J SOFTWARE DESIGN DOCUMENT

FOR THE

GLOBAL ULTRAVIOLET IMAGER

-GUVI-

DATA PROCESSING

-DP-

PAYLOAD OPERATIONS CENTER

-POC-

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Release A

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1. Scope

1.1 Identification

This Software Design Document (SDD) establishes the detailed design baseline for the Global Ultraviolet Imager (GUVI) Data Processing (DP) Payloads Operation Center (POC) software for the Thermosphere, Ionosphere, and Mesosphere Energetics and Dynamics (TIMED) mission. This design baseline satisfies the requirements of the Software Requirements Specification (SRS) for the GUVI POC as set forth in Reference 1 and elaborates upon the design presented at the GUVI Software Preliminary Design Review (SPDR), Reference 2. The DP POC software is composed of the following three Computer Software Configuration Items (CSCIs):

- Algorithms CSCI
- User Interface CSCI
- Webserver Capability CSCI

This design document describes the software design for all the CSCIs comprising the DP POC and Figure 1.1-1 depicts the overall data flow between the CSCIs that comprise the DP POC software.

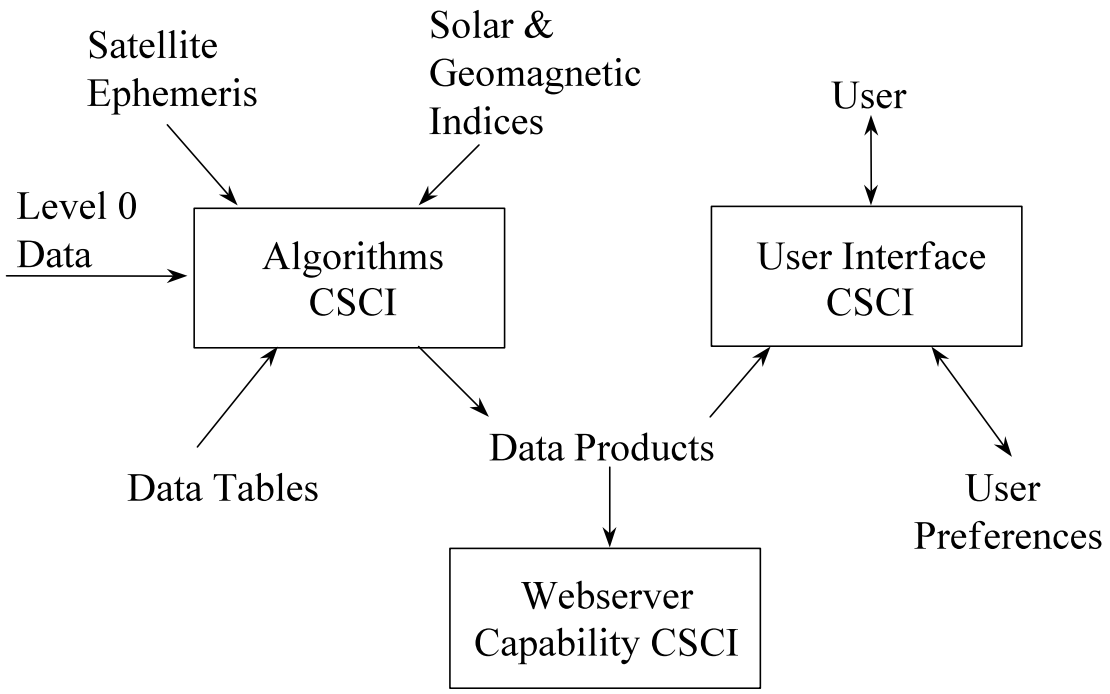

Figure 1.1-1. DP POC CSCI Data Flow Diagram

1.2 System Overview

GUVI is a horizon-to-horizon scanning spectrographic imager operating in the far ultraviolet (FUV: 110 to 180nm). The GUVI spectrograph, with a Rowland Circle mount, uses a two-dimensional detector to record spatial and spectral information for each step position as it scans over 140°. To reduce the downlinked data rate, the GUVI data

is processed onboard the TIMED spacecraft to produce five "colors" or monochromatic bands that are useful diagnostics of the dynamics and energetics of the thermosphere and ionosphere.

The GUVI DP POC is responsible for processing, displaying and providing access to the GUVI sensor data. Together the three CSCIs convert raw light intensities measured by the instrument into displays of useful environmental parameters, which characterize the state of the ionosphere and the neutral atmosphere.

The Algorithms CSCI generates a set of GUVI data products that is classified to a data level based on the type of data contained in the product. The GUVI data levels are adapted from the TIMED Project Data Management Plan (DMP), Reference 7, and are described in Table 1.2-1.

Data Level	Description
Raw Telemetry	Unprocessed digital telemetry
Level 0	Unprocessed instrument data at full resolution that has been separated by instrument or subsystem
Level 1A	Unprocessed instrument data at full resolution, time referenced and annotated with ancillary information including radiometric and geometric parameters
Level 1B	Level 1A data processed to sensor units (e.g. Rayleighs/color)
Level 1C	Level 1B radiance data mapped on a uniform, earth-referenced grid
Level 2	Derived geophysical variables at the resolution of retrieval
Level 3	Derived geophysical variables mapped on a uniform, earth-referenced, space-time grid
Survey	Summary or low fidelity data used for quicklook or data mining
Status	Reports and/or timelines describing planning or status information

Table 1.2-1. GUVI Data Level Definitions

The GUVI data products that will be automatically and routinely generated are identified in Table 1.2-2 along with the following dynamic graphical overlays:

- Satellite ground track
- Sunward disk scan boundaries
- Anti-sunward disk scan boundaries
- Terminator crossings
- Universal time of along track position
- F10.7, Kp and Ap
- Local solar time
- Solar zenith angle

The data products are placed in files utilizing NetCDF. These data product files along with their file structure, file headers and contents are defined in Appendixes A and B.

The User Interface CSCI provides the capability to graphically display the GUVI data products. This CSCI provides a user interface to select GUVI data products, display static and dynamic graphical overlays, utilize various map projections, etc. and provide an overall browse capability.

The Webserver Capability CSCI provides a GUVI Internet web page. This capability displays information about GUVI, provides the ability to display and access GUVI data products across the Internet, provides access to the GUVI data catalog, provides links to TIMED and also provides links to other TIMED instruments and scientific sites of interest.

Product Name	Description	Generation Class	Content Class	Resolution	Data Required
Level 1A data	Uncompressed pixels. Unprocessed instrument data at full resolution, time-tagged, s/c location specified and tagged with a preliminary data quality flag.	Routine	Level 1A	N/A	
Disk data	Radiance data from disk mode. Gridded in GUVI-based viewing coordinates. Full 2-D resolution at 5 colors	Routine	Level 1C	25 km X 25 km	
Limb data	Radiance data from limb mode. Gridded in GUVI-based viewing coordinates. Full 2-D resolution at 5 colors	Routine	Level 1C	25 km X 25 km	
Proton auroral boundaries	Proton auroral boundaries. Provides poleward and/or equatorward boundaries.	Routine	Level 1C	25 km X 25 km	K_p
Mixed auroral boundaries	Mixed proton/electron auroral boundaries. Provides poleward and/or equatorward boundaries.	Routine	Level 1C	25 km X 25 km	K_p
Spectrograph Data	Spectrograph counts	Routine	Level 1C	25 km X 25 km	
TEC, nightside disk	Geolocated TEC along line of sight, superpixel, nightside disk	Routine	Level 2B	100 km X 100 km	
O/N_2 ratio, dayside disk	Geolocated O/N_2 ratio vertical column, superpixel, dayside disk	Routine	Level 2B	100 km X 100 km	
O NDP, dayside limb	O neutral density profile, superpixel, dayside limb	Routine	Level 2B	100 km X 100 km	
O_2 NDP, dayside limb	O_2 neutral density profile, superpixel, dayside limb	Routine	Level 2B	100 km X 100 km	
N_2 NDP, dayside limb	N_2 neutral density profile, superpixel, dayside limb	Routine	Level 2B	100 km X 100 km	
Temperature profile, dayside limb	Neutral-gas temperature profile, superpixel, dayside limb	Routine	Level 2B	100 km x 100 km	
Q_{euv}	Measure of the integrated solar flux	Routine	Level 2B	Minimum 1 per orbit	
Q, aurora	Effective* energy flux	Routine	Level 2B	25 km X 25 km	
<E>, aurora	Effective* average energy	Routine	Level 2B	25 km X 25 km	
Peak EDP, aurora	Altitude of the peak in the ionization rate	Routine	Level 2B	25 km X 25 km	
Column ionization rate, aurora	Total column ionization rate. Volume ionization production rate integrated from the bottom of the E layer to the spacecraft altitude.	Routine	Level 2B	25 km X 25 km	
Level 3 data	GUVI data products mapped on a uniform, earth-referenced, space-time grid	Routine	Level 3	N/A	
Survey	GUVI survey products	Routine	Survey	N/A	
Status	GUVI status products	Routine	Summary	N/A	

Table 1.2-2. GUVI Data Products

* Effective assumes precipitating particles are pure electrons

1.3 Hardware Overview

All of the DP POC CSCIs are intended to run on the DP POC. The DP POC is currently proposed to be a Hewlett Packard running HP-UX. The Webserver Capability CSCI may be moved to a Sun Ultra running Solaris or a Pentium Pro running Windows NT to minimize Internet traffic and to mitigate timing problems as deemed necessary. The Sun Ultra will have access to the HP disk drives and CD jukebox so there will be minimal software design and/or implementation impact.

In addition, the HP contains four CPUs and the Science Algorithms CSC will be executing across the multiple processors utilizing the Ada 95 tasking model. The Ada 95 tasking model automatically and properly allocates different processes (called tasks in Ada) across the different processors removing the need for any system calls by the DP POC software.

The HP will also be directly connected to a dedicated CD jukebox that will provide a near-line storage capability for long term archiving of the GUVI data products.

1.4 Document Overview

The purpose of this document is to provide the detailed design of the CSCIs for the GUVI DP POC software. The top-level design of the CSCIs for the GUVI DP POC is described in Reference 2, GUVI DP POC SPDR. The SDD also describes the allocation of requirements from each CSCI to its Computer Software Components (CSCs) and Computer Software Units (CSUs). It contains the following information:

Section 1 Identifies the GUVI DP POC and contains a brief overview.

Section 2 Lists applicable documents.

Section 3 Specifies the detailed design for the Algorithms CSCI.

Section 4 Specifies the detailed design for the Webserver Capability CSCI.

Section 5 Specifies the detailed design for the User Interface CSCI.

Section 6 Gives an alphabetical listing of acronyms and abbreviations used in this document.

Appendix A Provides the standard GUVI data product file header

Appendix B Provides the file formats and definitions of the GUVI data product files

Appendix C Provides a definition of the GUVI data catalog

2. Referenced Documents

Reference [1] TIMED GUVI POC Software Requirements Specification, JHU/APL 7366-9200, Feb. 1998

Reference [2] TIMED GUVI Software Preliminary Design Review, May 1997

Reference [3] TIMED Software Quality Assurance Plan, JHU/APL 7363-9101, Sept. 1996

Reference [4] TIMED GUVI Data Processing POC Software Development Plan (SDP), JHU/APL 7366-9201, Feb. 1998

Reference [5] TIMED Mission Operations Requirements Document, JHU/APL 7363-9021, Oct. 1996

Reference [6] TIMED System Requirements Document, JHU/APL 7363-9001, Dec. 1997

Reference [7] TIMED Project Data Management Plan (DMP) , JHU/APL 7363-9330, Dec. 1997

Reference [8] TIMED General Instrument Interface Specification (GIIS), Section 8, 7363-9050, Nov. 1997

Reference [9] GUVI Specific Instrument Interface Specification (SIIS), JHU/APL, 7363-9046, Nov. 1997

Reference [10] Flight Software Interface Control Document for the GUVI Flight Instrument, JHU/APL, 7366-9041, May 1997

Reference [11] GUVI Operational Concept Document, JHU/APL, 7366-9004, May 1997

Reference [12] TIMED GUVI Data Processing POC Software Test Plan, JHU/APL 7366-9203, Mar. 1998

Reference [13] SSUSI Auroral E-Region Algorithm Language Independent Description, JHU/APL, May 1996

Reference [14] Space Department Software Quality Assurance Guidelines, SDO-9989, Sept. 1992

Reference [15] Guidelines for Conducting Design Reviews, SDO-8336, Feb. 6, 1987

Reference [16] NASA Assurance Guidebook, NASA-GB-A201, on-line via http://satc.gsfc.nasa.gov/homepage.html

Reference [17] NASA Software Documentation Standards, NASA-STD-2100-91, on-line via http://satc.gsfc.nasa.gov/homepage.html

Reference [18] MIL-STD-498, Military Standard Software Development and Documentation, AMSC

Reference [19] NetCDF User's Guide for C, version 3.0, Unidata Program Center, June 1997

Reference [20] *Software Development Project, Planning, and Management*, P. Bruce and S.M. Pederson, John Wiley & Sons, 1982

Reference [21] *An ISO 9000 Approach to Building Quality Software*, L. Oskarsson and R.L. Glass, Prentice Hall PTK, 1996

Reference [22] *Software Reviews and Audits Handbook*, C.P. Hollocker, John Wiley & Sons, 1990

3. Algorithms CSCI

The Algorithms CSCI utilizes an object-oriented design methodology and is comprised of the following CSCs:

- Execution Control CSC
- Data Reformatter CSC
- Science Algorithms CSC
- Data Manager CSC
- Utilities CSC
- Operator Interface CSC
- Calibration CSC

The overall data flow of these CSCs is depicted in Figure 3-1 and the details for the individual CSCs are described in the following paragraphs.

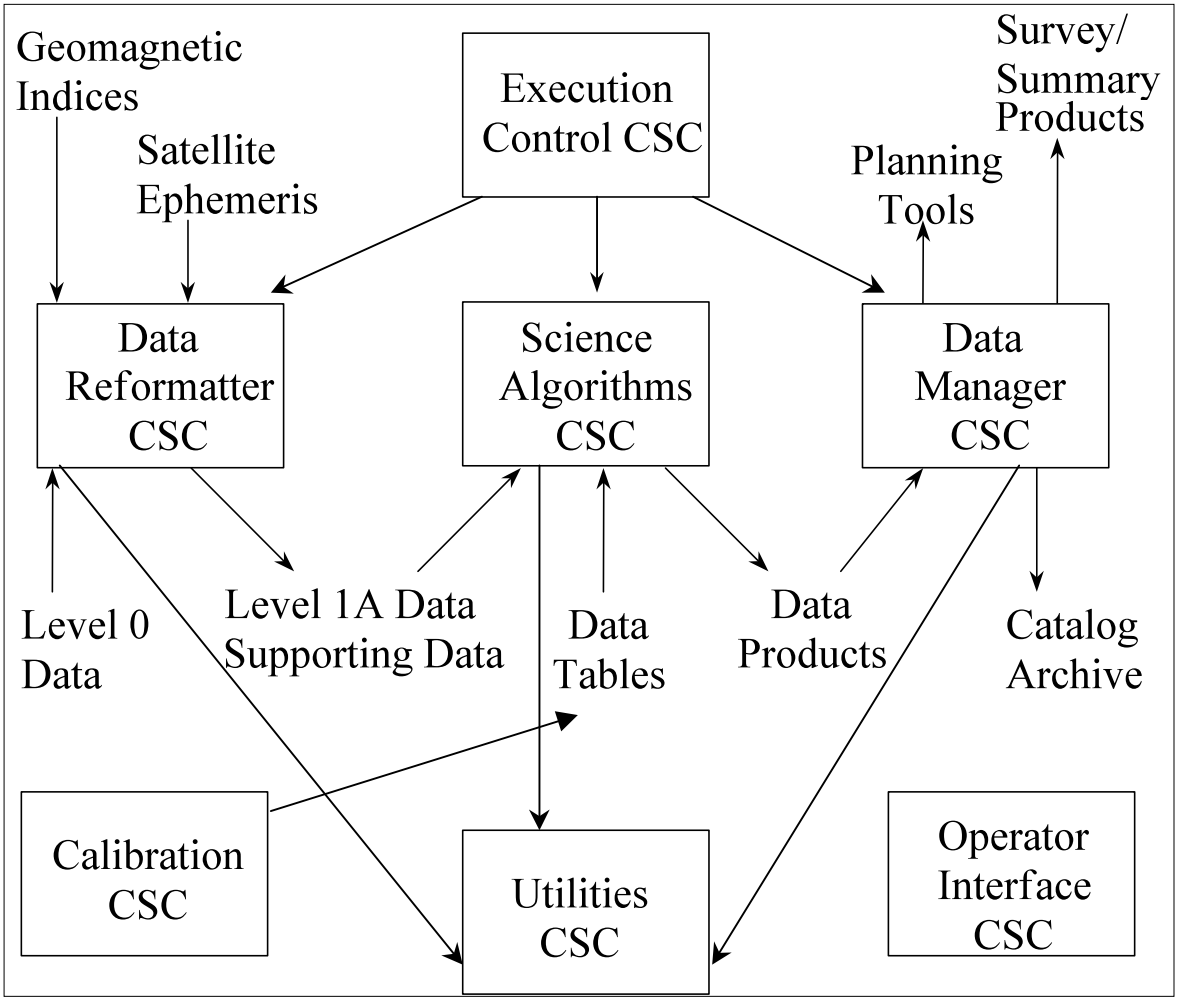

Figure 3-1. Algorithms CSCI Data/Control Flow Diagram

3.1 Execution Control CSC

The Execution Control CSC will be written in C++ and is invoked automatically upon startup of the DP POC. The purpose of the Execution Control CSC is to act as a scheduler and to ensure the timely processing of the DP POC responsibilities. This CSC is responsible for the processing of new data products as well as for the regeneration of existing data products, to check on the status of the DP POC, determining the duration of time the DP POC was down at startup, to sync up the DP POC to UTC time and to provide an archiving capability for the GUVI data products. In addition, Execution Control CSC will provide autonomous operation of the DP POC in the sense that it will automatically be invoked upon startup and will also automatically start processing on new data products and regeneration of existing data products.

The Execution Control CSC consists of the following CSUs:

- Startup CSU
- Watchdog Timer CSU
- Aliveness Check CSU
- Scheduler CSU
- Archiver CSU
- Sync to UTC CSU
- Regeneration Queue CSU

3.1.1 Startup CSU

The Startup CSU is automatically invoked upon startup of the DP POC. This CSU upon startup, determines if the DP POC went down via Unix system calls and if so, will determine how long the DP POC was down via Unix system calls and provide the duration to the Watchdog Timer CSU. This CSU will start up the Aliveness Check CSU that will periodically check on the DP POC system, will also startup the Watchdog Timer CSU to enable DP POC data product processing and will startup the Scheduler CSU to schedule in processing. This CSU fulfills part of the DP POC autonomous operations.

3.1.2 Watchdog Timer CSU

The Watchdog Timer CSU executes continuously and is invoked upon startup of the DP POC by the Startup CSU. The purpose of this CSU is to watch for certain conditions and/or events that will be utilized by the Scheduler CSU and it also performs time dependent tasks. This CSU is responsible for the following:

- Periodically syncs up the DP POC system clock to UTC time via calls to the Sync to UTC CSU. This will be performed approximately every hour.
- Periodically checks on the availability of new and/or unprocessed Support Data Status Change Notification file(s) from the Mission Data Center (MDC). This file contains a list of the support data products that have changed along with the duration of the change. Updates can consist of changes to any of the support data files for old data as well as for new data. This CSU will determine if any GUVI utilized support files, i.e. Solar & Geomagnetic Indices file, Orbit Number file, etc. are effected by invoking the Process Changed Support Data CSU for each unprocessed Support Data Status Change Notification file. If the data is determined to require processing, this CSU will then notify the Scheduler CSU so that the processing can be "scheduled" in for automatic regeneration without requiring any operator intervention as well as automatic generation of new data products. This file will also be utilized to process new and/or updated telemetry data that was generated during periods that the DP POC was down.
- Periodically checks on the availability of new and/or unprocessed Telemetry Status Change Notification file(s) from the MDC. This file contains a list of ApIDs that have been changed along with the duration of the change. Updates can consist of changes to the telemetry and housekeeping data for old data as well as for new data. This CSU will determine if any GUVI utilized ApIDs are affected by invoking the Process Changed Telemetry CSU for each unprocessed Telemetry Status Change Notification file. If the data is determined to require processing, this CSU will then notify the Scheduler CSU to "schedule" in automatic regeneration of the data

products as well as automatic generation of new data products. This file will also be utilized to process new and/or updated telemetry data that was generated during periods that the DP POC was down.

- If the Startup CSU indicates that the DP POC was down for any period of time, this CSU will automatically evaluate Telemetry Status Change Notification file(s) and Support Data Status Change Notification file(s) that were missed during the interim by invoking the Process Changed Support Data CSU and the Process Changed Telemetry CSU for each file. If the data is determined to require processing, this CSU will then notify the Scheduler CSU to "schedule" in automatic generation/regeneration of the data products.
- If no data products are currently being processed and no data products are currently being regenerated, this CSU will notify the Scheduler CSU to schedule in updates to the data product tables.
- If no processes are currently running, this CSU will invoke the Archiver CSU to move GUVI data products older than 6 months from the short-term data archive to the long-term data archive. Processes are defined as data product regeneration, data product generation, updating of the data tables, and another archiving process.
- Periodically invokes the Provide Percentage Complete CSU to obtain the status of the data product regeneration if a regeneration process is currently in progress.

An example of the DP POC data processing schedule is in Figure 3.1.2-1 and a nominal DP POC data processing schedule is depicted in Table 3.1.2-1. This CSU fulfills a portion of the DP POC autonomous operations.

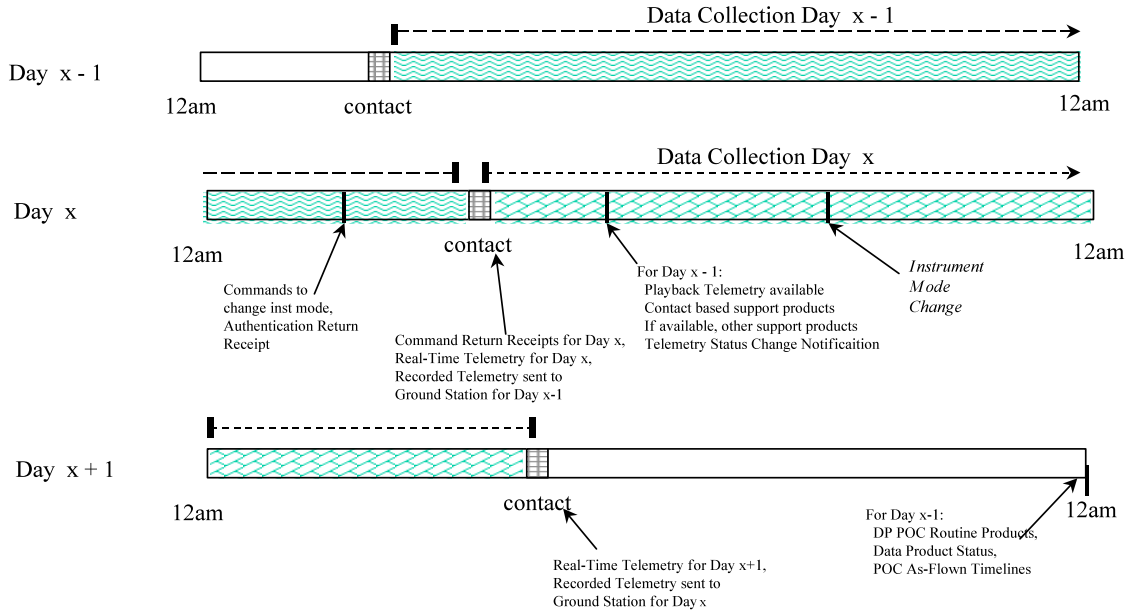

Figure 3.1.2-1. DP POC Data Processing Schedule

3.1.3Aliveness Check CSU

The Aliveness Check CSU is a Unix daemon that will run in the background and is disassociated from its inherited process group. This CSU will periodically check on the status of the DP POC. If the status of the DP POC is unrecoverable, this CSU will restart the system, as deemed necessary. This CSU has no inputs or outputs and is automatically invoked upon startup of the DP POC. This CSU fulfills part of the DP POC autonomous operations.

3.1.4Scheduler CSU

The Scheduler CSU is invoked by the Startup CSU upon startup of the DP POC. This CSU is responsible for scheduling the generation of new data products, the automatic regeneration of existing data products as well as for scheduling in operator initiated updates to the data tables and operator initiated regeneration of GUVI data products. The Watchdog Timer CSU indicates which actions are still outstanding.

The Scheduler CSU invokes the Data Reformatter CSC, the Data Table Updater CSC, the Data Manager CSC and the Science Algorithms CSC, as defined below. For the generating of new data products, this CSU will invoke the Data Reformatter CSC indicating the timeframes of the data to be obtained from the MDC. For the regenerating of data products, this CSU will also invoke the Data Reformatter CSC indicating the timeframes of the data to be obtained from the MDC and then go through the same methodology as the generation of new data products.

The primary purpose of the Scheduler CSU is to ensure that all of the operations executed on the DP POC is performed in an orderly and timely manner. Only one of its functions can be performed at any given time and all processes except the regeneration of data products will run until completion before "scheduling" in a new process. The generation and regeneration of data products will be broken down into up to 4 full orbits that will be simultaneously processed until completion, with each orbit being processed on a separate CPU. After completion of all 4 orbits of processing, a new task will be scheduled in according to its priority that could be the processing of the next 4 or fewer orbits worth of data, depending on how many orbits worth of data are remaining. This CSU will be implemented utilizing the following priority scheme, with one being the highest priority:

1. New data products are scheduled for generation every 24 hours. Approximately 24 hours worth of data will be processed. This number depends on the amount of data that can be stored on the spacecraft recorder. Data availability will be checked for the following time period, which will provide ample time for the MDC to receive the data as well as provide cleaned and merged data. A timeline of this is depicted in Table 4.

   - Start time: (Current time - 54 hours) - the starting time of the last partial orbit from the previous day
   - Stop time: ((Current time - 30 hours) + the starting time of the last partial orbit from the previous day) – starting time of partial orbit from the current day

   If data is available from the MDC, then data product generation will be initiated and this will always have precedence over all other Scheduler CSU activities. Partial orbits will not be processed until 24 hours later when the next days worth of data has been received and the full orbits worth of data is available. Full orbits containing data gaps will however be processed although the data products produced immediately around the time gap will be unreliable.

1. Updating the data tables will come second in priority but only if a data product regeneration process has not previously been started and still needs to be completed.

2. The regeneration of data products, both operator initiated and automatically identified, will be third in priority. This CSU will utilize the regeneration queue to determine which data products to process first.

3. Lastly, since the DP POC has a disk storage capacity greater than what will be required for storing six months worth of GUVI data products, moving data products from the short-term archive to the long-term data archive will have the lowest priority.

Note: Data product access via the Internet will be performed in an as requested manner. There will be no scheduling of this operation. If timing conflicts occur, we will investigate at that point in time, rehosting the Webserver Capability CSCI on a different platform and/or scheduling in data product access. In addition, because of the size of the GUVI data products, access to the larger data products will be restricted to authorized users via a user registration scheme implemented as part of the Webserver Capability CSCI.

	8 weeks to 4 hours prior to contact	Contact + ? hours	30 hours after data is acquired on S/C	Within 54 hours after data is acquired on S/C	Within 78 hours after data is acquired on S/C	Later….
Timelines	EPOC and MOC FTP planned timelines to MDC; MDC produces merged planned timeline products on WWW			First versions of the as-flown timelines for day x-1 are FTP'd to the MDC from the EPOC	MDC produces on WWW 1st version of the merged as-flown timeline products for day x-1	If applicable, EPOC and DP POC FTP updated as-flown timelines to the MDC; MDC updates the merged as-flown timeline products on the WWW
Telemetry		EPOC retrieves playback data from	Guaranteed best data for data collection day x-1 is available; DP POC retrieves playback data from the MDC			
Contact based support products (Actual PVAT)			MDC will post for data collection day x-1 on Web			
Other Support products (NMC data, Solar Geomagnetic Indices)		If available, MDC will post for data collection day x-1 on Web	MDC will post for data collection day x-1 on Web			
Routine data products		EPOC begins data processing for data collection day x-1	DP POC begins data processing for data collection day x-1	Routine data products are available on the WWW for data collection day x-1. These are Level 1 and Level 2 products.		Routine data products are available via CD-ROM to the GUVI Co-I's
Status		If available, the Good and Bad Telemetry Status files from MDC for data collection day x-1; Also if needed Telemetry Status Change Notification(s) for data collection day x-1 available from the MDC	If necessary, final telemetry status notification for data collection day x-1 is available from the MDC	DP POC FTPs Status products for data collection day x-1 to the MDC		

The overall data product generation/regeneration control flow of the Scheduler CSU is depicted in Figure 4 and is identified as follows:

- If GUVI Level 0 telemetry files are available, this CSU will invoke the Data Reformatter CSC to produce Level 1A data files indicating the start and stop times of the data to be retrieved. For new data products, the overall time duration for the data being processed will be approximately 24 hours. The overall duration will be determined by TIMED and will be the amount of data that can be downloaded from the spacecraft during a given pass, or passes if the backup contact is utilized.
- If GUVI Level 1A data files have already been generated by the Data Reformatter CSC, this CSU will then invoke the Science Algorithms CSC to process them and produce Level 1C and Level 2 data products. The procedure being called in the Science Algorithms CSC will actually be implemented as an Ada task utilizing the Ada 95 tasking model. This tasking model automatically handles (as part of the language) distribution of multiple processes (tasks) across multiple processors.

  The Scheduler CSC will be responsible for invoking up to 4 separate Science Algorithms CSC tasks to handle up to 4 orbits simultaneously. Note that the processes distributed across the multiple CPUs will all be the same, i.e. only generation of new data products, or only regeneration of existing data products and only the Science Algorithms CSC processing of Level 1 and Level 2 data products will be distributed across the multiple processes.
- If the Science Algorithms CSC have processed GUVI Level 1 and Level 2 data files, then the Data Manager CSC will be invoked to produce summary, status and routine Level 3 data products.

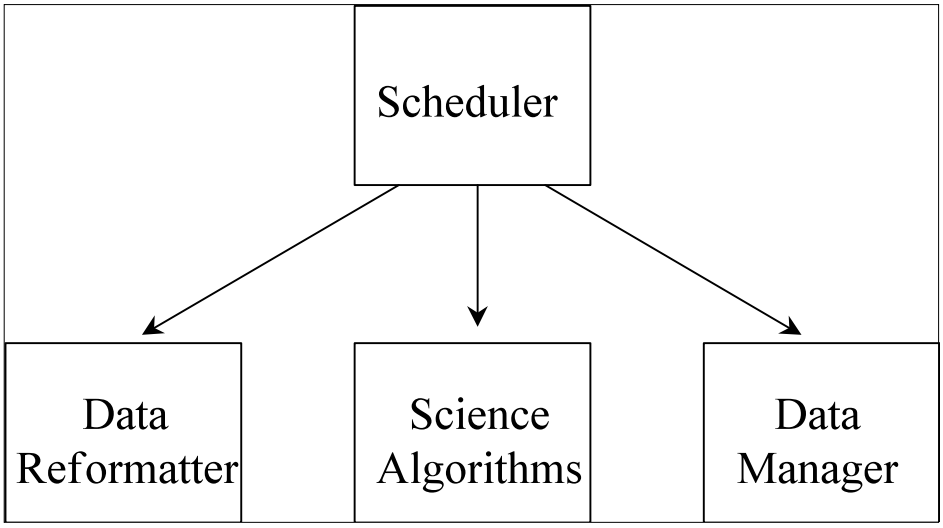

Figure 3.1.4-1. Scheduler CSC Control Flow Diagram

In addition, as requested by the operator via the Update Data Tables Dialog, this CSU will, as time allows, automatically go out and update the GUVI data tables by invoking the Update Data Tables CSU. This CSU will also, when notified by the Watchdog Timer CSU, move GUVI data products from the short-term archive to the long-term archive by invoking the Archiver CSU.

The system being implemented is such that either all or none of the data products from a specified time period get regenerated. However, the DP POC operator will have the capability to abort the regeneration of data products. As time allows, we are planning on adding the capability to regenerate portions of data products, i.e. specified region and/or specified data product levels like Level 2 and up.

3.1.5 Archiver CSU

The Archiver CSU is invoked by the Scheduler CSU to periodically move routinely created GUVI Level 1 and Level 2 data products from the short-term archive to the long-term archive. In addition, user created data products that have been manually registered with the DP POC will be long-term archived. Level 3 data products, summary products and survey products will remain in short-term archive.

As a rule, only six months of GUVI data products are stored on-line, the remaining data products are stored near-line on a CD jukebox attached and dedicated to the DP POC. This task is "scheduled" in by the Scheduler CSU so data products may not be moved to the long-term archived at exactly 6 months. To accommodate for this, there is an excess short-term storage capability on the DP POC that will prevent this from being a problem. This CSU invokes the Long Term Archiver CSU to move the data products to a long-term archive. The long-term archive for GUVI data products consists of a CD jukebox and as such, this CSU will invoke the CD Writer CSC to write the data product(s) to CD-ROM. This CSU is part of the DP POC autonomous operations.

When a data product has been moved to a long-term archival, the path and/or URL to that data product will also need to be updated as well as the data catalog entry. To accommodate that, this CSU will invoke the Data Catalog CSC to keep the catalog current and the Generate Data Product URL File CSU to notify the MDC.

3.1.6 Sync to UTC CSU

The Sync to UTC CSU is periodically invoked by the Watchdog Timer CSU to sync the DP POC system clock to UTC time and has no inputs or outputs. This CSU utilizes the APL Internet Network Time Protocol (NTP) to obtain UTC time and will then set the DP POC system clock to this time. NTP utilizes the User Datagram Protocol (UDP) protocol.

This CSU will ensure that the system clock will always have the correct time within a few seconds so that the DP POC system clock can be utilized when creating data products.

3.1.7 Regeneration Queue CSU

The Regeneration Queue CSU is responsible for maintaining a queue of all outstanding data product regeneration processes that are pending execution. This queue will be sorted in descending order on S/C time and items to be processed will be determined by the Process Change Telemetry Status CSU. The concept of having a history of change status files has not been documented in the GIIS, Reference 8. When these interfaces become finalized, the design of this CSU will be expanded.

3.2 Data Reformatter CSC

The Data Reformatter CSC will be written in C++ and is invoked by the Scheduler CSU to retrieve and process GUVI Level 0 telemetry files and TIMED supporting files into GUVI Level 1A data products. This CSC receives as inputs a start and stop time for the data to be processed. The Data Reformatter CSC will retrieve the data from the MDC and will also decommutate and convert the files into a series of single orbit Level 1A data files for processing by the Science Algorithms CSC.

The Data Reformatter CSC consists of the following CSUs and its data flow is depicted in Figure 3.2-1:

- Data Retriever CSU
- Data Converter CSU
- Orbit Partitioner CSU
- Level 1A File Output CSU

This CSC will be used to both regenerate existing data products as well as to generate new data products and it will be transparent as to which process is actually occurring. The start and stop times inputted indicate which data should be retrieved from the MDC and processed.

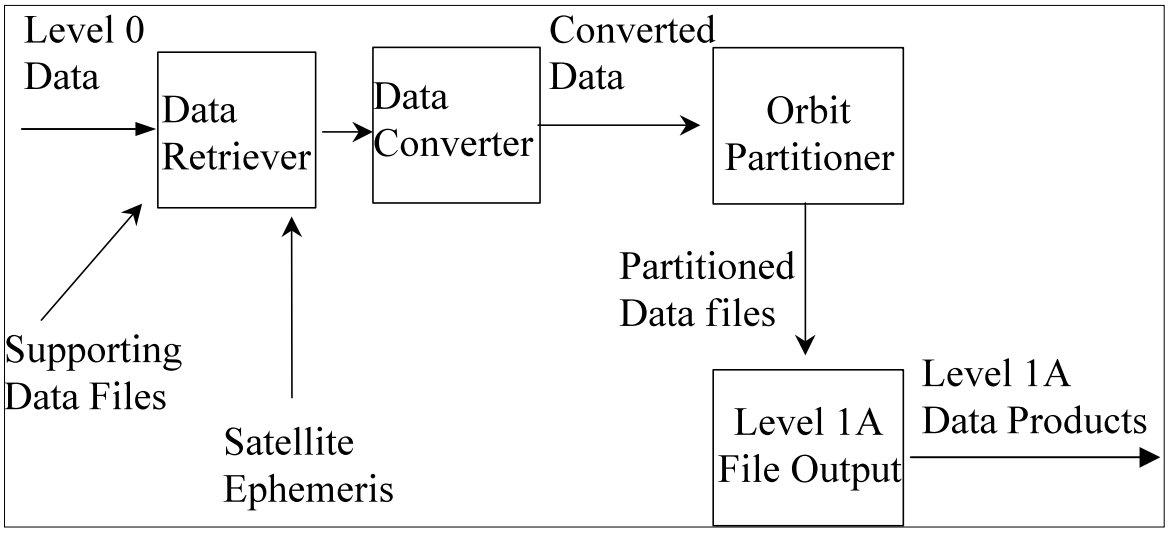

Figure 3.2-1. Data Reformatter CSC Data Flow Diagram

3.2.1Data Retriever CSU

The Data Retriever CSC is responsible for obtaining the following information from the MDC for an inputted time period:

- GUVI instrument telemetry
- GUVI instrument housekeeping
- TIMED S/C housekeeping
- Solar and Geomagnetic Indices file
- Orbit Number file
- Current Good Telemetry Status file
- Current Bad Telemetry Status file
- Actual Position, Velocity, Attitude and Time (PVAT) file

This CSC will retrieve the GUVI instrument telemetry, GUVI instrument housekeeping and TIMED spacecraft housekeeping as POC Telemetry Packets (PTPs) via a playback stream service sorted by s/c time from the MDC utilizing the MDC Socket Service CSC. This CSC will request of the MDC Socket Service CSC, a single stream for all of the ApIDs identified in Tables 3.2.1-1 and 3.2.1-2 for the given duration passed to the Data Reformatter CSC.

The GUVI instrument can be in only one mode at a given time and there are separate ApIDs for each operational instrument mode. Therefore, it is possible that the data for a given ApID may be empty. The remaining files identified above will be retrieved from the MDC via File Transfer Protocol (FTP) utilizing the FTP File Service CSU.

ApID	GUVI Data Type
480H	Housekeeping Data
481H	Imaging Mode Data
482H	Spectrograph Mode Data

Table 3.2.1-1. Utilized GUVI ApIDs

Lower 7 bits of ApID	S/C Housekeeping Data Type
000 0100	High Priority Housekeeping Data
000 0110	Low Priority Housekeeping #1 Data
000 0111	Low Priority Housekeeping #2 Data

Table 3.2.1-2. Utilized TIMED Spacecraft ApIDs

The data files and Level 0 data are always available from the MDC and will not be archived on the DP POC. If this data is needed at a later date, this CSC will retrieve again the files from the MDC.

There are additional TIMED data files available that will be utilized by the Science Algorithms CSC and they are also documented in the GIIS, Reference 8. These files only change infrequently and/or need to be read infrequently to determine whether processing is warranted. Currently, the mechanism has not been fully defined by TIMED as to how the POCs will be notified of changes to these files. The DP POC is making the assumption that they will be downloaded from a TBD CSU and checked for updates on a TBD frequency. The files that fall into this category are as follows:

- Spacecraft Telemetry Definitions file
- Support Data Status file

The GUVI DP POC is assuming that Kp or some variation that Kp can be derived from will be available in a timely manner so that the GUVI routine data products can be processed within 54 hours of its acquisition on orbit, as mandated in the TIMED DMP, Reference 7. The Science Algorithms CSC will utilize Kp or its variation to derive the auroral boundary. The GUVI DP POC is also assuming that Kp or the variation of Kp will be available via the daily Solar and Geomagnetic Indices file.

3.2.2Data Converter CSU

The Data Converter CSU is responsible for decommutating the TIMED spacecraft housekeeping and the GUVI instrument status word utilizing the previously downloaded Spacecraft Telemetry Definitions file. This CSU is also responsible for unpacking GUVI instrument telemetry data and converting the GUVI instrument data from engineering units. In addition, the Data Converter CSU is responsible for providing interpolation on the position and attitude data obtained in the PVAT file to align it with GUVI instrument telemetry based on s/c UTC time.

3.2.3Orbit Partitioner CSU

The Orbit Partitioner CSU is responsible for partitioning the following information on an orbit basis where an orbit is defined by TIMED in the Orbit Number file that was previously downloaded by the Data Retriever CSU:

- GUVI instrument telemetry converted data
- GUVI instrument housekeeping converted data
- TIMED S/C housekeeping converted data
- Solar & Geomagnetic Indices file
- Interpolated Actual Position, Velocity, Attitude and Time data
- Current Good Telemetry Status file
- Current Bad Telemetry Status file

3.2.4Level 1A File Output CSU

The Level 1A File Output CSU is responsible for outputting the Level 1A data to a file and/or pointer to a structure for use by the Science Algorithms CSC. The Level 1A data consists of a single orbit's worth of all of the data partitioned into single orbits by the Orbit Partitioner CSU.

The preferred method will be pointers to a structure as opposed to data files especially since GUVI Level 1A data files are not deliverable because of their large size. The exact implementation will be refined by a series of C++/Ada 95 tests since the Data Reformatter CSC will be implemented in C++ and the Science Algorithms CSC will be implemented in Ada 95. The tests will determine if pointers can be passed from C++ to Ada 95. Documentation indicates that the passing of pointers should be feasible.

3.3 Science Algorithms CSC

The Science Algorithms CSC will be written in Ada 95 and is invoked by the Scheduler CSU. The purpose of this CSC is to process the Level 1A data files into the GUVI Level 1C and Level 2 data products as identified in Table 2. This CSC receives as inputs the Level 1A data to be processed. Once generated, these data products can then be accessed by the Data Manager CSC and the User Interface CSCI for display and by the Webserver Capability CSCI for display and access.

3.4 Data Manager CSC

The Data Manager CSC will be written in C++ and is invoked by the Science Algorithms CSC, the Execution Control CSC, and the Webserver Capability CSCI. The purpose of this CSC is to provide general utilities for the management of the GUVI data products. This CSU is responsible for providing the data product configuration control, data product registration (as required by TIMED), management of the GUVI data catalog, utilities for the generation and regeneration of the GUVI data products as well as the generation of planning tools, summary products, survey products and routine Level 3 data products.

The Data Manager CSC consists of the following CSCs and its overall data flow is depicted in Figure 3.4-1

- Data Product Services CSC
- Version Control CSC
- Data Catalog CSC
- MDC Data Product Files CSC

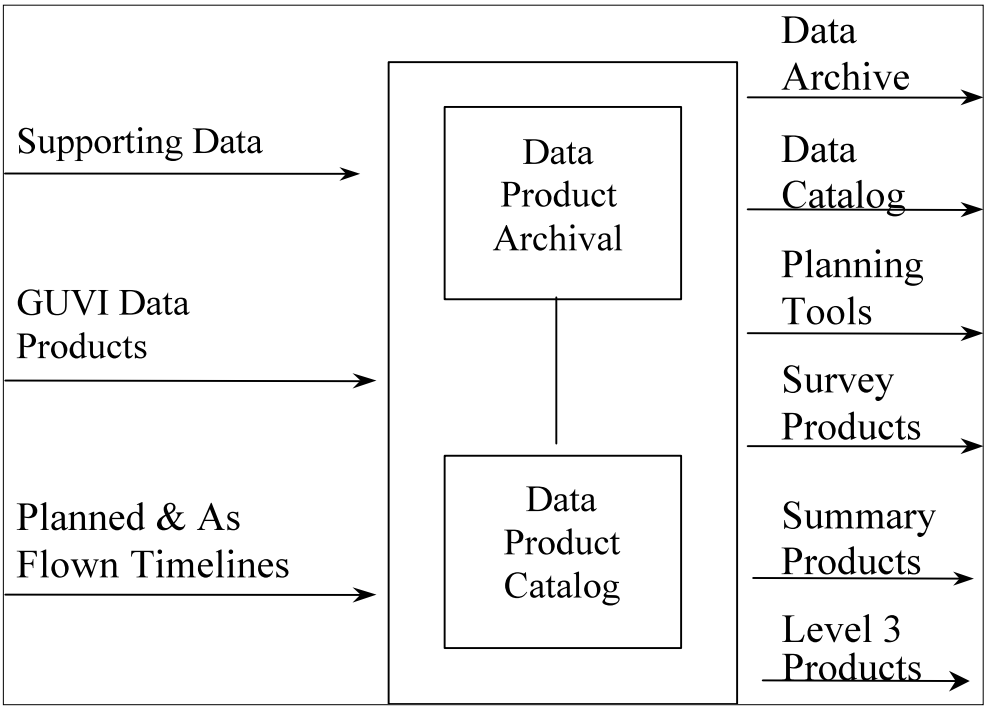

Figure 3.4-1. Data Manager CSC Data Flow Diagram

3.4.1Data Product Services CSC

The Data Product Services CSC provides general utilities for the generation and regeneration of data products as well as a data product registration capability. This CSC is invoked by the Science Algorithms CSC, the Execution Control CSC, the Operator Interface CSC and the Webserver Capability CSCI and consists of the following CSUs:

- Register Data Product CSU
- Short Term Archiver CSU
- Long Term Archiver CSU
- Generate Final Data Products CSC
- Anomaly Generator CSU
- Set Data Product Quality CSU
- Update Data Tables CSU
- Data Product Regeneration CSU
- Provide Daily Update CSU
- Process Changed Support Data CSU
- Process Changed Telemetry Data CSU

3.4.1.1Register Data Product CSU

The Register Data Product CSU provides the ability to register both new and regenerated data products as well as user defined data products. All automatically generated routine data products will automatically be registered via calls from the Science Algorithms CSC and the Data Manager CSC to this CSC.

User defined data products are data products not generated automatically by the DP POC and can consist of data products created by a GUVI Co-I as well as "automated" and "analysis" data products created requiring some level of human intervention. Calls to this CSU for user defined data products are initiated via operator selection from the Register Data Products Dialog.

This CSU receives as inputs the complete data product pathname (it assumes that the data product is physically located on the DP POC) and the data product filename. The data product must follow GUVI header conventions as identified in Appendix A, such that all pertinent information to a data product is located in its header and the data product must be stored utilizing NetCDF.

This CSU will handle all of the following requirements and invoke the appropriate routines in the MDC Data Product Files CSC:

- Invoke the Generate Data Availability Notification CSU as a TIMED MDC requirement
- Invoke the Generate Data Product Specification File CSU as a TIMED MDC requirement
- Invoke the Generate Data Product URL File CSU as a TIMED MDC requirement
- Invoke the Generate Data Product Status File CSC as a TIMED MDC requirement
- Invoke the Data Catalog CSC to include the data product into the GUVI data catalog
- Invoke the Short Term Archiver CSU to archive the data product in on-line storage
- Invoke the Provide Daily Update CSU to update the status of the data products

The exact files and formats for the TIMED MDC interface files required for GUVI data products have not been finalized and are currently in a state of flux. Until they have been finalized, this CSUs requirements, interfaces, design and implementation will also continue to be in a state of flux.

3.4.1.2Short Term Archiver CSU

The Short Term Archiver CSU is responsible for archiving the specified data product and is invoked by the Register Data Product CSU. The last six months of GUVI data products will be stored on-line so this CSU will place the data product into the appropriate GUVI data product directory structure on the DP POC for on-line storage. Note that the GUVI survey and summary products will always be stored on-line. This CSU assumes that the data product is already physically located on the DP POC.

3.4.1.3Long Term Archiver CSU

The GUVI DP POC will be utilizing a hierarchical storage manager for providing long-term archival of GUVI routine data products older than six months. The Long Term Archiver CSU is invoked by the Archiver CSU to periodically move GUVI Level 1, 2 and 3 data products from on-line storage to near-line storage on a CD jukebox physically attached and dedicated to the DP POC.

This CSU will invoke the CD Writer CSC to write the data to a CD-ROM and assumes that the data products to be long-term archived are already physically resident on the DP POC and have already been short-term archived via the Short Term Archiver CSU.

The hierarchical storage manager will be a commercial off-the-shelf (COTS) product and has not been currently selected. Once the product has been selected, the design and implementation for this CSU will be expanded and then finalized.

3.4.1.4Generate Final Data Products CSC

The Generate Final Data Products CSC is invoked by the Scheduler CSC after the Data Reformatter CSC has processed the GUVI Level 0 telemetry files and after the Science Algorithms CSC has produced the GUVI Level 1 and Level 2 data products. Final is actually a misnomer because the data products can be regenerated at any time but this is the "final" processing that needs to be performed when processing 24 hours worth of GUVI data.

This CSC is responsible for generating the summary products, survey products and all routine Level 3 data products given 24 hours worth of GUVI data products. This CSC consists of the following sub-level CSCs:

- Generate Summary Products CSC
- Generate Survey Products CSC
- Generate Routine Level 3 Data Products CSC

This CSC will invoke each of its sub-level CSCs to produce all of the GUVI "final" data products.

3.4.1.4.1Generate Summary Products CSC

The Generate Summary Products CSC is responsible for generating summary products utilizing 24 hours worth of GUVI Level 1 and Level 2 data products. A preliminary set of summary products has been generated and this will continue to be refined by Co-I interaction and user interface prototypes. The summary products produced will be documented in the GUVI Data Products List not included as part of this document.

This CSC will invoke the Register Data Product CSU to register all generated data products, the Short Term Archiver CSU to archive the data products as well as the other miscellaneous MDC interface data files necessary using the Register Data Product CSU.

3.4.1.4.2Generate Survey Products CSC

The Generate Survey Products CSC is responsible for generating survey products from 24 hours worth of GUVI Level 1 and Level 2 data products. Survey products are defined as summary or low fidelity data used for quicklook or data location. A preliminary set of survey products has been generated and this will continue to be refined via Co-I interaction and user interface prototypes. The survey products will be documented in the GUVI Data Products List not included as part of this document.

This CSC will invoke the Register Data Product CSU to register all generated data products, the Short Term Archiver CSU to archive the data products as well as the other miscellaneous MDC interface data files necessary using the Register Data Product CSU.

3.4.1.4.3Generate Routine Level 3 Data Products CSC

The Generate Routine Level 3 Data Products CSC is responsible for generating the routine GUVI Level 3 data products. The GUVI definition of routine Level 3 data products comprises multiple orbits worth of GUVI data. This CSC will utilize GUVI Level 1 and Level 2 data products as well as the summary and survey products produced by the Generate Summary Products CSC and the Generate Survey Products CSC. A preliminary set of Level 3 data products has been generated and this will continue to be refined by Co-I interaction and user interface prototypes. The Level 3 data products produced will be documented in the GUVI Data Products List not included as part of this document.

This CSC will invoke the Register Data Product CSU to register all generated data products, the Short Term Archiver CSU to archive the data products as well as the other miscellaneous MDC interface data files necessary using the Register Data Product CSU.

3.4.1.5Anomaly Generator CSU

The Anomaly Generator CSU is responsible for outputting all automatically detected anomalies into the appropriate as-flown timeline. The as-flown timelines are manually created by the EPOC every 24 hours and the EPOC operator is responsible for FTPing these files to the DP POC. This ensures that the DP POC always has access to the latest version of an as-flown timeline. Unix does not prevent the as-flown timelines from being simultaneously opened by multiple users however both the EPOC and the DP POC will be located at JHU/APL and since only the POC operators will be manually modifying the files, we are assuming that the operators will have to be individually responsible for not doing this.

The filenames of the as-flown timelines indicate the 24-hour period they encompass so the anomaly is placed in the correct file(s) based on the time that the anomaly occurs. After the appropriate as-flown timeline has been updated,

this CSU will invoke the FTP File Service CSU to FTP the updated version of the file to the MDC and to the EPOC. This will then ensure that the EPOC will also have the latest version of the as-flown timelines.

This CSU receives as inputs the anomaly identifier, the start and stop times for the anomaly, and a character string if the anomaly is user defined. When automatically detected anomalies are of a TBD severity, this CSU will also invoke the E-mail DP POC Operator CSU to alert the DP POC operator as part of the DP POC autonomous operations.

3.4.1.6Set Data Product Quality

The Set Data Product Quality CSU is responsible for changing a data product's quality indicators based on the class of the data product, the data product itself and the Data Product Version Number as defined in the TIMED DMP, Reference 7. This CSU is invoked by the Update Data Product Quality Dialog in the Operator Interface CSC as well as by the Science Algorithms CSC for newly created data products.

This CSU receives as inputs the specific data quality indicators to be updated, the data product class, the data product, the data product revision number and the values to change the data quality flags to. Data product quality indicators can be updated for an entire class of data products or for individual data products as well.

In addition, this CSU will update entries for the data product and/or data product class in the GUVI data catalog via calls to the Data Catalog CSC. This CSU will also invoke the Generate Data Product Status File CSU to generate a new file and FTP it to the MDC, noting that this file is affected by TIMED/MDC data product interface changes.

3.4.1.7Update Data Tables CSU

The Update Data Tables CSU is invoked by the Scheduler CSU after operator selection from the Update Data Tables Dialog in the Operator Interface CSC. This CSU automatically goes out and updates the GUVI calibration data tables as well as all other corresponding data tables based on the newly updated calibration. This CSU invokes a TBD CSU in the Science Algorithms CSC to do the actual update. This CSU also invokes the Data Table Version Control CSU to provide configuration control of the updated data tables as well as upgrading, as necessary, the version numbers for data products generated after the update was performed.

This CSU will only be invoked when there is no generation or regeneration of data products currently being performed.

3.4.1.8Data Product Regeneration CSC

The Data Product Regeneration CSC provides information on the status of the GUVI data product regeneration process, provides change notification status to the MDC and also provides a percentage complete for the current process. The Webserver Capability CSCI will utilize percentage complete for display purposes on the GUVI web page. This CSC will also provide an interface to allow the operator to stop the regeneration process via the Regenerate Data Products Dialog.

The change notification status required by the MDC is a two-tiered approach. Prior to the start of regeneration, an initial change notification status is sent to the MDC. When the data product regeneration process is complete, a final change notification status is then sent to the MDC. The MDC will take care of notifying interested TIMED and GUVI users that GUVI data products are going to be or have already been regenerated.

Note that only one manually initiated data product regeneration process can occur at any given time and to initiate another regeneration, the first one must have already completed or aborted.

This CSC consists of the following CSUs:

- Provide Preliminary Change Notification Status CSU
- Provide Final Change Notification Status CSU
- Provide Percentage Complete CSU
- Stop Data Product Regeneration CSU

3.4.1.8.1Provide Preliminary Change Notification Status CSU

The Provide Preliminary Change Notification Status CSU will provide notification to the MDC that the data product regeneration process is starting. This CSU is invoked by the Scheduler CSC both after operator selection on the Regenerate Data Products Dialog in the Operator Interface CSC and by the automatic regeneration process just prior to the start of data product regeneration.

The MDC interface for this is currently being defined and this CSU will FTP the MDC a TBD file indicating that the process has started via the FTP File Service CSU.

3.4.1.8.2Provide Final Change Notification Status CSU

The Provide Final Change Notification Status CSU provides notification to the MDC and to the Webserver Capability CSCI that the data product regeneration process has either been completed or aborted. This CSU is invoked by the Scheduler CSC and the Stop Data Product Regeneration CSU.

The MDC interface for this is currently being defined and this CSU will FTP the MDC a TBD file indicating that the process has been completed via the FTP File Service CSU.

3.4.1.8.3Provide Percentage Complete CSU

The Provide Percentage Complete CSU provides a status of the data product regeneration process. This CSU is invoked by the Webserver Capability CSCI for display on the GUVI web page a percentage complete and by the Watchdog Timer CSU to periodically update the status. Percentage complete is an approximation based on the overall processing time of 24 hours worth of data, the overall duration and the amount of data that has been currently processed.

3.4.1.8.4Stop Data Product Regeneration CSU

The Stop Data Product Regeneration CSU provides the interface that allows the DP POC operator to halt the currently established regeneration of data products. This CSU is invoked by the Regenerate Data Products dialog in the Operator Interface CSC and upon operator initiation, will notify the Scheduler to abort the currently ongoing regeneration process after it completes its current processing. This CSU will also call the Provide Final Change Notification Status CSU to output a regeneration completion status to the MDC. Only manually initiated regeneration processes can be aborted.

3.4.1.9Provide Daily Update CSU

The Provide Daily Update CSU provides daily updates on the GUVI data products as determined by the Provide Percentage Complete CSU. This CSU is invoked by the Register Data Product CSU to keep track of all newly created and regenerated data products. This CSU is also invoked by the Webserver Capability CSCI to provide the information on the newly created and regenerated data products to registered GUVI data product users.

3.4.1.10Process Changed Support Data CSU

The Process Changed Support Data CSU receives as input the address to the Support Data Status Notification File as provided by the MDC. Utilizing this address, this CSU will FTP the file from the MDC using the FTP File Service CSU. This CSU will then determine if any of the support data files that GUVI utilizes has changed and passes back a Boolean value indicating if data product processing and/or reprocessing is required for the inputted file. This CSU will need to be called multiple times if there are multiple Support Data Status Notification files that need to be evaluated. The support data files that are utilized by the DP POC to generate data products are as follows:

- Solar & Geomagnetic Indices file
- Actual PVAT file

- Orbit Number file

3.4.1.11Process Changed Telemetry Data CSU

The Process Changed Telemetry Data CSU receives as input the address to the Telemetry Status Change Notification File as provided by the MDC. Utilizing this address, this CSU will FTP the file from the MDC using the FTP File Service CSU. The exact mechanism for receiving Telemetry Status Change Notification updates has not been entirely resolved or documented yet. Therefore, the design of this CSU will be in a state of flux subject to the actual implementation.

This CSU will then determine if any of the ApIDs that GUVI is utilizing has changed and passes back a Boolean value indicating if data product processing and/or reprocessing is required for the inputted file. All files that indicate GUVI data processing is necessary will be moved onto a regeneration queue with the most recent Telemetry Status Change Notification files first. Items will be removed from this queue by the Scheduler CSU in descending time, thus the most recent changes will be processed first.

Currently, this CSU will need to be called multiple times if there are multiple Telemetry Status Change Notification files that need to be evaluated. The ApIDs that are utilized by the DP POC to generate data products are identified in Table 5 and Table 6.

3.4.2Version Control CSC

The Version Control CSC is responsible for providing version control on all GUVI automatically and routinely generated data products and all GUVI data tables utilized in generating the data products. This CSC consists of the following CSUs:

- Data Product Version Control CSU
- Data Table Version Control CSU
- Version Definition CSU
- Select Version CSU

3.4.2.1Data Product Version Control CSU

The Data Product Version Control CSU is responsible for providing version control on all GUVI automatically generated routine data products. User defined data products will not be under any form of version control. This CSU provides the ability to obtain the current version number for the inputted data product class and also provides the ability to input new data product versioning numbers for the inputted data product class.

This CSU invokes the Version Definition CSU when a data product version number is being changed.

3.4.2.2Data Table Version Control CSU

The Data Table Version Control CSU is responsible for providing version control on all manually updated and automatically updated GUVI data tables. This CSU provides the ability to obtain the current version number for the inputted data table(s) and also provides the ability to increment the data table versioning numbers.

This CSU invokes the Version Definition CSU when a data table version number is being changed.

3.4.2.3Version Definition CSU

The Version Definition CSU is responsible for keeping track of all of the sub-version numbers that comprise a Data Product Version Number. A Data Product Version Number consists of a Product Format Version Number, a major and minor Software Version Number, and a major and minor Input/Cal Version Number as defined in the TIMED DMP, Reference 7.

There are interim version numbers that affect the above mentioned version numbers and these are currently being refined. The interim numbers include the following:

- Detector processor software version
- Telemetry processor software version
- Unit parameter table version
- Color definition table version
- DP POC Data table versions
- Science Algorithms CSC version(s)
- Data Reformatter CSC version
- Data Manager CSC version
- Utilities CSC version

This CSU will write a cross-referenced table of Data Product Version Numbers and all of the sub-version numbers as identified above and in the TIMED DMP (Reference 7) to an ASCII text file. This CSU also invokes the Data Catalog CSC to store the version information, including the interim version numbers in the GUVI data catalog.

3.4.2.4Select Version CSU

The Select Version CSU is invoked via operator initiation from the SoftwareVersion dialog. This CSU provides the capability for the operator to generate data products or regenerate data products utilizing specific software versions and data table versions. If interface files, such as the data tables or the data product files change in actual format as opposed to content, only certain versions of the software may be available to read them.

The individually controlled ground processing software and ground data tables that can be selected are identified below. These areas will continue to be refined such that sub-version numbers within these components will be individually selectable as well:

- DP POC data table versions
- Science Algorithms CSC versions
- Data Reformatter CSC version
- Data Manager CSC version
- Utilities CSC version

The goal is to be able to individually select the appropriate algorithms to be utilized as well as to provide the ability to select individual data tables to be utilized for data product generation. The data products generated from these selections will have unique Data Product Versions and all of the parts that made up the generation process will be tracked by the Data Product Version Control CSU.

This process will be accomplished utilizing Unix symbolic links. A symbolic link is a file that contains the pathname of another file. For example, using this mechanism, a “generic” data table file will actually be a symbolic link to a specific version of that data table. The DP POC ground processing software will utilize the “generic” data table file name that will then automatically point to the appropriate data table version to be utilized when the software is actually executing. For software, this process will be accomplished utilizing dynamic make files and symbolic links on the object files that comprise an executable. This could cause a new software link, bind, etc. (as determined by the language of the software) which will be performed as part of this CSU processing via a Unix daemon after this software has exited gracefully (depending again on the extent of the software change).

3.4.3Data Catalog CSC

The Data Catalog CSC is responsible for providing the GUVI data catalog, a mechanism to search the GUVI data products for specific characteristics. This CSC provides the ability to add/update entries in the data catalog and also provides the ability to query the data catalog via an Internet browser. This CSC still has a TBD design. We are planning on utilizing a series of flat files to store the information as opposed to a relational database management system but that can change depending on the complexity of the catalog.

The items to be placed in the catalog are defined in Appendix C and will continue to be refined via a series of data catalog user interface prototypes and GUVI Co-I input. In addition, the full implementation and/or design of the data catalog will not be available pre-launch, but instead will be completed during MO/DA.

3.4.4 MDC Data Product Files CSC

The MDC Data Product Files CSC is responsible for generating and FTPing all MDC required interface files. This CSC consists of the following CSUs:

- Generate Data Availability Notification CSU
- Generate Data Product Specification File CSU
- Generate Data Product URL File CSU
- Generate Data Product Status File CSU

The TIMED/MDC interface requirements are documented in the TIMED GIIS, Reference 8 and the TIMED DMP, Reference 7 and are the sole driver for the requirements of this CSC. These requirements are currently in a state of flux so the actual design, interfaces and/or files implemented are subject to change.

3.4.4.1 Generate Data Availability Notification CSU

The Generate Data Availability Notification CSU is responsible for generating the MDC Data Availability Notification (DAN) required as an MDC interface and FTPing it to the MDC via the FTP File Service CSU. This interface is still being defined/refined by the TIMED Ground System folks. This CSU receives as inputs whatever is required as input to the MDC. The required information will be incorporated into the header of the data product file that will be read by this CSU.

3.4.4.2 Generate Data Product Specification File CSU

The Generate Data Product Specification File CSU is responsible for generating the Data Product Specification File as defined in the TIMED Data Management Plan, Reference 7. This CSU receives as inputs all data product information required to be inputted into this file as an MDC interface and FTPs it to the MDC via the FTP File Service CSU.

3.4.4.3 Generate Data Product URL File CSU

The Generate Data Product URL File CSU is responsible for generating the Data Product URL File. This CSU receives as inputs all data product information required to be inputted into this file required as an MDC interface and FTPs it to the MDC via the FTP File Service CSU.

3.4.4.4 Generate Data Product Status File CSU

The Generate Data Product Status File CSU is responsible for generating the Data Product Status File as defined in the TIMED GIIS, Reference 8. This CSU receives as inputs all data product information required to be inputted into this file required as an MDC interface and FTPs it to the MDC via the FTP File Service CSU.

3.5 Utilities CSC

The Utilities CSC will be written in C++ and is invoked by the Execution Control CSC, the Data Reformatter CSC, the Data Manager CSC and the Data Product Services CSC. This CSC provides basic utilities required by multiple CSCs within the Algorithms CSCI. This CSC is responsible for performing file FTPs as well as establishing socket service between the MDC and the DP POC, providing notification to the DP POC operator of alarming and/or erroneous conditions as well as providing NetCDF file readers.

This CSC consists of the following CSUs:

- FTP File Service CSU
- MDC Socket Service CSC
- Generic Socket Service CSC
- CD Writer CSC
- Write to Software Log CSU
- E-mail DP POC Operator CSU
- NetCDF File Services CSU

3.5.1FTP File Service CSU

The FTP File Service is responsible for FTPing a file(s) to/from the DP POC to/from a designated machine (if specified). The intention of this CSU is to provide an FTP file service between the MDC and the DP POC as well as between the DP POC and the EPOC. The designated machine will have the MDC as the default, the directional default will be from the MDC to the DP POC and the file type will default to binary. This CSU receives as inputs the directory and file name(s) of the source file, the machine to copy/receive the file from, the destination directory, a direction (get or put) and the file transfer type (i.e. binary). This CSU will then FTP the source file to/from the designated machine.

This CSU will consist of Unix system calls utilizing standard Transmission Control Protocol/Internet Protocol (TCP/IP) FTP protocols. For gets, this CSU will invoke an FTP client process on the DP POC, establish a connection with an FTP server process on the designated machine, provide access information for the designated machine and then transfer the file(s). For puts, this CSU will invoke an FTP server process on the DP POC, establish a connection with an FTP client process on the designated machine, provide access information for the designated machine and then transfer the file(s).

3.5.2MDC Socket Service CSU

The MDC Socket Service CSU will provide the TIMED MDC protocol to open up a socket with the MDC and establish a stream. This CSU will utilize the MDC stream interface as defined in the GIIS, Reference 8 and will utilize a hardcoded host name and port number as provided from TIMED. The interface consists of specifying a set of stream parameters followed by a begin sequence after connecting to the MDC and will utilize the Generic Socket Service CSC to perform the actual communication protocols.

3.5.3Generic Socket Service CSC

The Generic Socket Service CSC will establish a non-blocking TCP/IP socket and receives an input stream from a designated machine and sends an output stream to the designated machine. Note that only one machine can be designated at a time and the MDC will be the default machine.

This CSC consists of the following CSUs:

- Get Stream CSU
- Connect CSU
- Close CSU
- Receive CSU
- Send CSU

3.5.3.1Get Stream CSU

The Get Stream CSU provides the capability to establish, send to, receive from and close a stream without requiring knowledge of the socket protocol. This CSU will automatically invoke the other routines in the Generic Socket Service CSC in the following order as depicted in Figure 3.5.3.1-1:

1. Connect CSU
2. Send CSU
3. Receive CSU

4. Close CSU

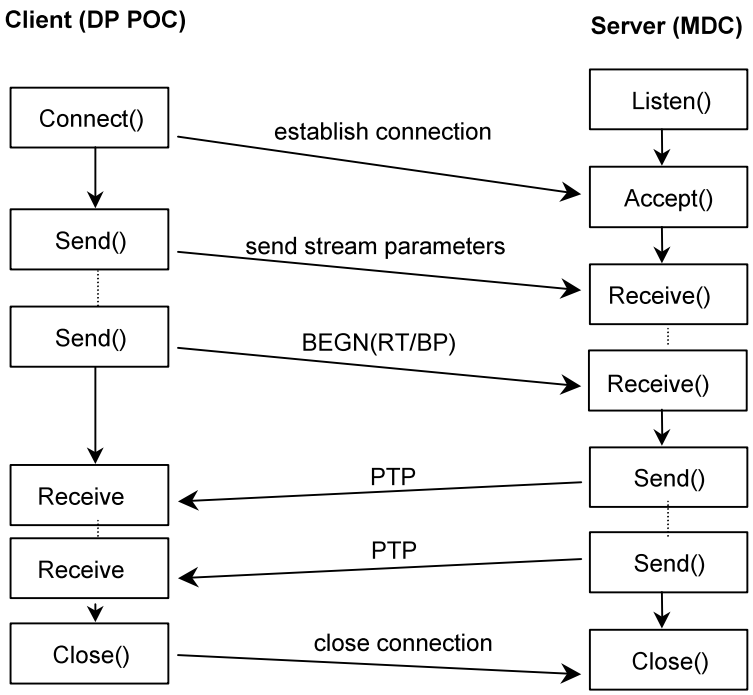

Figure 3.5.3.1. Socket Stream Service

3.5.3.2Connect

3.5.3.2CSU

The Connect CSU will establish a TCP/IP non-blocking stream socket connection utilizing the Internet protocol between a designated machine (defined by a host name and a port #) and the DP POC. The IP address and port # of the MDC will be utilized as the default for the designated machine and this address will be hardcoded as part of this CSC. This information is available in the GIIS, Reference 8 and will be hardcoded in the MDC Socket Service CSC.

This CSU is invoked by the Get Stream CSU and is responsible for opening the socket and establishing the connection. This CSU receives as input sockaddr_in structure (as defined the sys/socket.h) and will return a true or false depending on whether the socket connection has been successfully established.

3.5.3.3Close CSU

The Close CSU will close the designated socket. This CSU is invoked by the Get Stream CSU and will return an error status.

3.5.3.4Receive CSU

The Receive CSU receives as inputs the machine to receive from and a data structure to put each field of the stream into and characteristics to establish the socket (i.e. ApID, start and stop times, etc.) from a designated socket. This CSU will continue to receive data from the stream until a zero filled block is received indicating that there is no more data. This CSU is invoked by the Get Stream CSU and will return an error status.

3.5.3.5Send CSU

The Send CSU provides the ability to output a stream to the designated machine. This CSU receives as inputs the stream parameters as identified by TIMED which will be sent to the designated machine indicating the characteristics of the stream followed by a begin. This CSU is invoked by the Get Stream CSU and will return an error status.

3.5.4CD Writer CSC

The CD Writer CSC is responsible for providing the physical capability to generate CD-ROMs containing the GUVI data products and the GUVI data catalog. This CSC is invoked by operator selection on the Write Data Products to CD dialog in the Operator Interface CSC to cut CD-ROMs containing the GUVI data products for the GUVI Co-Is. This CSU will write the inputted operator selected data files to CD-ROM. The Long Term Archiver CSC also invokes this CSC to provide a long-term data product archive capability.

This CSU takes as inputs the selected data files, a destination, i.e. to CD-ROM for storage on the jukebox or to CD-ROM for data product delivery and the number of CD-ROMs to write, with one being the default. In addition, this CSC will also receive as inputs basic information about the CD-ROM to be written, i.e. volume name, format, etc. as required by the COTS package.

The CD writer utilized by the DP POC will either come with a COTS package or else a standalone COTS software package will be purchased to physically write data to a CD-ROM. The exact design and implementation will be refined upon receipt of the CD writer and COTS package. In addition, as new data storage technology becomes more readily available as well as more economically feasible, i.e. DVDs, alternative data storage mediums will be investigated.

3.5.5Write to Software Log CSU

The Software Log provides a history of events and erroneous conditions for the DP POC software and is intended for internal GUVI DP POC use only. This log will contain s/w processing errors, automatically detected anomalies, etc. The Write to Software Log CSU is responsible for writing inputted character strings and severity codes into the appropriate software log file which will be in an ASCII text format. This CSU can be invoked by any of the CSCs and/or CSUs that comprise the Algorithms CSCI. The Anomaly Generator CSU should process anomalies prior to them being written to the Software Log.

Software log errors will be tagged with an indication of the seriousness of the error and when errors are severe or exceed TBD criteria, this CSU will invoke the E-mail DP POC Operator CSU to directly notify the DP POC operator. This CSU fulfills a part of the DP POC autonomous operation.

3.5.6E-mail DP POC Operator CSU

The E-mail DP POC Operator CSU notifies the DP POC operator via e-mail of severe and/or erroneous conditions. This CSU utilizes an address for the DP POC operator as specified in a local alias file and makes a Unix system call to “sendmail” for the actual operation.

This CSU is automatically invoked by the Write to Software Log CSU and the Anomaly Generator CSU when processing errors are judged to be a TBD severe criteria or when total s/w processing errors exceed a TBD criteria. This CSU fulfills part of the GUVI DP POC autonomous operations.

3.5.7NetCDF File Services CSC

The NetCDF File Services CSC provides utilities to read and write all of the routinely generated GUVI data products that are stored in NetCDF. This CSC is capable of reading and writing all of the NetCDF routine data

product files identified in Appendix B. This CSC will be invoked by Data Reformatter CSC, Science Algorithms CSC, and the Data Manager CSC.

3.6 Operator Interface CSC

The Operator Interface CSC is responsible for providing a user interface specifically designed for the DP POC operator. The DP POC operator is responsible for the following:

- Requesting the regeneration of GUVI data products
- Writing GUVI data products to CD-ROM for delivery to the GUVI Co-Is
- Registering new GUVI data products that were not automatically and/or routinely generated
- Updating GUVI data product quality indicators
- Updating the as-flown timelines for manually detected anomalies
- Initiating a program to automatically update the GUVI data tables
- Manually FTP an operator modified as flown timeline to the MDC and the EPOC
- Specifying specific software versions and data table versions to utilize for generating/regenerating of data products

To facilitate these actions, the Operator Interface CSC will be providing a series of dialogs that the DP POC operator can invoke and utilize. Upon DP POC operator request via these dialogs, the appropriate routines in the Execution Control CSC, Data Manager CSC, Science Algorithms CSC and/or the Utilities CSC will be invoked.

The Operator Interface CSC provides the following dialogs for the DP POC operator to utilize:

- Master dialog
- Regenerate Data Product dialog
- Write Data Products to CD dialog
- Register New Data Products dialog
- Update Data Product Quality dialog
- Update Data Tables dialog
- Update As-Flown Timeline dialog
- Manual FTP File Service dialog
- Specify Version dialog

These dialogs will be implemented in C++ utilizing XWindows/Motif calls to generate the actual dialogs and widgets. If available in-house, a COTS graphical user interface (GUI) Builder will be used to simplify the task of generating the dialogs and the widgets on the dialogs.

The overall flow of control for this CSC is depicted in Figure 3.6-1.

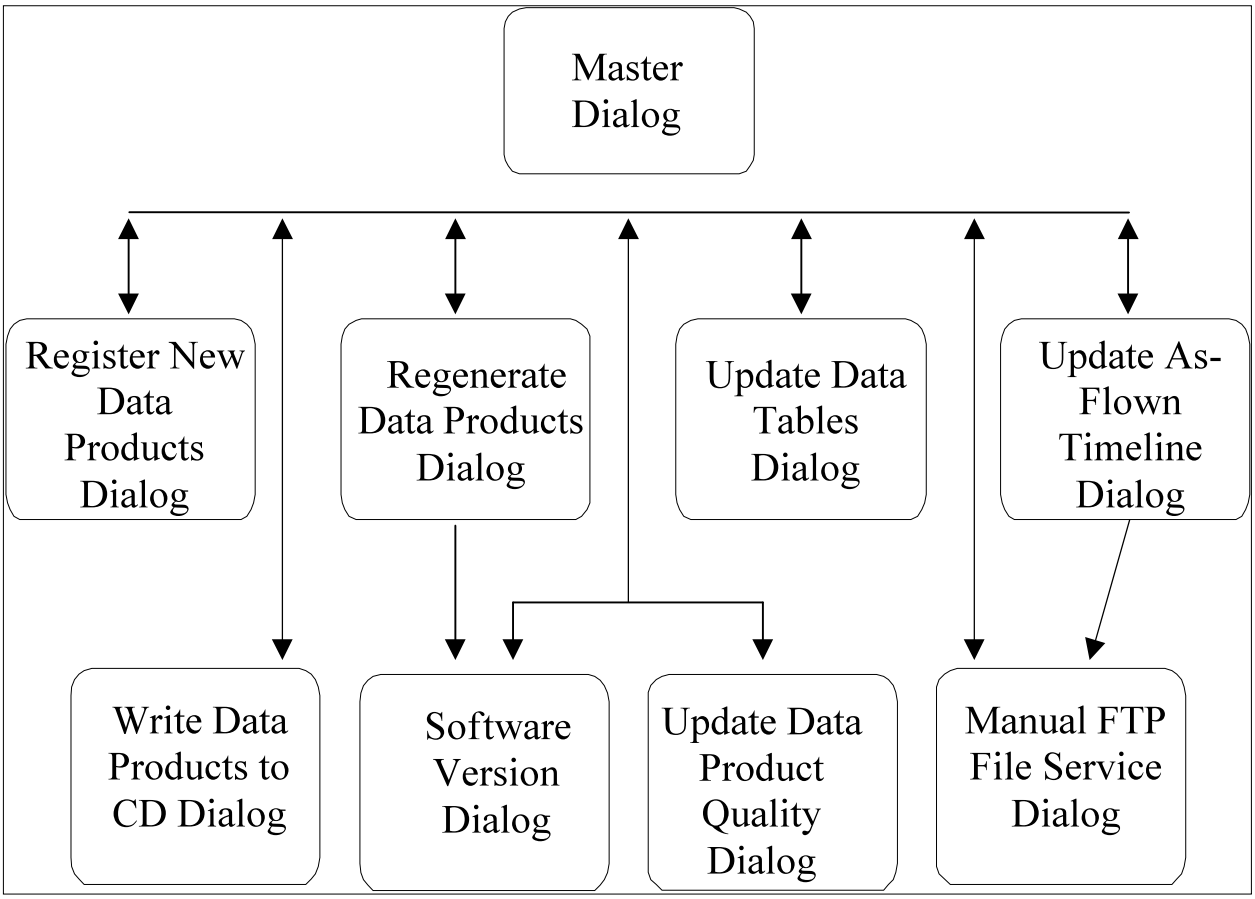

Figure 3.6-1. Operator Interface CSC Control Flow Diagram

3.6.1Master Dialog

The Master dialog's sole purpose is to provide an easy way for the DP POC operator to navigate through the dialogs in the Operator Interface CSC. This dialog contains selections to go to any of the other dialogs identified below. The DP POC operator will be able to invoke these dialogs at any time.

The DP POC operator will also be able to return back to the Master dialog from any of the other dialogs.

3.6.2Regenerate Data Products Dialog

The Regenerate Data Products dialog allows the operator to specify start and stop times as well as start and stop dates of which data products should be regenerated. Only full orbits of data will be processed. If the operator specifies dates/times consisting of partial orbits, the full orbit that comprises that time will be processed. This dialog also allows the operator to specify which versions of the ground processing software and ground processing data tables to be used for the data product regeneration by invoking the Specify Version dialog. Allowable software and data table versions are obtained via calls to the Version Control CSC. If not specified, the default will be to use the current versions of the ground processing software and data tables.

Note that GUVI data products will already be automatically regenerated if the GUVI telemetry or the S/C PVAT file changes without requiring operator initiation. If time allows, this dialog will also allow the operator to specify data product criteria to regenerate (i.e. day only, Level 2B only, etc.). Once initiated, the actual operation will get "scheduled" in by the Scheduler CSU, however only one regeneration of data products process is allowed at any

time. To regenerate different data products, the operator will have to wait until the initial regeneration process has been completed or has been aborted.

This dialog will also provide the operator with the capability to cancel the process of regeneration data products. However if data products are currently in the process of being regenerated, this process will not be halted until after the current activity has completed. In addition, data products that have already been regenerated will not be re-regenerated again.

This dialog also provides a Master Dialog button to return to the Master dialog at any time.

3.6.3Write Data Products to CD Dialog

The Write Data Products to CD dialog allows the operator to specify start and stop dates and orbit numbers of which data products should be written to CD-ROM as well as the number of CD-ROMs to write out. This dialog is utilized by the DP POC operator to cut CD-ROMs for the GUVI Co-Is. In addition, the operator will be able to change defaults for the CD-ROM properties, i.e. volume number, configuration, etc. Upon operator initiation, the CD Writer CSC will be invoked passing it all of the operator-inputted information to physically write out the CD-ROM.

This dialog also provides a Master Dialog button to return to the Master dialog at any time.

3.6.4Register New Data Products Dialog

The Register New Data Products dialog provides a mechanism to incorporate analysis data products, automated data products and other data products not routinely created by the Algorithms CSCI into the GUVI data product suite. The DP POC operator provides information about the physical location of the data product as well as various "data product registry" information. This dialog will then invoke the appropriate routines in the Data Manager CSC to "register" the data product and send interface information to the MDC, however the new data product must meet the following criteria:

- Already be physically resident on the DP POC
- Be implemented in NetCDF if it is to be distributed by the SDS
- Follow GUVI file naming conventions
- Follow GUVI and TIMED header conventions. TIMED header conventions are defined in the GIIS, Reference 8 and GUVI header conventions are defined in Appendix A.

This dialog also provides a Master Dialog button to return to the Master dialog at any time.

3.6.5Update Data Product Quality Dialog

The Update Data Product Quality dialog provides the DP POC operator with a mechanism to change the data quality indicators for the GUVI data products. It accepts as inputs the data product class, the data product version number and the new data quality indicator and will invoke the appropriate routines in the Version Control CSC. This dialog also provides the DP POC operator with the ability to update specific data products as opposed to data product classes.

The allowable values as well as the criteria for the data quality indicators will be defined in the TIMED DMP, Reference 7. After the quality indicators have been updated for a specific data product class and level, this dialog will invoke the FTP File CSU to automatically FTP MDC interface information to the MDC.

This dialog also provides a Master Dialog button to return to the Master dialog at any time.

3.6.6Update Data Tables Dialog

The Update Data Tables dialog provides the DP POC operator with the ability to automatically update the GUVI calibration data tables and related data tables via calls to the Update Data Tables CSU which will invoke a TBD CSC in the Science Algorithms CSC. The operator initiates the operation which will actually get "scheduled" in by the Scheduler CSU.

This dialog also provides a Master Dialog button to return to the Master dialog at any time.

3.6.7Update As-Flown Timelines Dialog

The Update As-Flown Timelines dialog provides the DP POC operator with the ability to easily update the GUVI as-flown timelines. The GUVI as-flown timelines are manually created by the EPOC every 24 hours and the EPOC physically stores these files on the DP POC. This ensures that the DP POC always has access to the latest version of an as-flown timeline and the DP POC system will take care of locking out a file when it is currently open for manual editing or writing.

This dialog provides a file open dialog box that is defaulted to the directory where the as-flown timelines are stored on the DP POC. When the operator selects a file, an Excel spreadsheet is opened up with the appropriate timeline displayed that allows the operator to manually modify the timeline. Once modified, the DP POC operator must manually FTP the file to the MDC and to the EPOC via the Manual FTP File Service dialog. There will be a widget from the Update As-Flown Timelines dialog to invoke the Manual FTP File Service dialog with the modified as-flown timeline file name being the defaulted file to FTP.

GUVI planned timelines can also be opened by the DP POC operator utilizing this interface, however they will be read-only.

This dialog also provides a Master Dialog button to return to the Master dialog at any time.

3.6.8Manual FTP File Service Dialog

The Manual FTP File Service dialog provides the DP POC operator with the ability to easily FTP a file to/from the DP POC and an operator designated machine. The MDC will be the default and the direction will default from the DP POC to the MDC however this dialog can also be utilized by the operator to FTP the as-flown timeline from the DP POC to the EPOC. This dialog assumes that files originating from the DP POC must already be resident on the DP POC and files originating from the designated machine already are resident on that machine.

The operator must select the file and the direction prior to initiating the operation. This dialog can be used for any file or files, including manually updated GUVI as-flown timelines and can be invoked from either the Master dialog or the Update As-Flown Timelines dialog. Upon operator initiation, this dialog will invoke the FTP File Service CSU to physically FTP the file passing it the operator inputs.

This dialog also provides a Master Dialog button to return to the Master dialog at any time.

3.6.9Software Version Dialog

The Software Version dialog provides the DP POC operator with the capability to specify which versions of software and data tables are to be utilized in both the generation of new data products and the regeneration of existing data products. Versions available are specified by the Version Definition CSU and when selected, the Select Version CSU is invoked to set up the appropriate links necessary to begin generating data products from. As a default, the latest software versions and latest data table versions will be utilized. Only new data product generation and regeneration processes can have their versions changed.

This dialog also provides a Master Dialog button to return to the Master dialog at any time.

3.7 Calibration Services CSC

This CSC provides calibration services for the scan data objects. All subprograms defined in this CSU are functions which accept a *Count* type input, plus other input data as indicated per function description below, perform a specific correction operation on the *Count* variable, and convert the corrected *Count* to an output intensity value expressed in Rayleigh units. Both the input Count and output Rayleigh types are actually value-variance pairs.

3.7.1 CALIBRATION CSU

This CSU provides calibration services for the scan data objects. All subprograms defined in this CSU are functions which accept a *Count* type input, plus other input data as indicated per function description below, perform a specific correction operation on the *Count* variable, and convert the corrected *Count* to an output intensity value expressed in Rayleigh units. Both the input Count and output Rayleigh types are actually value-variance pairs.

The CALIBRATE services are called by the SIS_IMAGING_SCAN_PIXEL CSU (for each of the five colors) to obtain corrected Rayleigh and variance values for each pixel in their respective grids. The typical call chain is as follows:

```
SCIENCE_ALGORITHMS.ADA  =>
        SIS_DISK_LEVEL_1C_GRID.CONSTRUCT   or
        SIS_LIMB_LEVEL_1C_GRID.CONSTRUCT =>
                SIS_DISK_SCAN_GRID.CONSTRUCT   or
                SIS_LIMB_SCAN_GRID.CONSTRUCT =>
                        SIS_IMAGING_SCAN_PIXEL .CONSTRUCT =>
                                CALIBRATE (color)
```

Operations Exported by package CALIBRATE:

CALIBRATE (1216): Accepts the following input to remove dark counts, scattered light, and return intensity in Rayleighs:

- Counts
- Across_Track_Nadir_Angle
- Along_Track_Nadir_Angle
- SIS_Detector
- SIS_Scan_Mode
- SIS_Slit_Width
- Background_Count
- Dark_Count

CALIBRATE (1304): Accepts the same input listed above to remove dark counts, scattered light, and return intensity in Rayleighs.

CALIBRATE (1356): Accepts the same input listed above to remove dark counts, scattered light, and return intensity in Rayleighs.

CALIBRATE (LBH1): Accepts the same input listed above to remove dark counts, scattered light, and return intensity in Rayleighs.

CALIBRATE (LBH2): Accepts the same input listed above to remove dark counts, scattered light, and return intensity in Rayleighs.

CALIBRATE (4278): Converts input 4278 **Counts** to output Rayleigh intensity value.

CALIBRATE (6294): Converts input 6294 **Counts** to output Rayleigh intensity value.

CALIBRATE (6300): Converts input 6300 **Counts** to output Rayleigh intensity value.

Limitations and Dependencies: This CSU uses the types, exceptions, and services provided by the following packages and CSUs:

- Level_1B_Types
- GUVI_Types
- Scan_Grid_Exceptions
- GUVI_Math

In addition, this CSU uses services provided by the CALIBRATION_DATA_TABLE CSU, defined in the GUVI Data Tables CSC.

Error Handling and Special Conditions: One exception is defined:

Name	Condition causing exception to be raised

Derivation_Failed	An unrecoverable error was detected during proces-sing of a calibration operation; e.g., Constraint_Error.

4. Webserver Capability CSCI

The Webserver Capability CSCI is written in a combination of Java, CGI, PERL, and HTML. This CSCI provides the capability to view information about the GUVI instrument, the GUVI team, GUVI documentation, links to other relevant sources as well as the ability to view and access GUVI data products via the Internet. This CSCI will also be invoking Java applications and Java applets from the User Interface CSCI.

This CSCI mimics the TIMED web page and is broken down into the following areas:

1. Mission summary: this area provides a description of the mission of the GUVI instrument
2. Instrument characteristics: this area provides a detailed description of the GUVI instrument
3. Orbital coverage: this area maps out the orbital coverage of the GUVI instrument
4. Data Processing: this area will provide a tutorial for using the GUVI data products
5. On-line Documents: this area provides access to all GUVI documentation
6. GUVI directory: this area provides a list of GUVI team members
7. Data Access: this area provides access to all of the GUVI data products and it also provides the capability to download the GUVI data products

This CSCI will be developed iteratively utilizing a series of prototypes. Because of this and the fact that the Webserver Capability is web-based, no design will be presented. Instead, the overall capabilities, the philosophy and the requirements fulfilled will be presented here. An initial version of the GUVI web page has already been created and can currently be accessed at the following URL: http://breit.jhuapl.edu/dev/guvi/.

The GUVI web page will provide the following functionality:

- Graphically display GUVI survey products
- Graphically display GUVI summary products
- Provide the ability to categorize and/or search the GUVI data utilizing the GUVI data catalog
- Provide the ability to download the GUVI data products
- Provide access to the GUVI planned and as-flown timelines
- Provide links to TIMED web pages
- Provide links to other TIMED instrument web pages
- Provide links to ground site web pages
- Provide links to other relevant information
- Provide the GUVI Co-I's with the capability to register user created data products with the DP POC to be incorporated into the GUVI data product suite.

The overall data flow diagram for the Webserver Capability CSCI is depicted in Figure 4-1.

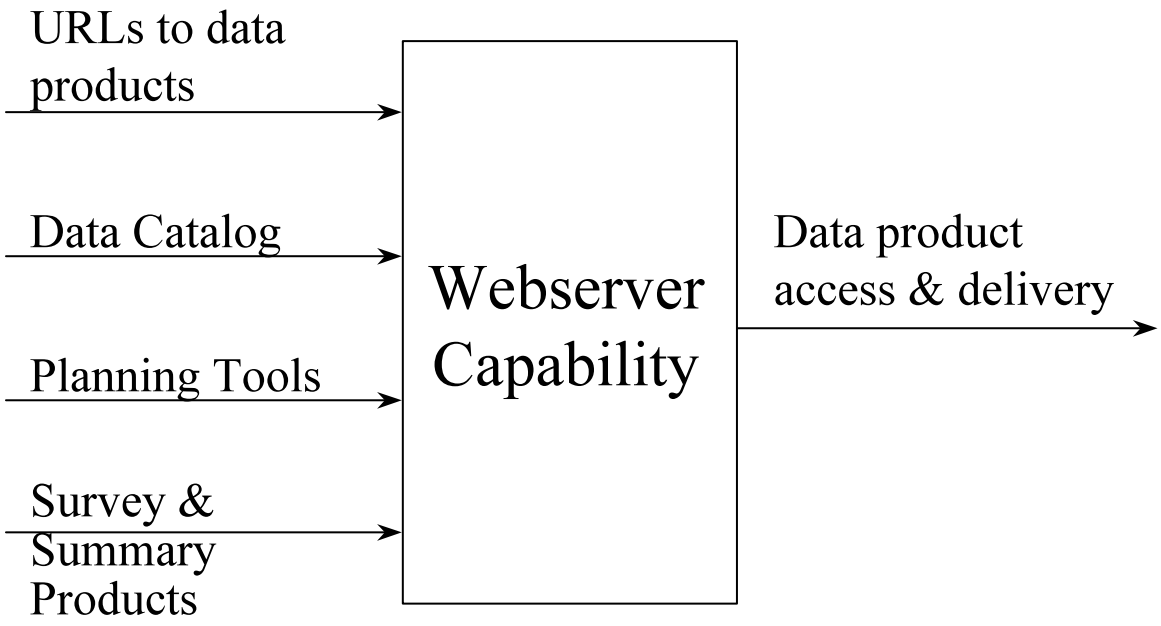

Figure 4-1. Webserver Capability CSCI Data Flow Diagram

5. User Interface CSCI

The User Interface CSCI will be implemented in Java utilizing a combination of Java applications and Java applets. This CSCI is responsible for providing a GUI to display the following GUVI data products as identified in Table 1.2-1 to the user:

- Level 1C disk data on a user grid
- Level 1C limb data on a profile plot
- Level 1C spectrograph data on a UV spectrum plot
- Level 2B disk data on a global map projection
- Level 2B limb data on a profile plot
- Routine Level 3 data
- Summary products
- Survey products

This CSCI is implemented utilizing an object-oriented design methodology and is comprised of the following CSCs:

- Startup CSC
- Windows CSC
- Displays CSC
- Window Utilities CSC

These CSCs were presented at a top-level detail at the GUVI SPDR, Reference 2 and the overall control flow is depicted in Figure 5-1. This design is still valid however, instead of presenting a detailed level design for the User Interface CSCI, the design will be refined via a series of prototypes. These prototypes will reflect enhancements to the user interface as well as incremental development of the User Interface display requirements.

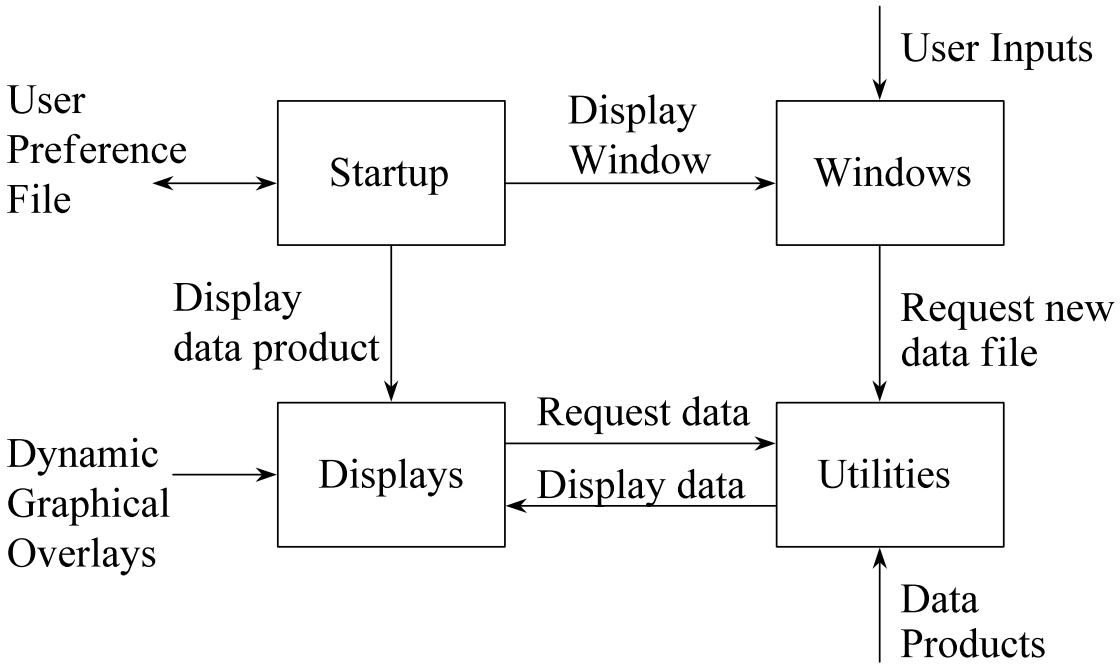

Figure 5-1. User Interface CSCI Control Flow Diagram

5.1 Startup CSC

The Startup CSC is invoked upon startup of the User Interface CSCI. This CSC is responsible for reading and writing user preferences file as well as displaying the currently selected user preferences and default startup configuration. In addition, based on the selected user preferences, this CSC is responsible for invoking the appropriate Displays CSC subclass.

5.2 Windows CSC

The Windows CSC is invoked by the Startup CSC at startup of the User Interface CSCI and by user request for a different display. This CSC is responsible for defining and accepting inputs from the menu bar as well as displaying a title and a legend for the currently selected display.

5.3 Displays CSC

The Displays CSC is invoked by the Startup CSC at startup of the User Interface CSCI and by the Windows CSC upon user request for a different display. This CSC is responsible for defining and laying out the screen, the graphics areas as well as displaying the GUVI data products including the static and dynamic graphical overlays.

5.4 Window Utilities CSC

The Window Utilities CSC is invoked by the Windows CSC and the Displays CSC and will provide functionality and processing tools for the GUVI Co-Is. The necessity of this CSC is still being evaluated. The Co-I requirements that this CSC will be fulfilling are still being evaluated. The intention of this CSC is to provide a "standard toolbox" of tools to perform the following:

- Data file readers
- Coordinate transformations
- Dynamic graphic overlay file readers

The software language(s) (i.e. IDL, Java, or just NetCDF readers) that these tools will be provided in is all still TBD. The language(s) for the subroutines that comprise this CSC will be decided on a case by case basis and will depend on what is most beneficial to the DP POC software as well as to the users of the User Interface CSCI. These utilities may also be implemented in multiple languages.

6. Notes

6.1 Acronyms and Abbreviations

Å	Angstrom
A_p	Planetary Geomagnetic Amplitude
ApID	Application Processor Identifier
ASCII	American Standard Code for Information Interchange
CD	Compact Disc
CDR	Critical Design Review
CGI	Common Gateway Interface
Co-I	Co-Investigator
COTS	Commercial Off-The-Shelf
CPI	Computational Physics, Inc.
CSC	Computer Software Component
CSCI	Computer Software Configuration Item
CSU	Computer Software Unit
DAN	Data Availability Notification
DID	Data Item Description
DITF	(Dayside) Discrete Inverse Theory Function
DMP	Data Management Plan
DP	Data Processing
EDP	Electron Density Profile
EDPP	EDP Parameters (i.e. TEC)
EDR	Environmental Data Record
<E>	Effective* average energy
EOS	Earth Observing System
EPOC	Engineering POC
EUV	Extreme Ultraviolet
$F_{10.7}$	Solar Flux Index
FTP	File Transfer Protocol
FUV	Far Ultraviolet
GIIS	General Instrument Interface Specification
GSE	Ground Support Equipment
GUI	Graphical User Interface
GUVI	Global Ultraviolet Imager
HP	Hewlett Packard
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transport Protocol
IDL	Interactive Data Language ™
IP	Internet Protocol
JHU/APL	Johns Hopkins University/Applied Physics Lab
K-12	Kindergarten through Secondary Education
K_p	Planetary Geomagnetic Index
LBH	Lyman-Birge-Hopfield molecular nitrogen emission bands
MDC	(TIMED) Mission Data Center
MOC	(TIMED) Mission Operations Center
MO/DA	Mission Operations/Data Analysis
NDP	Neutral Density Profiles (O, O_2, and N_2)

NetCDF	Network Common Data Format
NTP	Network Time Protocol
PDR	Preliminary Design Review
PERL	Practical Extraction and Report Language
PI	Principal Investigator
POC	Payload Operations Center
PTP	POC Telemetry Packet
PVAT	Position, Velocity, Attitude and Time
Q	Effective* energy flux
Q_{euv}	effective solar EUV (extreme Ultra-violet) flux (below 40 nm)
ROM	Read Only Memory
ROVCDN2VCD	Ratio of O Vertical Column Density to N_2 Vertical Column Density
SABER	Sounding of the Atmosphere using Broadband Emission Radiometry
S/C	Spacecraft
SEE	Solar EUV Experiment
SDD	Software Design Document
SDR	Science Data Record
SDS	Science Data System
SIIS	Specific Instrument Interface Specification
SIS	Scanning Image Spectrograph
SPDR	Software Preliminary Design Review
SRS	Software Requirements Specification
SSUSI	Special Sensor Ultraviolet Spectrographic Imager
STP	Software Test Plan
SZA	Solar Zenith Angle
TBD	To Be Determined
TCP	Transmission Control Protocol
TEC	Total Electron Content
TIDI	TIMED Doppler Interferometer
TIMED	Thermosphere, Ionosphere, and Mesosphere Energetics and Dynamics
TMDC	TIMED Mission Data Center
UDP	User Datagram Protocol
URL	Uniform Resource Locator
UTC	Universal Time Coordinate
WWW	World Wide Web

* Effective assumes precipitating particles are pure electrons

Appendix A. Standard GUVI Data Product Header

The GUVI data product file header requirements are changing as a function of the TIMED MDC interface files. The goal is to place in the headers all information required by the MDC interface files so that they can be derived directly from information within the header as opposed to passing that information from the Science Algorithms CSC to the Data Manager CSC. Data Manager CSC would then read the data product header and derive all of the interface files from them. As these interface files stabilize, the GUVI data product headers will be expanded and will become more solid. Table A-1 provides a listing of the fields in the GUVI data product file headers.

Field Name	Description
TIMED header requirements	Documented in the GIIS, Section 8 (Reference 8)

Table A-1. Routine GUVI Data Product File Header

User created data products are data products not generated routinely by the DP POC software. They can be Co-I created products, data products produced after analysis, etc. Their headers need to contain additional information so that they can be "registered" with the DP POC software as well as reproducible. This header requirement will also change as a function of the TIMED header requirement, the GUVI header requirement and the MDC interface files.

User created data products can be in any format however, if they are to be distributed by the Science Data System, they need to be in NetCDF format. Table A-2 provides a listing of the fields in the GUVI user created data product file headers.

Field Name	Description
TIMED header requirements	Documented in the GIIS, Section 8 (Reference 8)
GUVI header requirements	Documented in Table A-1
Data product version and revision information	All version and revision information for the data products that were utilized to generate this data product
Date, time and orbit number	Date, time and orbit number (as appropriate) for the data products that were utilized to generate this data product
Description	Description of the data product
Purpose	Purpose of the data product
File type	File type of the data product.
Intended recipient	GUVI Co-Is, TIDI, etc.

Table A-2. User Created GUVI Data Product File Header

Appendix B. GUVI Data File Definitions

Appendix C. GUVI Data Catalog

The GUVI data catalog will be refined via a series of prototypes. The Tables C-1 and C-2 are a master list of all of the items that would be nice to include in the GUVI data catalog. These fields consist of both solar and geomagnetic indices as well as GUVI housekeeping information and data product information. The purpose of the GUVI data catalog is to provide an easy and user-friendly mechanism to search the GUVI data products for specific characteristics. To provide a simple and easy to use mechanism, the number of fields that can be searched on and the number of fields that can be displayed needs to be simplified. The prototypes will be beneficial in prioritizing and minimizing the number of fields that are displayed in the following tables.

Table C-1. GUVI Data Catalog

Description	Searchable	Displayable in query	Frequency	Number of Fields	Units	Data Type	Size (Bits)	Values Allowed	Total Size (Bits)
Start date	X	X	entry	1	date	integer	32		32
Start time	X	X	entry	1	time	integer	16		16
Stop date	X	X	entry (as appropriate)	1	date	integer	32		32
Stop time	X	X	entry (as appropriate)	1	time	integer	3216		16
Orbit #	X	X	entry	1	N/A	integer	16	1 .. 15	16
URLs - per data product		X	data product	# data products	N/A	char string	640	80 chars	640
Date generated - date that this data product was generated	X	X	data product	1	date	integer	32		32
Product name	X	X	data product	1	N/A	char string	256	32 char	256
Description/purpose		X	data product	1	N/A	char string	640	80 chars	640
Reference - reference to another document describing this product		X	data product	1	N/A	char string	640	80 chars	640
Data generation classifier	X	X	data product	1	N/A	char string	72	routine, analysis, automated	72
Data content classifier	X	X	data product	1	N/A	char string	104	level n, survey, support, education, status, collaborative	104
File type	X	X	data product	1	N/A	char string	48	NetCDF, ASCII, other	48
File size		X	data product	1	MByte	integer	16	N/A	16
Day/night/auroral region flag	X	X	data product	1	N/A	Char string	56	Day, night, auroral, twilight, unknown	56
Overall data quality - describes investigator confidence in the data product as a whole	X	X	data product version #	1	N/A	char string	168	high confidence, reasonable confidence, low	168

								confidence	
Absolute calibration - describes investigator confidence in the absolute calibration of the values contained in the data set	X	X	input/cal version #	1	N/A	char string	168	high confidence, reasonable confidence, low confidence	168
Relative calibration - describes investigator confidence in the relative calibration of the values contained in the data set	X	X	input/cal version #	1	N/A	char string	168	high confidence, reasonable confidence, low confidence	168
Data completeness - describes investigator confidence in completeness of the data product, i.e. frequency of dropouts or other missing data	X	X	data product	1	N/A	char string	168	high confidence, reasonable confidence, low confidence	168
Pointing/Attitude - describes investigator confidence in the pointing or attitude information contained in the data product	X	X	data product version #	1	N/A	char string	168	high confidence, reasonable confidence, low confidence	168
Review status - describes the level of review the product has received	X	X	data product version #	1	N/A	char string	168	fully reviewed, partially reviewed, reviewed by inference, note reviewed	168
Uses	X	X	data product	1	N/A	char string	144	survey/browse, quicklook analysis, detailed analysis, long term trend	144
Comments - any additional description		X	data product	1	N/A	char string	640	free text	640
Data product revision #	X	X	data product	1	N/A	N/A	16	0 .. 99	16
Data Product version #	X	X	data product	1	N/A	N/A	16	0 .. 999	16
Product format version #	X	X	data product	1	N/A	N/A	16	0 .. 999	16
Major s/w version #	X	X	data product	1	N/A	N/A	16	0 .. 99	16
Minor s/w version #	X	X	data product	1	N/A	N/A	16	0 .. 99	16
Major input/cal version #	X	X	data product	1	N/A	N/A	16	0 .. 99	16
Minor input/cal version #	X	X	data product	1	N/A	N/A	16	0 .. 99	16
Local solar time	X	X		1		float	32		32
Solar zenith angle	X	X		1		Float	32		32
Mode	X	X	change	1	N/A	N/A	2	0 = Imaging	2

								1 = Spectrograph 2 = Maintenance 3 = Test	
Scan range		X if instrument characteristics selected	change	1	degrees	integer	16	-180 .. +180	16
Slit position (sizes)	X	X if instrument characteristics selected	change	1	N/A	integer	2	0 .. 2	2
Slit used	X	X if instrument characteristics selected	change	1	N/A	bit	1	0 .. 1	1
Detector used	X	X if instrument characteristics selected	change	1	N/A	bit	1	0 .. 1	1
Mirror position (spectrograph mode only)	X	X if instrument characteristics selected	change	1	N/A	integer	16		16
Instrument anomaly type?? Do we want anomalies in the catalog, because could still be producing data products on it	X	X	occurrence	1	N/A	char string	80	anomaly identifier (1-10 characters)	80
Instrument anomaly comment?? Do we want anomalies in the catalog, because could still be producing data products on it		X	occurrence	1	N/A	char string	640	free form text	640
Total per entry									112
Total per data product									3568
Total per data product version change									840
Total per instrument mode									2
Total per instrument events									36
Total per instrument anomalies									720

Overall total per day 142 data products / day (522,560) 1 instrument mode /day (114) 1 instrument event / day (148) 1 instrument anomaly / day (832) 1 version change / day (952)									523,046

Table C-2. GUVI Data Catalog - Solar & Geomagnetic Indices

Description	Searchable	Displayable if s&g indices selected	Frequency	Number of Fields	Units	Data Type	Size (Bits)	Values Allowed	Total Size (Bits)
81 day average F10.7	X	X	daily	1	Solar flux units (10^{-22} Js-1m-2Hz-1)	float	32		32
F10.7 daily	X	X	daily	1	Solar flux units (10^{-22} Js-1m-2Hz-1)	float	32		32
Kp: 3-hour quasi-logarithmic planetary index	X	X	3 hour	1	N/A	float	32	0 .. 9 by thirds	32
Kp valid time		X	3 hour	1	UT	integer	32	N/A	32
ap: 3-hour range planetary index derived from Kp	X	X	3 hour	1	2nT	float	32	0 .. 400 w/28 steps	32
ap valid time		X	3 hour	1	UT	integer	32	N/A	32
Cp: Planetary daily magnetic character derived from Kp. Qualitative estimate of overall level of magnetic activity for the day determined from the daily sum of 8 ap amplitudes	X	X	daily	1		float	32	0 .. 2.4 by tenths	32
Ap: Amount of heating in Thermosphere??	X	X	daily	1		float	32	0 .. 400	32
am, an, as: 3-hour range (mondial, northern, southern) indices	X	X	3 hour	3	gammas	float	32	0 .. 667	96
aa: 3-hour range index derived from 2 antipodal stations	X	X	3 hour	1	nT (gammas)	Integer	16	2 .. 667	16
AE: auroral electrojet indices??	X	X	1 minute, 2.5 minute or hourly??	1	gammas	float	32		32
Dst: Hourly index mainly related to the ring current and/or equatorial distance??	X	X	hourly	1	gammas	float	32		32
Km: 3-hour mean index derived	X	X	3 hour	1		float	32		32

from an average of K indices (not to be confused with the Km of the next item)									
Km, Kn, Ks: 3-hour quasi-logarithmic (mondial, northern, southern) indices derived from am, an, as	X	X	3 hour	3		float	32		96
Rz: Zurich sunspot number	X	X	daily	1	N/A	float	32		32
Sa	X	X	daily?			float	32		32
Ri	X	X	daily?			float	32		32
Ra	X	X	daily?			float	32		32
Rs	X	X	daily?			float	32		32
By	X	X	daily?			float	32		32
Bz: Magnitude of the interplanetary magnetic field??	X	X	daily	1	nT	float	32		32
Total per hour									64
Total per 3 hour									368
Total per day									352
Overall total per day									4832

End of DP POC SDD