MODIS DATA SYSTEM STUDY

TEAM PRESENTATION

September 9, 1988

AGENDA

1. MIDACS External Interface Document
2. Preliminary Performance Requirements for MIDACS
3. Action Items

MIDACS EXTERNAL INTERFACE DOCUMENT

1.0 INTRODUCTION

This document is the first in a series of data flow diagrams that will be used to develop the detailed structure within the MODIS Information, Data, and Control System (MIDACS, formerly known as the MIDACC). One requirement of good software design is to maintain strict definitions of data passed between individual software modules; definitions are particularly important during the software maintenance cycle when revisions to individual modules will be made by programmers who had no first-hand knowledge of original program structure or intent. In a large system that contains a number of physically separated data processing components, strict definition of data flow across physical boundaries is doubly important since a physical medium to support data transfer across the interface must be provided. Hardware upgrades will likely occur during the system life cycle, and as new hardware is introduced, data transfer requirements between physically separate components will be reexamined and physical interfaces will be reimplemented.

Internally, the MIDACS is designed to include a number of physically separate components. The nature of the interface between internal physical components of the MIDACS are specified in individual context diagrams generated for each component. This document addresses the external interface requirements of the MIDACS, and as such, each component boundary is to be understood as both a logical and physical interface. The high-level description of the situation is contained in the overall MIDACS Context Diagram shown in Figure 1. Interfacing elements include the Data Handling Center (DHC, presently under development as a component of the Customer Data and Operations System, [CDOS]), the EosDIS Mission and Operations Center (EMOC), the Information Management Center (IMC), and Other EosDIS Data Archiving and Distribution Systems (DADS), all under development as components of EosDIS, and a host of Users and potential Non-Eos Data Sources. The data dictionary following the MIDACS Context Diagram specifies the precise nature of the data flow to be supported. Since these diagrams have many implications affecting the operational utility of the system, revisions are to be expected as system needs and functions are further defined.

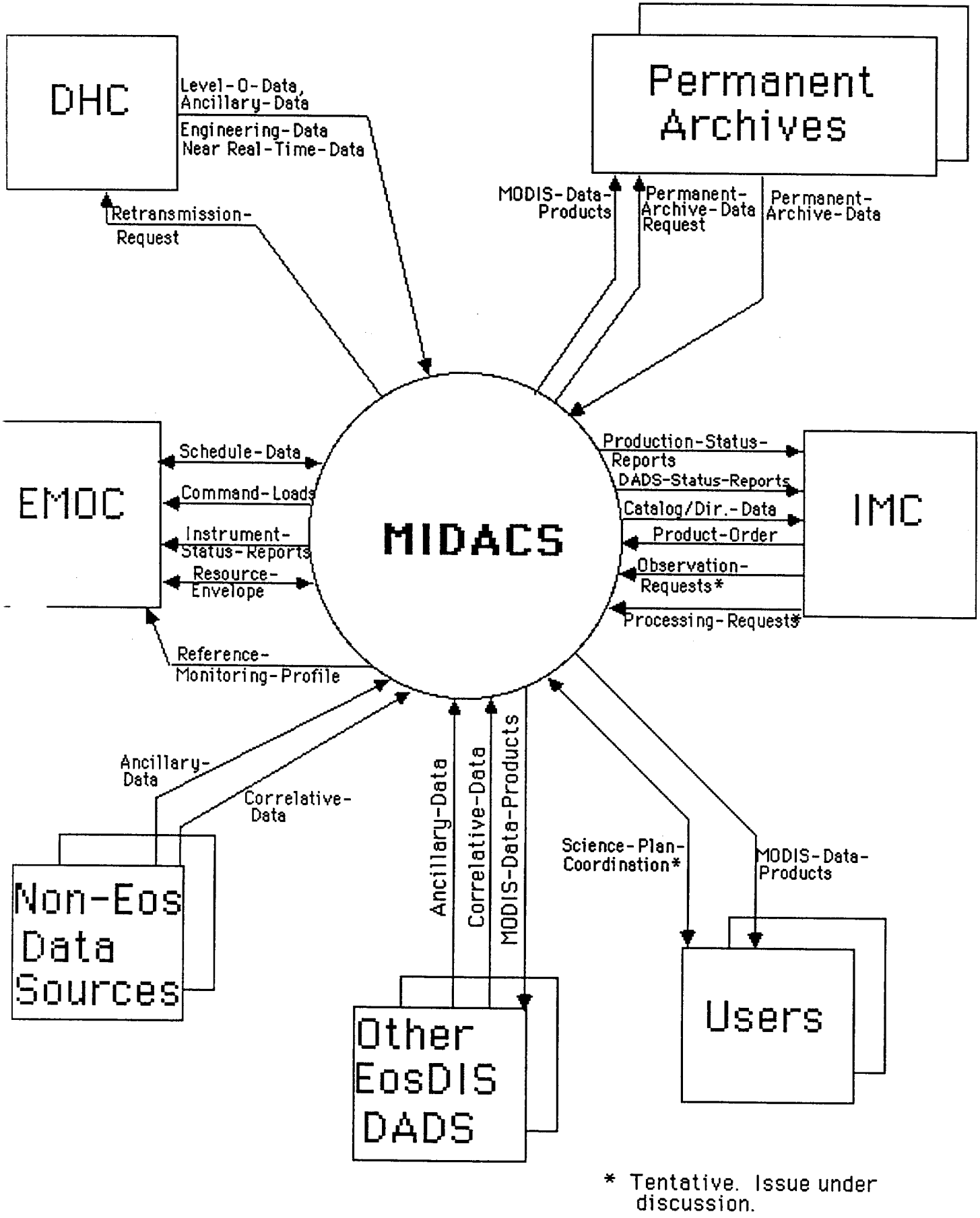


Figure 1. MIDACS Context Diagram

DATA DICTIONARY

Ancillary-Data	=	*Data other than MODIS-Instrument-Data required to perform MODIS data processing.*
Catalog/Directory Data	=	*Listings of data available from the MIDACS DADS listed by platform, instrument, data processing level, algorithm identifier, parameter, time, geographic location, or combination.
Command-Loads	=	*Encoded MODIS instrument command sequences as required by the onboard MODIS instrument control system.*
Correlative-Data	=	*Scientific data not from the MODIS instrument used to validate MODIS data products.*
DADS-Status-Reports	=	*Information describing the operational status of the MODIS DADS.
Instrument-Status-Report	=	*Information on the operating configuration of the MODIS instrument.*
Level-0-Data	=	*MODIS-Instrument-Data at original resolution, time order restored, with duplicates removed.*
MODIS-Data-Products	=	*MIDACS-generated data items retained for potential user access.*
MODIS-Engineering-Data	=	*Data other than MODIS-Science-Data generated within the MODIS instrument.*
MODIS-Instrument-Data	=	*Data originating within the MODIS instrument.*
	=	MODIS-Science-Data + MODIS-Engineering-Data
MODIS-Science-Data	=	*Unprocessed radiance observations as generated by the MODIS instrument.*
Near-Real-Time-Data	=	*MODIS-Instrument-Data designated for Priority Processing.*

Observation-Request	=	*Request by a User to execute a MODIS observation sequence.*
Permanent-Archive-Data	=	*Data retrieved from permanent archival storage.*
Permanent-Archive-Data-Request	=	*Information supporting the retrieval of data from permanent archives.*
Priority Processing	=	*Immediate processing of designated data items without considering data item position in processing queues. Cf. Routine Processing.*
Processing-Request	=	*Request by a User to generate MODIS-Data-Products not previously available.*
Production-Status-Reports	=	*Information describing recently-generated MODIS-Data-Products.*
Product-Order	=	*Information specifying a MODIS-Data-Product to be delivered to a User from the MIDACC DADS.*
Reference-Monitoring-Profile	=	*Expected MODIS instrument engineering parameter levels annotated with limits at which alarm status should be declared.*
Resource-Envelope	=	*Maximum allowable resource consumption levels for the MODIS instrument.*
Retransmission Request	=	*Request for retransmission of data packets that do not meet quality standards.*
Routine Processing	=	*Processing that considers data item position in data processing queues. Cf. Priority Processing.*
Schedule-Data	=	*English language descriptions of planned instrument maneuvers.*
Science-Plan-Coordination	=	*Information exchange between a User requesting special MODIS services and the MODIS Instrument Team Leader. The exchange should culminate in a plan for MODIS Instrument Operation.*

Preliminary Performance Requirement for MIDACSs

I. INTRODUCTION

Here we consider the set of performance requirements that have been compiled for the MODIS data system. These performance requirements follow as a natural consequence of the functional requirements. They specify the requirements for response times, throughput capabilities, storage capacities, and other parameters that relate to the performance of the system. For the MODIS data system, they apply to the:

- entire MODIS data system;
- specific elements of the data system (the CDHF, DADS, ICC, TMCF, and IST);
- processes or functions within each element.

The performance requirements are dependent on the:

- MODIS Science and Instrument Team requirements and
- EosDIS standards.

The following two figures illustrate in a very general sense the relationship between various aspects of the MODIS data system and the EosDIS. Figure 1 presents the interactions between the IST, the ICC, and the EMOC. We see observation requests originating from the IST being passed to the ICC. From the ICC, schedule data is then forwarded to the EMOC, which must then respond with the command confirmation. The ICC then provides a response to the IST. In Figure 2, the primary downlink data flows between the relevant EosDIS, MODIS data system, and the science community are portrayed; specifically, the DHC, MODIS ICC, CDHF, DADS, and the data users. These relationships become important (in addition to the functional requirements for the data system elements) in developing a complete set of, and logical flow between, the performance requirements.

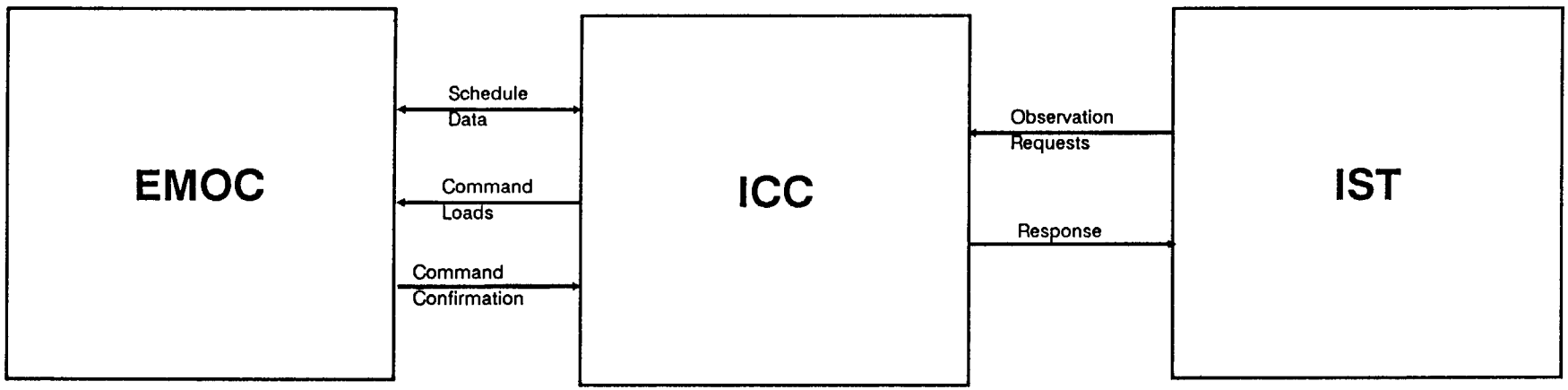
II. MODIS DATA SYSTEM PERFORMANCE REQUIREMENTS

2.1 INSTRUMENT CONTROL CENTER (ICC) PERFORMANCE REQUIREMENTS

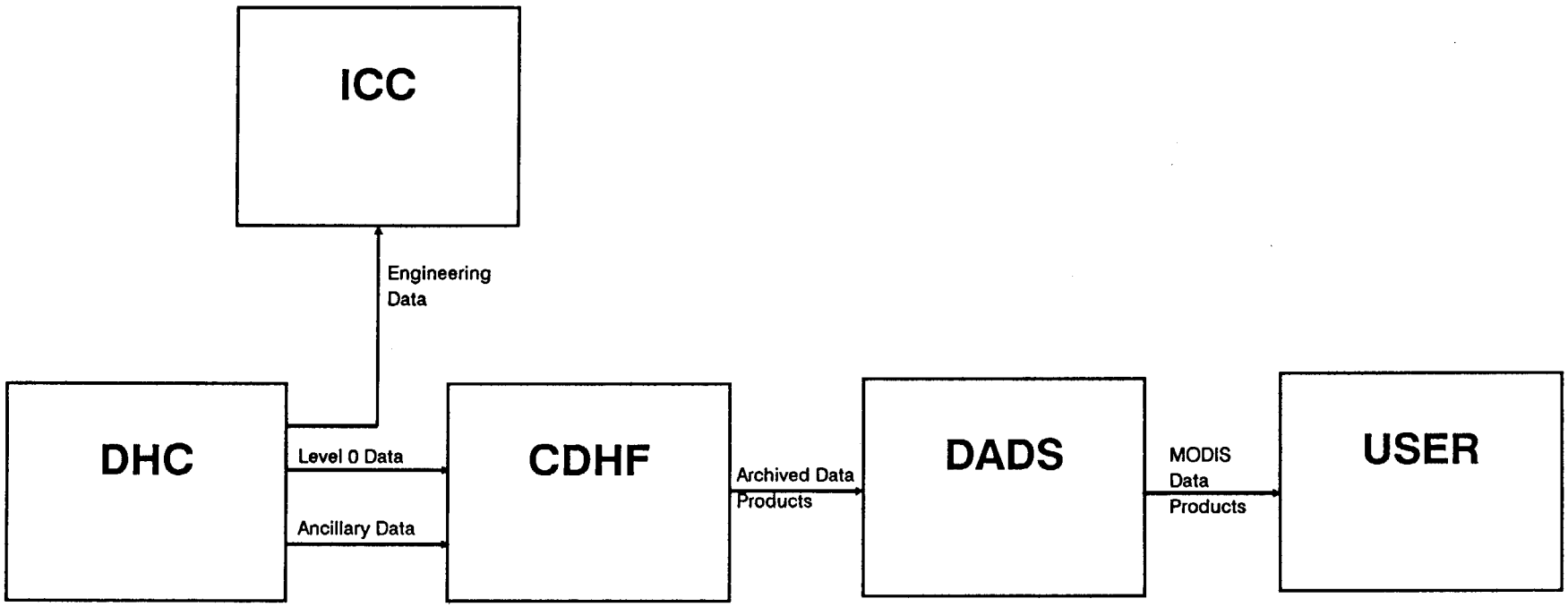
The ICC is responsible for four basic functions:

- planning and scheduling;
- commanding;
- monitoring, and;
- status tracking.

PRIMARY COMMAND DATA FLOWS



PRIMARY DOWNLINK DATA FLOWS



2.1.1 Planning and Scheduling

1. The ICC shall provide the IST confirmation of the correctness and feasibility of observation requests within TBD of the receipt of the request.

2. The ICC shall disseminate to the EMOC within TBD minutes the detailed schedule for the MODIS instrument after receipt of the EMOC resource envelope.

3. The ICC shall, upon receipt of a reschedule request from EMOC, generate an updated command load associated with a MODIS instrument schedule within TBD minutes.

2.1.2 Commanding

1. The ICC will generate target-of-opportunity commands in near real-time.

2. The ICC shall forward unconditionally allowable commands in real-time.

3. For commands, loop delays shall not be more than 10 seconds between command delivery and received response.

4. In some cases, instrument command decisions will have to be made within the time period of one orbit.

5. The ICC shall respond to a request for near-real-time data products within the time period of one orbit.

6. The ICC shall automatically generate, or select from sets of predefined command sequences, a safing command sequence for transmission to the EMOC within TBD seconds.

7. The ICC shall provide a new command sequence within TBD hours in response to a schedule change directed by the MODIS Instrument Team leader.

2.1.3 Monitoring

1. The ICC shall monitor instrument status and confirm responses to uplink commands in near real-time. 95% of the real- time data broadcast by the satellite should be received, preprocessed, and displayed within 60 seconds from the transmission.

2. The ICC shall assess the quality of science data in near real-time for selected samples of data.

3. Raw instrument data from the DHC shall be immediately processed to provide a select set of graphic data products that are useful in assessing the instrument function. The exact data presentations to be supported are TBD.

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3. Raw instrument data from the DHC shall be immediately processed to provide a select set of graphic data products that are useful in assessing the instrument function. The exact data presentations to be supported are TBD.

4. An alarm shall be generated by the ICC within TBD seconds, upon receipt of engineering data and other input data for each scene, to inform the IST and EMOC whenever an operation parameter exceeds the allowable range.

5. The ICC shall generate an alarm, upon receipt of status information about EMOC, PSC, TDRSS, or other instruments from the EMOC, indicating anomaly condition which may affect the operation of the MODIS instrument within TBD seconds. This alarm shall be forwarded to the IST.

2.1.4 Status Tracking

1. The ICC shall, upon request from the IST or EMOC, generate an instrument SOH report based on engineering data covering that period within TBD minutes.

2. The ICC shall, upon request from the IST, generate an instrument operational history report using data quality assessments (DQA), engineering data, detailed schedule information, and commands, within TBD minutes.

2.2 INSTRUMENT SUPPORT TERMINAL (IST) PERFORMANCE REQUIREMENTS

2.2.1 Provide Science Planning and Coordination

TBD

2.2.2 Monitor Instrument Performance

TBD

2.3 TEAM MEMBER COMPUTING FACILITY (TMCF) PERFORMANCE REQUIREMENTS

The TMCF is responsible for three basic functions:

- support calibration;
- develop and maintain scientific algorithms, and;
- produce specialized data products.

2.3.1 Support Calibration

1. The TMCF shall provide the CDHF with calibration coefficients in sufficient time such that level-1b data processing can occur on schedule.

2.3.2 Develop and Maintain Scientific Algorithms

1. The TMCF shall verify that the pointing accuracy of the MODIS instrument data sets is within the required accuracy of TBD kilometers.

2.3.3 Produce Specialized Data Products

TBD

2.4 CENTRAL DATA HANDLING FACILITY (CDHF) PERFORMANCE REQUIREMENTS

The CDHF is responsible for four basic functions:

- receive data;
- manage processing, and;
- produce standard MODIS data products.

2.4.1 Receive Data

1. The CDHF shall provide a storage system utilizing fast access storage for on-line working storage and for protection against data loss.

2. The CDHF shall be capable of storing data at the volume of TBD Gbytes/day in its data store to facilitate retention of data, algorithms, and products.

2.4.2 Manage Processing

1. Investigator processing requests for near-real-time data should be completed within the time frame of one orbit.

2. All data shall be reprocessed a maximum of two times during the 20-year mission. [Clearly, this EosDIS assumption is questionable. Past experience indicates that data sets may be reprocessed more than twice; for example, as improved calibration algorithms and geophysical parameter retrieval algorithms become available.]

3. The CDHF shall be sized to be capable of simultaneously supporting processing, reprocessing, backlog processing, near-real-time processing, browse processing, and normal system maintenance.

4. The CDHF shall be sized such that it will not be utilized in excess of 70% of the system's processing capacity.

2.4.3 Produce Standard MODIS Data Products

1. The amount of level-0 data to be processed to level-1A is equal to TBD times the raw MODIS instrument data.

2. All level-0 data sets received within a 24-hour period shall be completely level-1A processed within 12 hours.

3. The amount of level-1A data to be processed to level-1B is equal to TBD times the raw MODIS instrument data.

4. Results of Level 1A processing shall be available to authorized investigators within 48 hours of the original observation.

5. All level-1A data sets received within a 24-hour period shall be completely level-1B processed within 12 hours.

6. The amount of level-1B data to be processed to level-2 is equal to TBD times the raw MODIS instrument data.

7. All level-1B data sets received within a 24-hour period shall be completely level-2 processed within 8 hours.

8. The amount of level-2 data to be processed to level-3 is equal to TBD times the raw MODIS instrument data.

9. All level-2 data sets received within a 24-hour period shall be completely level-3 processed within 8 hours.

10. The amount of level-3 data to be processed to level-4 is equal to TBD times the raw MODIS instrument data.

2.5 DATA ARCHIVE AND DISTRIBUTION SYSTEM (DADS) PERFORMANCE REQUIREMENTS

The DADS is responsible for four basic functions:

- receive data products;
- manage data products;
- process user requests, and;
- distribute data products.

2.5.1 Receive Data Products

1. The DADS catalog will be updated with the information provided by the data set producing organization as soon as practical (i.e., daily). The catalog entry associated with each archive data set shall be inserted into the catalog as the data set is inserted into the archive.

2.5.2 Manage Data Products

1. The DADS archive shall maintain data on media that provide long lifetimes, rapid and random access, and economical storage.

2. The DADS shall provide a data storage system using slow access with buffering.

3. The DADS shall size base system for a user community of 1,000 to 10,000; 50 to 200 active at any time, ordering 5 to 10 tapes per month; 1 to 10 users ordering large volumes of data and handle up to 10-0 simultaneous users.

4. The DADS shall be capable of storing data at the volume of TBD Gbytes/day in its data store to facilitate retention of data and products.

5. The number of catalog entries to be managed by the DADS is TBD.

6. The average and maximum total archive data retrieval volume for electronic distribution is estimated to be TBD GBytes.

2.5.3 Process User Requests

1. The estimated daily number of retrieval orders for electronic distribution is TBD.

2. The DADS shall handle up to 100 simultaneous interactive catalog/browse/ordering system users.

3. The DADS shall provide for interactive, electronic catalog and ordering functions with a minimum 9600 bps dial-up capability.

4. An interactive catalog system should provide a response to most search commands within 1 to 15 seconds.

5. The amount of queries supported by the DADS is TBD.

6. The archive shall be accessible from remote terminals or workstations via a prompting menu or natural language interface, supplemented by a free-form command language for experienced users.

7. Response time of the DADS to a user should be timely, and shall be limited by the search capability of the system.

2.5.4 Distribute Data Products

1. The DADS shall be capable of responding to orders requesting archive data on tape, optical disk, or listings within three working days. The DADS shall receive and process these orders in terms of locating the requested data, producing them on the request medium, preparing them for mailing, and properly accounting for their production.

2. The DADS shall be capable of satisfying the need for data by multiple users, each user possibly requiring a different time line and path.

3. The retrieval and transfer of catalog information shall be accomplished with a bit error rate of TBD. [10^{-12}?]

4. Near-real-time processed data shall be required for operational purposes, and may be of value for interactive browse activities.

5. Browse files should be visually searchable via attributes (e.g., day, position, time, channel, parameter) and by an expert system.

6. On-line browse capabilities may not be possible for many users; this shall necessitate publication of an image browse catalog.

7. The DADS will transmit electronic orders which do not require interactive servicing (e.g., data retrieved for recalibration) at convenient times.

8. The DADS shall be capable of providing a minimum requirement (or maximum response time) for all archive data orders placed electronically requiring interactive servicing and requesting on-line data (e.g., browse data).

9. Response time of the DADS to a user should be timely, and shall be limited by the search capability of the system.

10. It is a goal that the DADS retrieve the first data set of the order and start the transmission of the data set for orders requesting on-line data within 40 seconds of receipt of the order for 50 percent of all orders and within 100 seconds for 90 percent of all orders.

11. The DADS shall be capable of retrieving the products, including associated ancillary data, for a scene ordered by the user and make them available for dissemination to the user or DDC in less than an hour upon receipt of the product order.

12. The DADS will retrieve the first data set of orders for off-line data within 30 minutes for 90 percent of all such orders.

2.6 ON-BOARD PROCESSOR PERFORMANCE REQUIREMENTS

1. On-board compression of the MODIS instrument data shall be applied if necessary to insure that the maximum and mean data rates do not exceed TBD and TBD Mbps, respectively.

2.7 INTERFACE PERFORMANCE REQUIREMENTS

TBD

III. PRESENT STATUS

At the present time, we have accumulated on the order of 250 functional requirements for the MODIS data system and its elements. There are, at present, only about 50 performance require-

ments for the system. Many of the performance requirements are specified only in a general sense, with the precise details of the performance requirements left "TBD." Moreover, the individual requirements, compiled from different sources, are sometimes in conflict, or overlap, with each other. A continued refinement of these performance requirements will occur throughout this Phase-B data system study.

List of Acronyms

CDHF	Central Data Handling Facility
DADS	Data Archive and Distribution System
DDC	Discipline Data Center
DHC	Data Handling Center
EMOC	Eos Mission Operations Center
Eos	Earth Observing System
EosDIS	Eos Data and Information System
ICC	Instrument Control Center
IST	Investigator Support Terminal
MIDACS	MODIS Information, Data, and Control System
MODIS	Moderate-Resolution Imaging Spectrometer
PSC	Platform Support Center
SOH	State of Health
TBD	To Be Determined
TDRSS	Tracking and Data Relay Satellite System
TMCF	Team Member Computing Facility

ACTION ITEMS:

7/8-3 (Han) Review the draft data product questionnaire with members of the MODIS instrument team. ** Comments received from team; closed **

8/19-1 (Ormsby) Investigate the definition of Quick Look data for the MODIS instrument. ** Definition of quick-look data developed: "real-time engineering data (platform, instrument, and house keeping) only"; closed **