HUGHES INFORMATION TECHNOLOGY CORPORATION

ERRATA NOTICE

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Document No.: 305-CD-014-001

Title: Release A GSFC DAAC Design Specification for the ECS Project

The following change pages have been incorporated into the subject document (attached):

3-3 (Figure 3.1.1-2)

3-17 through 3-18 (Internetworking Subsystem)

3-27 (Figure 3.4.1-1)

3-29 (Table 3.4.1-1)

3-31 (Figure 3.4.2-1)

3-59 (Section 3.4.2.6.2)

3-72 (Section 3.4.2.8.2)

If you have any questions, please contact our Data Management Office at (301) 925-0322.

305-CD-014-001

EOSDIS Core System Project

Release A GSFC DAAC Design Specification for the ECS Project

July 1995

Hughes Information Technology Corporation
Landover, Maryland

Release A GSFC DAAC Design Specification for the ECS Project

July 1995

Prepared Under Contract NAS5-60000
CDRL Item #046

APPROVED BY

Parag N. Ambardekar /s/	7/28/95
Parag N. Ambardekar, Release A CCB Chairman EOSDIS Core System Project	Date

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Preface

This document is one of sixteen comprising the detailed design specifications of the SDPS and CSMS subsystem for Release A of the ECS project. A complete list of the design specification documents is given below. Of particular interest are documents number 305-CD-004, which provides an overview of the subsystems and 305-CD-018, the Data Dictionary, for those reviewing the object models in detail. A Release A SDPS and CSMS CDR Review Guide (510-TP-002) is also available.

The SDPS and CSMS subsystem design specification documents for Release A of the ECS Project include:

305-CD-004	Release A Overview of the SDPS and CSMS Segment System Design Specification
305-CD-005	Release A SDPS Client Subsystem Design Specification
305-CD-006	Release A SDPS Interoperability Subsystem Design Specification
305-CD-007	Release A SDPS Data Management Subsystem Design Specification
305-CD-008	Release A SDPS Data Server Subsystem Design Specification
305-CD-009	Release A SDPS Ingest Subsystem Design Specification
305-CD-010	Release A SDPS Planning Subsystem Design Specification
305-CD-011	Release A SDPS Data Processing Subsystem Design Specification
305-CD-012	Release A CSMS Segment Communications Subsystem Design Specification
305-CD-013	Release A CSMS Segment Systems Management Subsystem Design Specification
305-CD-014	Release A GSFC Distributed Active Archive Center Design Specification
305-CD-015	Release A LaRC Distributed Active Archive Center Design Specification
305-CD-016	Release A MSFC Distributed Active Archive Center Design Specification
305-CD-017	Release A EROS Data Center Distributed Active Archive Center Design Specification
305-CD-018	Release A Data Dictionary for Subsystem Design Specification
305-CD-019	Release A System Monitoring and Coordination Center Design Specification

This document is a contract deliverable with an approval code 2. As such, it does not require formal Government approval, however, the Government reserves the right to request changes within 45 days of the initial submittal. Once approved, contractor changes to this document are handled in accordance with Class I and Class II change control requirements described in the EOS Configuration Management Plan, and changes to this document shall be made by Document Change Notice (DCN) or by complete revision.

Any questions should be addressed to:

Data Management Office
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Abstract

The Release A Goddard Space Flight Center (GSFC) Distributed Active Archive Center (DAAC) Design Specification describes the ECS subsystems at the GSFC DAAC. ECS Subsystem-Specific Design Specifications provide detailed design descriptions of the subsystems. This document shows the specific implementation of that design at the GSFC DAAC, including the identification of the specific software, hardware and network configuration for the DAAC.

Keywords: GSFC, DAAC, configuration, design

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Change Information Page

List of Effective Pages	
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1. Introduction

1.1 Identification

This Release A GSFC DAAC Design Specification for the ECS Project, Contract Data Requirement List (CDRL) Item 046, with requirements specified in Data Item Description (DID) 305/DV2, is a required deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract NAS5-60000.

1.2 Scope

Release A of ECS supports the early operational stages of the Tropical Rainfall Measuring Mission (TRMM). TRMM Release follows an earlier ECS delivery, referred to as Interim Release 1 (IR-1), which provided certain enterprise infrastructure in preparation for down stream deliveries. IR-1 also provided science software integration and testing capabilities. The infrastructure delivery of ECS, involves four Distributed Active Archive Centers, these being the Goddard Space Flight Center (GSFC), the Marshall Space Flight Center (MSFC), the Langley Research Center (LaRC), and the EROS Data Center (EDC). Even though, only three of the DAACs (GSFC, MSFC and LaRC) directly support the TRMM effort all four are updated to the TRMM level at Release A to simplify configuration management and to allow for interface testing for future ECS releases. For Release A, the IR-1 configurations of GSFC, MSFC and LaRC are updated with major hardware and software deliveries while EDC, which is not part of TRMM operations, receives a minor update to support interface testing.

This document is part of a series of documents comprising the Science and Communications Development Office design specification for the Communications and System Management segment (CSMS) and the Science and Data Processing Subsystem (SDPS) for Release A. The series of documents include an overview, a design specification document for each subsystem, and a design implementation document for each DAAC involved in the release, as well as one for the System Monitoring and Control (SMC) center.

This document specifically focuses on the GSFC DAAC's ECS configuration and capabilities at Release A. It is released in, and reviewed at the formal Release A Critical Design Review. Consistent with the associated ECS subsystem-specific design specifications, this document reflects the Technical Baseline submitted via contract correspondence number ECS 194-00343.

This document reflects the June 21, 1995 Technical Baseline maintained by the contractor configuration control board in accordance with ECS Technical Direction No. 11, dated December 6, 1994.

1.3 Purpose

The Release A GSFC Design Specification establishes the GSFC DAAC's ECS configuration and capabilities at Release A. These capabilities are selected from two ECS design segments referred to as the Science Data Processing Segment (SDPS) and the Communications and Systems Management Segment (CSMS). This document will address how the GSFC Release A version of SDPS will provide the hardware, software, and operations to:

- receive, process, archive and manage data from the Tropical Rainfall Measuring Mission;
- receive, archive and manage ancillary data required by the Release A science software;
- receive, archive and manage in situ correlative data;
- provide the Earth science community with access to data held by the ECS and the data products resulting from research using these data;
- promote exchange of data and research results within the science community and across the multi-agency/multi-national data collection systems and archives; and
- facilitate development, experimental usage, and community acceptance of new and/or improved science software for computing geophysical parameters from remotely sensed data.

This document will also address how the GSFC Release A version of CSMS will provide the hardware, software, and operations to:

- interface with Nascom Operation Local Area Network (NOLAN) for the ingest of Level 0 TRMM data at Marshall Space Flight Center (MSFC) and Langley Research Center (LaRC);
- provide EOSDIS Science Network (ESN) links among the Release A Distributed Active Archive Centers (DAACs) and Goddard Space Flight Center (GSCF) mission operations and monitoring centers and National Oceanic Atmospheric Administration (NOAA) to support exchange and archive of mission-related science products, and ancillary data sets required by SDPS; and
- support status exchange between TRMM sites and other DAACs for both operational and test efforts.

The purpose of this document is to show the elements of the Release A ECS science data processing and communications design that will support ECS at the GSFC DAAC. The Release A Overview of SDPS and CSMS (305-CD-004-001) provides an overview of the ECS subsystems and should be used by the reader to get a basic understanding of ECS design components. The Release Plan Content Description document (222-TP-003-005) provides a detailed mapping of functional capabilities and services that will be available for each release. While some DAAC configurations vary depending on the mission/capability requirements for ECS at their DAAC, the GSFC DAAC at full ECS capability will include all the ECS science data processing and communications subsystems; however, the TRMM Mission does not include operational processing requirements at the GSFC DAAC. Since processing and

production planning capabilities are available at the GSFC DAAC as part of IR-1 to support science software integration and testing, they will remain in Release A to continue MODIS algorithm integration and test activities, as well as to provide the DAAC operations staff the capability to test/operate the planning and processing capabilities.

1.4 Status and Schedule

This submittal of DID 305/DV2 meets the milestone specified in the Contract Data Requirements List (CDRL) for Critical Design Review (pre-CDR) of NASA contract NAS5-60000. The submittal will be reviewed during the Release A (CDR) and changes to the design which resulted from that review will be reflected in subsequent updates. The CDR may trigger follow up actions in response to Review Item Discrepancies (RID) the results of which will be incorporated into the Test Readiness Review (TRR) version of this document.

1.5 Document Organization

This document is organized to describe the design of ECS at the GSFC DAAC as follows:

Section 1 provides information regarding the identification, scope, purpose, status and schedule, and organization of this document.

Section 2 provides a listing of the related documents which were used as source information for this document.

Section 3 provides a description of the ECS design at the GSFC DAAC. It includes a description of the DAAC external interfaces, ECS software implementation, including identification of Commercial Off the Shelf (COTS) products, hardware configuration and operational activities.

- Subsection 3.1 establishes the context for the technical discussions with an overview of the specific GSFC mission and GSFC Release A operations. It identifies the key ECS related mission and operations activities that are supported via the ECS functionality at the DAAC.
- Subsection 3.2 addresses the external interfaces of the ECS subsystems as implemented at GSFC DAAC. Major interfaces include those with the users, TSDIS, the Version 0 System, Version 0 DAACs, ECS Release A DAACs and the MODIS Scientific Computing Facility (SCF).
- Subsection 3.3 provides a software component analysis. There are 10 ECS data processing and communications subsystems that contain Hardware Configuration Items (HWCIs) and Computer Software Configuration Items (CSCIs). This section addresses the CSCIs and their corresponding lower level Computer Software Components (CSCs). The CSCs are described in detail in their respective subsystem design specification documents. In this section, the CSCs are captured in a single table, broken down by Subsystem/CSCI. The table lists the CSCIs and the associated CSCs. Notes are provided to expand upon generic explanations from the body of the Subsystem Design Specifications to describe what makes the particular CSC specific to the DAAC. In

addition, when a CSC is identified as Off-the-shelf (OTS), the candidate product is identified.

- Subsection 3.4 provides a DAAC specific discussion of the ECS data processing and communications Hardware Configuration Items (HWCIs). This section identifies the HWCI components and indicates the specific components and quantities that are resident at the DAAC. It includes the Local area network (LAN) configuration and the rationale for the specific hardware configuration.
- Subsection 3.5 provides a software to hardware configuration mapping.

Section 4 gives a description of what can be expected in the next version of this document which is planned for each subsequent Release of ECS.

The section, Abbreviations and Acronyms, contains an alphabetized list of the definitions for abbreviations and acronyms used in this document.

2. Related Documentation

2.1 Parent Documents

The parent documents are the documents from which the scope and content of this Release A GSFC DAAC Implementation/Design Specification is derived.

194-207-SE1-001	System Design Specification for the ECS Project
305-CD-002-002	Science Data Processing Segment (SDPS) Design Specification for the ECS Project
305-CD-003-002	Communications and System Management Segment (CSMS) Design Specification for the ECS Project
305-CD-004-001	Release A Overview of the SDPS and CSMS System Design Specification for the ECS Project
305-CD-012-001	Release A CSMS Communications Subsystem Design Specification for the ECS Project
305-CD-013-001	Release A CSMS Systems Management Subsystem Design Specification for the ECS Project
305-CD-018-001	Release A Data Dictionary for Subsystem Design Specification for the ECS Project

2.2 Applicable Documents

The following documents are referenced within this Specification, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this volume.

206-CD-001-002	Version 0 Analysis Report for the ECS Project
209-CD-001-001	Interface Control Document Between EOSDIS Core System (ECS) and the NASA Science Internet
209-CD-008-002	Interface Control Document Between EOSDIS Core System (ECS) and the Goddard Space Flight Center (GSFC) Distributed Active Archive Center (DAAC)
209-CD-009-002	Interface Control Document Between EOSDIS Core System (ECS) and the Marshall Space Flight Center (MSFC) Distributed Active Archive Center (DAAC)

209-CD-010-001	Interface Control Document Between EOSDIS Core System (ECS) and the Langley Research Center (LaRC) Distributed Active Archive Center (DAAC)
209-CD-011-002	Interface Control Document Between EOSDIS Core System (ECS) and the Version 0 System
304-CD-002-002	Science and Data Processing Segment (SDPS) Requirements Specification for the ECS Project
304-CD-003-002	Communications and System Management Segment (CSMS) Requirements Specification for the ECS Project
305-CD-003-002	Communications and System Management Segment (CSMS) Design Specification for the ECS Project
305-CD-014-001	Release A GSFC DAAC Implementation/Design Specification for the ECS Project
305-CD-015-001	Release A LaRC DAAC Implementation/Design Specification for the ECS Project
305-CD-016-001	Release A MSFC DAAC Implementation/Design Specification for the ECS Project
305-CD-017-001	Release A EROS Data Center DAAC Implementation/Design Specification for the ECS Project
313-CD-004-001	Release A CSMS/SDPS Internal Interface Control Document for the ECS Project
604-CD-001-004	Operations Concept for the ECS Project: Part 1-- ECS Overview
604-CD-003-001	Operations Concept for the ECS Project: Part 2A -- ECS Release A
210-TP-001-003	Technical Baseline for ECS Project
222-TP-003-006	Release Plan Content Description for the ECS Project
423-41-03	Goddard Space Flight Center, EOSDIS Core System (ECS) Contract Data Requirements Document

2.3 Information Documents Not Referenced

The following documents, although not referenced herein and/or not directly applicable, do amplify and clarify the information presented in this document. These documents are not binding on the content of the DAAC Implementation/Design Specification.

333-CD-003-001	SDP Toolkit Users Guide for the ECS Project
194-302-DV2-001	ECS Facilities Plan for the ECS Project

101-303-DV1-001	Individual Facility Requirements for the ECS Project
601-CD-001-004	Maintenance and Operations Management Plan for the ECS Project
608-CD-001-002	ECS Operations Plan for Release B of the ECS Project
101-620-OP2-001	List of Recommended Maintenance Equipment for the ECS Project
193-801-SD4-001	PGS Toolkit Requirements Specification for the ECS Project
828-RD-001-002	Government Furnished Property for the ECS Project
222-TP-003-006	Release Plan Content Description for the ECS Project
430-TP-001-001	SDP Toolkit Implementation with Pathfinder SSM/I Precipitation Rate Algorithm, Technical Paper
440-TP-001-001	Science Data Server Architecture Study [for the ECS Project]
420-TD-001-001	ECS Data Server Taxonomy Technical Description [for the ECS Project]
423-16-01	Goddard Space Flight Center, Data Production Software and Science Computing Facility (SCF) Standards and Guidelines
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System
540-022	Goddard Space Flight Center, Earth Observing System (EOS) Communications (Ecom) System Design Specification
560-EDOS-0211.0001	Goddard Space Flight Center, Interface Requirements Document Between EDOS and the EOS Ground System (EGS)

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3. GSFC ECS DAAC Configuration

3.1 Introduction

3.1.1 GSFC DAAC Overview

The GSFC Distributed Active Archive Center (GSFC DAAC) is one of the nine DAACs that are part of NASA's Earth Observing System Data and Information System (EOSDIS). These DAACs are generally organized to support specific scientific disciplines. The objective of the GSFC DAAC is to archive science data and provide support services to its users in the discipline areas of upper atmosphere, atmospheric dynamics, global biosphere, and geophysics. In the pre-EOS time frame, the GSFC V0 DAAC has been developed, and is still being developed, to enhance and improve scientific research and productivity by consolidating access to remote sensor earth science data, as well as by providing services that provide added value to the data stored at the DAAC and help people realize the scientific and educational potential of the global climate data stored at the DAAC.

The GSFC V0 DAAC supports over 150 data sets/products which are developed from heritage data centers concerned with climate, land and ocean data. The DAAC also supports the initial NOAA Advanced Very High-Resolution Radiometer (AVHRR) and TOVS data to be used in the development efforts of the NASA Pathfinder data sets. The V0 DAAC is also currently preparing to archive and distribute data received from the Sea Viewing Wide-Field-of-View Scanner (SeaWiFS) Project after satellite launch in 1995. The GSFC DAAC V0 System is constantly adding new data sets, and will continue to archive and distribute a variety of Earth science products before the dedicated EOS AM satellite is launched in 1998.

In preparation for the TRMM Mission, an early release of ECS (Interim Release 1) will be made available to support early TRMM interface testing. The equipment and software suites will be augmented as part of the implementation of Release A which is provided to support the TRMM Mission, Landsat 7 early interface testing, EOS AM-1 interface testing, science software integration and test, data flow and end-to-end testing, V0 interoperability and simulation readiness testing. The Release Content Plan provides a description of the missions and the driving requirements which must be satisfied to support these missions. In the Release A time frame, the GSFC ECS DAAC will support archive and distribution of data products for the Visible Infrared Scanner (VIRS) instrument flown onboard the TRMM observatory. In addition, GSFC ECS DAAC will also support the EOS AM-1 interface testing, data flow and end-to-end testing, and simulation readiness testing missions. To support the EOSDIS ongoing missions, parallel operation of the DAAC's Version 0 system and the ECS TRMM Release will occur to ensure full access to existing datasets and services.

Figures 3.1.1-1 and 3.1.1-2 illustrate the SDPS and CSMS subsystems and their components. The bulk of this document focuses on the selected elements of the ECS design that are use to

achieve Release A objectives at the DAAC. Section 2.1 of this document identifies CDR Design Specifications which provide detailed information on each subsystem.

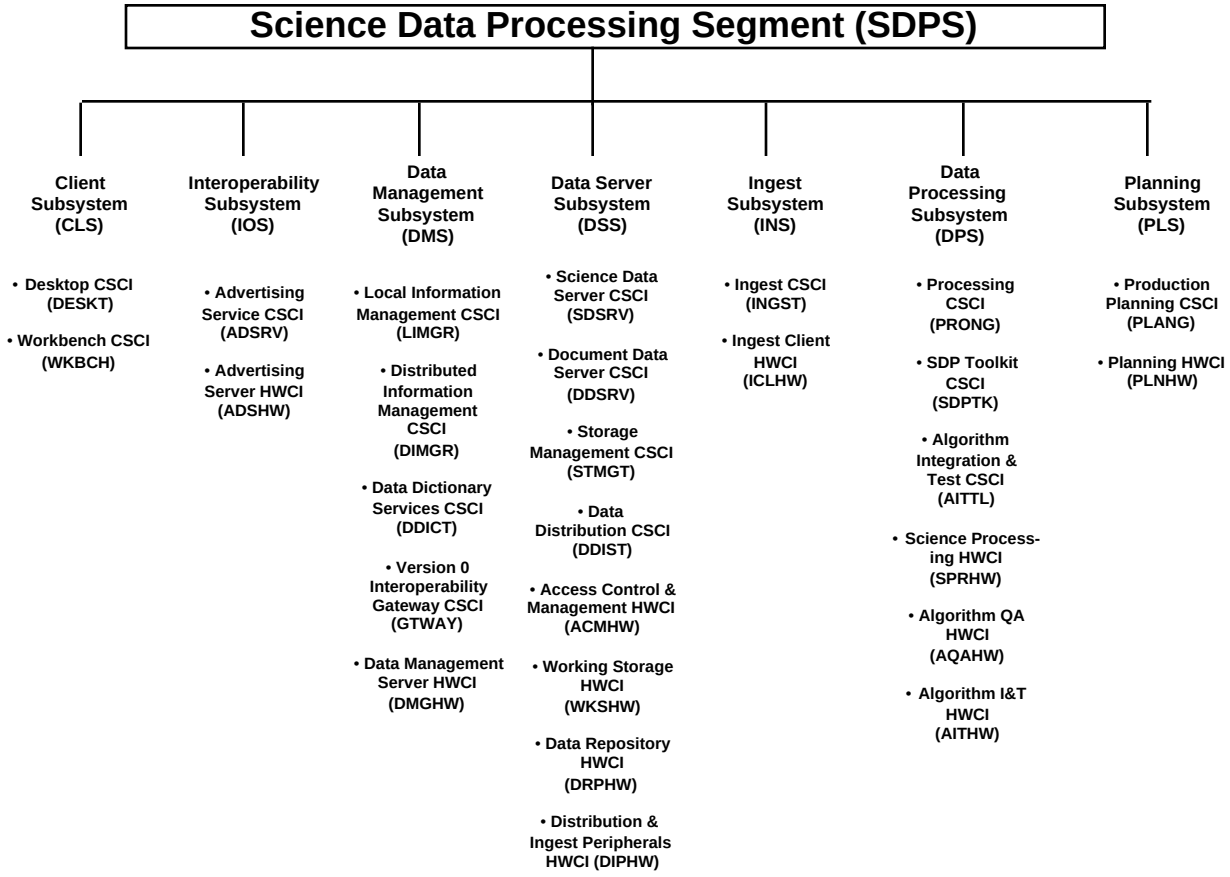

Figure 3-.1.1-1. SDPS Subsystems and Components

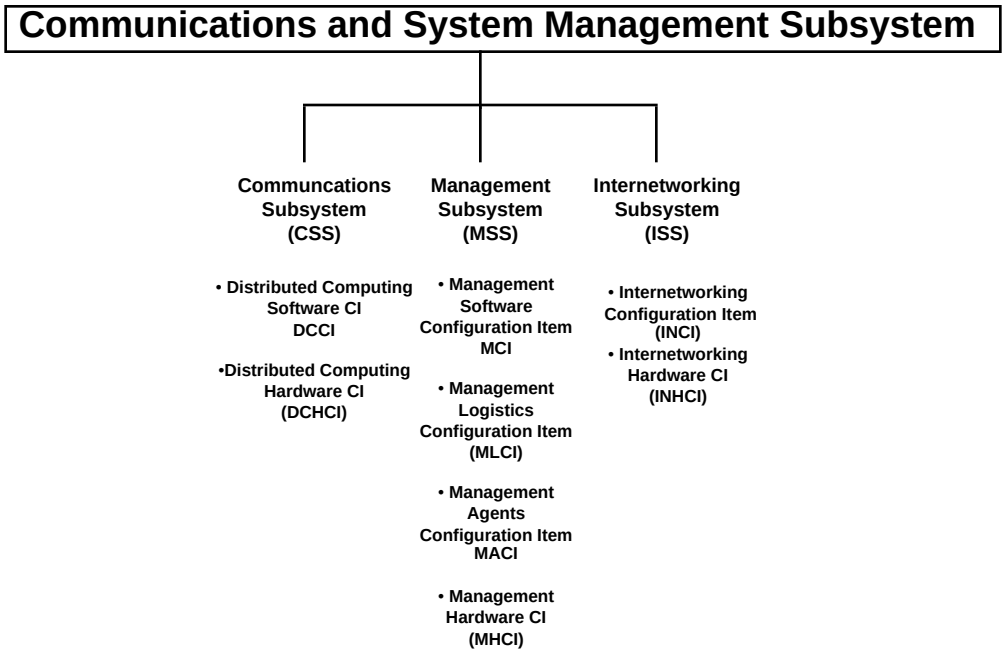

Figure 3.1.1-2. CSMS Subsystems and Components

3.1.2 DAAC-Specific Mission and Operations Activities

ECS subsystems provide mission and operations functionality for Release A. Key ECS related mission and operations activities supported by the ECS GSFC DAAC include:

- VIRs data ingest, archive and distribution - The TRMM Science Data and Information System (TSDIS) and ECS work together to provide support for the Visible and Infrared Scanner (VIRS), TRMM Microwave Imager (TMI), and Precipitation Radar (PR) instruments to be flown on the TRMM observatory, and corresponding Ground Validation (GV) data. The standard VIRS data products and associated browse products are allocated to the GSFC DAAC for ingest, archive and distribution.
- MODIS algorithm integration and test - Algorithm Integration and Test includes support to integrate Version 1 science software for EOS-AM-1 instruments into the DAAC. SDPS components to support Algorithm Integration and Test are provided by the Data Processing and Ingest Subsystems. Ingest hardware and software components provide the capabilities to support the interface for Algorithm Package delivery. Data Processing hardware and software components provide the capabilities to validate the science software operates in the DAAC environment including standards checking, integration with the SDP Toolkit, and execution on the DAAC processing resources.
- AM-1 interface test support - EOS-AM-1 interface testing includes testing EDOS/ECS interfaces and ADC/ECS interfaces required for EOS-AM-1 ancillary data. Hardware and software components provide capabilities to exchange messages and transfer data.

Message validation and limited data checking is supported. Temporary storage of messages and data is provided to validate the EOS-AM-1 interfaces. MODIS interface testing is performed at the GSFC DAAC.

- V0 data migration, archive and distribution - Version 0 (V0) data migration includes the ability to transition V0 data sets from V0 to V1; and provide support, data management, search, and access capabilities for these data sets. A subset of V0 data sets is available at Release A. Additional data migration takes place during Release A operations.

In addition to the above, V0 interoperability and transition to Release B baseline will be part of the operations activities at the GSFC DAAC.

During the operations period for ECS Release A, all the normal GSFC DAAC V0 operations will continue to occur in parallel with the ECS operations . As the releases progress and increased capability and data products become part of the ECS DAAC, parallel operations will not occur, except in those cases where the unique elements of the GSFC DAAC necessitate similar operations.

In addition to automated support, ECS subsystems provide the capability for the ECS operations staff to perform a number of roles in support of these activities. These operational roles are identified in Table 3.1.2-1. The table identifies the corresponding SDPS or CSMS subsystem that enables the DAAC ECS operations staff to perform a particular role/function. Detailed descriptions of these activities are captured in the ECS Operations Concept for the ECS Project: Part 2A - ECS Release A (604-CD-003-001) document.

Table 3.1.2-1. GSFC SDPS Operations Support Functions

ECS DAAC Operational Roles	ECS Capability
User Services - Support user with data expertise - Generate and maintain data interface	Data Management Subsystem
Data Ingest - Monitor electronic - Handle media	Ingest Subsystem
Production Planning	Planning Subsystem (1)
Resource Planning	Planning Subsystem Systems Management Subsystem
Production Monitoring and control	Processing Subsystem (1)
Archive Management	Data Server Subsystem
Data Distribution - Monitor electronic - Handle media	Data Server Subsystem
Resource Management	Processing, Ingest, Distribution & Data Server Subsystems in coordination with Systems Management Subsystem
Algorithm Integration Support	Processing Subsystem (2)
Database Maintenance	Data Management Subsystem Data Server Subsystem Application specific (3)
System and Performance Analysis	Systems Management Subsystem
Security	Systems Management Subsystem
Accounting and Billing	Systems Management Subsystem (4)
Sustaining Engineering	Office Support Systems Management Subsystem Communication Subsystem
S/W and H/W Maintenance	Office Support Systems Management Subsystem Communication Subsystem
Configuration Management (chg control)	Systems Management Subsystem
Testing, training, property management, integrated logistics support, library administration	Office Support Systems Management Subsystem Communication Subsystem

Notes:

1. Capability used to support testing; not used for full operational support. No product generation for Release A.
2. Capability used to support MODIS algorithm integration and testing for AM-1 readiness.
3. Included to ensure that the number of small DBMSs throughout the system are not explicitly excluded (e.g., Planning Subsystem has a DBMS)
4. Not part of Release A.

3.2 GSFC External Interfaces

The GSFC ECS DAAC will interface with multiple entities external to the DAAC. The ECS subsystem-specific DID305 design documents address the interfaces generically in a series of tables supported by textual explanations. For details, the reader is referred to those documents in addition to the various Interface Control Documents (ICDs). Figure 3.2-1 schematically illustrates the interfaces between the ECS subsystems at the GSFC DAAC and its external entities (sinks and sources of data). The figure enumerates data flows which are elaborated upon in Table 3.2-1.

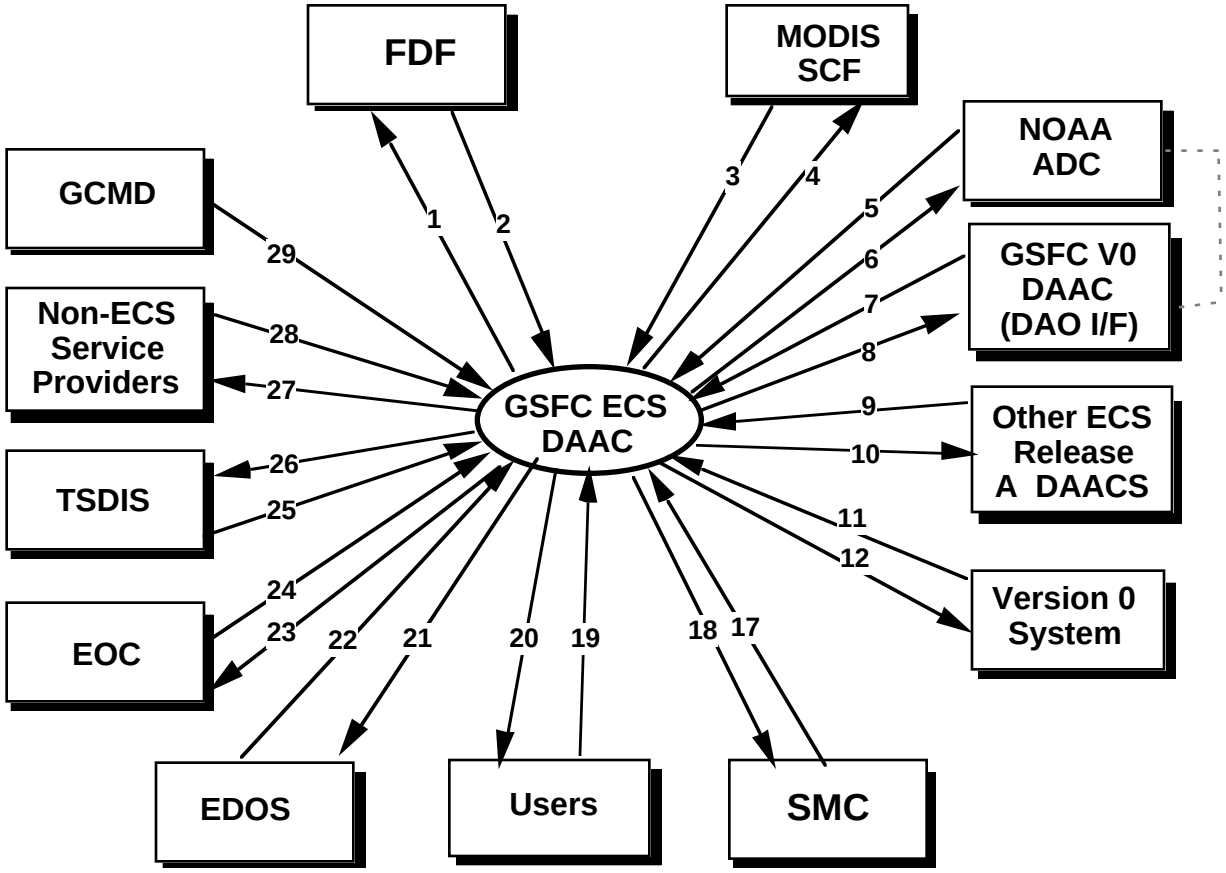

Figure 3.2-1. GSFC ECS DAAC External Interfaces

Note: The dashed line for beween NOAA and GSFC V0 DAAC reflects the DAAC unique interface required to support NMC ancillary data for Release A. At Release B, this will be intergrated into the GSFC ECS DAAC.

The following further describes the external entities, including those identified to support interface testing:

- TSDIS - This interface primarily supports the transfer of data between the GSFC DAAC and TSDIS for the purpose of archival of VIRS data sets including ancillary data,

metadata and documentation. ECS ingests this data product and then on an as required basis, provides the TRMM data products back to TSDIS for reprocessing.

- MODIS SCF - This interface supports the MODIS Instrument Team. MODIS algorithms, metadata, status, quality control products, standard products, calibration data, correlative data, algorithm updates and documentation are example of things that will cross this interface. During the Release A time frame, this interface will be used to support interface testing and algorithm test and integration activities. All ECS-SCF interfaces involve humans at the SCF interacting with ECS via ECS-provided (Client Subsystem), public domain, or COTS. The interface implementation between the SCF and DAAC include media, telephonic, WWW, electronic mail, and electronicelectronic file transfer the DAAC operations staff (M&O)
- ADC - This interface supports access to non-EOS data sets to satisfy ECS user queries and to retrieve ancillary data for ECS standard product generation. NOAA is the only ADC that GSFC ECS DAAC will communicate with for Release A. The interface to NOAA to obtain the NMC ancillary data set used to support TRMM processing is via the GSFC V0 DAAC unique interface.
- Other Release A DAACs - The GSFC ECS DAAC will interface with the MSFC and LaRC ECS DAACs. All Release A data products migrated from the V0 DAACs will be available from these DAACs for access by users. Guide, inventory, standard products and other related information, identified in Table 3-1, will flow across this interface.
- Version 0 System - This interface to GSFC ECS DAAC supports access to the V0 holdings that have not currently migrated to ECS. It is used to support the interoperability required for cross-DAAC access.
- GSFC V0 DAAC - This interface provides access to data or other information that comes into the DAAC via the V0 IMS system but are archived into ECS, or into both ECS and the GSFC V0 archive. The migration of Version 0 datasets into ECS will occur via this interface. Three GSFC V0 datasets (TOMS-nimbus 7, CZCS L1, AVHRR Pathfinder) have been identified for inclusion into Release A. These datasets will be among the first maintained within the ECS Data Server paradigm, as described in Section 3.3. This interface also includes the DAO unique interface which supports the request and exchange of NOAA NMC ancillary data required for TRMM processing. Thus, at Release A, the ECS to NOAA NMC interface for the ancillary data is via the interface with the V0 DAAC. Details are documented in the ECS to GSFC ICD.
- SMC - This interface provides the capability for the GSFC DAAC to receive performance information, processing status, scheduling and policy data and user registration information. Policy data includes that established by the ESDIS project. The GSFC DAAC sends it system performance and status reports to SMC as part of this interface.
- GSFC Users - This interface is the mechanism for user community access to ECS data and services. It is the mechanism by which advertisement, user registration, order and product status, desktop object manipulations, and command languages capabilities are utilized.

FDF - The FDF interface provides refined orbit/attitude data. Provided at Release A for interface testing.

- EDOS- The data handling function for the EOS Ground Segment is allocated to the EDOS. The science data stream downlinked from the EOS instruments is routed from EDOS to ECS after L0 processing. This interface is present for testing purposes. Further information is available from the EDOS ICD.
- EOC - The EOS operation control center (EOC) interfaces with the GSFC DAAC for the exchange of instrument operations plans and schedules for the AM-1 spacecraft and mission historical information. The Release A interface is available for connectivity testing only. Further information is available from the EOC ICD.
- Non-ECS Service Providers - This interface is required for specialized users who use ECS data to provide and advertise value-added services. These providers include commercial, institution, or other government agencies, as well as IPs, SCFs, and ADCs. (Not Release A)..
- GCMD - The Global Change Master Directory (GSCM) is a multidisciplinary database of information about data holdings of potential interest to the scientific research community. It contains high level descriptions of data set holdings of various agencies and institutions. It also contains supplemenaty descriptions about these data centers, as well as scientific campaigns and projects, sources (spacecraft, platforms), and sensors. This interface will allow the GSFC ECS DAAC to import directory level information from the GCMD via GCMD export files and generate ECS data product advertisements.

Table 3.2-1. GSFC External Interfaces (1 of 8)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
1 _	Ingest	FDF	Repaired/Retained Orbit Data Request	low	infrequent (depends on mission requirements)
2_	FDF	Ingest	Repaired Orbit Data	medium	as requested
3_	MODIS SCF	Ingest	Status	low	as required
3_	MODIS SCF	Ingest	Metadata/updates	low	as required
3_	MODIS SCF	Ingest	Documents	low	as required
3_	MODIS SCF	Ingest	Algorithms/Updates	medium	as required
3_	MODIS SCF	CSS (DAAC Ops via email)	Test Reviews by MODIS SCF	low	as required

Table 3.2-1. GSFC External Interfaces (2 of 8)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
3_	MODIS SCF	CSS (DAAC Ops via email)	Request for Resource Usage	low	as required
3_	MODIS SCF	CSS (DAAC Ops via email)	Reprocessing Request	low	as required
3_	MODIS SCF	Data Server	QA Data request	low	as required
3_	MODIS SCF	Data Server	QA Data Subscription	low	as required
4_	Data Server	MODIS SCF	Status	low	as required
4_	Data Server	MODIS SCF	Metadata/updates	low	as required
4_	Data Server	MODIS SCF	Calibration data	medium	as required
4_	Data Server	MODIS SCF	Correlative data	medium	as required
4_	Data Server	MODIS SCF	Documents	low	as required
4_	Data Server	MODIS SCF	Algorithms/updates	medium	as required
4_	Data Server	MODIS SCF	Standard Products	medium	daily as required for QA
4	CSS (DAAC Ops via email, EDHS)	MODIS SCF	Toolkit Delivery and Update Package	low	as required
4_	CSS (DAAC Ops via email, kftp)	MODIS SCF	Test Results, QA, and Production History Data	low	as required
4_	CSS (DAAC Ops via email, kftp)	MODIS SCF	Resource Usage	low	as required
4_	CSS (DAAC Ops via email, kftp)	MODIS SCF	Status	low	as required
5	ADC (NOAA)	data server	Advertising Information	low	as required
5	ADC (NOAA via V0 Valids Group)	Client / Data Server	Dependent Valids Update	low	as required
5	ADC (NOAA)	Client (Release A)	User Authentication Requests	low	as required
5	ADC (NOAA)	Client (Release A)	Guide Query Results	low	as required
5	ADC (NOAA)	Client (Release A)	Inventory Query Results	low	as required

Table 3.2-1. GSFC External Interfaces (3 of 8)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
5	ADC (NOAA)	Client (Release A)	Cost Estimates	low	as required
5	ADC (NOAA)	Client (Release A)	Product Delivery Status	low	as required
5	ADC (NOAA)	ECS (DAAC operaions)	Schedule Adjudication via telephone	N/A	as required
6	Number not used				
7	GSFC V0 DAAC (DAO)	Ingest	NMC Ancillary Data:	20MB/day	frequency dependent on data set
7	GSFC V0 DAAC (DAO)	Ingest CSS	Authentication request, DAA,mget, DDN	low	frequency dependent on data set
7	GSFC V0 DAAC	Ingest	V0 Data Migration Data Sets	medium	varies depending on migration strategy
8	Ingest CSS	GSFC V0 DAAC	Authentication response, DAN, file transfer,DDA	low	frequency dependent on data set
9	Other ECS Rel A DAACs	Ingest	Ancillary Data	high	as required
9	Other ECS Rel A DAACs	Ingest	Correlative Data	high	as required
9	Other ECS Rel A DAACs	Ingest	Calibration Data	medium	as required
9	Other ECS Rel A DAACs	Ingest	QA Data	medium	as required
9	Other ECS Rel A DAACs	Interoperability	Advertisements	medium	as required
9	Other ECS Rel A DAACs	Data Server	Result Sets	medium	as required
9	Other ECS Rel A DAACs	Client	Product Requests	medium	as required
10	Data Server	Other ECS Rel A DAACs	Standard Products	high	as required
10	Data Server	Other ECS Rel A DAACs	Metadata	medium-high	as required
10	Data Server	Other ECS Rel A DAACs	Ancillary Data	high	as required

Table 3.2-1. GSFC External Interfaces (4 of 8)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
10	Data Server	Other ECS Rel A DAACs	Correlative Data	high	as required
10	Data Server	Other ECS Rel A DAACs	Calibration Data	high	as required
10	Data Server	Other ECS Rel A DAACs	Documents	medium	as required
10	Data Server	Other ECS Rel A DAACs	Orbit/Attitude Data	medium	as required
10	Data Server	Other ECS Rel A DAACs	Data Availabiity Schedules	medium	as required
10	Data Server	Other ECS Rel A DAACs	Algorithms	high	as required
10	Data Server	Other ECS Rel A DAACs	Special Products	high	as required
10	Data Server	Other ECS Rel A DAACs	L0 Data	high	as required
10	Data Server	Other ECS Rel A DAACs	Expedited Data	medium	as required
10	Data Server	Other ECS Rel A DAACs	QA Data	medium	as required
10	Data Server	Other ECS Rel A DAACs	Result Sets	medium	as required
10	Interoperability	Other ECS Rel A DAACs	Advertisements	medium	as required
10	Client	Other ECS Rel A DAACs	Product Requests	medium	as required
11	Version 0 System	Data Server	Inventory	low	as required
11	Version 0 System	Data Server	Guide	low	as required
11	Version 0 System	Data Server	Browse data	medium	as required
11	Version 0 System	Data Server	Dependent Valids	low	as required
11	Version 0 System	Data Management	V0 Directory search request	low	as requested
11	Version 0 System	Data Management	V0 Inventory search request	low	as requested
11	Version 0 System	Data Management	V0 browse request	low	as requested

Table 3.2-1. GSFC External Interfaces (5 of 8)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
11	Version 0 System	Data Management	V0 product order request	low	frequency dependent on user input
12	Data Mgmt	Version 0 System	V0 Browse Result	low-medium	in response to ECS browse result
12	Data Mgmt	Version 0 System	V0 product order response	low	in response to product request result
12	Data Server	Version 0 System	Result Sets	medium-high	in response to request
12	Data Server	Version 0 System	Session Mgmt responses	low	in response to request
12	Data Server	Version 0 System	Product Request Status	low	as required
13 -16	Numbers not used				
17	SMC	MSS	Policies	low	as required
17	SMC	MSS	Conflict Resolution	low	as required
17	SMC	MSS	Procedures	low	as required
17	SMC	MSS	Directives	low	as required
18	MSS	SMC	Conflict Resolution Request	low	as required
18	MSS	SMC	Status	low	as required
18	MSS	SMC	Performance	low	as required
19	Users	Client	User registration information	low	as requested
19	Users	Client	User login information	low	as requested
19	Users	Client	Search requests	low	as requested
19	Users	Client	Product requests	low	as requested
19	Users	Client	Acquisition requests	low	as requested
19	Users	Client	Desktop manipulate commands	low	as supplied by user
19	Users	Client	Configuration/Profile information	low	as supplied by user
19	Users	Client	Data manipulate requests	low	as requested
19	Users	Client	Command language request	low	as requested
19	Users	Client	Advertisements, Software, and Documents	low	as supplied by user

Table 3.2-1. GSFC External Interfaces (6 of 8)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
19	Users	Ingest	User Methods	medium	as required
19	Users	Ingest	Ingest Status Requests	low	as required
20	Data Server	Users	Metadata	low	as requested
20	Data Server	Users	Documents	low	as requested
20	Data Server	Users	Data Products	medium	as requested
20	Data Server	Users	Browse Products	medium	as required
20	Data Server	Users	Product Request Status	low	as requested
20	Data Server	Users	DAR Status	low	as requested
20	Data Server	Users	Schedules	low	as requested
20	Client	Users	Results Set	medium	as requested
20	Client	Users	Application user interfaces	low	as requested
20	Client	Users	Formatted data	medium	as requested
20	Client	Users	Desktop Objects	low	as requested
20	Client	Users	Advertisement and Software	low	as requested
20	Client	Users	Error and Status information	low	as available
20	Ingest	Users	Ingest Status	low	as requested
21_	Ingest	EDOS	Service Requests (Back-up data requests)	low	rare
21_	Ingest	EDOS	Fault Report	low	rare
21_	Ingest	EDOS	Fault Isolation Request	low	depends on EDOS
21_	Ingest	EDOS	L0 data	high	rare
22_	EDOS	Ingest	Service Request Disposition	low	as required
22_	EDOS	Ingest	PDSs (L0 Data)	high	several times a day

Table 3.2-1. GSFC External Interfaces (7 of 8)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
22_	EDOS	Ingest	ADSs (Back-up L0 Data)	high	as required
22_	EDOS	Ingest	PDS Delivery Record	low	several times a day
22_	EDOS	Ingest	ADS Delivery Record	low	as required
22_	EDOS	Ingest	Physical Media Unit Delivery Record	low	as required
22_	EDOS	Ingest	Undetected Fault Isolation	low	as required
23	Number not used				
24_	EOC	Ingest	Telemetry Data	173 MB/day	Twice per day (12 files each transfer)
24_	EOC	Ingest	Event	12MB/day	Every hour
24_	EOC	Ingest	EOC statistics, schedules, reports, etc.	25MB/day	Twice per day (25 files total each day)
25	TSDIS	Ingest	Metadata	1 days worth of products	daily
25	TSDIS	Ingest	Ancillary Data (GV)	1 days worth	daily
25	TSDIS	Ingest	Data Products (VIRS Levels 1A,1B)	4.2 GB/day Processing and Reprocessing	
25	TSDIS	Ingest	Algorithms	medium	as required
25	TSDIS	Ingest	Documents	low	as required
25	TSDIS	Ingest	Status	low	as required
25	TSDIS	Ingest	VIRS Browse Data	TBD MB/day	daily
25	TSDIS	Ingest	Directory	low	as required
25	TSDIS	Ingest	Guide	low	as required
25	TSDIS	Ingest	Schedule Data	low	as required

Table 3.2-1. GSFC External Interfaces (8 of 8)

Flow No.	Source	Destination	Data Types	Data Volume	Frequency
25	TSDIS	Data Server	Subscription Data	low	as required
25	TSDIS	Ingest	Platform Ephemeris		
26	Data Ser ver	TSDIS	Platform Ephemeris		
26	Data Server	TSDIS	Ancillary Data (NMC)		as required to support reprocessing
26	Data Server	TSDIS	Data Products (VIRS Levels 1A,1B)		as required to support reprocessing
27	Interoperability	Non-ECS Service Providers	Notifications	low	in response to subscriptions
28	Non-ECS Service Providers	Interoperability	Advertisements	low-medium	as required
28	Non-ECS Service Providers	Interoperability	Subscriptions	low	as required
29	GCMD	Interoperability	Advertisements	low-medium	as required

In the table, where an exact number is unavailable, the data volume is estimated as low (less than 1 MB), medium (between 1 MB and 1 GB), or high (greater than 1 GB) per use defined in the frequency column . The frequency information will be updated as the interfaces are fully defined. "_" in the Flow No. column indicates interfaces are implemented only to the extent needed for purposes of early interface testing.

3.3 Computer Software Component Analysis

3.3.1 Software Subsystem Overview

The 10 ECS software subsystems are described in detail in the ECS Subsystem-specific DID305 documents. This section provides a brief overview description of each of the subsytems.

- **Client Subsystem (CLS):** This software consists of graphic user interface (GUI) programs, tools for viewing and/or manipulating the various kinds of ECS data (e.g., images, documents, tables) and libraries representing the client application program interface (API) of ECS services. For Release A, the client subsystem will consist of the desktop, an advertising user interface, and a data visualization tool (EOSView). The remainder of the Release A user interface will be provided by an enhanced version of the V0 System Client. The client subsystem components will available to users for installation on their workstations and will also be deployed on workstations within the DAAC in support of normal operations, including User Services support.
- **Interoperability Subsystem (IOS):** This subsystem maintains a database of information about the services and data offered by ECS, and allows users to search through this database to locate services and data that may be of interest to them. It provides an advertising service that will be implemented as an SDPS developed distributed database

application on top of a commercial off-the-shelf Data Base Management System (DBMS). The user interface to this subsystem is the Client subsystem.

- **Data Management Subsystem (DMS):** This subsystem includes functions which provide uniform access to descriptions of the data and the data elements offered by the EOSDIS repositories and provide a bidirectional gateway between ECS and Version 0. This subsystem also includes distributed search and retrieval functions and corresponding site interfaces, however, they are not part of the Release A design.
- **Data Server Subsystem (DSS):** The subsystem provides the physical storage access and management functions for the ECS earth science data repositories. Other subsystems can access it directly or via the data management subsystem (if they need assistance with searches across several of these repositories). The subsystem also includes the capabilities needed to distribute bulk data via electronic file transfer or physical media. Other components include, for example, administrative software to manage the subsystem resources and perform data administration functions (e.g., to maintain the database schema); and data distribution software, e.g., for media handling and format conversions.The main components of the subsystem are the following:
  - database management system - SDPS will use an off-the-shelf DBMS (SYBASE) to manage its earth science data and implement spatial searching, as well as for the more traditional types of data (e.g., system administrative and operational data). It will use a document management system to provide storage and information retrieval for guide documents, scientific articles, and other types of document data.
  - file storage management systems - they are used to provide archival and staging storage for large volumes of data. SDPS is considering the use of several hardware/software configurations which are either off-the-shelf or a mixture of off-the-shelf and developed software.
  - data type libraries - they will implement functionality of earth science and related data that is unique and not available off the shelf (e.g., spatial search algorithms and translations among coordinate systems). The libraries will interface with the data storage facilities, i.e., the database and file storage management systems.
- **Ingest Subsystem (INS):** The subsystem deals with the initial reception of all data received at an EOSDIS facility and triggers subsequent archiving and processing of the data. Given the variety of possible data formats and structures, each external interface, and each ad-hoc ingest task may have unique aspects. Therefore, the ingest subsystem is organized into a collection of software components (e.g., ingest management software, translation tools, media handling software) from which those required in a specific situation can be readily configured. The resultant configuration is called an ingest client. Ingest clients can operate on a continuous basis to serve a routine external interface; or they may exist only for the duration of a specific ad-hoc ingest task.
- **Data Processing Subsystem (DPS):** The main components of the data processing subsystem - the science algorithms - will be provided by the science teams. The data processing subsystem will provide the necessary hardware resources, as well as software for queuing, dispatching and managing the execution of these algorithms in an

environment which eventually will be highly distributed and consist of heterogeneous computing platforms. The DPS also interacts with the DSS to cause the staging and de-staging of data resources in synchronization with processing requirements.

- **Planning Subsystem (PLS):** This subsystem provides the functions needed to pre-plan routine data processing, schedule ad-hoc processing, and dispatch and manage processing requests. The subsystem provides access to the data production schedules at each site, and provides management functions for handling deviations from the schedule to operations and science users.
- **Management Subsystem (MSS):** The Management Subsystem (MSS) provides enterprise management (network and system management) for all ECS resources: commercial hardware (including computers, peripherals, and network routing devices), commercial software, and custom applications. Enterprise management reduces overall development and equipment costs, improves operational robustness, and promotes compatibility with evolving industry and government standards. Consistent with current trends in industry, the MSS thus manages both ECS's network resources per ESN requirements and ECS's host/application resources per SMC requirements. Additionally MSS also supports many requirements allocated to SDPS and FOS for management data collection and analysis/distribution.

  The MSS allocates services to both the system-wide and local levels. With few exceptions, the management services will be fully decentralized, no single point of failure exists which would preclude user access. In principle every service is distributed unless there is an overriding reason for it to be centralized. MSS has two key specializations: Enterprise Monitor and Coordination Services and Local System Management Services.

  For IR-1 and Release A not all of the MSS services will be fully implemented, some will be provided through COTS and COTS customization, while others will be provided through the use of Office Automation (OA) tools.
- **Communications Subsystem (CSS):** The CSS services include Object Services, Distributed Object Framework (DOF) and Common Facility Services. Support in this subsystem area is provided for peer-to-peer, advanced distributed, messaging, management, and event-handling communications facilities. These services typically appear on communicating end-systems across an internetwork and are not layered, but hierarchical in nature. Additionally, services to support communicating entities are provided, included directory, security, time, and other ancillary services. The services of the Communications Subsystem are functionally dependent on the services of the Internetworking Subsystem. The services of the common facility, object and DOF are the fundamental set of interfaces for all CSMS management and FOS and SDPS user access (i.e., pull) domain services. The DOF services are the fundamental set of dependencies of the common facility and object services.
- **Internetworking Subsystem (ISS):** The Internetworking Subsystem provides for the transfer of data transparently within the DAACs, SMC and EOC, and for providing interfaces between these components and external networks. ECS interfaces with external systems and DAAC to DAAC communications are provided by the EOSDIS Backbone

Network (EBnet). EBnet's primary function is to transfer data between DAACs, including both product data and inter-DAAC queries and metadata responses. Other networks, such as NSI, will provide wide-area services to ECS. In addition, "Campus" networks, which form the existing networking infrastructure at the ECS locations, will provide connectivity to EOSDIS components such as SCFs and ISTs.

3.3.2 Software Subsystem Analysis Summary

This summary addresses the CSCIs for each subsystem, focusing upon those CSCIs that are specific to the GSFC ECS DAAC. For the most part, the software is the same for GSFC, LaRC, and MSFC ECS DAACs. When differences occur they are due more to things like the content of databases and schema constructions than to software. In the case of OTS packages, the possibility arises for the purchase of different versions for different DAAC hardware, but even this will be minimal for Release A. The following addresses each subsystem in a somewhat general manner to point out whether or not there are any GSFC DAAC specific portions.

- Client Subsystem–The client software will have no GSFC DAAC specific portions. This software supports the GSFC ECS DAAC M&O staff (e.g. operations, user services, system administrators) and will be hosted on ECS workstations defined within the system. The Client software may be hosted on existing DAAC workstations to provide additional user access, but the GSFC DAAC will be responsible for providing additional Client host workstations when required by the DAAC's user community.

- Data Server - This subsystem will have certain portions that may be specific to the GSFC ECS DAAC due to the GSFC ECS DAAC data collections. Each data collection is mapped to a logical data server. A logical data server implies that for each of the collections there will be a window into the GSFC ECS DAAC that is associated with that collection of data. Each data collection will be managed by its own logical data server. The logical data servers will be mapped to physical data servers (i.e. hardware) using sizing projections from modeling efforts currently underway. Several physical data servers will be mapped to a given configuration of processing and archive resources.

- The data collections were identified by number and name, as part of the PDR Taxonomy activities performed in support of the Data Modeling Working Group. The types of data services available with each data collection and the data type services software may vary. These data type services contribute to the uniqueness of the GSFC ECS DAAC. The following list extracted from the Release A/PDR Data Server Taxonomy (420-TD-001-004), identifies the Release A data collections (and, by definition, their logical data servers). The logical data servers are also mapped to the physical data servers (expressed in CSC nomenclature as found in the Release A SDPS Data Server Subsystem Design Specification for the ECS Project (DID 305-CD-008-001)).

  - 46- GSFC AVHRR Land Surface Vegetation - This logical data server is required to support Version 0 to Version 1 data migration. This logical data server maps to the physical data server defined in the Data Server subsystem, SDSRV CSCI, Non-Product Science ESDTs CSC.

- 51- GSFC VIRS, L0/L1 - This logical data server is required to support the ingesting of the VIRS levels 1A and 1B products . This logical data server maps to the physical data server defined in the Data Server subsystem, SDSRV CSCI, VIRS CSC.
- 53- GSFC TOMS, Atmospheric Composition- This logical data server is required to support Version 0 to Version 1 data migration. This logical data server maps to the physical data server defined in the Data Server subsystem, SDSRV CSCI, Non-Product Science ESDTs CSC.
- 94- GSFC, CZCS, L0/L1- This logical data server is required to support Version 0 to Version 1 data migration. This logical data server maps to the physical data server defined in the Data Server subsystem, SDSRV CSCI, Non-Product Science ESDTs CSC.

• Data Management –None of the data management software will be specific to the GSFC DAAC. In Release A, neither the LIMGR or the DIMGR will be provided. Only the functionality of the Data Dictionary and Gateway CSCIs are provided. The V0 Gateway

• (GTWAY) CSCI will interface with the data servers at each site. Local and cross-DAAC searches are provided via capabilities resulting from integrating the components from the V0 System IMS into ECS.

• Ingest–The software portions for ingest at GSFC may differ from those of other DAACs because of dataset dependencies. Data ingestion procedures must match the peculiarities of the ingested data sets.

• Interoperability–There are no GSFC DAAC specific portions of the Interoperability Subsystem.

• Production Planning–There are no GSFC DAAC specific portions of the production Planning subsystem. The configuration and database information will be specific to the DAAC and the production plans developed for each DAAC will be different. Script files, while they may use the same language, will differ for things like fault recovery, fault notification, production management, and exception handling. At Release A, the capabilities of this subsystem will be for testing purposes only, since no standard products are being produced at the GSFC DAAC. In addition, these capabilities may also be utilized to provide early DAAC staff training on the use of the planning tools.

• Data Processing–Due to dataset characteristics there may be some software unique to GSFC in the area of Science Data Processing (e.g., compilers for the Science software) and Pre-processing (e.g., DAAC-specific external interface EDOS). However, the Release A capabilities at the GSFC DAAC are available only as a function of supporting the integration and test of MODIS algorithms.

• Communications Subsystem - There are no LaRC ECS DAAC specific portions of this subsystem.

• Systems Management - This subsystem is composed of a variety of management applications, providing services such as fault, performance, security and accountability management for ECS networks, hosts, and applications. Two tiers of "view" (domain of

management service interface) provided by the applications in this subsystem. Only the local management view is provided at the GSFC ECS DAAC. There are no GSFC ECS DAAC specific portions of this subsystem.

- Internetworking Subsystem - There are no LaRC ECS DAAC specific portions of this subsystem.

Table 3.3-1 lists the ECS subsystems and associated CSCIs and CSCs. For each CSC, there is an indication of the type of component. As defined in the DID 305 subsystem-specific documents, type indicates whether the component is custom developed (DEV), off the shelf (OTS), a CSC reused from another subsystem (reuse), a wrapper (WRP), or a combination of these types. The Use column indicates whether a generic (Gnrc) form of the CSC is implemented or specific (Spf) tailoring or use is required at a DAAC. The Notes column is included to comment about the characteristics of the system, data, and/or software that makes the CSC specific, as well as to provide any additional information about the generic CSCs. This column also identifies the OTS product.

Table 3.3.2-1. GSFC Components Analysis (1 of 7)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Client	DESKT	Desktop	DEV	Gnrc	
Client	WKBCH	Hypertext Viewer CSC	OTS	Gnrc	Netscape
Client	WKBCH	Data Visualization (EOSView) CSC	DEV	Gnrc	
Client	WKBCH	SDPS Toolkit CSC	DEV	Gnrc	
Client	WKBCH	CSMS Toolkit CSC	DEV	Gnrc	
Client	WKBCH	Release A Client	OTS	Gnrc	enhanced V0 client
CSS	DCCI	File Access Services	OTS/ DEV	Gnrc	native operating system (ftp)
CSS	DCCI	Message Passing Services	DEV	Gnrc	Developed with OODCE
CSS	DCCI	Time Services	OTS/ DEV	Gnrc	OODCE
CSS	DCCI	Event Logger Services	DEV	Gnrc	
CSS	DCCI	Electronic Mail Services	OTS/ DEV	Gnrc	native operating system
CSS	DCCI	Thread Services	OTS	Gnrc	OODCE
CSS	DCCI	Directory/Naming Services	OTS/ DEV	Gnrc	OODCE
CSS	DCCI	Life Cycle Services	OTS/ DEV	Gnrc	OODCE
CSS	DCCI	Security Services	OTS/ DEV	Gnrc	OODCE
CSS	DCCI	DOF Services	OTS	Gnrc	OODCE
CSS	DCCI	Virtual Terminal Services	OTS	Gnrc	native operating system

Table 3.3.2-1. GSFC Components Analysis (2 of 7)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Data Management	GTWAY	Gateway Server	DEV	Gnrc	
Data Management	GTWAY	V0 IMS server	OTS	Gnrc	enhanced version of V0 server
Data Management	GTWAY	Gateway DBMS	OTS	Gnrc	Sybase DBMS
Data Processing	AITTL	Documentation Viewing Tools	OTS	Gnrc	SoftWindows/MS Office Ghostview
Data Processing	AITTL	Standards Checkers	OTS/ DEV	Spf	FORCHECK for Fortran 77; otherwise, native compilers
Data Processing	AITTL	Code Analysis Tools	OTS	Spf	CASEVision SPARCWorks
Data Processing	AITTL	Data Visualization Tools	OTS	Gnrc	IDL
Data Processing	AITTL	ECS HDF Visualization Tools	DEV	Gnrc	CSC reused from WKBCH CSCI - EOSView
Data Processing	AITTL	Binary File Comparison Utility	DEV	Gnrc	
Data Processing	AITTL	Profiling Tools	OTS	Spf	CASEVision
Data Processing	AITTL	PGE Processing GUI	DEV	Gnrc	
Data Processing	AITTL	PGE Registration GUI	DEV	Gnrc	
Data Processing	AITTL	Report Generation Tools	OTS/ DEV	Gnrc	OTS: SoftWindows/MS Office, DEV: AI&T manager
Data Processing	AITTL	SDP Toolkit-related Tools	DEV	Gnrc	
Data Processing	AITTL	Product Metadata Display Tool	DEV	Gnrc	reused from HDF File Comparison Utility CSC
Data Processing	PRONG	Resource Management	DEV	Gnrc	
Data Processing	PRONG	COTS	OTS	Gnrc	AutoSys and AutoXpert
Data Processing	PRONG	COTS Management	DEV	Gnrc	
Data Processing	PRONG	Data Management	DEV	Gnrc	
Data Processing	PRONG	Data Pre-Processing	DEV	Spf	Based on uniqueness of ancillary data products

Table 3.3.2-1. GSFC Components Analysis (3 of 7)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Data Processing	PRONG	PGE Execution Management	DEV	Gnrc	
Data Processing	PRONG	Quality Assurance Monitor	DEV	Spf	
Data Processing	SDPTK	Ancillary Data Access	DEV	Gnrc	
Data Processing	SDPTK	Celestial Body Position	DEV	Gnrc	
Data Processing	SDPTK	Coordinate System Conversion	DEV	Gnrc	
Data Processing	SDPTK	Constant and Unit Conversions	DEV	Gnrc	
Data Processing	SDPTK	Ephemeris Data Access	DEV	Gnrc	
Data Processing	SDPTK	Geo Coordinate Transformation	DEV	Gnrc	
Data Processing	SDPTK	Input/Output	DEV	Gnrc	
Data Processing	SDPTK	Memory Management	DEV	Gnrc	
Data Processing	SDPTK	Process Control	DEV	Gnrc	
Data Processing	SDPTK	Status Message File (Error/Status)	DEV	Gnrc	
Data Processing	SDPTK	Time Date Conversion	DEV	Gnrc	
Data Processing	SDPTK	Math Package	OTS	Gnrc	IMSL
Data Processing	SDPTK	Graphics Library	OTS	Gnrc	IDL
Data Processing	SDPTK	EOS-HDF	DEV	Gnrc	
Data Server	SDSRV	VIRS	DEV	Spf	
Data Server	DDIST	Distribution Products	DEV	Gnrc	
Data Server	DDIST	Distribution Client Interface	DEV	Gnrc	
Data Server	DDIST	Distribution Request Management	DEV	Gnrc	
Data Server	DDSRV	DDSRV	DEV	Gnrc	
Data Server	DDSRV	DDSRV Server	DEV	Gnrc	
Data Server	DDSRV	DDSRV Client	DEV/ OTS	Gnrc	HTTP libraries

Table 3.3.2-1. GSFC Components Analysis (4 of 7)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Data Server	DDSRV	DDSRV ESDT	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	DDSRV	DDSRV CSDT	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	DDSRV	DDSRV Search Engine	OTS	Gnrc	Text Search Indexor and HTTP server
Data Server	SDSRV	Administration/ Operation	DEV	Gnrc	
Data Server	SDSRV	Client	DEV/ OTS	Gnrc	RogueWare class libraries and OODCE
Data Server	SDSRV	Configuration/Startup	DEV	Gnrc	
Data Server	SDSRV	Metadata	DEV/ WRP	Gnrc	Sybase DBMS
Data Server	SDSRV	CSDT	WRP	Gnrc	HDF-EOS
Data Server	SDSRV	DB WRPs	WRP	Gnrc	Sybase
Data Server	SDSRV	Descriptors	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	SDSRV	General ESDT	DEV	Gnrc	
Data Server	SDSRV	Global	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	SDSRV	GUI	DEV	Gnrc	
Data Server	SDSRV	Non-Product Science ESDTs	DEV	Gnrc	
Data Server	SDSRV	Non-Science ESDTs	DEV	Gnrc	
Data Server	SDSRV	Server	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	SDSRV	Subscriptions	DEV/ OTS	Gnrc	RogueWare class libraries
Data Server	STMGT	Service Clients	DEV/ OTS	Gnrc	CSC encapsulates the AMASS File Storage Management System OTS product . Also RogueWare class libraries.
Data Server	STMGT	Resource Management	DEV	Gnrc	
Data Server	STMGT	Data Storage	DEV/ OTS	Gnrc	AMASS File Storage Management System
Data Server	STMGT	Peripherals	DEV	Gnrc	This CSC encapsulates the CSS supplied API which supports the OTS FTP product.
Data Server	STMGT	File	DEV	Gnrc	

Table 3.3.2-1. GSFC Components Analysis (5 of 7)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
Ingest	INGST	Ingest Session Manager	DEV	Gnrc	
Ingest	INGST	Polling Ingest Client Interface	DEV	Gnrc	
Ingest	INGST	Ingest Request Processing	DEV	Gnrc	
Ingest	INGST	Ingest Data Transfer	DEV	Gnrc	
Ingest	INGST	Operator Ingest Interface	DEV	Gnrc	
Ingest	INGST	User Network Ingest Interface	DEV	Gnrc	
Ingest	INGST	Ingest DBMS	OTS	Gnrc	Sybase DBMS
Ingest	INGST	Ingest Administration Data	DEV	Gnrc	
Ingest	INGST	Peripheral Software	Reuse	Gnrc	CSC reused from DDIST CSCI
Ingest	INGST	Viewing Tools	Reuse	Gnrc	CSC reused from WKBCH CSCI - EOSView
Ingest	INGST	Client Services	Reuse	Gnrc	
Ingest	INGST	Ingest Data Preprocessing	DEV	Spf	
Ingest	INGST	Data Storage Software	Reuse	Gnrc	CSC reused from SDSRV CSCI and STMGT CSCI NOTE: Used for L0 storage
Ingest	INGST	Resource Administration	Reuse	Gnrc	CSC reused from SDSRV CSCI and STMGT CSCI
Interoperability	ADSRV	AdvApplDBMSServer	DEV	Gnrc	
Interoperability	ADSRV	AdvDBMSServer	OTS	Gnrc	Sybase DBMS
Interoperability	ADSRV	AdvTextServer	OTS	Gnrc	reuse of data server subsystem, DDSRV CSCI , Search engine CSC text search indexor
Interoperability	ADSRV	AdvNavigatingServer	OTS	Gnrc	reuse of data server subsystem, DDSRV CSCI , Search engine CSC HTTP server
Interoperability	ADSRV	GCMD Exporter	DEV	Gnrc	
ISS	INCI	Datalink/Physical	OTS	Gnrc	firmware, vendor-supplied with hardware
MSS	MCI	Management Framework	OTS/ DEV	Gnrc	HP OpenView Network Node Manager
MSS	MCI	Diagnostic Tests	OTS	Gnrc	vendor-supplied with hardware
MSS	MCI	Application Management	DEV	Gnrc	
MSS	MCI	Automatic Actions	DEV	Gnrc	
MSS	MCI	Resource Class Category	DEV	Gnrc	

Table 3.3.2-1. GSFC Components Analysis (6 of 7)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
MSS	MCI	Performance Manager	OTS/ DEV	Gnrc	not chosen yet
MSS	MCI	Report Generation and Distribution	DEV	Gnrc	
MSS	MCI	Performance Test	OTS	Gnrc	vendor-supplied with hardware
MSS	MCI	Performance Management Proxy	DEV	Gnrc	
MSS	MCI	Security Manager	DEV	Gnrc	
MSS	MCI	Security Databases	OTS	Gnrc	Operating System Password Files, DCE Registry Database, Router Configuration Files, TCP Wrappers configuration files, Operating System Access Control Lists, DCE Access Control Lists
MSS	MCI	Tests	OTS	Gnrc	CRACK, COPS, SATAN, TRIPWIRE
MSS	MCI	DCE Cell Management	OTS	Gnrc	HAL DCE Cell Manager
MSS	MCI	Security Management Proxy	DEV	Gnrc	
MSS	MCI	Accountability Manager	DEV	Gnrc	
MSS	MCI	User Profile Server	DEV	Gnrc	
MSS	MCI	Management Proxy	DEV	Gnrc	
MSS	MCI	Physical Configuration Manager	OTS	Gnrc	Mountain View
MSS	MCI	Network Manager	OTS	Gnrc	HP OpenView Network Node Manager
MSS	MCI	Physical Configuration Proxy Agent	DEV	Gnrc	
MSS	MCI	Trouble Ticketing Management Services	OTS	Gnrc	Remedy Action Request System
MSS	MCI	Trouble Ticketing User Interface	DEV	Gnrc	
MSS	MCI	Trouble Ticketing Service Requester	DEV	Gnrc	
MSS	MCI	Trouble Ticketing Proxy Agent	DEV	Gnrc	
MSS	MCI	Management Data Access Services	DEV	Gnrc	
MSS	MCI	Management Data Access User Interface	DEV	Gnrc	

Table 3.3.2-1. GSFC Components Analysis (7 of 7)

Subsystem	CSCI	CSC	TYPE	USE	NOTES
MSS	MCI	Ground Events Planning	reuse	Gnrc	reused from Planning Subsystem, PLANG CSCI, planning workbench CSC
MSS	MLCI	Baseline Manager	OTS/ DEV	Gnrc	Not chosen yet
MSS	MLCI	Software Change Manager	OTS/ DEV	Gnrc	ClearCase
MSS	MLCI	Change Request Manager	OTS/ DEV	Gnrc	Distributed Defect Tracking System
MSS	MACI	Extensible SNMP Master Agent	OTS/ DEV	Gnrc	Peer Network's agent, along with its toolkit for DEV
MSS	MACI	ECS Subagent	DEV	Gnrc	
MSS	MACI	DCE Proxy Agent	DEV	Gnrc	
MSS	MACI	Encapsulator for non-Peer Agent	OTS/ DEV	Gnrc	non-Peer agents not chosen yet, thus encapsulation not chosen yet.
MSS	MACI	SNMP Manager's Deputy	DEV	Gnrc	
MSS	MACI	Instrumentation Class Library	DEV	Gnrc	
MSS	MACI	Application MIB	DEV	Gnrc	
Planning	PLANG	Production Request Editor	DEV	Gnrc	
Planning	PLANG	Subscription Editor	DEV	Gnrc	
Planning	PLANG	Subscription Manager	DEV	Gnrc	
Planning	PLANG	Planning Workbench	DEV	Gnrc	
Planning	PLANG	Planning Object Library	OTS	Gnrc	Delphi C++ class libraries
Planning	PLANG	PDPS DBMS	OTS	Gnrc	Sybase DBMS

Note: The Planning and Processing Subsystems are provided for testing, but not for full operational use.

3.4 DAAC Hardware and Network Design

This section provides an overview of the hardware configuration currently envisioned to support the Release A TRMM mission for GSFC. Included below are details with respect to the Release A LANs (within Section 3.4.1), and the SDPS and remaining CSMS hardware (within Section 3.4.2). The LAN configuration discussion provides an overview diagram, Figure 3.4.1-1, which focuses on the GSFC configuration from the "networks" point of view. The remaining hardware discussions include an overview of the processing, server, workstation and associated peripherals with an overview diagram, Figure 3.4.2-1, providing details on sizes, quantities, classes and in most cases vendor and model numbers.

Note that the recommended configurations are based on design analysis and/or prototyping analysis in progress. Some design analysis is still proceeding on the incremental development track which relies heavily on prototyping. As further prototyping and design analysis is

performed, the ECS Team will continue to provide cost /performance analysis that is expected to impact the recommended configurations given in this document. Therefore, "selected" make and model numbers are still subject to change.

The following subsections provide details of the design rationale and recommended configuration for each of the CSMS and SDPS subsystems.

3.4.1 GSFC DAAC LAN Configuration

The GSFC DAAC LAN topology is illustrated in Figure 3.4.1-1. The network consists of six FDDI rings supporting the DAAC subsystems and connections to external systems. The Ingest, PDPS, and MSS (LSM) subsystems are contained on individual FDDI rings, while Data Server and Data Manager have been combined onto a single ring. There are also dedicated FDDI rings for external connections to the V0 network and to the EBnet router. The FDDI switch is the central device connecting the rings together. (For a description of the generic DAAC LAN topology and the reasons behind it, refer to Section 5.2.2 of Release A Overview (305-CD-004-001).)

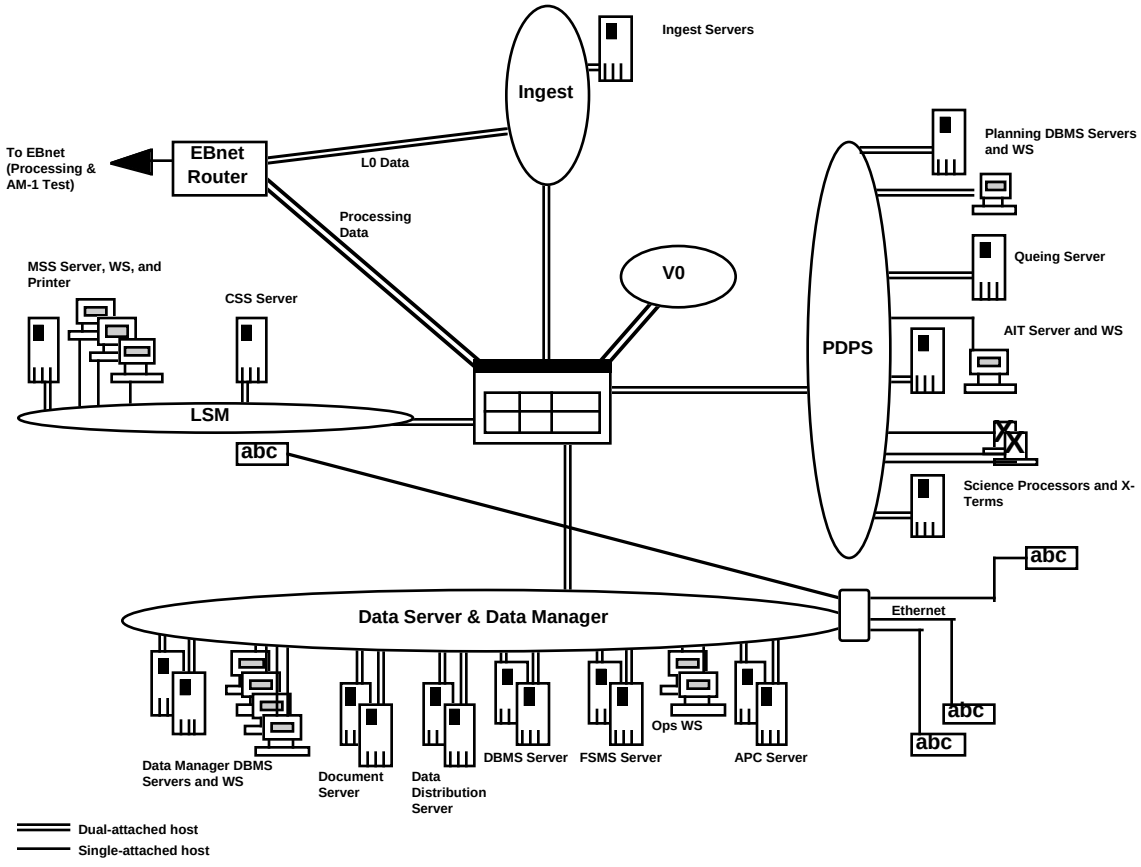

Figure 3.4.1-1. GSFC DAAC LAN Topology

The individual FDDI rings will be implemented with FDDI concentrators to provide ease of wiring and central points of management. All DAAC hosts will have FDDI interfaces and will be attached directly to the FDDI rings. Workstations will have single-attached FDDI cards, whereas the high-performance servers and processors will have dual-attached FDDI cards to provide redundancy. (Note that hosts with DAS cards are identified in Figure 3.4.1-1 by dual lines connecting to the FDDI ring.) Dual-attached hosts will be dual-homed to two separate FDDI concentrators to provide an additional level of redundancy in the event of a hub failure. Printers, which will be the only Ethernet devices in the DAAC, will be connected to the Data Server FDDI ring via an FDDI-to-Ethernet hub. (Note that the detailed network implementation on a subsystem basis is presented in the subsystem-specific design documents.)

The GSFC DAAC will have connections to the existing V0 network and to EBnet. The V0 network will be directly connected to the FDDI switch, primarily to facilitate V0 data migration to the Data Server subsystem. Although the detailed implementation of EBnet is still in progress (see Section 5.1.1 of Release A Overview (305-CD-004-001)), Figure 3.4.1-1 reflects current understanding of the interface. The DAAC connection to EBnet will be via separate FDDI interfaces on a single router. One interface will connect directly to the Ingest subsystem to facilitate early interface testing for AM-1 MODIS L0 data. The second interface to the EBnet router will carry both DAAC-to-DAAC processing flows as well as user traffic to/from NSI. This interface will connect directly to the FDDI switch which will route data to the proper subsystem (Data Manager, Data Server, MSS/LSM, etc.).

The quantities of networking hardware components for each DAAC subsystem are presented in Table 3.4.1-1. Specific vendor information and selection rationale is presented in Section 5.3 of Release A Overview (305-CD-004-001). Note that the FDDI switch vendor selection is currently under evaluation.

Table 3.4.1-1. Networking Hardware for GSFC DAAC LAN

Networking Component	DAAC Subsystem	Quantity	Comments
FDDI Concentrator	Ingest	2	Synoptics 2914-04 concentrator with 12 M ports and 1 A/B Port
	Data Manager & Data Server	3	
	PDPS	2	
	LSM	2	
FDDI Cables	Ingest	6	Multimode fiber cables with MIC connectors. Also, an additional four cables (not listed) are required for connection to EBnet and V0.
	Data Manager & Data Server	33	
	PDPS	16	
	LSM	9	
FDDI-to-Ethernet Hub	N/A	1	Used only for Ethernet-based printers; connects to printers used in all subsystems
Ethernet Cables	N/A	4	10baseT connection to printers
FDDI Switch	N/A	1	Connects all subsystems together

3.4.1.1 Sizing/Performance Rationale

The data flow estimates used as input to the design process for the GSFC DAAC LAN topology are contained in Tables 3.4.1.1-1 and 3.4.1.1-2. The first table, based on both dynamic and static analysis performed by ECS, is arranged according to the source and sink of the flow. The second table simply aggregates these flows by subsystem to provide insight into the amount of data expected on each of the GSFC DAAC FDDI rings.

The values contained in the table include all overhead and contingency factors. The "raw" numbers provided by the model were 24 hour averages. Factors for protocol overhead (25%, or a multiplier of 1.25) and circuit utilization (1.25) were applied, as was a 1.2 factor to provide for AI&T. A factor of 1.5 was used to convert from the 24 hour averages to peaks, and a factor of 1.2 was used in order to allow the network to "catch up" within 24 hours after a 4 hour down period (derived from 24/20 = 1.2). In addition, an operational availability factor was used for each of the DAACs to account for processing being performed only during staffed hours. This factor was 1 at GSFC (since it will be 24x7). Note that this factor is applied only to processing flows.

Table 3.4.1.1-1. Estimated Rel. A Data Flows for the GSFC DAAC

Flow Description	Data Flow Volume (in Mbps)
L0 Ingest to Data Server	Test Flows Only
V0 Ingest to Data Server	1.460
Data Server to Processing	5.276
Data Server to Distribution Server	5.643
Processing to Distribution	5.743
Data Server to/from other DAACs	15.497
Data Server/Data Manager to Users	5.538
MSS/LSM to other Subsystems	0.01

Table 3.4.1.1-2. Estimated Rel. A Data Flows per DAAC LAN FDDI Ring for GSFC

DAAC Subsystem FDDI Ring	Data Flow Volume (in Mbps)
Ingest	Test Flows Only
Planning and Data Processing	11.019
Data Manager and Data Server	39.157
Interface to EBnet Router (For DAAC-DAAC and User Flows)	20.035
MSS/LSM	0.01

3.4.2 GSFC Hardware Configuration

The GSFC hardware configuration builds on the Ir1 supplied capacity and is designed primarily to support TSDIS product archival, early AI&T for MODIS and various forms of interface testing. Given these requirements, a significant subset of the subsystems have supplied components at the site: Data Server (for TSDIS data archival, and document services), Data Management (for V0 Gateway and Advertising Support), Data Processing (for AI&T science processing capacity), Planning (for early interface testing and demonstration, not operations), Ingest (for interface testing), Management (MSS, for local site management), Communications (CSS) and communications infrastructure support (ISS).

The subsections which follow below provide a synopsis of the design process, and the resultant configuration for the GSFC site for Release-A. Figure 3.4.2-1 below, provides an overview of the entire configuration and includes the core Ir1 configuration built upon by the Release-A required units (shaded components are added at Release A).

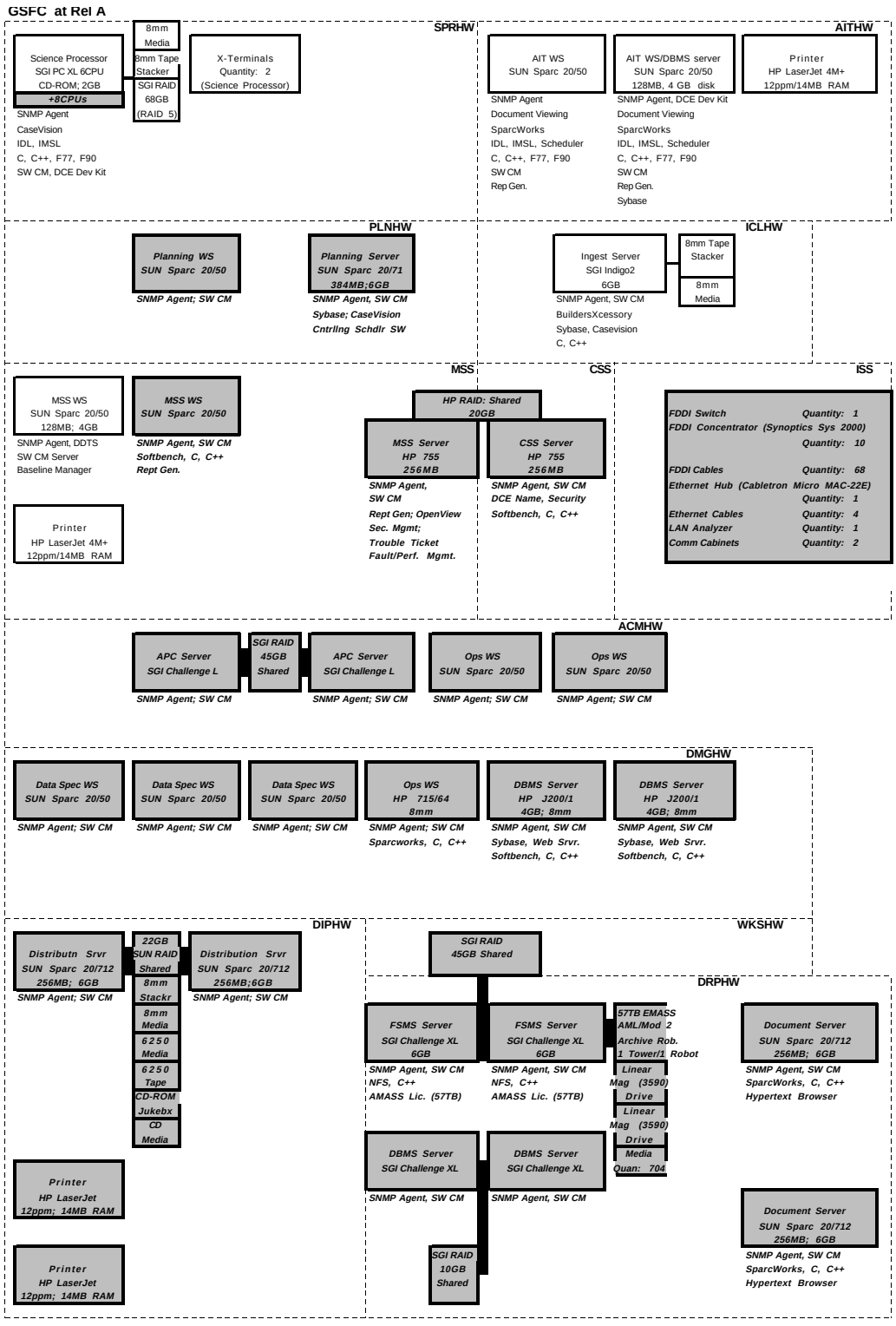

Figure 3.4.2-1. GSFC DAAC Hardware Configuration Overview Diagram

3.4.2.1 Client Subsystem

There is no dedicated hardware support (HWCI) for the Client Subsystem. The Client software configurations are supported by: (1) non-ECS provided hardware platforms, in the case of Client software utilized by the user community, or (2) ECS provided workstations utilizing Client software in support of operations users (network management, DAAC operations, etc.).

3.4.2.2 Data Server Subsystem

During the Release A time frame at the GSFC DAAC, a Data Server configuration is supplied to support TRMM data storage and access services, as well as V0 migration data. The largest data component requiring support in this time frame at GSFC is V0 migration data. Additional data set storage and access is provided as well and is detailed below. The configuration discussed in the subsections that follow provide a snapshot view of Data Server hardware for Release A; that hardware may be enhanced with additional capabilities for ECS Release B. The Data Server Subsystem configuration provides a GSFC configuration supported by four hardware CIs and is sized for TRMM support for a period of one calendar year beyond TRMM launch date plus V0 data migration for a period of one calendar year beyond initial Release A operations:

- Access Control & Management (ACMHW HWCI) -- The access hardware allows for client access (both the client subsystem and direct "push/pull" user access) to the Data Server subsystem, provides tools and capabilities for system administration, and is broken down into two components; Administration Stations (AS) which consist typically of operations support workstations, and Access/Process Coordinators (APCs) which consist of server class machines with host attached RAID disk pools.
- Working Storage (WKSHW HWCI) -- Working Storage (WS) hardware of the Data Server supplies a pool of storage used for temporary file and buffer storage within the data Server architecture. During the Release A time frame, this consists of disk storage only (no archive tape and robotics)
- Distribution and Ingest Peripheral Management (DIPHW HWCI) -- The hardware of the Distribution and Ingest Peripheral Management supports the hard media distribution methods for data dissemination from the system, as well as hard media ingest of data into the system. The hardware provided by this HWCI includes a variety of media and media drives, jukeboxes/stackers as necessary, and server hosts and disk storage for network distribution.
- Data Repository (DRPHW HWCI) -- Data Repositories (DRs) are the hardware components that store and maintain data permanently. For Release A, this consists of DBMS based repositories and archive tape library based repositories. This HWCI provides the disk, server, archive robotics, media and archive tape drives required to support the "permanent" storage repositories.

3.4.2.2.1 Rationale

The following subsystem-wide assumptions were applied in sizing the Data Server hardware components. Data Server Subsystem is sized for TRMM support for a period of one calendar

year beyond TRMM launch date plus V0 data migration for a period of one calendar year beyond initial Release A operations. Dynamic modeling was used to size the permanent data repository components, such as the number of robotic arms, tape drives, and production related staging disk. Technical baseline for 1/95 was used both in dynamic modeling as well as in static analysis. User modeling data was used in estimating the user access rates to the system. Table 3.4.2.2-1 summarized the dynamic modeling result for the Data Server components. The table parameters are as follows: Blocking Buffer and DH (Data Handler) disk together constitute the production related disk allocation in the Working Storage disk formula, Archive Station is equivalent to an archive tape drive, Archive Robot is self explanatory.

Table 3.4.2.2- 1. Synopsis of Relevant Dynamic Modeling Parameters (Epoch E)

Site	Blocking Buffer Usage, max. (GB)	DH Disk Usage, max. (GB)	Archive Robot Usage, avg.	Archive Station Usage
GSFC	7.86	10.16	0.07	0.28

ACMHW--Analysis was undertaken primarily for the sizing of the APC server hosts and their attached RAID storage. The administration workstations are assumed to be minimally configured workstations designed to perform various operations functions (e.g. DBMS administration, repository administration, etc.). Client desktop services is the driving sizing factor.

APC server host runs the following software processes and applications: ScienceDataServer Process, ScienceDataServer Administration Process, SubscriptionServer Process, Network ResourceManager Process, PullMonitor Process, CSS DCE client, CSS logging API, and an MSS agent. The anticipated internal I/O to be sustained by the processor averaged over 24 hours of operation is calculated as follows:

I/O = [Distribution of 19.27 GB *(GSFC daily DS intake)* / 86,400

*(sec in 24 hrs.) + 20% for ingest + 5% control traffic] *2 (read/write)*

= *0.56 MB/sec nominal load*

Challenge L series I/O bandwidth is 320 MB/sec, which greatly exceeds the requirements, however the same machine will be used in Release B, when the I/O rate is expected to grow by several orders of magnitude.

APC Host Disk--The APC server host disk is sized for electronic ingest (almost exclusively from sources external to the DAAC), as well as distribution (again, almost exclusively to the recipients external to the DAAC) since this pool of hosts is designed to manage the requests to the Data Server as well as the service response. For Release A, the electronic distribution, as defined within the ECS Technical Baseline for CDR, is "one times" of the total Data Server "intake" volume at Release A. It is assumed to occur over a 24-hour period. 48 hours accumulation capacity of 19.27 GB/day at GSFC plus 10% for potential electronic ingest is sized. The total allocated disk capacity rounded upward to the nearest 5 GB is 45 GB.

WKSHW--The formula for the total capacity of Working storage disk (adapted to the FSMS host) is sized to deal with the following three categories of staging requirements, which are in turn summed together to provide the site sizing:

- *Production Staging* -- consists of the following items summed together

  (Modeling Estimate for Maximum Blocking Buffer Requirement)

  + (Modeling Estimate for Maximum Data Handler Disk Usage)

  + (*10%* * (Modeling Estimate for Maximum Data Handler Disk Usage) for failed products)

- In support of Electronic Distribution Staging (transfers to the APC Host's access disk):

  (MAX. of [disk space for 1 largest granule requested for distribution from the AHWGP data (3.6 GB) times 4 users {from User Modeling analysis for PDR} (latency of 1/2 hour)]]

  or... [minimum FSMS staging cache requirement (8 GB)])

- In support of Electronic Ingest: (transfers from Ingest into the Data Server):

  + (MAX. of [disk space for one largest granule requested for distribution (3.6 GB)]

  or... [% of the ingest storage buffer, see considerations for the APC associated disk])

- In support of Hard Media Distribution/Ingest: (transfers to/from Hard Media Distribution/Ingest into the Data Server):

  + (disk space for one largest granule requested for distribution (3.6 GB))

Thus, for the GSFC configuration, the Working Storage estimate is calculated as follows...

*[Production (7.86) + (10.16) + [Failed Products (0.1*10.16)]] + [Electronic Ingest/Distribution (3.6*4) + (3.6)] + [Hard Media Ingest/Distribution (3.6)]= 40.6 GB ~> 45 GB*

DIPHW--The DIPHW configuration at GSFC includes primarily server host and disk units to serve media based distribution production temporary staging (as well as for some types of Ingest as well), and includes a number of peripheral form factors.

- Temporary Staging Server Support -- This server is designed to support the media distribution load (as well as a small factor for ingest loads). That is it is designed to handle the I/0 for 1x (one times) distribution of the Data Server "intake" volume per twenty-four hours of operation. The platform is sized to handle the network transfer traffic to local disk from the FSMS Server Host source, as well as the media preparation and media ingest I/O. The software processes/applications mapped to this server are: DistributionServer process, ResourceManager Processes for CDROM, various tape, and printers, CSS DCE client, CSS logging API, and an MSS agent. Two server hosts are provided in order to comply with RMA requirements for the function of archiving and distributing data with the required availability of 0.98 and the mean down time not to exceed 2 hours. The hosts are cross-strapped with access to a common pool of staging

storage (discussed below). The nominal I/O load to be supported by this platform is calculated as follows for GSFC:

I/O = [**19.27** GB (GSFC daily DS intake) / 2880 (sec in 8 hrs.)

+ 10% for ingest] * 2 (read/write)

= 14.7 M/sec nominal load

The disk associated with the hard media distribution platform is sized for hard media distribution of 1x (one times) of the total Data Server "intake" volume per twenty-four hour operations. Twenty-four hours accumulation capacity, plus ten percent, for potential hard media ingest is sized. The ingest activity is assumed to be negligible, since the Ingest Subsystem is sized to handle the nominal ingest loads both electronically and via media.

•≠ Peripheral Support -- The peripherals supported at the GSFC site for Release A were selected based on Level Four requirements: S-DSS-30440, S-DSS-30470, S-DSS-30480 (reference SDPS Requirements Specification for the ECS Project, 304-CD-002-001). Device counts, including jukeboxes, stackers and drives as well are driven primarily by RMA considerations, and less by volume in Release A. The only exception is the single 6250 Tape drive. In the case of 6250, V0 operational experience has shown, that its use as a heritage device is low enough to make the provision of a spare drive unnecessary. In the event of the drive failure the low workload will allow waiting for the drive repair or replacement without a noticeable impact on operations. Additional types of peripherals may be added due to Release B analysis, and the HWCI complement may be easily scaled for both media types as well as capacity. The peripherals supplied here are included in the configuration to primarily support distribution functions. However, the Ingest Subsystem (Ingest Client) residing at GSFC may utilize peripherals to perform some media based ingest, as necessary, based on media form received for storage. This applies only to peripherals not already configured into the Ingest complement for performance reasons.

The types of media form factors/formats selected for Release A include:

- 8mm Tape,
- 6250 Tape (heritage),
- CD-ROM.

The aggregate bandwidth of the peripheral devices exceeds the estimated required bandwidth of media based data distribution and ingest in Release A: GSFC - 0.74 MB/sec (For reference, the throughput rate of a representative 8 mm drive in an uncompressed mode is 3 MB/sec.) The required bandwidth was computed based on the assumption of the hard media distribution equal in volume to one time archive repository ingest: GSFC - 19.27 GB/day, peak and a 8 hours per day operation of the hard media preparation. V0 re-ingest during Release A, constituting 17.87 GB/day at GSFC, is included in these figures.

It is also worthy to note that this HWCI provides the network laser printers for the DAAC DS operations.

DRPHW--The DRPHW configuration at GSFC includes both archive based as well as DBMS based physical repositories. They are sized as follows:

- Archive Repository -- The archive component was sized through a combination of both static analysis as well as dynamic simulation. The model employed was the dynamic system model, based on a discrete event simulation with constrained resources assumed. Modeling runs based on the January 1995 Technical Baseline were performed. Nominal and peak resource utilization data was used from the model runs and gave specific data regarding disk, tape drive and robotic resource utilization. This data was used in a static sizing analysis synopsized here for GSFC that was coupled with the key driving requirements with respect to distribution (e.g. the x2 distribution cap, the User Model service access predictions for epoch e, 1st. Q '98), flow analysis, and data with respect to hardware and software COTS selections.

  For the FSMS Manager host server: the platform is selected on the basis of FSMS(AMASS)/platform COTS S/W compatibility. Memory and cache estimates are currently based on vendor recommendations, reference "AMASS Archival Management and Storage System, Installation on Silicon Graphics", EMASS Part Number 600149, AMASS Version 4.2.4, March 1995. Aside from the AMASS FSMS the following processes and applications will run on this server: ResourceManager Process for the staging disk, StagedDataMonitor Process, CSS DCE client, CSS logging API, and an MSS agent. Two server machines (for RMA failover capability) will share access to the Working Storage disk pool.

  For the Archive Tape Library Robotics an EMASS Automated Management Library system (Quadro Tower) was selected for Release A based on its ability to accommodate multiple media form factors, storage density, growth capacity, floor space utilization, compatibility with COTS software and a number of other factors. (This selection process is documented in the SDPS Storage Technology Insertion Plan white paper (June 1995, #420-WP-003-001) and is not fully discussed here). Given data with respect to this device (assuming the smallest tower configuration), the dynamic model analysis resulted in a utilization factor for sizing estimation purposes as given below:

  GSFC: Configuration: 1 unit Calculated Robotics Utilization: 0.07

  For Tape Drives, 3590 (NTP) linear tape drives were assumed for the configuration. The dynamic model runs allocated a number of drives, however the drive utilization for the Release A time frame was shown to be minimal:

  GSFC: Calculated Tape Drive Resource Utilization: 0.28

  Double the integral quantity is allocated for RMA failover purposes and operational growth within the TRMM mission (sizing here for 1 calendar year).

Media requirements were calculated based on the one year TRMM operations at GSFC, and media to support V0 migration. The total carrying capacity of the archive data repository robotics library (tower system discussed above) to be purchased for Release A at GSFC and LaRC sites is 57.6 TB, maximum (assuming 3590 technology). Therefore the figures discussed here relate primarily to media piece-count configurations for GSFC ECS V1 operations, and are not limiting factors with respect to the tape library configuration itself. The volume calculations are based on the Technical Baseline of 1/95 for the TRMM product data volumes, on the Technical Baseline of 6/95 for the V0 migration. It is assumed that the product data cumulates over the 8/97 through 8/98 time period (1 year after TRMM launch). 3590 Cartridge capacity is assumed to be 10 GB maximum capacity, assuming 100% utilization of the media. No compression is assumed. Backup capacity of 20% and a spare tape capacity of 10% are added. For V0 migration the assumption is of migration over time period of 1/96 through 9/97 (Release A activation to Release B activation) of the data sets identified in Tables "Release A Initial Operations" and "Release B Initial Operations". The data sets in the "Release B Initial Operations" Table where the volume is listed as TBD are not included for sizing. The total calculated media support requirement for TRMM and V0 operations is as follows:

(TRMM=514 GB) + (V0=4,896 GB) + 20% backup capacity + 10% spare media capacity

= 7,033 GB --> 704 count of 3590 tapes required.

- ≠ DBMS Repository -- The Data Base Management System (DBMS) Repository component was sized as follows based on static data size analysis as well as transaction based analysis. The transaction analysis is based on both "push" (production metadata update) and "pull" (user access and distribution) loads. Transaction rate was modeled based on the user service request rates as described at PDR time in the User Pull Analysis Notebook, 160-TP-004-001, Question 47 and a cross section of query types derived from the DBMS Benchmark Report, 430-TP-003-001.

  The DBMS Server Host was sized based on the transaction analysis mentioned above, as well as platform suitability analysis based on the DBMS COTS software selection for Release A Data Servers (Sybase). Platform suitability is based on the DBMS software manufacturer's compatibility recommendations, benchmark data, and project bench marking activities. Aside from the Data Base engine, the following processes will run on this host: CSS DCE client, CSS logging API, and an MSS agent.

  DBMS Server Disk was sized based on the *core metadata* associated with TRMM data as well that associated with the V0 data sets identified for migration within release A. The data sets identified in Table 3.4.2.2-2 were included. It must be noted, that not all of the included data sets will migrate over the Release A time frame, however, since the ones to migrate have not been fully identified, the entire table is used for a conservative estimate of the metadata volume. The size of the metadata granule for V0 was assumed to be 0.91 KB half that of the full ECS

metadata granule of 1.82 KB. That assumption is based on the 50% mapping of V0 attributes to ECS core attributes across all products throughout the Release A duration. Table 3.4.2.2-2 is based on the Science Data Plan for the EOS Data and Information System (EOSDIS) Covering EOSDIS Version 0 and Beyond, Version 3, July 1994.

The key assumptions associated with the DBMS repository sizing are as follows:

- The products lists have been derived from the ECS Technical Baseline, specifically the AHWGP data.
- The period of data capture is 12/96 (start of Release A) through 9/97 (start of Release B) for V0 metadata migration and 8/97 (TRMM launch date) through 8/98 (1 calendar year from the date of TRMM launch) for TRMM metadata.
- All products are assumed to conform to the Proposed ECS Core Metadata Standard v2.0, 420-TP-001-005, Dec. 1994.
- The metadata sizing has been calculated from the Metadata Expected with each granule table on Page 94 in the Proposed ECS Core Metadata Standard v2.0, 420-TP-001-005, Dec. 1994.
  - The calculated size of 1.823 KB per granule has been obtained from this data source.
- An overhead factor of 2.695 for implementation in Sybase has been estimated based on the bench marking activities as outlined in the DBMS Benchmark Report, 430-TP-003-001.
- An estimated overhead of 153.1 MB will be made for the Sybase application code.

The calculated disk capacity for the GSFC repository (static analysis) results in a computed requirement of 3,075.3 MB. Due to the operational experience with the user space requirements, at least 5 GB of disk space must be allocated for a high use data base functioning. Therefore, at least 5 GB beyond the calculated storage requirement will be allocated - 8 GB. (The closest available quantity of disk equal or exceeding 8 GB will be purchased.) Dual host configuration will allow for failover.

DOCUMENT DATA SERVER--Document handling is handled via a dedicated Data Server implementation, geared to the predicted document ingest and access volumes and the nature of the COTS S/W requirements imposed on the support hardware. The Document Data Server is provided as a simple server configuration with network access. The following assumptions were made in the preparation of the GSFC Document Data Server configuration:

- Metadata alone has been considered as a basis for the sizing calculations.
- GSFC figures for the Document sizes have been used.
- The period for Release-A products on the TRMM mission is 8/17/97 to 8/17/98 (we size for one calendar year of TRMM mission support for Release-A).
- The figures are approximations, which will be refined overtime. The Document Data Server architecture is scalable.

Table 3.4.2.2-2. Release A Datasets Held by the Data Server Subsystem (1 of 4)

Prod ID	Platform	Inst or Exp	Data Set Name
1A			**(HighPriority, High Service [4/5])**
G-1	"NOAA 7,9,11"	AVHRR	Daily Land Mosaic
G-2	"NOAA 7,9,11"	AVHRR	10 Day Land Mosaic
G-5	NOAA PO	"TOVS (HIRS2, MSU)"	Path A Daily Gridded Product
G-6	NOAA PO	"TOVS (HIRS2, MSU)"	Path A 5 Day Gridded Product
G-7	NOAA PO	"TOVS (HIRS2, MSU)"	Path A Monthly Gridded Product
G-8	NOAA PO	"TOVS (HIRS2, MSU)"	Path B Daily Gridded Product
G-9	NOAA PO	"TOVS (HIRS2, MSU)"	Path B 5 Day Gridded Product
G-10	NOAA PO	"TOVS (HIRS2, MSU)"	Path B Monthly Gridded Product
G-15	UARS	SOLSTICE	Daily Avg. Solar Spectral Irradiance
G-16	UARS	SUSIM	Daily Avg. Solar Spectral Irradiance
G-17	UARS	PEM	Averaged Geophysical Parameters
G-18	UARS	CLAES	Temperature and Trace Gas Profiles
G-19	UARS	ISAMS	Temperature and Composition Profiles
G-20	UARS	MLS	Pressure and Trace Gas Profiles
G-21	UARS	HALOE	Pressure and Trace Gas Profiles
G-22	UARS	HRDI	Horizontal Vector Wind Fields
G-23	UARS	WINDII	Temperature and Wind Profiles
G-24	Model	Analysis	UKMO Assimilated Data (UARS Corr. data)
G-25	Model	Analysis	NMC Analyzed Data (UARS Corr. data)
G-26	Nimbus-7	TOMS	TOMS Daygrids
G-28	"NOAA 7,9,11"	AVHRR	Land Climate Product
G-39	Meteor-3	TOMS/2	TOMS/2 Daygrids
G-40	Meteor-3	TOMS/2	TOMS/2 Full Resolution Data
G-41	Earth Probe	TOMS/3	TOMS/3 Daygrids
G-42	Earth Probe	TOMS/3	TOMS/3 Full Resolution Data
G-43	ADEOS	TOMS/4	TOMS/4 Daygrids
G-44	ADEOS	TOMS/4	TOMS/4 Full Resolution Data
1A			**(High Priority, High Service [4/5])**
G-45	*SeaStar*	*SeaWiFS*	*Recorded GAC*
G-46	*SeaStar*	*SeaWiFS*	*Recorded LAC*
G-47	*SeaStar*	*SeaWiFS*	*HRPT*
G-48	*SeaStar*	*SeaWiFS*	*GAC Derived Geophysical Parameters*
G-49	*SeaStar*	*SeaWiFS*	*GAC Derived Compressed Products (Binned)*
G-50	*SeaStar*	*SeaWiFS*	*GAC Derived Mosaic Products (Standard Mapping)*
G-51	*SeaStar*	*SeaWiFS*	*Browse*
G-61	Model	Analysis	4-D Assimilated Data (5 Year Full Dataset)
1A=35			

Table 3.4.2.2-2. Release A Datasets Held by the Data Server Subsystem (2 of 4)

Prod ID	Platform	Inst or Exp	Data Set Name
1B			**(High Priority, Medium Service [3/2])**
G-11	Nimbus-7	CZCS	High Resolution Raw Data
G-12	Nimbus-7	CZCS	Resampled Raw Data
G-13	Nimbus-7	CZCS	Geophysical Parameters
G-14	Nimbus-7	CZCS	"Gridded Composites and PSTs (""Postage Stamps"")"
G-27	Model	Analysis	4-D Assimilated Data (5 Yr Time Series-Subset)
1B = 5			
1D			**(High Priorty, TBD Service)**
G-3	"NOAA 7,9,11"	AVHRR	Daily Browse Product
G-4	"NOAA 7,9,11"	AVHRR	10 Day Browse Product
1D = 2			
1E			**(High Prority, TBD Volume)**
G-52	Model	Analysis	Ancillary Data
2A			**(Medium Priority, High Service [5/4])**
G-31	Ship	TOGA/COARE	Precipitation Radar data
G-35	NOAA PO	"TOVS (HIRS2, MSU)"	"Spot-by-Spot Atmospheric, Surface, and Cloud Parameters"
G-38	Nimbus-7	TOMS	TOMS Full Resolution Data
G-70	Various	GEDEX	GEDEX Data Sets on CD-ROM
2A = 4			
2B			**(Medium Priority, Medium Service [3/2])**
G-29	Aircraft (DC8)	TOGA/COARE	Passive microwave & lidar data
G-30	Aircraft (ER2)	TOGA/COARE	"Microwave, IR,Vis & radar data"
G-32	Satellite(GMS)	TOGA/COARE VISSR	Visible/IR imagery
G-33	Station	TOGA/COARE	Radiation data
G-34	NOAA PO	"TOVS (HIRS2, MSU)"	TOVS NOAA 1B input data
G-66	Nimbus-7	LIMS	Map Archive Tapes LAMAT
G-67	Nimbus-7	LIMS	Seasonal Map Archive Tapes LASMAT
G-53	UARS	HALOE	Pressure and Trace Gas Profiles
G-54	UARS	PEM	In-situ Geophysical Parameters
G-62	Nimbus-7	SBUV	CPOZ (Reflectivity and Ozone)
G-64	Nimbus-7	SBUV	Full Resolution Data (HDSBUV)

Table 3.4.2.2-2. Release A Datasets Held by the Data Server Subsystem (3 of 4)

Prod ID	Platform	Inst or Exp	Data Set Name
G-77	UARS	SOLSTICE	Solar Spectral Irradiance
G-79	UARS	SUSIM	Solar Spectral Irradiance
2B			**(Medium Priority, Medium Service [3/2])**
G-82	UARS	CLAES	Temperature and Trace Gas Profiles
G-84	UARS	ISAMS	Temperature and Composition Profiles
G-86	UARS	MLS	Pressure and Trace Gas Profiles
G-89	UARS	HRDI	Horizontal Vector Wind Fields
G-91	UARS	WINDII	Temperature and Wind Profiles
2B = 18			
3A			**(Low Priority, High Service [5/4])**
G-36	"NOAA PO, in-situ"	"TOVS (HIRS2, MSU), R/S"	"6-Hour Gridded, Analyzed Fields"
G-37	"NOAA PO, in-situ"	"TOVS (HIRS2, MSU), R/S"	"6-Hour Gridded, Forecast Fields"
3A = 2			
3B			**(Low Priority, Medium Service [3/2])**
G-68	Nimbus-7	SMMR	Microwave Vegitation Index
G-69	Ground	Specphomtrs	Optical Thickness
G-55	UARS	CLAES	Temperature and Trace Gas Profiles
3B			**(Low Priority, Medium Service [3/2])**
G-56	UARS	ISAMS	Temperature and Composition Profiles
G-57	UARS	MLS	Pressure and Trace Gas Profiles
G-58	UARS	HRDI	Horizontal Vector Wind Fields
G-59	UARS	WINDII	Temperature and Wind Profiles
G-65	Nimbus-7	LIMS	Temperature & Mixing Ratio Profile LAIPAT
3B = 9			
3C			**(Low Priority, Low Service [1])**
G-63	Nimbus-7	SBUV	Raw Instrument Data (RUT-S)
3D			**(Low Priority, TBD Service)**
G-93	Nimbus-7	TOMS	RUT-T (new media)
G-93	Meteor-3	TOMS/2	RUF
G-93	Earth Probe	TOMS/3	RUF (TOMS/3)

Table 3.4.2.2-2. Release A Datasets Held by the Data Server Subsystem (4 of 4)

Prod ID	Platform	Inst or Exp	Data Set Name
G-76	UARS	SOLSTICE	Instrument Science Data
G-78	UARS	SUSIM	Instrument Science Data
G-80	UARS	PEM	Instrument Science Data
3D			**(Low Priority, TBD Service)**
G-81	UARS	CLAES	Instrument Science Data
G-83	UARS	ISAMS	Instrument Science Data
G-85	UARS	MLS	Instrument Science Data
G-87	UARS	HALOE	Instrument Science Data
G-88	UARS	HRDI	Instrument Science Data
G-90	UARS	WINDII	Instrument Science Data
G-92	UARS	N/A	Engineering Data
G-93	ADEOS	TOMS/4	RUF (TOMS/4)
3D = 14			
3E			**(Low Priority, TBD Volume)**
G-60	Space Shuttle	"ATLAS-1, -2"	ATLAS Data and Derived Products

A 2 CPU SMP server was selected based upon operational experience with the EDF EDHS. A WAIS-like, full text indexer, an http server, and additional custom developed software will reside on this host. The following processes/applications run on this host: Document Data Server Process, WWW Server Process, Document Repository Process, Client Applications Process, CSS DCE client, CSS logging API, and an MSS agent.

The disk complement was sized to hold the document metadata for the data product collections associated with the TRMM mission, and for the V0 data sets identified for migration. Sizing for document metadata was based on available V0 guide document sizing, and the 2.0 Core metadata baseline. Growth was based on the phased migration of V0 data sets and the TRMM data product collections acquired during Release A operations. The calculated required disk capacity for the document collection alone is 142 MB.

3.4.2.2.2 Configuration

The specific sizing for the Release A GSFC Data Servers, derived from the rationale described above, is synopsized below. Figures 3.4.2-1 and 3.4.2-2 provide the full details for the site's configuration *(assumed here is that the figures will be split into two parts when they are re drawn).* Additional details on specific component configurations and sizing are provided within the figures (including make and model numbers assumed as candidates for implementation).

For the GSFC Science Data Server....

ACMHW

- Admin. Workstations: 2 ea. of SUN Sparc 20/50
- APC Hosts: two 1 CPU SGI Challenge, configured with 45 GB, minimum, of RAID Disk.

WKSHW

- 45 GB, minimum, of RAID Disk.

DIPHW

- Staging Server Host: two SUN Sparc 20/712, with access to 22 GB disk.
- Standard Release A Peripheral Set: 8mm Tape drives and stackers, 6250 Drive, CD-ROM drive and jukebox.

DRPHW

- FSMS Server Host: two 1 CPU SGI Challenge XL, which utilizes WKSHW for primary disk
- Archive Tape Library Robotics: 1 AMASS AML Model 2 Tall Quadro Tower system (57 TB capacity with NTP), single robotics
- Tape Drives: 2 NTP 3590 drives
- Tape Media: 704 of 3590 tapes, each at 10 GB capacity including 20% backup capacity and 10% spare tape capacity.
- DBMS Server: two of 2 CPU SGI Challenge XL, with 10 GB of shared disk

For the GSFC Document Data Server....

- WAIS/http Data Server 2 of 2 CPU SMP Server
- Data Server Disk: 6 GB mirrored in two machines for Release-A

3.4.2.3 Data Management Subsystem

The Data Management Subsystem (DMS) consists of a single Hardware CI that will also support the processing requirements of the Interoperability Subsystem (IOS) in Release A at the GSFC DAAC site.

The DMS is responsible for Advertising Service CI and Gateway CI DBMS processing activities generated directly from user "pull" service invocations. The DMGHW CI consists of four major components: 1) DBMS/Web Processing Server, 2) Database Management Workstation, 3) Data Specialists Workstations, 4) User Support Workstations.

The DBMS/Web server is the primary HWCI in the Data Management Subsystem. The server contains resources for DBMS storage, input/output (I/O), and processing resources necessary to perform processing functions in support of the Advertising Service CI and Gateway CI databases in Release A. The functionality of the Data Dictionary CI, Local Information Manager CI and Distributed Information Manager CI will be added to the DMGHW CI in Release B.

The DMGHW CI configuration provided in Section 3.4.2.3.2 is specific to Release A, but incorporates Release B platform design issues concerning scalability, evolvability, and migration. The candidate hardware design is tailored to Release A GSFC DAAC specific DBMS processing needs for the Advertising Service CI and Gateway CI databases in support of TRMM mission datasets.

3.4.2.3.1 Rationale

The performance impact on the DMGHW CI DBMS server hardware in Release A has been determined to be negligible; therefore, the DMGHW CI design reflects sizing, scalability and migration issues that are relevant to Release B in order to avoid unnecessary swap-outs of hardware after Release A. The performance drivers for sizing the DMGHW CI server are:

- User Characterization analysis of science and non-science user service invocations
- DBMS transaction rate analysis
- DBMS prototype/benchmark analysis
- Hardware Scalability, Evolvability and Migration Analysis

User Characterization Analysis--User Characterization data provides the projected number of science users, number of non-science users, frequency of search service invocations per time period, and the percentage of invocations for each search service in the Release B time frame. Since the current mission/operations time-line is relatively short between Release A and Release B, it has been determined that the DBMS server platforms be sized according to Release B User Characterization projections. Applying Release B User Characterization Data to the Release A design provides results that are significant to hardware scalability, migration and evolvability issues; therefore, the data provided is projected for the Release B time-frame, but it is applied to the Release A design. For Release A, the primary users that will access the Gateway CI are from the science community, and the primary users that will access the Advertising Service CI are from the non-science community. The following tables summarize the User Characterization

service invocation percentages applied to each service (search) type and frequency of service (search) invocations per minute, as documented by the User Characterization Team.

Table 3.4.2.3-1. GSFC User Characterization Service (search) Type for Science Users

Search Type	Fraction of total invocations/year
Simple Search/1 site	0.294
Simple Search/multi-site	0.182
Match-up Search/1 site	0.328
Match-up Search/multi-site	0.194
Coincident Search/1 site	.00101
Coincident Search/multi-site	.000076

Table 3.4.2.3-2. GSFC User Characterization Service (search) per minute for Science Users

DAAC	Service Searches per minute (busiest time of day)
GSFC	1.19721827

The following tables summarize the User Characterization user accesses per day and percentage of service (search) invocations for non-science users, as documented by the User Characterization Team.

Table 3.4.2.3-3. GSFC User Characterization User Accesses per Day for Non-Science Users

DAAC	User Accesses per Day
GSFC	3411.972

Table 3.4.2.3-4. GSFC User Characterization Service (search) Type for Non-Science Users

Search Type	Percentage of Total Searches
Simple Search/1 site	60%
Match-up Search/1 site	15%
Coincident Search/1 site	25%

DBMS Transaction Rate Analysis--In order to size the DBMS server it is necessary to estimate the size of the Advertising Service CI and Gateway CI databases and then determine the transaction rates, or database throughput that must be provided in support of the "pull" service activities that are invoked by the user community. The transaction rate analysis is based on

assumptions regarding the processing weight that is associated with the six different types of search services that pertain to the Gateway CI and Advertising Service CI databases. Transaction assumptions were made to define transaction loadings per service request. Service requests are provided by the User Characterization Team. The transaction loadings are assumptions and are based on service complexity. The loadings will be refined with actual performance benchmarks as future prototypes are completed. The observed loadings from future prototyping/bench marking activities will then be compared to the predicted ones below and the sizing analysis will be updated as a result (these transaction loading assumptions are defined as "nominal" cases). The transaction data provided is projected for the Release B time-frame, but it is applied to the Release A design; therefore, transactions for the Local Information Manager, Distributed Information Manager, and Data Dictionary CIs are not included in the transaction analysis results.

The primary users of the Gateway CI database are projected to be from the science community. The projected frequency and percentage of science user service invocations are documented in the User Characterization Analysis section above. The following table lists the transaction loadings for the Advertising Service CI and Gateway CI database based on science user service invocations. Searches/hour are calculated for the busiest time of day. The processing (transactions per service invocation) assumptions are based on Advertising Service CI and Gateway CI database preliminary transaction analysis results and will be revised based on future prototyping/bench marking analysis results as they become available.

Table 3.4.2.3-5. GSFC Science User Transaction Loading for Advertising Service CI and Gateway CI Databases

Search Type	Percentage Invoked	Searches /hour worst case	Processing Assumptions (Transactions per Service Type)	Transactions /hour
Simple Search/1 Site	29.4%	21.119	5	105.595
Simple Search/Multi-Site	18.2%	13.074	20	261.48
Match-up Search/1 Site	32.8%	23.561	5	117.805
Match-up Search/Multi-Site	19.4%	13.936	20	278.72
Coincident Search/1 Site	.101%	.0726	5	.363
Coincident Search/Multi-Site	.0076%	.0056	20	.112

The following table lists the transaction loadings for the Gateway CI database based on non-science user service invocations as depicted in "User Characterization and Requirements Analysis" (19400312TPW). The table is completed with the assumption that there will be at least five service invocations per access on average.

Table 3.4.2.3-6. GSFC Non-Science User Transaction Loading for Gateway CI Database

Search Type	Percentage Invoked	Searches /hour worst case	Processing Assumptions (Transactions per Service Type)	Transactions /hour
Simple Search/1 Site	29.4%	29.258	5	146.29
Simple Search/Multi-Site	18.2%	18.112	20	362.24
Match-up Search/1 Site	32.8%	32.641	5	163.205
Match-up Search/Multi-Site	19.4%	19.306	20	386.12
Coincident Search/1 Site	.101%	.1005	5	.5025
Coincident Search/Multi-Site	.0076%	.0076	20	.152

The primary users of the Advertising Service CI are projected to be from the non-science community. The estimated total non-science user accesses per day for the Advertising Service CI is calculated to be 3411.972 as depicted in "User Characterization and Requirements Analysis" (19400312TPW). The percentage that each service type, pertaining to the Advertising Service DBMS, is invoked is also taken from "User Characterization and Requirements Analysis" (19400312TPW). The following transaction loading table is completed with the assumption that there will be at least five service invocations per access on average, and that each service invocation produces five transactions for the processor/DBMS. Service invocation transaction ratings will be revised based on future prototyping/bench marking analysis results as they become available.

Table 3.4.2.3-7. GSFC Non-Science User Transaction Loading for Advertising Service CI Database

Search Type	Percentage Invoked	Searches /hour worst case	Processing Assumptions (Transactions per Service Type)	Transactions /hour
Simple Search/1 Site	60%	366.787	5	1833.935
Match-up Search/1 Site	15%	91.697	5	458.485
Coincident Search/1 Site	25%	152.828	5	764.14

The following table summarizes science, and non-science user transaction loading per hour for both the Advertising Service CI and Gateway CI Databases.

Table 3.4.2.3-8. DBMS Transaction Summary

DAAC	User Type	DBMS	Searches /hour worst case	Transactions /hour	TPM
GSFC	Science	Gateway/Advertising	71.768	764.075	12.735
GSFC	Non-Science	Gateway	99.425	1058.51	17.642
GSFC	Non-Science	Advertising	611.312	3056.56	50.943
Totals:			782.505	4879.145	81.32

A sensitivity analysis has been performed with larger loading allocations. The results are shown in Table 3.4.2.3-9.

Table 3.4.2.3-9. DBMS Transaction Sensitivity Analysis Results (loading has been doubled for both service (search) invocations and transaction rates)

DAAC	User Type	DBMS	Searches /hour worse case	Transactions /hour	TPM
GSFC	Science	Gateway/Advertising	143.536	3056.3	50.938
GSFC	Non-Science	Gateway	198.850	4234.038	70.567
GSFC	Non-Science	Advertising	1222.624	12226.24	203.771
Totals:			1565.01	19516.578	325.276

The transaction per service (search) values for the processing load of the Advertising Service CI and Gateway CI databases are currently assessed as being very small, as depicted in Tables 3.4.2.3-8 and 3.4.2.3-9. Future Incremental Track Development prototyping/bench marking activities will provide a more in-depth performance analysis of Advertising Service CI and Gateway CI processes. Furthermore, Local Information Manager CI and Distributed Information Manager CI transaction (rates) loadings are expected to introduce an added, significant processing load on the DMGHW CI DBMS servers in Release B. Performance analysis loadings will be revised according to future prototyping/bench marking results.

DBMS Prototyping/Bench marking Analysis--Currently, preliminary Incremental Track Development performance data is being used to size the DMGHW CI DBMS server. Performance analysis results will be revised as planned prototyping/bench marking activities are completed. Future major prototyping activities that will affect performance estimates for the DMGHW CI include the following:

- Gateway CI prototype
- EP6 prototype
- Prototype workshop 2

DBMS performance estimates provided in "DBMS Benchmark Report" technical paper (430-TP-003-001), show that for multi-user (32 users) queries (20 similar queries accessing different parts of the test database) running concurrently, the test-bed CPU, a SUN SPARCstation 20/50, became saturated. A performance comparison of the DBMS benchmark test-bed processor (SUN SPARC 20/50) and the candidate processor (HP J200) for Release A operations is shown in Table 3.4.2.3-10.

Table 3.4.2.3-10. Vendor Platform Performance Estimates

Platform	TPS	MIPS
SUN SPARCstation 20/50 (SMP) with 1 processor	135	133
HP J200 (SMP) with 1 processor (PA 7200 CPU)	240	146

NOTE: As a rule vendor supplied Transaction Per Second (TPS) ratings tend to be a maximum, or high-end value and does not take into account overhead associated with other system processes.

Disk Capacity Sizing--Disk storage capacity sizing for the DMGHW CI was determined for each DAAC site based on preliminary DBMS sizing efforts for the Advertising Service CI and Gateway CI operational databases plus vendor inputs for the following COTS software: 1) DBMS software, 2) Development software, 3) HTTP & WAIS server software, 4) Operating System software, 5) Communications and Utilities software. The amount of disk storage needed for the DMGHW CI in Release A is relatively insignificant, as depicted in Table 3.4.2.3-11.

The following table is filled with preliminary sizing results for Release A Interoperability and Data Management operational databases and COTS software packages that will be installed on the DMGHW CI at the GSFC DAAC site. Some of the results are estimates (such as database sizes) since the DBMS design will mature and impact disk capacity sizing as the Advertising Service CI and Gateway CI under-go future evaluation and prototyping.

Table 3.4.2.3-11. DMGHW CI Disk Capacity

S/W Component	Release A Sizing
COTS Software:	
Open Client	45 MB
SQL Server	60 MB
Replication Server	80 MB
Open Client ESQL/C	26 MB
SQL Monitor Server	1 MB
SA Companion	8 MB
Sybooks	42 MB
	Total: 262 MB
WWW COTS:	
HTTP Server	40 MB (Estimate)
WAIS Server	60 MB (Estimate)
	Total: 100 MB
Databases:	
Advertising Database	150 MB (Estimate)
Advertising DB Workspace	150 MB (Estimate)
Advertising DB Logging	100 MB (Estimate)
Advertising HTML Files	100 MB (Estimate)
WAIS Database	150 MB (Estimate)
Gateway Database	150 MB (Estimate)
	Total: 800 MB
Operating System & Utilities:	
Operating System Software	700 MB
Utilities	200 MB (Estimate)
DCE Client	40 MB
	Total: 940 MB
Grand Total	2.102 GB

3.4.2.3.2 Configuration

The selected DMGHW CI DBMS server to be implemented in Release A is a low-end SMP server. A single CPU configuration has been determined to be appropriate for Release A since light processing loads are expected. Scalability, evolvability and migration issues are determined to be the key design drivers for the DMGHW CI in Release A. The chosen DBMS SMP server is scalable from one to two processors and; therefore, ensures a minimum risk transition from Release A to Release B.

There are two physical DBMS/Web servers that will be implemented at the GSFC DAAC site: the primary, or "active" server and the secondary, or "standby" server. The standby server will house RAID disk that is a mirror set of the DBMS disk devices located on the active server in case of failure to the active servers DBMS disk devices. Looking ahead to Release B, the configuration can be changed to an "active", "active" cluster host configuration. The active/active host configuration would allow for applications to be run in parallel across processors residing in both clustered hosts, which enhances load balancing and availability/recovery capabilities.

Since the Release B processing requirements for the Local Information Manager CI and Distributed Information Manager CI are largely unknown at this time, the flexibility of the recommended design assures minimum risk as the CI processes will most likely introduce significant processing loads to the DMGHW CI DBMS servers. The design also allows for significant growth of the Advertising Service CI in Release B.

A single 8mm tape drive unit will be configured on both active, and standby servers in Release A. The 8mm tape drives will be used to backup Advertising Service CI and Gateway CI databases, as well as perform DBA and routine maintenance operations.

The DMGHW CI DBMS servers will provide four gigabytes of disk drive storage for Release A. Although the estimates for Advertising Service CI and Gateway CI operational databases, COTS software, and operating system and utilities sizing is relatively small, the total disk volume has been bumped up in support of Sybase swap (workspace) area and 100% growth capacity for the base operational software.

A low-end DBMS/DBA workstation will be used in support of database administration, and other M&O activities. A single 8mm tape drive unit will be configured on the DBMS/DBA workstation in Release A. The 8mm tape drive will perform backup/recovery and routine maintenance operations in support of the DMGHW CI DBMS host servers. A small pool of low-end workstation will support Data Specialist/User Support operations. At a minimum the low-end workstations will be configured with two gigabytes of local disk.

Table 3.4.2.3-12 summarizes the DMGHW CI recommended processing configuration for implementation at the GSFC Release A DAAC. The processing configuration is based primarily on scalability, evolvability and migration issues as they have been determined to be the primary design drivers for Release A.

NOTE: The HP J200 SMP shown in Table 3.4.2.3-12 is a high-end workstation class server that is scalable from 1-2 CPUs.

Table 3.4.2.3-12. GSFC DAAC Hardware Configuration

Component	Class/Type	Platform	Qty	Number of Proc.	Disk Capacity
DBMS/Web Server	SMP	HP J200	2	1 (each)	4 GB
DBA Workstation	Uni-processor	HP 715/64	1	1	2 GB
Data Specialist and User Support Workstations	Uni-processor	SUN Sparc 20/50	3	1 (each)	2 GB

Technical Specifications for candidate DBMS server platform:

- Make: Hewlett Packard
- Model: J200 (SMP workstation class server)
- CPU: PA7200 (upgrade able to future PA800 processor)
- Clock Frequency: 100 MHz
- Number of processors: 1 or 2
- MIPS: 146
- TPS: 240
- MFLOPS: 40
- SPECint92: 139
- SPECfp92: 222
- Memory: Expandable to 1 GB RAM
- Internal bus bandwidth: 800 MB/sec

3.4.2.4 Ingest Subsystem

Ingest subsystem hardware at GSFC is responsible for support of early interface testing of the EDOS interface in preparation for the AM-1 mission. Ingest subsystem hardware will also be involved in the migration of existing Version 0 data into ECS Release A. Subsystem configuration and specific component sizing rationale are provided in the following paragraphs.

3.4.2.4.1 Rationale

The sizing of Ingest Subsystem hardware both from a system level and a component level is based on the 6/21/95 version of the ECS Technical Baseline. Among the information included in the baseline is:

- data by instrument,
- average daily data volume by level,
- and data destination.

Table 3.4.2.4-1 provides a synopsis of the Ingest data volumes required for Release-A at GSFC.

Table 3.4.2.4-1. GSFC DAAC Specific Ingest Volume Requirements

Release A DAAC	Daily L0 Volume (MB/day)	Annual L0 Volume (GB/year)	Version 0 Data Migration Volume (GB)
GSFC	None (i/f testing)	None (i/f testing)	2000

The average expected daily, annual, and Version 0 migration data volumes at each site were calculated from this information and used to determine the required ingest hardware capabilities. Ingest client hosts are sized to accommodate the required ingest volumes as well as I/O and CPU capabilities to support internal data transfers associated with metadata validation and extraction and transfer of data to the Data Server Subsystem. Working storage disks are sized to accommodate the above functions. RMA is not a critical driver for the Ingest Subsystem, at this site in Release A as there is no time-critical Level 0 data ingest at this time.

Queuing Analysis Model--An Ingest Queuing Model (Imodel) was developed to assist in the sizing of Ingest Subsystem components for the Release A GSFC configuration. This analysis was dependent on a series of model input parameters such as:

- data to be ingested,
- data to be processed,
- data to be stored,
- network component capabilities (assumed at Release A to be FDDI, at 60% efficiency),
- Ingest Subsystem component capabilities (e.g. CPU, I/O, disk I/O, operations per byte).

Data flow sensitivity analysis was conducted with respect to changes in data flows and system architecture (parameters). The load presented by each flow in packets per second is a function of the number of bits per second input from the previous process and the mean size of data set that this process expects. Server host read and write operations have associated transfer rate and access time estimates for each data transfer. Conservative estimates of 2 MB/sec are used based on results from Data Server prototyping efforts.

Projected maximum individual component utilization in support of early interface testing is less than 10%. The additional subsystem capacity in support of Version 0 ingest functions increases subsystem component utilization to the 40% to 70% range, depending on the required daily ingest volume. Select output parameters from the modeling effort for a likely set of input parameters are shown in Figure 3.4.2.4-2. Note that one or more individual flow utilization figures may sum to comprise the total utilization for a particular component. Specifics of the Imodel characteristics and output parameters may be found in the ECS Ingest Subsystem Topology Analysis (440-TP-014-001).

Table 3.4.2.4-2. Queuing Model Derived Requirements for the GSFC Configuration at Release A

Flow	Flow Utilization (% of maximum available)	Time in System (Range for 10 MB - 160 MB file size, in seconds)
Source	10.29	.0006
Working store in	28.92	2.76 - 44.26
Working store out	28.92	2.76 - 44.26
Distribution	41.1	.0007

3.4.2.4.2 Configuration

Brief descriptions of the generic components, provided within the GSFC configuration at Release A are provided in Table 3.4.2.4-3. The SGI Indigo 2 in place for Ir1 TRMM early interface testing will support AM-1 early interface testing during the Release A time frame as well. The client host and magnetic disk resources will also be utilized as the Version 0 migration facility, which will perform data format conversion, metadata extraction and generation, and other functions required to prepare the Version 0 data for ingest into ECS.

Table 3.4.2.4-3. Ingest HWCI Component Descriptions

Component Name	Class/Type	Comments
Client Host	Server W/S	Single processor workstation-based server
Working Storage	magnetic disk	One unit, site capacity sized. .

The specific sizing derived for GSFC Release-A requirements is synopsized within Table 3.4.2.4-4 and is highlighted in Section 3.4.2 within the site configuration overview Figure 3.4.2-1. The site overview figure provides additional details on specific component configurations and sizing. The Ingest Subsystem resources at GSFC are sized principally to support the migration of data products from Version 0.

Table 3.4.2.4-4. Ingest HWCI Component Sizing for the GSFC DAAC Configuration

Ingest Component	Component Class	Quantity	Comments
Client Host (ICLHW)	SGI Indigo 2	1	L0 Ingest Client host. Hosts are adapted to EBnet I/F (FDDI for Release-A) and ESN. Host attached disk. SCSI I/F to working storage.
(Working Storage)	Magnetic Disk (host attached)	1 (6 GB)	Host adapted magnetic disk. SCSI / SCSI II
Client Host (ICLHW)	8 mm tape stacker	1	Support for Version 0 ingest
Client Host (ICLHW)	X-Terminal	1	OPS support for Data Ingest Technician(s).

3.4.2.5 Interoperability Subsystem

For the Release A time frame, the hardware support for the Interoperability Subsystem, particularly the Advertising capabilities are provided by the Data Management HWCI. Please see Section 3.4.2.3 for a complete description of this capability.

3.4.2.6 Production Planning Subsystem

The Planning Subsystem consists of a single Hardware Configuration Item (HWCI) providing the hardware resources to support its production planning and plan management for data processing production management (plan implementation) functions. The Planning hardware consists of one or more Production Planning/Management workstation(s) and a Planning (DBMS) server.

The Production Planning/Management server(s) support Planning operations staff in performing their routine production planning and management functions. Workstations are provided for operations personnel access to management GUIs. These functions include candidate plan generation, plan activation, entry of production request information and report generation. The server and workstation classes chosen will be based on projected planning workloads for that DAAC.

The planning and production database is a key component within the Planning subsystem with the database server(s) providing the persistent storage for data which are shared between the applications. The database marshals requests for concurrent access to data and provides the protocols to allow applications to be allocated to distributed platforms.

Since there are no full-up production operations at GSFC at Release A, there is only one physical server for the Planning function. The Production Queuing Server, normally allocated within the SPRHW HWCI, is not provided as the secondary server (backup) for the planning and queuing function.

3.4.2.6.1 Rationale

A basis for the PLNHW capacity sizing is provided in the following paragraphs. Section 3.4.2.6.2, which follows, provides details on site configuration. The Planning Server is provided at Release-A for sites supporting processing operations for TRMM, with one exception. The GSFC Planning configuration is a follow on to a minimal (planned) Ir1 configuration. The Ir1 configuration grows from a small workstation used to provide capacity for the scheduling tool, up to an initial Planning/Queuing configuration, consisting of an operations workstation and a small server. The GSFC Planning HWCI configuration is supplied in the Release A time frame to support early evaluation, prototyping, demonstration as well as supplying a vehicle for early operations preparation.

The sizing of the server for the Release A GSFC configuration is assumed to be equivalent to the LaRC configuration, which is the largest planning configuration supplied to a DAAC site hosting TRMM production. Refer to the 3.4.2.6 section of the LaRC DAAC Specific Volume for full details regarding the LaRC configuration rationale. A synopsis of the relevant prototyping and

static analysis used, as well as the key assumptions made is provided below. Database sizing and processing loads are described in the LaRC volume.

An the initial estimate for the Planning database sizing and processing loads was made for the Release A and Release B time periods. However, the results of this sizing indicated that a very small system load would be experienced in comparison to the load that would occur during the

Release B time period. It was determined that the most cost effective approach for Planning is to select for the Release A period the Planning hardware that would support the Release B workload.

The Planning server supports the Planning database that contains all the information central to the functioning of the Planning Subsystem. To size the Planning server, it is necessary to estimate the size of the Planning database and to determine the database throughput it would have to support (transaction rates).

The size of the Planning subsystem server is estimated by developing a model of the Planning subsystem database and processing loads that would be imposed on the server. The following paragraphs summarize the procedures used, assumptions made and other information used to develop the Planning subsystem workload model for the CDR phase.

- Planning DBMS Size -- The starting point for the sizing effort is the analysis done prior to the ECS PDR for the sizing of the Planning database. This analysis was documented following the PDR in "Planning Subsystem Database Size Estimate for the ECS Project" (440-TP-012-001, February 1995). The fundamental data structures presented in that document remain valid (e.g., PGE Profiles, Production Requests) although some revisions have been within the data structures. For example, parameters within the data structures related to the number of files per job were effected by the initial assumptions made about the average number of files input to or output from a job. More realistic numbers were used.
- Technical Baseline -- The January Technical baseline information was used to derive key parameters that effect the planning and processing workload at each DAAC site. These key parameters include the number of job activations per day for each PGE at each DAAC, the number of input files and output files for the PGEs, and the number of PGEs maintained at each DAAC. For example, the following parameters are derived:
  - No. PGEs at the DAAC
  - Average number of activations (jobs) per day
  - Average number of files input to processing per day, all jobs
  - Average number of files output from processing per day, all jobs
  - Average number of files input to an average job per day, per jobs
  - Average number of files output from processing per day, per jobs

- OPS Concept -- At the Operations Concept Workshop held in June 1995 certain concepts were presented concerning the manner in which the Planning subsystem would be used at each DAAC. These assumptions have been adopted here. In summary:
  - The production scheduler/planner at each DAAC will prepare and publish a 30 day plan every two weeks. This plan is used to provide some assistance in longer range planning. The 30 day plan is only prepared and published every two weeks - if changes occur after a plan is published, the changes will only be incorporated in the next 30 day plan.
  - The production scheduler/planner at each DAAC will prepare and publish a 10 day plan every week. This plan will provide a finer grain description of planned activities. Like the 30 day plan, this plan will not be replanned and distributed except on the regular weekly boundaries.
  - The production scheduler/planner at each DAAC will prepare and activate a daily plan or schedule once per day. This schedule will be replanned as required during the course of the day.

    It needs to be noted in this regard, and as is described in more detail in the Planning Subsystem design document, that the manner in which each DAAC operations production scheduler/planner decides to conduct planning and scheduling can vary from DAAC to DAAC. The planning and scheduling tools are sufficiently flexible to support a variety of planning and scheduling strategies. The sizing of the storage and the performance of the server is based upon the assumptions given here. It should also be noted that it is not essential that the operations staff conduct replanning for the active schedule if events arise (e.g., processor failures) that would cause the predictions of the active schedule to depart from reality. Processing will continue regardless since jobs will be released for execution as resources (processors and input data) become available.
- It was assumed that the reprocessing workload in jobs would be equal to the standard processing workload. Additionally, it was assumed that planning and scheduling in support of testing activities would add an additional 10% to the base workload.
- Several other parameters were estimated as a part of the process of developing a model for the database sizing and processing activity. Some of these parameters and their values are:
  - No. of working hours per day
  - No. of long term (30 day) plans stored
  - No. of short term plans stored
  - No. of production request per PGE
  - No. of replans (active plans) per day
- Volume Estimates -- Database storage volume estimates were prepared for each DAAC site by summing each of the database tables as applicable to that DAAC site.

- Planning Activities -- The design for the Planning subsystem was then represented as a collection of several activities or functions (e.g., Subscription Manager, Planning Workbench: Candidate Plan Creation, etc. See Planning Subsystem Design). Functions that were activated only infrequently (e.g., Subscription Submittal) were ignored. The activation frequency of these subsystem activities was then identified, where possible from the January technical baseline summary, for example number of jobs activated per day. Subactivities within these functions were identified and an estimate of the processing load was made based upon the complexity of the activity. These processing load estimates were made in terms of the number of CPU seconds required for a processor estimated to perform at a 1 MIPS rate - i.e. a low end processing system. In one instance for the Processing subsystem, a key parameter (job submission overhead) was used which was measured during bench marking of candidate planning & scheduling subsystems prior to the COTS procurement. Amount of I/O activity was also estimated in terms of records read or written and a CPU load estimate was applied to that value as well. These load estimates were then totaled across the complete set of Planning subsystem activities for the specified frequency of activation for each DAAC site. Planning subsystem server sizing is then estimated by scaling upwards from the base processor size.

RMA analysis performed for the science data production equipment string, does not suggest the need for stringent fail-safe operations at the operational sites. Availability and Mean Down Time (MDT) requirements for the Planning Subsystem function are 0.96 and 4 hours, respectively. It is assumed that since no full-up production operations are supported at GSFC that the RMA requirements are not effective for Release A. (Reference: "Availability Model/Predictions for the ECS Project," 515-CD-001-003, July 1995).

DATABASE SIZING--Refer to the 3.4.2.6 section of the Release A LaRC DAAC Design Specification for full details regarding the LaRC database configuration rationale. The supplied configuration for GSFC is based on a server with like capacity to the LaRC configuration. See Section 3.4.2.6.2 for the provided configuration for GSFC.

PROCESSING TIMES--Refer to the 3.4.2.6 section of the Release A LaRC DAAC Design Specification for full details regarding the LaRC DBMS server processor rationale. The supplied configuration for GSFC is based on a server with like capacity to the LaRC configuration. See Section 3.4.2.6.2 for configuration provided for GSFC.

The procedure used to develop processing workload estimates is described above. It is essentially a static analysis. Service times for various subfunctions of the Planning and Processing activities were assumed, and an overall workload was computed by this static analysis. The desired loading is achieved by scaling from the low-end system performance to the target system performance. Comparative benchmarks for various processing systems have been used to perform the scaling and selection.

Bench marking and prototyping activities are underway at the time of publication of this document. Information acquired from this process will be used to assess integration issues as well as to obtain more precise performance and capacity measurements, especially in helping to define Release B requirements which pose a more significant load than for A. As the prototypes

mature, observed performance characteristics under simulated request loads will be used to check / refine / replace the various assumptions made in the sizing efforts.

3.4.2.6.2 Configuration

The Planning Subsystem is a single HWCI providing hardware resources to support production planning and plan management for data processing production management (plan implementation) functions. The Planning hardware consists of a Planning Server and one or more Production Planning/ Management workstations. The PLNHW server architecture is based primarily on providing facilities with which a common RDBMS for planning and queuing can be serviced.

Provided capacities for the Planning Subsystem platforms within the configuration are summarized here:

- Planning Server: Sun SPARC 20/71
  - Clock: 75 MHz
  - CPUs: 1
  - Disk: 1.05 GB, with the supplied configuration higher based on procurement units (provided capacity = 6GB).
  - RAM: 384 MB
  - TPC: SPECint92 = 125, SPECfp92 = 121

- Planning Workstation: Sun SPARC 20/50
  - Clock: 50 MHz
  - CPUs: 1
  - Disk: 1.05 GB, with the supplied configuration higher based on procurement units.
  - RAM: 64 MB
  - TPC: SPECint92 = 82, SPECfp92 = 89

The site configuration overview diagram, Figure 3.4.2-1 depicts the PLNHW hardware components at Release A within the context of the overall site configuration.

3.4.2.7 Data Processing Subsystem

The Data Processing Subsystem (DPS) consists of three hardware CIs:

- Science Processing -- the primary HWCI in the Processing Subsystem and contains staging (working storage), input/output (I/O), and processing resources necessary to perform routine processing, subsequent reprocessing, and Algorithm Integration & Test (AI&T). SPRHW CI consists of two components: Science Processing which provides a pool of cluster configured processing resources, and Processing Queue Management

which provides the workstation(s) required to manage, control and status tasked dispatched to the processing resources.

- Quality Assessment and Monitoring (AQAHW) -- This HWCI contains the hardware necessary to support DAAC operations users performing planned routine QA of product data. At a minimum, the hardware can be configured for general user and subscription use (client support). This HWCI may, over time, consist of QA monitors and workstations ranging from X-terminals, to small user workstations, to medium or large graphics workstations. The complement is site dependent and is a function of the classes of production performed. The need for visualization support will be explored as product specific QA processes and requirements are worked jointly with the DAAC operations personnel as well as the science teams.
- Algorithm Integration and Testing (AI&T) -- .This HWCI provides the hardware resources to support DAAC operations users performing: science software algorithm integration and test , systems validation and integration and test.. This HWCI provides the workstation and server based operations support hardware, while the prime science software integration and test capacity is provided within the SPRHW HWCI (i.e. no science processors are provided by the AITHW CI to the DAAC configuration). The AITHW HWCI provides the operations support workstations to allow DAAC personnel to configure, control and manage the AI&T processes engaged on the target science processes. AITHW also has provision for a small dedicated DBMS server to support AI&T., which does not interfere with the operational environment

DPS is responsible for managing, queuing, and executing processes on a specified set of processing resources at each DAAC site, and operates in conjunction with the Planning Subsystem.

The overall hardware design for ECS is that of a heterogeneous computing environment. The configuration highlighted here is specifically for Release A (including components provided at Ir1), but factors in requirements with a "look ahead" to Release B for platform suitability, scalability and evolvability. The candidate hardware is tailored to DAAC unique instrument processing needs.

3.4.2.7.1 Data Processing Rationale

The purpose of the system level performance and capacity analysis is to provide a basis for sizing for Processing, Data Server and Ingest Subsystem capacity as a system. The subsystems are viewed as parts of an integrated system as static and dynamic analysis are applied to generate recommended configurations.

The rationale supplied here addresses SPRHW, AQAHW and AITHW. The sizing for SPRHW focuses heavily on science processor MFLOPS, I/O, communications and host attached disk requirements. As indicated above, this analysis meshes with the Ingest, Data Server and Communications sizing, and to a lesser degree with the Planning analysis as well. Rationale for the configuration recommendations are provided below for SPRHW, AQAHW and AITHW in turn below.

WITH RESPECT TO THE SPRHW HWCI: The primary focus at Release A for GSFC is to support early algorithm integration and test operations for MODIS and COLOR. No full-up production operations are supported during this time frame. The hardware provided at GSFC to support AI&T processing and interface testing is carried over from Ir1, with some additional capacity added at Release-A as discussed below. This AI&T sizing is based on Ir1 sizing agreements as well as the processing phasing requirements applied to Release B performance and capacity. Migration to Release B, platform suitability and scalability are applied in the analysis.

The following major driving requirements govern the sizing rationale for the processing hardware:

- RMA requirements,
- capacity phasing (discussed below in detail),
- January 1995 ECS Technical Baseline, incorporating AHWGP estimates
- Hardware suitability (software support, mission support) and scalability
- Parallel AI&T and production operations (at the operational sites)

Release A performance and capacity analysis is based upon the January 1995 Technical Baseline/ AHWGP data. New AHWGP data has been supplied in June 1995 primarily affecting MODIS at GSFC and to a lesser extent CERES and MISR at LaRC. Although this data is being analyzed by the modeling and science team, it has not been applied to the CDR design and analysis described in this volume. Similarly, DAO data will be provided in mid-August with performance and capacity assessment being reported at Release B IDR.

Capacity phasing rules, which are part of the ECS Technical Baseline, are applied to the calculated capacities to produce the required capacities for the project phase in question. A subset of the capacity phasing rules apply to the SPRHW HWCI configuration for GSFC since it is sized for Release A (10 months prior to AM-1 launch).

The following items describe the required phasing factors and how they are applied to processing capacity based on launch dates. This phasing is applied to each processing platform.

- **0.3X for L-2 < t < L-1** For pre-launch AI&T starting at launch minus 2 years, AI&T requires 0.3 of the processing estimate at launch during the period 1 to 2 years prior to launch. X is defined as at-launch processing estimate for pre-launch AI&T.
- **1.2X for L-1 < t < L+1** For pre-launch AI&T and system I&T, starting at launch minus 1 year, AI&T and system I&T requires 1.2 times the processing estimate at launch during the year prior to launch. Standard instrument processing requirements begin from launch date and last for the remainder of the life of the instrument. X is defined as at-launch processing estimate for pre-launch AI&T and systems I&T.

Spreadsheet analysis (or static analysis) was used to generate the processing capacities for GSFC AI&T support, based on the AHWGP data roll-up summaries. Performance and data volume demands were summarized and translated into average processing (MFLOPS), input/output, (I/O) and network bandwidth requirements.

WITH RESPECT TO THE AQAHW HWCI: The Algorithm Quality Assurance HWCI (AQAHW) contains hardware resources to support DAAC operations users performing planned routine QA of product data. This HWCI facilitates the performance of "DAAC based" QA. While the actual processing resources are included within the SPRHW, this HWCI provides the basic facilities to control and enable QA as a process within each DAAC facility (as needed per site specific science and operational policies). Since there are no operational processing requirements at GSFC at Release-A, this HWCI does not contribute to the site complement until Release B.

WITH RESPECT TO THE AITHW HWCI: The Algorithm Integration & Test HWCI (AITHW) provides essentially the same configuration at Release-A that was provided at Ir1. Operations workstations and a small server are provided to support the AI&T activity, which utilizes AI&T capacity provided by the SPRHW Science Processors to actually host and test the science algorithm software applications. Thus, the AITHW HWCI just provides the operations support workstations to allow DAAC personnel to configure, control and manage the AI&T processes engaged on the target science processors.

The design rationale supplied for the Ir1 components applies, and is not repeated in this volume. AI&T requirements, which increase at Release-A for configurations that were supplied at Ir1, affect the SPRHW hardware CI, not the core of the operations support hardware which is supplied within AITHW. See the site specific design rationale discussion provided earlier within this section for AI&T science processing capacity information as well as the supplied configuration discussed in the section that follows.

3.4.2.7.2 Processing Configuration

The specific configurations provided for the Release A GSFC SPRHW and AITHW HWCIs, as derived from the rationale described above, is synopsized below. Figures 3.4.2-1 and 3.4.2-2, which provide the full details for the site's configuration, include layouts for these HWCIs. Additional details on specific component configurations and sizing are provided within the figures (including make and model numbers assumed as candidates for implementation).

Table 3.4.2.7-1 summarizes the *required* capacities vs. the recommended data processing platform's *provided* capacities within the recommended configuration. The AHWGP required capacities are derived from the sizing efforts briefly outlined in 3.4.2.7.1 above. Required capacities were modified given the assumptions discussed in the table notes below.

Table 3.4.2.7-1. Provided Processing Capacity for the GSFC Science Processing Configuration

		AHWGP Required Capacity			Provided Capacity			
DAAC	Rel	MFLOPS	Bandwidth	Disk Volume	Platform	Peak MFLOPS	Peak I/O Bandwidth	Disk Volume
GSFC	Ir1	2,150	+250 MB/sec	75 GB	SMP (8 CPU)	2,400	640 MB/sec	75 GB
	Rel A	+2,040	No Change	No Change	+6 CPU	+1,800	No Change	No Change

NOTES:

1. ESDIS phasing factors and machine efficiencies are applied.
2. GSFC MFLOPS at Ir1 assumes 50% of 0.3 X phasing factor (i.e. 2150 MFLOPS)
3. AI&T environment for GSFC.
4. "AHWGP provided capacity" and "provided capacity" based on static analysis for this site.

The recommended platform for GSFC is a high-end SMP (SMP-H) configuration (e.g. 8 CPUs) to support MODIS for Ir1 and an additional 6 CPUs for Release A. GSFC supports AI&T in Release A and, therefore, does not require a backup processor for a Process Queuing Server.

The core configuration of 2GB of RAM, provided at Ir1, is unchanged for Release A. Future recommendations with respect to Release B RAM allocations will be based on technical exchanges with the science and algorithm teams. Changes in RAM utilization within science software can affect local I/O, disk utilization and possibly archive drive bandwidth utilization estimates given in the AHWGP information sets, and will require further mutual engineering.

Sizing of SPRHW HWCIs are derived from static (or spreadsheet) analysis of the Technical Baseline. Peak values have been estimated. More precise estimates of dynamic peak CPU processing performance, I/O bandwidth, and staging values will be determined by system modeling results and applied as soon as they are available for GSFC Release B (MODIS).

AQAHW--There are no DAAC based QA workstations supplied at GSFC for Release-A since there are no processing clusters supporting actual operations in this time frame. Any "QA" processing on data produced by science processes under early AI&T are analyzed through mechanisms at the SCF as well as the GSFC compliment of AITHW supplied workstations and server (discussed below).

AITHW--The GSFC requirement for an AI&T server and OPS workstation doesn't change given that the SPRHW provides the science processing capacity. The Ir1 configuration supplied prior to Release-A remains in place and is not augmented further.

3.4.2.8 Communication & Management Subsystems (CSS/MSS)

The MSS and CSS Subsystem hardware have been sized and configured in a redundant configuration in order to provide for high availability of communications infrastructure and

management services. The sizing rationale, therefore, applies to both MSS and CSS servers and will be presented in a single subsection.

The MSS Subsystem consists of a single hardware CI (MSS-HCI), which provides the servers, workstations, and printers needed for all local system management functions. The MSS-HCI provides processing and storage for the following MSS software components:

- Management Software CI (MCI) - provides system monitoring and control (via HP Openview), the database management system (Sybase), trouble ticketing; and management data access (custom code / scripts used to import log file data to the RDBMS)
- Management Logistic CI (MLCI) - Site and SMC maintenance and operations staffs will rely on the Configuration Management Application Service (CMAS) to track ECS baselines; manage system changes; store ECS source code, binaries, test data and documentation; and provide resource version and status information.
- Management Agent CI (MACI) -Agents are processes used to monitor and/or control managed objects distributed across heterogeneous platforms. Current COTS technology for network management uses network protocols such as SNMP to provide a way for the manager, the managed objects, and their agents to communicate. SNMP defines specific messages, referred to as commands, responses, and notifications.

The CSS Subsystem consists of a single hardware CI (CSS-DCHCI), which provides the server for all CSS functionality. CSS contains a single CI, the Distributed Communications CI, which provides the following services:

- Common Facility Services - includes electronic mail, file access, bulletin board, virtual terminal, and event logger services
- Object Services - includes security, naming, message passing, event, thread, time and life cycle services
- Distributed Object Framework - includes OODCE framework functionality

3.4.2.8.1 Rationale

The MSS/CSS processing complement for GSFC was designed and sized for both the TRMM and AM-1 missions. Storage was sized based on a worst case estimate of GSFC requirements for the TRMM mission (Release A). The sizing of MSS/CSS subsystem hardware is based on the 6/21/95 version of the technical baseline. Storage Requirements MB have been rounded upward.

Processing Requirements--Processing requirements for the MSS and CSS subsystem are driven by the following types of transactions:

- HP Openview data collection from managed objects and ad hoc queries (server)
- Conversion / import of HP Openview and log file data to MSS Sybase DBMS (server)
- DBMS usage for report generation / ad hoc queries (server)

- Usage for configuration management, baseline management, trouble-ticketing, and associated report generation (workstation)
- DCE logical server transactions (directory, security, time)

Server Sizing--ECS already has experience with many of the COTS products to be loaded on the MSS server from previous work in Evaluation Prototypes (EPs) and EDF installations. Based on this experience, a profile of the MSS/CSS server that is operating under nominal load (e.g., HP Openview map is displayed, but no collections are in process) has been developed. To this, processing requirements have been added for specific types of transactions.

In the EDF, an HP 9000/735/125 (rated at 154 MIPS), equipped with 213 MB RAM was loaded with HP Openview, DCE client, Sybase server, X-server, and operating system. Tests were run to examine the impact of various types of HP Openview functions on CPU utilization. HP Openview was configured to discover approximately 500 nodes within EDF and then displayed them as a node map. Minimal status polling was performed at 15 minute intervals. A variety of HP Openview on-line reports were generated to show such items as packet throughput and CPU utilization. During the testing, processes resident on the server were monitored. CPU utilization remained extremely low (i.e., less than 3%) except during operator queries and initialization. At system start-up, initialization of the various daemons used by HP Openview generated a load of approximately 50%. After start-up, functions that involved initialization of x-windows screens (e.g., generation of the node map or display of a performance graph) generated loads of 25-40% for a brief (less than 15 seconds) period of time. Multiple SNMP queries on a router increased CPU usage to approximately 20 percent, with the primary driver appearing to be the x-windows server. Simultaneous queries of two routers (to two different x-window screens) consumed a total of 50-60% of the CPU. Based on this benchmark, we assume that a basic configuration of a server, including HP Openview, Sybase, DCE client, and the operating system will require approximately 72 MIPS, and will provide adequate resources for routine HP Openview operations. To this must be added processing capacity to handle DCE server functions, HP Openview monitoring, processing of log files, Sybase report generation / ad hoc query capability, Remedy, and mail.

HP Openview and log file-to-Sybase data conversion are primary processing drivers that are expected to vary by DAAC. Table 3.4.2.8.1-3 shows estimated numbers of transactions for HP Openview data collection. HP Openview data collection is driven by the number of managed objects to be monitored and the number of MIB objects to be collected for each. Managed objects for each MIB type were counted based on the Release A CDR hardware plan for GSFC (see Figure 3.4.2-1) and an assumed worst case for Release B. The number and frequency of data collection for each class of managed objects was provided by MSS developers (see 311-CD-003-003, Appendix B). HP Openview provided an estimate of 100,000 instructions per transaction. Using this information, an average number of instructions per second required for HP Openview data collection was developed. These estimates appear to be reasonably in line with HP-provided performance information, which indicates that an HP 9000/735, a machine rated at 125 MIPS, is capable of performing approximately 1300 collections per second.

An estimate of 100,000 instructions per transaction was assumed for the conversion of each logged event to Sybase, based on the number of source lines of code for the MSS MDA

component involved and an estimate of instructions needed to update the Sybase database. Instructions per transaction was multiplied by the number of logged events, including both HP

Openview events and events collected from applications via the logging API. HP Openview events (transactions) are described in the previous paragraph. The number of application-generated log files, see Tables 3.4.2.8.1-1 and 3.4.2.8.1-2, was developed using the following assumptions:

- One log file (average 192 bytes each) is generated for every system transaction, by every process that is included in the transaction thread..
- The number of "pull" transactions is based on the user model and reflects user service requests by DAAC. Pull transactions (e.g., directory, inventory search requests) are assumed to generate a conservative estimate of 10 log entries each from CIDM and data server processes.
- The number of transactions on the "push" side includes external (DAAC-to-DAAC and L0) file transfers (4 log files each), processing-to-archive requests (4 log files each), and PGE execution (2 log files each). Push transactions were based on AHWGP data, which showed that GSFC executes 25 PGEs per day only for AI&T purposes and each PGE requires an average of 39 input/output file requests at Release A. At Release B, GSFC executes 8,764 PGEs, and we assumed the same number of input/output file requests (this was expressed as an hourly average in the tables below for consistency).
- In addition, major processes generate a log file of approximately 512 K (based on the MSS application MIB) once every 15 minutes. There are estimated to be 15 processes at each DAAC that will generate log files every 15 minutes.

The MIPs required to import the total number of log files per day are given in Table 3.4.2.8.1-4.

Table 3.4.2.8.1-1. GSFC Log File Storage Volume - Release A

Log File	Log Events per Transaction	Transaction Frequency per Hour	Total Logged Events per Hour	Bytes per Transaction	Total Size of Bytes/Hr	14-Day Storage Requirements (MB)
User service requests	20	1	20	192	3,840	2
PGE execution	2	1	2	192	384	1
External file transfers	4	1	4	192	768	1
Processing-to-Archive Requests	4	0	0	192	0	0
Application MIB poll	15	4	60	512	30,720	7
Total		7	86		35,712	12

Table 3.4.2.8.1-2. GSFC Log File Storage Volume - Release B

Log File	Log Events per Transaction	Transaction Frequency per Hour	Total Logged Events per Hour	Bytes per Transaction	Total Size of Bytes/Hr	14-Day Storage Requirements (MB)
User service requests	20	71	1,420	192	272,640	90
PGE execution	2	365	730	192	140,160	46
External file transfers	4	19	76	192	14,592	5
Processing-to-Archive Requests	4	14,233	56,934	192	10,931,328	3,687
Application MIB poll	15	4	60	512	30,720	11
Total Rel B		14,692	59,220		1,1389,440	3,839

Table 3.4.2.8.1-3. GSFC HP Openview Collection Processing Requirement

	# MIB Objects	Average Size (Bytes)	GSFC Managed Objects	Collections per hour*	Collections per second	Estimated MIPS
R-A GSFC (Hosts, RDBMS, Router, hubs)	1,953	4	64	51,828	14	1.4
R-B GSFC (Hosts, RDBMS, Router, hubs)	1,953	4	256	207,312	58	5.8

* Note that the number of collections per hour was derived by multiplying each class of MIB objects (e.g., MIB II objects) by the number of managed objects within that class, and summing the results.

Table 3.4.2.8.1-4. MDA Data Conversion to Sybase Processing Requirement

	Total HP Openview Events / Day	Total Log File Events / Day	MIPS for 8 hour Sybase import
Release A	1,243,872	2,064	4
Release B	4,975,488	1,421,280	22

At Release A, only ad-hoc queries and reports will be generated from the Sybase database, which will be relatively small. Queries are not expected to exert a substantial load on the server. At Release B, an additional workstation may be used as a Sybase server. Sybase performance benchmarks will be run as Release B reporting requirements are defined in order to better analyze server / workstation capacity needs.

DCE has been installed in the EDF and used in the Engineering Prototypes (EPs). Running on an HP 715, rated at 77 MIPS, the DCE server functions used 8% of the CPU, or approximately 6 MIPS. An analysis was performed to determine how much additional load would be placed on the DCE server at Release A and B.

Load imposed on the DCE server is a function of the number of directory, security and time look-ups from client applications. A client application maintains its own cache containing the most recently accessed directory and security information, and will only access the server when a user is not found in its own cache. The client cache is sized at 512 KB or 1/2 percent of the client memory, whichever is greater. This enables storage of approximately 425 directory and security records (a directory record is 1000 bytes; a security record is 200 bytes) at each client. Many client applications will only access other clients within the DAAC, and so will never exceed their cache. CIDM and the Data Server APC, however, will be directly accessed by external user clients and so will need to access directory and security information for each user access. At Release A, given the user baseline of 448 total ECS users, it is unlikely that any client at a single DAAC will exceed its cache storage; therefore, after the initial access for each client, the server may not be accessed again for directory and security information, unless re-initialization occurs. At Release B, the user model reflects a maximum of 71 users accessing a GSFC per hour. Given that a directory and security lookup typically requires less than 0.5

seconds, it is unlikely that there will be more than 1-2 simultaneous hits on the DCE server. We estimate that 1 additional MIP processor capacity will be sufficient for the level of DCE accesses required.

The server requirements, as dictated by the rationale given above, is synopsized in Table 3.4.2.8.1-5.

Table 3.4.2.8.1-5. CSS/MSS Server Configuration - Requirements Estimate

Server Load Sources	Estimated R-A MIPS	Estimated R-B MIPS
Basic configuration (includes HP Openview and DCE client)*	72	72
Additional HP Openview data collection*	1	6
Sybase Server and Client*	30	50
Remedy*	30	30
MDA (log conversion to Sybase)	4	22
MSS Agent*	3	3
DCE server (including additional processing for peak directory and security transactions)*	6	7
Word Processor	1	1
Spreadsheet	1	1
Mail User Interface	3	3
Other Common Services (Mail, file transfer, etc.)*	5	5
Operating System*	6	6
Total (Items with an asterisk were considered to be potentially active at the same time. MDA database update is assumed to be run in off-peak hours, and not concurrently with Sybase report generation functions.)	153	179

Workstation Sizing--On the MSS workstation, the biggest drivers will be the MLCI software COTS, including Clearcase, the Software Change Manager, the Inventory Change Manager, and the Baseline Control Manager. In addition, the MSS Workstation will contain the Sybase client, DCE client, MSS agent, and operator tools. Although the CM database will be much larger at the DAACs, it is expected to be more stable than in a development environment, requiring fewer updates and fewer extractions. In the EDF, Clearcase was installed on a SPARCstation 10, equipped with 120 MB RAM, rated at 109 MIPS, and with an Ethernet interface. The SPARCstation 10 was initially used for Toolkit development, as well as CM of the Evaluation Prototypes. With moderate numbers of users, the SPARCstation 10 provided good performance. At peak use (15-20 simultaneous users viewing items, manipulating the contents of the database,

and executing directly out of Clearcase), performance was adversely affected. Usage at the DAAC is not anticipated to require more than 5 simultaneous users, frequency of use is anticipated to be much lower, and applications will not be executed from the Clearcase tool. Although additional bench marking or analysis will help determine the precise Clearcase processing requirements at the DAAC, EDF experience suggests that a workstation configuration in the SPARCstation 20 range should be adequate to support Clearcase, other MLCI COTS, and DCE and Sybase clients.

Table 3.4.2.8.1-6 below reflects a best estimate of load to be imposed on the MSS workstation at Release A. It assumes that most functions run concurrently. Since two workstations are planned to support MSS functionality at Release A, and additional workstation(s) at Release B, operator functions can be spread across workstations in such a way as to minimize load.

Table 3.4.2.8.1-6. MSS Workstation Configuration - Requirements

Workstation Load Sources	Estimated, R-A and R-B MIPS
Basic configuration (includes Clearcase and Operating System)*	50
Inventory Manager, Change Request Manager, Baseline Manager*	20
Sybase Client*	10
Word Processor	1
Spreadsheet	2
Graphics	1
MSS Agent*	2
DCE Client*	5
Other Common Services (Mail, file transfer, etc.)	5
Total * (Items with an asterisk were considered to be potentially active at the same time)	87

Storage Requirements--Major data stores for the MSS and CSS subsystems include: HP Openview files, application log files, the Management DBMS, and Clearcase-managed data. Other significant data stores include DCE directory and security data, mail, trouble ticketing database, inventory management database, baseline control database, and software change database.

The size of the data storage for HP Openview has been estimated from the determination of the frequency of transmission of the necessary information of all the appropriate attributes of the managed objects during one hour period. It was assumed that fourteen days worth of HP Openview data are stored.

A description of how application log file volume was estimated is in the previous section (Processing Requirements). Log file volume is provided in Tables 3.4.2.8.1-1 and 3.4.2.8.1-2, based on an assumption of fourteen days storage prior to archiving in the data server archive.

The storage requirement for the Management DBMS was based on a worst case assumption that all the records from both the log files and HP Openview are stored in the Management DBMS, with an additional 10% for table overhead and summarization records. It is assumed that three months worth of data are maintained in the Management DBMS at a time.

Storage requirements for Clearcase are based on the assumption that Clearcase will store, at Release A, two copies of all source code (including ECS application source and algorithms) and two copies of all executables. Storage requirements for source were based on an assumption of This will enable recovery of the previous version of any application if required. In addition, Clearcase will store test data and configuration files. At Release A, the storage requirement for the Sybase DBMS is estimated to be 218 MB, Clearcase 2.9 GB, and 3.1 GB for all other COTS combined. The storage requirement for CSS includes those of directory, security, mail and DCE COTS. Storage requirements for DCE directory and security stores (1 Kbyte per record and 200 bytes per record respectively) were derived from the number of Release A users in the technical baseline. The total storage requirements for CSS is estimated to be 1 MB for Release A.

The total storage requirement for Release A is estimated to be between 8 and 10 GB (assuming some additional storage for Sybase swap space. Note that storage is not being estimated for Release B, as shown in Tables 3.4.2.8.1-7 and 3.4.2.8.1-8 below, since RAID disk can be easily added without disruption of operations.

Table 3.4.2.8.1-7. GSFC MSS Release A Storage Requirements

Data store	Freq. of Events/Hr	Size in Bytes/ Transaction	Size in Bytes Transmitted/Hr	Storage Requirements (MB)
HP Openview Data store	51,828	5	259,140	86
Application log files	86	192*	35,712	12
Sybase DBMS				218
Clearcase				2,907
Other COTS and product executables				3,128

* Application polling generates 512 byte logs. These have been included in the per hour total.

Table 3.4.2.8.1-8. GSFC CSS Release A Storage Requirements

CSS Data Store	# of Users	Size of Record (# Bytes)	Storage Requirements (MB)
DCE Directory	448	1,000	0.4
DCC Security	448	200	0.1
Mail (per day)	150	4,000	0.6
Total Storage Requirement			**1**

Processor Selection--Choice of the MSS/CSS Server platform was based on Release A and Release B processing requirements, COTS to be hosted on the platform, and price/performance data provided by EDS. Based on the Release B processing requirements, a medium-range server class platform (uni-processor) was chosen. HP is the preferred vendor, since HP Openview and OODCE will be principal COTS products on these platforms, and HP is one of the principal developers of DCE and OODCE.

3.4.2.8.2 Configuration

The following configuration will be provided for the GSFC LSM for Release A, which includes the MSS HWCI and the DC HWCI.

- MSS Local Management Server and CSS Communications Server: 2 HP 9000s755/125 processors, rated at 213 MIPS, 256 MB of RAM and 2 GB of storage.
- RAID Storage: 10 GB storage x 2 RAID partitions for 20 GB total
- Workstations:
  - 2 Sun Sparc 20/50 workstations
  - 1 Sun Sparc 20/50 with 130 MIPS, 128 MB of RAM and 4 GB of storage (This workstation will house configuration management software)
  - 1 Sun Sparc 20/50 with 130 MIPS, 64 MB of RAM and 2 GB of storage
  - 1 HP Laser Jet 4M+ Printer, 12 ppm/14 MB.

The GSFC DAAC will contain two primary servers for its LSM configuration, cross-strapped to RAID disk to enable warm backup. MSS and CSS applications will run on separate processors but in case of contingency, either system will be capable of running both subsystems.

The HP 9000s 755/125 is a high performance processor specifically designed for compute intensive and graphic applications. It includes a 213 MIPS processor which will more than support our requirements of 100 MIPS for Release A as shown in Table 3.4.2.8.1-5. Our storage requirements is 8 to 10 GB for Release A. Accordingly, we configured 10 GB of storage along with 755/125.

The configuration at GSFC will include two Sun Sparc 20/50 workstations. One of the workstations which will house configuration management software will be configured with higher memory and higher storage (128 MB of RAM and 4 GB of hard drive).

3.5 Software/Hardware Mapping

With the exception of the Client subsytem, each subsystem has been designed to incorporate hardware CIs that include the components (processors, servers, archive robotics, etc) on which the software components run. While the Interoperability Subsystem includes a hardware CI, Advertising Server (ADSHW), at Release A, the advertising capabilities will be supported on the Data Management HWCI. The Management and Communications subsytems include software components that execute on hardware within these subsystems, as well as on hardware across all the subsystems with hardware CIs. Table 3.5-1 provides a mapping of GSFC ECS Release A software components to the applicable hardware components. See note at bottom of table for mapping of HWCI units to the numbers identified in the table.

Table 3.5-1. GSFC Software to Hardware Component Mapping (1 of 6)

Subsystem	CSCI	CSC	HWCI /units	NOTES
Client	DESKT	Desktop	5,7,9,12,22,23,26	
Client	WKBCH	Hypertext Viewer CSC	5,7,9,12,22,23,26	
Client	WKBCH	Data Visualization (EOSView) CSC	5,7,12,22,23	
Client	WKBCH	SDPS Toolkit CSC	none	
Client	WKBCH	CSMS Toolkit CSC	none	
Client	WKBCH	Release A Client	none	
CSS	DCCI	File Access Services	29	
CSS	DCCI	Message Passing Services	29	
CSS	DCCI	Time Services	29	
CSS	DCCI	Event Logger Services	29	
CSS	DCCI	Electronic Mail Services	29	
CSS	DCCI	Thread Services	29	
CSS	DCCI	Directory/Naming Services	28	
CSS	DCCI	Life Cycle Services	29	
CSS	DCCI	Security Services	28	
CSS	DCCI	DOF Services	28	
CSS	DCCI	Virtual Terminal Services	28	

Table 3.5-1. GSFC Software to Hardware Component Mapping (2 of 6)

Subsystem	CSCI	CSC	HWCI /units	NOTES
Data Management	GTWAY	V0 IMS server	24	Release A only
Data Management	GTWAY	Gateway DBMS	24	Release A only
Data Processing	AITTL	Documentation Viewing Tools	4, 5	
Data Processing	AITTL	Standards Checkers	4, 1	
Data Processing	AITTL	Code Analysis Tools	4, 1	
Data Processing	AITTL	Data Visualization Tools	4, 5	
Data Processing	AITTL	ECS HDF Visualization Tools	4, 5	
Data Processing	AITTL	HDF File Comparison Utility	4, 1	
Data Processing	AITTL	Binary File Comparison Utility	4, 1	
Data Processing	AITTL	Profiling Tools	4, 1	
Data Processing	AITTL	PGE Processing GUI	5	
Data Processing	AITTL	PGE Registration GUI	5	
Data Processing	AITTL	Report Generation Tools	4	
Data Processing	AITTL	SDP Toolkit-related Tools	5	
Data Processing	AITTL	Product Metadata Display Tool	5	
Data Processing	PRONG	Resource Management	2,8(backup), 1	
Data Processing	PRONG	COTS	4 or 5	
Data Processing	PRONG	COTS Management	4 or 5	
Data Processing	PRONG	Data Management	4 or 5	
Data Processing	PRONG	Data Pre-Processing	1	
Data Processing	PRONG	PGE Execution Management	2,8(backup), 1	
Data Processing	PRONG	Quality Assurance Monitor	7 (if configured)	

Table 3.5-1. GSFC Software to Hardware Component Mapping (3 of 6)

Data Processing	SDPTK	Ancillary Data Access	1, 4	
Data Processing	SDPTK	Celestial Body Position	1, 4	
Data Processing	SDPTK	Coordinate System Conversion	1, 4	
Data Processing	SDPTK	Constant and Unit Conversions	1, 4	
Data Processing	SDPTK	Ephemeris Data Access	1, 4	
Data Processing	SDPTK	Geo Coordinate Transformation	1, 4	
Data Processing	SDPTK	Input/Output	1, 4	
Data Processing	SDPTK	Memory Management	1, 4	
Data Processing	SDPTK	Metadata Access	1, 4	
Data Processing	SDPTK	Process Control	1, 4	
Data Processing	SDPTK	Status Message File (Error/Status)	1, 4	
Data Processing	SDPTK	Time Date Conversion	1, 4	
Data Processing	SDPTK	Math Package	1, 4	
Data Processing	SDPTK	Graphics Library	1, 4	
Data Processing	SDPTK	EOS-HDF	1, 4	
Data Server	SDSRV	VIRS	13	
Data Server	DDIST	Distribution Products	14	
Data Server	DDIST	Distribution Client Interface	14	
Data Server	DDIST	Distribution Request Management	14	
Data Server	DDSRV	DDSRV	20	
Data Server	DDSRV	DDSRV Server	20	
Data Server	DDSRV	DDSRV Client	20	
Data Server	DDSRV	DDSRV ESDT	20	
Data Server	DDSRV	DDSRV CSDT	20	
Data Server	DDSRV	DDSRV Search Engine	20	
Data Server	SDSRV	Administration/Operation	13	
Data Server	SDSRV	Client	13	
Data Server	SDSRV	Configuration/Startup	13	

Table 3.5-1. GSFC Software to Hardware Component Mapping (4 of 6)

Subsystem	CSCI	CSC	HWCI /units	NOTES
Data Server	SDSRV	CSDT	13	
Data Server	SDSRV	DB WRPs	13	
Data Server	SDSRV	Descriptors	13	
Data Server	SDSRV	General ESDT	13	
Data Server	SDSRV	Global	13	
Data Server	SDSRV	GUI	13	
Data Server	SDSRV	Non-Product Science ESDTs	13	
Data Server	SDSRV	Non-Science ESDTs	13	
Data Server	SDSRV	Server	13	
Data Server	SDSRV	Subscriptions	13	
Data Server	STMGT	Service Clients	13,14,17	
Data Server	STMGT	Resource Management	13,14,17	
Data Server	STMGT	Data Storage	17	
Data Server	STMGT	Peripherals	13,14,17	
Data Server	STMGT	File	13,17	
Ingest	INGST	Ingest Session Manager	10	
Ingest	INGST	Polling Ingest Client Interface	10	
Ingest	INGST	Ingest Request Processing	10	
Ingest	INGST	Ingest Data Transfer	10	
Ingest	INGST	Operator Ingest Interface	11	(X-term access)
Ingest	INGST	User Network Ingest Interface	30	
Ingest	INGST	Ingest DBMS	10	
Ingest	INGST	Ingest Administration Data	11	
Ingest	INGST	Peripheral Software	10	
Ingest	INGST	Viewing Tools	11	
Ingest	INGST	Client Services	10	
Ingest	INGST	Ingest Data Preprocessing	10	
Ingest	INGST	Data Storage Software	10	
Ingest	INGST	Resource Administration	11	
Interoperability	ADSRV	AdvApplDBMSServer	24	Release A only
Interoperability	ADSRV	AdvDBMSServer	24	Release A only
Interoperability	ADSRV	AdvTextServer	24	Release A only
Interoperability	ADSRV	AdvNavigatingServer	24	Release A only
Interoperability	ADSRV	GCMD Exporter	24	Release A only
ISS	INCI	Datalink/Physical		

Table 3.5-1. GSFC Software to Hardware Component Mapping (5 of 6)

MSS	MCI	Management Framework	26 or 27	
MSS	MCI	Diagnostic Tests	26 or 27	
MSS	MCI	Application Management	26 or 27	
MSS	MCI	Automatic Actions	26 or 27	
MSS	MCI	Resource Class Category	26 or 27	
MSS	MCI	Performance Manager	27,28	
MSS	MCI	Report Generation and Distribution	27,28	
MSS	MCI	Performance Test	26 or 27	
MSS	MCI	Performance Management Proxy	26 or 27	
MSS	MCI	Security Manager	26 or 27	
MSS	MCI	Security Databases	26 or 27	
MSS	MCI	Tests	26 or 27	
MSS	MCI	DCE Cell Management	26 or 27	
MSS	MCI	Security Management Proxy	26 or 27	
MSS	MCI	Accountability Manager	27,28	
MSS	MCI	User Profile Server	26 or 27	
MSS	MCI	Management Proxy	26 or 27	
MSS	MCI	Physical Configuration Manager	27, 28	
MSS	MCI	Network Manager	27, 28	
MSS	MCI	Physical Configuration Proxy Agent	27, 28	
MSS	MCI	Trouble Ticketing Management Services	27,28	
MSS	MCI	Trouble Ticketing User Interface	27,28	
MSS	MCI	Trouble Ticketing Service Requester	26 or 27	
MSS	MCI	Trouble Ticketing Proxy Agent	27,28	
MSS	MCI	Management Data Access Services	26 or 27	
MSS	MCI	Management Data Access User Interface	26 or 27	
MSS	MCI	Ground Events Planning	26 or 27	
MSS	MLCI	Baseline Manager	26 or 27	
MSS	MLCI	Software Change Manager	26 or 27	
MSS	MLCI	Change Request Manager	26 or 27	
MSS	MACI	Extensible SNMP Master Agent	26 or 27	

Table 3.5-1. GSFC Software to Hardware Component Mapping (6 of 6)

MSS	MACI	ECS Subagent		
MSS	MACI	DCE Proxy Agent		
MSS	MACI	Encapsulator for non-Peer Agent		
MSS	MACI	SNMP Manager's Deputy		
MSS	MACI	Instrumentation Class Library		
MSS	MACI	Application MIB		
Planning	PLANG	Production Request Editor	2,8	
Planning	PLANG	Subscription Editor	2,8	
Planning	PLANG	Subscription Manager	2,8	
Planning	PLANG	Planning Workbench	2,8	
Planning	PLANG	Planning Object Library	2,8	
Planning	PLANG	PDPS DBMS	2,8	

Note: Units mapping

1== SPRHW/science processors
2==SPRHW/queuing management server
4==AITHW/AI&T DBMS server
5==AITHW/AI&T Operations workstations
7==AQAHW/QA workstations
8==PLNHW/planning server
9==PLNHW/planning workstations
10==ICLHW/ingest server
11==ICLHW/ingest workstation
12==ACMHW/administration and operations workstations
13==ACMHW/APC servers
14==DIPHW/distribution servers
17==DRPHW/FSMS servers
18==DRPHW/archive robotics
19==DRPHW/DBMS servers
20==DRPHW/document server
22==DMGHW/data specialist workstations
23==DMGHW/administration and operations workstations
24==DMGHW/DBMS servers
26==MSS/MSS workstations
27==MSS/MSS Local System Management server
28==CSS/CSS server
29== all workstations and hosts
30== User workstation

4. Future Releases

This document has described the implementation of ECS subsystems for the GSFC DAAC at Release A of ECS. Three other releases are currently planned. The next release, Release B is scheduled for September 1997. There will be a significant increase in functionality with Release B, as identified in the Release Plan Content Description document. The impact of the new capabilities offered by Release B on the GSFC DAAC, and other DAACs will be considerable. Release B will be the first to bring together all DAACs. As the system design progresses the precise nature of the impact on GSFC can be better determined.

An updated version of this document will be generated for Release B and will reflect the design corresponding to that release. In particular, items which will be reflected include:

- Incorporation of additional data sets resulting from the data migration process, as well as the addition of new instruments
- Standard product generation performed at the GSFC DAAC
- Remapping of software to hardware components
- Additional interfaces
- Incorporation of a multi-tiered storage configuration

In addition to document changes made as a result of added ECS capabilities, this document will incorporate the resolution of DAAC issues, where current issues include:

- Identification of DAAC unique requirements
- Level of data set migration from V0 to ECS
- Incorporation of SeaWiFS as part of ECS: The delay of the launch now makes this an operational data stream after ECS releases have been implemented. With the original launch date, the SeaWiFS data would (and still may be) considered as part of the data migration activity.
- Clarification of NOAA ancillary data ingest, archive and distribution site(s).
- Plan for integrating the DAO/DAS into the ECS design at the GSFC DAAC).

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Abbreviations and Acronyms

ACMHW	Access Control and Management HWCI
ADC	Affiliated Data Center
ADS	Archive data sets
ADSHW	Advertising Service HWCI
ADSRV	Advertising Service CSCI
AITHW	Algorithm Integration & Test HWCI
AITTL	Algorithm Integration and Test Tools (CSCI)
AM	Ante meridian
ANSI	American National Standards Institute
APC	Access/Process Coordinators
API	Application Programming Interface
APID	Application Process Identifier
AQAHW	Algorithm QA HWCI
ASAP	As soon as possible
ASCII	American Standard Code for Information Interchange
ASF	Alaska SAR Facility (DAAC)
ATM	Asynchronous Transfer Mode
CCSDS	Consultative Committee for Space Data Systems
CD ROM	Compact disk read only memory
CDRL	Contract Data Requirements List
CERES	Clouds and Earth's Radiant Energy System
CI	Configuration Item
CIESIN	Consortium for International Earth Science Information Network
CLS	Client Subsystem
COTS	Commercial off-the-shelf
CPU	Central processing unit
CSC	Computer Software Component
CSCI	Computer Software Configuration Item

CM	Configuration Management
CSDT	Computer Science Data Types
CSMS	Communications and Systems Management Segment
CSS	Communication Subsystem (CSMS)
DAA	DAN Acknowledge
DAAC	Distributed Active Archive Center
DADS	Data Archive and Distribution System
DAN	Data Availability Notice
DAO	Data Assimilation Office
DAR	Data Acquisition Request
DAS	Data Availability Schedule
DBA	Database administrator
DBMS	Database Management System
DDA	Data Delivery Acknowledgement
DDICT	Data Dictionary CSCI
DDIST	Data Distribution CSCI
DDN	Data Delivery Notice
DDSRV	Document Data Server CSCI
DESKT	Desktop CI
DEV	Developed code
DID	Data Item Description
DIM	Distributed Information Manager
DIMGR	Distributed Information Management CSCI
DIPHW	Distribution & Ingest Peripheral Management HWCI
DMGHW	Data Management HWCI
DMS	Data Management System
DMS	Data Management Subsystem
DOF	Distributed Object Framework
DP	Data Processing
DPR	December Progress Review
DPREP	Science Data Pre-Processing CSCI

DPS	Data Processing Subsystem
DR	Data Repository
DRPHW	Data Repository HWCI
DS	Data Server
DSM	Distribution Storage Management
DSS	Data Server Subsystem
DT	Data Type
ECS	EOSDIS Core System
EDC	EROS Data Center (DAAC)
EDOS	EOS Data and Operations System
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
EP	Evaluation Package
EP	Early Prototype
ESDIS	Earth Science Data and Information System
ESDT	Earth Science Data Types
F&PRS	Functional and Performance Requirements Specification
FC	Fiber Channel
FDDI	Fiber distributed data interface
FDF	Flight Dynamics Facility
FOS	Flight Operations Segment
FSMS	File and Storage Management System
Ftp	File transfer protocol
GB	Gigabyte
GDAO	GSFC Data Assimilation Office
GFLOPS	Giga (billions) Floating Point Operations per Second
GOES	Geostationary Operational Environmental Satellite
GRIB	Gridded Binary
GSFC	Goddard Space Flight Center
GTWAY	Version 0 Interoperability Gateway CSCI
GUI	Graphic user interface

HDF	Hierarchical Data Format
HiPPI	High Performance Parallel Interface
HMI	Human machine interface
HTML	Hypertext Markup Language
HWCI	Hardware Configuration Item
I&T	Integration and Test
I/O	Input/Output
IAS	Image Assessment System
ICD	Interface Control Document
ICLHW	Ingest Client HWCI
IDL	Interface Definition Language
IEEE	Institute of Electrical and Electronics Engineers
IERS	International Earth Rotation Service
IGS	International Ground Station
IP	International Partner
IR-1	Interim Release 1
IRD	Interface Requirements Document
IS	Ingest Subsystem
JPL	Jet Propulsion Laboratories
LaRC	Langley Research Center
LIM	Local Information Manager
LIMGR	Local Information Management CSCI
LIS	Lightning Imaging Sensor
L0	Level 0
MB	Megabyte
Mbps	Megabits per second
MBps	Megabytes per second
MD	Maryland
MFLOP	Millions of Floating Point Operations per Second
MOC	Mission Operations Center
MODIS	Moderate-Resolution Imaging Spectrometer

MPP	Massively Parallel Processor
MRF	Medium Range Forecast
MSFC	Marshall Space Flight Center
MSS	Management Subsystem (CSMS)
MTBF	Mean time between failures
MTTR	Mean time to restore
NESDIS	National Environmental Satellite Data and Information Service
NMC	National Meteorological Center
NOAA	National Oceanic and Atmospheric Administration
NSIDC	National Snow and Ice Data Center (DAAC)
O/A	Orbit/Attitude
ODC	Other Data Center
ODL	Object Description Language
ORNL	Oak Ridge National Laboratory (DAAC)
OSM	Open Storage Manager
OTS	Off-the-shelf
PAM	Permanent Archive Manager
PCI	Periphewral Component Interface
PDPS	Planning and Data Processing System
PDR	Preliminary Design Review
PDS	Production Data Set
PDS	Production Data Specialist
PGE	Product Generation Executive
PGS	Product Generation System
PLNHW	Planning HWCI
POSIX	Portable Operating System for UNIX
PRONG	Processing CSCI
Q	Quarter
Q/A	Quality Assurance
QA	Quality Assurance
QAC	Quality and Accounting Capsule

RAID	Redundant Array of Inexpensive Disks
RAM	Random Access Memory
REL	Release
RID	Review Item Discrepancy
RMA	Reliability, Maintainability, Availability
RTF	Rich Text Format
S/C	Spacecraft
SAA	Satellite Active Archives (NOAA)
SCF	Science Computing Facility
SCSI II	Small Computer System Interface
SDF	Software Development File
SDP	Science Data Processing
SDPF	Sensor Data Processing Facility (GSFC)
SDPS	Science Data Processing Segment
SDPS/W	Science Data Processing Software
SDPTK	SDP Toolkit CSCI
SDSRV	Science Data Server CSCI
SFDU	Standard Format Data Unit
SMC	System Management Center
SMP	Symmetric Multi-Processor
SPRHW	Science Processing HWCI
STMGT	Storage Management CSCI
TBD	To be determined
TBR	To be resolved
TDRSS	Tracking and Data Relay Satellite System
TONS	TDRSS Onboard Navigation System
TRMM	Tropical Rainfall Measuring Mission
TSDIS	TRMM Science Data and Information System
UR	Universal Reference
USNO	United States Naval Observatory
V0	Version 0

VC	Virtual Channel
VCDU-ID	Virtual Channel ID
WAIS	Wide Area Information Servers
WAN	Wide Area Network
WKBCH	Workbench CI
WKSHC	Working Storage HWCI
W/S	Workstation
WORM	Write Once Read Many
WS	Working Storage
WWW	World Wide Web

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