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EOSDIS Core System Project

ECS Project Training Material Volume 2: Introduction and System Overview

December 1997

Hughes Information Technology Systems
Upper Marlboro, Maryland

ECS Project Training Material Volume 2: Introduction and System Overview

December 1997

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Preface

This document is a contract deliverable with an approval code of 3. As such, it does not require formal Government approval. This document is delivered for information only, but is subject to approval as meeting contractual requirements.

Any questions should be addressed to:

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Abstract

This is Volume 2 of a series of lessons containing the training material for Version 2.0 of the Earth Observing System Data and Information System (EOSDIS) Core System (ECS). This lesson provides an introduction to the training course and an overview of the ECS.

***Keywords**:* training, instructional design, course objective, Version 2.0, V0, Science Data Processing Subsystem, Communications and System Management Subsystem, COTS

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Introduction

Identification

Training Material Volume 2 is part of Contract Data Requirements List (CDRL) Item 129, whose requirements are specified in Data Item Description (DID) 625/OP3 and is a required deliverable under the Earth Observing System Data and Information System (EOSDIS) Core System (ECS), Contract (NAS5-6000).

Scope

Training Material Volume 2 includes descriptions of the ECS Version 2.0 mission, goals, objectives, structure, functions, products, services, and users. In addition, it provides an opportunity to gain some familiarity with an actual ECS facility and the ECS desktop. This lesson is designed to provide the operations staff with sufficient knowledge and information to satisfy all lesson objectives.

Purpose

The purpose of this Student Guide is to provide a course of instruction that forms the basis for a general understanding of the ECS. Lesson objectives are developed and will be used to guide the flow of instruction for this lesson. The lesson objectives will serve as the basis for verifying that all lesson topics are contained within this Student Guide and slide presentation material.

Status and Schedule

This lesson module provides detailed information about training for Version 2.0 Drop 2. Subsequent revisions will be submitted as needed.

Organization

This document is organized as follows:

Introduction:	The Introduction presents the document identification, scope, purpose, and organization.
Related Documentation:	Related Documentation identifies parent, applicable and information documents associated with this document.
Student Guide:	The Student Guide identifies the core elements of this lesson. All Lesson Objectives and associated topics are included.
Slide Presentation:	Slide Presentation is reserved for all slides used by the instructor during the presentation of this lesson.

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Related Documentation

Parent Document

The parent document is the document from which this ECS Training Material's scope and content are derived.

423-41-01	Goddard Space Flight Center, EOSDIS Core System (ECS) Statement of Work

Applicable Documents

The following documents are referenced within this ECS Training Material, or are directly applicable, or contain policies or other directive matters that are binding upon the content of this document:

420-05-03	Goddard Space Flight Center, Earth Observing System (EOS) Performance Assurance Requirements for the EOSDIS Core System (ECS)
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)

Information Documents

Information Documents Referenced

The following documents are referenced herein and amplify or clarify the information presented in this document. These documents are not binding on the content of the ECS Training Material.

535-TIP-CPT-001	Goddard Space Flight Center, Mission Operations and Data Systems Directorate (MO&DSD) Technical Information Program Networks Technical Training Facility, Contractor-Provided Training Specification
609-CD-003-001	Operations Tools Manual
611-CD-004-001	Mission Operation Procedures for the ECS Project

Information Documents Not Referenced

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

220-TP-001-001	Operations Scenarios - ECS Release B.0 Impacts

305-CD-020-002	Release B SDPS/CSMS System Design Specification Overview for the ECS Project
305-CD-021-002	Release B SDPS Client Subsystem Design Specification for the ECS Project
305-CD-022-002	Release B SDPS Interoperability Subsystem Design Specification for the ECS Project
305-CD-023-002	Release B SDPS Data Management Subsystem Design Specification for the ECS Project
305-CD-024-002	Release B SDPS Data Server Subsystem Design Specification for the ECS Project
305-CD-025-002	Release B SDPS Ingest Subsystem Design Specification [for the ECS Project]
305-CD-026-002	Release B SDPS Planning Subsystem Design Specification for the ECS Project
305-CD-027-002	Release B SDPS Data Processing Subsystem Design Specification for the ECS Project
305-CD-028-002	Release B CSMS Communications Subsystem Design Specification for the ECS Project
305-CD-029-002	Release B CSMS System Management Subsystem Design Specification for the ECS Project
305-CD-030-002	Release B GSFC DAAC Design Specification for the ECS Project
305-CD-031-002	Release B Langley DAAC Design Specification for the ECS Project
305-CD-033-002	Release B EDC DAAC Design Specification for the ECS Project
305-CD-034-002	Release B ASF DAAC Design Specification for the ECS Project
305-CD-035-002	Release B NSIDC DAAC Design Specification for the ECS Project
305-CD-036-002	Release B JPL PO.DAAC Design Specification for the ECS Project
305-CD-037-002	Release B ORNL DAAC Design Specification for the ECS Project
305-CD-038-002	Release B System Monitoring and Coordination Center Design Specification for the ECS Project

305-CD-039-002	Release B Data Dictionary Subsystem Design Specification for the ECS Project
601-CD-001-004	Maintenance and Operations Management Plan for the ECS Project
604-CD-001-004	Operations Concept for the ECS Project: Part 1-- ECS Overview
604-CD-002-003	Operations Concept for the ECS Project: Part 2B -- ECS Release B
605-CD-002-001	Release B SDPS/CSMS Operations Scenarios for the ECS Project
607-CD-001-002	ECS Maintenance and Operations Position Descriptions
500-1002	Goddard Space Flight Center, Network and Mission Operations Support (NMOS) Certification Program, 1/90

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Objectives

Lesson Overview

This lesson will provide you with an introduction to the ECS training course and an overview of ECS. It includes descriptions of the ECS mission, goals, objectives, structure, functions, products, services, and users. In addition, it provides an opportunity to gain some familiarity with an actual ECS facility and the ECS desktop.

Lesson Objectives

Overall Objective - The overall objective of the Introduction and System Overview lesson is for Science and Communications Maintenance and Operations (M&O) personnel to describe the mission, goals, objectives, structure, functions, products, services, and users of the Earth Observing System (EOS) Data and Information System (EOSDIS) Core System (ECS).

Condition - The student will be given a copy of 625-CD-002-001, *ECS Training Material Volume 2: Introduction and System Overview*, a copy of 609-CD-002-002, *Version 2.0 Operations Tools Manual*, and a copy of 611-CD-004-001, *Mission Operation Procedures for the ECS Project*.

Standard - The student will describe specified characteristics of ECS without error in accordance with the lesson content.

Specific Objective 1 - The student will describe the mission of ECS, including its relationships to the Mission to Planet Earth, the Earth Observing System and the EOS Data and Information System.

Condition - The student will be given a copy of 625-CD-002-001, *ECS Training Material Volume 2: Introduction and System Overview.*

Standard - The student will describe the mission of ECS without error in accordance with the lesson content.

Specific Objective 2 - The student will describe how the ECS functions in terms of general data flow and ECS operations centers/locations.

Condition - The student will be given a copy of 625-CD-002-001, *ECS Training Material Volume 2: Introduction and System Overview.*

Standard - The student will describe ECS functioning in terms of general data flow and ECS operations centers/locations without error in accordance with the lesson content.

Specific Objective 3 - The student will describe ECS operational software configuration of the Science Data Processing Segment (SDPS) and the Communications and System Management Segment (CSMS).

Condition - The student will be given a copy of 625-CD-002-001, *ECS Training Material Volume 2: Introduction and System Overview.*

Standard - The student will describe ECS operational software configuration of the SDPS and the CSMS without error in accordance with the lesson content.

Specific Objective 4 - The student will describe the ECS operation hardware configuration.
Condition - The student will be given a copy of 625-CD-002-001, *ECS Training Material Volume 2: Introduction and System Overview.*
Standard - The student will describe the ECS operation hardware configuration without error in accordance with the lesson content.
Specific Objective 5 - The student will describe commercial off-the-shelf (COTS) software used in ECS.
Condition - The student will be given a copy of 625-CD-002-001, *ECS Training Material Volume 2: Introduction and System Overview.*
Standard - The student will describe ECS COTS software without error in accordance with the lesson content.
Specific Objective 6 - The student will describe ECS operational processes, i.e., system operations management activities and science operations activities.
Condition - The student will be given a copy of 625-CD-002-001, *ECS Training Material Volume 2: Introduction and System Overview.*
Standard - The student will describe ECS operational processes, i.e., system operations management activities and science operations activities, without error in accordance with the lesson content.
Specific Objective 7 - The student will describe ECS facility layout and the locations of ECS components within the facility.
Condition - The student will be given a copy of 625-CD-002-001, *ECS Training Material Volume 2: Introduction and System Overview.*
Standard - The student will describe ECS facility layout and the locations of ECS components within the facility without error in accordance with the lesson content.
Specific Objective 8 - The student will log on to ECS.
Condition - The student will be given appropriate access codes (e.g., user identification, password), access to ECS (through a workstation or terminal), a copy of 609-CD-003-001, *Version 2.0 Operations Tools Manual*, and a copy of 611-CD-004-001, *Mission Operation Procedures for the ECS Project*.
Standard - The student will perform without error the steps involved in logging on to ECS without error in accordance with the applicable procedure.
Specific Objective 9 - The student will describe the features of the ECS desktop.
Condition - The student will be given a copy of 625-CD-002-001, *ECS Training Material Volume 2: Introduction and System Overview*, a copy of 609-CD-003-001, *Version 2.0 Operations Tools Manual*, and a copy of 611-CD-004-001, *Mission Operation Procedures for the ECS Project*.
Standard - The student will describe ECS desktop features without error in accordance with the lesson content.

Importance

This lesson applies to students who will be ECS operators (including support staff). The lesson will provide them with the knowledge and skills needed for taking subsequent ECS training lessons and for communicating with other ECS personnel about the system in general. They will need the knowledge and skills on the job when they encounter ECS hardware, software, documentation or procedures. The lesson describes the ECS mission, goals, objectives, structure, functions, products, services, and users. In addition, it provides them some familiarity with an actual ECS facility and the ECS desktop.

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System Overview

Mission to Planet Earth (MTPE) and the Earth Observing System (EOS)[1]

The **Mission to Planet Earth (MTPE)** is a NASA managed, long-term, multi-disciplinary, and inter-disciplinary research effort. MTPE uses space, ground and aircraft-based measurement system to:

- Study the processes leading to global climate changes.
- Develop a predictive capability for Earth systems on time scales of decades to centuries.

MTPE is NASA's contribution to the U.S. Global Change Research Program (USGCRP). The USGCRP is the focal point of U.S. activities in support of the worldwide research collaboration now under way to study global change. The goal of MTPE is to advance scientific understanding of the entire Earth system by developing a deeper comprehension of the components of the system and the interactions among components (Figure 1).

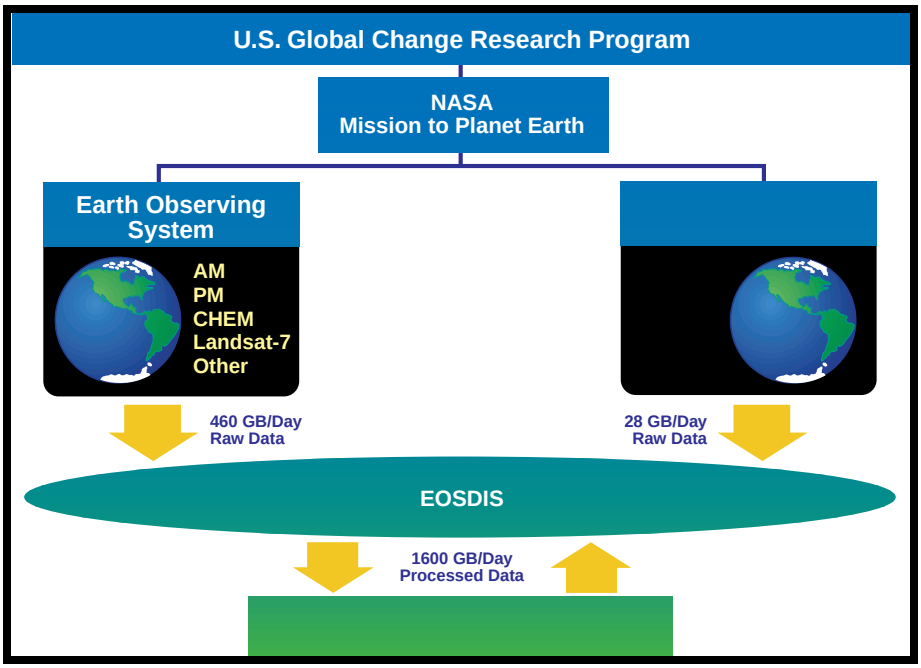

Figure 1. MPTE Mission Context

[1] Information in this section has been extracted from Asrar, G. and Greenstone, R., 1995: 1995 EOS Reference Handbook. NASA Headquarters.

The principal element of MTPE is the **Earth Observing System (EOS)**, which is designed to collect earth science data, with emphasis on long-term, sustained data sets from carefully calibrated instruments on satellites in low Earth orbits. Accordingly, the goal of EOS is to provide quantitative data from systematic, continuous satellite observations from low-Earth orbit for a minimum of 15 years.

EOS's broad mission objectives in support of the goal are to:

- ↑ Create an integrated scientific observing system that will enable a study of the Earth's critical, life-enabling, interrelated processes involving the atmosphere, oceans, land surfaces, and polar regions.
- ↑ Develop a comprehensive data and information system, including a data retrieval and processing system, to serve the needs of scientists.
- ↑ Acquire and assemble a global database of remote-sensing measurements from space as key to understanding global climate change, including:
  - The role of clouds, radiation, water vapor, and precipitation.
  - The productivity of the oceans, their circulation, and air-sea exchange.
  - The sources and sinks of greenhouse gases, and their atmospheric transformations.
  - Changes in land use, land cover, primary productivity, and the water cycle.
  - The role of polar ice sheets and sea level.
  - The coupling of ozone chemistry with climate and the biosphere.
  - The role of volcanoes in climate change.

The physical-modeling and data-gathering activities are intended to make a major contribution to establishing the distinction between natural variability in the Earth system and changes that are introduced by human activities.

The choices of intervention strategies to mitigate possible undesirable changes or their impacts will have to be based at least in part on the findings of MTPE- and EOS-supported scientists in the U.S. and their counterparts around the world.

The three primary components of the EOS program are shown in Figure 2.

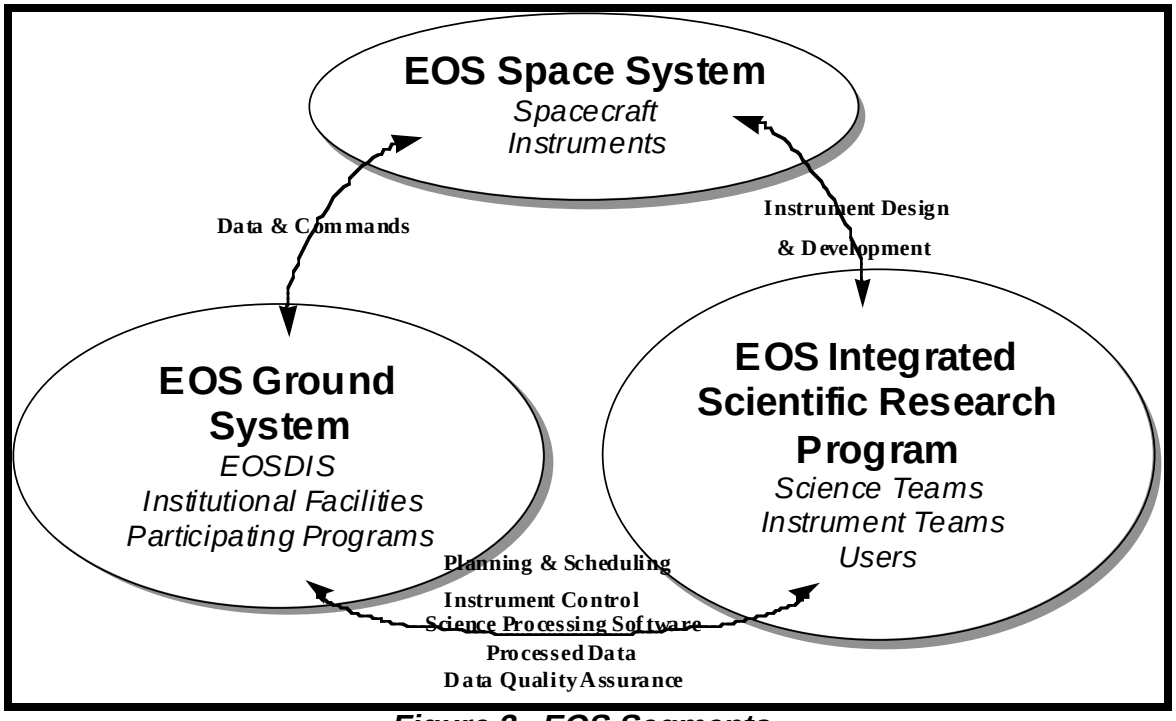

Figure 2. EOS Segments

The purpose of each segment is as follows:

- EOS Space System — acquire essential global earth science data on a long-term sustained basis and in a manner that maximizes the scientific utility of the data and simplifies data analysis.
- EOS Ground System (EGS) — provide the earth science research community with easy, affordable, and reliable access to the full suite of earth science data from U.S. and International Partner (IP) platforms.
- EOS Integrated Scientific Research Program — investigate processes in the Earth System and improve predictive models.

Earth Observing System Data and Information System (EOSDIS)

In addition to collecting earth science data, MTPE and EOS are committed to providing the earth science community with easy, affordable, and reliable access to EOS and other earth science data. The EOS Data and Information System (EOSDIS) is NASA's overall earth science discipline data system. In conjunction with NASA Institutional Facilities and participating programs, EOSDIS provides the ground system for the collection and analysis of science data to support scientists in resolving the dynamics of the Earth's components and the processes by which they interact. For example, EOSDIS supports the following EOS activities:

- Planning, scheduling, and control of the EOS series of spacecraft.
- ↑ Exchanging commands, data and algorithms with the European Space Agency (ESA), Japan, Canada, the National Oceanic and Atmospheric Administration (NOAA), and any other non-NASA entities involved in the overall EOS mission.
- The coordination of these activities with other data-gathering systems.
- ↑ The transformation of the observations into physical variables, providing for higher levels of processing.
- ↑ Presenting the data to users in forms that facilitate and stimulate interactive scientific research.

The EOSDIS is being developed under the direction of the earth science Data and Information System (ESDIS) Project. An initial (prototype) version called Version 0 (V0) has been in operation since August 1994, meeting NASA's commitment to the earth science community. An integrated scientific research program investigates processes in the Earth system and uses this information to improve predictive models. Current V0 capabilities include:

- ↑ Management of data from NASA's past and current earth science research satellites and field measurement programs.
- Data archiving, distribution, and information management services.

During the EOS era EOSDIS will command and control satellites and instruments, and will generate useful products from orbital observations. Furthermore, EOSDIS will generate data sets made by assimilation of satellite and *in situ* observations into global climate models. System upgrades and data migration plans include:

- ↑ Parallel operation and interoperability with Version 0 until the data from Version 0 have migrated into a subsequent version and the Version 0 hardware components have become obsolete.
- ↑ "Launch-ready" version for EOS AM-1, Color, and Landsat-7 satellites scheduled for launch in 1998.

- ↑ Support of pre-launch testing for the flights mentioned and support of operations after the launches occur.

Subsequent versions of EOSDIS will supplement capacity and services as required by EOS spacecraft launches. EOSDIS capabilities will evolve based on continuing evaluation by the research community, and technology will be enhanced as the need arises.

EOSDIS Services. The EOSDIS services include user support, data archive management and distribution, information management, product generation, spacecraft command and control, data capture and telemetry processing.

- ↑ **User Support**. Users interact with EOSDIS via Distributed Active Archive Centers (DAACs) using human-machine interfaces. The DAACs, described in subsequent sections, assist users in data acquisition, search, access, and usage.
- ↑ **Data Archive Management and Distribution.** EOSDIS will store all standard and special products computed from EOS and non-EOS instruments and distribute requested information to users electronically. Other information such as product generation algorithms, software, documentation, calibration data, engineering, and other ancillary data are stored and provided to users upon request.
- ↑ **Information Management.** EOSDIS provides an intuitive system that provides convenient mechanisms for locating and accessing subsets of products of interest. EOSDIS provides an extensible set of tools and capabilities that allow investigators to provide access to special products from their own computing facilities.
- ↑ **Product Generation.** EOSDIS will support data product generation from EOS instrument observations.
- ↑ **Spacecraft Command and Control.** EOSDIS will perform EOS spacecraft and instrument planning and scheduling, and command and control.
- ↑ **Data Capture and Telemetry Processing.** EOSDIS will be able to capture data from all EOS spacecraft and process them to remove telemetry errors, eliminate any artifacts, and create “raw” data as measured by the instruments.

EOSDIS Data Products. EOSDIS data products are arranged in a pyramid or hierarchy, with "raw" data at the bottom level (Level 0) and increasing levels of refinement through Level 4 at the top. The data levels are:

- Level 0 – "raw" data products that are reconstructed, unprocessed instrument/ payload data at full resolution with all communications artifacts (e.g., synchronization frames, communications headers, duplicate data) removed.
- Level 1A – reconstructed, unprocessed instrument data at full resolution, time-referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and georeferencing parameters, e.g., platform ephemeris, computed and appended but not applied to the Level 0 data.
- Level 1B – Level 1A data that have been processed to sensor units (not all instruments will have a Level 1B equivalent).
- Level 2 – derived geophysical variables at the same resolution and location as the Level 1 source data.
- Level 3 – variables mapped on uniform space-time grid scales, usually with some completeness and consistency.
- Level 4 – model output or results from analyses of lower-level data, e.g., variables derived from multiple measurements.

EOS instruments provide long-term collection of data and allow for measurement of Earth over the long-term to help detect climate changes and reasons for those changes, Data collected using these instruments will be the first "new" data; this will be in addition to the DAACs V0 historical data. Figure 3 shows some examples of EOS instruments and the kinds of measurements they make.

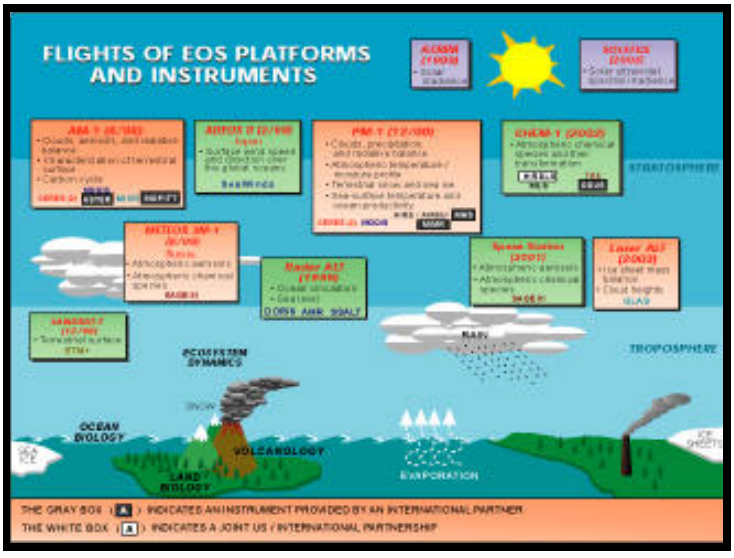

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Figure 3. Sample EOS Instruments and Measurements

EOSDIS Core System (ECS)

The EOSDIS Core System (ECS) is the major component of the EOSDIS. The ECS mission is "to provide centralized mission and instrument command and control functions, and distributed (but common) product generation, archiving, and information management functions" for the EOSDIS. As previously mentioned, capabilities also exist outside of the core, including the following functions:

- ↑ Spacecraft data capture and distribution functions performed by the EOS Data and Operations System (EDOS).
- ↑ Data communication services provided by the EOSDIS Backbone Network (Ebnet).

The main functions of ECS are to provide control of the EOS spacecraft and instruments; process data from the EOS instruments; and manage and distribute EOS data products and other selected data sets to the scientific community. The relationship of ECS to EOSDIS, EOS, MTPE, and global change research is depicted in Figure 4.

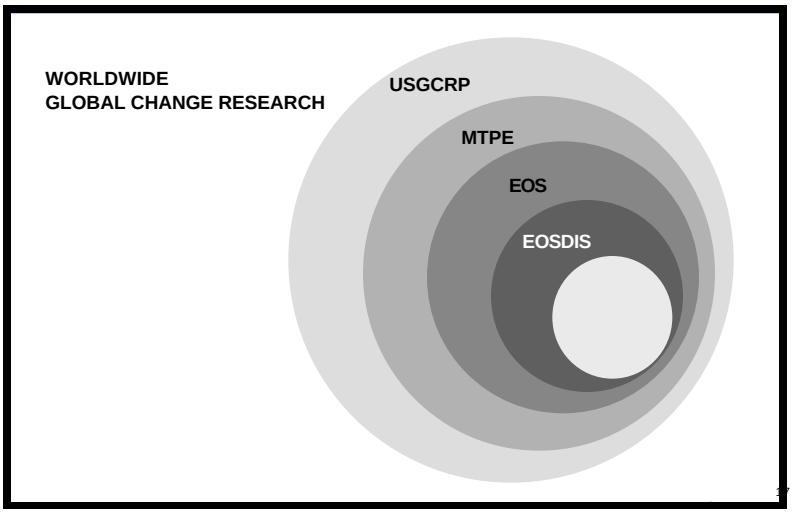

Figure 4. Relationship of ECS to Global Change Research

The ECS is divided into the following three major functional components/segments (see Figure 5) :

- Science Data Processing Segment (SDPS).
- Communications and System Management Segment (CSMS).
- Flight Operations Segment (FOS).

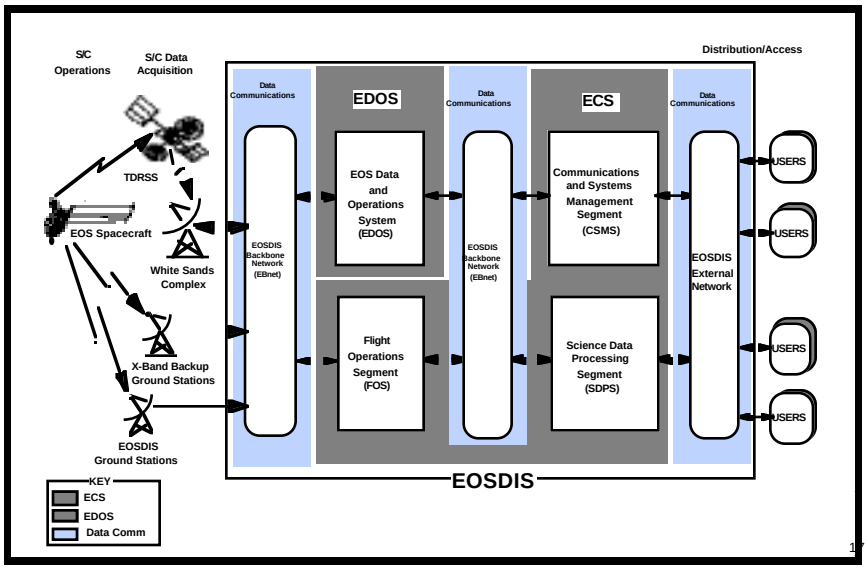

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Figure 5. EOSDIS Principal Components

The **Science Data Processing Segment (SDPS)** functions and features include:

- ↑ Receiving, processing, archiving and managing all data from EOS and other NASA Probe flight missions.
- ↑ Providing support to the user community in accessing the data as well as products resulting from research activities that utilize this data.
- ↑ Promoting, through its advertising service, the effective utilization and exchange of data within the user community.
- ↑ Playing a central role in providing the science community with the proper infrastructure for development, experimental usage and quality-checking of new earth science algorithms.
- ↑ Being structured as a distributed system with its components eventually to be located at eight DAACs.

The **Communications and System Management Segment (CSMS)** provides for the interconnection of users and service providers, transfer of information between the ECS and many EOSDIS components, and monitoring and coordination of all EOSDIS components.

It supports and interacts with the SDPS and the FOS. The CSMS provides ECS operations, management and maintenance personnel with local and in cases remote access to its enterprise management services. These interfaces support reporting of a wide range of status information, coordination, and performance of administration and maintenance services. Within ECS, CSMS supports SDPS and FOS with physical network connectivity for their workstations, servers and peripheral components. The CSMS is composed of the following three major subsystems:

- Systems Management Subsystem (MSS).
- Communications Subsystem (CSS).
- Internetworking Subsystem (ISS).

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. NASA institutional facilities like the Flight Dynamics Facility (FDF) and the Network Control Center (NCC)/Space Network Control (SNC) interact with the FOS. The FOS consists of the following two major elements:

- ↑ EOS Operations Center (EOC). The EOC focuses on the command and control of the flight segment of EOS and the interaction it has with the ground operations of the ECS.
- ↑ Instrument Support Terminal (IST). The Instrument Support Terminal (IST) connects a Principal Investigator (PI) or Team Leader (TL) facility to the FOS in remote support of instrument control and monitoring. PI/TL facilities are outside the FOS, but connected to it by way of the EBnet.

FOS is not a function of the Maintenance and Operations (M&O) Organization for which this training course has been developed. Consequently, relatively little emphasis is given to the FOS in the remainder of this lesson.

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Program Releases

The ECS is being developed and released for installation and operation in phases. ECS development phases (see Figure 6) include the following releases:

- ↑ Interim Release 1 (Ir1) – preliminary release for concept validation and testing (January 1996).
- ↑ Pre-Release B Testbed – deployed in May-June 1997 at four DAACs to support science software integration and test (SSI&T) in support of Instrument Teams (ITs) for Landsat-7 and EOS AM-1 missions.
- ↑ Version 2.0 – to be deployed in two phases (Version 2.1 in February 1998 and Version 2.1 in September 1998) support future EOS missions such as AM-1.
- Version 3.0 and 4.0 – future deployments to support additional EOS missions.
  - Incorporate evolutionary changes such as new processing and storage technologies.
  - Provide expanded and increasingly enhanced data search and access, based on feedback from the science community.

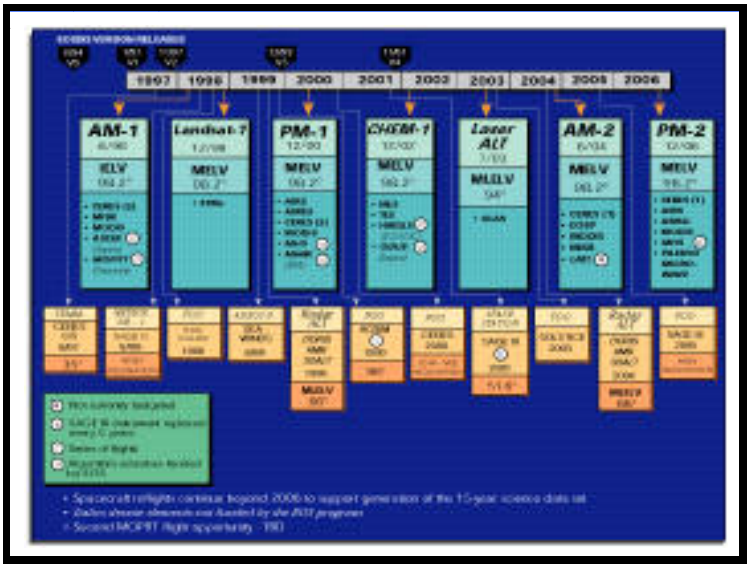

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Figure 6. EOS Missions

Version 2.0

Version 2.0 is the first operational release of the ECS. It will be delivered in two phases. Version 2.0 is scheduled to be completed on December 30, 1997; Version 2.1 will be delivered on September 1, 1998.

Version 2.0 will consist of all functions critical to mission success at launch and for initial science activities related to support of the AM-1 and Landsat-7 satellites and their instruments. Version 2.1 will provide all remaining Version 2.0 functions.

Version 2.0 has the following mission objectives:

- Support AM-1 operations.
- Support Landsat-7 operations.
- Perform science data processing.

Version 2.1 has the same mission objectives as Version 2.1 plus will support the Advanced Earth Observing Satellite (ADEOS) II operations.

System Functional Overview

EOSDIS Data Flow

The ECS supports the collection and distribution of data from space-, ground- and aircraft-based measurement systems to provide the scientific basis for understanding global change. To accomplish this requires:

- ↑ ECS data product generation, archive, distribution, and information management services.
- Command and control functions for EOS spacecraft and instruments.
- ↑ Internal interfaces among elements which are responsible for the operation of the distributed elements of the ECS at their respective sites:
  - Distributed Active Archive Centers (DAACs).
  - System Monitoring and Coordination (SMC) functions.
  - EOS Operations Center (EOC).

Figure 7 shows data flow through the EOSDIS, including ECS components, other EOSDIS components and external elements. The figure indicates key interfaces and interactions in the system.

Inputs

EOS AM-1

Data from EOS AM-1 satellite instruments are transmitted from EOS satellites through the Tracking and Data Relay Satellites (TDRS) to the receiving station at White Sands, New Mexico. This data is transmitted in a single, combined telemetry stream.

From White Sands, the data are transmitted via EOSDIS Backbone Network (EBnet) circuits to the EDOS Level Zero Processing Facility (LZPF) at the Goddard Space Flight Center (GSFC), where the data are processed to recover the raw instrument data.

- ↑ For EOS missions subsequent to AM-1, the science data will be transmitted to the LZPF from high-latitude X-band EOSDIS ground stations in Alaska and Norway.

International Partner (IP)

IP satellites downlink directly to the International Partner Ground Systems (IPGSs) via their ground receiving stations. Data from NASA instruments on the IP platforms are transmitted to GSFC via commercial networks or sent on hard media (disk or tape).

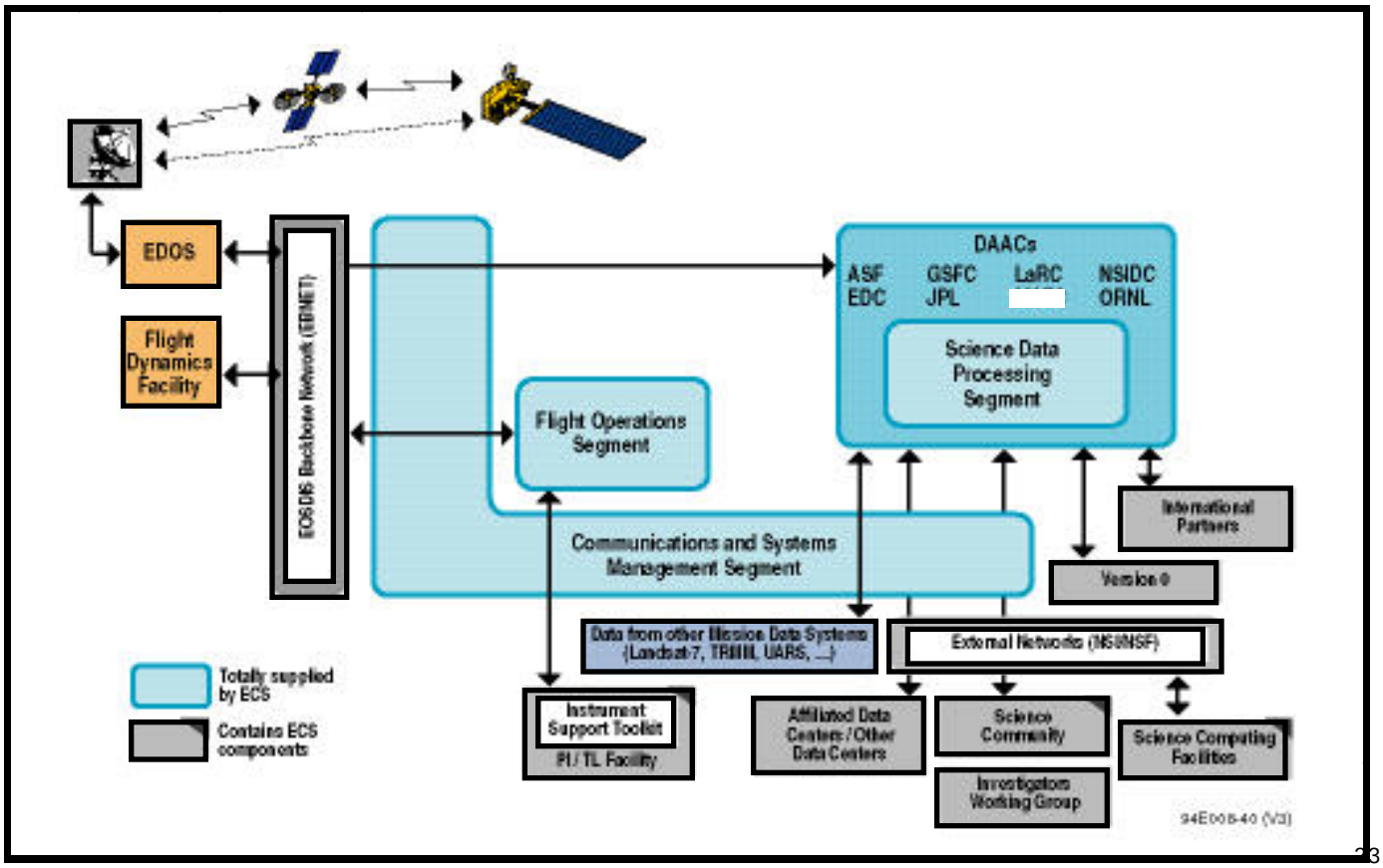

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Figure 7. EOSDIS Data Flow

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Landsat-7

Landsat-7 transmits downlink data directly to the Landsat-7 Ground Station (LGS) at the Earth Resources Observation Systems (EROS) Data Center (EDC) and to International Ground Stations.

Additional Data Providers

In addition to data from EOS satellites, each DAAC may receive data products from non-EOS suppliers such as:

- Affiliated Data Centers (ADCs) which are centers such as The National Environmental Satellite Data and Information Service (NESDIS).
  - National Center for Environmental Prediction (NCEP).
  - Space Science and Engineering Center of the University of Wisconsin.
  - Incorporated Research Institutions for Seismology (IRIS) Data Center.

- ↑ Other Data Centers (ODCs) are centers such as the Landsat Processing System (LPS).

Interfaces

EDOS

EDOS is responsible for the following:

- Spacecraft data capture and distribution.
- Processing satellite data to recover the raw Level 0 instrument data.
- ↑ Distributing Level 0 instrument data for archiving and processing to the ECS SDPS, specifically to the designated DAACs, via EBnet.
- ↑ Providing archive services for Level 0 data at the EDOS Data Archive Facility (DAF) in Fairmont, West Virginia.

DAACs

- ↑ The DAACs house the ECS computing facilities and operational staff needed for product generation and managing and storing EOSDIS data, as well as the associated metadata[1] and browse[2] data required for effective use of the data holdings (SDPS functions).
- ↑ The DAAC receives requests for data products and other archived information from the users, and distributes the requested data.
- ↑ System management functions and communications services, such as local area network (LAN) services and connectivity to external networks, are provided to the DAACs and FOS by CSMS.

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[1] Metadata are data about data sets, i.e., information that is provided to the ECS by the data supplier or the generating algorithm and which provide a description of the content, format, and utility of the data set. Metadata may be used to select data for a particular scientific investigation.

[2] Browse data are subsets of a larger data set, other than the directory and guide, generated for the purpose of allowing rapid interrogation (i.e., browsing) of the larger data set by a potential user. For example, the browse product for an image data set with multiple spectral bands and moderate spatial resolution might be an image in two spectral channels, at a degraded spatial resolution. The form of browse data is generally unique for each type of data set and depends on the nature of the data and the criteria used for data selection within the relevant scientific disciplines.

Science Users

- ↑ Most science users access EOS data products at the DAACs via external networks such as the NASA Science Internet (NSI) or the National Science Foundation (NSF) Internet.
- ↑ ECS users include facilities and organizations not participating directly in the EOS Program such as university research users, international investigators/data centers and commercial data systems.
- When necessary, the DAACs exchange data via the EBnet.

EBnet

Ebnet provides wide-area communications circuits (Figure 8) and facilities between and among various EOS Ground System (EGS) elements.

Transports spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week.

Serves as the interface to other systems such as DAACs, users, and the NSI.

Includes a campus interface which provides communications between the Wide Area Network (WAN) and Local Area Network (LAN).

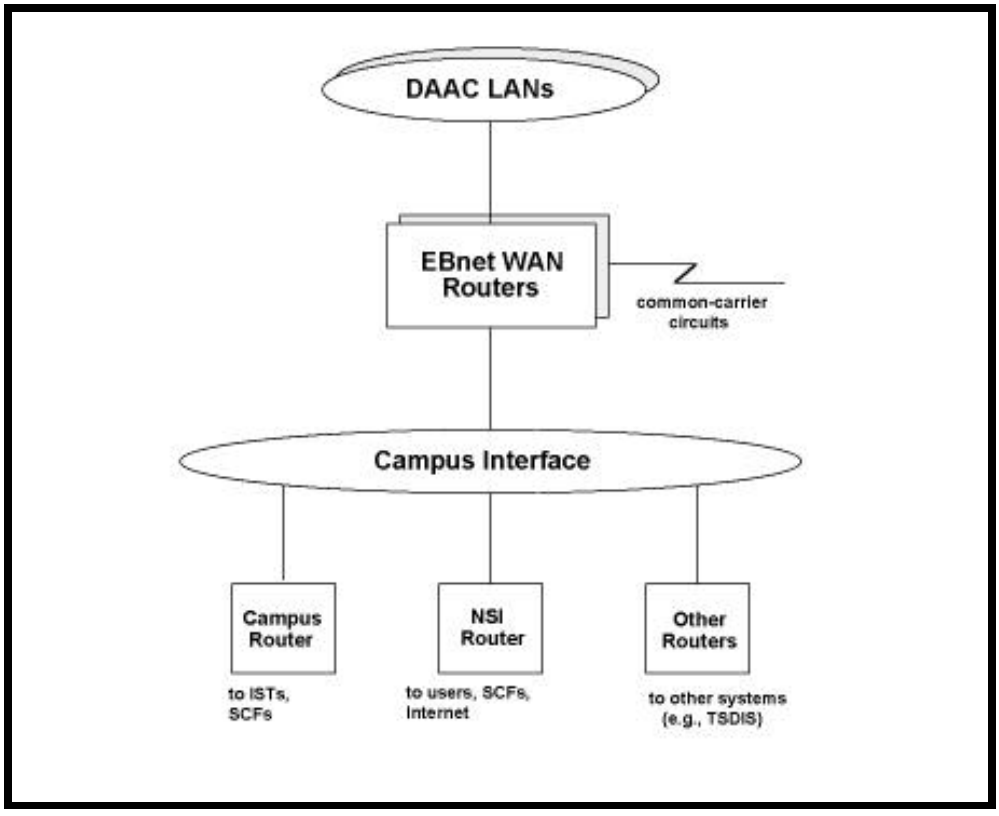

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Figure 8. EOSDIS Backbone Network (EBnet)

Science Computing Facilities

The ECS provides interfaces to instrument and interdisciplinary investigator Science Computing Facilities (SCFs) which develop science data processing software and employ a user interface that facilitates browsing, requesting, and delivering data from archives to investigators.

- ECS provides toolkits to support the SCFs' activities.
- ↑ The Science Data Processing (SDP) Toolkit is used for developing and validating science algorithms at the SCF and transferring the algorithms to the DAACs.
- ↑ The Instrument Support Terminal (IST) Toolkit, available at some SCFs, is provided by the ECS to support planning and scheduling of spacecraft instruments.
- ↑ Software for EOS standard science data product generation is developed by the science investigators responsible for those products at their facilities.
  - Investigator-developed software and algorithms for EOS **standard** products are integrated with the ECS and installed at the DAACs for routine production.
  - **Special** products are produced at the investigator facilities.

EOS Operations Center (EOC)

EOS missions are coordinated from the EOC; flight operations (including spacecraft and instrument operations) are conducted from the EOC.

ECS Flight Operations Segment (FOS) at the EOC maintains spacecraft and instrument health and safety and monitors spacecraft performance (among other functions).

- EOC (FOS) interfaces with EDOS for the following functions:
  - Provides spacecraft and instrument uplink data to EDOS.
  - Receives real-time or spacecraft recorder and instrument housekeeping data, spacecraft and instrument command status data, and spacecraft processor memory dump data from EDOS.
  - Exchanges accounting, fault coordination, data operations status, and planning information with EDOS.
  - Coordinates data delivery services with EDOS.
- ↑ EOC interfaces with the Flight Dynamics Facility (FDF) for the following functions:
  - Receives predicted orbit data, including predicted ground track for scheduling from the FDF.
  - Receives contact scheduling data from the FDF.

  - Cooperates with FDF in the development of plans for corrective firings for spacecraft maneuvers.
  - Receives, schedules, and implements plans from FDF.
  - Provides attitude sensor data to the FDF for determining spacecraft attitude.
- EOC provides the SDPS with the following types of information:
  - Spacecraft information, including orbit data.
  - Acquisition plans and schedules.
- ↑ EOC exchanges planning and scheduling information with the IP-ICCs, sends mission status to the IP-ICCs, and receives instrument commands and status from the IP-ICCs.
- ↑ EOC exchanges instrument planning and scheduling information with the IST (consistent with the concept of global access to planning and scheduling information).
- ↑ Instrument team (which is responsible for the contents of its instrument microprocessor loads) uses the IST to generate instrument uplink data.
- ↑ EOC accepts instrument uplink data from the IST, validates them at a high level, and integrates them. EOC receives instrument status information from the IST to perform high-level monitoring.
- ↑ Via the SMC (CSMS), the EOC receives EOS management and operation directives, including science policy and guidelines from the IWG plan. In return the EOC furnishes EOC management and operations status.

Version 0

EOSDIS Version 0 (V0), an early "working prototype" of selected EOSDIS functionality, is hosted and operated by the DAACs to provide data ingest, archive, catalog, distribution, and user support services (including cross-DAAC catalog for interdisciplinary users).

It interconnects existing data systems at the DAACs via electronic networks, integrates catalogs, and provides common data distribution procedures to ensure access to data.

NASA Institutional Services

EOS, like many other NASA projects, makes use of NASA institutional services, which consist of several ground system elements that provide generic services plus some project-unique services. Table 1, NASA Institutional Services, summarizes the NASA elements included as institutional services.

Table 1. NASA Institutional Services

INSTITUTIONAL SERVICE	SUMMARY OF SERVICES
Space Network (SN): Tracking and Data Relay Satellite System (TDRSS), Ground Terminals, Network Control Center	Space and ground communications and tracking services; scheduling for TDRSS support.
Flight Dynamics Facility (FDF)	Predictive and definitive orbit, attitude, and navigational computational support services in the spacecraft.
NASA Communications (NASCOM), NASCOM Operational Local Area Network (NOLAN)	NASCOM provides communications and data transport services between White Sands Complex (WSC) and ground located elements; and communications support for end-to end spacecraft simulations and training. NOLAN is used for transporting science and ancillary data from NASA data processing facilities (such as the GSFC Sensor Data Processing Facility (SDPF)) to the DAACs for designated NASA missions.
Deep Space Network (DSN)	Tracking and data acquisition support , including backup radio-frequency (RF) communication services for relaying housekeeping telemetry and low bit-rate commands.
Ground Network (GN)	Backup transmission services to and from the spacecraft, in case of TDRSS malfunction.
X-Band Backup Ground Stations	Provide backup science data communications services for AM-1.
Wallops Orbital Tracking Station (WOTS)	Backup low-rate spacecraft communications services.
Program Support Control Network (PSCN)	Backbone for programmatic communications.
Sensor Data Processing Facility	Data distribution facility.

ECS Operations Locations

This section describes the ECS operations locations and their roles. ECS elements will be deployed to the following institutions:

- Distributed Active Archive Centers (DAACs):
- System Monitoring and Coordination Center (SMC): GSFC Building 32
- EOS Operations Center (EOC): GSFC Building 32
- ECS Sustaining Engineering Organization (SEO): Landover
- ECS System Integrated Logistics Support Organization (ILS): GSFC Building 32

Distributed Active Archive Centers (DAACs)

It is the goal of EOSDIS to provide end-to-end services from EOS instrument data collection to science data processing to full access to EOS and other earth science data holdings. Eventually eight DAACs across the U.S. (see Figure 9) will process, archive, and distribute EOS and related data, and provide a full range of user support. The DAACs provide a link between the EOS program and the user community.

- EROS Data Center (EDC): Sioux Falls, South Dakota
- Goddard Space Flight Center (GSFC): Greenbelt, Maryland
- Jet Propulsion Laboratory (JPL): Pasadena, California
- Langley Research Center (LaRC): Hampton, Virginia
- National Snow and Ice Data Center (NSIDC): University of Colorado, Boulder, Colorado
- Oak Ridge National Laboratory (ORNL): Oak Ridge, Tennessee
- Socioeconomic Data Applications Center (SEDAC): Consortium for International earth science Information Network (CIESIN), University Center, Michigan

The DAACs chosen by NASA demonstrated expertise in specific disciplines and long-term commitments to the corresponding user communities. DAAC areas of specialization are shown in Table 2.

Table 2. DAAC Summary

DAAC	Science Discipline Assignments Made	Mission/Platform	Instrument/Experiment
Alaska SAR Facility (University of Alaska - Fairbanks)	Synthetic Aperture Radar Study, Polar Processes	ERS and JERS series RADARSAT	SAR SAR
EROS Data Center (USGS)	Land Processes Imagery	AM-1 Landsat-7	ASTER and MODIS (L2+/land) ETM
Goddard Space Flight Center (NASA)	Upper Atmosphere, Atmospheric Dynamics, Global Biosphere, Geophysics	TRMM SEASTAR ADEOS-I AM and PM series PM series Laser Altimeter CHEM-1 Flight of Opportunity	VIRS (a/d) PR (a/d), TMI (a/d), GV (a/d) SeaWiFS TOMS (a/d) MODIS AIRS, AMSU, MHS, AMSR GLAS (LO/1) HIRDLS, MLS SOLSTICE III
Jet Propulsion Laboratory Interaction (Cal Tech)	Ocean Circulation and Air-Sea Interaction	ADEOS-I ADEOS-II Radar-Altimeter	NSCAT (a/d) Seawinds MR, POD, DFA
Langley Research Center Tropospheric (NASA)	Radiation Budget, Aerosols, Chemistry	TRMM AM-1 AM-2 PM series, FOO FOO FOO, Meteor, and Space Station CHEM-1	CERES CERES, MISR, and MOPITT CERES, MISR, EOSP CERES ACRIM SAGE III TES
National Snow and Ice Data Center (U. of Colorado)	Cryosphere (Non-SAR)	AM-1 and PM-1 PM-1 Laser Altimeter	MODIS AMSR GLAS (L2+)
Oak Ridge National Laboratory (DOE)	Biogeochemical Dynamics	None	None
Socio-Economic Data Applications Center (CIESIN)	Policy/Decision Making Applications of Combined MTPE and Socio-Economic Data	None	None

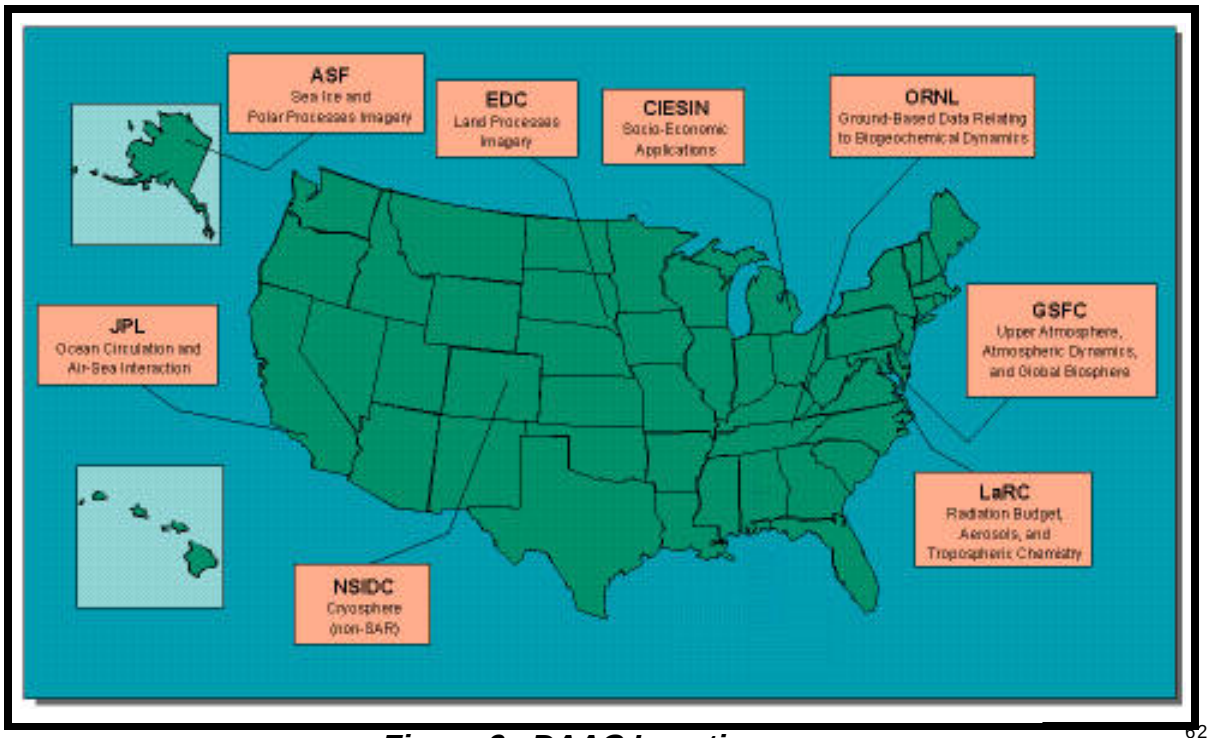

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Figure 9. DAAC Locations

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DAAC Main Functions

The DAACs provide the following:

- Integration and test of the science software, in order to verify that the software will run properly, i.e., will not interfere with other software or DAAC operations. The integration and test activity will also allow the SCF to verify that the software will run correctly (i.e., produce scientifically correct results) in the production environment.
- Archiving all source files, documentation, test information, and other files associated with the science software.
- Supplying the operational environment for the science software and running the software in an ongoing production mode to generate data products.
- Archiving and distributing the data products.
- Distributing source files, documentation, test information, and other files associated with the science software to authorized users.
- Accepting, archiving, and distributing special products generated by other facilities.
- Advertising data and providing user support.

System Monitoring and Coordination Center (SMC)

The SMC that are collectively referred to as Enterprise Monitoring and Coordination (EMC) provide the following main functions:

- Performance Management: The DAACs' local area network (LAN) LSM provides real-time performance monitoring and reporting and post analysis and reporting through the database management system. The SMC receives summary reports and provides system-wide performance analysis.
- Security Management: Initially MSS provides limited security services to support intrusion detection, file access attempts, log-on authentication and authorization, and virus detection. The SMC's primary functions include evaluating site reports and detecting system-wide trends or related intrusion incidents.
- Configuration Management: Software, hardware and document configuration management is provided by a commercial off-the shelf (COTS) package configured for each site. Each individual site maintains information regarding the particular site and the SMC maintains system-wide and baseline configurations.

Sustaining Engineering Organization (SEO)

The ECS Sustaining Engineering Organization (SEO), housed at GSFC, provides a system-wide M&O function that is responsive to the ESDIS Project Office and the Project Scientist. Supported by the other M&O organizations, the ECS SEO organization also provides the focus for development organization interactions and assuring that ECS Science goals are met. The following are the SEO Main Functions:

- Analysis of ways to accommodate needed improvements to ECS, including the integration of new technologies and new concepts.
- Evaluating user inputs, conducting operational readiness reviews and performing regular monitoring of M&O activities to assure ECS reliability, maintainability and availability.
- Identifying and (as authorized by the CCB) implementing needed improvements to the current operational version of the ECS hardware, software and/or firmware.
- Providing ECS software support through such activities as planning ECS system integration of science software, developing new ECS custom software, producing, delivering and documenting corrections, modifications and enhancements to ECS software (including commercial off-the-shelf (COTS) software and/or adapting or incorporating COTS software for ECS use.
- Installing and tuning ECS software, COTS packages, operating systems, compilers, tools, utilities, networks and databases.
- Testing new and upgraded ECS software and participating in the operations integration and testing of software at the DAACs, in particular evaluating the results of integration and test to verify that the software will run safely.
- Working with DAAC personnel to analyze system requirements, problems, and anomalies and formulate recommended solutions.
- Coordinating the resolution of ECS system-level problem reports and providing support for the problem resolution process.
- Defining the ECS science operation objectives, priorities, performance metrics/satisfaction criteria and performance reporting.
- Performing ECS configuration management; i.e., maintaining control of ECS baseline-configured hardware, documents, databases and software.
- Managing the ECS M&O training program, including planning, scheduling and conducting all ECS training courses.

Integrated Logistics Support (ILS) Organization

The Integrated Logistics Support (ILS) organization has system-wide responsibility for the management of logistics operations in support of ECS objectives and the science support missions. The organization is concerned with the **system-level** logistics support, especially the installation, maintenance and training functions associated with the procurement of commercial off-the-shelf (COTS) hardware and software. The following highlight the ILS Main Functions:

- Determining requirements for, procuring, and accounting for spares, repair parts and consumable items used to support ECS operations.
- Planning, coordinating and monitoring all installations of ECS equipment at ECS sites.
- Managing and accounting for ECS contractor-purchased, vendor-loaned, and government-furnished equipment and software, including managing COTS software licenses and software maintenance contracts.
- Planning and coordinating vendor-provided training related to COTS equipment and software.
- Planning, coordinating and managing the installation of ECS COTS hardware and software.
- Controlling contractor and government ECS property at the SEO, the SMC and the EOC and maintaining a continuous audit trail from receipt of a COTS item until accountability has been transferred.
- Receiving failed ECS HW from the SMC/EOC Maintenance Coordinator and shipping it to the appropriate maintenance vendor for repair or replacement.
- Monitoring vendor repair actions and the return of repaired or replaced item(s) to the SMC or EOC.

EOS Operations Center

The EOC is located at the Goddard Space Flight Center in Greenbelt, Maryland, and is operated by the Flight Operations Team (FOT). The Flight Operations Team is responsible for maintaining spacecraft and instrument health and safety, monitoring spacecraft performance, performing spacecraft engineering analysis, performing high-level monitoring of the mission performance of the instruments, and providing periodic reports to document the operations of the spacecraft and instruments. The EOC is the EOS mission control center and is responsible for the mission planning, command and control of the U.S. EOS spacecraft and the instruments onboard. The EOC supports the entire EOS mission life cycle, which includes pre-launch, launch, and on-orbit operations that occur in parallel with operator simulations training as well as interface tests, system tests, and end-to-end tests. It supports concurrent operations with maintenance, system upgrades, and sustaining engineering activities, and supports command, control, and analysis of multiple spacecraft and their instruments simultaneously. The following highlight the EOC Main Functions:

- Coordinating multi-instrument, multi-organization observations.
- Resolving any scheduling conflicts that exist between the instruments/organizations.
- Providing the final science conflict resolution.
- Exercising ultimate authority in decisions regarding spacecraft and instrument health and safety.
- Generating a detailed activity schedule for the spacecraft based on instrument operations requests received from PIs and TLs via their ISTs, and information received from the Network Control Center (NCC) and the Flight Dynamics Facility (FDF).
- Forwarding instrument command data and spacecraft command data to the EDOS for uplink to the spacecraft.
- Maintaining spacecraft and instrument health and safety.
- Monitoring spacecraft performance.
- Performing spacecraft sustaining engineering analysis
- Performing high-level monitoring of the mission performance of the instruments.
- Providing periodic reports to document the operations of the spacecraft/instruments.

Operational Software Configuration Overview

As previously mentioned, the major functional components of ECS that affect the M&O Organization are the Science Data Processing Segment (SDPS) and the Communications and System Management Segment (CSMS):

- Science Data Processing Segment (SDPS) includes ECS applications that provide:
  - Data management and archiving functions.
  - A processing environment for the execution of science software.
  - External interfaces for the acquisition of data for processing or archiving.
  - Functions which support the search and retrieval of ECS-managed data by science and other users.
- Communications and System Management Segment (CSMS) is responsible for all communications, networking, and enterprise management functions, including:
  - A distributed applications and operating system infrastructure.
  - Various communications services such as electronic mail and file transfer.
  - Monitoring and management of networking, system, and application resources.
  - Access control and security management.
  - Local area network services and external network connectivity.

Science Data Processing Segment (SDPS)

The Science Data Processing Segment consists of the following subsystems as shown in Figure 10:

- Client Subsystem (CLS)
- Interoperability Subsystem (IOS)
- Data Management Subsystem (DMS)
- Data Server Subsystem (DSS)
- Ingest Subsystem (INS)
- Planning Subsystem (PLS)
- Data Processing Subsystem (DPS)

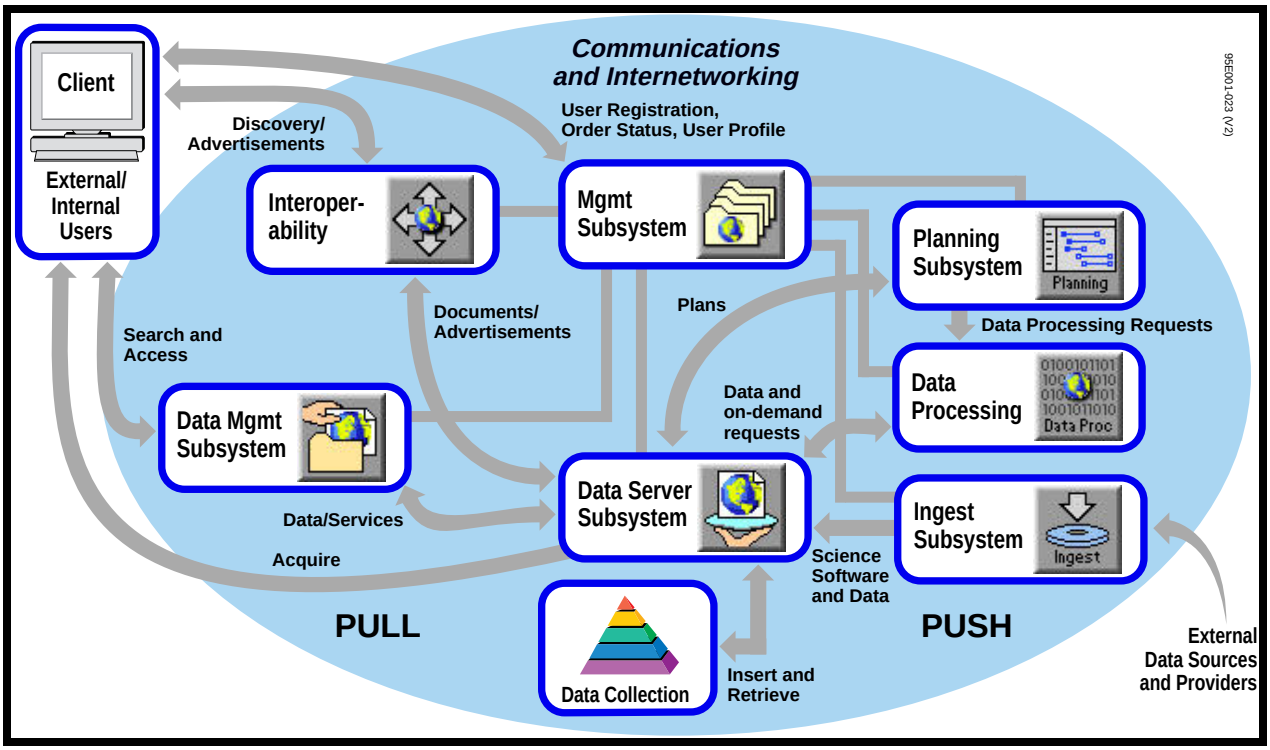

Figure 10. Science Data Processing Segment (SDPS)

SDPS Subsystems. The seven subsystems of the SDPS can be grouped into 4 main categories:

- **Data Storage and Management** as represented by the Data Server Subsystem (DSS), provides the functions needed to archive science data, search for and retrieve archived data, manage the archives, and stage data resources needed as input to science software or resulting as output from their execution.
- **Data Search and Retrieval** (also called the "Data Pull Side" of the system) is represented by the science user interface functions in the Client Subsystem (CLS), data search support functions in the Data Management Subsystem (DMS), and capabilities in the Interoperability Subsystem (IOS) which assist users in locating services and data of interest to them and their projects.
- **Data Processing** (considered a part of the "Data Push Side" of the system) is represented by a processing environment (the Data Processing Subsystem or DPS) for the science software; and capabilities for long and short term planning of science data processing, as well as management of the production environment provided by the Planning Subsystem (PLS).
- **Data Ingest** (also considered part of the "Data Push Side") is represented by the Ingest Subsystem (INS). The subsystem provides the interfaces with external applications, data staging capabilities, and storage for an approximately one-year buffer of Level 0 data (so that reprocessing can be serviced from local storage).

Communications and System Management Segment (CSMS)

The Communications and System Management Segment consists of the following subsystems as shown in Figure 11:

- Communications Subsystem (CSS)
- Systems Management Subsystem (MSS)
- Internetworking Subsystem (ISS)

Communications and System Management Segment (CSMS)

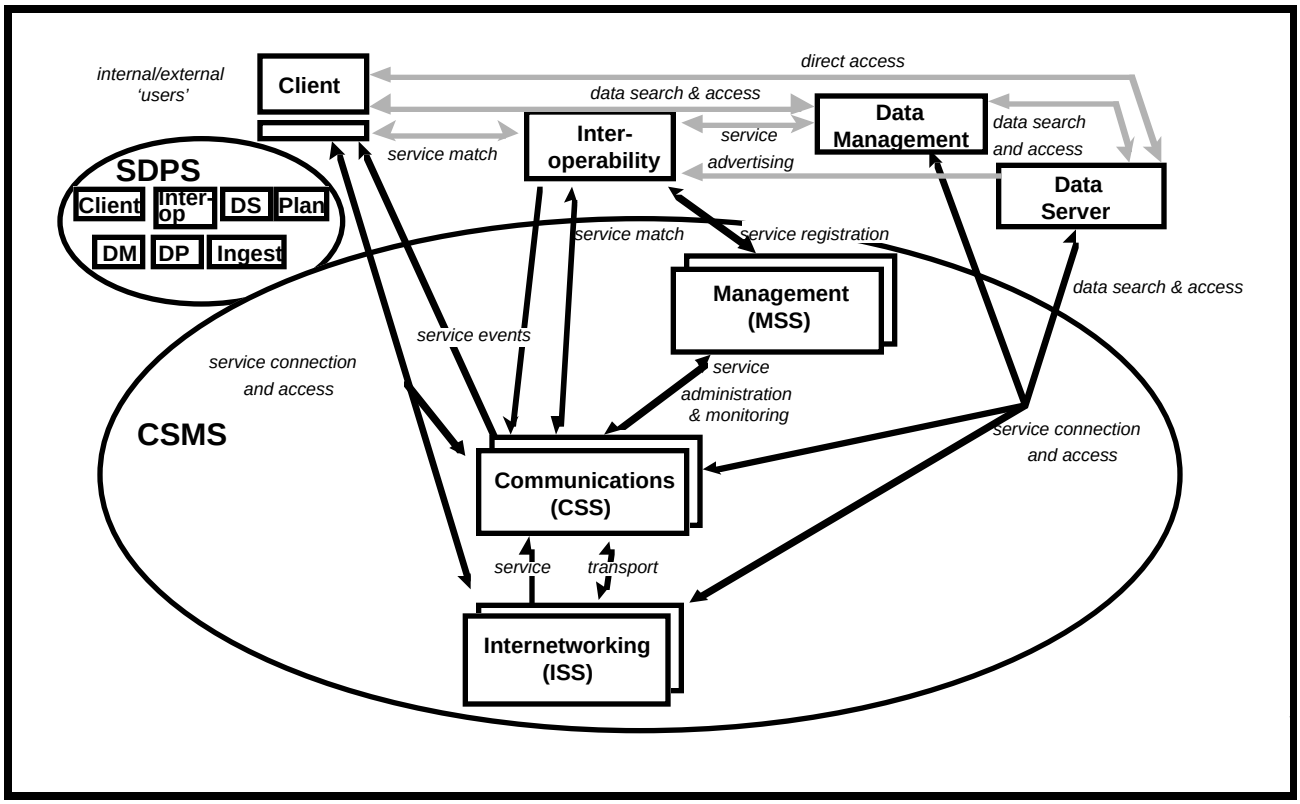

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Figure 11. Communications and System Management Segment (CSMS)

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The **Communications Subsystem (CSS)** is characterized as “middleware” and consists as a collection of services providing interoperability and information transfer among ECS Clients. Important features of the CSS include:

- Common Facilities: Includes communication services required for file transfer, electronic mail, bulletin board and remote terminal support.
- Object Services: Supports all applications with interprocess communication and specialized services such as security, directory, and event handling.
- Distributed Object Framework: Provides services required to support both the development and execution of object-oriented, client-server application services.

The **Systems Management Subsystem (MSS)** provides ECS M&O staff with the capability to perform network and system management services for all ECS resources, including all SDPS, FOS, and CSMS components. MSS is characterized by the following management services:

- Provide policy decisions, coordinate policy, and monitor policy compliance
- Monitor, detect, isolate, diagnose and recover from faults using HPOV.
- Provide system performance analysis via reports.
- Document problem reports, track actions and closure using Remedy.
- Maintain physical location and configuration information using Accugraph.
- Site security using DCE Cell management.
- Software configuration management of ECS baseline.
- Baseline Management for operational system configuration.
- System wide and site-level performance reporting.

The **Internetworking Subsystem (ISS)** provides local area networking (LAN) services at ECS installations to interconnect and transport data among ECS resources. The ISS includes all components associated with LAN services, including routing, switching, and cabling as well as network interface units and communications protocols within ECS resources.

The ISS also provides access services to link the ECS LAN services to Government-furnished wide-area networks (WANs), point-to-point links and institutional network services. Examples include the NSI and various campus networks "adjoining" ECS installations.

Operation Hardware Configuration Overview

The operation hardware description in this section is generalized from available information. There are variations from the generalization from site to site.

ECS Equipment

The operation hardware consists of the following seven general types of equipment:

- Server hosts.
- Science processors.
- Operator interfaces (workstations or X-terminals).
- Temporary data storage units.
- Archive data storage units.
- Printers.
- Network equipment, including fiber distributed data interface (FDDI) network equipment.

The following models of computers, some with single, others with multiple central processing units (CPUs), are manufactured either by Hewlett-Packard (HP), Silicon Graphics, Incorporated (SGI), or Sun MicroSystems (SUN) and function as servers at either the DAACs or SMC:

- HP J210
- HP J210/1
- SGI Challenge L
- SGI Challenge XL
- SGI Indigo2
- SUN Sparc 20/50
- SUN Sparc 20/71
- SUN Sparc 20/712

The following model of computer functions as a science processor at the DAACs:

- SGI PC XL

The following models function as either workstations or X-Terminals at the DAACs:

- HP 715/64 (workstations)
- SUN Sparc 20/50 (workstations)
- NCD HMX-Pro (X-Terminals)

The following items of equipment are available at the DAACs or SMC for use as temporary storage, working storage or database management system (DBMS) data files:

- HP redundant arrays of inexpensive disks (RAIDs)
- SUN RAIDs
- 8mm stackers
- 4mm stackers
- 6250 tape drives
- Compact disk - read-only memory (CD-ROM) drives

The following items of equipment are available at the DAACs for archival storage:

- EMASS Automated Media Library (AML) Mod 2 Archive Robot (1 tower/1 robot)
- 3590 linear magnetic drives

The following model of laser printer is available at the DAACs and SMC:

- HP LaserJet 4M+

Ethernet and fiber distributed data interface (FDDI) network equipment is available at the DAACs or SMC for internetworking.

Types of Equipment Involved in ECS Functions

The operation hardware is configured to perform the following functions as described in the sections that follow:

- Advertising Server (ADSHW)
- Data Management (DMGHW)
- Access Control and Management (ACMHW)
- Working Storage (WKSHW)
- Document Data Server (DDSHW)
- Data Repository (DRPHW)
- Distribution and Ingest Peripherals (DIPHW)
- Ingest Client (ICLHW)
- Planning (PLNHW)
- Science Processing (SPRHW)
- Algorithm Quality Assurance (AQAHW)
- Algorithm Integration and Test (AITHW)
- Distributed Computing (DCHCI)
- Management Hardware (MHCI)
- Internetworking (INCI)

Advertising Server (ADSHW)

The advertising service will be implemented through an SDPS-developed distributed database application on top of a commercial off-the-shelf database management system (Sybase). Advertising will be included in the Interoperability Subsystem.

Data Management Subsystem

The Data Management Subsystem contains one hardware configuration item (HWCI), the Data Management Server HWCI. This HWCI is summarized below:

- **Data Management Server HWCI (DMGHW).** This covers the hardware associated with the LIMGR, DIMGR, GTWAY, and DDICT CSCI. The servers and the operations positions associated with those servers are completely covered by this HWCI. It includes the following:
  - The physical server, disk, channel, (etc.) hardware needed to process the service requests and administrative functions associated with the previously mentioned CSCIs, and to store the administrative and temporary data required for their operation.
  - The workstations, X-Terminals, (etc.) needed to support the operator interfaces to these CSCI at each site. This includes hardware for: DBMS administration, data specialists, user support, phone/mail support, etc. The HWCI does not include the operations position hardware associated with the data servers at each site. These hardware requirements are covered by a separate HWCI.

The following configuration items are available to support data management:

- Data Specialist workstations (SUN Sparc 20/50)
- Database Administrator (DBA) operations workstations (HP 715/64)
- Data management (DMG) servers (HP J210)
- RAIDs (shared by data management servers)

Data Server Subsystem

The Data Server Subsystem contains five (HWCIs): Access Control and Management HWCI, Working Storage HWCI, Document Data Server HWCI, Data Repository HWCI, and the Distribution and Ingest Peripherals HWCI. These HWCIs are summarized below.

- **Access Control & Management HWCI (ACMHW) -** 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 supports many of the infrastructure requirements of the Data Server. The following configuration items are available to support access control and management:
  - Access/process coordinator (APC) servers (SGI Challenge L)
  - RAIDs (shared by servers)
  - Operations workstations (SUN Sparc 20/50)
  - Front-end SUN (SUN Sparc 20/50)
- **Working Storage HWCI (WKSHW).** Working Storage (WS) hardware configuration item supplies a pool of storage used for temporary file and buffer storage within the data Server architecture. WS provides the disk staging capacity for data acquires and inserts. The following configuration items are available to support working storage:
  - RAIDs (shared by FSMS servers)
- **Document Data Server HWCI (DDSHW).** The Document Data Server (DDSRV) provides storage and retrieval services on earth science data type (ESDT) related documents and their metadata. Full text and keyword searching is provided, as well as the support for hypertext presentation of document metadata. Document Data Server supports user access to the Guide and Reference Papers. The following configuration items are available to support document data server operations:
  - Document servers (SUN Sparc 20/712)
  - Front-end SUN (SUN Sparc 20/712)
- **Data Repository HWCI (DRPHW).** This HWCI provides the permanent storage devices associated with the Data Server Subsystem (and some forms of Ingest Data Servers like the L0 Ingest Client). This includes archive robotics, drives, Data Base repositories (with embedded database software), and file servers. The following configuration items are available to support data repository operations:
  - File Storage Management System (FSMS) servers (SGI Challenge XL)
  - Database Management System (DBMS) servers (SGI Challenge XL)
  - Archive robot (EMASS AML/Mod 2)
  - Linear magnetic drives (3590)
  - RAIDs (supporting DBMS servers)

- **Distribution and Ingest Peripherals HWCI (DIPHW).** This HWCI provides the pool of peripherals needed for hard media data distribution and data ingest (the HWCI is shared by the Data Server and Ingest Subsystems). The HWCI includes disk, tape and other media ingest and/or preparation devices (e.g., 8mm tape, CD-ROM, printers) as needed to fulfill requirements of the site. The HWCI also covers the workstations needed by ingest and distribution operators.

The following configuration items are available to support data and ingest peripherals operations:

- Distribution servers (SUN Sparc 20/712)
- RAIDs (shared by distribution servers)
- 8mm tape stacker
- 4mm tape stacker
- Tape drive (6250)
- CD-ROM drive
- Printers (HP LaserJet 4M+)

Ingest Subsystem

The Ingest Subsystem contains one HWCI, the Ingest Client HWCI. This HWCI is summarized below.

- **Ingest Client HWCI (ICLHW).** Note that the Ingest Subsystem includes instantiations of the Data Server Subsystem HWCIs needed for archiving and staging Level 0 Data. The Ingest subsystem also shares Data Server Subsystem input/output peripherals contained in the Distribution & Ingest Peripherals HWCI Ingest Client HWCI (ICLHW). This HWCI covers any servers and/or workstations required for Ingest management, control, monitoring and/or processing. It includes any X-Terminals and/or workstations associated with ingest technician operator positions.

The following configuration items are available to support ingest client operations:

- Ingest servers (SGI Indy or SGI Challenge L)
- Disk array (SUN)
- 8mm tape stackers
- RAIDs (shared by ingest servers)
- X-terminals (NCD HMX-Pro)
- Front-end SUN (SUN Sparc 20/50, SUN Sparc 20/712)

Planning Subsystem

The Planning Subsystem contains one HWCI, the Planning HWCI. This HWCI is summarized below.

- **Planning HWCI (PLNHW).** This HWCI provides workstations (including user interface hardware), and servers as needed, to support production planning, the maintenance of planning data, and the interaction with and reaction to the processing environment during execution, e.g., to accept and process notifications of PGE completion and submit new Data Processing Request (DPR).

The following configuration items are available to support planning operations:

- Planning server (SUN Sparc 20/71)
- Planning workstation (SUN Sparc 20/50)
- RAIDs

Data Processing Subsystem

The Data Processing Subsystem contains three HWCIs: Science Processing HWCI, Algorithm QA HWCI and Algorithm Integration and Test HWCI. These HWCIs are summarized below.

- **Science Processing HWCI (SPRHW).** This HWCI provides all processing pools/strings associated with the following forms of processing: standard, reprocessing, and testing. This includes processing platforms and working storage required during processing. The HWCI also includes workstations for managing the production queues and dispatching processing requests.

The following configuration items are available to support science processing:

- Science processors (SGI PC XL)
- Queuing server (SUN Sparc 20/71)
- X-Terminals (NCD HMX-Pro)
- 8mm tape stacker
- RAIDs

Algorithm QA HWCI (AQAHW)

This HWCI provides the workstations, X-Terminals, and other devices needed for algorithm quality assurance (QA). For example, the HWCI supports the manual QA of algorithm results within the DAAC. The HWCI will execute the Client Subsystem, as well as additional user interface software needed to give the QA staff access to QA-related information.

The following configuration item is available to support QA:

- QA workstation (SGI Indigo2)

Algorithm Integration and Test HWCI (AITHW)

This HWCI provides the workstations, X-Terminals, and other devices needed by the algorithm I&T staff. Hardware needed to run tests in simulated production mode is part of the SPRHW. The HWCI will execute, for example, software development tools, test and integration tools, and the Client Subsystem.

The following configuration items are available to support algorithm integration and test operations:

- Algorithm integration and test (AIT) workstations/DBMS servers (SUN Sparc 20/50)
- AIT workstations (SUN Sparc 20/50)
- Printers (HP LaserJet 4M+)

Communications Subsystem

The Communications Subsystem contains one HWCI, the Distributed Computing HWCI. This HWCI is summarized below.

- **Distributed Computing HWCI (DCHCI).** The Distributed Communications Hardware CI (DCHCI) logically includes an enterprise communications server, a local communications server, and a bulletin board server. The complete configuration of the CSS and MSS HWCIs, based on the combined requirements of the subsystems and site-specific requirements, are presented in the site-specific subdocuments.

The following configuration items are available to support the communications subsystem:

- Communications Subsystem (CSS) server (HP J210/1)
- Bulletin board (BB) server (SUN Sparc 20/50) (SMC)
- RAID (shared with the Management Subsystem)

Systems Management Subsystem

The Communications Subsystem contains one HWCI, the Management Hardware HWCI. This HWCI is summarized below.

- **Management Hardware HWCI (MHCI).** This HWCI provides the servers and workstations needed to host the enterprise monitoring, local management and configuration management software, CM data, and backup copies of all ECS "infrastructure" software.

The following configuration items are available to support the management subsystem at the DAACs or the SMC:

- Management subsystem (MSS) servers (HP J210/1)
- Configuration management (CM) servers (SUN Sparc 2/50 or SUN Sparc 20/71)
- MSS Netscape server (SUN Sparc 20/50)
- MSS workstations (SUN Sparc 20/50)

- RAIDs (shared with the Communications Subsystem)
- SUN Disks
- Printers (HP LaserJet 4M+)

Internetworking Subsystem

The Internetworking Subsystem contains one HWCI, the Internetworking Hardware HWCI. This HWCI is summarized below.

- Internetworking Hardware HWCI (INCI)
- This HWCI provides the networking hardware for the intra-DAAC, DAAC to V0, DAAC to EBnet, SMC, and EOC connectivity.

The following configuration items are available to support internetworking at the DAACs or the SMC:

- FDDI switch
- Atlantec Power Hub 7000 with FDDI cards and power supplies
- FDDI concentrators
- Bay networks
- FDDI cables
- Ethernet hub
- Cabletron Micro MAC-22E w/BRIM F6
- Ethernet cables
- Local area network (LAN) analyzer
- Communications cabinets

Commercial Off-the-Shelf (COTS) Software Overview

Commercial Off-the-Shelf (COTS) Software

The commercial off-the-shelf (COTS) software consists of the following packages:

- HP OpenView
- Remedy
- Tivoli
- Sybase
- AMASS
- Illustra
- Distributed Defect Tracking System (DDTS)
- MountainView
- HAL
- AutoSys/AutoXpert
- Delphi
- ClearCase
- XRP-II

HP OpenView

HP OpenView (HPOV) is a software tool that the Management Subsystem (MSS) uses in real time to monitor and report on the performance of ECS hardware components. Its features and capabilities include:

- Display of the current status of ECS hardware resources.
- Access and display of performance data that has been logged by the database management program (Sybase). For example, an operator can request HP OpenView to display a graph of interface traffic, a graph of central processing unit (CPU) load, or an event history log.
- System monitoring, with pop-up window and audible alarm to alert the resource manager. HP OpenView also sends a message to the production monitor and user services informing them of the fact that there is a hardware failure that will affect production.

HP OpenView is used most frequently by those ECS personnel who are involved in resource management and fault management at the SMC, the DAACs and the SEO, for example, the SMC Resource Controller, the SMC Fault Manager, the SMC Computer Operators, the DAAC Resource Manager, the DAAC System Test Engineer, and the DAAC Computer Operators and the SEO System Test Engineer.

Remedy

Remedy is a computer database tool in the MSS. It is used primarily for managing trouble tickets that originate within ECS. (Trouble tickets from external sources are submitted through the Trouble Ticketing Home Page on the Internet.) In addition, it maintains the user contact logs for User Services.

Remedy provides the following services:

- Documenting problems with ECS hardware, software, documentation or procedures.
  - The Remedy database is updated as the trouble ticket passes through the various steps of the problem management process.
  - Personnel at other ECS sites can be notified of the problem and have the opportunity to provide input concerning their assessment of the problem and how to resolve it.
  - Remedy can be queried to determine the current status of a particular trouble ticket (keep track of action taken).
  - Remedy produces reports when information is needed about one or more trouble tickets, such as whether there are trends showing up in trouble tickets.
  - Remedy can escalate the priority of a trouble ticket if the trouble ticket does not progress through the problem management process in a timely manner.
- Recording interactions with members of the user community (via user contact logs) and tracking follow-up activities.

Remedy is used by all internal personnel who use ECS for the purpose of submitting problems for investigation and resolution. It is used by those personnel who are involved in problem management at the SMC, the DAACs and the SEO, especially, the operations supervisors and system engineers. The SMC Configuration Management (CM) Administrator, the DAAC Operations Readiness and Performance Assurance Analyst and the SEO Operations Readiness and Performance Assurance Analyst are the database administrators for Remedy.

User Services personnel use Remedy for maintaining user contact logs.

Tivoli

Tivoli is a set of utility programs available through the Management Subsystem (MSS). Tivoli programs perform the following functions:

- Tivoli/Admin
  - Host management.
  - Operator (M&O) account management.
  - Group (UNIX) management.
- Tivoli/Sentry
  - Monitoring system resources and services [some software and non-SNMP (simple network management protocol) resources].
- Tivoli/Enterprise Console
  - Resource management from a central location.
  - Collection of management events from other Tivoli applications, Tivoli partner applications, and Tivoli logfile adapters.

Sybase

The SDPS uses an off-the-shelf relational database management system (DBMS) called Sybase located on the Data Servers 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). Other Sybase capabilities include:

- Management of other databases (e.g., site event history database collected via the MSS interfaces from the various ECS resources at each ECS site).
- Sybase query and report writing capabilities are used to extract regular and ad-hoc reports from it.
- Physical storage access and management functions on the Data Server Subsystem 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 SMC Fault Manager, who is responsible for system-wide fault data collection, trending, long-term fault analysis, etc., uses detailed data extracted using Sybase that is provided by the sites. If necessary the SMC Fault Manager can “query” site databases for details. The DAAC Database Administrator uses Sybase database administration and reporting writing tools to perform the database administration utilities, such as database backup, Database Transaction Logs maintenance and database recovery due to Database access error, Sybase read/write errors.

AMASS

AMASS is a file storage management system (FSMS) for the UNIX operating system. The purpose of AMASS in ECS is to provide an easy-to-use interface to a large tape archive in the Data Server Subsystem (DSS), e.g., the EMASS AML/Mod 2 science data archive.

The DAAC Archive Managers use AMASS for managing archive operations.

Illustra

Illustra is an off-the-shelf relational database management system (DBMS). It is located on the Document Data Server. It handles all of the system documents to be maintained in ECS; e.g., guide documents, production plans, reference papers, algorithm descriptions and algorithm packages.

Distributed Defect Tracking System (DDTS)

The Distributed Defect Tracking System (DDTS) is a software tool that is available through the Management Subsystem (MSS). It is used for the following functions:

- Support configuration management by acting as the ECS Change Request Manager.
- Track Configuration Change Requests (CCRs).

The CM Administrators at the SMC, DAACs and SEO act as database administrators for DDTS at the appropriate levels. The SMC/EOC Maintenance Coordinator and the DAAC Maintenance Coordinators record configuration changes (e.g., completed installation of approved software upgrade) using DDTS. The ILS Logistics Engineer uses DDTS for monitoring and reporting logistics activities.

MountainView

MountainView is the network physical configuration management software. It provides the following capabilities:

- Track, manage, and control all the physical elements in the network.
- Integrate graphics with data to create a complete electronic model of the physical infrastructure of the network.
- Tools to locate physical proximity of down nodes, place newly discovered nodes, and manage circuit changes.
- Support for a variety of network administration applications including inventory, billing, and troubleshooting.
- Mechanisms for tracking everything from maintenance data and network protocol data to software registration.
- Tracking the physical location of configuration items and detecting changes to the approved configuration.
- Integration support for several Trouble Ticket applications.

HAL

HAL is a software package that aids in providing security services for the ECS distributed computing environment (DCE). The security design provides for a “cell” around each DAAC set of resources to prevent general public access into production environments. Of course there is a host with low security to provide public access (through a “gateway”). HAL is the DCE cell manager residing in the MSS. It provides a graphical DCE Cell Management capability.

The SMC Resource Controller, DAAC Resource Manager, DAAC System Administrator, and the SEO System Administrator use HAL in managing the applicable DCE cells. The DAAC Database Administrator maintains user accounts for the users from the external system in both the DCE and Kerberos Security databases and creates user registration and account access control permissions in the Security databases.

AutoSys/AutoXpert

The AutoSys/AutoXpert software is a production scheduling tool intended to support the operational activities surrounding production processing in the SDPS. Its features and capabilities include:

- Job monitoring, scheduling, fault notification and restart capabilities.
- Assist the Production Monitor in determining the effects of failure of a Data Processing Request (DPR) and in determining the cause and actions to be taken due to the failure (although it does not perform any planning activities).
- AutoSys scheduling software is part of the Data Processing Subsystem (DPS).
- Displays the DPRs as job boxes. Each DPR represents the execution of a single science software Product Generation Executive (PGE). Any DPRs that have dependencies on data which are not yet available, are kept in a "held" state by AutoSys until their data availability subscriptions are fulfilled.

The DAAC Production Monitor uses AutoSys/AutoXpert for monitoring/managing on-demand thresholds processing queues to optimize resource utilization, modifying DPR priorities and inputs as required, transferring/deleting/suspending/resuming DPRs as required (e.g., requests, resource problems, input data schedule problems, special events, schedules replans, etc.). In addition, the Production Monitor uses AutoSys/AutoXpert to monitor/provide processing status upon request, monitor/review input and output data, and implement production system reconfiguration in response to operations anomalies.

Delphi

Delphi software is a production planning/scheduling tool intended to support the production processing in the SDPS. It resides between the resource/production planning custom software and AutoSys/AutoXpert. Delphi is an aid to fitting production job schedules within the anticipated resource constraints. It makes it possible to see (on a chart) how resources are scheduled and visually identify schedule conflicts. When a planner submits a candidate plan, Delphi pops up automatically with a chart of the schedule, including conflicts.

The DAAC Production Planner and Resource Planner use Delphi to assist in scheduling resources and production jobs.

ClearCase

ClearCase is the ECS software baseline and change manager in the MSS. Its capabilities and features include:

- Providing version control of software objects.
- Supporting installation of approved new versions of software. New versions are first entered into ClearCase, which is then used for installing the new software code.
- Checking software to confirm suspected software problems. As with new software, revised software is installed through ClearCase.

The CM Administrators at the DAACs, SMC, and SEO act as the database administrators for several tools including the Software Change Manager (ClearCase). As such they record, report, manage and distribute changes to custom ECS software, science software and database control files in the ClearCase tool.

The SMC Network Analyst uses ClearCase when exercising control and/or monitoring configuration of the SMC local area network (LAN), storing the configuration information collected and displaying the configuration for reporting purposes. The DAAC and SEO Software Maintenance Engineers use ClearCase to make changes to custom ECS software and database control files.

XRP-II

The configuration management Baseline Manager in the MSS is XRP-II. It supports the management of ECS resources by tracking what constitutes ECS baselines. It provides ECS with the following capabilities:

- Making available functional and physical characteristics data needed to operate and maintain the system.
- Aiding in managing system requirements and changes.
- Providing reports.
- Maintaining details about system resources (hardware, software, and assemblies), documents, and baselines.

The CM Administrators at the DAACs, SMC, and SEO act as the database administrators for several tools including the Baseline Manager (XRP-II). As such they use XRP-II to record, report and maintain system-level changes to the as-built operational baseline of ECS products. They generate the Configuration Status Accounting Records (CSAR) and maintain inventory of control items and version control of ECS Configuration Items.

The DAAC and SMC/EOC Maintenance Coordinators interface with XRP-II to determine present configuration and/or to determine if a configuration change has resulted from a maintenance action.

The DAAC Administrative Assistant uses XRP-II when maintaining the DAAC ECS Technical Library database listing. The SEO Librarian maintains document inventory and links to the ECS Configuration Items in XRP-II with support and coordination of the SMC Configuration Management Administrator.

The ILS Logistics Engineer uses XRP-II in monitoring and reporting logistics activities. The ECS Property Administrator uses XRP-II as one of the tools for ensuring the accuracy of property records (by reconciling VCATS records with the Inventory, Logistics and Maintenance Manager (MSS) and XRP-II).

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Operational Processes

System Operations Management and System Operations

Operational processes are discussed more in terms of what M&O personnel do rather than what the system does.

The System Operations Management activities described in this section are:

- System Administration.
- Network Administration.
- Problem Management.
- System Troubleshooting.
- Configuration Management.

The Science Operations activities described in this section are:

- Ingest.
- Archive.
- Data Distribution.
- Production Planning and Processing.
- Resource Planning.
- Database Administration.
- User Services.
- Science Software Integration and Test.

System Operations Management Activities

System Administration

System administration involves performing such functions as installing workstations, starting up and shutting down the system, backing up and restoring the system, maintaining the system log, controlling access to the system, and monitoring system security. The DAAC, SMC and SEO System Administrators perform most of the system administration functions. Among the tasks they perform are the following items:

- Create, modify, delete and maintain accounts for ECS personnel.
- Initialize hosts and workstations.
- Perform preventive maintenance for all office staff and operations support hosts and workstations.
- Diagnose and correct system problems on-demand.

- Document, investigate and resolve errors, faults and observations for site hosts, peripherals and workstations.
- Coordinate system maintenance scheduling with other ECS centers.
- Monitor workstation performance - tuning when applicable.
- Maintain local-area network (LAN) and local distributed computing environment (DCE) configuration.
- Provide system-level management of directory services.
- Perform backups and recoveries.
- Install latest version of ECS and COTS software on hosts and workstations.
- Administrating the Advertising Service

Among the important software tools used in system administration are HAL, Illustra, HP OpenView, Remedy and the Management Subsystem (MSS) graphical user interfaces (GUIs).

Network Administration

Network administration includes network performance monitoring, supporting and maintaining the high-level network event schedule and reporting on network operations. The SMC, SEO and DAAC System Administrators, SMC Network Analyst and DAAC Resource Managers perform network administration functions.

As previously mentioned, the SMC, SEO and DAAC System Administrators are responsible for maintaining LAN and local DCE configuration.

The Network Analyst is responsible for performing the following tasks (among others):

- Provides performance monitoring of networks (e.g., EBnet, NSI, GSFC DAAC User Network)
- Provides a focal point (in cooperation with affected sites) for inter-ECS network problems.
- Coordinates with external network operations organizations (e.g., EBnet, NSI, GSFC DAAC User Network) on such issues as:
  - configuration scheduling/compatibility.
  - fault isolation and resolution.
  - change planning.
  - performance reporting.
- Interacts with external systems on inter-system problems (EBnet).
- Supports and maintains the high-level network event schedule.
- Analyzes soft and hard copy reports on network effectiveness, productivity, capacity and performance (e.g., LAN errors and faults).
- Analyzes network faults.

- Supports fault diagnosis testing for hardware, software and resource-to-resource connectivity.
- Monitors network security and responds to security alarms and events.

The DAAC Resource Managers coordinate with SMC for network problems and DAAC reconfigurations in response to ECS system anomalies. They are responsible for site hardware, software, LAN and local DCE cell configuration, allocation and utilization performance. They coordinate local network activities with other network management centers (e.g., SMC, NSI, other DAACs, etc.).

Software resources that are frequently used in network administration include ClearCase, HP OpenView and Remedy.

Problem Management

Problem management is a process of identifying, documenting, investigating, and resolving problems with ECS hardware, software, documentation, and procedures. It involves all M&O operations and support personnel because all have at least the responsibility to report problems that they encounter. Specific functions involved in problem management include writing trouble tickets and managing trouble tickets through the problem resolution process.

The SMC CM Administrator acts as database administrator for the Trouble Ticketing Service at the SMC. The SEO and DAAC Operations Readiness and Performance Assurance Analysts are the Trouble Ticketing Service database administrators at their ECS centers.

Remedy is the software package through which M&O personnel have access to the Trouble Ticketing Service.

System Troubleshooting

System troubleshooting is a process of identifying, locating, analyzing, and determining the cause of system hardware and software faults. It involves system monitoring to check system status and performance. All ECS operators participate in troubleshooting of the systems they operate. The SMC, DAAC and SEO System Administrators perform troubleshooting of their systems as part of their maintenance responsibilities. The SMC Fault Manager provides a focal point for inter-ECS site problems and provides support for other centers' troubleshooting activities. The SMC Fault Manager's support for fault isolation, diagnosis, analysis, includes the following tasks:

- Evaluates fault data from multiple sources.
- Runs network analysis tools as required.
- Provides common point of contact to external systems.
- Evaluates cross-site incident reports.
- Resolves trouble tickets escalated from sites.

- Correlates with trouble tickets status data from external providers.
- Coordinates and distributes problem resolutions common to all sites.
- Performs system-wide fault data collection, trending, long-term fault analysis, planning and information distribution across multiple local system managements (LSMs) and networks.

Software resources that are frequently used during system troubleshooting include HP OpenView, Tivoli, Sybase, Remedy, ClearCase and the MSS GUIs.

Configuration Management

Configuration management is a process for ensuring that hardware, software, and procedure changes to the baseline are properly documented and coordinated. The SMC, DAAC and SEO CM Administrators provide configuration management and monitoring at their respective levels. They act as database managers for such tools as the Change Request Manager, SW Change Manager, and Baseline Manager. They provide support to their respective Configuration Control Boards and Trouble Ticket Review Boards. Library administration involves managing documents related to the operational baseline. The documents include system requirements, design, interfaces and baselined operations plans. Baselined ECS documents are entered into the Document Data Server and are controlled at sites and at the system-level. Library administration includes processing change packages for distribution and maintaining and updating the controlled master copy of all documents. The SEO Librarian maintains the ECS system-level technical library. In addition, the SEO Librarian serves as the Database Administrator for the Document Data Server Subsystem which is used for managing documents related to the operational baseline. The DAAC Administrative Assistants administer the DAAC ECS technical libraries. The following tasks in are performed in these roles:

- Change Request Manager.
  - Record and manage proposed and approved Configuration Change Requests (CCRs) in the Change Request Manager (DDTS).
  - Act as the Change Request Manager database administrator.
  - Coordinate all center CCRs with external interfaces.
  - Coordinate impact assessments and propagating system CCR resolutions to the site-level.
  - Provide support for the deliberations of the Configuration Control Board.

- SW CM Manager.
  - Record, report, manage and distribute changes to custom ECS SW, science SW and database control files.
  - Maintain privileged access to the ECS SW library for the Sustaining Engineering Organization, Maintenance Engineers and off-site facilities (EDF, DAACs and EOC).
- Baseline Manager.
  - Record, report and maintain system-level changes to the as-built operational baseline of ECS products in the Baseline Manager.
  - Generate the Configuration Status Accounting Records (CSAR).
  - Maintain inventory of control items and version control of ECS Configuration Items and ECS Technical Library.
  - Note that CM Administrators have the responsibility for maintaining control of all controlled documents.

Software resources that are essential to configuration management include ClearCase, XRP-II, DDTS, Tivoli, and Remedy.

Science Operations Activities

Ingest

Ingest refers to the functions performed when data are initially received at an EOSDIS facility for subsequent processing and incorporation in the archives. Data may be delivered through any of a wide variety of media, including electronically via communications networks, on tapes, disks or hardcopy. The data received are transferred to a magnetic disk in the data server either via an electronic file transfer or by reading the data from hard media. (A specialized ingest client reads data from hard media and transfers it to the data server's internal disks.)

Ingest functions include receiving, logging and marking all non-electronic media for processing and storage, either returning original media to those who sent them or filing/storing them; and coordinating with data senders to resolve any ingest problems. It involves creating and submitting data availability notices (DANs).

The DAAC Ingest/Distribution Technicians perform the preceding functions and assist the DAAC Archive Managers in monitoring the performance of the ingest function. DAAC Ingest/Distribution Technicians perform the following tasks related to ingest:

- Monitor and report on the performance of data requests, data arrival and delivery schedules.
- Monitor the receipt, validation and internal distribution of incoming data and metadata.

- Manage the ingest data queue.
- Perform actions necessary for the system to ingest approved hard-media data and metadata including mounting, monitoring quality assessment, logging, creating metadata and archiving.
- Coordinate input data schedules and quality problems with external data providers and the DAAC Production Monitor.
- Report the status and performance of data ingest operations to the DAAC Archive Manager.

The DAAC Ingest/Distribution Technicians use the Ingest Subsystem GUIs when performing ingest functions.

Archive

Archive functions are centered on putting data into the archive and retrieving data from the archive. Archiving functions affect and are affected by the data ingest and distribution functions. Ingest is the source of data to be archived; the archive is the source of data to be distributed.

The data server accepts, processes, and stores data. Robotics linear tape technology provides the primary data storage mechanism.

The DAAC Archive Managers monitor data archiving to ensure that the data are properly logged into and out of the ECS system. The Archive Managers maintain the catalog of data and monitor the distribution of data that is made available for use by science and the operations community on demand. They ensure the viability and safety of storage media and replace or repair media as necessary. Among other functions, the DAAC Archive Managers perform the following tasks:

- Monitor the performance of science data ingest, archiving, and distribution operations.
- Establish and maintain configuration of peripherals and associated data servers.
- Document and support investigation of archive errors and faults.
- Maintain site data catalogue and data directory.
- Supervise the DAAC Ingest/Distribution Technicians.
- Manage ingest, distribution and archiving data servers.
- Manage the archive processing queue (order, priority, data content, approval status).
- Manage archive content and capacity.
  - Perform approved data deletions, archive backups and restorations.
  - Perform periodic data sampling to ensure data integrity.
- Submit new data archive requests to the DAAC Science Coordinator for review/approval processing and review/creation of metadata, browse and advertising data.

The DAAC Archive Managers monitor the performance of the archives from workstation consoles using both ingest and data server subsystem supplied GUI tools.

Data Distribution

Data distribution involves providing archived data to those who request it. Data are distributed in several forms, e.g., electronic (over a communications network), compact disk (CD), tape, etc.

Data routing and processing is dictated by the nature of the data distribution request. Electronic distribution supports file transfers in both "push" and "pull" modes. Electronic "push" is where the data server itself, based on information contained in the distribution request, places data on a destination storage resource of the requester's choosing. This is done asynchronously from the requester's point of view. Electronic "pull" is where the data server supplies information in a data availability notification to the requester. This notification alerts the requester to the availability of the data and supplies the information necessary for the requester to initiate a file transfer procedure. Data identified as pull data are retained in the manner identified in the data availability notification for a finite period of time. Data can also be distributed via hard media such as 8-mm and 6250-bpi tape or CD.

In addition to performing functions related to data ingest, the DAAC Ingest/Distribution Technicians perform data distribution tasks. Among other tasks the Ingest/Distribution Technicians perform the following tasks:

- Monitor and report performance of data requests and delivery schedules.
- Perform approved data transfer to hard media, logging, data validation monitoring, labeling and shipping.
- Monitor non-electronic output data schedules, status and data quality.
  - Manage the output data queue (delete, suspend, resume, change priority).
- Document and support investigation of data archival and distribution errors and faults.
- Manage hard copy output consumable and supplies.
- Provide mail distribution.
- Report status and performance of data distribution operations to the DAAC Archive Managers.
- Review and monitor data output subscription status.

The DAAC Ingest/Distribution Technicians use a workstation console that provides access to data server subsystem GUI tools.

Production Planning and Processing

The goal of production planning is to make optimum use of computing resources when generating science data products (during production processing). As a result science data products are generated according to plans/schedules for the production processing/reprocessing of ECS data. Production planning also assesses the impact of algorithm changes or reallocations on data transfer requirements and on the processing schedule of other products.

The DAAC Production Planners develop daily, weekly and monthly DAAC science production schedules. They maintain the production database, specifying science software characteristics and production priorities.

The DAAC Production Monitors manage processing schedules and monitor science software execution.

The following tasks describe some of the functions performed by Production Planners:

- In coordination with data providers, develop, and maintain Data Availability Schedules.
- Approve, develop, add, delete, modify, review and validate processing requests.
- Develop daily, weekly and monthly production resource requirements and provide schedules to the Resource Planners.
- Develop and maintain primary and alternate plans and schedules and their associated Data Processing Requests in response to loading/resource changes.
- Manage the Production Planning Database based on science software I&T, instrument team inputs and DAAC policies.
- Develop production operations plans/schedules.
- Develop production plans/schedules to support science software I&T and site system testing and training.
- Coordinate production schedule interdependencies/problems with other producer-receiver sites and SMC.

The following tasks describe some of the functions performed by Production Monitors:

- Monitor Data Processing Request (DPR) validation.
- Monitor/manage processing queues to make optimum use of production resources.
  - Modify DPR priorities and inputs as required.
  - Transfer/delete/suspend/resume DPRs as required (e.g., in response to requests, resource problems, input data schedule problems, special events, schedules replans, etc.).
- Monitor processing status.
- Monitor input and output data.

- Provide real-time science product QA support.
- Implement production system reconfiguration in response to anomalies in production operations.
- Monitor and analyze resource configurations and utilization.
  - Provide feedback to Resource Planners and Production Planners to aid in making optimum use of the system.
- Perform on-line authorized production replans as required in response to processing anomalies.
- Provide support for Science Software Integration And Test (SSI&T)

The DAAC Production Planners use a workstation console that provides access to the Production Request Editor GUI and the Planning Workbench GUI. Among the principal tools used by DAAC Production Monitors are AutoSys and the Planning Workbench GUI.

Resource Planning

Production planning depends upon having the resources available to process data processing requests. Resource planning applies to production processing hardware that includes host computers, storage devices, (sub)networks, and 'strings' that are made up of computers and storage devices. Resource planning involves reserving time for various events on the resources. The events include production, maintenance, testing and training. Reservations are needed to prevent conflicts between events. In addition to entering resource reservation requests, it is possible to plan and allocate the use of resources. The Resource Planner determines what resources are available for production processing. The Production Planner uses that information (in conjunction with other data) to prepare the production plan.

The DAAC Resource Planners are responsible for reviewing and integrating all resource requests for DAAC system resources into daily, weekly and monthly DAAC resource schedules. The following tasks describe some of the functions performed by Resource Planners:

- Ensure that all resource requests are validated and approved.
- Schedule all resources on a daily, weekly and monthly basis.
- Provide assistance for resource scheduling.
- Distribute proposed resource schedules for review.
- Conduct schedule meetings for coordination and DAAC management approval of resource schedules.
- Publish and distribute approved DAAC resource schedules.

Among the principal tools used by the DAAC Resource Planners are the Resource Planning Workbench GUIs and the Resource Definition GUI.

Database Administration

Database administration involves the maintenance of database by installing SQL server products, managing disk storage space, managing ECS personnel accounts and privileges, and performing database backup and recovery operations.

The DAAC Database Administrators maintain the databases and perform structure management for the integrated SDPS. They initiate database administration utilities, such as database backup and recovery, performance monitoring and tuning. The following tasks are among the functions performed by Database Administrators:

- Perform the database administration utilities, such as database backup, maintenance of database transaction logs, and database recovery.
- Monitor and tune the physical allocation of database resources.
- Maintain user accounts for users from the external system.
- Create user registration and account access control permissions in the security databases.
- Work with Data Specialists in information management tasks involving databases, data sets and metadata management.
- Perform daily database synchronization.

The DAAC Database Administrators use Sybase and Illustra database administration and reporting writing tools.

User Services

There are four major categories of functions that constitute user services. They are accomplished using the User Contact Log, the User Registration Service, the Data Search and Order Services (earth science Search Tool and Advertising Service), and the Order Tracking Service. Advertising, network monitoring, and trouble ticketing functions are also involved in user services when it is necessary to investigate and report a problem a user is having with the network or with the system software or hardware.

The DAAC User Services Representatives provide services and expertise necessary to facilitate users' access to and use of EOSDIS-related systems, data, software, tools, services and products. Users can contact User Services Representatives by e-mail, fax, mail, Internet and WWW tools (Mosaic, TCP Connect, etc.), telephone or by walking into a DAAC. The User Services Organization also assists with the data ingest/advertising efforts of the DAAC, and provides local DAAC management with routine and on-demand reports on various User Services-related topics.

The following tasks are among the functions performed by the DAAC User Services Representatives:

- Assist users in locating and gaining access to EOSDIS-related data regardless of location. (May include referral to non-EOSDIS centers.)

- Assist users with EOSDIS-related catalog, search and order systems, bulletin boards, tools kits, services, etc.
- Provide assistance and/or sources of in-depth expertise to users experiencing difficulties with EOSDIS on-line systems or tool kits, and/or center-specific data sets, software, on-line systems or tools, including hardware requirements necessary to operate these systems.
- Provide users directly with the necessary information and/or with the sources of in-depth expertise on instruments, data sets, and projects for them to assess the applicability of EOSDIS-related products to their individual studies or research.
- Provide users with product update information; e.g., processing/validation news, new products.
- Provide users with information on the status of their order.
- Work with users who have received data, software or documents and who are having difficulties with their orders because their orders were not filled properly, data errors or difficulty in using the products delivered.
- Attend/participate in user community and provider-sponsored activities to increase knowledge of user community/products/services and to promote site/system products and services.
- Periodically poll/survey the user community to assess user satisfaction and requirements.
- Develop/sponsor system changes based on experience and user recommendations.
- Document user problems and support problem resolution.
- Provide account and profile information, status and assistance to users, including billing questions.

Among the principal tools used by the DAAC User Services Representatives are the User Registration Tool, the User Contact Log, the User Profile Database query tool, the Document Data Server Search Tools, the Advertising Service, the Trouble Ticket Service, the CCR query tool, the Order Tracking Tool, and the Network Monitor.

Science Software Integration and Test

Science data production software is developed independently of ECS at SCFs, which may employ different computing hardware and different operating systems. Consequently, Science Software Integration and Test (SSI&T) functions must be performed to ensure that science production software packages are properly integrated into the production environment at the applicable DAAC(s). During SSI&T the science data production software is tested to determine its ability to run to normal completion repeatedly over the normal range of data inputs and run-time conditions. Furthermore, the SSI&T process seeks to ensure that the software executes without interfering with DAAC operations or with other software executing at the DAAC. SSI&T is performed at each DAAC responsible for generating the respective product(s).

The DAAC Science Software I&T Support Engineers provide DAAC SSI&T execution support, ECS tool and system expertise and science software processing problem support. They provide support to scientists in the development and integration of science software for both updates and new science software into the DAAC ECS system. The following tasks are among the functions that DAAC Science Software I&T Support Engineers perform:

- Provide support to Instrument Teams for the development and integration of science software into the DAAC ECS system.
- Perform standards checking on all delivered software, including source code, scripts, process control files and related documentation.
- Provide support for metadata updates and additions for science data products.
- Support science processing problem investigation and resolution.
- Recommend, assess, develop, and implement changes to science toolkit software.
- Provide support for the integration and testing of new and modified toolkit functions into the science software.

The DAAC Science Data Specialists serve as the DAAC interface to the Instrument Teams for SSI&T. The following tasks are among the functions that DAAC Science Data Specialists perform in support of SSI&T:

- Interface with the ECS Science office, DAAC and IT and lead ECS-related long-range planning and preparations for data set SSI&T.
- Sponsor IT requests for DAAC testing resources, receive IT delivery and lead DAAC review and feedback, lead DAAC SSI&T team, including problem resolution management, provide progress reports to DAAC management and conduct the acceptance reviews to DAAC management.

ClearCase is one of the principal software tools used during SSI&T.

Practical Exercise

Introduction

This exercise is intended to give the students an orientation to the facility, perform login to the system and to familiarize them with a few of the features of the system.

Equipment and Materials

ECS Facility.

One ECS workstation per student.

Tour of the Facility

The exercise involves taking a tour of the facility. The purpose is to become familiar with the layout of the facility and the locations of ECS components within the facility.

Perform the following steps:

1. Follow a tour guide on a tour of the facility and observe the positions of ECS components in the facility.
2. Ask the tour guide relevant questions.

Performing an Operator Login and Logout

The exercise involves logging in to and out from the ECS. The exercise begins with the instructor demonstrating an operator login.

Perform the following steps:

1. Observe the instructor's login to ECS.
2. Log in to ECS.
3. Observe the features of ECS as the instructor describes them.
4. Observe the instructor's logout from ECS.
5. Log out from ECS.

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Slide Presentation

Slide Presentation Description

The following slide presentation represents the slides used by the instructor during the conduct of this lesson.

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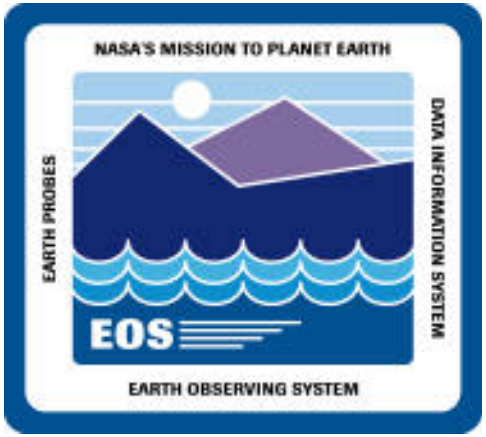
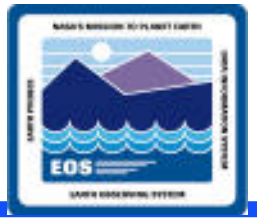


INTRODUCTION AND SYSTEM OVERVIEW

ECS Version 2.0 Training

Overview of Lesson



- Introduction
- ECS Overview
- Version 2.0
- System Functional Overview
- Operational Software Configuration Overview
- Operation Hardware Configuration Overview
- Commercial Off-the-Shelf (COTS) Software Overview
- Operational Processes

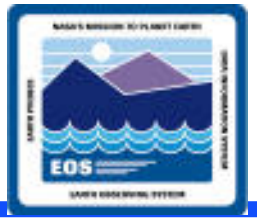
Overview of Lesson (Cont.)

- **Practical Exercises**
  - **Tour of the facility**
  - **Performing an operator login and logout**

Objectives

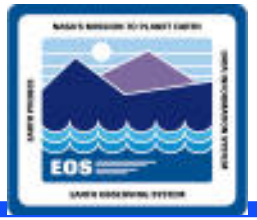
- **OVERALL:**
  - **Describe the mission, goals, objectives, structure, functions, products, services and users of ECS**
- **SPECIFIC:**
  - **Describe the mission of ECS**
  - **Describe how the ECS functions in terms of:**
    - » **general data flow**
    - » **ECS operations centers/locations**
  - **Describe the ECS operational software configuration of:**
    - » **Science Data Processing Subsystem (SDPS)**
    - » **Communications and System Management Subsystem (CSMS)**

Objectives (Cont.)



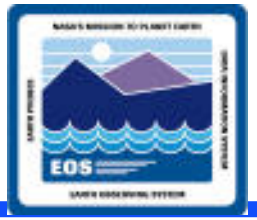
- Describe the ECS operation hardware configuration
- Describe commercial off-the-shelf (COTS) software
- Describe ECS operational processes
- Describe ECS facility layout and the locations of ECS components within the facility
- Log in to ECS
- Log out of ECS

ECS Overview - Mission



- **Mission to Planet Earth (MTPE)**
  - **NASA research mission**
  - **Space-, ground-, and aircraft-based measurements to study the processes leading to global climate changes and develop a predictive capability for earth systems on time scales of decades to centuries**
  - **NASA's contribution to the U.S. Global Change Research Program (USGCRP)**
  - **Goal:**
    - » **advance scientific understanding of the entire Earth system by developing a deeper comprehension of the components of the system and the interactions among components**

ECS Overview - Mission

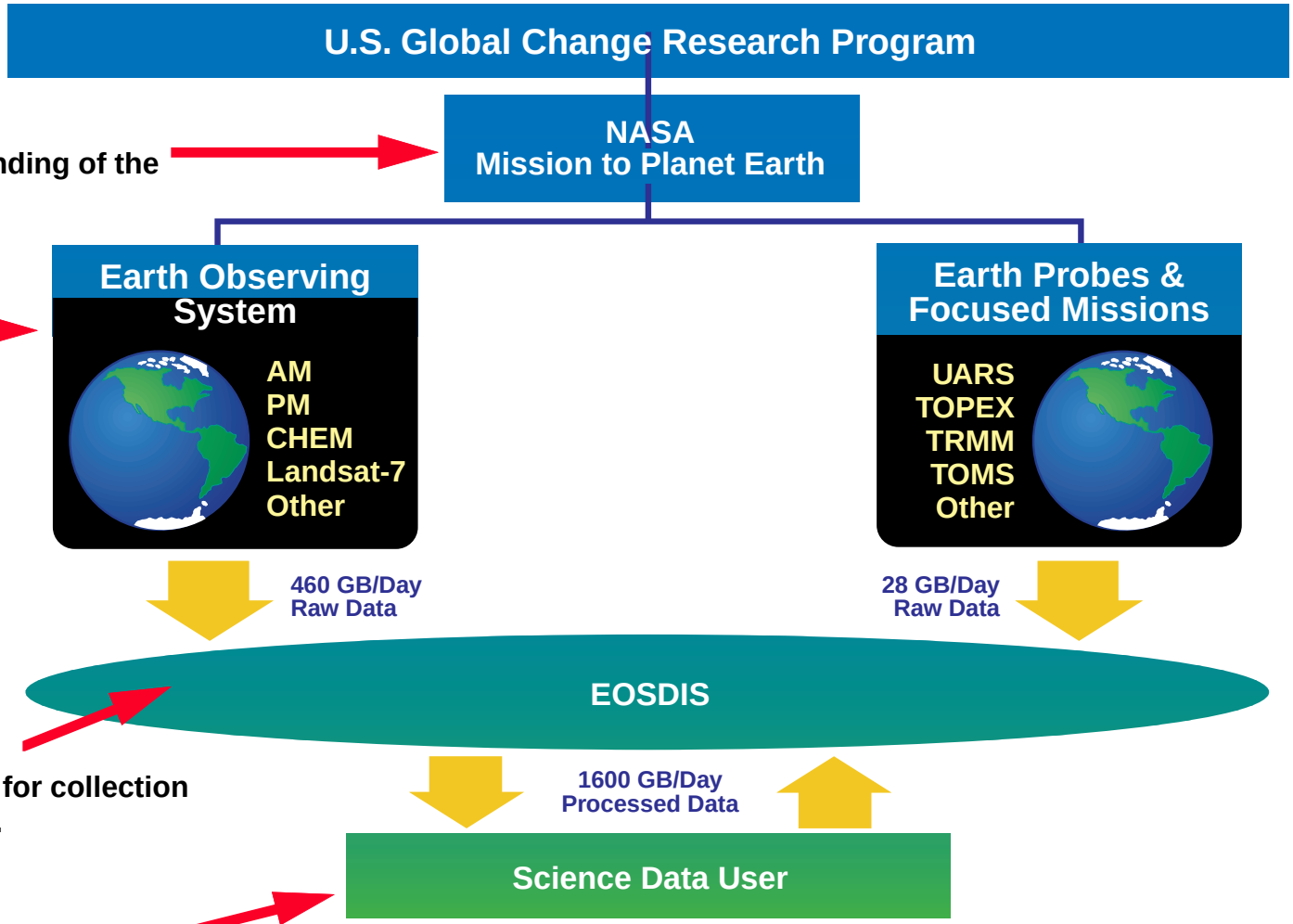


MTPE:
- Advance scientific understanding of the entire Earth system.

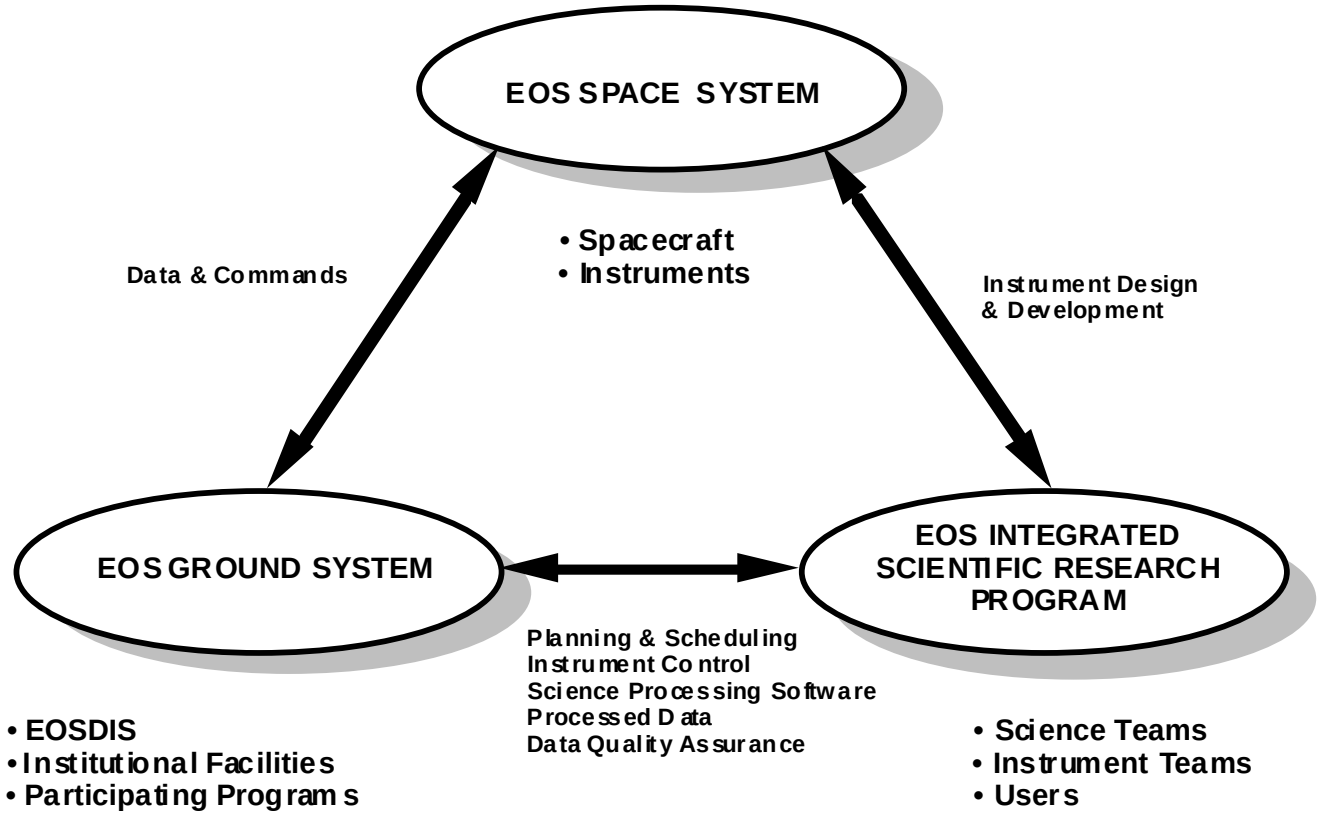
EOS:
- Principle element of MTPE.
- Designed to collect Earth Science data.
- 3 Components: space system, ground system, research system.

EOSDIS:
- Provides the ground system for collection and analysis of science data.

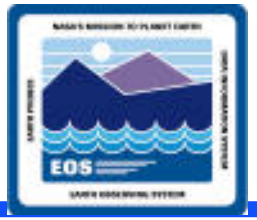
Science Data User:
- Science Researchers



ECS Overview - Mission (Cont.): Major EOS Segments

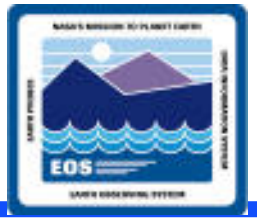


EOS Data and Information System (EOSDIS)



- **Purpose**
  - **NASA's overall Earth Science data system. Directed by the ESDIS Project**
  - **Ground system for the collection and analysis of science data on the dynamics of the Earth**
- **Supports the Following EOS Activities:**
  - **Planning, scheduling and control of EOS spacecraft**
  - **Exchanging commands, data and algorithms with non-NASA entities involved in EOS**
  - **Coordinating activities with other data-gathering systems**
  - **Transforming observations into physical variables**
  - **Presenting data to science users for scientific research**

EOSDIS (Cont.)

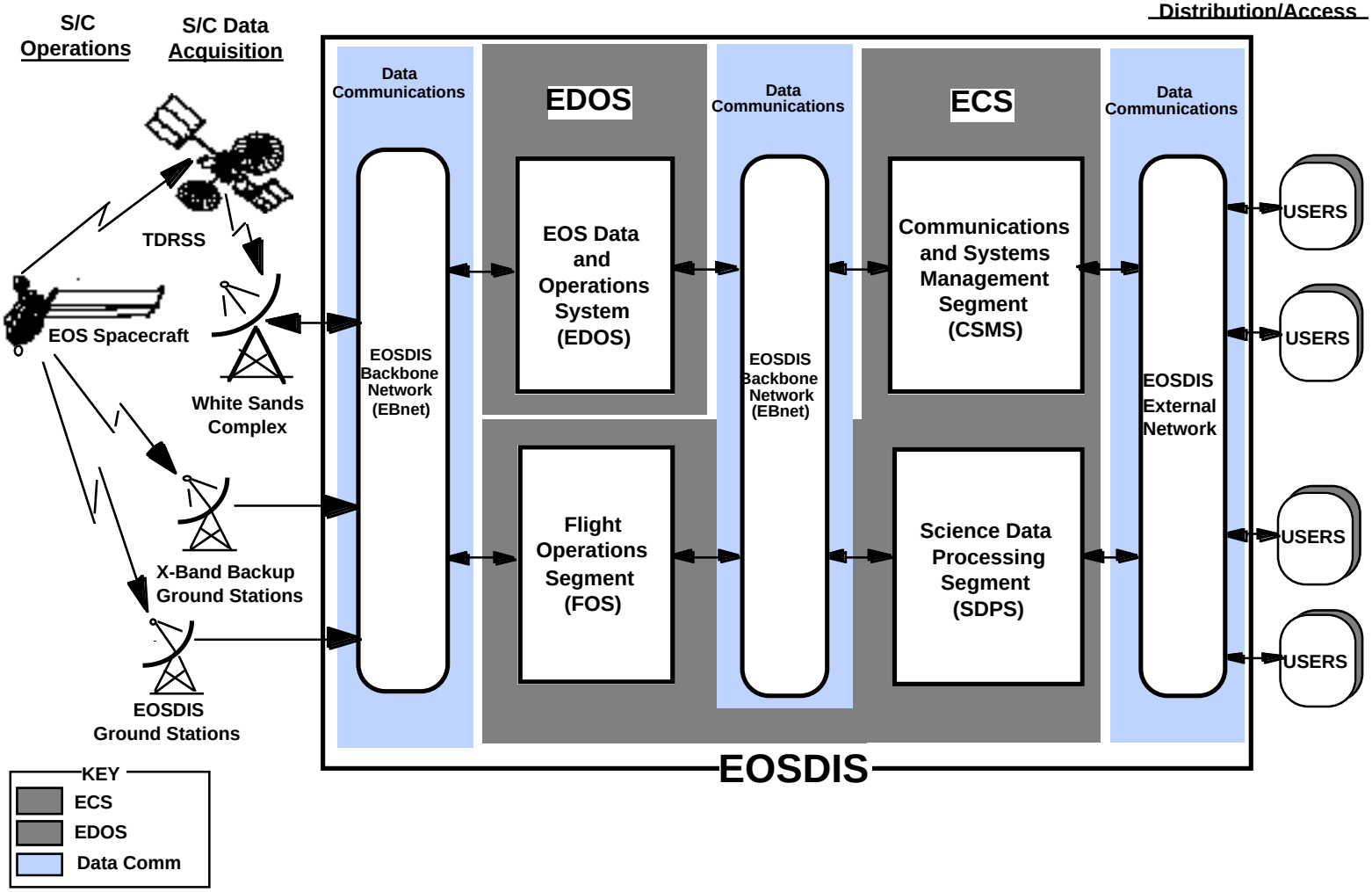


- **During EOS/ECS era EOSDIS will provide:**
  - **user support**
  - **data archive management and distribution**
  - **information management**
  - **product generation**
  - **spacecraft command and control**
  - **data capture and telemetry processing**

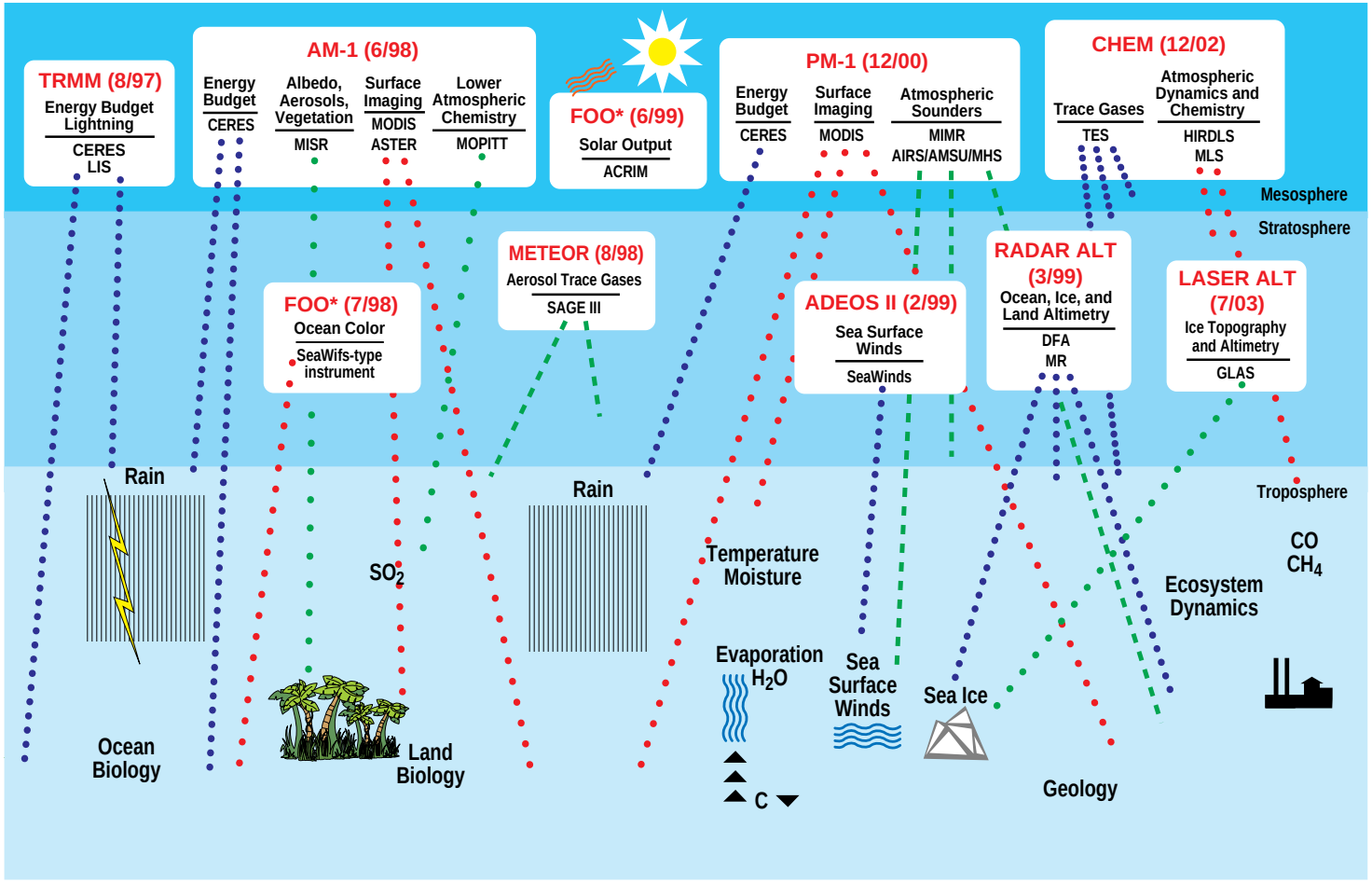
EOSDIS (Cont.)

- **EOSDIS data products**
  - **Level 0 - “raw” data**
  - **Level 1A - time-referenced, annotated**
  - **Level 1B - processed to sensor units**
  - **Level 2 - derived geophysical variables**
  - **Level 3 - variables mapped on space-time grid scales**
  - **Level 4 - model output or results from analyses of lower-level data**

EOSDIS Principal Components

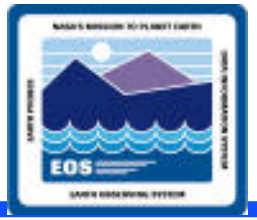


Sample EOS Instruments and Measurements



*FOO = Flight of Opportunity

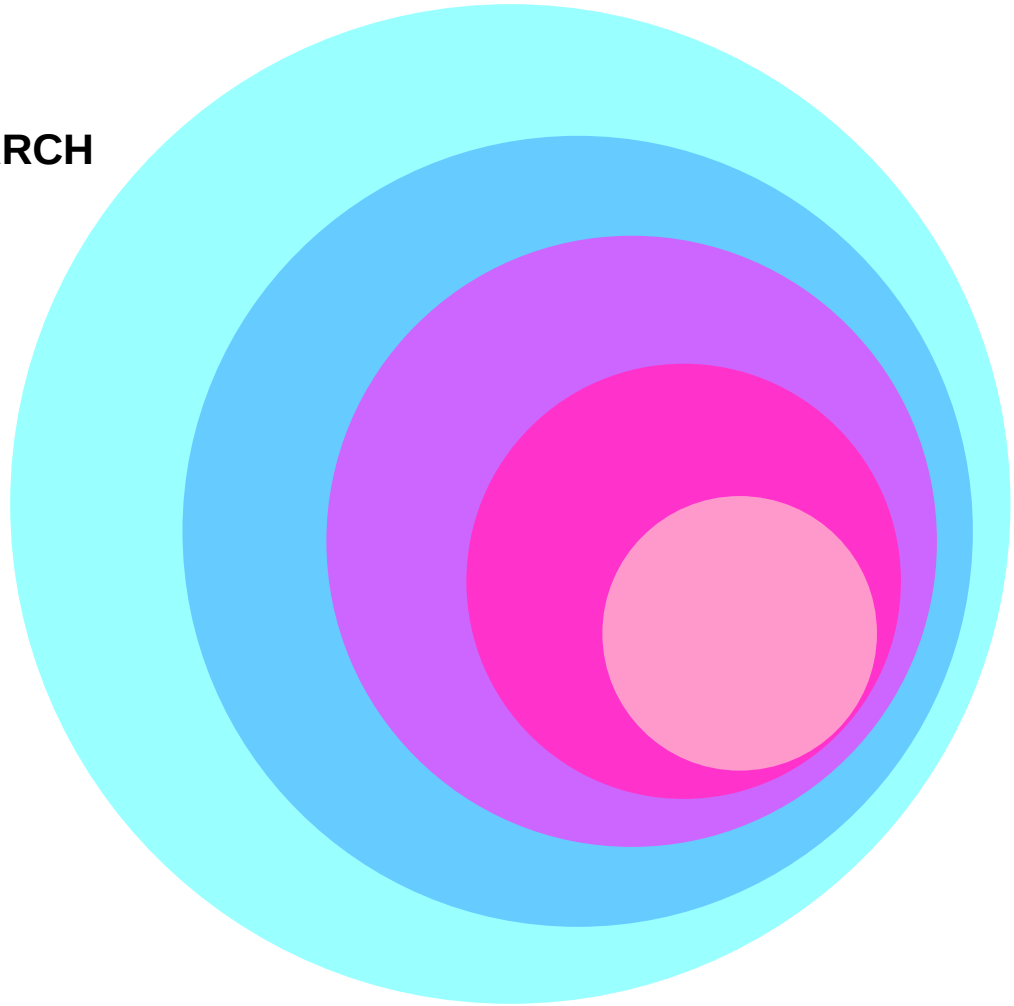
EOSDIS Core System (ECS)



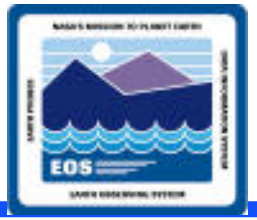
- **Major component of EOSDIS**
- **Mission**
  - **provide centralized mission and instrument command and control functions, product generation, archiving, and information management**
- **Main Functions**
  - **provide control of EOS spacecraft and instruments**
  - **process data from EOS instruments**
  - **manage and distribute EOS data products and other selected data sets to the scientific community**

Relationship of ECS to Global Change Research

WORLDWIDE
GLOBAL CHANGE RESEARCH

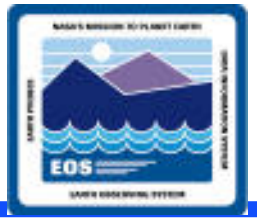


ECS Components/Segments



- **Science Data Processing Segment (SDPS)**
  - **Receives, processes, archives and manages all data from EOS and other NASA Probe flight missions**
- **Communications and System Management Segment (CSMS)**
  - **Interconnects users and service providers**
- **Flight Operations Segment (FOS)**
  - **Manages and controls EOS spacecraft and instruments**

Version 2.0

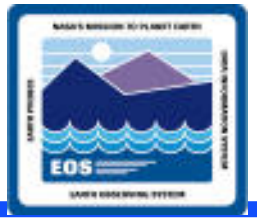


- **ECS development proceeds in phases**
  - **Interim Release 1 (Ir1)**
    - » **preliminary release for concept validation and testing (January 1996)**
  - **Pre-Release B Testbed**
    - » **deployed in May-June 1997 at four DAACs**
    - » **supports science software integration and test (SSI&T) in support of Instrument Teams (ITs) for Landsat-7 and EOS AM-1 missions**
    - » **based on the canceled Release A**
  - **Version 2.0**
    - » **support for future EOS missions, such as EOS AM-1 and EOS PM-1**

Version 2.0 (Cont.)

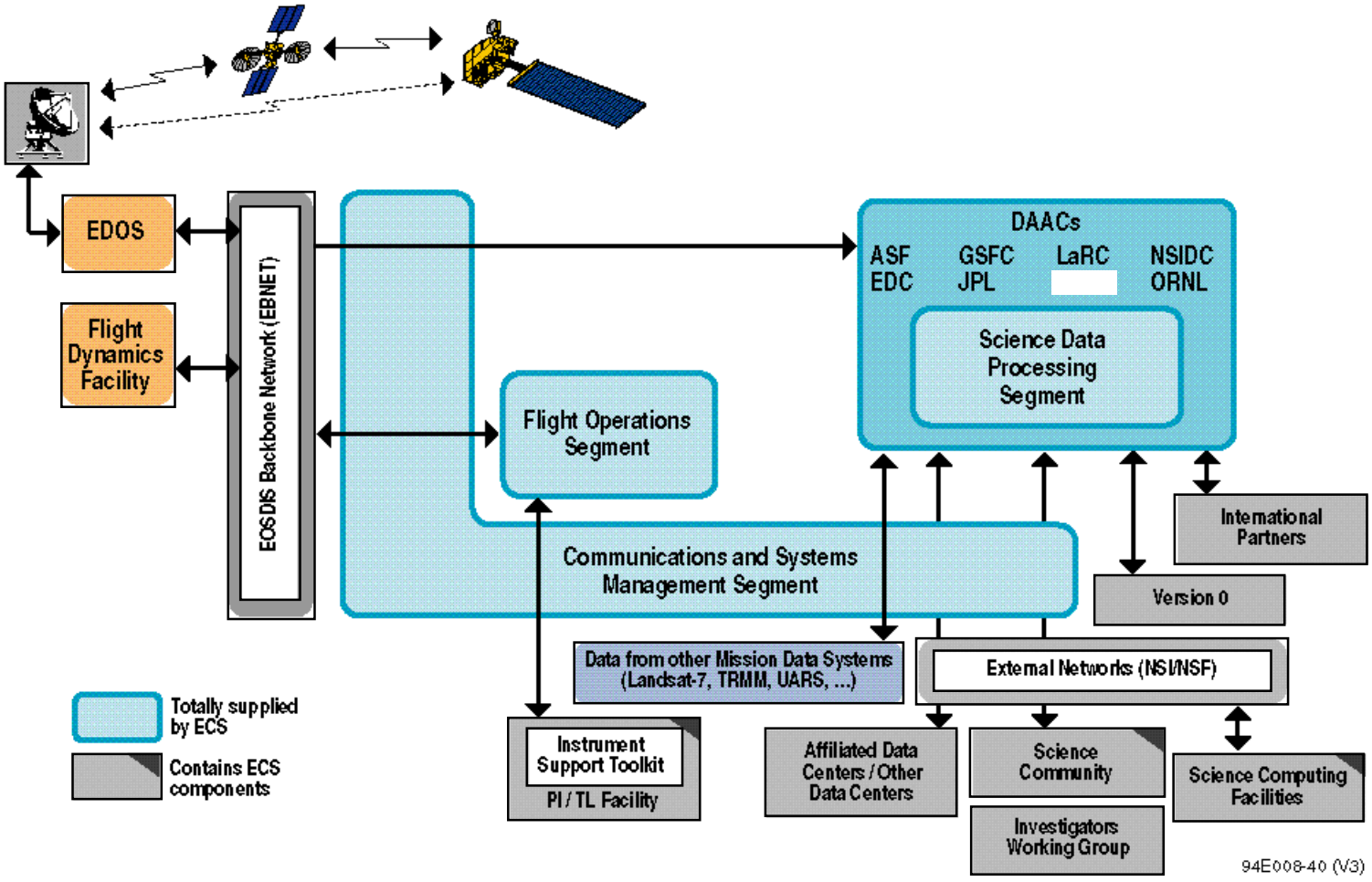
- **Mission Objectives**
  - **Support AM-1**
  - **Support Landsat-7**
  - **Perform Science Data Processing**

System Functional Overview



- **EOSDIS Data Flow**
  - **ECS components and other EOSDIS (non-ECS) components support the following types of services:**
    - » **data product generation**
    - » **archive**
    - » **distribution**
    - » **information management**
    - » **spacecraft/instrument command and control**
  - **internal interfaces**
    - » **DAACs**
    - » **System Monitoring and Coordination functions**
    - » **EOS Operations Center (EOC) - Flight Operations**

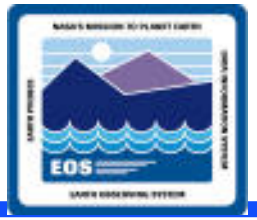
EOSDIS Data Flow - Overview



EOSDIS Data Flow - Inputs

- **EOS AM-1: science data will be transmitted to the LZPF from high-latitude X-band EOSDIS ground stations in Alaska and Norway.**
- **International Partner (IP) satellites: Downlink directly to the International Partner Ground Systems (IPGSs) via their ground receiving stations.**
- **Landsat-7: Transmits downlink data directly to the Landsat-7 Ground Station (LGS) at the Earth Resources Observation Systems (EROS) Data Center (EDC).**

EOSDIS Data Flow - Inputs (Cont.)

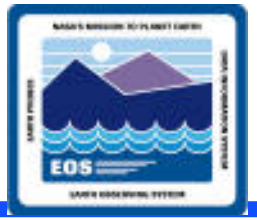


- **Suppliers of non-EOS data products (data sets)**
  - **Affiliated Data Centers (ADCs)**
    - » **allow access to non-EOS data sets to satisfy ECS user queries and to provide ancillary data for the generation of ECS standard products**
    - » **National Environmental Satellite Data and Information Service (NESDIS) of the National Oceanic and Atmospheric Administration (NOAA) (for example)**
  - **Other Data Centers (ODCs)**
    - » **Landsat Processing System (LPS)**
    - » **ECS provides user access, and product archive and distribution functions for Landsat-7 data and information**

EOSDIS Data Flow - Interfaces

- **EDOS:**
  - **Responsible for spacecraft data capture and distribution.**
  - **Processes satellite data to recover the raw, Level 0 instrument data.**
  - **Distributes Level 0 instrument data for archiving and processing to the ECS SDPS (designated DAACs).**
  - **Provides archive services for Level 0 data EDOS Data Archive Facility (DAF), Fairmont, WV.**

EOSDIS Data Flow - Interface (Cont)



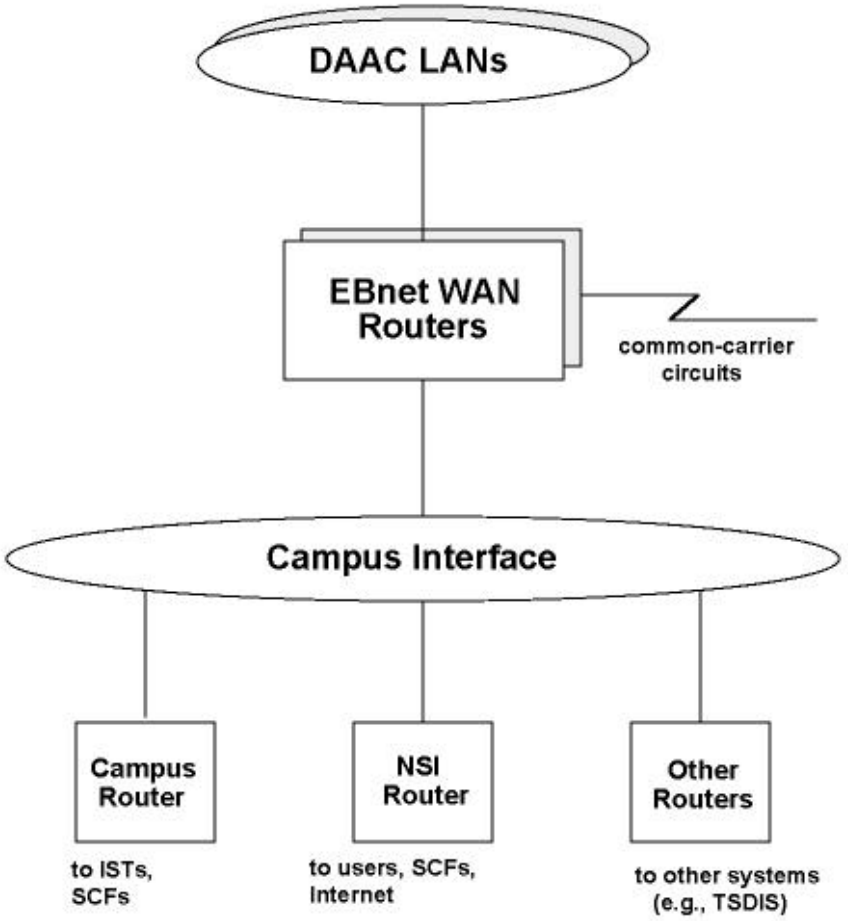
- **DAACs**
  - **House the ECS computing facilities and operational staff needed for product generation and managing and storing:**
    - » **EOSDIS data**
    - » **Associated metadata**
    - » **Associated browse data**
  - **Receive requests for data products and other archived information from users**
  - **Distribute requested data**
  - **Provide open access to the EOS data by all members of the science community**

EOSDIS Data Flow - Interface (Cont)

- **Science Users**
  - **Most science users access EOS data products at the DAACs via external networks such as the NSI or the National Science Foundation (NSF) Internet**
  - **Include facilities and organizations not participating directly in the EOS Program**
    - » **users of other NASA data systems and archives**
    - » **users of other government data systems and archives**
    - » **university research users**
    - » **international investigators/data centers**
    - » **commercial data systems**
  - **Data exchanged via the EBnet.**

EOSDIS Data Flow - Interface (Cont)

EOSDIS Backbone Network (EB



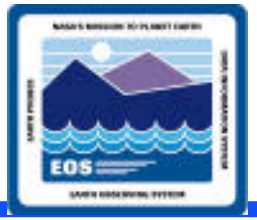
EOSDIS Data Flow - Interface (Cont)

- **Science Computing Facilities (SCFs)**
  - **Located at science investigator facilities**
  - **Performs scientific research**
  - **Develops science data processing software**
  - **Employs a user interface that facilitates browsing, requesting, and delivering data from archives to investigators**
  - **Some perform scientific quality assurance of EOS data products (applicable SCFs for the investigators responsible for the products)**

EOSDIS Data Flow - Interface (Cont)

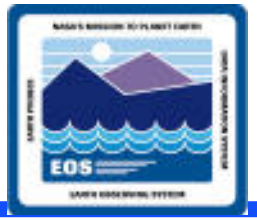
- **EOC - EOS Flight Operations (FOS)**
  - **EOS missions (flight operations) are coordinated from the EOC**
    - » **spacecraft operations**
    - » **instrument operations**
  - **FOS (at the EOC)**
    - » **maintains spacecraft and instrument health and safety**
    - » **monitors spacecraft performance**
    - » **provides spacecraft and instrument uplink data to EDOS**

EOSDIS Data Flow - Interface (Cont)



- **EOSDIS Version 0 (V0)**
  - **Early "working prototype" of selected EOSDIS functionality**
  - **Hosted and operated by the DAACs**
  - **Interconnects existing data systems at the DAACs via electronic networks**
  - **Provides services such as….**
    - » **data ingest**
    - » **archive**
    - » **catalog**
    - » **distribution**
    - » **user support services**

EOSDIS Data Flow - Interface (Cont)



- **NASA Institutional Services**
  - **Space Network (SN)**
    - » **Tracking and Data Relay Satellite System (TDRSS)**
    - » **Ground Terminals**
    - » **Network Control Center**
  - **Flight Dynamics Facility (FDF)**
  - **NASA Communications (NASCOM)**
    - » **NASCOM Operational Local Area Network (NOLAN)**
  - **Deep Space Network (DSN)**
  - **Ground Network (GN)**
  - **X-Band Backup Ground Station**
  - **Wallops Orbital Tracking Station (WOTS), Program Support Control Network (PSCN), Sensor Data Processing Facility (SDPF)**

ECS Operations Locations

- DAACs
- System Monitoring and Coordination Center (SMC)
- EOS Operations Center (EOC)
- ECS Sustaining Engineering Organization (SEO)
- ECS System Integrated Logistics Support Organization (ILS)

ECS Operations Locations (Cont.)

- **DAACs**
  - **ASF - Synthetic Aperture Radar Study, Polar Processes**
  - **EDC - Land Processes Imagery**
  - **GSFC - Upper Atmosphere, Atmospheric Dynamics, Global Biosphere, Geophysics**
  - **JPL - Ocean Circulation and Air-Sea Interaction**
  - **LaRC - Tropospheric Radiation Budget, Aerosols, Chemistry**
  - **NSIDC - Cryosphere (Non-SAR)**
  - **ORNL - Biogeochemical Dynamics**
  - **SEDAC - Policy/Decision Making Applications of Combined MTPE and Socio-Economic Data**

ECS Operations Locations (Cont.)

- DAACs (Cont.)
  - Functions:
    - » Integration and test of science software
    - » Archiving science software files/documentation
    - » Supplying operational environment for science software
    - » Executing science software to produce standard data products
    - » Archiving and distributing standard data products
    - » Accepting, archiving and distributing special products generated by other facilities
    - » Advertising data and providing user support

ECS Operations Locations (Cont.)

- **SMC**
  - **Located at GSFC (Release B.0)**
  - **Enterprise Monitoring and Coordination (EMC) - set of CSMS services at the SMC**
    - » **MSS provides a system-wide management view for monitoring and control purposes**
    - » **CSS provides services (e.g., electronic mail and bulletin boards) for coordination**
  - **Provides:**
    - » **Performance management (system-wide performance analysis/ management)**
    - » **Configuration management (system-wide baseline configurations)**
    - » **Security management (detect system-wide trends and incidents)**

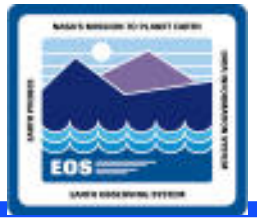
ECS Operations Locations (Cont.)

- **SEO**
  - **Located at EDF**
  - **Responsive to the ESDIS Project Office and the Project Scientist**
  - **System perspective on:**
    - » **maintenance**
    - » **sustaining engineering**
    - » **training**
  - **Analyzes how to integrate new technologies and concepts into ECS**
  - **Monitors M&O activities to assure ECS reliability, maintainability and availability**

ECS Operations Locations (Cont.)

- **ILS Organization**
  - **system-level logistics support of commercial off-the-shelf (COTS) software and hardware**
    - » **procurement**
    - » **accounting**
    - » **installation**
    - » **maintenance**
    - » **training**

ECS Operations Locations (Cont.)



- **EOC**
  - **Located at GSFC**
  - **EOS mission control center**
    - » **mission planning**
    - » **command and control of U.S. EOS spacecraft and instruments**
  - **operated by the Flight Operations Team (FOT)**
    - » **maintains spacecraft and instrument health and safety**
    - » **monitors spacecraft performance**
    - » **performs spacecraft engineering analysis**
    - » **monitors mission performance of instruments**

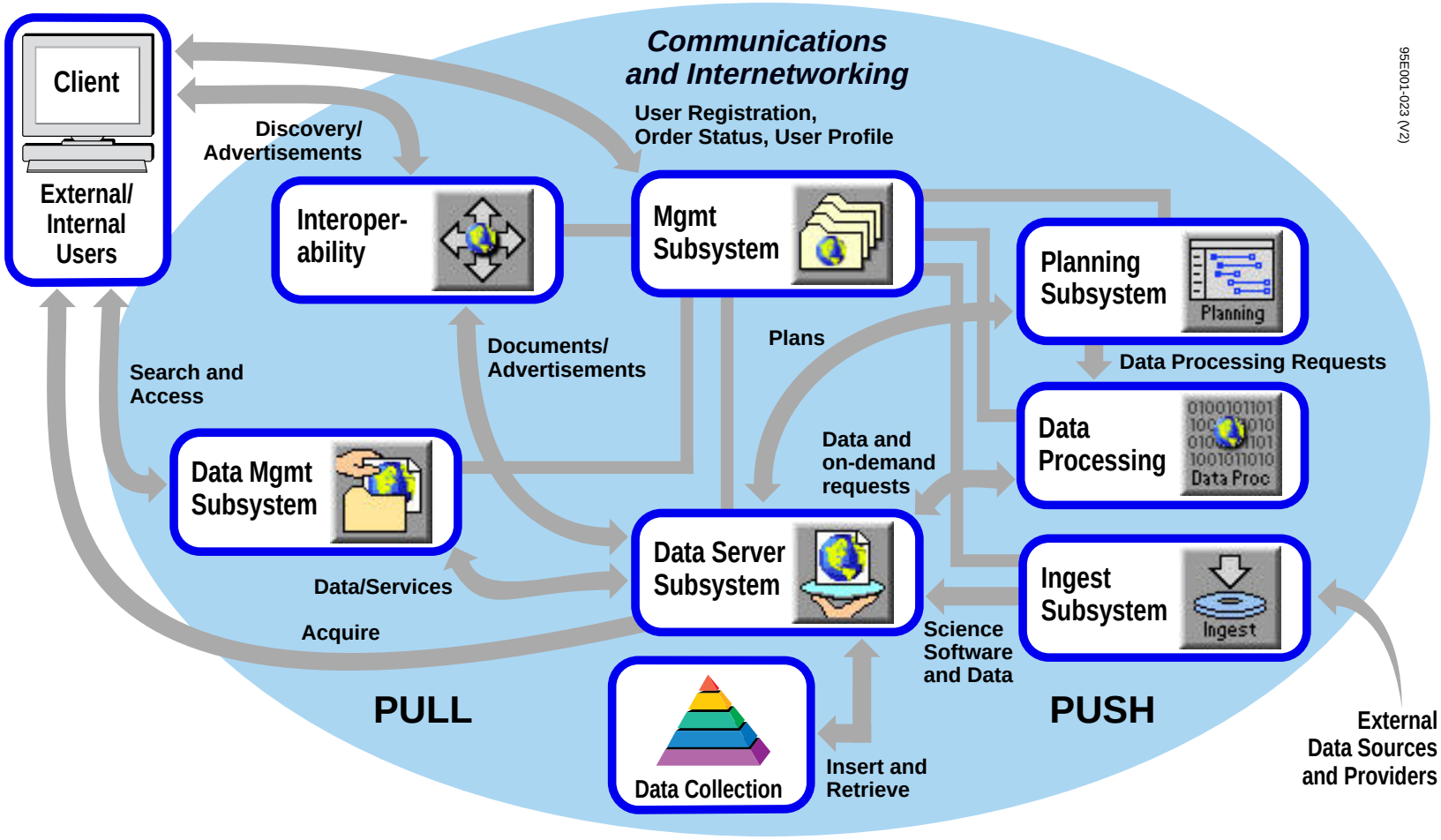
Operational Software Configuration Overview

- **Major functional components used by M&O:**
  - **Science Data Processing Segment (SDPS)**
  - **Communications and System Management Segment (CSMS)**

Operational Software Configuration Overview (Cont.)

- **SDPS subsystems (7)**
  - **Client Subsystem (CLS)**
  - **Interoperability Subsystem (IOS)**
  - **Data Management Subsystem (DMS)**
  - **Data Server Subsystem (DSS)**
  - **Ingest Subsystem (INS)**
  - **Planning Subsystem (PLS)**
  - **Data Processing Subsystem (DPS)**

Science Data Processing Segment (SDPS)



Operational Software Configuration Overview (Cont.)

- **SDPS functional groupings**
  - **Data storage and management (Data Server Subsystem)**
    - » **Archive science data**
    - » **Search for and retrieve archived data**
    - » **Manage the archives**
    - » **Stage data resources needed as input to or resulting as output from science data processing**

Operational Software Configuration Overview (Cont.)

- **SDPS functional groupings (Cont.)**
  - **Data search and retrieval (Client Subsystem, Data Management Subsystem and Interoperability Subsystem)**
    - » **“Data pull side” of the system**
    - » **Science user interface functions (CLS)**
    - » **Data search support functions (DMS)**
    - » **Location of services and data (IOS)**

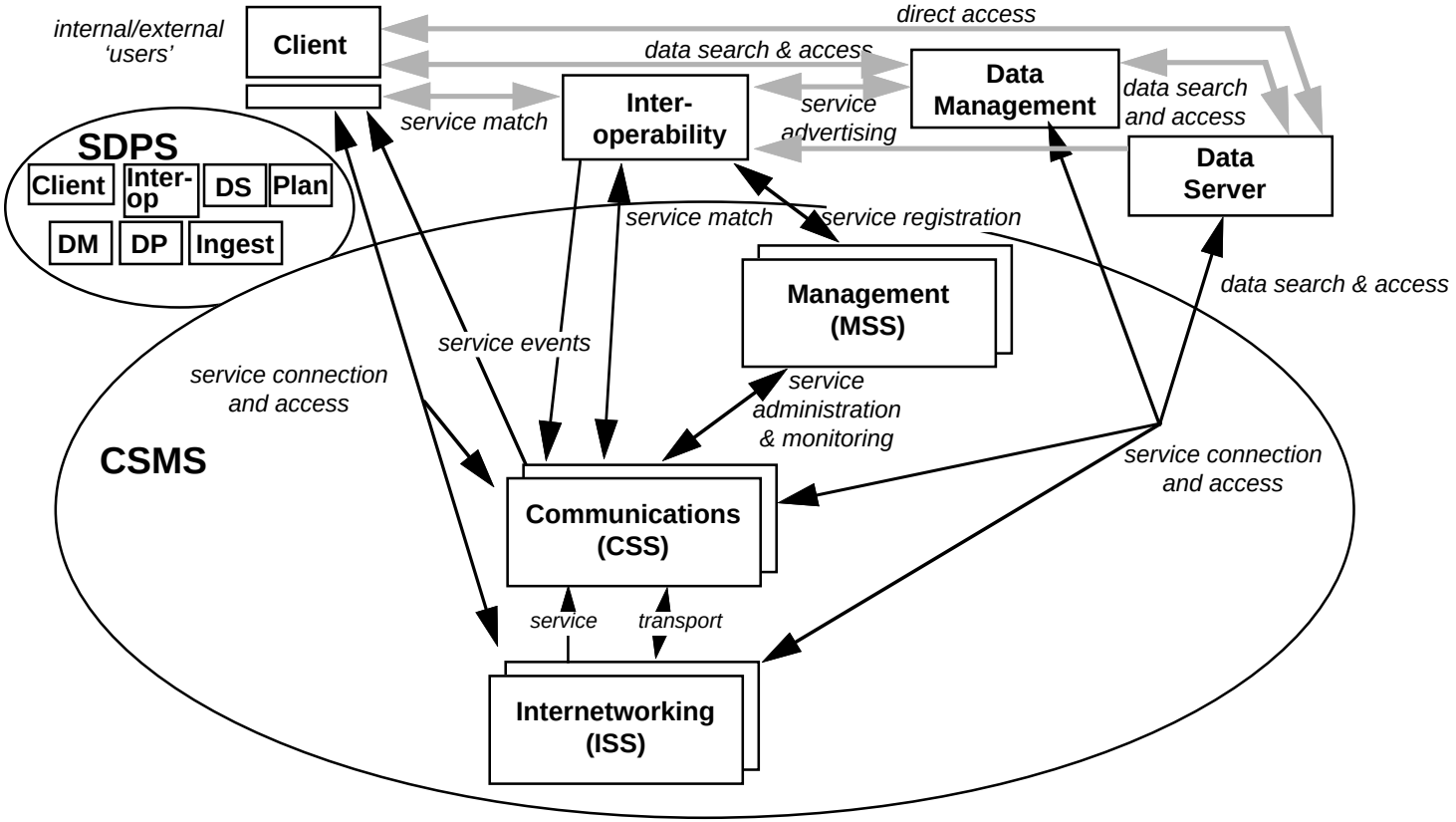
Operational Software Configuration Overview (Cont.)

- **SDPS functional groupings (Cont.)**
  - **Data processing (Data Processing Subsystem and Planning Subsystem)**
    - » **“Data push side” of the system**
    - » **Processing environment for science software (DPS)**
    - » **Long- and short-term planning of science data processing (PLS)**
    - » **Management of the production environment (PLS)**
  - **Data ingest (Ingest Subsystem)**
    - » **“Data push side” of the system**
    - » **Interfaces with external applications**
    - » **Data staging capabilities**
    - » **Storage buffer for Level 0 data**

Operational Software Configuration Overview (Cont.)

- **CSMS subsystems (3)**
  - **Communications Subsystem (CSS)**
  - **Systems Management Subsystem (MSS)**
  - **Internetworking Subsystem (ISS)**

Communications and System Management Segment (CSMS)



Operational Software Configuration Overview (Cont.)

- **CSMS functional groupings**
  - **Communications Subsystem**
    - » **Key to the interoperation of SDPS subsystems in an object-oriented, distributed-object communications environment**
    - » **CSS provides the distributed-object communciations environment**
    - » **Allows software objects to communicate reliably without regard to location or the specifics of the communications mechanisms**
    - » **Provides infrastructure services for the distributed object environment based on Distributed Computing Environment (DCE)**
    - » **Provides common facilities for file transfer, electronic mail, bulletin board services and remote terminals**

Operational Software Configuration Overview (Cont.)

- **CSMS functional groupings (continued)**
  - **Systems Management Subsystem**
    - » **Provides network and system management for all ECS resources (hardware and software)**
    - » **Decentralized system**
    - » **Two-level ECS management view - EMC & LSM**
    - » **Agents (software that interacts with a device's control software to facilitate the exchange of command information) provide information to or receive commands from MSS**
    - » **Proxies monitor software applications that do not interact directly with MSS (e.g., DPS is the proxy for the science software it executes)**
    - » **General management functions include security management and configuration management**

Operational Software Configuration Overview (Cont.)

- **CSMS functional groupings (continued)**
  - **Internetworking Subsystem**
    - » **Provides local area networking (LAN) services at ECS installations to interconnect and transport data among ECS resources**
    - » **Provides access services to link ECS LAN services to wide-area networks (WANs), point-to-point links and institutional network services (e.g., NSI)**

Operation Hardware Configuration Overview

- **ECS equipment**
  - **general types**
    - » **server hosts**
    - » **science processors**
    - » **operator interfaces (workstations or X-terminals)**
    - » **temporary data storage units**
    - » **printers**
    - » **network equipment, including fiber distributed data interface (FDDI) network equipment**

Operation Hardware Configuration Overview (Cont.)

- **Servers**
  - **HP J210**
  - **SGI Challenge L**
  - **SGI Challenge XL**
  - **SGI Indigo**
  - **SUN Sparc 20/50**
  - **SUN Sparc 20/71**
  - **SUN Sparc 20/712**

Operation Hardware Configuration Overview (Cont.)

- **Science processors**
  - **SGI PC XL**
  - **SGI Indigo Impact**
- **Workstations**
  - **SUN Sparc 20/50**
- **X-Terminals**
  - **NCD HMX-Pro**

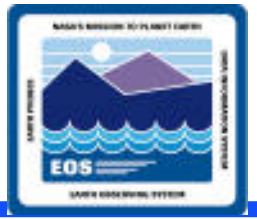
Operation Hardware Configuration Overview (Cont.)

- **Temporary storage, working storage or database management system (DBMS) data files**
  - **HP redundant arrays of inexpensive disks (RAIDs)**
  - **SUN RAIDs**
  - **SGI RAIDs**
  - **8mm stackers**
  - **4mm stackers**
  - **6250 tape drives**

Operation Hardware Configuration Overview (Cont.)

- **Printers**
  - **HP LaserJet 4M+**
- **Internetworking equipment**
  - **FDDI network equipment**

Operation Hardware Configuration Overview (Cont.)



- **Equipment functions**
  - **Planning (PLS)**
  - **Science processing (DPS)**
  - **SSI&T (DPS)**
  - **Ingest client (INS)**
  - **Access control and management (DSS)**
  - **Working storage (DSS)**
  - **Data repository (DSS)**
  - **Distribution and ingest peripherals (DSS)**
  - **System management (MSS)**
  - **Distributed computing (CSS)**
  - **Internetworking (ISS)**

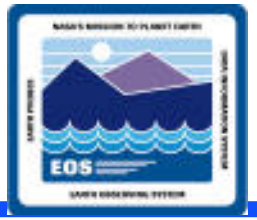
Operation Hardware Configuration Overview (Cont.)

- **Planning Subsystem**
  - **Planning hardware**
    - » **Planning server (SUN Sparc 20/71)**
    - » **Planning workstation (SUN Sparc 20/50)**
    - » **RAIDs**

Operation Hardware Configuration Overview (Cont.)

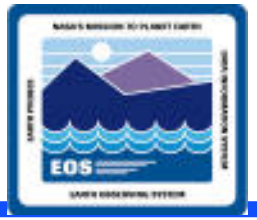
- **Data Processing Subsystem**
  - **Science processing**
    - » **Science processors (SGI PC XL)**
    - » **Queuing server (SUN Sparc 20/71)**
    - » **X-Terminals (NCD HMX-Pro)**
    - » **8mm tape stacker**
    - » **RAIDs**
  - **science software integration and test (SSI&T)**
    - » **SSI&T workstations/DBMS servers (SUN Sparc 20/50)**
    - » **SSI&T workstations (SUN Sparc 20/50)**
    - » **Printers (HP LaserJet 4M+)**

Operation Hardware Configuration Overview (Cont.)



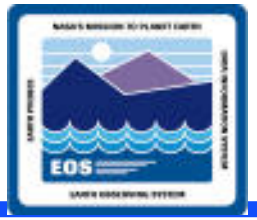
- **Ingest Subsystem**
  - **Ingest client**
    - » **Ingest servers (SGI Indy or SGI Challenge L)**
    - » **8mm tape stackers**
    - » **RAIDs (shared by ingest servers)**
    - » **Front-end SUN (SUN Sparc 20/50, SUN Sparc 20/712)**

Operation Hardware Configuration Overview (Cont.)



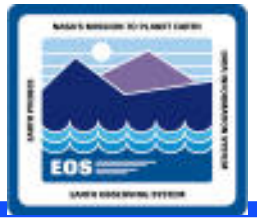
- **Data Server Subsystem**
  - **Access control and management**
    - » **Access/process coordinator (APC) servers (SGI Challenge L)**
    - » **RAIDs (shared by servers)**
    - » **Operations workstations (SUN Sparc 20/50)**
    - » **Front-end SUN (SUN Sparc 20/50)**
  - **Working storage**
    - » **RAIDs (shared by FSMS servers)**

Operation Hardware Configuration Overview (Cont.)



- **Data Server Subsystem (continued)**
  - **Data repository**
    - » **File Storage Management System (FSMS) servers (SGI Challenge XL)**
    - » **Database Management System (DBMS) servers (SGI Challenge XL)**
    - » **Archive robot (EMASS AML/Mod 2)**
    - » **Linear magnetic drives (3590)**
    - » **RAIDs (supporting DBMS servers)**

Operation Hardware Configuration Overview (Cont.)



- **Data Server Subsystem (continued)**
  - **Distribution and ingest peripherals**
    - » **Distribution servers (SUN Sparc 20/712)**
    - » **RAIDs (shared by distribution servers)**
    - » **8mm tape stacker**
    - » **4mm tape stacker**
    - » **Tape drive (6250)**
    - » **Printers (HP LaserJet 4M+)**

Operation Hardware Configuration Overview (Cont.)

- **Systems Management Subsystem**
  - **Management hardware**
    - » **Management Subsystem (MSS) servers (HP J210/1)**
    - » **Configuration management (CM) servers (SUN Sparc 2/50 or SUN Sparc 20/71)**
    - » **MSS Netscape server (SUN Sparc 20/50)**
    - » **MSS workstations (SUN Sparc 20/50)**
    - » **RAIDs (shared with the Communications Subsystem)**
    - » **Printers (HP LaserJet 4M+)**

Operation Hardware Configuration Overview (Cont.)

- **Communications Subsystem**
  - **Distributed computing**
    - » **Communications Subsystem (CSS) server (HP J210/1)**
    - » **RAID (shared with the Management Subsystem)**

Operation Hardware Configuration Overview (Cont.)

- **Internetworking Subsystem**
  - **Internetworking hardware**
    - » **FDDI switch**
    - » **Alantec Power Hub 7000 with FDDI cards and power supplies**
    - » **FDDI concentrators**
    - » **Bay networks**
    - » **FDDI cables**
    - » **Ethernet hub**
    - » **Cabletron Micro MAC-22E w/BRIM F6**
    - » **Ethernet cables**
    - » **Local area network (LAN) analyzer**
    - » **Communications cabinets**

COTS Software Overview

- **HP OpenView (HPOV)**
  - **Available through the Management Subsystem (MSS)**
    - » **Monitors and reports on the performance of ECS hardware components**
    - » **Displays the current status of ECS hardware resources**
    - » **Can access and display performance data that has been logged by the database management program (Sybase)**
    - » **Receives notification of faults and alerts the resource manager, production monitor and user services**

COTS Software Overview (Cont.)

- **HP OpenView (HPOV) (continued)**
  - **Used by ECS personnel involved in resource management and fault management at the DAACs and the SEO**
    - » **DAAC Resource Manager**
    - » **DAAC System Test Engineer**
    - » **DAAC Computer Operators**
    - » **SEO System Test Engineer**

COTS Software Overview (Cont.)

- **Remedy**
  - **Available through the Management Subsystem (MSS)**
    - » **Manages trouble tickets that originates within ECS**
    - » **Maintains user contact logs**
    - » **Documents problems with ECS hardware, software, documentation or procedures**
  - **Used by all internal personnel who are involved in problem management**

COTS Software Overview (Cont.)

- **Tivoli**
  - **A set of utility programs available through the MSS**
    - » **Performs host management**
    - » **Operator Account management**
    - » **Group (UNIX) management**
    - » **Monitors system resources and services**

COTS Software Overview (Cont.)

- **Sybase**
  - **Relational database management system (DBMS)**
  - **Located on the Data Servers (SDPS)**
  - **Manages Earth Science data**
  - **Implements spatial searching**
  - **Handles system administrative and operational data**
    - » **Maintains logs**
    - » **Database backup**
    - » **Maintenance of database transaction logs**
    - » **Database recovery**

COTS Software Overview (Cont.)

- **Sybase (continued)**
  - **Manages other databases**
    - » **e.g., site event history database**
  - **Has query capability**
    - » **access to site logs for detailed data used in system-wide fault data collection, trending, long-term fault analysis**
  - **Has report writing capability**
  - **Users:**
    - » **DAAC Database Administrator**

COTS Software Overview (Cont.)

- **AMASS**
  - **File storage management system for the UNIX operating system**
  - **Provides easy to use interface to a large tape archive**
  - **Users:**
    - » **DAAC Archive Managers**

COTS Software Overview (Cont.)

- **Illustra**
  - **Database management system**
  - **Maintains all of the system documents**

COTS Software Overview (Cont.)

- **Distributed Defect Tracking System (DDTS)**
  - **Available through the Management Subsystem (MSS)**
  - **Supports configuration management by acting as the ECS Change Request Manager**
    - » **Keeps track of Configuration Change Requests (CCRs)**
  - **Users:**
    - » **DAAC Maintenance Coordinators**
    - » **ILS Logistics Engineer**
  - **Database administrators:**
    - » **CM Administrators at the DAACs and SEO**

COTS Software Overview (Cont.)

- **MountainView**
  - **Provides network physical configuration**
- **HAL**
  - **Provides security services for ECS distributed computing environment**

COTS Software Overview (Cont.)

- **AutoSys/AutoXpert**
  - **Production scheduling tool**
  - **Part of the data processing subsystem (DPS)**
  - **Supports production processing in the SDPS**
    - » **job monitoring**
    - » **scheduling**
    - » **fault notification**
    - » **restart**
  - **Assists in determining**
    - » **effects of failure of a Data Processing Request (DPR)**
    - » **cause of failure**
    - » **actions to be taken due to the failure**
  - **User:**
    - » **DAAC Production Monitor**

COTS Software Overview (Cont.)

- **Delphi**
  - **Production planning tool used to support the production processing**
  - **Places production jobs within the anticipated resource constraints**

COTS Software Overview (Cont.)

- **ClearCase**
  - **Software baseline and change manager**
  - **Provides version control of software objects**
  - **Used for installing new/revised software code**
  - **Used for checking software to confirm problems**
  - **Users:**
    - » **DAAC and SEO Software Maintenance Engineers**
  - **Database administrators:**
    - » **CM Administrators at the DAACs and SEO**

COTS Software Overview (Cont.)

- **XRP-II**
  - **CM Baseline Manager**
  - **Supports maintaining the DAAC technical library**

Operational Processes

- **Operational Processes**
  - **System Operations Management**
    - » **System Administration**
    - » **Network Administration**
    - » **Problem Management**
    - » **System Troubleshooting**
    - » **Configuration Management**

Operational Processes (Cont.)

- **Operational Processes (Cont.)**
  - **Science Operations**
    - » **Ingest**
    - » **Archive**
    - » **Data Distribution**
    - » **Production Planning and Processing**
    - » **Resource Planning**
    - » **Database Administration**
    - » **User Services**
    - » **Science Software Integration and Test**

Operational Processes (Cont.)

- **System Administration**
  - **DAAC and SEO System Administrators perform system administration functions**
    - » **installing workstations**
    - » **starting up and shutting down the system**
    - » **backing up and restoring the system**
    - » **maintaining the system log**
    - » **controlling access to the system**
    - » **monitoring system security**

Operational Processes (Cont.)

- **System Administration (continued)**
  - **Software tools (examples):**
    - » **HP OpenView**
    - » **Management Subsystem (MSS) graphical user interfaces (GUIs)**

Operational Processes (Cont.)

- **Network Administration**
  - **SEO and DAAC System Administrators, system-level Network Analyst and DAAC Resource Managers perform network administration functions**
    - » **maintaining LAN and local DCE configuration**
    - » **network performance monitoring**
    - » **reporting on network operations**
  - **Software resources (examples)**
    - » **ClearCase**
    - » **HP OpenView**

Operational Processes (Cont.)

- **Problem management**
  - **All M&O operations and support personnel are involved in problem management activities**
    - » **identifying, documenting, investigating, and resolving problems with ECS hardware, software, documentation, and procedures**
    - » **writing Non-Conformance Reports (NCRs)**
    - » **managing NCRs through the problem resolution process**
  - **software resource:**
    - » **Remedy, DDTS**

Operational Processes (Cont.)

- **System Troubleshooting**
  - **all ECS operators participate in troubleshooting of the systems they operate**
    - » **identifying, locating, analyzing, and determining the cause of system faults**
    - » **monitoring system status and performance**
  - **DAAC and SEO System Administrators**
    - » **perform troubleshooting of their systems**
  - **ECS Fault Manager**
    - » **focal point for inter-ECS site problems**
    - » **provides support for other centers' troubleshooting activities**

Operational Processes (Cont.)

- **System Troubleshooting (continued)**
  - **software resources (examples)**
    - » **HP OpenView**
    - » **Sybase**
    - » **Remedy**
    - » **ClearCase**
    - » **MSS GUIs**

Operational Processes (Cont.)

- **Configuration Management**
  - **DAAC and SEO CM Administrators provide configuration management and monitoring at their respective levels**
    - » **ensure that hardware, software, and procedure changes to the baseline are properly documented and coordinated**
    - » **manage Change Request Manager database**
    - » **manage SW Change Manager database**
    - » **manage Baseline Manager database**
  - **support the respective Configuration Control Boards**

Operational Processes (Cont.)

- **Configuration Management (continued)**
  - **software resources:**
    - » **ClearCase**
    - » **XRP-II**
    - » **DDTS**

Operational Processes (Cont.)

- **Ingest**
  - **The DAAC Ingest/Distribution Technicians:**
    - » **Monitor the performance of data requests, arrival and delivery schedules**
    - » **Moniyor the receipt, validation and internal distribution of incoming data**
    - » **Manage the ingest data queue**
    - » **Assists system in ingesting hard-media**

Operational Processes (Cont.)

- **Archive**
  - **The DAAC Archive Manager:**
    - » **monitors data archiving to ensure that the data are properly logged into and out of ECS**
    - » **maintains the catalog of data**
    - » **monitors the distribution of data**
    - » **ensure viability and safety of storage media**

Operational Processes (Cont.)

- **Data Distribution**
  - **Provides archived data to those who request it**
  - **DAAC Ingest/Distribution Technician:**
    - » **monitors and reports performance data requests**
    - » **performs approved data transfers to hard media**
    - » **monitors non-electronic output data schedules**
    - » **manages hard copy output consumables and supplies**

Operational Processes (Cont.)

- **Production Planning and Processing**
  - **DAAC Production Planners and Production Monitors perform the production planning and processing functions**
    - » **production planning is intended to make optimum use of computing resources when generating science data products (during production processing)**
    - » **DAAC Production Planners develop daily, weekly and monthly DAAC science production schedules. They maintain the production database, specifying science software characteristics and priorities**
    - » **DAAC Production Monitors manage processing schedules, monitor science software execution, and support science software integration and test (SSI&T)**
  - **software resources**
    - » **Production Request Editor GUI**
    - » **Planning Workbench GUIs**
    - » **AutoSys/AutoXpert**

Operational Processes (Cont.)

- **Resource Planning**
  - **Involves reserving time for various events to occur on the resources**
  - **DAAC Resource Planners:**
    - » **ensure that all resource requests are validated and approved**
    - » **schedules all resources on a daily, weekly and monthly basis**
    - » **provides assistance for resource scheduling**

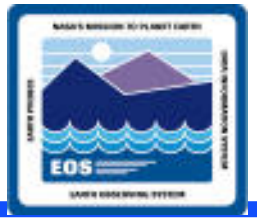
Operational Processes (Cont.)

- **Database Administration**
  - **DAAC Database Administrators perform database administration functions**
    - » **maintain databases**
    - » **install SQL server products**
    - » **manage disk storage space**
    - » **manage ECS personnel accounts and privileges**
    - » **perform database backup and recovery operations**
    - » **perform daily database synchronization**
  - **software resources:**
    - » **Sybase**

Operational Processes (Cont.)

- **User Services**
  - **Four major categories of functions**
    - » **User Contact Log**
    - » **User Registration Service**
    - » **Data Searce and Order Services**
    - » **Order Tracking Services**
  - **DAAC User Services Representative**
    - » **provides services necessary to facilitate user access to EOSDIS systems**

Operational Processes (Cont.)



- **Science Software Integration and Test (SSI&T)**
  - **DAAC Science Software I&T Support Engineers and DAAC Science Data Specialists perform the SSI&T functions**
    - » **provide support to scientists in the development and integration of science software for both updates and new science software into the DAAC ECS system**
    - » **perform standards-checking on all delivered software, including source code, scripts, process control files and related documentation**
    - » **provide support for metadata updates and additions for science data products**
    - » **support the investigation and resolution of science processing problems**
    - » **lead ECS-related long-range planning and preparations for data set SSI&T**
  - **software resource:**
    - » **ClearCase**

Exercise: Tour of the Facility

- **Follow a tour guide on a tour of the facility and observe the positions of ECS components in the facility**
- **Ask the tour guide relevant questions**

Exercise: Performing an Operator Login and Logout

- Observe the instructor's login to ECS
- Login to ECS
- Observe the features of ECS as the instructor describes them
- Observe the instructor's logout from ECS
- Log out from ECS