



Data Management

GS SDR Section 7

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Outline

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- ▶ ***Data Latency Requirements***
- ▶ ***Data Accountability Tracking***
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- ▶ ***Nominal USN Data Flow***



Data Processing Requirements



- ▶ **The data capture and latency requirements are listed in the Ground System Requirements Document (GSRD)**
 - *Ground system requirements are based on an orbit average generation rate of 1.2 Mbps for LAT, 26 kbps for GBM, and 51 kbps observatory housekeeping data*
- ▶ **The Ground System as a whole is required to capture 98.1% of all data sent from the spacecraft to the ground**
 - *Ground Stations contribute a data loss of no more than 0.9%*
 - *MOC contributes a data loss of no more than 1%*
- ▶ **Ground System has the ability to recover operations disrupted by communication line or link faults, user interruption of transfer, or even a system crash via the file transfer protocols being used**
 - *Re-transmission requests will be generated whenever data gaps are detected*



Data Latency Requirements

- ▶ **LAT level-1 and GBM trigger products are generated within 72 hours of receipt of the observatory data at the ground site 95% of the time**
- ▶ **GBM level-1 products are generated within 96 hours of receipt of the observatory data at the ground site 95% of the time**
- ▶ **The latency for each of the elements is sub-allocated as follows:**
 - 10 hours of recorded observatory data is to be transferred within 4 hours from the SN to the MOC
 - 24 hours of observatory housekeeping data is to be transferred within 5 hours from the GN to the MOC
 - MOC generates the Level 0 data files and initiate transmission to the GSSC and the IOCs within 4 hours of receiving the dump files
 - The LISOC and GIOC process Level 1 data within 24 hours of receipt of Level 0 data
 - GSSC provides access to the science community to the Level 1 data within 24 hours
- ▶ **Burst data is sent to the MOC from the ground station within 5 seconds of receipt of the signal from the observatory for at least 80% of all burst alerts**



Data Accountability Tracking

- ▶ **GLAST Mission Director will be provided with data accountability metrics from all Ground System elements during mission operations**
- ▶ **Ground System elements will monitor the status and progress of each operation being carried out and provide an "audit trail" of all log messages given by each process**
 - *Interface Control Documents (e.g. Operations Data Products ICD) will contain the format of the metrics being provided between the elements*
 - *Operations Agreements between the elements will contain the frequency and the protocols for exchanging the metrics between the ground elements*
- ▶ **MOC is the one entry point for all data from the antenna sites and the GSSC is the one end point for all archived data**
 - *SN and Ground Station provide real-time data quality statistics to the MOC and include frame counts, missing VCDUs, uncorrectable VCDUs, and any other data statistics required by the MOC*



Data Accountability Reporting

- ▶ **Data distribution at the two “ends” will be used to determine the total amount of data captured**
 - MOC maintains a record of the quality and completeness of the telemetry for the duration of the mission
 - monitors the delivery of telemetry data, assesses the quality of each file; including total number of frames received, good frames, sequence errors, and Reed-Solomon decoding errors
 - GSSC production pipeline will provide autonomous re-transmission requests to the MOC, LISOC and GIOC as appropriate when data gaps are detected
- ▶ **Intermediate metrics will be taken along the science data processing pipeline**
 - LISOC will evaluate the LAT data to determine the number of events detected and compare with the number of events processed; verify continuity between level-0 files provided by the MOC and remove duplication
 - GIOC will create 24 hour level-1 data sets to ensure all science data is received and processed



Data Types - Real Time

▶ Real Time Housekeeping

- 51 kbps Downlinked on VC 0
- LAT, GBM and S/C Housekeeping Data
 - Health and safety telemetry
- Used for 8 ten minute passes per day

▶ Real Time Diagnostic

- 104 kbps Downlinked on VC 1
- Used for Diagnostics situations
 - Routine engineering activities
 - Anomaly resolution and recovery
- Used infrequently

▶ Real Time Burst Alerts

- 1 kbps Downlinked on VC 1
- Initial burst messages followed by periodic updates for up to 10 minutes
- Expect about 3 bursts per day

▶ Real Time RAM Dumps

- 104 kbps Downlinked on VC 2
- Used to retrieve memory from on-board cards



Data Types - Stored

▶ **Stored Housekeeping Partition**

- *Downlinked via TDRS @ 8 Mbps on VC3*
- *Downlinked via USN @ 1.99 Mbps on VC3*
- *Contents*
 - *51 kbps Housekeeping (RT and Back Orbit)*
 - *RAM Dumps (RT and Back Orbit)*
 - *1 kbps Burst Alerts (RT and Back Orbit)*
 - *104 kbps Diagnostic Data (RT and Back Orbit)*

▶ **Stored Science Partition**

- *Downlinked at 31 or 39 Mbps on VC8 and VC9*
- *1.2 Mbps LAT Science is written to the Science Partition*
- *26 kbps GBM Science is written to the Science Partition*



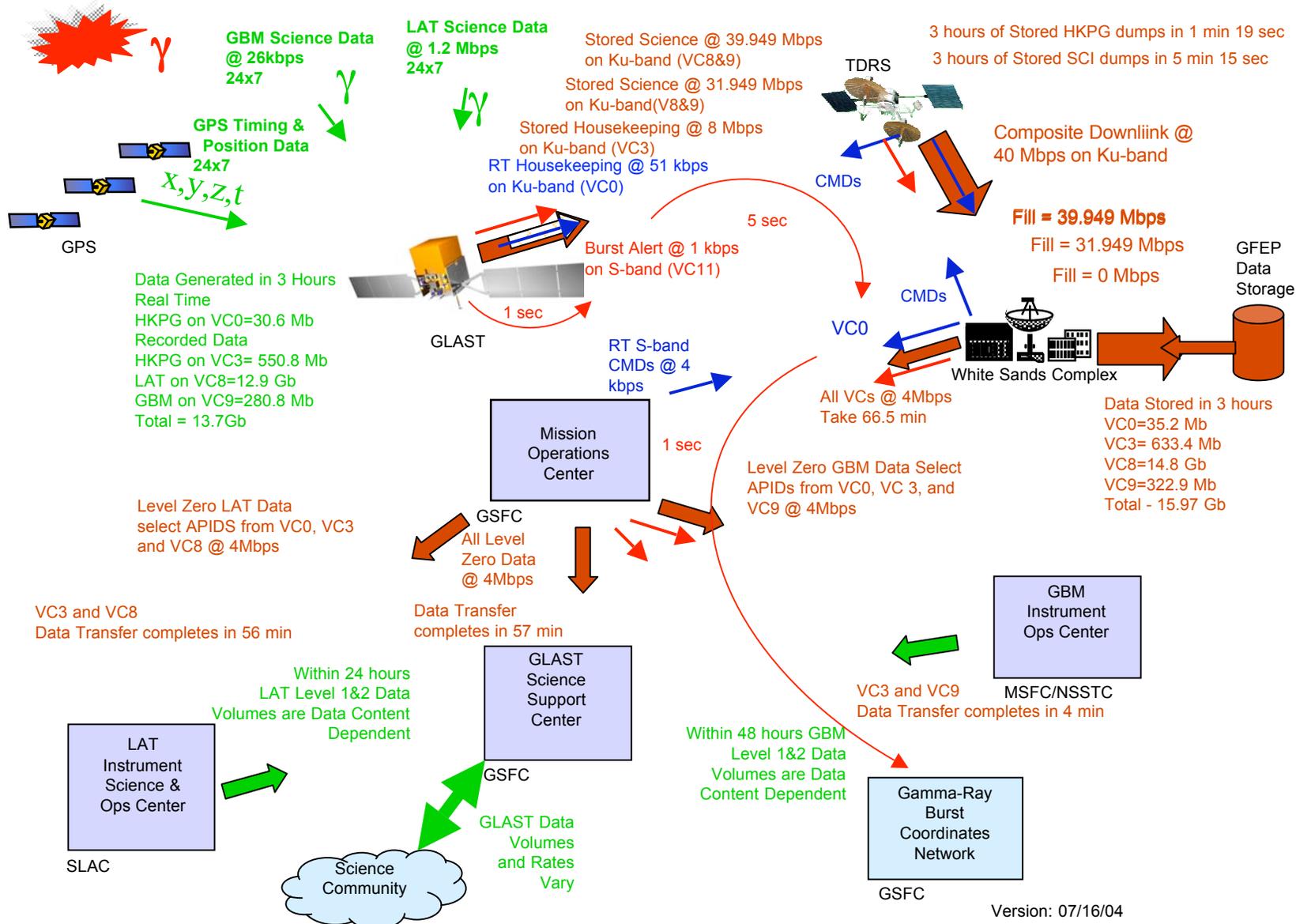
Data Types - Near Real Time

▶ **Back Orbit Burst Alerts**

- *Downlinked @ 1 kbps on VC11*
- *Near = 7 seconds*
- *Used to communicate to other Gamma-ray Astronomers that an interesting Gamma-ray event has taken place*
 - *Messages passed to the Gamma-ray Burst Coordinates Network (GCN)*
 - *Initial message delivered in 7 seconds, subsequent updates are not constrained*
- *Downlink via TDRS Demand Access Service (DAS)*
 - *DAS is a way to schedule MAR 24x7*
 - *Two ways to schedule*
 - *DAS ANY = WSC choose the TDRS that support user at any given time*
 - *DAS ALL = any TDRS that receives a signal from the user will report it, and the user selects one*

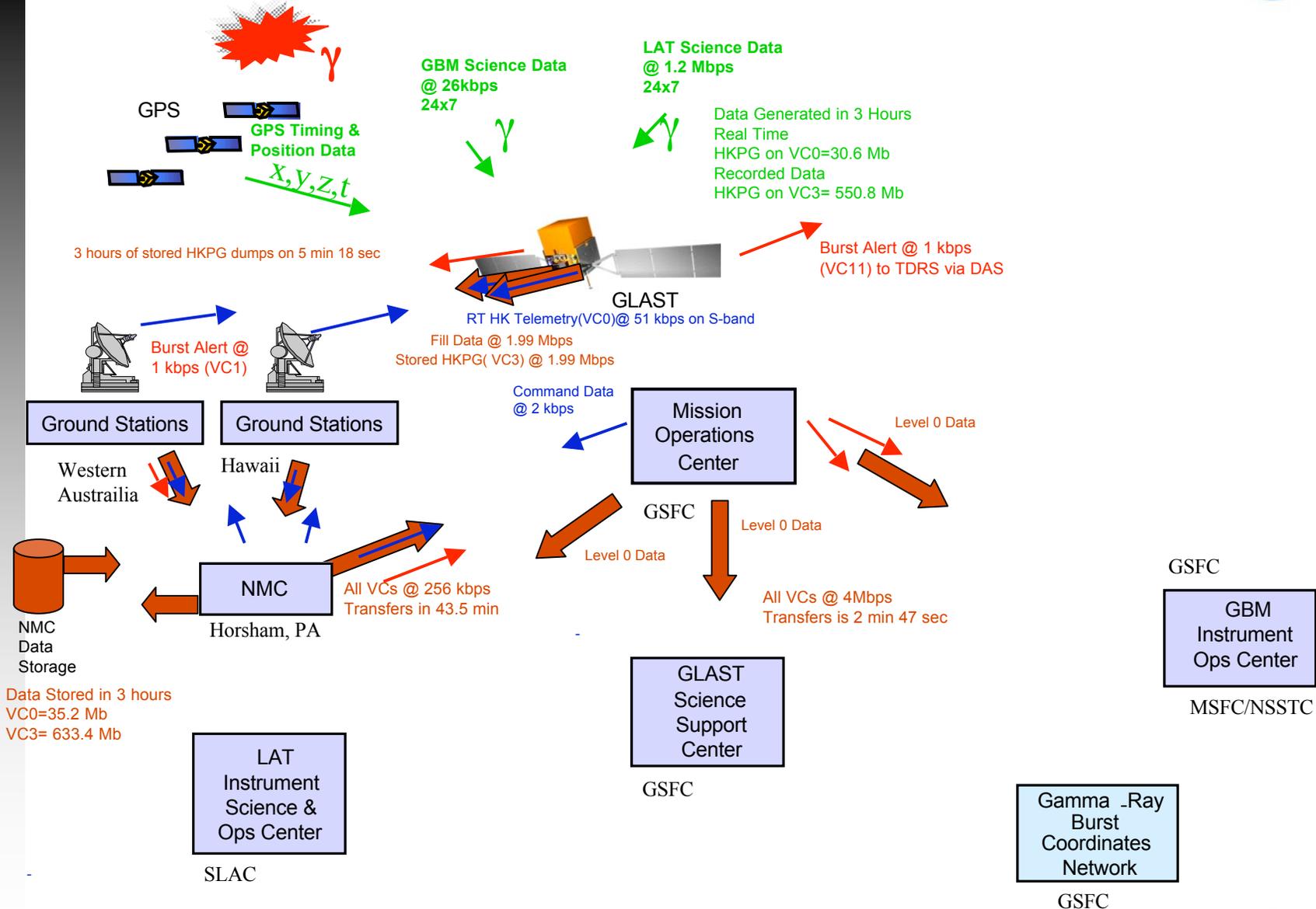


Nominal TDRS Data Flow





Nominal USN Data Flow





Backup Slides

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Virtual Channel Allocations

Virtual Channel	Transmitter	Telemetry Description
0	GN/SN	Real-time Observatory Housekeeping Telemetry
1	GN/SN	REAL-TIME ALERT AND DIAGNOSTIC TELEMETRY
2	GN/SN	Stored Observatory Housekeeping and Diagnostic Data from Random Access Memory (RAM)
3	GN/SN	Stored Observatory Housekeeping and Diagnostic Data from Solid State Recorder (SSR)
8	SN	Stored Large Area Telescope (LAT) Science
9	SN	Stored GLAST Burst Monitor (GBM) Science
10	SN	Diagnostics and Alerts (via S-Band TDRS SA)
11	SN	Real-time Observatory Alerts (via S-Band TDRS MA)
63	GN/SN	Fill Frame



Data Volumes and Transmit Times



Source	05-10-04	LAT (avg)	HKPG	GBM (avg)	TOTALS
Data Gen Rate (per second)		1,200,000	51,000	26,000	1,277,000
Volume Per Day		103,680,000,000	4,406,400,000	2,246,400,000	110,332,800,000
Downlink Overhead		1.15	1.15	1.15	
Volume Downlinked from S/C to GS		119,232,000,000	5,067,360,000	2,583,360,000	126,882,720,000
Time to Downlink at 40 Mbps (in sec.)		2,981	127	65	3,172
Time to Downlink at 40 Mbps (in min.)		49.68	2.11	1.08	52.87
Time to Downlink at 2.5Mbps (in sec)		47,693	2,027	1,033	50,753
Time to Downlink at 2.5Mbps (in min)		794.88	33.7824	17.2224	845.88
Volume Transmitted from GS to MOC		119,232,000,000	5,067,360,000	2,583,360,000	126,882,720,000
Time to Transmit at 4.3 Mbps (in sec)		27,728	1,178	601	29,506
Time to Transmit at 4.3 Mbps (in min)		462	20	10	491.79
Time to Transmit at 4.3 Mbps (in hrs)		7.70	0.33	0.17	8.20
Volume after VC Overhead Stripped, Transmitted from MOC to LISOC		103,680,000,000	3,304,800,000		106,984,800,000
Time to Transmit at 4 Mbps (in sec)		25,920	826		26,746
Time to Transmit at 4 Mbps (in min)		432	14		445.77
Time to Transmit at 4 Mbps (in hrs)		7.20	0.23		7.43
Volume after VC Overhead Stripped, Transmitted from MOC to GIOC			1,101,600,000	2,246,400,000	3,348,000,000
Time to Transmit at 4 Mbps (in sec)			275	562	837
Time to Transmit at 4 Mbps (in min)			4.6	9.4	13.95
Time to Transmit at 4 Mbps (in hrs)			0.08	0.16	0.23
LIOC data reduction factor		0.033333333	1	0	
Volume Transmitted from LISOC to GSSC		3,456,000,000		0	3,456,000,000
Time to Transmit at 4 Mbps (in sec)		864			864
Time to Transmit at 4 Mbps (in min)		14.40			14.40
Time to Transmit at 4 Mbps (in hrs)		0.24			0.24
GIOC data reduction factor		0	0.25	1	
Volume Transmitted from GIOC to GSSC		0	1,101,600,000	2,246,400,000	3,348,000,000
Time to Transmit at 4 Mbps (in sec)			275	562	837
Time to Transmit at 4 Mbps (in min)			4.6	9.4	13.95
Time to Transmit at 4 Mbps (in hrs)			0.08	0.16	0.23
Volume Transmitted from MOC to GSSC		103,680,000,000	4,406,400,000	2,246,400,000	110,332,800,000
Time to Transmit at 4 Mbps (in sec)		25,920	1,102	562	27,583
Time to Transmit at 4 Mbps (in min)		432.00	18.36	9.36	459.72
Time to Transmit at 4 Mbps (in hrs)		7.20	0.31	0.16	7.66