GLAST Large Area Telescope:

ISOC Subsystems
WBS: 4.1.B

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ISOC Deputy Manager

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Review History

- IOC Peer Design Review August 2001
- LAT PDR/Baseline Review January 2002
- Delta PDR/Baseline Review July 2002
- LAT CDR/CD3 May 2003
- ISOC Peer Review March 2004
Significant Changes Since Last Lehman Review?

• GLAST Ground System Operation management team in placed
• Completed element peer reviews:
  – GLAST Science Support Center Peer Review
  – Mission Operations Center Peer Review
  – Instrument Science Operations Center Peer Review
• A Working Group was formed to review the Instrument Operations Center (IOC) implementation plan
  – Formulation of the Science Operations Group within ISOC
• Rebaselined the ISOC budget
• Bill Craig is acting ISOC manager
Mission Block Diagram – ISOC View

- GLAST
- TDRS
- White Sands Complex
- USN, Wallops
- GBM
- Level 0 Data
- Alerts
- Raw Data
- Commands
- Instrument Uploads
- Raw Data
- Level 0 and RT HK Data
- Ops Data Products
- Instrument Uploads*
- Commands*
- Ops Data Products
- Level 1 and Level 2 Data
- Analysis Tools
- GBM Level 0 Data
- Alerts
- Refined Alerts
- GLAST Burst Monitor (GBM) IOC
- Refined Alerts
- GRB Coordinates Network (GCN)
- Schedules and Commanding
- GLAST Science Support Center (GSSC)
- Level 1 and Level 2 Data
- Analysis Tools
- Schedules
- Commands
- Instrument Uploads
- LAT Collaboration
- LOF
- SOG
- SAS

* test, early orbit, and backup only
ISOC Mission

• Science
  • Acquisition, Analysis, Calibration, etc...

• Review and maintain LAT Instrument health and safety
  • Review and trend health and safety telemetry
  • Provide necessary support for contingency operations
    – Immediate health and safety operations are handled at the GLSAT-MOC

• Configure and maintain the instrument’s flight software and ground data bases
  • Instrument flight (on-board) software configuration
  • Command, telemetry, and calibration

• Instrument command generation and validation

• Archive Level 0 telemetry packets and higher-level products
To Meet The Mission

• An Ad Hoc Working Group was formed to review the Instrument Operations Center (IOC) implementation plan
• Members of the Working Group are: S. Digel (chair), E. do Couto e Silva, R. Dubois, P. Nolan, H. Tajima (with participation from S. Ritz, instrument scientist)
• Charge to the working by the Project PI
  – Examine the plans to date for the IOC and, in particular, assess the adequacy of the IOC plan for serving the science needs of the collaboration.
  – Develop an operational picture/description that illustrates the role of each IOC element and the relationships between the elements.
  – Develop a strawman staffing plan that identifies needed full-time (and part-time) scientists, engineers, technicians, etc. Consideration should be given to how I&T activities will eventually phase out and the IOC will become fully operational.
  – Examine examples from other space astrophysics missions (e.g. CGRO/EGRET, SWIFT, Chandra, RXTE, SOHO/MDI., etc.) to understand the “lessons learned” and apply them in the context of GLAST
Major Findings from Working Group

• Identified the need for a Science Operations Group within ISOC to support the instrument activities

• Established a preliminary staffing plan/road map for formulating and staffing the ISOC

• Identified the roles and responsibilities for the three major components of the ISOC
ISOC Elements Description

- LAT Operations Facility (LOF)
  - Responsible for day-to-day operations of the LAT instrument and facility
  - Generate and coordinate commanding plans for the LAT instrument
- Science Operations Group (SOG)
  - Supports LAT instrument calibration activities
  - Performs LAT instrument activity planning, trending & performance analysis and anomaly investigation
  - Perform sustaining engineering for the LAT instrument
- Science Analysis Software (SAS)
  - Performs higher level data processing (Level 1 & 2) using Level 0 data provided by MOC, and provides data products to the GSSC
  - Archives and distributes science data products (for LAT collaborations)
ISOC Elements & Functions

LAT IOC Manager

LAT Operations Facility
- Operations Planning and Commanding
- Health & Safety Monitoring
- Flight Software

Science Operations Group
- Instrument Performance Monitoring
- Monitoring & Diagnostics
- Calibrations
- Optimization
- Data Processing
- Transient Source Alerts

Science Analysis Software
- Simulation/Recon
- Software Infrastructure
- Science Tools
- Processing Server
- Science Support
ISOC Design Approach

- ISOC design approach is to use as much as possible of the software and tools developed by Electronics, I&T and SAS
  - Many of the ISOC physicist and engineers are matrixed with other LAT subsystem to gain experience

- LOF
  - ISOC ground software and operational tools will be developed and derived in coordination with I&T efforts
  - Command and telemetry database will be developed in coordination with I&T efforts
  - LOF team will include technicians, engineers and programmers who were involved with I&T throughout the instrument integration and testing

- SOG
  - Draw from Science Verification Analysis and Calibration (SVAC) pre-launch efforts
  - Use analysis tools, instrument simulation, and processing pipeline developed by SAS
  - Use or develop additional operational tools from tools used for I&T
  - SOG personnel will include scientists and programmers who were involved with I&T

- SAS
  - Experienced scientists and programmers who have developed the data processing, simulation/reconstruction, science tools and databases in support of Data Challenges and I&T
**ISOC Organization**

- **LAT Performance Assurance**
- **Instrument Science Operations Center**
  - WBS: 4.1.B
  - W. Craig
  - D. Lung (Deputy)
- **Operations Integrated Product Team**
  - SU-HEPL, SU-SLAC, GSFC, NRL, UCSC

- **LAT Operations Facility**
  - L. Bator, SLAC

- **Science Operations Group**
  - TBD

- **Science Analysis Software**
  - R. Dubois

- **Console Operators**
  - transfer from I&T

- **Mission (Instrument) & Ops Planning**
  - L. Bator, SLAC

- **Facility Engineering**
  - SW - J. Panetta*
  - SW - TBD
  - Network – TBD
  - Systems – TBD

- **SAS Physicist/Engr**
  - A. Borgland*
  - X. Chen*

- **Physicists/Engineers**
  - transfer from I&T

- **FSW & Test Bed**
  - J.G. Thayer*
  - J.B. Thayer*

- **SAS Physicist/Engineers**
  - transfer from SAS 4.1.D

* Matrixed to other Subsystems

Section ISOC 12
ISOC Peer Review (3/2/04) Summary

• Charge for the review
  – Requirements properly address the principal function of the center
  – ISOC design maturity, qualification and verification planning near CDR level
  – Open design issues and appropriate closure plans
  – Are the design, planning, and formulation of the ISOC properly defined?

• Review was focused on the operation aspect of ISOC

• 20 Request For Action/Recommendations
  – Concern areas are:
    • Staffing profile
    • ISOC organization
  – No significant technical finding or recommendation
## ISOC Peer Review RFAs

<table>
<thead>
<tr>
<th>No.</th>
<th>Section</th>
<th>RFA Summary</th>
<th>Requestor</th>
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<tbody>
<tr>
<td>1</td>
<td>1.1 Overview</td>
<td>Need ISOC Management Plan &amp; Approach</td>
<td>R. Schweiss</td>
</tr>
<tr>
<td>2</td>
<td>1.1 Overview</td>
<td>Need overall functional block diagram illustrating the functional capabilities and data flow during various phases</td>
<td>R. Schweiss</td>
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<tr>
<td>3</td>
<td>1.1 Overview</td>
<td>Risk Analysis</td>
<td>R. Schweiss</td>
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<tr>
<td>4</td>
<td>1.1 Overview</td>
<td>Reschedule ISOC CDR</td>
<td>M. Rackley/C. Young</td>
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<tr>
<td>5</td>
<td>2.1 Requirements</td>
<td>Level III requirements for the LOF and SOG are not complete</td>
<td>M. Rackley</td>
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<tr>
<td>6</td>
<td>1.1 Overview</td>
<td>Staffing plan and profile</td>
<td>M. Rackley/C. Young</td>
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<td>7</td>
<td>3.0 Ops Concept</td>
<td>Define the ISOC reports for internal use and external use</td>
<td>M. Rackley</td>
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<tr>
<td>8</td>
<td>3.0 Ops Concept</td>
<td>The ISOC does not yet know what system it is using to process Observatory HSK data or perform the commanding</td>
<td>M. Rackley</td>
</tr>
<tr>
<td>9</td>
<td>1.1 Overview</td>
<td>Describe lesson learned &amp; approach</td>
<td>M. Rackley</td>
</tr>
<tr>
<td>10</td>
<td>2.3 V&amp;V</td>
<td>ISOC verification does not involve early opportunities to validate/test using LAT instrument</td>
<td>M. Rackley/N. Johnson</td>
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<tr>
<td>11</td>
<td>3.0 Ops Concept</td>
<td>Verify LAT modes</td>
<td>M. Davis</td>
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<td>12</td>
<td>4.2 SW Maintainance</td>
<td>Understand the number of writes to EEPROM</td>
<td>C. Young</td>
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<tr>
<td>13</td>
<td>1.1 Overview</td>
<td>ISOC detailed development schedule</td>
<td>K. Lehtonen</td>
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<td>14</td>
<td>4.3 Networking</td>
<td>Enter a more formal agreement with SLAC management on required data storage and processing requirements</td>
<td>N. Johnson</td>
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<td>15</td>
<td>1.1 Overview</td>
<td>ISOC organization structure &amp; communications</td>
<td>N. Johnson</td>
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<tr>
<td>16</td>
<td>2.3 Dev Approach</td>
<td>Define mechanism for ISOC requirements being placed on I&amp;T and SAS</td>
<td>N. Johnson</td>
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<td>17</td>
<td>6.1 Gnd Ops SW</td>
<td>Define LOF/SOG tools</td>
<td>R. Corbert</td>
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<tr>
<td>18</td>
<td>6.1 Gnd Ops SW</td>
<td>Specify plans and requirements for automation of Ops software</td>
<td>R. Corbert/M. Rackley</td>
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<tr>
<td>19</td>
<td>6.1 Gnd Ops SW</td>
<td>Specify plans and requirements for Ops SW to be of sufficient robustness</td>
<td>R. Corbert</td>
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<tr>
<td>20</td>
<td>1.1 Overview</td>
<td>Specify what other ground system elements will be involved in LAT operations</td>
<td>R. Corbert</td>
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## Major ISOC Release & Review Dates

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
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<tbody>
<tr>
<td>ISOC Detail Design Review</td>
<td>August 4, 2004</td>
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<tr>
<td>LOF SW Release 1</td>
<td>March 15, 2005</td>
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<td>Support GRT #2</td>
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<tr>
<td>LOF SW Release 2</td>
<td>October 14, 2005</td>
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<tr>
<td>Support GRT #5</td>
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<td>Mission Operations Review</td>
<td>October 18, 2005</td>
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<tr>
<td>Operation Readiness Review</td>
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<td>Launch</td>
<td>December 15, 2006</td>
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<td>February 2007</td>
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Approved
Cost Changes Since Rebaseline

- No significant changes from rebaseline

(k$)

4.1.B Baseline, November 03 $326
Changes:
Stanford Benefits Rate Increase $2

4.1.B Baseline, February 04 $328
Road Map to ISOC Detail Design Review

- Establish agreements between the subsystems and ISOC for transitioning the necessary tools and staffing
  - Between I&T and ISOC
  - Between SAS and ISOC
  - Between Electronics and ISOC
- Increase LOF staff
- Address all RFAs/Recommendations from the Peer Review