Gamma-Ray Large Area Space Telescope (GLAST) Project

Mission Operations Center (MOC) to GLAST Science Support Center (GSSC) / Instrument Operations Centers (IOCs)

Operations Data Products (ICD)

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Gamma-Ray Large Area
Space Telescope
(GLAST)
Project

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

Operations Data Products
Interface Control Document (ICD)

July 31, 2004

Gamma-Ray Large Area Space Telescope (GLAST) Project
Operations Data Products Interface Control Document

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ACRONYM LIST

ACD	Anticoincidence Detector
AGN	Active Galactic Nuclei
ATS	Absolute Time Sequence
BAP	Burst Alert Processor
BGO	Bismuth Germanate
CCB	Configuration Change Board
CCSDS	Consultative Committee for Space Data Systems
C&DH	Command and Data Handling
CMD	Command
COP-1	Communications Operations Procedure-1
COTS	Commercial Off-the-Shelf
CsI	Thallium-doped Cesium Iodide
DAS	Demand Access System
DPU	Data Processing Unit
DSMC	Data Services Management Center
ETE	End-to-End test
FDF	Flight Dynamics Facility
FITS	Flexible Image Transport System
FOT	Flight Operations Team
GBM	GLAST Burst Monitor
GCN	Gamma Ray Burst Coordinates Network
GRB	Gamma Ray Burst
GI	Guest Investigator
GIOC	GBM Instrument Operations Center
GLAST	Gamma-ray Large Area Space Telescope
GSSC	GLAST Science Support Center
GN	Ground Network
GPS	Global Positioning System
GS	Ground Station
GSFC	Goddard Space Flight Center
HEASARC	High Energy Astrophysics Science Archive Research Center
ICD	Interface Control Document
IOC	Instrument Operations Center
ITP	? fix in text
kbps	Thousand Bits Per Second
km	Kilometer
L0	Level-Zero
L&EO	Launch and Early Orbit
LAN	Local Area Network
LAT	Large Area Telescope
LAT DPF	Large Area Telescope Data Processing Facility
LHEA	Laboratory for High Energy Astrophysics
LIOC	LAT Instrument Operations Center
MAR	Multiple Access Return

Mbyte	Million Bytes
MOC	Mission Operations Center
MPS	Mission Planning System
MSFC	Marshall Space Flight Center
NaI	Sodium Iodide
NASA	National Aeronautics and Space Administration
NCC	Network Control Center
NORAD	North American Air Defense Command
NPG	NASA Policy and Guideline
PB	Playback
PDU	Packet Data Unit
PI	Principal Investigator
PROCs	STOL procedures for the telemetry and command system
RTS	Relative Time Sequence
RS	Reed-Solomon
SA	Single Access
SAA	South Atlantic Anomaly
SCP	Stored Command Processor
SOH	State of Health
SSA	S-Band Single Access
SN	Space Network
SNAS	Space Network Access System
SSR	Solid State Recorder
STDN	Spacecraft Tracking and Data Network
STOL	Spacecraft Test and Operation Language
STK	Satellite Tool Kit
SWSI	Space Network Web Services Interface
TB	10^{12} Bytes
TBD	To Be Determined
TBR	To Be Resolved
TCP/IP	Transmission Control Protocol / Internet Protocol
TDRSS	Tracking and Data Relay Satellite System
TLM	Telemetry
ToO	Target of Opportunity
WDISC	White Sands Complex Data Interface Service Capability
WSC	White Sands Complex

1.0 Introduction

1.1 Purpose

This Interface Control Document (ICD) defines the interfaces, formats, schedules, and procedures for delivering products between the GLAST Mission Operations Center (MOC) and the GLAST Science Support Center both located at Goddard Space Flight Center (GSFC) and the GLAST Instrument Teams. The Instrument Teams include the Large Area Space Telescope (LAT) team at the Stanford Linear Accelerator Center (SLAC) located at Stanford University and the GLAST Burst Monitor (GBM) team located at the University of Alabama-Huntsville (UAH).

1.2 Scope

This document governs the technical interfaces, product deliveries, and protocols between the MOC and the GLAST Science Support Center (GSSC) and Instrument Operations Center (IOCs). Specific message and data product examples are included in the appendices.

1.3 Documentation

1.3.1 Applicable Documents

The interfaces defined in this ICD were derived from high-level requirements contained in the following sources:

- “GLAST Science Requirements Document”, 433-SRD-0001
- “GLAST Mission System Specification Document”, 433-SPEC-0001
- “GLAST Gamma–ray Burst Monitor (GBM) Instrument – Spacecraft Interface Requirements Document”, 433-IRD-002
- “GLAST Large Area Telescope (LAT) Instrument – Spacecraft Interface Requirements Document”, 433-IRD-002
- “GLAST Science Support Center Functional Requirements Document”, 433-RQMT-002
- “GLAST LAT-GBM ICD”, 433-ICD-0001
- “GLAST Ground System Requirements Document”, 433-RQMT-0006

1.3.2 Reference Documents

The following documents contain background information relevant to this ICD:

- *GLAST Project Mission Operations Concept Document*, 433-OPS-0001, Rev A, August 2003.
- CCSDS 701.0-B-2: Advanced Orbiting Systems, Networks and Data Links: Architectural Specification. Blue Book. Issue 2. November 1992. (Reconfirmed June 1998.)

2.0 Facilities Overview

2.1 GLAST Ground Network Description

The GLAST ground system is comprised of new and existing facilities. The Ground System for GLAST is the organizational entity responsible for ensuring that interface requirements are met between ground system elements. The interface between the MOC and GLAST will be tested and verified as part of the GLAST Ground System Readiness test program.

The MOC is responsible for operating the spacecraft and its payload. The LAT IOC (LIOC) and GBM IOC (GIOC) are responsible for processing GLAST instrument telemetry into scientifically useful data sets and making these data available to the GLAST Science Support Center (GSSC) at GSFC. The GSSC performs science planning, supports the community with data analysis, and will also provide tools for analyzing GLAST data. NASA's Space Network (SN), the Wallops Ground Station on Wallops Island, Virginia (TBD) and the Universal Space Network (USN) Hawaii ground station will provide communication links with GLAST. The Instrument Teams are responsible for providing detailed knowledge of the operation and calibration of the instruments. The spacecraft contractor, Spectrum Astro, will provide detailed knowledge of the operation of the spacecraft. The GLAST Ground System mission architecture overview is shown in Figure 2-1.

The GLAST Science Teams will review the implementation strategies of the ground system and provide recommendations to the PI.

The High Energy Astrophysics Science Archive Research Center (HEASARC) is the designated U.S. data center responsible for public access and long-term archive. All data derived from GLAST observations will be delivered to the GSSC. The GSSC will make the data available electronically to the public.

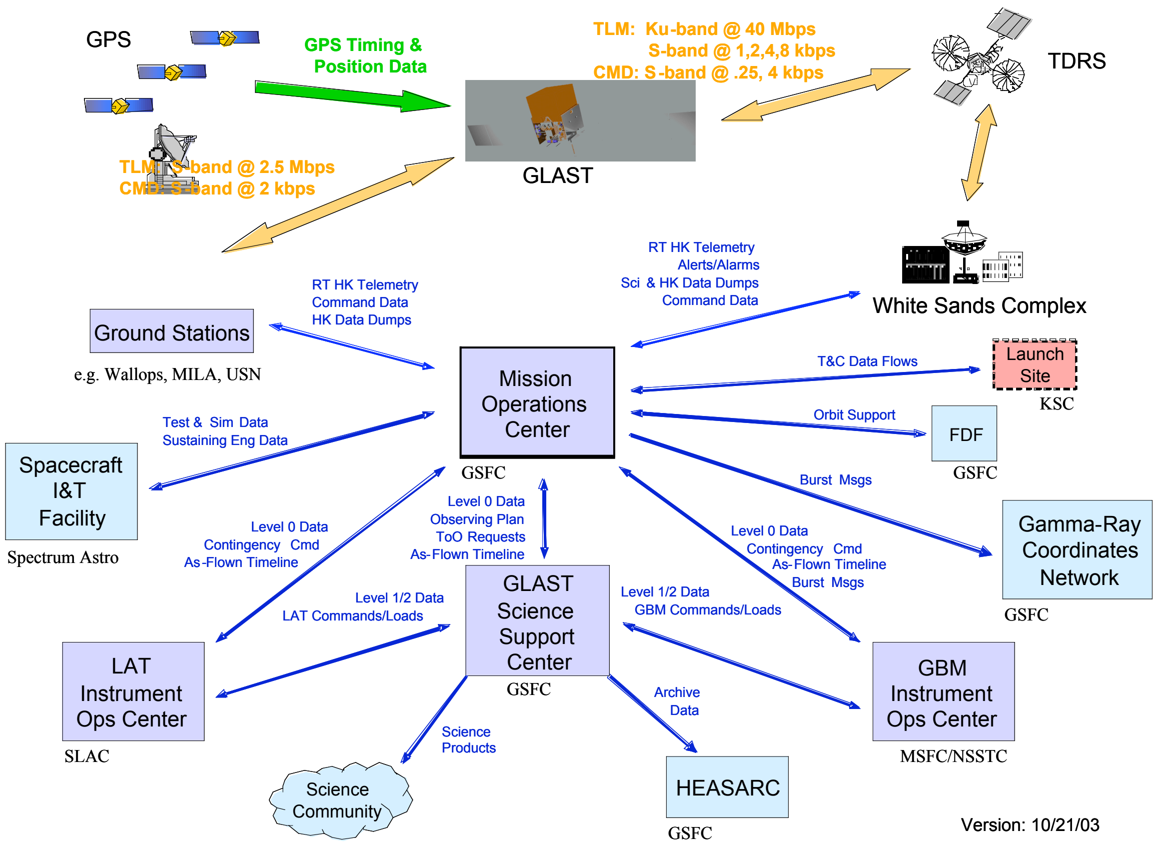

Figure 2-1 GLAST Mission Architecture

2.2 Mission Operations Center Description

The MOC performs all observatory commanding, monitoring, and level 0 data processing and delivery to the IOCs and GSSC. The MOC provides rapid response for the follow-up of Target of Opportunities (ToOs) requested by the science team or science community. The MOC incorporates automation of spacecraft operations and data processing to permit a small operations team and "lights-out" operation, and to speed data processing and response to ToOs. The MOC is staffed by a Flight Operations Team (FOT) on an eight-hour per day, five-day per week basis. MOC automation software will also identify potential anomalies and notify personnel if necessary. The MOC shall generate Pass-oriented Level-0 (L0) telemetry data, and provide the data to the GSSC and IOCs. The Pass-oriented L0 data will be retained online for 7 days at the MOC. A subset of the housekeeping telemetry is maintained online for 30 days, and trend data is accumulated over the life of the mission. In addition, the raw telemetry files as received from TDRSS (or the ground station), command logs, orbit data, the as-flown timelines, and MOC processing statistics and status are archived for the life of mission.

The MOC is based on the Integrated Test and Operations System (ITOS) command and telemetry system, government-off-the-shelf (GOTS) software products, and commercial-off-the-shelf (COTS) hardware and software tailored for GLAST mission support. ITOS provides all command and telemetry functions, such as front-end processing, command and telemetry processing, real-time monitoring, and archiving. Computer security, with use of firewalls and other techniques, prevents intrusion and disruption of operations.

The MOC shall receive all transfer frames from the Tracking and Data Relay Satellite System (TDRSS) SN and the backup Ground Network. The MOC shall produce Pass-oriented L0 products and deliver these products to the GSSC and IOCs. The L0 processing functions include the decoding of transfer frames, the extraction of Consultative Committee for Space Data Systems (CCSDS) packets, and the creation of L0 products with associated quality and statistical gap accounting.

2.3 GLAST Instrument Operations Centers Description

The GLAST Instrument Teams include the LAT team located at the Stanford Linear Accelerator Center (SLAC) of the Stanford University and the GBM team located at University of Alabama-Huntsville. The Instrument Teams maintain facilities for the maintenance of instrument flight software and for the analysis of instrument performance. These sustaining engineering facilities receive engineering data from the MOC, and provide flight software loads and commands to the MOC via the GSSC.

The IOCs perform science planning and assessment of science data and instrument performance. The IOC science plans and instrument flight software loads are sent to the GSSC. The GSSC incorporates the science timelines into a single observatory timeline. The GSSC then forwards the observatory timeline and any instrument loads to the MOC for uplink to GLAST. The IOCs also have remote instrument-specific science workstations to receive and process telemetry and perform analysis and monitoring tasks. The MOC will forward the real-time telemetry to the IOCs upon request to support the additional processing and analysis.

2.4 Data Interface

The MOC makes available real-time telemetry and post-pass telemetry files to the instrument operations centers and sustaining engineering facilities. The Instrument Team sustaining engineering facilities provide real-time commands and flight software loads to the MOC via the GSSC prior to real-time supports designated for such activities. The majority of real-time commands are expected in the form of absolute time commands destined for the weekly absolute time sequence loads uplinked to GLAST. The data interfaces between the MOC, GSSC, and IOCs are summarized in the following figures. The details of each data product including the transfer mechanism originating from the MOC are described in Section 3. The data products originating from the GSSC and the IOCs are described in Section 4.

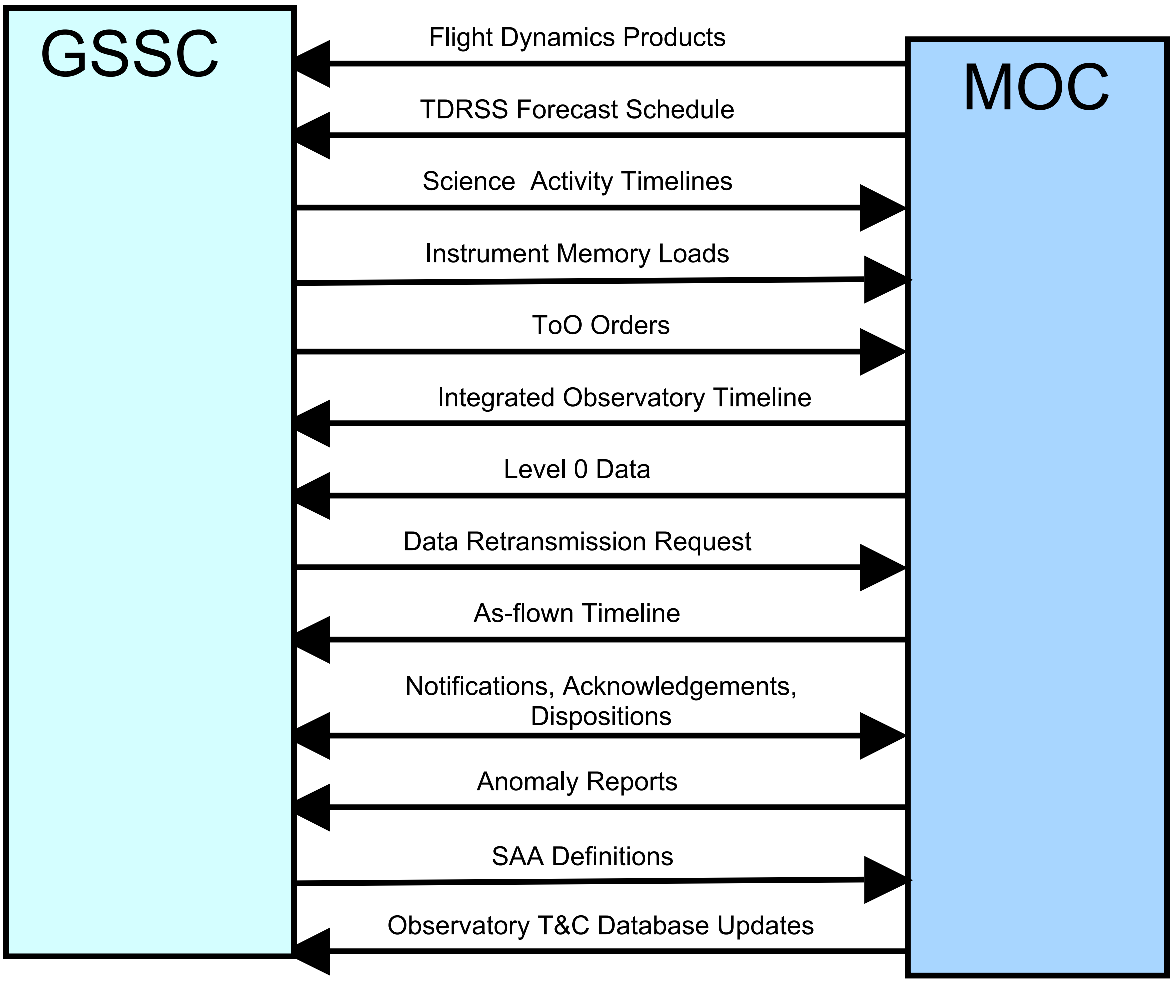

Figure 2-1 GSSC to MOC Data Interfaces

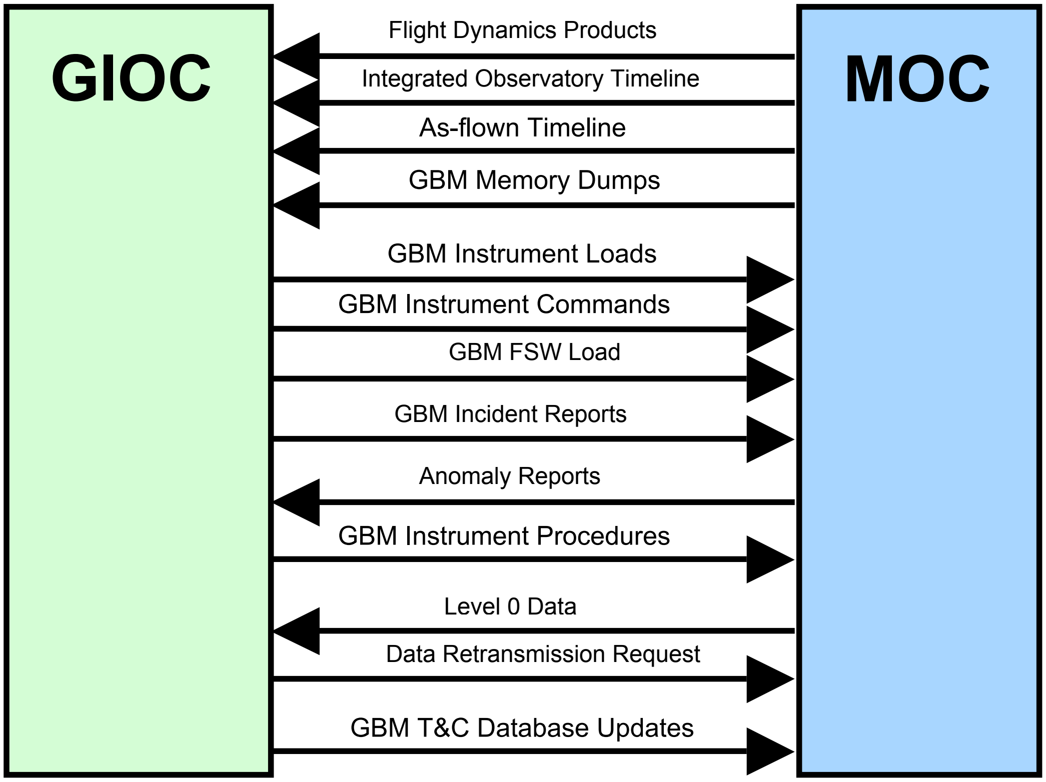

Figure 2-2 GIOC to MOC Data Interfaces

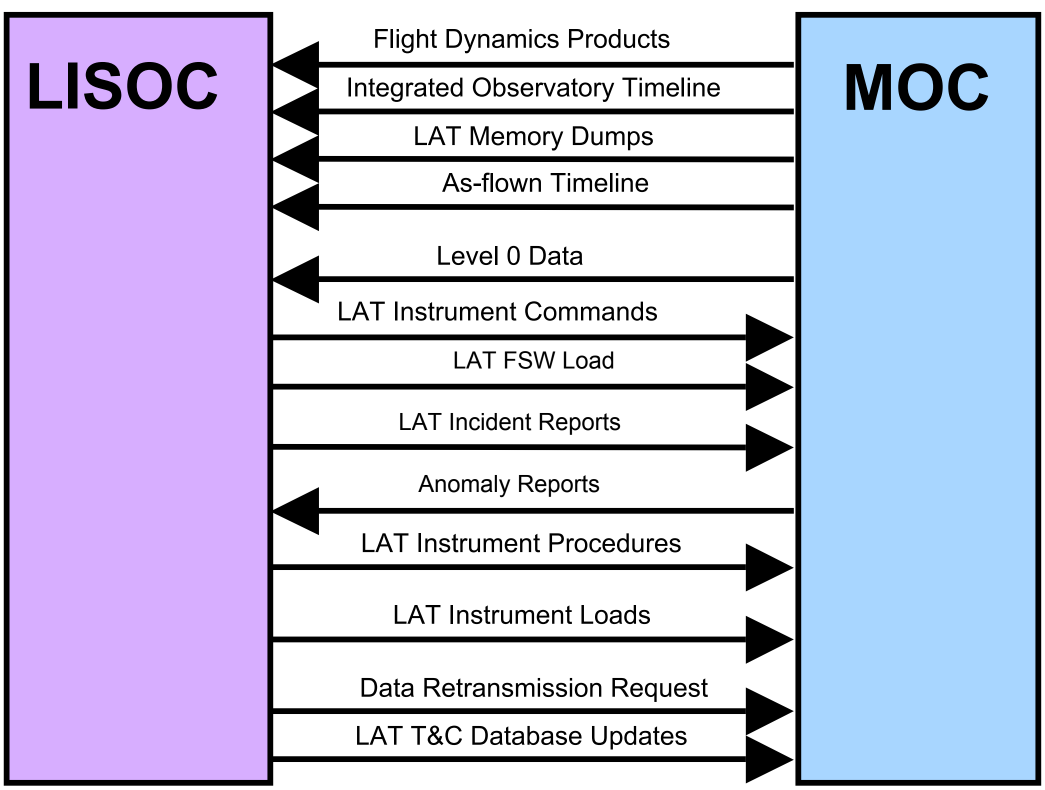

Figure 2-3 LISOC to MOC Data Interfaces

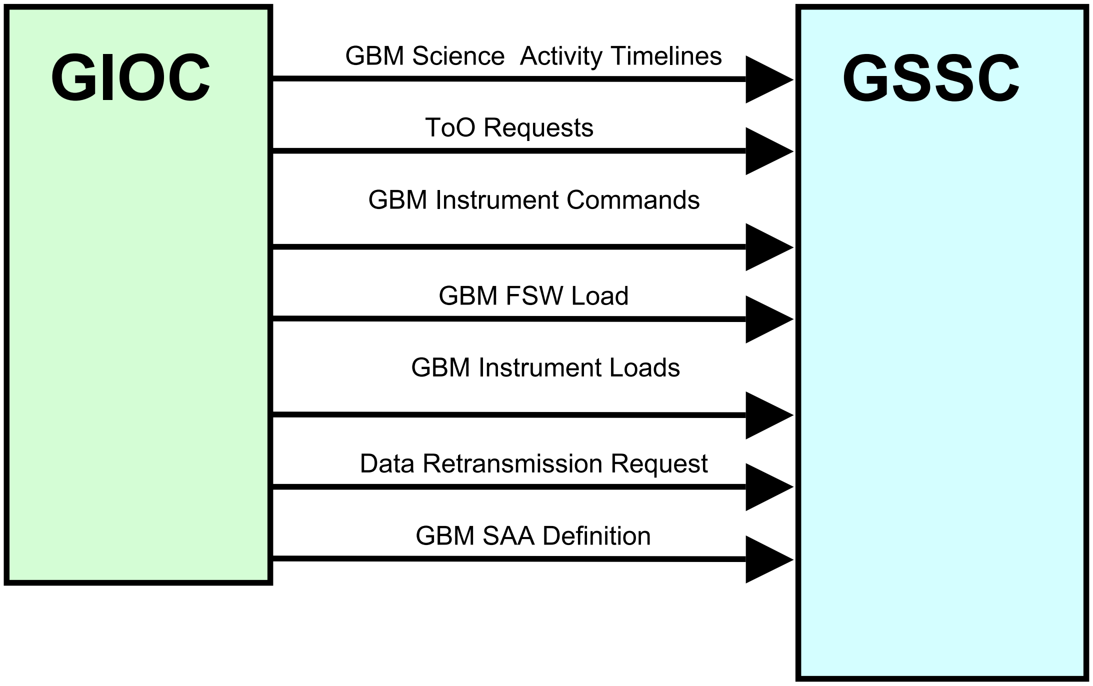

Figure 2-5 GIOC to GSSC Data Interfaces

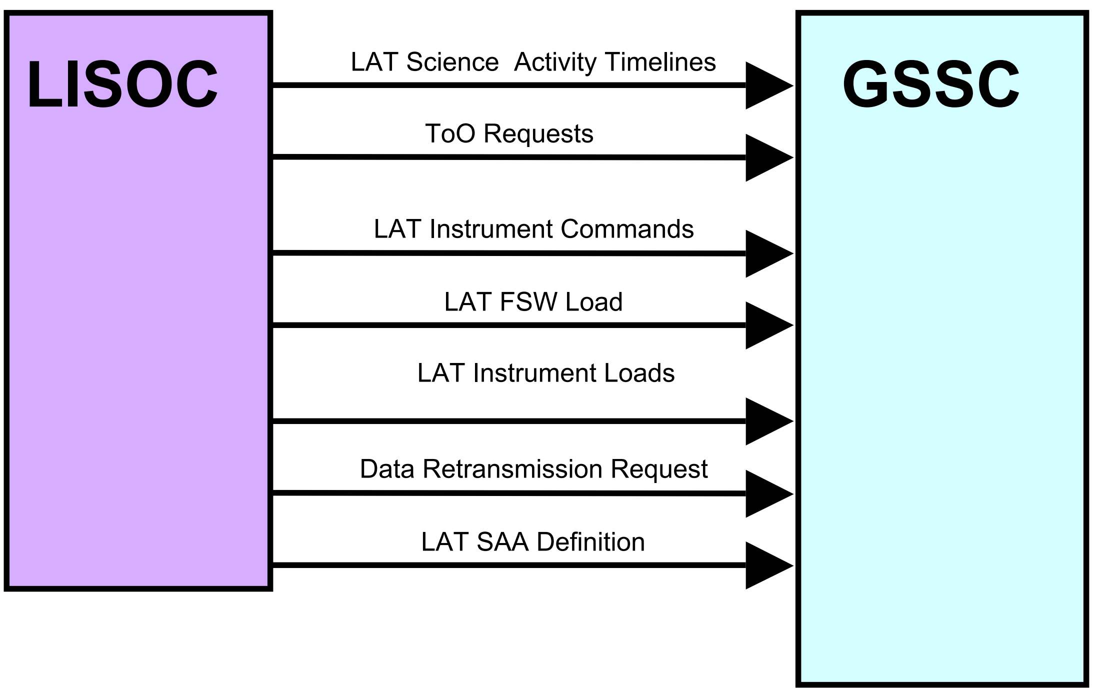

Figure 2-4 LISOC to GSSC Data Interfaces

3.0 MOC Products

Tables 3-1, 3-2, and 3-3 summarize all of the products transferred from the MOC to the GSSC, LIOC, and the GIOC. The appendices provide samples of each product. The following subsections provide more detail on each product's content and attributes including the transfer mechanism.

Table 3-1 Products from MOC to GSSC

Product	Primary or Backup Interface	Section
Anomaly Reports	Primary	3.10
As-Flown Timeline	Primary	3.9
Confirmed TDRSS Contact Schedule	Primary	3.13
Flight Dynamics Orbital Products	Primary	3.8
Integrated Observatory Timeline	Primary	3.2
Level 0 Data	Primary	3.1
Notifications, Acknowledgements, and Dispositions	Primary	3.4
Observatory Telemetry and Command Database Updates	Primary	3.3
Requested TDRSS Contact Schedule	Primary	3.12

Table 3-2 Products from MOC to LIOC

Product	Primary or Backup Interface	Section
Anomaly Reports	Primary	3.10
As-Flown Timeline	Primary	3.9
Flight Dynamics Orbital Products	Primary	3.8
Integrated Observatory Timeline	Primary	3.2
LAT Memory Dumps	Primary	3.5
Level 0 Data	Primary	3.1
Observatory Telemetry and Command Database Updates	Primary	3.3
MOC Command Logs	Primary	3.7
Real-time Housekeeping Data	Primary	3.6
Data Analysis and Remote Access	Primary	3.11

Table 3-3 Products from MOC to GIOC

Product	Primary or Backup Interface	Section
Anomaly Reports	Primary	3.10
As-Flown Timeline	Primary	3.9
Flight Dynamics Orbital Products	Primary	3.8
GBM Memory Dumps	Primary	3.5
Integrated Observatory Timeline	Primary	3.2
Level 0 Data	Primary	3.1

Observatory Telemetry and Command Database Updates	Primary	3.3
MOC Command Logs	Primary	3.7
Data Analysis and Remote Access	Primary	3.11

This ICD follows the CCSDS bit ordering and bit significance convention for serial telemetry links as shown in Figure 3-1. The first bit in a field of N bits is defined as "Bit 0" (i.e., the most left justified appears first in this ICD and is the first transmitted); the following bit is defined as "Bit 1" and so on up to "Bit N-1". Data fields are grouped into 8-bit "words" called octets or bytes. Each byte contains an American Standard for Code Information Interchange (ASCII) character or binary data.

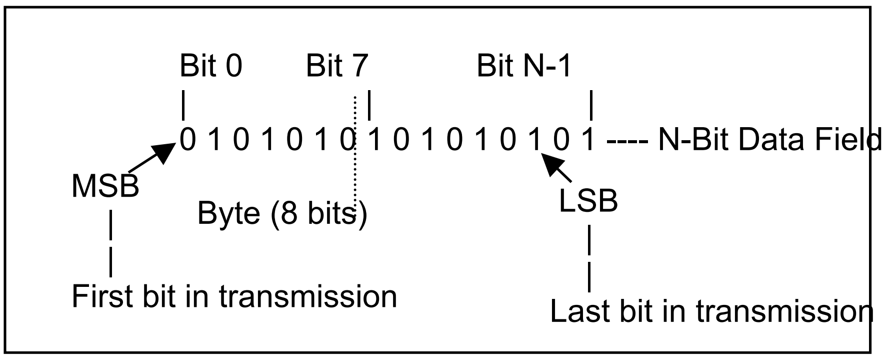

Figure 3-1 Data Format Convention

3.1 Observatory Level-0 Data

The MOC shall receive all CCSDS-compliant telemetry frames from the SN and ground stations. Pass-oriented Level-0 (L0) products will be generated on all mission telemetry and maintained within the mission archive at the MOC. The L0 processing functions include the decoding of transfer frames, the extraction of CCSDS packets sorted by Application Process ID (APID), removal of duplicate packet data within individual data sets, and the creation of L0 products with associated quality and gap accounting statistics. The MOC will transfer the L0 data products electronically within 4 hours after receipt of data from the contacts.

After each pass, the MOC will receive Virtual Channel (VC) telemetry frame files from the Ku-band front end, located at the White Sands Complex. As each file is received, the MOC will automatically process the file through the ITOS frame sorter task and create individual L0 packet files with appended Annotation Headers organized by APID. The MOC will take all packet files for a given VC and compress the files (i.e., via GZIP or a similar protocol) prior to storing the data on the MOC fileserver. The MOC will transfer the Level 0 files to the GSSC and IOCs.

3.1.1 Data Format

A L0 product is created from a single virtual channel frame file, and consists of files, each one containing ITOS packet annotation headers and the CCSDS telemetry source packets for a single APID. The L0 product format is the same format as the Packet Data Unit (PDU) shown in Figure 3.6-3.

3.1.2 Level-0 File Name Format

The L0 data file naming convention will be as follows:

PKT_*YYYYDDDhhmm*_*nnnnn*_VC*NN*_*ppppp*.0.gz

where:

- PKT is a fixed field indicating that the file is a packet file
- *YYYYDDDhhmm* is the time tag (GMT) of the first error-free TLM Transfer Frame from which the L0 packet file was generated, where:
  - *YYYY* is the calendar year
  - *DDD* is the day of year
  - *hh* is the hour
  - *mm* is the minute
- *nnnnn* is the Pass Number in which the Transfer Frame was received (nnnnn in decimal representation)
- VC*NN* is the Virtual Channel ID (NN in decimal representation)
- *ppppp* represents the APID of the packets contained within the packet file (If the file is a composite of all APIDs from the frame file, the APID number will be 99999.)
- 0 is a fixed field
- gz is the extension indicating the file is compressed with gzip

In the event of a data anomaly, suspect packet files can be traced to their parent frame files via time stamp and pass number. Example L0 file names are as follows:

PKT_20031040234_02343_VC01_00873.0.gz
PKT_20050992359_16534_VC01_99999.0.gz

3.1.3 Data Transfer Mechanism

The MOC will transfer the relevant L0 packet files to the GSSC and IOCs using SoftLink's FASTCopy software. A data delivery content listing, or signal file, will be provided with each set of L0 products generated from a telemetry frame file. The signal file will consist of an ASCII text file listing the file names of all created L0 packet files.

3.1.4 Signal File Naming Convention

The L0 signal file naming convention will be as follows:

`SIG_YYYYDDDhhmm_nnnnn_VCNN.txt`

where:

- `SIG` is a fixed field indicating that the file is a signal file
- *YYYYDDDhhmm* is the time tag of the first error-free TLM Transfer Frame from which the L0 packet files were generated, where:
  - *YYYY* is the calendar year
  - *DDD* is the day of year
  - *hh* is the hour
  - *mm* is the minute
- *nnnnn* is the Pass Number in which the Transfer Frame was received (nnnnn in decimal representation)
- VC*NN* is the Virtual Channel ID (*NN* in decimal representation)
- `txt` is a fixed field file extension

The file format of the L0 signal file will be as follows:

```
filename1.gz
filename2.gz
filename3.gz
```

where:

- filename*x* is the L0 filename to transferred
- `gz` is the extension indicating the file is compressed with `gzip`

Example L0 signal file filename:

`SIG_20033452302_55555_VC03.txt`

Example L0 signal file contents:

```
PKT_20033452302_55555_VC03_00873.0.gz
PKT_20033452302_55555_VC03_00874.0.gz
PKT_20033452302_55555_VC03_00875.0.gz
PKT_20033452302_55555_VC03_00876.0.gz
```

3.2 Integrated Observatory Timeline

The Integrated Observatory Timeline is a text listing of the commands contained in the absolute time sequence (ATS) table loads along with predicted orbital events. ATS table loads are nominally created weekly by the MOC and contain the science timelines received from the GSSC as well as any necessary commands to operate the spacecraft bus such as transmitter on/off sequences and solid state recorder playback commands.

3.2.1 Data Format

The Integrated Observatory Timeline file is a text file that contains a tabular listing of the events and stored commands that are scheduled to occur during the specified planning period.

The Integrated Observatory Timeline file is composed of three sections:

1. Header
2. Detail List
3. Load Continuity

1. Header Section

The header section contains summary information about an ATS stored command load. The information is fairly self explanatory. See the sample file in the appendix.

2. Detail List Section

The detail list section contains a time-ordered list of the stored commands and events that are scheduled to occur during the planning period. Commands from the ATS and any RTS invoked by the ATS are included. For continuity, the list begins with the commands from the previous prime load, and ends with commands from the following prime load. The table columns are:

Column Label	Column Contents
EVENT	For events, the name of a predicted event such as SAA Entry or Ascending Node. Blank for commands.
TIME	The date and time stamp of the command or event. Format is YY DDD/HH:MM:SS
CMD #	For commands, this column contains the sequence number of the command within the load. Blank for events.
CRIT	For commands, 'Y' indicates that the command is a critical command as defined in the command database and is 'N' otherwise. Blank for events.
COMMAND	For commands, the command mnemonic. Blank for events.
SUBMNEMONICS	For commands, the command submnemonics in a comma-separated list. The submnemonic list will wrap to the next line if necessary. Blank for events.
SEQUENCE DURATION	The duration of an activity.

ATS BUFF	For commands, the ATS buffer the command is stored in (A or B). Blank for events.
TRIG/ACT/RTS NAME	This column can contain one of the following: • The name of the event trigger definition that caused the command to be scheduled. • The name of the ATS activity definition containing the command • The name of the RTS activity definition containing the command
TRIGGER/ACTIVITY/ EVENT/RTS DESCRIPTION	The comment field of the trigger, activity, event, or RTS involved with the command or event.

3. Load Continuity

This section contains information about the preceding and succeeding ATS loads. See sample file in Appendix.

3.2.2 File Name Format

`IOTL_yyyyddd_hhmmss_loadname.txt`

Where `IOTL` is fixed text identifying the file type

`yyyyddd_hhmmss` is the time of the first command in the load

`loadname` is the name used in Mission Planning System (MPS) to identify the load. The MPS user may enter any useful name. MPS defaults the name to: `SCSdddbv`

Where `SCS` is the onboard processor name

`ddd` is the day of year

`b` is the ATS buffer for the load.

`v` is the sequence number (initially 1) and is incremented, if several loads are defined for the day.

Note that the load name is not the same as the ATS load file name.

Examples:

```
IOTL_2002171_164325_SCS171B1.txt
IOTL_2002172_000000_SCS172A2.txt
```

3.2.3 Data Transfer Mechanism

The MOC will transfer the Integrated Observatory Timeline file to the IOCs and GSSC using secure shell file transfer protocol (SFTP).

3.3 Observatory Telemetry and Command Database

The Observatory Telemetry and Command Database contains the definition of telecommands, telemetry, discretes, analogs, limits, flight parameter mnemonics, and ground system parameters. Whenever a change is made to the Telemetry and Command Database following the 60-day checkout period, it is necessary to distribute the new database to the GSSC and IOCs.

3.3.1 Database Format

The Observatory Telemetry and Command Database format is controlled by the *GLAST Database Format Control Document*, 433-xxx-0001.

3.3.2 Data Transfer Mechanism

The files will be available from a directory designated on the open MOC file server. The GSSC and IOCs are notified when an updated set of database files is available. The GSSC and IOCs initiates the transfer of the files from the open server to the GSSC and IOC computer systems.

3.4 Notifications, Acknowledgements, and Dispositions

Here is a list of the notifications, acknowledgements and disposition messages (TBS)

- ToO acknowledgement is the notification the MOC has received the ToO order.
- ToO dispositions - Once a compatible SN/GN contact has been scheduled, the FOT will notify the GSSC that the load has been generated and that the load will be uplinked/executed at the scheduled time
- ToO notifications – execution notification. Upon successful uplink of the load the FOT will notify the GSSC that the ToO order has been executed
- Science Timeline acknowledgement - Acknowledgement when the MOC receives either a science timeline or an instrument command request from the GSSC

3.4.1 Data Format

TBD

The format has not been defined. It could be like the signal files or an email

3.4.2 Data Transfer Mechanism

The MOC will transfer a file to the IOCs and GSSC using secure shell file transfer protocol (SFTP) or e-mail TBD

3.5 Memory Dumps

The LAT or GBM Instrument Teams will notify and coordinate with the FOT for instrument memory dumps. The Instrument Teams will provide the procedure name and parameters to be used for the memory dump. The Instrument Teams will also provide a time frame for the dump to occur.

Each instrument will have designated APIDs, as defined in the *GLAST Telemetry and Command Handbook,* to downlink memory dump data. The MOC will create a L0 product for each requested memory dump APID and will transfer the products to the appropriate IOC.

3.5.1 Data Format

A L0 product may include several files. Each file contains ITOS packet annotation headers and the CCSDS telemetry source packets for a single APID. The L0 product format is the same format as the PDU shown in Figure 3.6-3.

3.5.2 Data Transfer Mechanism

The MOC will transfer memory dump files to the IOCs using secure shell file transfer protocol (SFTP)

3.6 Real-time Housekeeping Data

The MOC is responsible for spacecraft and instrument health and safety monitoring, as well as the verification of nominal mission execution and system status. The MOC monitors received real-time state-of-health (SOH) telemetry for out-of-limit situations, and proper spacecraft and/or instrument configuration. The MOC receives all CCSDS-compliant real-time VC0 telemetry frames from the Space Network and backup Ground Stations. The real-time VC0 telemetry data from the MOC/ITOS workstation is relayed to the LIOC as needed. The real-time data can be displayed on each science team workstation connected to the MOC ITOS workstation.

3.6.1 Data Format

All real-time data transmitted by the prime MOC/ITOS workstation is formatted into ITOS messages for transport through secure data lines to the ITOS workstations. The message format consists of an ITOS ITP message header identifying the message type and a variable-length message data field consisting of one or more packet data units (PDUs), as shown in Figure 3.6-1. The structure of the ITP message header is shown in Table 3.6-1. Quality information is appended to each CCSDS source packet to form a PDU.

MESSAGE HEADER (16 bytes)	MESSAGE DATA (variable length)

Figure 3.6-1 ITOS Message

Table 3.6-1 ITOS ITP Message Header

Field Name	Bytes	Description
Message Length	0-1	Message length, including ITP header.
Message Class	2-3	Message data class; for example: telemetry, command, etc.
Message Type	4-5	
Signature	6-7	
Message Subtype	8-11	
PDU Count	12-13	In some contexts, the number of packet data units in the message.
User Area	14-15	

ITOS will extract the CCSDS Version 1 Telemetry Source Packets from the CCSDS telemetry frames. The structure of the CCSDS Path Protocol Data Unit (CP_PDU) is shown in Figure 3.6-2.

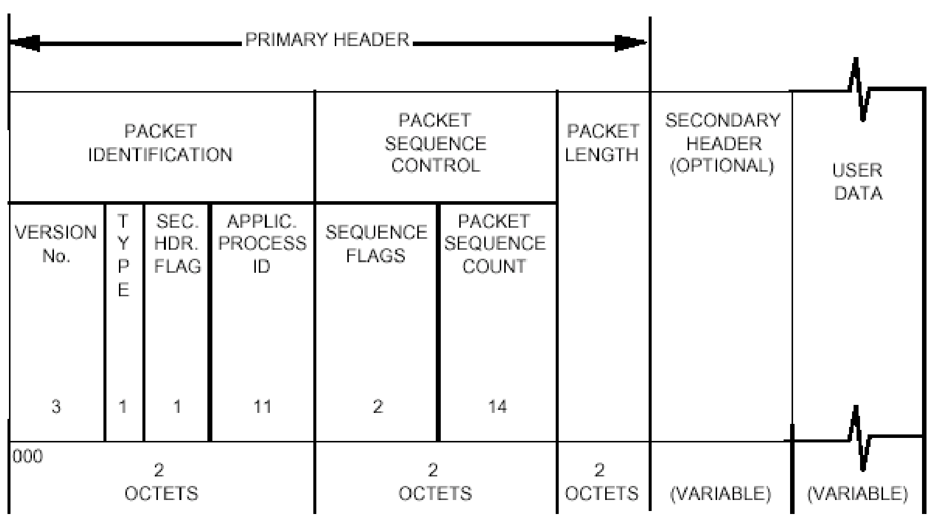

Figure 3.6-2 CCSDS Path Protocol Data Unit

The Primary Header shall consist of 6 bytes subdivided into the fields shown in Table 3.6-2. [CCSDS 701.0-B-2 (Blue Book), Section 3.3.3].

Table 3.6-2 CCSDS Primary Header Format

Field Name	Sub-Field Name	#Bits	#Bytes
Packet Identification	Version Number	3	
	Type	1	
	Secondary Header Flag	1	
	Application Process ID	11	2
Packet Sequence Control	Sequence Flags	2	
	Packet Name or Sequence Count	14	2
Packet Length		16	2
TOTAL		48	6

A single ITOS PDU, shown in Figure 3.6-3, consists of a CCSDS telemetry source packet annotated with a 12-byte quality information header.

ANNOTATION HEADER (12 bytes)	CCSDS TELEMETRY SOURCE PACKET

Figure 3.6-3 Packet Data Unit

The packet annotation header is 12 bytes in length and the format is shown in Table 3.6-3.

Table 3.6-3 Packet Annotation Header Content and Format

Field	Word (16-bit)	Bit Location	Description/Values
Frame version	1	Bits 0-1	Copied from transfer frame header
Frame spacecraft identifier (SCID)	1	Bits 2-11	Copied from transfer frame header
Frame VCID	1	Bits 12-14	Copied from transfer frame header
Reserved	1	Bit 15	
Reed-Solomon Enabled	2	Bit 0	0 = RS error detection and correction not enabled 1 = RS error detection and correction enabled
Reed-Solomon error	2	Bit 1	0 = no uncorrectable RS error detected 1 = uncorrectable RS error detected
Reed-Solomon corrected	2	Bit 2	0 = no RS error detected 1 = RS corrected one or more error
Reserved	2	Bit 3	
Time format	2	Bits 4-7	Defines time code format.
Packet header error	2	Bit 8	0 = packet from frame without CRC error 1 = packet from frame with CRC error
Data direction	2	Bit 9	0 = data received in forward order

Field	Word (16-bit)	Bit Location	Description/Values
			1 = data received in reverse order
Packet sequence error	2	Bit 10	0 = no discontinuity found in packet sequence count 1 = this packet's sequence count not successor of previous packet with same APID on same VC
Frame CRC error	2	Bit 11	0 = no CRC error detected 1 = CRC error detected in one or more frames from which this packet is extracted
Frame error checking enabled	2	Bit 12	0 = frame error checking not enabled 1 = frame error checking enabled
Incomplete packet	2	Bit 13	0 = packet is complete 1 = packet is incomplete and filled to specified length (see "location of fill")
VC sequence error	2	Bit 14	0 = no discontinuity found in frame VC sequence count 1 = Transfer frame's VC sequence count is not successor of previous frame on same VC
Frame header error	2	Bit 15	0 = no error 1 = SCID or transfer frame version was not the expected value
Location of fill	3	Bits 0-15	0 to 65,535 (unsigned value); identifies first byte of fill data in byte offset from end of packet primary header
Ground receiving time	4-6	Bits 0-15	Local processing time in format defined in "time format", word 2, bits 4-7 above

3.6.2 Data Transfer Mechanism

Real-time telemetry packet data formatted into ITOS messages will be transmitted from the MOC/ITOS workstation over a TCP/IP socket connection to remote ITOS workstations.

3.7 MOC Command Logs

3.7.1 Data Format

The logs are ASCII text files output from the ITOS system. They are readable with a text editor.

3.7.2 Data Transfer Mechanism

The MOC will transfer command log files to the GSSC and IOCs using secure shell file transfer protocol (SFTP)

3.8 *Flight Dynamics Orbital Products*

3.8.1 TDRSS Ephemerides

The TDRSS ephemeris product provides the position and velocity vector for a TDRS updated every minute.

3.8.1.1 Data Format

Line 1: Field Headings:
`"Time (UTCJ4)","x (m)","y (m)","z (m)","vx (m/sec)","vy (m/sec)","vz (m/sec)"`
Line 2 and so forth:

The lines will have the following fields that are space delimited:
Field 1: Day of year and year: ddd/yyyy
Field 2: Time of day: HH:MM:SS.ss
Field 3: X position in meters
Field 4: Y position in meters
Field 5: Z position in meters
Field 6: X velocity vector in meters/second
Field 7: Y velocity vector in meters/second
Field 8: Z velocity vector in meters/second

Satellite positions are in meters using the J2000 Earth-Centered Internal (ECI) coordinate system.

3.8.1.2 File Name Format

*TDRSid*_EPH_*yyyyddd*_*yyyyddd*_*vv*.txt

where *TDRSid* is the TDRS ID: TDE, TDW, TDS, etc
yyyy is the 4-digit year
ddd is the 3-digit day of the year (001 – 366)
vv is a version number

The two dates indicate the start and end dates of the ephemeris data contained in the file.

The version number (initial version is 00) is incremented for subsequent versions of the file generated for the same time range of data.

```
Example:
TDE_EPH_2003202_2003214_00.txt
```

3.8.1.3 Data Transfer Mechanism

TBD
The MOC will transfer command log files to the GSSC and IOCs using secure shell file transfer protocol (SFTP)

3.8.2 GLAST Ephemerides

This section describes the format of the ephemeris file generated by Satellite Tool Kit (STK). The ephemeris file is used to determine orbital constraints for scheduling observations.

3.8.2.1 Data Format

Line 1: Field Headings:
"Time (UTCJ4)" "x (km)" "y (km)" "z (km)" "Lat (deg)" "Lon (deg)" "RightAscension (deg)" "Declination (deg)"
Line 2 and so forth:
The lines will have the following fields that are space delimited:
Field 1: Day of year and year: ddd/yyyy
Field 2: Time of day: HH:MM:SS.ss
Field 3: Satellite X position in kilometers
Field 4: Satellite Y position in kilometers
Field 5: Satellite Z position in kilometers
Field 6: Latitude in degrees
Field 7: Longitude in degrees
Field 8: Velocity vector Right Ascension (RA), J2000, in degrees
Field 9: Velocity vector Declination (DEC), J2000, in degrees

Satellite positions are in kilometers using the J2000 Earth-Centered Internal (ECI) coordinate system

3.8.2.2 File Name Format

`STK_EPH_`*`yyyyddd`*`_`*`yyyyddd`*`_`*`vv`*`.txt`

Where: *yyyy* is the 4-digit year
ddd is the 3-digit day of the year (001 – 366)
vv is a version number

The two dates indicate the start and end dates of the ephemeris data contained in the file.

The version number (initial version is 00) is incremented for subsequent versions of the file generated for the same time range of data.

3.8.2.3 Data Transfer Mechanism

The MOC will transfer command log files to the GSSC and IOCs using secure shell file transfer protocol (SFTP).

3.9 As-Flown Timeline

Periodically, the MOC Timeline Monitor software extracts actual observation times and attitude data from new SSR (Solid State Recorder) data. An As-Flown Timeline will be created to reflect this sequence of events.

3.9.1 Data Format

The As-Flown Timeline will be an ASCII file in columnar format with '|' separators. A sample file format is shown in Table 3-7.

Table 3-7 As-Flown Science Timeline Format

Column	Description	Format
1	GMT Time of event	`YYYY-DDD-HH:MM:SS.ssssss`
2	Type of event	Text: *Observation mode = rocking, nadir, inertial point, etc.* *AR = Autonomous Repoint* *ToO = Target of Opportunity* *SAA=entry or exit* *Yaw flip* *Safe Hold = Spacecraft in Safe Hold mode* *No ACS Data = Gap in ACS data, unable to determine* [The types are dependent upon the information available in the telemetry.]
3	Begin or End of event	Text: Begin or End
4	RA of s/c boresight in degrees decimal.	Floating point (64-bit) – Optional depending on event type
5	DEC of s/c boresight in degrees decimal	Floating point (64-bit) – Optional depending on event type
7	Remarks	Text

3.9.2 File Name Format

The As-Flown Timeline file naming convention will be as follows:

AFST_*YYYYDDDhhmm*_*YYYYDDDhhmm*_*VV*.txt

where:

AFST is a fixed field indicating that the file is an As-Flown Timeline file
YYYYDDDhhmm is the start and end timeframe covered within the file where:
- *YYYY* is the calendar year
- *DDD* is the day of year
- *hh* is the hour
- *mm* is the minute

VV is a two-digit version number incrementing from 01
.txt is an extension to indicate this is a text file

3.9.3 Data Transfer Mechanism

The MOC will transfer the As-Flown Timeline files to the GSSC and IOCs using secure shell file transfer protocol (SFTP).

3.10 Anomaly Reports

The MOC will notify the GLAST Instrument Teams and GSSC after any spacecraft or instrument anomaly. This notification shall consist of e-mail dispatches from the Spacecraft Emergency Response System (SERS) TBD anomaly-reporting software. The MOC will notify the Instrument Teams by voice for any significant instrument anomaly, as specified in contingency response plans. As MOC resources allow, the MOC may provide the GLAST Instrument Teams with more detailed status updates during the anomaly resolution process. Subsequent anomaly status updates may also be posted on the GLAST Web page.

3.11 Data Analysis and Remote Access

The Instrument Teams provide sustaining engineering support during the mission. Remote access to the MOC archive data allows the Instrument Teams to review instrument housekeeping data, analyze L0 science data, and perform trending of selected subsystem parameters. The Data Trending and Analysis System (DTAS) provides the capability for the user/client to view plots and tables of the housekeeping and trend data and save these products to a file. Each Instrument Team will have the DTAS client application software installed on a user workstation using an install shield that can be downloaded via the MOC web site. The client application consists of a Trending Tool and an Analysis Tool. The Trending Tool allows a user to plot individual mnemonics vs. time including min, max and mean. The Analysis Tool allows the user to view tables, plots, statistics and compare data. Additional details of the DTAS capabilities can be found at:

`http://radlab.gsfc.nasa.gov/DTASHome.html`

The Instrument Teams may also view real-time telemetry during a pass via ITOS Java display pages over the internet. The remote user accesses the pages via a web browser. The MOC open server hosts a web server that will be used to service the instantiation of an ITOS Java client initiated by a remote instrument engineer. The ITOS Java client script is responsible for launching the ITOS Java client when initiated to do so by a remote instrument engineer. Once the ITOS Java client is launched it makes a socket connection to the ITOS Datapoint server. The ITOS Java client script is GOTS software and merely needs to be installed on the target platform in the proper directory.

3.12 Requested TDRSS Contact Schedule

The MOC provides the GSSC with a copy of the TDRSS contact requests made to Data Services Management Center (DSMC) several weeks before the start time of science activity timeline. See Appendix X for details of the science scheduling flow. The requests define the time ranges when the MOC will would like to have TDRSS contacts. The time ranges are based in part on the spacecraft attitudes indicated in the preliminary science activity timeline. The requested TDRSS contact schedule spans 7 days (Monday thru Sunday). Spacecraft attitude can affect whether the spacecraft can contact a particular TDRS. The TDRSS contact requests are used by the GSSC when updating the preliminary science activity timeline. No changes can be made to the science activity timeline that will affect the spacecraft attitude during the requested TDRSS contact times.

3.12.1 Data Format

The file consists of ASCII text records. Each record defines a window in which TDRS contact is desired. The fields in the record are separated by commas. The file may contain blank lines or comment lines. Comment lines will have a number sign (#) in the first character. The fields relevant to science planning are Start Time, and Stop Time. The other fields are used by components of the MOC

Field Name	Description	Valid Values
TDRS	TDRS set name	3 alphanumeric characters, e.g. TDE, TDS
Priority	Indicates relative priority for this	“1” is the highest priority, “9” is

Field Name	Description	Valid Values
	event.	the lowest.
Service Specification Code (SSC)	Specifies the requested service configuration	3 alphanumeric characters, e.g. A02
Service Type	Type of antenna service requested	3 alphanumeric characters, eg. MAF, MAR
Start Time	Time of the beginning of the window	YYYY/DDD-HH:MM:SS
Stop Time	Time of the end of the window	YYYY/DDD-HH:MM:SS
Minimum duration	Minimum contact duration to be scheduled with in the window	HH:MM:SS This value must be less than or equal to the difference between Start Time and Stop Time

Example:

```
TDE, 5, A02, MAF, 2007/123-10:00:00, 2007/123-11:00:00, 00:20:00
```

3.12.2 File Name Format

TSR_*yyyyddd*_*vv*.txt

where TSR is fixed text indicating that this is a TDRSS schedule request file.

yyyyddd indicates the first day of the scheduling period.

vv indicates the file version. Normally, this is 00. The version is incremented by 1 when additional request files for the same time period are generated.

txt is fixed text extension indicating that the file contains ASCII text

Example:
TSR_2007123_00.txt

3.12.3 Data Transfer Mechanism

The MOC will transfer files to the GSSC and IOCs using secure shell file transfer protocol (SFTP)

3.13 TDRSS Forecast Schedule

The MOC provides the GSSC with a copy of the TDRSS forecast schedule received from DSMC several days before the start time of the science activity timeline. See Section X for details of the science scheduling flow. The TDRSS forecast schedule is used by the GSSC when creating the refined final science activity timeline. No changes can be made to the science activity timeline that will affect the spacecraft attitude during the scheduled TDRSS contact times.

3.13.1 Data Format

Refer to SWSI Users Guide, NCC Active Schedule File (or SNAS User Guide)

3.13.2 File Name Format

OPS_NCC_*sic*_asf_*yyyydddhhmmss*.txt

where sic is the GLAST support identification code
yyyydddhhmmss is the creation time of the file as year, day of year, hour, minutes, seconds

Example:
OPS_NCC_3782_asf_2002365030040.txt

3.13.3 Data Transfer Mechanism

The MOC will transfer files to the GSSC and IOCs using secure shell file transfer protocol (SFTP)

3.14 Status Reports

The MOC provides daily status reports on command and telemetry processing activity.

3.14.1 Data Format

TBD

3.14.2 File Name Format

TBD

3.14.3 Data Transfer Mechanism

The MOC will transfer status report files to the GSSC and IOCs using secure shell file transfer protocol (SFTP)

4.0 IOC and GSSC Products

Tables 4-1, 4-2, and 4-3 summarize all of the products transferred from the GSSC, LIOC, and GIOC to the MOC. Appendix A provide samples of each product. The following subsections provide more detail on each product's content and attributes.

Table 4-1 Products from GSSC to MOC

Product	Primary or Backup Interface	Section
Data Retransmission Requests	Primary	4.1
Instrument Memory Loads and Commands (LAT and GBM)	Primary	4.2
SAA Defintion Updates	Primary	4.10
Science Activity Timelines	Primary	4.4
ToO Orders	Primary	4.5

Table 4-2 Products from LIOC to MOC

Product	Primary or Backup Interface	Section
Data Retransmission Requests	Primary	4.1
LAT Anomaly Incident Reports	Primary	4.6
LAT FSW Loads	Backup	4.2
LAT Instrument Loads and Commands	Backup	4.3
LAT Instrument Procedures	Primary	4.7
LAT Telemetry and Command Database Updates	Primary	4.8

Table 4-3 Products from GIOC to MOC

Product	Primary or Backup Interface	Section
Data Retransmission Requests	Primary	4.1
GBM Anomaly Incident Reports	Primary	4.6
GBM FSW Loads	Backup	4.2
GBM Instrument Loads and Commands	Backup	4.3
GBM Instrument Procedures	Primary	4.7
GBM Telemetry and Command Database Updates	Primary	4.8

4.1 Data Retransmission Requests

4.1.1 Data Format

Level 0 Data Sets are available on the MOC open server for 7 days following downlink of the data, after which they are deleted from the system. However, the raw telemetry files are retained for the life of the mission. They may be used to regenerate the Level 0 data sets on request. Requests for regeneration of Level 0 Data sets are sent to the FOT and specify the following information:

1. Time range of interest
2. VC numbers

Once the Level 0 Data Sets are recreated, the GSSC/IOCs may retrieved them as usual. (Section 3.1)

4.1.2 Data Transfer Mechanism

Requests for regeneration of Level 0 Data sets are made via email or fax to the FOT.

4.2 Instrument Flight Software Memory Loads

The MOC T&C system provides an uplink capability for sending to the spacecraft a file of data in a stream of telecommands.

The load files are required to be properly formatted and consist mainly of the data to be loaded, in ASCII hexadecimal notation. Along with the data, the load file contains information on what spacecraft commands must be sent to prepare for the load, to carry the load data, to commit the load, and additional information on command formatting.

A file containing ancillary data is also transmitted with the load file. This file is also called the load wrapper. This file contains support information for the load including the MD5-format checksum value, a description of the purpose of the load and any constraints on the uplink such as uplink time.

4.2.1 Data Formats

4.2.1.1 Load File Format

A properly formatted load file from a binary data file can be created using the ***make_load_file*** program supplied by the MOC. This formatted file is sent to the spacecraft using the ***load*** STOL directive. The ***load*** directive creates a formatted image load file and uplinks it to the spacecraft.

Two examples of load files are shown below. Note: The *smtblload*, *smtblcommit*, *smtblselect*, and *uvotload* were specified in other mission databases. Corresponding commands will be defined in the GLAST database.

Example 1:

```
Table Load
WIRE,TB145,98-133:05:40:05,001,I&T,00C8,UI
/SMTBLSELECT TABLEID=145, SRCZERO, DESTRAM
/SMTBLLOAD OFFSET=H'0'
```

```
/SMTBLCOMMIT CKENABLE, CHECKSUM=H'E0C3'
;
;
X385F12B5 ; Timestamp
;
X 00 04 00 02 99 C9 42 6F 11 F6 3F EE 87 0F 74 30;
X E3 A8 3F D5 14 7B 47 AE 7A E1 3F 84 A9 FC D2 F1;
X 62 4D 3F 60 7E FA BC 6A 93 74 3F 58 00 00 00 00;
...
X 00 00 00 00 00 00 00 00 00 00 00 00 00 00 99 9A;
X 99 99 99 99 3F F1 33 32 38 3F 6B 10 3F 09 33 32;
X 38 3F 6B 10 3F 09 00 0A 00 00;
;
```

Example 2:

```
Code load
UVOT,OPER,2000.11.29-13:00:00,001,I&T,002e,U12,2
/NOSELECT
/UVOTLOAD OFFSET=H'14',mid=4
/NOCOMMIT
X 006d 0001 0000 3800 00e6 85d0 2a5f
X 8320 0906 b122 4820 400e 4800 4009 8520
X dd40 4820 2000 4810 2002 b700 0d00 0d02
X 0d04 85f0 fd00 81ef b122 8510 383b b100
```

In a load file, comments begin with either semi-colon (;) or hash (#) and continue to the end of the line. Blank lines and lines containing only comments are ignored.

The first non-blank, non-comment line is the abstract record; this is copied to the formatted image load file but otherwise ignored. It is intended as a comment to identify the load.

The second line is the mission information line, which consists of several comma-separated fields:

Mission Information Line	
mission name	This field is ignored by the ITOS ***LOAD*** directive.
image ID	This field is ignored by the ITOS ***LOAD*** directive.
date	Copied to the formatted image load file but otherwise ignored.
version	This field is ignored by the ITOS ***LOAD*** directive.
source	This field is ignored by the ITOS ***LOAD*** directive.
packet size	Maximum packet size. When the ***LOAD*** directive formats the raw image load file into packets, this is the maximum number of data bytes in each packet.

swap	Indicates whether or not the ***LOAD*** directive should swap bytes when generating the formatted image load file. Valid values for the swap field are: `SWAPBYTES` and `NOSWAP`. Use `NOSWAP` because the GLAST spacecraft does not swap bytes. See Note 1.- Why swap bytes?

data size	This is an optional field which gives the size in bytes of data items being loaded. It may be set to `1', `2', or `4'. This option controls how the load program sets the *ADDRESS* or *OFFSET* and *NUMBYTES* fields in the load command. It serves as a divisor for those field values, which normally are set with respect to bytes; that is, byte addresses and byte counts, respectively. Set the data size to 2, and the command fields are set with respect to 16-bit words; set it to 4, and they are set with respect to 32-bit words. In other words, if this field is set to 2, the *ADDRESS* field is calculated to be a 16-bit word address, and *NUMBYTES* is the number of 16-bit words in the data field of the load command. (It really represents *numwords* in that case, though its name still is *NUMBYTES*.)
	
	Consider the load:
	
	`Code load`
	`UVOT,OPER,2000.11.29-13:00:00,001,I&T,002e,U12,2`
	`/NOSELECT`
	`/UVOTLOAD OFFSET=H'14',mid=4`
	`/NOCOMMIT`
	`X 006d 0001 0000 3800 00e6 85d0 2a5f`
	`X 8320 0906 b122 4820 400e 4800 4009 8520`
	`X dd40 4820 2000 4810 2002 b700 0d00 0d02`
	`X 0d04 85f0 fd00 81ef b122 8510 383b b100`
	
	for which the load command is defined as follows:
	
	`cmd¦uvotload¦+¦0x662¦0¦¦¦¦¦¦¦¦¦"test load command"`
	`fld¦uvotload¦mid¦+¦u12¦¦8¦¦¦¦¦¦"memory bank ID"`
	`fld¦uvotload¦offset¦+¦u1234¦¦10¦¦¦¦¦¦"load address"`
	`fld¦uvotload¦numbytes¦+¦u12¦¦14¦¦¦¦¦¦"count of load data bytes in this cmd"`
	`fld¦uvotload¦data¦+¦u12¦¦16¦¦¦¦¦¦"load data starts here"`
	
	This results in the following two load commands. Note the fields, which are the 4-byte *OFFSET* and 2-byte *NUMBYTES* fields:
	
	`/LOAD: 004E004302C1 1E62C0000037`
	`00000004000000140017006D00010000380000`
	`E685D02A5F83200906B1224820400E480040098520DD404820200048102 0`
	`02B7000D000D02`
	`/LOAD: 004E002503C1 1E62C0000019`
	`000000040000002B00080D0D85F0FD0081EFB1 228510383BB100`

Note 1 - Why swap bytes? <This note will disappear when we confirm that GLAST will not be using byte swapping during the load process.>	

Some spacecraft (TRACE and WIRE, for example) ingest loads as a sequence of 16-bit little-endian words, which is fine if the load is such a sequence. For an arbitrary sequence of bytes, however, this results in each pair of bytes being swapped.

An example might make this clearer:

Suppose we want to load a simple eight byte table so that the byte at the load offset plus zero is 0x00, the byte at load offset plus one is 0x11, the byte at load offset plus two is 0x22, and so on. A load file in the `correct' byte order would contain:

```
X 00 11 22 33 44 55 66 77
```

However, this must get transmitted as

```
1100332255447766
```

in order for the spacecraft to store the data in memory correctly. (Remember, the spacecraft reads this load as the `words' 1100, 3322, 5544, and 7766. The spacecraft is little-endian, so when it writes these words to RAM they will end up in the proper order, 0011223344556677.)

The third line is the ***select*** command. The ***select*** command is defined using the STOL command syntax. If the load does not need a select command, the string NOSELECT is used as a placeholder.

The fourth line is the ***load*** command. The ***load*** command, not to be confused with the STOL ***load*** directive, is defined using the STOL command syntax. The ***load*** command is the command that contains the load data to be uplinked. The load data is supplied in the load file following the ***commit*** command.

Three ***load*** command fields are treated specially by the load software:

DATA – A *load* command is required to have a field named *DATA*. This field serves only to mark the beginning in the packet of the start of the load data, which continues to the end of the packet.

ADDRESS or OFFSET - A load command may have a field giving the address to which the portion of the load contained with any given command should be loaded. If the *load* command has a field named either *ADDRESS* or *OFFSET*, the load program will increment that field according to the *data size* element in the mission information line. If *ADDRESS* or *OFFSET* is specified in the load command in the load file, then this field gives the starting address for the load.

NUMBYTES - A load command also may have a field named *NUMBYTES*, which gives the number of bytes (or words or longwords, according to *data size*) contained in the load command. If this field is defined, the load program will set it accordingly in each load command.

The fifth line is the ***commit*** command. The ***commit*** command defined using STOL directive syntax. This command will be placed at the end of the formatted load so that it is uplinked after the load commands. If this load does not require a ***commit*** command, use the string NOCOMMIT as a placeholder.

The rest of the file is the load data, in hexadecimal notation. Load data lines optionally begin with X, and must contain an even number of hexadecimal characters.

4.2.1.2 Ancillary Data File

The ancillary data file accompanies each load file transferred to the MOC. This file contains support information concerning the load. The file format is TBD. The only fields that are required for MOC usage are:

- MD5 message digest value. The MD5 value for the load file is recomputed by the MOC and compared with the value sent in the Ancillary Data File. The MD5 value is computed using the md5sum application available from the GNU Project, http://www.gnu.org/software/textutils/textutils.html or similar application.
- Load File Name. This is another means to connect the load file with the ancillary data file.

4.2.2 File name format

The load file name convention is:

`III_`*`yyyyddd.vv`*

where *`III`* is either LAT for LAT table loads or GBM for GBM table loads.
`yyyyddd.vv` is the creation time of the file as year, day of year, and version number. The version number is initially 00.

Example:
`GBM_2007123.00`

Ancillary Data File name convention is

`loadfilename``_adf.txt`

`where` *`loadfilename`* is the name of the load file associated with this ancillary data file

`adf` is fixed text identifying this file as an ancillary data file
`.txt` is an extension to indicate this is a text file

Example:
`GBM_2007123.00_adf.txt`

4.2.3 Data Transfer Mechanism

The load files and ancillary files will be transferred to the GSSC and then to the MOC. Protocol TBD.

4.3 Instrument Commands

4.3.1 Data Format

TBD

4.3.2 Data Transfer Mechanism

TBD

4.4 Science Activity Timelines

During the science planning process, the GSSC shall produce a Science Activity Timeline spanning at least 7 days. To accommodate TDRSS scheduling, two versions of the timeline are produced:

1. Preliminary Science Activity Timeline
2. Final Science Activity Timeline

The Preliminary Science Activity Timeline is provided several weeks in advance of the timeline start. It reflects the current science plan. The MOC uses the spacecraft attitudes indicated in this version of the timeline to determine when to request TDRSS contact times. A few days before the timeline start, the GSSC will transmit the Final Science Activity Timeline. It is a refinement of the Preliminary Science Activity Timeline. Both files have the same format and are transmitted to the MOC in the same manner. Refer to section X for a detailed description of the Scheduling Flow.

4.4.1 Data Format

The science activity timeline file contains:
1. One header record
2. One or more command records

All non-comment records are terminated by a semicolon, thus records can span lines in the file.

The time format used for all times in the science activity timeline file is:
Absolute: YYYY/DDD:HH:MM:SS example 2003/116:12:20:20
Relative [-] [YD/] DDD:HH:MM:SS example -20:12:20:20

Header:

Field	Type	Description
filename	string	the name of this file (Required)
creation time	absolute time	the date and time that this file was created (blank is accepted)
mission identifier	string (e.g., GLAST)	mission name (blank is accepted)
originator	string	name of person or organization who prepared the timeline (blank is accepted)
project database version	string	version number of the command database that the command definitions came from (blank is accepted)
destination processor	string (SCP)	name of the spacecraft processor that will execute the commands (blank is accepted)
start time	absolute time	time tag of the first command (Required)
stop time	absolute time	time tag of the last command. must be greater than start time (Required)
execute flag	string	not used by MPS (blank is accepted)
timeline type	string	not used by MPS (user defined content)
version number	string	not used by MPS (user defined content)
reference timeline file name	string	not used by MPS (user defined content)
comment	string	user defined

For example,
```
G06123REGOTL.00,2006/122:10:23:45,GLAST,GIOC,1.00,SCP,2006/123:00:00:00,2006/130:23.59.59,,,00,,mm;
```

Comments
All characters on a line following two slash characters (//) are ignored. Comments may not start within a command or activity reference. Comments may occur with in an event trigger record between commands, but readability can suffer.

Command Records

The command records can be:
1. absolute time command
2. absolute time activity
3. event trigger

1. Absolute time command

```
abstime CMD mnemonic (submnemonic=value, submnemonic2=value2, … );
```

Where *abstime* is the execution time of this command as an absolute time (UTC).
Where *mnemonic* is a command mnemonic. The command must be defined in the mission's command database. If required, the submnemonics are assignments are given as a comma-separated list within parentheses.
Spaces are allowed anywhere between elements.

2. Absolute time activity reference

```
abstime ACT activity (parameter=value, parameter2=value2, … );
```

Where abstime is the start time of this activity as an absolute time (UTC).
Where activity is an activity name. The activity must be defined in the MPS activity dictionary. If required, the activity parameter assignments are given as a comma-separated list within parentheses.

3. Event Trigger Record

The event trigger enables the scheduling of commands relative to a predicted event. Relative-time-tagged commands and activity references must follow an event trigger record.

IF (*eventtype condition*) THEN AT *edge* DO *relcommands* ;

Where *eventtype* is an MPS event type (The event types are mission specific but can include orbital events such as SAA, APOGEE, ASCENDING NODE, ECLIPSE as well as Pass events.)

Where *condition* is an optional expression that specifies which particular events of that event type are to trigger the commands. The expression is in terms of the event attributes. For example, IF PASS (STATIONID == GN_MAL01). The expression can contain the logical operators NOT and AND (! and &&).

Where *edge* is START or STOP. Indicates for duration events whether to schedule the commands relative to the beginning of the event or to the end. Non-duration events (instantaneous events) use START.

Where *relcommands* is a comma-separated list of relative-time-stamped commands or activity references.

Examples:

```
IF (SAA) THEN AT START DO
 +000:00:00:00 ACT ENTERSAA;
IF (ECLIPSE) THEN AT STOP DO
 +000:00:00:00 ACT EXITUMBRA ,
//  Set instrument mode
 +000:00:04:30 CMD ICTERM (ITERM=7, DTERM = -7) ,
 +000:00:05:00 CMD  SCNOOP;
```

a. Relative time command

reltime CMD *mnemonic* (*submnemonic*=*value*, *submnemonic2*=*value2*, …)

Where *reltime* is the execution time of this command as a time offset from the trigger event
Where *mnemonic* is a command mnemonic, if required, the *submnemonic* assignments are given as a comma-separated list within parentheses.

b. Relative time activity reference

reltime ACT *activity* (*parameter*=*value*, *parameter2*=*value2*, …)

Where *reltime* is the start time of this activity as a time offset from the activity start.
Where *activity* is an activity name. The activity must be defined in the MPS activity dictionary. If required, the activity *parameter* assignments are given as a comma-separated list in parentheses. (Note: RTS activities do not have parameters.)

4.4.2 File Name Format

TBD

As an example, current format accepted by the MPS is:

G*yydddxxxxxx.v*

Where G is the mission identifier (G for GLAST)
yyddd is the initial date of the timeline
yy is the 2-digit year (minus the century)
ddd is the day of year
xxxxxx is used to identify different types of timelines.
PREOTL for the preliminary science activity timeline
FINOTL for the final science activity timeline

`v` is an optional version number for the case that more than one timeline is created for the same initial date

[Is it expected that the MPS will be modified to accept the file name format decided upon by the MOC and Science Teams. The other files produced by the MOC have a 3 or 4 digit product id, a date stamp or date range and a version number. e.g., `PPST_2004123_2004130_00.txt`]

4.4.3 Data Transfer Mechanism

The GSSC and IOCs will transfer science timeline files MOC to the using secure shell file transfer protocol (SFTP).

4.5 ToO Orders

ToOs orders are submitted to the MOC from the GSSC specifying the ToO to be executed. The MOC acknowledges receipt of each ToO order within an hour (TBR), and will inform the GSSC of the status of execution of the ToO Order within 24 hours. An electronic log is also maintained showing all ToOs orders received and their disposition. The GSSC will be notified via e-mail for each ToO.

4.5.1 Data Format

TBD
What are the subfields of the ToO command? The FOT will execute ToO execution proc and input the requested subfields.

4.5.2 Data Transfer Mechanism

TBD
Should this be a file? e.g., a PROC containing at calls the ToO execution proc with the appropriate subfield values. GSSC can ftp this proc and the MOC software can notify the FOT of its arrival. Feedback of receipt can be included in this process. Issues include approvals and uplink times and whether new contacts need to be scheduled to support the ToO uplink. Adding PROC to pass plan.
Could this be a fax or email? Issues: feed back e.g. phone call to GSSC on receipt. Rekeying errors

4.6 Anomaly Incident Reports

The MOC would like access to or copies of documented instrument anomaly/incident reports.

4.6.1 Data Format

Depends upon the anomaly/incident tracking system used by the IOCs.

4.6.2 Data Transfer Mechanism

TBD

May be a link or courtesy copy of the anomaly/incident report.

4.7 Instrument Procedures

4.7.1 Data Format

TBD

4.7.2 Data Transfer Mechanism

TBD

4.8 Telemetry and Command Database Updates

4.8.1 Data Format

The Observatory Telemetry and Command Database format is controlled by the *GLAST Database Format Control Document*, 433-xxx-0001.

4.8.2 Data Transfer Mechanism

TBD

4.9 Status Reports

The GSSC, GIOC, and LIOC provide daily status reports on file processing activity. These reports include IOCs Operation Status Reports, Insturment Status, and forecast of activities.

4.9.1 Data Format

The reports consist of ASCII text.

4.9.2 File Name Format

TBD

4.9.3 Data Transfer Mechanism

TBD

4.10 South Atlantic Anomaly Definition Update

The spacecraft has a stored definition of the South Atlantic Anomaly region (SAA). The region is specific to each instrument and is used to alert the instruments when they are entering or exiting the SAA so they may take appropriate action. It may be necessary to update the SAA definition throughout the mission to account for orbit altitude or changes in the instrument. Updates to the SAA region for each instrument are forwarded to the GSSC. The GSSC forward the SAA regions for both instruments to the MOC. In addition to uplinking the new SAA data to the observation, the MOC uses the data in its planning software. The MOC will coordinate the uplink time with the instrument team and GSSC to ensure each update their ground software with the new definition at the time the change is made to the observatory.

4.10.1 Data Format

TBD – The exact format of the file or command needed by the spacecraft is not yet known in the MOC. It may be a series of parameter commands or a small file upload.

4.10.2 File Name Format

TBD -

4.10.3 Data Transfer Mechanism

The GSSC will transfer SAA definition updates to the MOC using secure shell file transfer protocol (SFTP)

APPENDIX A: Product Examples

Sample Science Activity Timeline (TBR)

Sample science timeline from TRACE

```
T00340REGOTL   ,        2000:339:17:28:27,TRACE, EOF, 0.0, SCS,
                        2000:340:00:00:00, 2000:341:00:00:00,
                         , ,  1, ,
                        Regular timeline for 2000.12.05_00:00:00;
// TRACE Science Timeline for 2000.12.05_00:00:00
// Created: Mon Dec  4 17:28:27 2000
// TIM File: /tsw/obs/timeline/T00340TIMFIL.02
IF (FULLSUN) THEN AT START DO
    +000:00:07:00 ACT ECLIPSEEXIT;
IF (FULLSUN) THEN AT STOP DO
    -000:00:08:00 ACT ECLIPSEENTRY;

2000:340:00:00:03    CMD ICDPMLM (SEG=0X1000,
                            OFFSET=0XFF04,  NUMBYTES=2,
                            WORD1=0X0265);             //! PNT  top3.pos1 557 - 214
//! 2000:340:03:59:00 station pass, duration=12 minutes
//! 2000:340:05:35:00 station pass, duration=12 minutes
2000:340:06:00:03    CMD ICDPMLM (SEG=0X1000,
                            OFFSET=0XFF04,  NUMBYTES=2,
                            WORD1=0X0165);             //! PNT   top3.pos1 622 - 218
```

Sample Integrated Observatory Timeline File

```
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
                                                                    SWIFT Release 1 INTEGRATED PRINT
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
LOAD NAME: SCS330B2                                        LOAD PERIOD START: 2001 330/00:00:00                        TIME FIRST ATS COMMAND: 2001 330/00:00:04
LOAD GENERATION ERRORS: 0                                  LOAD PERIOD STOP:  2001 330/23:59:59                        TIME LAST  ATS COMMAND: 2001 330/23:59:59
CHECKSUM: 00000fd0                                         TIME LOAD   GENERATED: 2001 319/21:52:48                    BUFFER AUTOSWITCH: Yes
LOAD SIZE: 114                                             TIME REPORT GENERATED: 2001 319/21:55:05                    TIME BUFFER SWITCH COMMAND: 2001 330/23:59:59
BYTES FREE IN BUFFER: 34886                                LOAD STATUS: Alternate TYPE: Command                        TIME FIRST RTS COMMAND: No RTS Commands
NUMBER OF LOAD COMMANDS: 1                                 PREVIOUS LOAD: SCS329A1                                     TIME LAST  RTS COMMAND: No RTS Commands
NUMBER OF CRITICAL COMMANDS: 0                             NEXT LOAD:     No Next Prime Load                           FIRST COMMAND NUMBER: 1
ATS LOAD UPLINK WINDOW START: 2001 329/00:00:00            PREV LOAD BUFFER: A                                         LAST  COMMAND NUMBER: 5
ATS LOAD UPLINK WINDOW STOP:  2001 330/00:00:04            THIS LOAD BUFFER: B                                         NUMBER OF RTS TABLES USED: 0
TOTAL COMMANDS: 5                                          NEXT LOAD BUFFER:                                           ORBIT VECTORS: None

SELECT COMMAND: SMTBLSELECT TABLEID=65,SOURCE_TABLE=SRCZERO,DEST_TABLE=DESTSRAM                                            FOT: : :  [01-319-16:52:48]
COMMIT COMMAND: SMTBLCOMMIT SELECT=CKENABLE,CHECKSUM=4048                                                                  FOT: : :  [01-319-16:52:48]
OUTPUT FILES:                                              INPUT FILES:
T01330SLTN65.00 2001 319/21:52:48                          prime.con 2001 318/08:54:21
T01330SCTN65.00 2001 319/21:52:48                          prime.evt 2001 318/15:44:05
                                                           triggers 2001 318/17:24:29
                                                           dictionary 2001 319/10:19:55
                                                           cdb.current 2001 318/09:05:26
                                                           PPST_20013291334_20013301200_01.txt
RTS LOADS REQUIRED FOR UPLINK
LOAD NAME                     UPLINK WINDOW
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Error Messages:
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
Informational/Warning Messages:
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
                                                                      SWIFT Release 1 INTEGRATED PRINT
                             CMD                                                                                    SEQUENCE  ATS  TRIG/ACT/RTS  TRIGGER/ACTIVITY/EVENT/RTS
EVENT        TIME             #   CRIT COMMAND      SUBMNEMONICS                                                    DURATION  BUFF NAME          DESCRIPTION
------------------------------------------------------------------------------------------------------------------------------------------------------------------------------
             01 329/16:34:15  4     N  FOPPTREQUEST OBSERVATION_ID=0x02000135,MERIT=0.5,RA=123.45,                             A   TargetTrigger
                                                    DEC=15.23,ROLL=105.1,BAT_MODE=0x0000,XRT_MODE=1,
                                                    UVOT_MODE=2
             01 329/17:34:15  5     N  FOPPTREQUEST OBSERVATION_ID=0x03000134,MERIT=0.99,RA=23.45,                             A   TargetTrigger
                                                    DEC=-5.23,ROLL=5.1,BAT_MODE=0x0000,XRT_MODE=1,
                                                    UVOT_MODE=2
             01 329/18:34:15  6     N  FOPPTREQUEST OBSERVATION_ID=0x01000130,MERIT=0,RA=0,DEC=0,                              A   TargetTrigger
                                                    ROLL=0,BAT_MODE=0x0000,XRT_MODE=0,UVOT_MODE=0
             01 329/19:00:00  7     N  FOPPTREQUEST OBSERVATION_ID=0x02000130,MERIT=0,RA=0,DEC=0,                              A   TargetTrigger
                                                    ROLL=0,BAT_MODE=0x0000,XRT_MODE=0,UVOT_MODE=0
             01 329/23:59:59  8     N  SCATSSWITCH                                                                             A
             01 330/00:00:04  1     N  BATNOOP_HI                                                                              B
             01 330/00:00:06  2     N  BATNOOP_LO                                                                              B
```

```
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------
                                                                                         SWIFT Release 1 INTEGRATED PRINT
                             CMD                                                                                              SEQUENCE  ATS  TRIG/ACT/RTS   TRIGGER/ACTIVITY/EVENT/RTS
EVENT        TIME             #   CRIT COMMAND      SUBMNEMONICS                                                              DURATION  BUFF NAME           DESCRIPTION
-----------------------------------------------------------------------------------------------------------------------------------------------------------------------
             01 330/00:00:08  3     N  BATBCNOOP                                                                                        B
AscendingNod 01 330/01:32:44
SAA ENT      01 330/03:01:14
SAA EXIT     01 330/03:06:19
AscendingNod 01 330/03:09:34
SAA ENT      01 330/04:36:03
SAA EXIT     01 330/04:46:15
AscendingNod 01 330/04:46:24
SAA ENT      01 330/06:10:52
AscendingNod 01 330/06:23:14
SAA EXIT     01 330/06:26:02
SAA ENT      01 330/07:45:44
AscendingNod 01 330/08:00:04
SAA EXIT     01 330/08:03:02
SAA ENT      01 330/09:22:48
AscendingNod 01 330/09:36:54
SAA EXIT     01 330/09:38:01
SAA ENT      01 330/11:01:05
SAA EXIT     01 330/11:11:35
AscendingNod 01 330/11:13:45
             01 330/12:00:00  4     N  FOPPTREQUEST OBSERVATION_ID=0x02000130,MERIT=0,RA=0,DEC=0,                                       B   TargetTrigger
                                                    ROLL=0,BAT_MODE=0x0000,XRT_MODE=0,UVOT_MODE=0
AscendingNod 01 330/12:50:35
AscendingNod 01 330/14:27:25
SAA ENT      01 330/15:18:12
SAA EXIT     01 330/15:25:25
AscendingNod 01 330/16:04:15
SAA ENT      01 330/16:52:28
SAA EXIT     01 330/17:04:42
AscendingNod 01 330/17:41:05
SAA ENT      01 330/18:26:51
SAA EXIT     01 330/18:44:07
AscendingNod 01 330/19:17:56
SAA ENT      01 330/20:02:59
SAA EXIT     01 330/20:19:57
AscendingNod 01 330/20:54:46
SAA ENT      01 330/21:41:53
SAA EXIT     01 330/21:55:33
AscendingNod 01 330/22:31:36
SAA ENT      01 330/23:23:38
SAA EXIT     01 330/23:28:26
             01 330/23:59:59  5     N  SCATSSWITCH                                                                                      B

----------------------------------------------------------------------------
                    SWIFT Release 1 LOAD CONTINUITY REPORT
  Between  Load:  SCS329A1  Buffer: A
      and  Load:  SCS330B2  Buffer: B
----------------------------------------------------------------------------


----------------------------------------------------------------------------
                    SWIFT Release 1 LOAD CONTINUITY REPORT
  Between  Load:  SCS330B2  Buffer: B
      and  Load:            Buffer:
----------------------------------------------------------------------------
```

Sample TAKO Ephemeris File
This sample does not represent a real GLAST orbit. It just illustrates the file format.

```
"Time (UTCJ4)" "x (km)" "y (km)" "z (km)" "Lat (deg)" "Lon (deg)" "RightAscension (deg)" "Declination (deg)"
087/2002 18:00:00.00 2332.298836 6428.972921 394.948808 3.330 -25.891 159.955 -2.153
087/2002 18:01:00.00 1897.463541 6571.361054 376.870140 3.177 -22.308 163.783 -2.370
087/2002 18:02:00.00 1454.150256 6684.387651 357.102839 3.010 -18.726 167.611 -2.576
087/2002 18:03:00.00 1004.339308 6767.545665 335.735368 2.829 -15.145 171.441 -2.770
087/2002 18:04:00.00 550.040337 6820.461495 312.863376 2.636 -11.565 175.272 -2.952
087/2002 18:05:00.00 93.283309 6842.896702 288.589270 2.431 -7.986 179.104 -3.121
087/2002 18:06:00.00 -363.890558 6834.749104 263.021759 2.215 -4.408 -177.062 -3.276
087/2002 18:07:00.00 -819.437932 6796.053274 236.275361 1.989 -0.831 -173.227 -3.416
```

Sample TDRSS Ephemeris File
This sample does not represent a real TDRS orbit. It just illustrates the file format.

```
"Time (UTCJ4)","x (m)","y (m)","z (m)","vx (m/sec)","vy (m/sec)","vz (m/sec)"
202/2003 00:00:00.00,4114963.892,-5598555.427,65351.367,5390.983156,3911.577924,-3615.089165
202/2003 00:01:00.00,4429384.375,-5352042.872,-151540.223,5085.924535,4302.547437,-3612.003983
202/2003 00:02:00.00,4724843.008,-5082618.597,-367781.374,4759.152341,4675.027110,-3593.415828
202/2003 00:03:00.00,5000078.820,-4791440.139,-582444.148,4412.076407,5027.426411,-3559.410554
202/2003 00:04:00.00,5253918.048,-4479757.870,-794607.754,4046.192797,5358.242572,-3510.140490
202/2003 00:05:00.00,5485279.118,-4148909.528,-1003362.518,3663.077117,5666.066994,-3445.823654
202/2003 00:06:00.00,5693177.203,-3800314.398,-1207813.787,3264.377493,5949.591182,-3366.742666
202/2003 00:07:00.00,5876728.360,-3435467.129,-1407085.770,2851.807256,6207.612207,-3273.243378
202/2003 00:08:00.00,6035153.213,-3055931.254,-1600325.279,2427.137377,6439.037665,-3165.733223
202/2003 00:09:00.00,6167780.183,-2663332.423,-1786705.375,1992.188687,6642.890112,-3044.679309
202/2003 00:10:00.00,6274048.238,-2259351.384,-1965428.877,1548.823930,6818.310970,-2910.606248
202/2003 00:11:00.00,6353509.169,-1845716.746,-2135731.748,1098.939681,6964.563891,-2764.093759
202/2003 00:12:00.00,6405829.370,-1424197.563,-2296886.321,644.458176,7081.037561,-2605.774044
202/2003 00:13:00.00,6430791.137,-996595.756,-2448204.367,187.319091,7167.247965,-2436.328958
202/2003 00:14:00.00,6428293.448,-564738.505,-2589040.002,-270.528616,7222.840093,-2256.486983
202/2003 00:15:00.00,6398352.335,-130470.149,-2718792.311,-727.135260,7247.589083,-2067.020055
202/2003 00:16:00.00,6341100.589,304355.163,-2836907.978,-1180.558090,7241.400852,-1868.740188
202/2003 00:17:00.00,6256787.166,737881.643,-2942883.504,-1628.869708,7204.312166,-1662.495993
```

Sample Confirmed TDRSS Contact Schedule

```
CREATIONTIME="2002/365 03:00:40"

EVENTCOUNT="10"

SCHEDULEDEVENT1
  EVENTSTART="2002/365 00:46:00"
  EVENTSTOP="2002/365 03:32:00"
  EVENTID="0011870"
  SUPIDEN="A3782MS"
  TDRS="TDW"
  VIC="01"
  USMTYPE="Fixed-Normal"
  SERVICECOUNT="2"
  PROTOTYPE_EVENTID=""
  SBANDPNCODE="04"
  KBANDPNCODE="04"
  SERVICE1
    SERVICETYPE="MAF"
    SSCCODE="A01"
    SERVICESTART="2002/365 00:46:00"
    SERVICESTOP="2002/365 03:32:00"
    LINKID=""
    PARAMETERCOUNT="6"
      PARAMETERS
        DATARATEMAXF="1000"
        DOPC="Yes"
        DTR1="2000"
        FRQ1="210640535"
        UDAN="No type"
        UIFCADDRESSF="M14"
      ENDPARAMETERS
  ENDSERVICE1
  SERVICE2
    SERVICETYPE="MAR"
    SSCCODE="B04"
    SERVICESTART="2002/365 00:46:00"
    SERVICESTOP="2002/365 03:32:00"
    LINKID="01"
    PARAMETERCOUNT="29"
      PARAMETERS
        BIPHLOCVTI="No"
        BIPHLOCVTQ="No"
        CONFIGURATION="Both I and Q Channel"
        CPR="-60"
        CROSSFL="-60"
        DATACHANNELCONFIG="Dual Data Source"
        DATARATEMAXI="32000"
        DATARATEMAXQ="32000"
        DSD1="214"
        DSD2="216"
        DTF1="NRZ-M"
        DTF2="NRZ-M"
        DTR1="4000"
        DTR2="4000"
```

```
        ERP1="+285"
        ERP2="+281"
        FRQ1="228749902"
        G2II="Invert"
        G2IQ="Invert"
        JTR1="0.1%"
        JTR2="0.1%"
        MDMMAXI="32000"
        MDMMAXQ="32000"
        MODE="Mode 1 (Coherent)"
        RECEIVERCONFIG="Normal"
        RTNCHANDLYDATA="Yes"
        UDAN="No type"
        UIFCADDRESSI="M64"
        UIFCADDRESSQ="M66"
      ENDPARAMETERS
  ENDSERVICE2
ENDSCHEDULEDEVENT1
```

Sample As-Flown Timeline

```
2007-327-20:13:50.123456|Begin|Rocking survey|35.00|0.00|
2007-327-20:43:51.123456|Begin|SAA|||
2007-327-20:59:12.123456|End|SAA|||
2007-327-20:53:52.123456|Begin|Rocking survey|0.00|-35.00|
2007-327-21:03:51.123456|Begin|Yaw flip|||
2007-327-21:05:52.123456|Begin|Rocking survey|0.00|-35.00
2007-327-23:02:51.123456|Begin|SAA|||
2007-327-21:15:52.123456|Begin|AR|135.00|-35.00|
2007-327-21:30:51.123456|End|SAA|||
2007-328-00:43:51.123456|Begin|SAA|||
2007-328-02:17:51.123456|Begin|Inertial|240.00|5.00|
2007-328-02:21:52.123456|Begin|No ACS Data|||
2007-328-03:00:59.123456|End|No ACS Data|||
```