220-CD-001-004

EOSDIS Core System Project

Communications Requirements for the ECS Project

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October 1995

Hughes Information Technology Corporation
Upper Marlboro, Maryland

Communications Requirements for the ECS Project

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SUBMITTED BY

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Preface

This document is a formal contract deliverable with an approval code 1. It requires Government review and approval prior to acceptance and use. This document is under ECS contractor configuration control. Once this document is approved, Contractor approved changes 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.

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Abstract

This document provides the ESDIS Project office, and the NASA Science Internet (NSI) organization with information to size, and specify the necessary Government Furnished Equipment (GFE) common carrier circuits for use in the EOSDIS Core System (ECS) Project. Current best estimates of the ECS-related, "raw" 24 hour-average logical data flows to be supported for the Tropical Rainfall Measuring Mission (TRMM), and the AM-1 mission including the Sea Winds Sensor (SWS) and the Dual Frequency Altimeter (DFA) instruments, and the Data Assimilation System (DAS) at Goddard by the (1) Earth Observing System (EOS) Data and Information System (EOSDIS) backbone network (EBnet) and (2) data outflows at the NSI/Internet interface at each Distributed Active Archive Center (DAAC) are provided.

The ECS-related data flow estimates have been extracted from information provided by the Ad Hoc Working Group on Production (AHWGP) scenarios (version 2.2) as expressed in the ECS Technical Baseline of August 1995. The impact of subsetting data is included in the estimates.

Keywords: DAAC to DAAC, Data flows, EBnet, Production, Reprocessing, Subsetting, AHWGP, NSI, Internet interfaces, ECS interfaces, Data distribution, SCF, IST, ADC

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Abbreviations and Acronyms

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1. Introduction

1.1 Identification

This is the Communications Requirements Document for the ECS project, CDRL item 040, whose requirements are specified in Data Item Description (DID) 220/SE3. DID 220 is a required deliverable under EOSDIS Core System (ECS) contract (NAS5-60000), attachment D, revision A.

1.2 Scope

This document provides estimates of the DAAC to DAAC, ECS data flows to be transported on the EBnet and the NSI/Internet Wide Area Networks (WAN) in support of the TRMM and AM-1 missions including the SWS and the DFA instruments[1]. Specifically, estimates of the (1) 24-hour average logical data flows, transported between ECS sites on the EBnet and (2) output data flows at the NSI/Internet interfaces at each DAAC are provided. The effect of subsetting production data (as described in the Technical Paper, "Reducing Inter-DAAC Data Transfers Through Subsetting", dated October 10, 1995) is included in the estimates. However, the effect of data compression is not included. This is because the potential reduction in data volume by application of compression techniques to the ECS data sets has not yet been fully analyzed or validated. A detailed listing of the "raw" 24 hour-average, inter-DAAC traffic flows (resulting from processing and reprocessing) for the years 1997 through 2000, is provided in appendix A. Current best estimates of the data flows for non-ECS platforms (e.g., V0) are also provided in this document.

The NASA Communications (Nascom) organization is responsible for the design, implementation and maintenance of the EBnet. Consequently, this document does not (1) specify the "burdened" traffic requirements or circuit size requirements for EBnet, (2) provide a topology for the EBnet WAN, since topology will depend on the choice of circuit offerings, and the specific plan for migrating from the current V0 topology to the ECS topology, (3) provide internet connectivity requirements for non-ECS locations, as these are defined and limited by the Earth Science Data and Information System (ESDIS)-NSI Inter-Project Agreement, and (4) provide information on the Local Area Network (LAN) requirements at the ECS-DAACs.

This document supersedes the previous edition of DID 220 (220-CD-001-003) dated February 1995.

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.

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[1] The EDOS to ECS-elements data flow estimates will be included in the next version of DID 220, after these estimates are approved by the ESDIS Configuration Control Board.

1.3 Purpose

The purpose of this document is to provide the ESDIS Project office, and the NSI organization with information on the data flow estimates to size, specify, provision and budget for, in a timely manner, the necessary Government Furnished Equipment (GFE) common carrier circuits for ECS use. This document provides current estimates and assumptions regarding the data flow volumes for the EBnet and NSI WANs.

1.4 Status and Schedule

This document will be revised at each Release IDR in response to any requirements or design changes. The Government Furnished Property (GFP) for the ECS Project will also be updated and re-issued accordingly.

1.5 Document Organization

This document contains four sections.

- Section 1 identifies the document and describes its scope, purpose and objectives.
- Section 2 identifies parent, applicable, and information documents.
- Section 3 provides an overview of the EBnet WAN. Estimates of the ECS related 24-hour average "raw" data flows due to (1) DAAC to DAAC processing and reprocessing flows in support of the TRMM mission, (2) DAAC to DAAC flows resulting from standard product generation, reprocessing and subsetting in support of the AM-1 mission including the Sea Winds Sensor (SWS) and the Dual Frequency Altimeter (DFA) instruments, (3) user query and query-responses, and (4) ADC operations is provided.
- Section 4 provides estimates of the data volumes distributed electronically from the DAACs to science users in the 1997-2000 time frame via the NSI/Internet provider. This includes estimates for the Instrument Support Terminals (IST) and the Science Computing Facility (SCF) Quality Control (QC) data flows.
- Appendix A provides a detailed listing of the "raw" 24 hour-average, inter-DAAC traffic flows (resulting from processing and reprocessing) for the years 1997 through 2000 in support of the TRMM and AM-1 missions. This includes data flows from the SWS and the DFA instruments.

2. Related Documentation

2.1 Parent Documents

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

301-CD-002-003	System Implementation Plan for the ECS Project
423-10-01-0	Goddard Space Flight Center, Earth Science Data and Information System (ESDIS) Project -- Level 2 Requirements, Volume 0
423-10-01-1	Goddard Space Flight Center, Earth Science Data and Information System (ESDIS) Project -- Level 2 Requirements, Volume 1
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)
210-TP-001-004	Technical Baseline for the ECS Project

2.2 Applicable 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, this document shall take precedence.

194-219-SE1-001	Interface Requirements Document Between EOSDIS Core System (ECS) and the NASA Science Internet (NSI)
505-41-18	Goddard Space Flight Center Interface Requirements Document Between EOSDIS Core System (ECS) and MITI ASTER GDS Project
505-41-14	Goddard Space Flight Center Interface Requirements Document Between EOSDIS Core System (ECS) and Tropical Rainfall Measuring Mission (TRMM) Ground System
none	Goddard Space Flight Center, Earth Science Data and Information System (ESDIS) - NASA Science Internet (NSI) Inter-Project Agreement, April 14, 1994

2.3 Information Documents

The following documents, although not be directly applicable, amplify or clarify the information presented in this document. These documents are non-binding in nature.

828-RD-001-002	Government Furnished Property for the ECS Project
194-TP-313-001	ECS User Characterization Methodology and Results [for the ECS Project]
160-TP-005-001	Reducing Inter-DAAC Data Transfers Through Subsetting, Technical Paper

3. EBnet Wide Area Network Flows

3.1 EBnet Overview

The EBnet is a Wide Area Network (WAN) that provides, in combination with other institutional and public networks, connectivity between geographically distributed EOSDIS facilities to support ECS mission operations and data production functions. Specifically, EBnet will provide connectivity between the ECS DAACs, the Earth Observing System (EOS) Data and Operations System (EDOS) facilities, selected ADCs, and other designated EOSDIS sites. The EBnet WAN serves as the interface between EDOS, and the DAACs. The EBnet WAN will be designed, implemented and maintained by the Nascom organization.

3.2 ECS Data Flows for TRMM and AM-1 Mission[2]

The ECS data flows to be transported on the EBnet in support of the TRMM and AM-1 mission can be summarized under the following categories:

- DAAC to DAAC Data flows
- Version 0 Data Flows
- ADC Data Flows

Estimates of the individual data flows for each of the above categories are listed in the following sections. The following notes apply:

- Data flows from the TRMM and AM-1 mission (including the SWS and DFA instruments only) are provided.
- Data flows from instruments from the PM-1 mission are not included.
- Data flows from the Goddard Data Assimilation System (DAS) are included.
- Data flow estimates are based on the Interface Requirements Document between ECS and TRMM (February 1995 version containing the revised TRMM product volume estimates as approved by the ESDIS CCB in August 1995) and version 2.2 of AHWGP information as expressed in the ECS Technical baseline of August 1995.
- For TSDIS products, reprocessing proceeds at twice the processing rate, starting in the same year as TRMM launch. For AM-1 standard products reprocessing proceeds at one times the processing rate starting one year after launch and at two times the processing rate starting two years after launch.
- Data products are subsetted (where appropriate) prior to transfer on the WAN.

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[2] Data flows from SWS and DFA instruments are also included in the estimates as these instruments are launched between the AM-1 and the PM-1 launch time frame.

- Data flows are shown only if there is a data transfer dependency (for processing, reprocessing, or archiving) between the DAACs.
- Data flow estimates represent "raw", 24 hour-average logical flows. Factors for scheduling contingency, circuit utilization, or Protocol overhead have not been applied to the estimates.
- Unless otherwise noted, the data flow estimates are expressed in MB/day and are rounded off to the nearest integer.

3.2.1 DAAC to DAAC Data Flows

The following categories of DAAC to DAAC flows have to be to be transported on the EBnet:

- Production Data Flows for TRMM Platform
- Reprocessing Data Flows for TRMM Platform
- Production Data Flows for AM-1 Platform
- Reprocessing Data Flows for AM-1 Platform
- Production and Reprocessing Data Flows for SWS instrument
- Production and Reprocessing Data Flows for DFA instrument
- Production and Reprocessing Data Flows for the DAS
- DAAC to DAAC User Query Flows
- DAAC to DAAC User Query-Response Flows

The DAAC-DAAC production and reprocessing flows represent data transfers for moving input data from the archive DAAC to the processing DAAC and for moving output products from the processing DAAC to the archive DAAC (in the case that the archive and processing DAACs are not the same). The DAAC-DAAC production and reprocessing data flow estimates are based on the assumption that data subsetting (and/or masking of fill values) is performed, where appropriate, prior to data transfer on the EBnet WAN. For many of the large volume flows, only those subsets of the data that are required at the target DAAC (for processing or reprocessing) are transferred instead of the entire granule[3]. The following sections give estimates of the data flows for each of the categories identified above.

3.2.1.1 DAAC-DAAC Production Data Flows for TRMM Platform

Per the ECS-TRMM IRD requirement TRMM-3120, EBnet is required to carry the PR, TMI, GV and Combined Instruments products data from the TRMM Science Data and Information System (TSDIS) facility (at GSFC) to the MSFC DAAC for archiving, and for distribution to the users. The return data flows resulting from transfer of ancillary data products needed for TSDIS

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3 The potential impacts of subsetting data products on processing capacity requirements and reallocation of working storage requirements have not been fully analyzed yet. These are planned to be completed by the ECS Release B CDR time frame.

processing (from MSFC to GSFC) and for Clouds and Earth's Radiant Energy System **(**CERES) processing (from MSFC to LaRC) are also to be carried on EBnet[4]. Data flows estimates for the TRMM platform are listed in Tables 3.2.1.1-1 to 3.2.1.1-4. These estimates are based on the information available in the ECS-TRMM IRD.

Table 3.2.1.1-1. Production Data Flows for TRMM Platform only (MB/day) 1997

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC							
GSFC						13,330	
JPL							
LaRC							
MSFC			227		1,378		
NSIDC							

Table 3.2.1.1-2. Production Data Flows for TRMM Platform only (MB/day) 1998

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC							
GSFC						13,330	
JPL							
LaRC							
MSFC			227		1,378		
NSIDC							

Table 3.2.1.1-3. Production Data Flows for TRMM Platform (MB/day) 1999

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC							
GSFC						13,330	
JPL							
LaRC							
MSFC			227		1,378		
NSIDC							

[4] The CERES Level 0 data (transferred from GSFC to LaRC via NOLAN) and the LIS Level 0 data (transferred from GSFC to MSFC via NOLAN) are not included in the estimates.

Table 3.2.1.1-4. Production Data Flows for TRMM Platform (MB/day) 2000

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC							
GSFC						13,330	
JPL							
LaRC							
MSFC			227		1,378		
NSIDC							

3.2.1.2 DAAC-DAAC Reprocessing Data Flows for TRMM Platform

TSDIS reprocessing occurs at twice the processing rate, starting in the same year as TRMM launch (3rd quarter 1997). Reprocessing requires existing TSDIS archival products to be transferred from MSFC to GSFC. Ancillary data required to support this reprocessing is also required to be transferred from MSFC to GSFC. Additionally, data products required for CERES reprocessing are transferred from the MSFC to LaRC DAAC. The DAAC-DAAC reprocessing flows, to be transported on the EBnet, in support of TRMM are listed below.

Table 3.2.1.2-1. Reprocessing Data Flows for TRMM Platform (MB/day) 1997

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC							
GSFC						26,660	
JPL							
LaRC							
MSFC			27,110				
NSIDC							

Table 3.2.1.2-2. Reprocessing Data Flows for TRMM Platform (MB/day) 1998

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC							
GSFC						26,660	
JPL							
LaRC							
MSFC			27,110		1,378		
NSIDC							

Table 3.2.1.2-3. Reprocessing Data Flows for TRMM Platform (MB/day) 1999

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC							
GSFC						26,660	
JPL							
LaRC							
MSFC			27,110		2,756		
NSIDC							

3.2.1.2-4. Reprocessing Data Flows for TRMM Platform (MB/day) 2000

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC							
GSFC						26,660	
JPL							
LaRC							
MSFC			27,110		2,756		
NSIDC							

3.2.1.3 DAAC-DAAC Production Data Flows for AM-1 Platform[5]

The subsetted DAAC-DAAC production data flow estimates for the AM-1 platform are derived from version 2.2 of AHWGP information as expressed in the ECS Technical baseline of August 1995. The AHWGP information contains processing scenarios provided by the instrument teams for the TRMM CERES, TRMM LIS, the EOS AM-1 ASTER, CERES, MISR, MODIS, and MOPITT instruments on the AM-1 platform, the DAS, the SeaWinds Sensor on ADEOS II, and the DFA instrument on the Radar ALT platform. Table 3.2.1.3-1 through 3.2.1.3-4 provide these estimates.

[5] Production data flows for the SWS and DFA instruments are included in these estimates. These instruments commence operations in early 1999.

Table 3.2.1.3-1. Production Data Flows for AM-1 Platform, SWS and DFA Instruments, and DAS (MB/day) 1997

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC					64		
GSFC					1,429		
JPL							
LaRC							
MSFC							
NSIDC							

Table 3.2.1.3-2. Production Data Flows for AM-1 Platform, SWS and DFA Instruments, and DAS (MB/day) 1998

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC			7,535		64		
GSFC		35,670			87,440		2,942
JPL							
LaRC		1,500					
MSFC							
NSIDC		365					

Table 3.2.1.3-3. Production Data Flows for AM-1 Platform, SWS and DFA Instruments, and DAS (MB/day) 1999

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC			7,535		64		
GSFC		35,670		22	95,030		2,942
JPL			47				3
LaRC		1,500	11,520				
MSFC							
NSIDC		365					

Table 3.2.1.3-4. Production Data Flows for AM-1 Platform, SWS and DFA Instruments, and DAS (MB/day) 2000

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC			7,535		64		
GSFC		35,680		22	99,250		2,942
JPL			47				3
LaRC		1,500	11,520				
MSFC							
NSIDC		365					

3.2.1.4 DAAC-DAAC Reprocessing Data Flows for AM-1 Platform, SWS, and DFA Instruments and the DAS

The current technical baseline for standard products assumes that reprocessing proceeds at one times the processing rate starting one year after the launch date (3rd quarter 1998) and at two times the processing rate starting two years after launch. It should be noted that the reprocessing data flows (from JPL to GSFC, GSFC to JPL, and JPL to NSIDC) for the SWS and DFA instruments, start in the year 2000, because these instruments commence operations in early 1999. Similarly, reprocessing flows (from LaRC to GSFC and JPL to GSFC) in support of the DAS_Final_Analysis process start in year 2000. The reprocessing flows for the relevant years, assuming that all DAAC to DAAC data transfers to support reprocessing are transported on the EBnet, are listed below.

Table 3.2.1.4-1. Reprocessing Data Flows for AM-1 Platform, SWS and DFA Instruments, and DAS (MB/day) 1998

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC					36		
GSFC					1,395		
JPL							
LaRC							
MSFC							
NSIDC							

Table 3.2.1.4-2. Reprocessing Data Flows for AM-1 Platform, SWS and DFA Instruments, and DAS (MB/day) 1999

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC			7,535		100		
GSFC		35,670			96,430		2,942
JPL							
LaRC		1,500					
MSFC							
NSIDC		365					

Table 3.2.1.4-3. Reprocessing Data Flows for AM-1 Platform, SWS and DFA Instruments, and DAS (MB/day) 2000

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF							
EDC			15,070		129		
GSFC		71,340		22	198,500		5,885
JPL			47				3
LaRC		3,001	11,520				
MSFC							
NSIDC		730					

3.2.1.5 DAAC-DAAC User Query and Query-Response Flows

In addition to the production data transported between the DAACs, EBnet also has to carry the following flows:

- DAAC-DAAC User Query flows
- DAAC-DAAC User Query-Response flows

DAAC-DAAC queries and query response flows result from queries that are spawned to different DAACs, to satisfy the initial user-query received at a DAAC. Based on the user's discipline of interest, his/her connection point to EOSDIS and his/her initial query, metadata or data sets located at other DAAC(s) may have to be accessed to satisfy the initial user query. Such accesses to other DAACs create the inter-DAAC flows on the EBnet. The following sections gives estimates of these data flows[6]. Details of how the estimates were developed are provided in the User Characterization Information Catalog, August 1995. The DAAC-DAAC query/response traffic has currently only been analyzed for year 1998 and 1999. The values for 1999 were used for year 2000 as the minimum expected flows. Data flows smaller than 0.5 MB/day are represented by "Trace" in these tables.

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[6] Data flows generated (to service a user query) between the Distributed Information Manager and the Local Information manager co-located at the same site are not shown, as they do not constitute DAAC-DAAC traffic.

3.2.1.5.1 DAAC-DAAC User Query Flows

The number of DAAC-DAAC queries spawned between DAACs depends largely on where the initial user-query is received, on the location of data sets and metadata within ECS, on the inter-connection of the DAACs, and on mechanisms for locating a particular data set. Tables 3.2.1.5.1-1 to 3.2.1.5.1-3 provide estimates of the DAAC-DAAC flows due to user queries for years 1998 through 2000.

Table 3.2.1.5.1-1. DAAC-DAAC User Query Flows (MB/day) 1998

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF		Trace	Trace	Trace	Trace	Trace	Trace
EDC	Trace		Trace	Trace	Trace	Trace	Trace
GSFC	Trace	Trace		Trace	Trace	Trace	Trace
JPL	Trace	Trace	1		Trace	Trace	Trace
LaRC	Trace	Trace	Trace	Trace		Trace	Trace
MSFC	Trace	Trace	Trace	Trace	Trace		Trace
NSIDC	Trace	Trace	Trace	Trace	Trace	Trace	

Table 3.2.1.5.1-2. DAAC-DAAC User Query Flows (MB/day) 1999

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF		Trace	Trace	Trace	Trace	Trace	Trace
EDC	Trace		Trace	Trace	Trace	Trace	Trace
GSFC	Trace	Trace		Trace	1	Trace	Trace
JPL	Trace	Trace	1		Trace	Trace	Trace
LaRC	Trace	Trace	Trace	Trace		Trace	Trace
MSFC	Trace	Trace	Trace	Trace	Trace		Trace
NSIDC	Trace	Trace	Trace	Trace	Trace	Trace	

Table 3.2.1.5.1-3. DAAC-DAAC User Query Flows (MB/day) 2000

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF		Trace	Trace	Trace	Trace	Trace	Trace
EDC	Trace		Trace	Trace	Trace	Trace	Trace
GSFC	Trace	Trace		Trace	1	Trace	Trace
JPL	Trace	Trace	1		Trace	Trace	Trace
LaRC	Trace	Trace	Trace	Trace		Trace	Trace
MSFC	Trace	Trace	Trace	Trace	Trace		Trace
NSIDC	Trace	Trace	Trace	Trace	Trace	Trace	

3.2.1.5.2 DAAC-DAAC User Query Response Flows

The volume of data transferred between the DAACs in response to user queries depends largely on where the initial user-query is received, on the location of the data sets and metadata within ECS, and on the inter-connection of the DAACs. Estimates of DAAC-DAAC query response data flows are listed in Tables 3.2.1.5.2-1 to 3.2.1.5.2-3.

Table 3.2.1.5.2-1. DAAC-DAAC Query Response Flows (MB/day) 1998

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF		3	4	4	4	3	1
EDC	1		4	3	4	7	1
GSFC	2	4		75	18	4	2
JPL	Trace	Trace	2		2	Trace	Trace
LaRC	1	3	31	7		3	1
MSFC	1	1	8	4	8		1
NSIDC	1	Trace	2	1	2	Trace	

Table 3.2.1.5.2-2. DAAC-DAAC Query Response Flows (MB/day) 1999

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF		5	5	5	5	5	1
EDC	2		6	5	6	10	2
GSFC	3	6		112	27	6	4
JPL	Trace	1	2		2	1	Trace
LaRC	1	4	46	10		4	2
MSFC	1	2	12	7	12		1
NSIDC	1	1	3	1	3	1	

Table 3.2.1.5.2-3. DAAC-DAAC Query Response Flows (MB/day) 2000

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC
ASF		5	5	5	5	5	1
EDC	2		6	5	6	10	2
GSFC	3	6		112	27	6	4
JPL	Trace	1	2		2	1	Trace
LaRC	1	4	46	10		4	2
MSFC	1	2	12	7	12		1
NSIDC	1	1	3	1	3	1	

3.2.2 Version 0 Data Flow Estimates

The Version 0 (V0) WAN currently links seven DAAC sites (ASF, EDC, GSFC, JPL, LaRC, MSFC and NSIDC), the ADC at NOAA (Suitland, MD), the Hughes facility at Landover MD, and National Space and Development Agency (NASDA) facilities at Hatoyama, Japan, in support of the pre-EOS missions including ADEOS. Table 3.2.2-1 shows the daily average node-to-node data flows on the V0 network. These data flows are based on traffic measurements conducted from 11/20/94 to 12/1/94. Data flows smaller than 0.5 MB/day are represented by "Trace" in this table.

Table 3.2.2-1. V0 Network Data Flows (MB/day)

FROM/TO	ASF	EDC	GSFC	LaRC	MSFC	NSIDC	NOAA
EDC						Trace	
GSFC		6		Trace	1	Trace	1
LaRC			Trace			Trace	
JPL			1				
MSFC			8				15
NSIDC		Trace	Trace				
Hughes EDF				2	10		
NOAA (Suitland)				31	361		

Note: V0 data flows are assumed to exist only until December 1998, after which V0 migrates to V1 system

3.2.3 ADC Data Flow Estimate

Several ancillary data sets, resident at the ADC site (NOAA facility at Suitland, MD), are expected to be transported to GSFC using the EBnet. A total data product volume of 67.2MB/day is estimated to be transferred from NOAA (Suitland, MD) to GSFC for ECS Release A and B.

3.3 ECS Consolidated Data Flow Requirement

The consolidated data flows between ECS nodes for years 1997 through 2000 in support of the TRMM and AM-1 mission, the SWS and DFA instruments, and the DAS is presented in Tables 3.3-1 through 3.3-6. These data flow estimates were developed by appropriately summing the following flows:

- Production Data Flows for TRMM Platform
- Reprocessing Data Flows for TRMM Platform
- Production Data Flows for AM-1 Platform
- Reprocessing Data Flows for AM-1 Platform
- Production and Reprocessing Data Flows for SWS instrument
- Production and Reprocessing Data Flows for DFA instrument

- Production and Reprocessing Data Flows for DAS
- DAAC to DAAC User Query Flows
- DAAC to DAAC User Query-Response Flows

The following notes apply to these consolidated data flows.

1. As the V0 WAN will migrate to the V1 system, the V0 data flows are assumed to exist only until December 1998
2. Reprocessing data flows for the SWS and DFA instruments, start in year 2000, because these instruments commence operations in early 1999.
3. The ADC flow of 67.2MB/day (from NOAA facility at Suitland, MD to GSFC) exists in years 1997 through 2000.
4. Data flows listed in tables 3.3-1 to 3.3-6 are the "raw" 24 hour-average flows. No overhead factors have been applied to them.
5. The flows have been rounded off to the nearest integer. Data flows of less than 0.5MB/day are represented as "Trace".

Table 3.3-1. ECS Consolidated Data Flows 1997 (MB/day)

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC	NOAA
ASF								
EDC					64		Trace	
GSFC		6			1,429	39,991	Trace	1
JPL			1					
LaRC			Trace				Trace	15
MSFC			27,345		1,378			
NSIDC		Trace	Trace					
NOAA			67		31	361		

Note: Version 0 flows are assumed to exist only until December 1998

Table 3.3-2. ECS Consolidated Data Flows 1998 (MB/day)

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC	NOAA
ASF		3	4	4	4	3	1	
EDC	1		7,539	3	104	7	2	
GSFC	2	35,680		75	88,854	39,995	2,945	1
JPL	Trace	Trace	3		2	1	Trace	
LaRC	1	1,503	31	7		3	1	15
MSFC	1	1	27,353	4	2,764		1	
NSIDC	1	366	2	1	2	Trace		
NOAA			67		31	361	T	

Note: Version 0 flows are assumed to exist only until December 1998

Table 3.3-3. ECS Consolidated Data Flows 1999 (MB/day)

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC	NOAA
ASF		5	5	5	5	5	1	
EDC	2		15,076	5	170	10	2	
GSFC	3	71,347		134	191,488	39,997	5,888	
JPL	Trace	1	51		3	1	3	
LaRC	2	3,004	11,566	10		4.2	2	
MSFC	1	2	27,349	7	4146		1	
NSIDC	1	731	3	1	3	1		
NOAA			67					

Table 3.3-4. ECS Consolidated Data Flows 2000 (MB/day)

FROM/TO	ASF	EDC	GSFC	JPL	LaRC	MSFC	NSIDC	NOAA
ASF		5	5	5	5		1	
EDC	2		22,611	5	199	10	2	
GSFC	3	35,687		156	297,778	39,997	8,831	
JPL	Trace	1	98		3	1	6	
LaRC	2	4505	23,086	10		4	2	
MSFC	1	2	27,349	7	4,146		1	
NSIDC	1	1,096	3	1	3	1		
NOAA			67					

3.4 EBnet Connectivity

The EBnet will provide connectivity between EDOS, the DAACs, and selected ADCs. Most of the sites are presently connected via the V0 network, and will remain connected to support the V0 to V1 transition. Table 3.4-1 lists sites which must be connected via EBnet, by each ECS Release.

Table 3.4-1. EBnet Connectivity to DAACs

ECS Release	Site	Location (City/State)
IR-1, A	GSFC DAAC	Greenbelt, MD
IR-1, A	LaRC DAAC	Hampton, VA
IR-1, A	MSFC DAAC	Huntsville, AL
IR-1, A	EDC DAAC	Sioux Falls, SD
IR-1, A	NOAA (Suitland)	Suitland, MD
B	ASF DAAC	Fairbanks, AK
B	JPL DAAC	Pasadena, CA
B	NSIDC DAAC	Boulder, CO
B	ORNL DAAC	Oak Ridge, TN

3.5 EBnet Connectivity Schedule

In order that ECS can conduct connectivity and performance tests in a timely manner, it is assumed that the EBnet WAN circuits will be ordered significantly ahead of their need date. A seven (7) month lead time (prior to the ECS Release-specific Consent To Ship Review (CSR) date) is assumed to be sufficient to allow for common carrier provisioning/coordination activities. Table 3.5-1 lists the currently scheduled ECS release-specific CSR dates and the need date by which the circuits should be ordered/upgraded for ECS Release A and B. The corresponding dates by which the links must be available, to allow ECS to do the connectivity/performance testing, is also provided. For ECS Release IR-1, it is assumed that existing EBnet circuits will be adequate, and will be used for conducting the connectivity testing which is scheduled for the December 1995 to January 1996 time frame.

Table 3.5-1. ECS Connectivity Need Dates

ECS Release	ECS CSR date	Logical Connectivity From - To	Assumed WAN Circuit Order/upgrade Deadline	WAN Circuit(s) Needed No Later Than
A	1st. week Sept.1996	All Source - All Destination DAACs	1st. week Feb.1996	1st. week July 1996
B	1st. week June 1997	All Source - All Destination DAACs	1st. week Nov. 1996	1st. week April 1997

NOTES:
1. Only high level recommendations regarding the lead time for circuit ordering have been provided since individual circuit requirements will depend on the existing infrastructure and on the EBnet plan for migrating from the current V0 topology to the EBnet topology.
2. It is the responsibility of Nascom to order the circuits and coordinate their provisioning to ensure that the circuits are available to ECS in a timely manner.

4. NSI Data Flow Estimates at ECS Interfaces

4.1 NSI Overview

The NASA Science Internet (NSI) is an open, international computer network that serves the NASA science and research community. NSI will provide effective network communications between and among EOS researchers, EOS facilities, and the general science community. The NSI connects almost 200 sites worldwide. It interconnects to research, educational, and commercial networks via two Federal Internet Exchanges (FIXes). NSI provides Internet access to the GSFC, EDC, JPL, LaRC, NSIDC, ASF, and the MSFC DAACs. The Internet Protocol (IP) and the associated upper layer protocols are used by NSI to interoperate with ECS.

The NSI is managed by a Network Operations Center (NOC) from the Ames Research Center. The NOC monitors the network 24 hours/day, 7 days/week. The NOC also coordinates with other network provider NOCs to identify any circuit problems and resolve them in a timely manner. Information is transmitted between ECS and NSI to enable network communications and network management. Data to cooperatively provide services such as fault management, security management, and performance management will be shared between NSI and ECS.

4.2 Data Flow to Users at ECS Interfaces

Outflows to users via the ECS-NSI/Internet at each DAAC consists of three data types:

- Archived Products
- IST Data
- QC Data

The current ESDIS policy and ECS technical baseline of August, 1995 is to distribute a data volume equal to 2 times production to the users from each DAAC: 1X via media and 1X over the NSI. The following paragraphs provide estimates of the volume of data to be distributed electronically for each of three categories listed above.

4.2.1 Archived Products Data Flow Estimates

To estimate the volume of data to be distributed electronically the data sets were categorized as follows:

- Version 0 migrated data
- Landsat 7 data
- TRMM, SWS and AM-1 data

The volume of V0 migrated data to be distributed via the network was based upon current DAAC experience and projected changes in the future. Recent trends regarding the data volume distributed from each DAAC as a function of the sizes of the archive and their science user

community was analyzed in cooperation with the DAAC personnel. Projections were then made as to how the archive size will increase with the addition of new data between now and 1997 and how the user community might expand accordingly. Assuming the current ratio of distributed volume to archive volume and its relationship to the size of the science user community, the volume to be distributed from each DAAC was estimated for the 1997-2000 time frame.

The volume of Landsat 7 data to be distributed was assumed to be the amount specified in the Landsat data system specification, namely 50 GB/day, for 365 days/year. The volume of TRMM, SWS and AM-1 data to be distributed via networks was assumed to be two times the production plans, half of which would be distributed via networks. The production numbers for TRMM were obtained from the TRMM project, the SWS from the project at JPL, and the AM-1 production estimates for each DAAC as a function of time came from the results of the AHWGP information.

The data volume distributed via networks per year from each of the DAACs, as obtained from the ECS Technical baseline of August 1995, for the April 1997, April 1998, April 1999 and January 2000 epochs, is listed in Table 4.2-1 below.

Table 4.2-1. Data Flows to Users (GB/year)

From	April-97	April-98	April-99	January-2000
ASF	0	594	13,553	13,553
EDC	0	5,564	91,744	119,817
GSFC	2,965	3,416	107,568	140,812
JPL	0	3,693	3,446	3,627
LaRC	903	2,404	30,727	75,574
MSFC	409	5,544	7,186	6,827

Notes:
1. Data volume distributed equals 1X production for the period indicated. Science users were phased in at the rate of 50% in 1997, 75% in 1998 and 100% in 1999
2. The volume of V0 migrated data distributed to users is extrapolated from current estimates of the ratio of distributed volume and archive volume at each DAAC
3. Landsat-7 data distribution of 50GB/day is included
4. The AM-1 and TRMM production volumes are based on input from the AHWGP

4.2.2 IST Data Flow Estimates

The IST toolkit enables PIs and TLs who are not physically located at the EOC to participate in the planning, scheduling, commanding and monitoring of their instruments. The current understanding is that data is transferred between the ISTs and the EOC LAN via the NSI and campus networks. Consequently, no IST to EOC flows are included in the EBnet flows. The data flows exist between the EOC (at Goddard) and sites with ISTs at GSFC, JPL, LaRC, NCAR, Canada, Valley Forge, and Japan. The total data flow between the EOC and these sites for the AM-1 timeframe is shown in Table 4.2.2-1. The EOC to IST data flows represent the driving data flows because this data flow is larger than the ISTs to EOC flow.

Table 4.2.2-1. EOC to IST Data Flows for AM-1 Timeframe (MB/day)

From	To	Number of ISTs	Transport Network	Data Flow: EOC To ISTs	Data Flow: ISTs to EOC
EOC	GSFC	3	NSI	4,417	378
EOC	JPL	3	NSI	4,417	378
EOC	LaRC	6	NSI	7,032	756
EOC	NCAR	1	NSI	1,933	119
EOC	Canada	1	NSI	1,933	119
EOC	Valley Forge	1	NSI	1,933	119
EOC	Japan	1	NSI	1,933	119
TOTAL				**23,598**	**1,988**

Note:
1. The data flows shown are "raw " flows with no overhead factors applied
2. The transport network for the EOC to Japan IST data flow is currently under discussion.
3. The EOC to IST data flow estimation details are documented in Section 5.2.2, "IST Connectivity Trade," of the FOS Design Specfication (305-CD-040-001) dated October 1995

4.2.3 SCF QC Data Flow Estimates

The SCFs are used by EOS investigators, team leaders and/or team members to perform functions such as interdisciplinary science, algorithm integration and test, and quality control (QC) of the data products. The current understanding is that the QC function is not "in-line" with production for any SCF associated with TRMM and AM-1 production and that no SCFs require direct connectivity to EBnet. SCFs will use existing campus and NSI/Internet facilities to connect to the DAAC sites. The SCF QC related data flows at the ECS interface to the NSI/Internet from each DAAC, for the years 1997, 1998, 1999, and 2000 epochs are shown in Table 4.2.3-1. These are provided solely as an extra level of detail. These flows are assumed to be contained within the 1X baseline and distribution of this data volume will not cause the total data distributed from any DAAC to exceed the 1X distribution baseline.

Table 4.2.3-1. SCF QC data flows at ECS interface to NSI/Internet

Instrument	Source DAAC	Destination SCF	1997 (MB/day)	1998 (MB/day)	1999 (MB/day)	2000 MB/day)
ASTER	EDC	TBD SCF(s)		1,825	1,228	632
CERES	LaRC	LaRC SCF	24,800	92,692	18,631	2,282
	LaRC	Blackmon	41	41		
	LaRC	Cess	210	210		
	LaRC	Coakley	2,077	17,583	16,890	
	LaRC	Kandel	18	18		
	LaRC	King	324	2,592		
	LaRC	Menzel	2,077	18,967		
	LaRC	Miller	17	17		
	LaRC	Ram	210	210		
	LaRC	Randall	2,676	2,676		
	LaRC	Welch	8,309	68,253	18,967	
LIS	MSFC	MSFC SCF	2,571	2,571	2,571	2,571
MISR	LaRC	JPL SCF		18,467	18,467	17,159
	LaRC	Muller		304	304	304
	LaRC	Davies		377	377	377
	LaRC	Ackerman		29	29	29
	LaRC	Gerstl		304	304	304
	LaRC	Sellers		27	27	27
	LaRC	Gordon		27	27	27
MODIS	EDC	GSFC SCF(s)		46,004	46,004	46,004
	EDC	CRSA (Boston)		23,965	23,965	23,965
	EDC	UCSB		609	609	609
	GSFC	UCSB		12,636	12,636	12,636
	GSFC	GSFC SCF		391,425	391,425	391,425
	GSFC	U of Miami		61,437	61,437	61,437
	GSFC	U of Wisconsin		23,000	23,000	23,000
	NSIDC	GSFC SCF		2,775	2,775	2,775
	GSFC	OSU		1,664	1,664	1,664
	LaRC	OSU		18	18	18
	JPL	OSU		47	47	47
MOPITT	LaRC	NCAR		456	456	456
	LaRC	U of Toronto		176	176	176
	EDC	NCAR		34	34	34
	GSFC	NCAR		236	236	236

Notes:

1. This data is based on GSFC/SPSO "DAAC-to-SCF Data Transfer for QA" spreadsheet 9/7/95.

2. These flows are assumed to be contained within the 1X baseline. Distribution of this data volume is assumed not to cause the total data distributed from any DAAC to exceed the 1X distribution baseline.

Appendix A. Detailed DAAC to DAAC Data Transfer Estimates

This appendix lists the DAAC to DAAC file transfers required to support processing, reprocessing, and movement of data from the processing DAAC to the archive DAAC, in cases where these are different. In the table, the flows are sorted (vertically) by the origin/destination DAACs. Within each DAAC to DAAC flow, each data set to be transferred is indicated, along with the process(es) requiring the transfer.

The columns in the table are defined as follows:

File ID - Name of the file to be transferred, using the AHWGP nomenclature. Ancillary data File IDs begin with "ANC_". Instrument data File IDs beginning with a short form of the instrument name (usually, the first three letters in the instrument acronym).

Process ID - Name of the process requiring the identified file as input, or the name of the process which creates the file (in the case of files which are created at a DAAC which is not the archive DAAC). Process IDs follow the AHWGP nomenclature. Most Process IDs begin with a short form of the instrument acronym. CERES processes begin with a number (*e.g.*, 4aV is a CERES process). All processes executed on the TSDIS data system are all labeled "TSDIS".

Processing Epochs - A lower case letter is used to indicate each quarter in which the identified process is active. The epochs begin with "a" in the first quarter of 1997. (See column headings on right half of each page for association of calendar quarters with their letter designations.)

Daily Volume (GB) - Rate of data production (in gigabytes per day) of data which are produced on a regular basis. For static or irregularly updated data (calibration tables, for instance), this column indicates the total size (in gigabytes) of the file.

Transfer Volume (GB/day) - Raw volume of data to be transferred (in gigabytes per day). In some cases, this is equal to the daily volume of data produced. However, the volume to be transferred may differ from the daily volume entry for one or more of the following reasons:

1. The file is already indicated as being transferred to support another process (*i.e.*, duplicate flows have been eliminated);
2. Although the file is archived at the "from" DAAC, it is produced at the "to" DAAC (the same DAAC where the process needing the file as input is executing). In this case, it is assumed that a local copy of the file is maintained until all processes needed the file have run to completion;
3. Only a subset of the data is transferred. The subset volume to be transferred is calculated based on the needs of the process, as described in the ECS technical paper "Reducing Inter-DAAC Data Transfers Through Subsetting" (160-TP-005-001) and
4. The file is static or updated at irregular intervals. In this case, we have assumed that the file is transferred once per week.

Repro Factor 1 - Multiplier characterizing the first period of reprocessing. For instance, EOS Standard Products are assumed to be reprocessed at a rate equal to the processing rate (Repro Factor 1 = 1) starting one year after launch; TSDIS products are reprocessed at twice the processing rate starting at launch (Repro Factor 1 = 2).

Repro Epochs 1 - Letter designations for the calendar quarters in which Repro Factor 1 applies.

Repro Factor 2 - Multiplier characterizing the second period of reprocessing. For instance, EOS Standard Products are assumed to be reprocessed at a rate equal to twice the processing rate (Repro Factor 2 = 2) starting two years after launch.

Repro Epochs 2 - Letter designations for the calendar quarters in which Repro Factor 2 applies.

Remaining Columns - These columns give the calculated raw data transfer rates (in gigabytes per day) for the quarters indicated in the column heading.

Abbreviations and Acronyms

ACRIMSAT	Active Cavity Radiometer Irradiance Monitor Satellite
ADC	Affiliated Data Center
AHWGP	Ad Hoc Working Group For Production
AI&T	Algorithm Integration & Test
ASF	Alaska Synthetic Aperture Radar Facility
ATM	Asynchronous Transfer Mode
bps	Bits per second
CCR	Configuration Change Request
CDRL	Contract Data Requirements List
CERES	Clouds and Earth's Radiant Energy System
CSMS	Communications and Systems Management Segment
DAAC	Distributed Active Archive Center
DCN	Document Change Notice
ECS	EOSDIS Core System
EDC	EROS Data Center (DAAC)
EOC	EOS Operations Center (ECS)
EOSDIS	Earth Observing System Data and Information System
ESDIS	Earth Science Data and Information System (GSFC)
ESN	EOSDIS Science Network
FIX	Federal Internet Exchange
FOS	Flight Operations Segment (ECS)
GB	gigabyte (10^9)
GFE	Government Furnished Equipment
GFP	Government Furnished Property
GSFC	Goddard Space Flight Center
GV	TRMM Ground Validation Data
HIRS/2	High-Resolution Infrared Sounder/Version 2
ICC	Instrument Control Center (ECS) (ASTER)

IDR	Incremental Design Review
IP	International Partner; Internet Protocol
IPA	Inter Project Agreement
IR-1	Interim Release-1
IRD	Interface Requirements Document
IST	Instrument Support Terminal (ECS)
JPL	Jet Propulsion Laboratory
Kbps	Kilobits per second
LaRC	Langley Research Center
LIS	Lightning Imaging Sensor
M&O	Maintenance & Operations
Mbps	Megabits per second
MDT	Mean Downtime
MISR	Multi-Angle Imaging SpectroRadiometer
MODIS	Moderate-Resolution Imaging SpectroRadiometer
MOPITT	Measurements of Pollution in the Troposphere
MSFC	Marshall Space Flight Center
MTTR	Mean Time To Repair
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NCAR	National Center for Atmospheric Research
NOAA	National Oceanic and Atmospheric Administration
NOC	Network Operations Center
NOLAN	Nascom Operational Local Area Network
NSI	NASA Science Internet
NSIDC	National Snow and Ice Data Center (DAAC)
ORNL	Oak Ridge National Laboratory (DAAC)
PACOR	Packet Processor
PDR	Preliminary Design Review
PI	Principal Investigator
PI/TL	Principal Investigator/Team Leader

PSCN	Program Support Communications Network
QC	Quality Control
RMA	Reliability, Maintainability, Availability
RRR	Release Readiness Review
SBUV/2	Solar Backscatter Ultraviolet/version 2
SCF	Science Computing Facility
SMC	System Management Center (ECS)
SSM/I	Special Sensor for Microwave/Imaging (DMSP)
SWS	Sea Winds
TBD	To Be Determined
TL	Team Leader
TMI	TRMM Microwave Imager
TRMM	Tropical Rainfall Measuring Mission
TSDIS	TRMM Science Data & Information System
VIRS	Visible Infrared Scanner (TRMM)
WAN	Wide Area Network