

211-CD-002-001

## **EOSDIS Core System Project**

# **Release B Trade-off Studies Analytical Data**

October 1995

Hughes Information Technology Corporation  
Upper Marlboro, Maryland

# Release B Trade-off Studies Analytical Data

October 1995

Prepared Under Contract NAS5-60000  
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## APPROVED BY

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# Preface

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This document is a formal contract deliverable intended as a final submittal with an approval code 3. This document is delivered to NASA for information only, but is subject to approval as meeting contractual requirements.

This document is under Release B CCB control. Any questions should be addressed to:

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# Abstract

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This document contains the status of trade-off studies to support design decisions within Release B and the ECS, and to support the Release B IDR process. This document identifies the studies used to support the generation of the Release B Segment level requirements and preliminary design.

**Keywords:** Study, Trade-Off, Analysis

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## **Abbreviations and Acronyms**

# 1. Introduction

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## 1.1 Identification

This document, Trade-off Studies Analysis Data for the ECS Project: IDR, is submitted as required by Contract Data Requirements List (CDRL) Item 031 and Data Item Description (DID) 211/SE3 under NASA Contract NAS5-60000. This document supplements Trade-off Studies Analysis Data for the ECS Project (211-CD-001-002) that was delivered in support of the ECS PDR.

## 1.2 Purpose and Scope

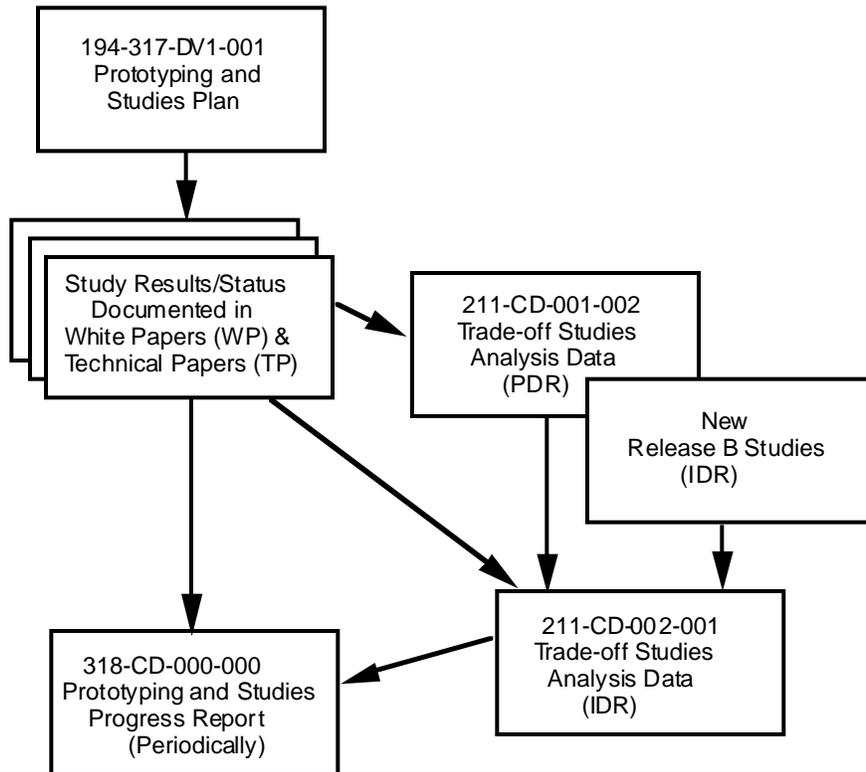
The purpose of this document is to present the status of the trade-off studies that support Release B design decisions. This document supplements, but does not replicate, the detailed information on trade-off studies contained in Trade-off Studies Analysis Data for the ECS Project (211-CD-001-002) (PDR). A majority of the trade-off studies included in 211-CD-001-002 (PDR) have been closed and, as available, this document includes references to the White Papers and Technical Papers that document the results of closed studies. The studies included in 211-CD-001-002 (PDR) that remain active are identified in this document as "on-going" in the Release B time frame.

In addition, this document includes descriptions and status of new studies pertinent to IDR. In conjunction with the studies included in 211-CD-001-002 (PDR), the new IDR studies support the generation of the Release B Segment level requirements and the preliminary design.

This document reflects the August 23, 1995 Technical Baseline maintained by the contractor configuration control board in accordance with ECS Technical Direction No. 11 dated December 6, 1994.

## 1.3 Status and Schedule

This submittal of DID 211/SE3 meets the milestone specified in the CDRL for NASA contract NAS5-60000. The current status of funded ECS studies is maintained in the ECS Data Handling System (EDHS) in DID 318/DV3, Prototyping and Studies Status Report (318-CD-000-000). DID 318/DV3 is updated periodically and tracks funded ECS studies to closure. Figure 1-1, ECS Study Documentation Relationships, illustrates the relationships among the various documents pertinent to the ECS studies.



**Figure 1-1. ECS Study Documentation Relationships**

## 1.4 Organization

This paper is organized as follows:

- Section 1 - Introduction
- Section 2 - Related Documents
- Section 3 - PDR Studies Status Summary
- Section 4 - Release B Studies
- Abbreviations and Acronyms

## 2. Related Documents

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### 2.1 Parent Documents

The following documents are the parents from which this document's scope and content are derived:

194-201-SE1-001	Systems Engineering Plan for the ECS Project
423-41-01	Goddard Space Flight Center, EOSDIS Core System (ECS) Statement of Work
423-41-02	Goddard Space Flight Center, Functional and Performance Requirements Specification for the Earth Observing System Data and Information System (EOSDIS) Core System (ECS)
423-41-03	Goddard Space Flight Center, EOSDIS Core System (ECS) Contract Data Requirements Document

### 2.2 Referenced Documents

The following documents are referenced herein and are directly applicable to this document. In the event of conflict between any of these documents and this document, the referenced document shall take precedence. Documents identified as Project Sensitive contain non-disclosure or proprietary information and are not for general distribution.

222-CD-001-001	COTS Analysis and Modeling Report (Project Sensitive)
304-CD-001-002	Flight Operations Segment (FOS) Requirements Specification for the ECS Project, Volume 1: General Requirements
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
304-CD-004-002	Flight Operations Segment (FOS) Requirements Specification for the ECS Project, Volume 2: AM-1 Mission Specific
304-CD-005-001	Release B SDPS/CSMS System Requirements Specification for the ECS Project
305-CD-020-001	Release B SDPS/CSMS Design Specification Overview for the ECS Project
305-CD-040-001	Flight Operations Segment (FOS) Design Specification for the ECS Project (Segment Level Design Overview)

318-CD-000-XXX	Prototyping and Studies Progress Report for the ECS Project
604-CD-002-002	Operations Concept for the ECS Project: Part 2B - ECS Release B
175-WP-001-001	HDF-EOS Primer for Version 1 EOSDIS
193-TP-561-001	DCE Migration Study for the ECS Project
193-TP-626-001	GCDIS/UserDIS Study
193-TP-632-001	DME Migration Study for the ECS Project
194-TP-316-002	Data Compression Study for the ECS Project
221-TP-001-002	Process vs. Store Technical Paper
420-TP-002-001	The ECS Ingest Subsystem Design Analysis
440-TP-003-001	Science Software Data Server Access: A Trade-off Study Analysis
440-TP-005-001	Physical Access and Media Management for the ECS Project
440-TP-006-002	Production Topologies: A Trade-off Study Analysis
440-TP-007-001	Production Platform Families for the ECS Project
440-TP-008-001	Distributed and Parallel Processing for ECS Science Algorithms: A trade-off Study Analysis
440-TP-009-001	Network Attached Storage Concepts & Industry Survey for the ECS Project
440-TP-010-001	DADS MR-AFS Proof of Concept Results for the ECS Project
440-TP-011-001	Manual vs. Automated Data Ingest Analysis
440-TP-014-001	ECS Ingest Subsystem Topology Analysis
441-TP-002-001	Hypertext Document Reading Tool Trade Study: Summary of Evaluation Results
540-TP-001-001	Communications and System Management Segment (CSMS) Preliminary Design Review (PDR) Trade Studies for the ECS Project
543-TP-001-003	A Cost Comparison of Transferring Inter-DAAC Data via Media versus the ESN WAN

## 2.3 Information Documents

The following documents provide background information and context to this document.

194-317-DV1-001	Prototyping and Studies Plan for the ECS Project
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### 3. Summary of PDR Studies

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This section provides status summaries of the ECS studies included in Trade-off Studies Analysis Data for the ECS Project (211-CD-001-002), as delivered for PDR. Separate sections are included below for the Communications and System Management Segment (CSMS), the Science Data Processing Segment (SDPS), the Flight Operations Segment (FOS), and the independent architecture studies. The tables include references to the applicable sections in 211-CD-001-002 (PDR) where detailed descriptions of each study can be found and, as applicable, references to White Papers, Technical Papers, or other documents containing study results.

#### 3.1 Communications and System Management Segment

CSMS focuses on the system components involved with the interconnection of user and service providers and with system management of the ECS components. The PDR version of CSMS is described in detail in the Communications and System Management Segment (CSMS) Requirements Specification for the ECS Project (304-CD-003-002). The Release B version of CSMS is described in the Release B SDPS/CSMS Segment Requirements Specification (304-CD-005-001).

Table 3-1, CSMS PDR Studies Status, summarizes the current status of the CSMS studies included in Trade-off Studies Analysis Data for the ECS Project (211-CD-001-002) (PDR) that was delivered for PDR. All of the CSMS studies included in 211-CD-001-002 (PDR) were completed prior to PDR and, with one exception, the detailed results are documented in the CSMS PDR Trade Studies Technical Paper (540-TP-001-001). Table 3-1 references for each study the applicable section numbers in 211-CD-001-002 (PDR) and 540-TP-001-001.

**Table 3-1. CSMS PDR Studies Status (1 of 3)**

Study Title	211-CD-001-002 <sup>1</sup> Section Ref.	Study Status	Release B Study Plans
A Comparison of Transferring Inter-DAAC Data	5.23	Completed. Reference 543-TP-001-003, A Cost Comparison of Transferring Inter-DAAC Data via Media versus the ESN WAN	None
Agent Configuration for a Typical Host	5.7	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 3.8	None
Common DBMS Server	5.2	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 3.3	None
Communications Server/Bulletin Board Server Integration	5.11	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 4.4	None

**Table 3-1. CSMS PDR Studies Status (2 of 3)**

<b>Study Title</b>	<b>211-CD-001-002<sup>1</sup> Section Ref.</b>	<b>Study Status</b>	<b>Release B Study Plans</b>
DBMS Technology	5.3	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 3.4	None
DCE Cell Configuration	5.10	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 4.3	None
DCE Encapsulation Prototype Study	5.9	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 4.2	None
EOC LAN Design	5.17	Completed. Reference . 540-TP-001-001, CSMS PDR Trade Studies, Section 5.3	None
FDDI LAN Media	5.19	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 5.5	None.
Hub vs. Physical Ring	5.18	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 5.4	None
IST Connectivity Analysis	5.20	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 5.6	None
IST Security Analysis	5.22	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 5.8	None.
Management Agents	5.4	Completed for Rel A. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 3.5	Consider SNMPv2 in CDR-B time frame
Management Data Archive	5.1	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 3.2	None
Message Passing	5.13	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 4.6	None
Multicast Analysis	5.14	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 4.7	None
OpenView License Requirements	5.6	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 3.7	None
Registration and Toolkit Distribution	5.12	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 4.5	None
Remote File Access (RFA)	5.15	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 4.8, and 530-TP-002-001, Communications Subsystem DFS/NFS Comparison for the ECS Project	None
Routing Protocol	5.16	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 5.2	None
SCF Connectivity Analysis	5.21	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 5.7. Study is now N/A due to EBnet consolidation.	None

**Table 3-1. CSMS PDR Studies Status (3 of 3)**

Study Title	211-CD-001-002 <sup>1</sup> Section Ref.	Study Status	Release B Study Plans
Selection of Management Framework Architecture and Product Selection	5.5	Completed. Reference: 540-TP-001-001, CSMS PDR Trade Studies, Section 3.6 193-TP-632-001, DME Migration Study 193-TP-561-001, DCE Migration Study	None
Software Configuration Management Tool	5.8	Completed. Reference 540-TP-001-001, CSMS PDR Trade Studies, Section 3.9	None

Note 1 - Trade-off Studies Analysis Data for the ECS Project (211-CD-001-002) (PDR)

### 3.2 Science Data Processing Segment

The Science Data Processing Segment (SDPS) receives, processes, archives and manages all data from EOS and other NASA Probe flight missions. It provides support to the user community in accessing the data as well as products resulting from research activities that utilize this data. SDPS also promotes, through advertisement services, the effective utilization and exchange of data within the user community. Finally, the SDPS plays a central role in providing the science community with the proper infrastructure for development, experimental usage and quality checking of new Earth science algorithms. SDPS is a distributed system and its components are currently located at eight Distributed Active Archive Centers (DAACs). The SDPS supports the services required to ingest, process, manage and access science data and related information from the entire EOSDIS.

The PDR version of SDPS is described in detail in the Science Data Processing (SDPS) Requirements Specification for the ECS Project (304-CD-002-002). The Release B version of SDPS is described in the Release B SDPS/CSMS Segment Requirements Specification (304-CD-005-001).

Table 3-2, SDPS PDR Studies Status, summarizes the status of the SDPS studies included in Trade-off Studies Analysis Data for the ECS Project (211-CD-001-002) (PDR).

### 3.3 Flight Operations Segment

The Flight Operations Segment (FOS) manages and controls the EOS spacecraft and instruments. The FOS is responsible for mission planning, scheduling, control, monitoring, and analysis in support of mission operations for U.S. EOS spacecraft and instruments. FOS also provides investigator-site ECS software (the Instrument Support Terminal (IST) tool kit) to connect a Principal Investigator (PI) or Team Leader (TL) facility to FOS in remote support of instrument control and monitoring. FOS is described in detail in the Flight Operations Segment (FOS) Requirements Specifications, Volumes 1 and 2, (304-CD-001-002 and 304-CD-004-002).

FOS studies are described in Section 4 of the Trade-off Studies Analysis Data for the ECS Project (211-CD-001-002) (PDR). The results of these studies form the basis for the FOS design and are described in Book 1 of the FOS System Design Specification for the ECS Project (305-CD-001-003).

### 3.4 Independent Architecture Studies

During the system design activity, three independent architecture studies were initiated with teams from George Mason University, University of California and the University of North Dakota. These studies are completed and the results are summarized in Trade-off Studies Analysis Data for the ECS Project (211-CD-001-002) (PDR), Section 7.

**Table 3-2. SDPS PDR Studies Status (1 of 3)**

Study Title	211-CD-001-002 <sup>1</sup> Section Ref.	Study Status	Release B Study Plans
Alternative File Formats	6.10	Ongoing study	Ongoing
Central versus Distributed Scheduling	6.27	Canceled. Some aspects decided by procurement of AutoSys/AutoXpert. No plans for central coordination of scheduling.	None
Compression Applied to Distribution and Transmission	6.5	Completed. Reference 543-TP-001-003, A Cost Comparison of Transferring Inter-DAAC Data via Media versus the ESN WAN	None
Compression Between ECS Subsystems	6.4	Ongoing Study. Reference 194-TP-316-002, Data Compression Study (PDR Status)	Ongoing
Compression within the archive	6.3	Ongoing Study. Reference 194-TP-316-002, Data Compression Study (PDR Status)	Ongoing
COTS DBMS Evaluation	6.7	Completed. Eleven DBMS products were evaluated and three selected for performance benchmarking. See the Data Server Architecture Study below.	None
COTS Desktop Environments	6.18	Completed.	None
Data Server Architecture Study	6.32	Completed. Three candidate COTS DBMS products were evaluated. Sybase is selected for Release A and Illustra for Release B.	None
Distributed and Parallel Processing	6.25	Completed. Reference 440-TP-008-001, Distributed and Parallel Processing for ECS Science Algorithms	None

**Table 3-2. SDPS PDR Studies Status (2 of 3)**

<b>Study Title</b>	<b>211-CD-001-002<sup>1</sup> Section Ref.</b>	<b>Study Status</b>	<b>Release B Study Plans</b>
Document Data Type Server	6.20	Ongoing Study	Ongoing
Earth Science Languages and Protocols	6.8	Ongoing Study. (Formally called "Query Language and Protocol Selection)	Ongoing
ECS HDF Standard	6.9	Ongoing Study. Deliver HDF-EOS Standards 7/95, 12/95, 5/96. Reference 175-WP-001-001, HDF-EOS Primer for Version 1 EOSDIS	Ongoing
FSMS Implementation	6.13	Completed. Reference 440-TP-010-001, DADS MR-AFS Proof of Concept Results	None
Hardware Technologies for Permanent Data Storage	6.12	Superseded by the Storage Technology Insertion Plan. (see below)	N/A
HDF Storage Issues for the ECS Project	6.30	Ongoing Study. Evaluate HDF 4.0 storage/compression efficiency after release by NCSA	Ongoing
HyperText Document Viewing Tool	6.21	Completed. Reference 441-TP-002-001, Hypertext Document Reading Tool Trade Study	None
I/O (HDF) Efficiency	6.29	Completed. Benchmark tests of HDF I/O show significant improvement with HDF 3.3.	None
Ingest Subsystem Design	6.16	Completed. Reference 240-TP-002-001, ECS Ingest Subsystem Design Analysis, and 440-TP-014-001, ECS Ingest Subsystem Topology Analysis	None
Manual versus Automated Data Ingest Analysis	6.17	Completed. Reference 440-TP-011-001, Manual vs. Automated Data Ingest Analysis	None
Map OTS Selection Trade	6.31	Ongoing Study.	Ongoing
Network Attached Storage Technologies	6.2	Ongoing Study. Reference 440-TP-009-001, Network Attached Storage Concepts & Industry Survey (PDR Status)	Ongoing
Physical Access Media Management (PAMM)	6.14	Completed. Reference 440-TP-005-001, Physical Access and Media Management	None
Portable File Formats	6.11	Ongoing Study	Ongoing
Production Platform Families	6.23	Completed. Reference 440-TP-007-001, Production Platform Families (Update of Technical Paper planned after IDR-B)	None

**Table 3-2. SDPS PDR Studies Status (3 of 3)**

<b>Study Title</b>	<b>211-CD-001-002<sup>1</sup> Section Ref.</b>	<b>Study Status</b>	<b>Release B Study Plans</b>
Production Topologies	6.22	Ongoing Study. Reference 440-TP-006-001, Production Topologies: A Trade-off Study Analysis (PDR Status)	Ongoing
Query Language and Protocol Selection	6.8	Superseded by the Earth Science Languages and Protocols Study (see above)	N/A
Reprocessing Paradigm Impacts on Production	6.34	Ongoing study	Ongoing
Scheduling Engine	6.26	Completed	None
Scheduling Guaranteed Level of Service	6.28	Ongoing Study	Ongoing
Science Software Data Server Access	6.24	Completed. Reference 440-TP-003-001, Science Software Data Server Access	None
SDPS Network Architecture	6.1	Ongoing Study	Ongoing
Selection of Products for On Demand Processing	6.33	Ongoing Study. Reference 221-TP-001-002, Process versus Store Assessment (Status)	Ongoing
Storage Technology Insertion Plan	6.12	Ongoing study with periodic updates.	Ongoing
Virtual Metadata	6.6	Ongoing Study	Ongoing
Visualization Software	6.19	Completed. IDL was selected as a toolkit visualization package. It is being distributed to instrument teams.	None
Working Storage	6.15	Ongoing Study	Ongoing

Note 1 - Trade-off Studies Analysis Data for the ECS Project (211-CD-001-002) (PDR)

## 4. IDR Studies

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This section contains the descriptions and status of other studies pertinent to IDR that were not included in the Tradeoff Studies analysis Data for the ECS Project (211-CD-001-002) (PDR), either because the studies had not started when it was published, or the studies were inadvertently omitted.

### 4.1 Coincident Search Paradigm

#### 4.1.1 Goal of this Study

The Coincident Search Paradigm Study is focused on defining the components and protocols necessary to complete coincident search requests (those searches where the user specifies that one data set must be coincident in spatial coverage and/or temporal coverage). The Earth Science Query Language Study will define how coincident search requests are expressed in a query language. This study will focus on how these queries get decomposed and executed. There are a variety of options discussed in the next section. This study will analyze these options and recommend one for further design specification in the Release B Critical Design Review period. The outcome of this study should affect the design of the Distributed Information Managers (DIM), the Local Information Managers (LIM), and possibly the Science Data Server (SDSRV).

#### 4.1.2 Alternatives and Options Analyzed

A coincident search can be decomposed and executed in a variety of ways by several components of the ECS system. Some of the possible scenarios are defined in the following list:

1. The DIM or LIM parses the query and poses one sub query to a SDSRV. For each result in the first query, the DIM or LIM creates a query to the second SDSRV that uses the space and time restrictions retrieved from the first query. This option is the simplest to implement for all concerned, but is the most inefficient.
2. The DIM or LIM gets back the query results from the first sub query and passes the results to the second SDSRV and asks the SDSRV to do the coincidence of this result set with some data stored in its SDSRV. This option puts the spatial search function down in the SDSRV where there is more knowledge of spatial data types, but it requires a protocol that will be difficult to express in a query language.
3. The DIM or LIM retrieves the results from all the SDSRVs involved and performs the spatial and temporal coincidence of all the result sets. This is the most efficient and sensible option, but requires the DIMs and LIMs to be more knowledgeable about spatial data types than was earlier anticipated.

Each of these options and possibly others will be analyzed in depth and the recommendations will be incorporated into the Release B detailed design.

### **4.1.3 Analysis Summary**

The current design model at the Release B Incremental Design Review is the model where the DIM and LIM do the coincidence operation. There may be COTS software implications in order to perform the spatial operations necessary. More analysis of the spatial data types and the implications on the DIMs and LIMs must be performed to determine the affect on the design.

## **4.2 COTS Analysis and Modeling Study**

### **4.2.1 Goal of This Study**

The purpose of this study is to conduct ongoing analysis and modeling of the total COTS hardware, software, and maintenance requirements. In addition, the study results provide recommended changes to existing capacity and design requirements contained in the Functional and Performance Requirements Specification for the ECS (423-41-02). A major objective of the analysis and modeling activity is to provide data for managing the COTS cost within its budget. The results of this ongoing study are documented in the COTS Analysis and Modeling Report (222-CD-001-00x), that is updated three times per year. Each revision of the report incorporates the latest information that is available at the time of publication.

### **4.2.2 Alternatives and Options Analyzed**

The goal of ECS is to maximize the delivered science capacities for processing, archive, access, and distribution within the allocated COTS budgets while minimizing the total life cycle costs. With the current analysis, the current ECS contract funding can satisfy processing and archive capacities for all missions through 1999. The disk requirements can be satisfied for all missions through 1998. Maintenance support can be provided for all missions through 1999 and beyond. The current allocation exceeds the estimated capacity requirements and provides science software integration and test (SSI&T) support for the later missions.

### **4.2.3 Analysis Summary**

The resolution of the estimation process has improved significantly as it is based on a physical design representing the current architecture. However, there are still uncertainties in the current design in areas such as Release B network capacities, Releases B and C COTS software requirements, and adequate equipment replications to support simultaneous operations and test activities. Other areas of uncertainty include the potential use of network attached disk storage and archive media technology. These uncertainties will be stabilized in the CDR time frame for the applicable releases.

## **4.3 Inter-DAAC Planning Study**

### **4.3.1 Goal of This Study**

When product(s) at DAAC A depend on the product(s) of DAAC B, the planning between the two DAACs may need to be coordinated to insure that DAAC A can produce its product within time constraints. This study will identify where potential conflicts lie and will look for

mechanisms to coordinate Inter-DAAC planning. This may result in the identification of local policies that can be implemented to reduce conflicts.

Even when the production plans between DAACs are coordinated, one DAAC's production problems will result in product delays that may impact another DAAC's plans. This study will investigate the best way to identify such conflicts. Communication pathways between DAACs will be investigated that might best fit automated and manual solutions for plan coordination.

#### **4.3.2 Alternatives and Options Analyzed**

The graphics and report capabilities of the Delphi Planning Object Library will be investigated and compared. The minimum subset of planning information required to identify and resolve conflicts will be analyzed so as to limit extraneous problem data. COTS products, shells and languages that can help to identify conflicts and suggest resolutions may be studied. Custom code solutions may be investigated. The cost/benefit effects of manual vs. automated mechanisms for schedule coordination will be analyzed.

#### **4.3.3 Analysis Summary**

This study will start post IDR-B.

### **4.4 Mode Management Study**

#### **4.4.1 Goal of Study**

The mode management study is focused on defining operational scenarios, level-4 requirements, and to provide a high-level system architecture which will enable the simultaneous execution of multiple software modes. In order to achieve these goals a cross-functional, cross-release mode management working group was assembled.

#### **4.4.2 Alternatives and Options Analyzed**

Mode Management, at a software level, must ensure data integrity between different modes of execution, enable process distinction and separation between modes, automatically provide the controls that will ensure all shared resources (COTS, network, hardware, etc.) handle multiple mode requests on a non-interfering basis, and enable process control and monitoring within each mode. Many different design and implementation methods were considered during the analysis process. The following lists some of the strategies considered and why they were not selected, followed by the basic design method chosen:

Methods Rejected:

1. Using DCE versioning for distinguishing modes - Distributed Computing Environment (DCE) version numbers are assigned at compilation time from within the Interface Definition Language (IDL) definition file. This solution does not provide a dynamic means by which to setup and initiate a new mode. While this may have served as an adequate solution for the Release A to Release B integration, since the Release B code could be compiled using a different version number prior to delivery, it does not allow a

test activity to be configured within the same release without having to first recompile the code.

2. Separate hardware partition, including network - This alternative is too costly, i.e., not feasible within the current budget.
3. Total procedural solution - This alternative relies on there being periods of no operational support during which another activity (testing/training) could then take place. Since some of the high-volume DAACs will be operational around the clock, this approach is not feasible.
4. Separate DCE Cell for each new mode - The setup and administration of a new DCE cell in support of an additional mode is too costly in both time and resources. A DCE cell requires a minimum of three dedicated hosts.
5. Dynamic process switching between modes - This capability is not possible within OODCE. In addition, if it were, maintaining internal process states would be a nightmare at best.

#### Methods Chosen:

1. DCE Cell Directory Service (CDS) process registration - An object framework incorporated into the ECS design will enable (require) each application to register its UUID and name into a specific DCE group within the namespace. The DCE group actually represents the "site", "mode", and "group". Where "site" represents the geographic location for Release A and the DCE cell for Release B; "mode" represents the software mode of execution in which the process was initiated, e.g., ops, ts1, ts2, tr1, etc., and "group" represents the functional association between applications, e.g., gateway, ingest, MSS, etc.. The "site" and "mode" are set dynamically as environment variables at application startup, and once the application has been initiated within a given mode, it remains in that mode for the life of the process.
2. Data partitioning will be handled at the application level - All data required to support a given mode must be clearly defined, segregated, and duplicated prior to the initiation of the new activity. It will be partitioned by using separate volumes or by a hierarchical directory structure within the same volume such that all reading/writing of data will be segregated between software modes. The application will know its site and mode via environment variables set at process initialization. All read/write operations will only have access to the data within the site and mode subtree.

#### 4.4.3 Analysis Summary

The original goals of the mode management study have been met. Operational Scenarios have been generated in the Operations Concept for the ECS Project: Part 2B - ECS Release B (604-CD-002-001) which address different activities that require mode management, e.g., release A to release B transition, testing a data server modification without interfering with operational activities, and operational component failure during the simultaneous execution of a test mode. In addition, a set of level-4 requirements have been generated and a high-level system architecture model has been developed.

Although the original goals of the study have been reached, many new areas of research and development have been identified. Some of these elements, due to their scope, involve other topics of issue as well. The new areas of development are as follows:

1. An object framework needs to be developed which will be incorporated into every ECS application as part of the system infrastructure design. This framework will provide a uniform method for enabling process monitoring and control, data integrity, and process separation and distinction between modes. A function this framework should also include is to provide a uniform method for event and error handling.
2. Release A's implementation of the mode management design will be required prior to Release A to Release B transition (at a minimum). This factor is driving the Release A participation in the Mode Management Working Group.
3. Shared resources need to be identified within each subsystem domain. Each design team responsible for the shared resources within their functional area will be responsible for providing a design solution which will enable multiple mode support.

Continued involvement of the mode management working group team is required to aid and support in the on-going development and design of these areas.

## **4.5 Other Studies Affecting IDR**

This section identifies other studies and "study-like" activities that form the basis for the Release B requirements and preliminary design.

### **4.5.1 GCDIS/UserDIS Study**

During its 1993 review of NASA's EOSDIS program, the National Research Council (NRC) recommended that EOSDIS be designed such that all users (EOS, non-EOS investigators, DAACs, other data centers) can build selectively on top of EOSDIS components without constraining local implementation of diverse functions or the autonomy of their organization or management. This would permit the EOSDIS program to collaborate in the development of a general multi-agency Global Change Data and Information System (GCDIS), and an expanded version open to general earth science data providers and users (UserDIS).

In response to these recommendations, NASA undertook a study of the potential role for ECS in GCDIS and UserDIS. The GCDIS/UserDIS Study White Paper (193-TP-626-001) presents a dimension of this driver category, in evaluating the needs of a larger community than ECS directly supports. The study explores the concept of an all-encompassing Earth Science information federation, based on complete subsystems like ECS, and linked into a larger "information superhighway." It also attempts to establish a larger context of which ECS is a part, in order that ECS might be able, through its development, to establish standards and components that could be adopted by the global change community at large.

The results of the GCDIS/UserDIS study were an important influence on the design of ECS, primarily because the flexibility and openness of the GCDIS/UserDIS solution closely matched

the perceived science drivers discussed above. The Release B design follows the concepts laid down during SDR in terms of distribution, interoperability and autonomy.

#### **4.5.2 Cross Subsystem Design Concepts**

The design of the ECS is based on a number of common software architecture principles. They ensure that (1) ECS applications will be able to interoperate, (2) ECS applications are easy to maintain, support and operate, and (3) software components can be reused across subsystems, thus reducing the implementation effort and risks. The Release B SDPS/CSMS Design Overview (305-CD-020-001), Section 6, describes the cross subsystem architectural concepts included in the Release B preliminary design.

# Abbreviations and Acronyms

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AFS	Andrews File System
CCB	Configuration Control Board (NASA Convention), Change Control Board (Hughes Convention)
CCR	commitment, concurrency, and recovery (protocol)
CCR	configuration change request
CDR	Critical Design Review
CDRL	contract data requirements list
CDS	cell directory service
CSMS	Communications and Systems Management Segment (ECS)
DAAC	Distributed Active Archive Center
DADS	data archive and distribution subsystem
DBMS	database management system
DCE	distributed computing environment (OSF)
DFS	Distributed File System
DIM	distributed information manager
ECS	EOSDIS Core System
EDHS	ECS Data Handling System
EOC	Earth Observation Center (Japan);
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
ESN	EOSDIS Science Network (ECS)
FDDI	fiber distributed data interface
FOS	Flight Operations Segment (ECS)
FSMS	file and storage management system
GCDIS	Global Change Data and Information System
HDF	hierarchical data format
IDL	interface definition language
IDR	Incremental Design Review
IST	Instrument Support Terminal (ECS)

LIM	local information manager
LSM	local system management
MR	Multi-Resident
NCSA	National Center for Supercomputing Applications
NFS	network file system
NRC	National Research Council
OODCE	object oriented distributed computing environment
OSF	Open Software Foundation
OTS	Off the shelf
PAMM	Permanent Archive and Media Management
PAMM	Physical Access Media Management
PDPS	planning and data processing system
PDR	Preliminary Design Review
PLS	planning subsystem
RFA	remote file access
RFC	request for comments
RFP	request for proposal
SCF	Science Computing Facility
SDPS	Science Data Processing Segment (ECS)
SDR	System Design Review
SDSRV	Science Data Server
SMC	system monitoring and coordination center
SNMP	Simple network management protocol
SSI&T	science software integration and test
TCP	Transmission Control Protocol
TL	team leader
TP	Technical Paper
UserDIS	User Data and Information System
UUID	universal unique identifier
WAN	wide area network
WP	white paper