionality to be provided, baseline control and verification approach.

The Committee is requested to evaluate and address the following questions:

- Is the LAT Flight Software at a design maturity sufficient to complete implementation and unit/package testing?
- Has the Flight Software team identified open design or implementation issues and established appropriate resolution plans?
- Is the LAT Flight Software test and verification planning and processes sufficiently mature to be prepared for Formal Qualification Testing (FQT)?
- Are there other issues the committee feels should be addressed?

The FSW Flight Unit Peer Review Committee Members are: Al Vernacchio (chair), Dick Horn (co-chair), Steve Scott (GSFC), Ron Zellar (GSFC), Stephe Leake (GSFC), Richard Mount (SLAC), Steve Gowdy (SLAC). Attendees at the review included Shirley Savarino (IVV) and Mike Beims (IVV).

This report is a summary of the Committee's assessment and the input received from the review committee members. The review committee member inputs received are included in this report. Six RFAs were received at the review and are included below.

Summary:

The review committee was able to answer yes to the questions posed by our charge.

It is the consensus of the committee that the review demonstrated a sound understanding of the functionality required for the Flight Unit Build as well as adequate baseline control, well organized plans for monitoring progress using demonstrations and a verification approach that when fully implemented will result in a high quality product.

The FSW Team demonstrated their readiness to start implementation and the completeness of the design phase for the Flight Unit. The Team presented a sound plan to conduct Formal Qualification Test before LAT System Test as well as the early integration risk reduction with increasingly complex and high-fidelity hardware engineering models.

Most of the issues discussed by at the review were already recognized by the development team and were being dealt with adequately. The Committee notes the following issues whose resolutions will be key to the success of the development effort.

1. The schedule remains very challenging. The available hardware resources to support FSW development and FSW test need to be made available at sufficient priority to support the software schedule. Both the FSW development and test teams need to elevate hardware resource conflicts to Electronics & LAT Project management should conflicts impact their progress. FSW, Electronics and LAT Project management should identify workarounds to ensure these conflicts have minimal impact on FSW delivery.

2. A plan for FSW FQT requirements/capability demonstration was presented which indicates a significant rate of progress required over the next three months. While it is recognized that progress to date has been hampered by LAT Project Priorities to resolve technical issues and to get the LAT Test Bed operational, it is imperative that FSW design implementation come to completion and a transition to system integration and FQT readiness begin in order to meet the needs of LAT System Test in 2005.

3. The LCB issues continue to drain resources. LAT Management should ensure that a clear closure plan is in place and resolution options consider avenues that have minimum impact to current FSW

4. FSW and Systems Engineering should ensure that a closure plan is in place for all remaining TBX requirements as well as clarification of any open issues that may lead to new requirements.

5. The plan for FQT readiness, test script development and dry-runs appears adequate. However, the team and LAT Management need to ensure sufficient resources, priorities and team focus are maintained as the inevitable distractions appear over the timeframe.

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Al Vernacchio

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Dick Horn

Request For Action (RFAs)

Action Item 1: Calibration

Specific Request: Establish an ICD between FSW and Ground Calibration

Reason/Comment: the two groups need to agree on what data the FSW calibration produces

Submitted by: Stephen Leake

Action Item 2: Requirements/Test of Modes

Specific Request: Please clarify how the LAT FSW Requirement Modes and FSW Implementation Modes are addressed through FSW teat. This is an area that should lead to an update of requirements so test is complete

Reason/Comment: There are LAT requirement modes, which are then transformed into LAT design/implementation modes. This leads to concern about how the test procedures will work through the two sets of modes

Submitted by: Shirley Savarino

Action Item 3: Gamma Ray Bursts

Specific Request: Clarify requirement and design for Gamma Ray Burst data capture. Make a clear commitment that attempting to meet this requirement will not be allowed to cause a schedule delay

Reason/Comment: Baseline design does not include buffering beyond the .5MB LCB event buffer. It may turn out that this is not adequate

Submitted by: Stephen Leake

Action Item 4: Mode Control

Specific Request: Provide clear, complete definitions of the three physics acquisition modes

Reason/Comment: It is not clear that three modes are needed

Submitted by: Stephen Leake

Request For Action (RFAs) Continued

Action Item 5: Requirement TBX Closure

Specific Request: Define deadlines for resolution of requirement TBXs and clearly communicate the deadlines to the appropriate LAT systems

Reason/Comment: LAT FSW needs to finalize its requirements and the other LAT systems need to contribute to this goal.

Submitted by: Ron Zellar

Action Item 6: Management

Specific Request: Clarify the approach to meeting deadlines for successful full integration of the flight software. Especially how integration problems will be handled

Reason/Comment: Keeping to the schedule looks possible, but there are many possibilities for slippage

Submitted by: Richard Mount

Specific Notes from review team members:

Steve Leake:
I attended the GLAST LAT FSW Flight Unit Peer Review, Sept 16 2004, at SLAC in Palo Alto, as a review committee member.

The review went well; the SLAC team is making good progress towards delivery.

The review team was asked to address these questions:

· Is the LAT Flight Software at a design maturity sufficient to complete implementation and unit/package testing?

Yes; the presentation indicates there is a good level of design documentation, and the team understands the hardware and software design. The design is at a CDR level of maturity.

· Has the Flight Software team identified open design or implementation issues and established appropriate resolution plans?

One issue that has not had sufficient attention is the requirement to "buffer" data during a gamma ray burst. This requirement is ill-defined, and is not supported in the baseline design of the LAT flight software.

It may require hardware support to buffer enough data from a gamma ray burst properly, which would be a huge impact on the delivery schedule.

This requirement was not presented in earlier reviews of the LAT. If it had, there would have been RFAs requesting clarification of the requirement (there is such an RFA now).

Otherwise, the only issues the LAT team faces are the typical ones of schedule and budget.

· Is the LAT Flight Software test and verification planning and processes sufficiently mature to be prepared for Formal Qualification Testing (FQT)?

I believe the LAT team will be ready for FQT according to the schedule presented.

· Are there other issues the committee feels should be addressed?

The LAT team is doing a good job. They need help from project management in getting the gamma ray burst buffering requirement clarified.

Shirley Savarino, GLAST IVV Project Lead
Mike Beims, GLAST IVV Senior SE

General Comments from IV&V:
There has been a lot of work on the LAT design since EM2 and it is much more quantitative and in-depth than before. The laid out scheulde has an ambitious test program in parallel with code development and FSW integration. Also during this time, the FSW design will be captured in the LAT design document. It is key that SLAC maintains the in-place team. The LAT managers all have a lot of ownership of their area and this commitment will be necessary to meet the milestones leading to FSW TRR.

Concerns IVV raised regarding primary boot were largely addressed through the presentations and discussions with Dan Wood and JJ Russell. This is an area we will continue to monitor given its criticality to LAT operation.

The presentations by the LAT team across all subsystems created confidence in the SLAC team's ability to handle contingencies across LAT subsystems. Areas of discussion were addressed, and questions were answered. Any shortcomings in an area questioned by the review board appeared to be localized and manageable without significant impact to the overall design or schedule.

IV&V has spent the last couple weeks working with the SLAC LAT team on resolving identified issues associated with the LAT FSW Requirements, Rev 3. At this time, all issues with requirements are closed or resolved. Mike DeKlotz is a pelasure to work with. We look forward to similarly productive interaction with Eric Hansen and the LAT FSW Test Team.

Ron Zellar

Status
A GLAST/LAT Flight Software Review was conducted on 16 September, 2004 and focused on the current state of the flight software and the work planned for the Flight Unit (FU) build of the software system. The FU build is the final build prior to Formal Qualification Testing (FQT) and delivery to Instrument I&T.

The Review Committee Members were: Al Vernacchio (chair), Dick Horn (co-chair), Steve Scott (GSFC), Ron Zellar (GSFC), Stephe Leake (GSFC), Richard Mount (SLAC), Steve Gowdy (SLAC). Shirley Savarino (IVV) and Mike Beims (IVV) also attended the review.

As summarized during the review by the LAT team, the flight software development appears to be approximately one month behind schedule. The planned software functional demonstrations are approximately two months behind schedule.

Software FQT is planned for April 2005 with one month slack prior to the I&T need date. A Test Readiness Review and a Post Qualification Review are planned before / after the FQT. The FQT procedures will be executed on a flight-like test bed system using commercial electronics.

The software test team recently lost a team member (who took employment elsewhere). The LAT Flight Software Team is looking to replace this individual as soon as possible, preferably with someone having a background in physics to assist with the more science-oriented test procedures.

Earlier this week, the team committed their requirements document to the CM system. The team acknowledged a number of outstanding TBX's in the document, These are mostly parameter values that need definition from non-software systems.

The LAT Flight Software is at a design maturity sufficient to complete implementation and unit testing. Open issues for the software design or implementation are relatively minor in nature and resolution plans are in place to address these items.

The LAT Flight Software test and verification processes will prepare the software for FQT. However, plans that address preparations for FQT may be unrealistic. See "Concerns" below.

Concerns

The test procedure development schedule is highly ambitious. Notwithstanding the recent reduction of the test workforce, approximately 184 procedures (one procedure for each of 198 requirements with 14 already developed) need to be created prior to FQT, currently scheduled for April 2005. The next month (or more) will be occupied with developing the test procedures for the ISIS (Spacecraft Sim) system and executing them. This means that each test team member will have to produce well over 2 fully functional procedures per week between November 2004 and April 2005. This allows no time for holidays and assumes any test bed resource conflict issues will not hinder procedure development. Test team members seemed to indicate during the review that the procedure development schedule was created without their full buy-in. This further makes me skeptical of the test development schedule.

I believe the development schedule is somewhat optimistic. The person developing the Calibration (LCI) software currently has other responsibilities. He was assigned this software unit to fill in for the team member that recently departed and comes to this work without the full background of its history. The Gamma Ray Burst Detection (GRB) software requires some unique understanding and adjustments to both the Burst Location algorithm and the Burst buffering software. Since these implementations are relatively novel and without a previous similar implementation to draw on, a trouble-free software development cannot be assured. Nevertheless, the people assigned to both the LCI and

GRB components are experts and, given an undistracted environment, will eventually derive solutions.

I am also concerned about the organizational structure of the development, test, and test bed electronics teams. The test team is not under the direction of the flight software manager, but exist as a separate group under the Electronics and Software (DAQ) subsystem manager. Furthermore, the test bed electronics team is distinct from the flight software development and from the software test teams, also answering to the DAQ manager. This raises two concerns. First, it may be unrealistic to expect the flight software manager to produce flight-qualified software in a timely manner without putting the test team within the scope of his direction. Second, the test bed resources are not within the scope of control for either the test team, or the development team. When test bed resources become constrained, adequate development and test time may not be given to the software system. The LAT team was confident that this arrangement will work, but I hold this as a concern nevertheless.

Requests for Action

I have only one RFA: Please define clear deadlines for resolution of the Software Requirement TBX's and communicate these to the appropriate subsystems to ensure on-time parameter delivery.

Recommendations

The software and test teams are about to begin a very intense work period – probably more intense than they realize at this time. To the extent possible, each team member should focus only on the critical tasks. Additional work that does not directly address specific requirements should be eliminated. Further, where possible, this team should be allowed to work uninterrupted and without additional reviews. Mechanisms exist to track the progress of the software and test development efforts. These should be used to communicate progress to external parties.