TIMED

Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

Mission Data Center(MDC)

Kenneth J. Heeres

JHU/APL

Kenneth.Heeres@jhuapl.edu

(301) 953-5853

This Page Intentionally Left Blank

TIMED

Topics

- **Requirements**
- **Products**
- **Facility**
- **Changes since PDR**
- **Status**

The mission level requirements on the Mission Data Center have not changed since PDR.

The MDC is the central point in the mission for the distribution and archival of data for the mission. It has the responsibility to distribute data amongst the program elements, maintain on online archive of mission data, and provide a final archive to the Space Physics Data System (SPDS).

The MDC is a facility within the Ground System and in that role is supporting Integration & Test (I&T), Launch & Early Operations (LEOP), and on orbit operations for the MOC and the various subsystems. The MDC is also a facility within the Science Data System and is supporting the gathering of ground based data, production of common ancillary science information, distribution of science data amongst the science teams and science community, providing a central public interface to the TIMED mission, and archiving the data to the SPDS.

TIMED

Mission Requirements

- **Generate Level 0 data products to support the TIMED Mission.**
  - Level 0 is Standard Telemetry Messages or Command Packets

- **Provide access to ground-based measurements in support of TIMED.**

- **Provide timely data distribution among TIMED program elements.**

- **Provide relevant and useful educational products derived from TIMED data to K-12 educators and the public in a timely manner.**

- **During the mission, archive products generated by the spacecraft and the MDC.**

- **Provide for the long term utility and archiving of data products generated by the TIMED program in cooperation with the Space Physics Data System (SPDS)**

These are a slightly more detailed list of requirements derived from the previous list.

One of the requirements that was dropped from the list since PDR is the requirement to provide for the distribution and playback of commands to the spacecraft. Thus an online copy of this information is not maintained by the MDC.

TIMED

Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

Derived Requirements - 1

- Maintain an on-line archive of packetized telemetry data for the life of the mission
- Maintain an on-line archive of packetized command data for the life of the mission
- Maintain a off-line copy of all data sent to and received from the spacecraft
- Provide access to packetized telemetry data: Real-time, Play-back, File download
- Produce and distribute TIMED products that will be useful to the K-12 educational community
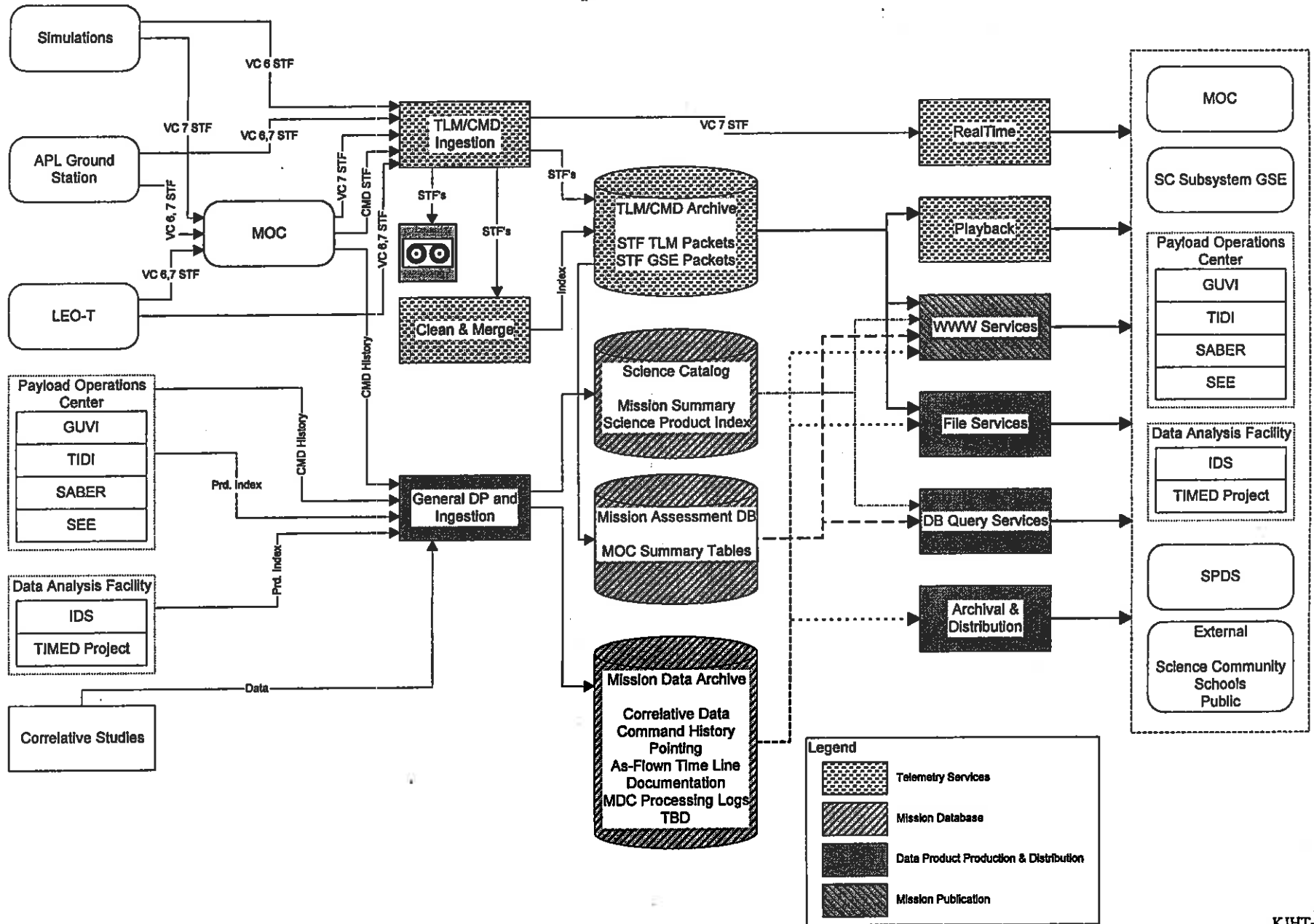
This Page Intentionally Left Blank

TIMED

Derived Requirements - 2

- Develop and serve TIMED Project WWW Page

- Ingest, maintain, provide access to, and document correlative measurements, ground based and other

- Maintain and provide access to an index of science products (MD)

- Pull the TIMED science products from the POC's and master media for delivery to the SPDS for long term archive

- Convert the level 0 mission data and the correlative ground-based measurements to a format compatible with the SPDS and deliver media to SPDS for long term archive

- Maintain and provide access to a mission summary database that describes the configuration of the spacecraft and instruments, the position and orientation of the spacecraft, and an estimate of the quality and availability of the data for each instrument

MDC Operational Data Flow

Simulations

APL Ground Station

MOC

LEO-T

VC 6 STF
VC 7 STF
VC 6,7 STF
VC 7 STF
CMD STF
VC 7 STF
VC 6,7 STF
VC 6, 7 STF
VC 6,7 STF

TLM/CMD Ingestion

STF's
STF's
STF's

Clean & Merge

CMD History
Index

TLM/CMD Archive

STF TLM Packets
STF GSE Packets

RealTime

VC 7 STF

Playback

WWW Services

Science Catalog

Mission Summary
Science Product Index

File Services

Mission Assessment DB

MOC Summary Tables

DB Query Services

Archival & Distribution

Payload Operations Center

GUVI
TIDI
SABER
SEE

Data Analysis Facility

IDS
TIMED Project

Correlative Studies

Prd. Index
CMD History
Prd. Index
Data

General DP and Ingestion

Mission Data Archive

Correlative Data
Command History
Pointing
As-Flown Time Line
Documentation
MDC Processing Logs
TBD

MOC

SC Subsystem GSE

Payload Operations Center

GUVI
TIDI
SABER
SEE

Data Analysis Facility

IDS
TIMED Project

SPDS

External

Science Community
Schools
Public

Legend

Telemetry Services

Mission Database

Data Product Production & Distribution

Mission Publication

TIMED

Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

MDC Operational Data Flow

Ground Station

Mission Operations Center

Payload Operations Center

Data Analysis Facility

Correlative Studies

Mission Data Center

Telemetry Archive

Mission Archive

Science Catalog

Subsystem GSE

Mission Operations Center

Payload Operations Center

Data Analysis Facility

General Public

SPDS
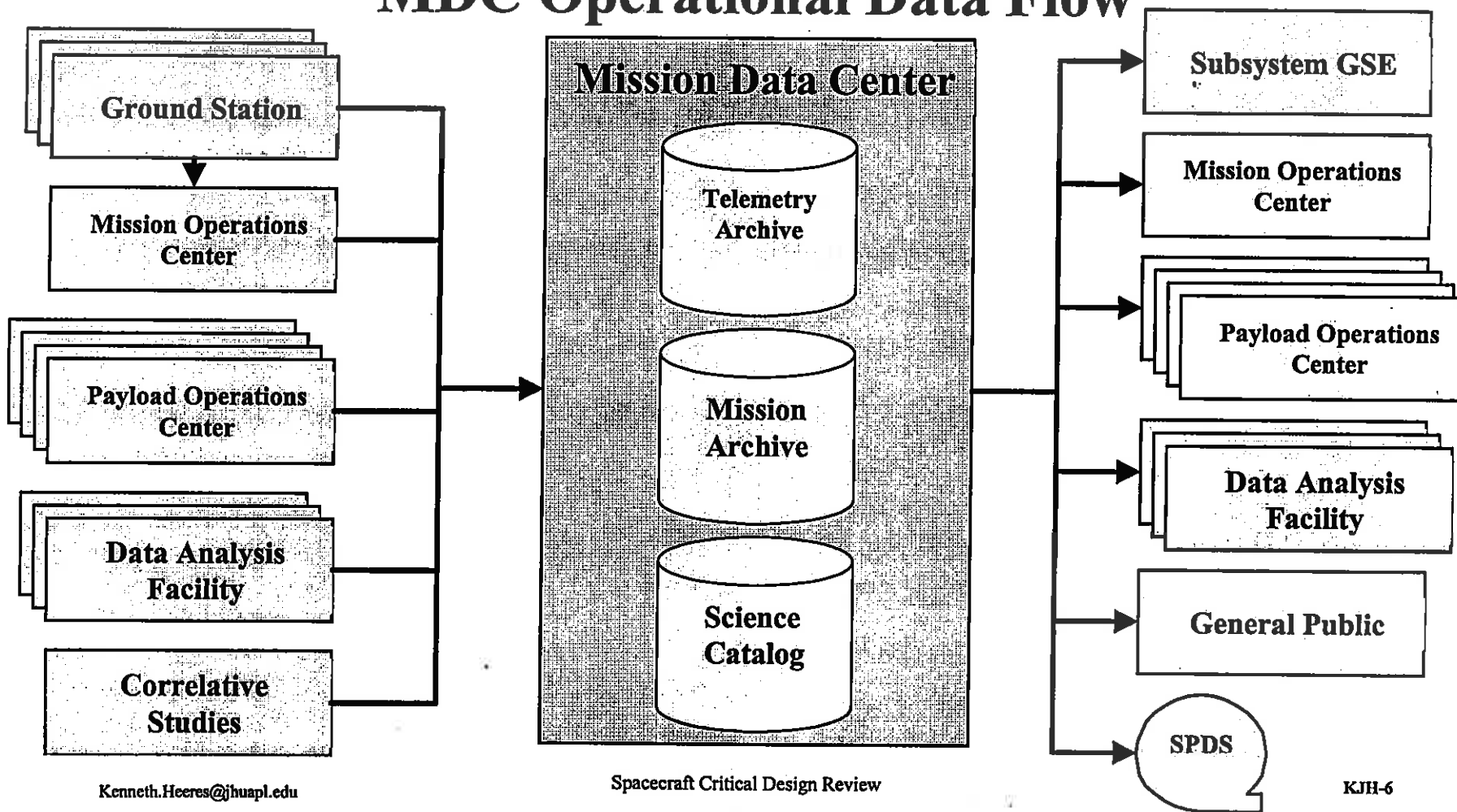
Besides the distribution and archival of data the MDC is responsible for the production of several sets of data or products. The common thread for the products is that they are needed by multiple program elements. If a set of data is needed by multiple program elements then, for the most part, the production of that data is the responsibility of the MDC.

TIMED

Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

Products

- **Real-Time telemetry (stream)**
  - Spacecraft, Simulators, Ground Support Equipment
- **Play-back telemetry of same (stream)**
- **Telemetry file service (http)**
- **Raw telemetry/commands archive (tape)**
- **National Meteorological Center (NMC) data (file)**
- **Solar and Geomagnetic Indices (file)**
- **Position, Velocity, Time, Attitude, and Orbital Elements (file)**
- **Predicted Position, Velocity, Time, Attitude, and Orbital Elements (file)**
- **Orbital elements errors (file)**
- **Orbit number (file)**
- **Contact plans (file)**
- **Telemetry status (file)**
- **Timelines (files)**

The TIMED mission makes extensive use of existing infrastructure. The mission uses the existing Internet to distribute data to the external world and the JHU/APL Local Area Network (LAN) to distribute data internal to APL. In addition the MDC will be located within the SR Branch Multi-Mission Processing Center (MMPC) in 4-171--177.

Laboratory Connection to the Internet

The Laboratory connection to the Internet is provided by two Internet Service Providers (ISP); Digex and BBN Planet. The Digex connection is via a 10 Mbs Ethernet connection and the BBN Planet connection is vi a 4 Mbs Switched Multimegabit Data Source (SDMS) connection. Access to the Internet is controlled by a gateway router that resides on the Laboratory 100 Mbs Fiber Distributed Data Interface (FDDI) backbone.

Laboratory LAN

The Laboratory LAN consists of two backbones. The current one is and FDDI network consisting of two redundant rings. This provides shared 100 Mbs connections between buildings. This is gradually being replaced by a switched 100 Mbs Ethernet backbone which covers some of the buildings. The Space Department is one one of the first departments to have it's buildings connected using the new switched backbone.

Multi-Mission Processing Center (MMPC)

The MMPC is a SR Branch facility for data processing, it includes rooms 4-171--177. Missions include Voyager, AMPTE, MSX, NEAR, and now TIMED. The facility uses Laboratory backup power and file backup besides the normal resources such as power, air conditioning, and networking. The Laboratory backup power consists of batteries and diesel generators with enough capacity to continue running. The file backup is for general user backup and project source files.

Configurations

The MDC will go through several configurations to support various phases of the mission.

MDC Mini-MOC Configuration

Most of the MDC equipment is contained in the MMPC and consists of two workstations which provide telemetry and command archival and distribution and database support. A workstation is located in the MOC to provide telemetry distribution within the MOC and to the MDC. Several development systems are included.

tmdc-ts1 -- Micron, single processor Pentium Pro, 200 Mhz, Solaris 5.5.2

tmdc-ts2 -- Micron, dual processor Pentium Pro, 200 Mhz, Solaris 5.5.2

MDC Mini-MOC Configuration

Digex

Internet

10 Mbs Ethernet

4 Mbs SMDS

BBN Planet

Cisco 7000 Router

Cisco 5500 Switch
Building 3

MOC

Multimission Processing Center

TIMED Mission Data Center

Cisco 5500 Switch
Building 7

**Distributed
Development
Equipment**

tmdc-ts1

Synoptics 3000
Hub

Cisco 7000 Router

Bldg. 23

Other TIMED
MOC Equipment

Disk array

tmdc-ts2

Tape drive

Disk array

eaton

RAID Disk array

Postscript Printer

Cisco 5500
Switch
Bldg. 4

tmdc-dev1

tmdc-dev2

tmdc-gse1

Switched 100 Mbs

Switched/Shared 10 Mbs

FDDI 100 Mbs

Infrastructure

KJH-8

tmdc-dev1 -- Micron, single processor Pentium Pro, 200 Mhz, Windows NT 4.0

tmdc-dev2 -- Micron, dual processor Pentium Pro, 200 Mhz, Solaris 5.5.2

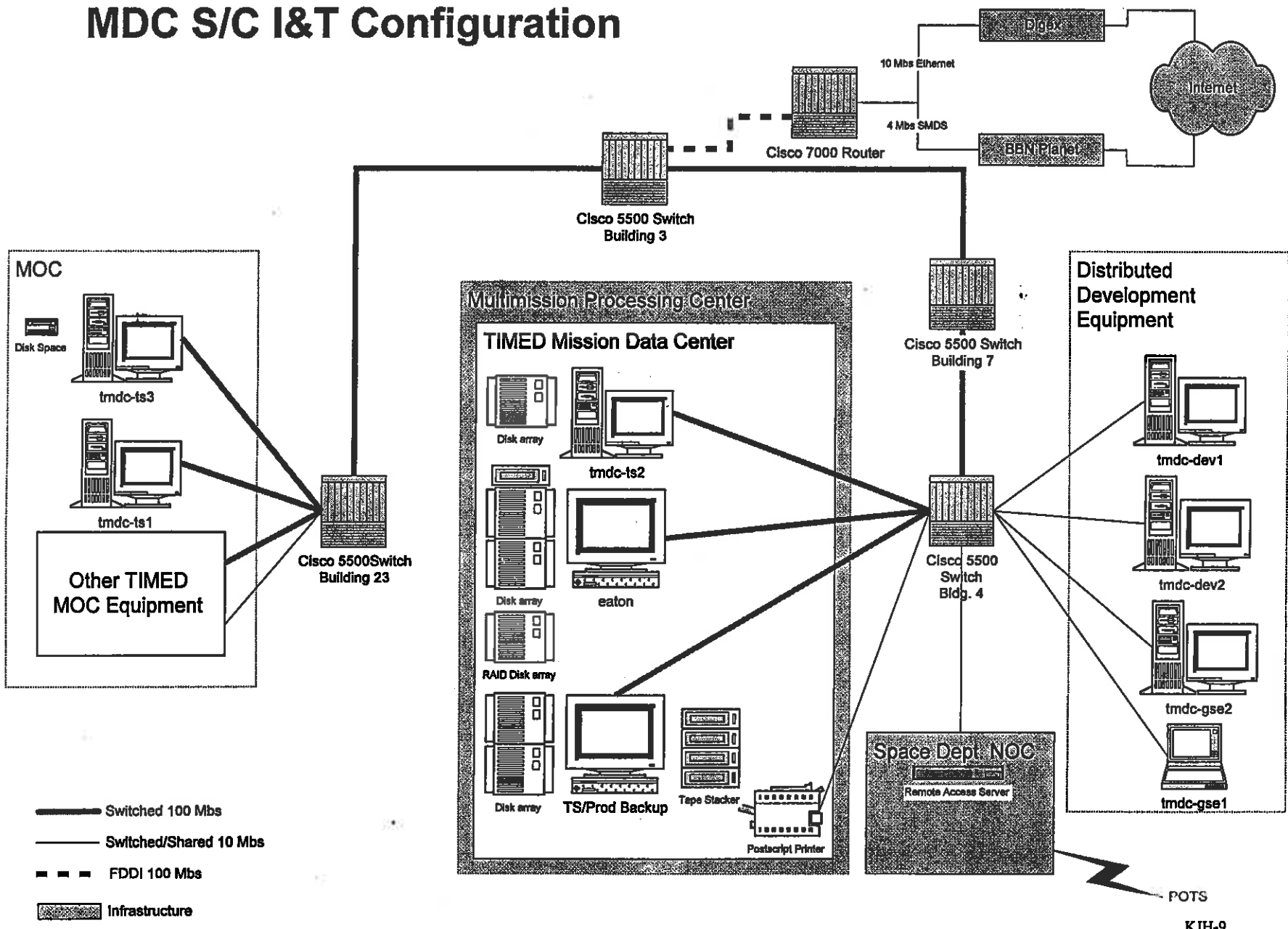tmdc-gse1 -- Dell Latitude LM, single processor Pentium MMX, 166 Mhz, Windows 95

eaton -- Sun Ultra Enterprise 2, dual processor Sparc, 200 Mhz, Solaris 5.5.2

MDC S/C I&T Configuration

The I&T configuration has changes and additions:

•Change from FDDI connection to switched Ethernet between Buildings 23 and 4.

•Addition of a remote access server. This is TIMED equipment which will provide modem access to the APL LAN so that POCs can get telemetry and send commands if the Internet is unavailable. There will be 8 modem lines available.

•Addition of a development workstation and a GSE workstation for testing

•Additional disk capacity to take us through the launch

•Additional telemetry server for the MOC. This is to prepare for separated field operations.

•Additional processing system to provide backup for the telemetry and database/production server.

•Addition of a system to provide data backup for the archive and databases
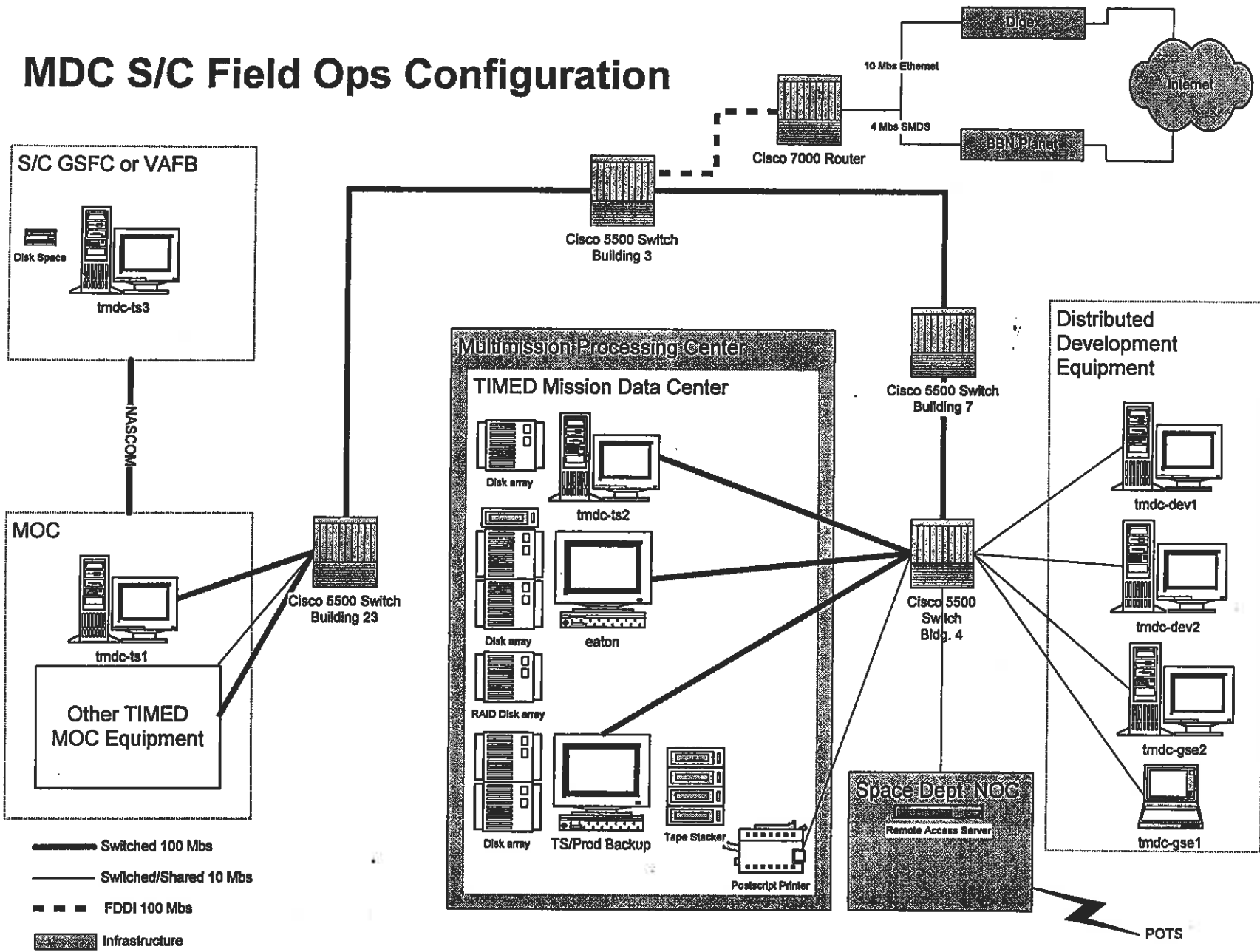
MDC S/C I&T Configuration

Legend:

━━━ Switched 100 Mbs

─── Switched/Shared 10 Mbs

▬ ▬ ▬ FDDI 100 Mbs

▨▨▨ Infrastructure

Components:
- Digex
- Internet
- 10 Mbs Ethernet
- 4 Mbs SMDS
- BBN Planet
- Cisco 7000 Router
- Cisco 5500 Switch Building 3
- MOC
  - Disk Space
  - tmdc-ts3
  - tmdc-ts1
  - Other TIMED MOC Equipment
  - Cisco 5500Switch Building 23
- Multimission Processing Center
  - TIMED Mission Data Center
    - Disk array
    - tmdc-ts2
    - Disk array
    - eaton
    - RAID Disk array
    - Disk array
    - TS/Prod Backup
    - Tape Stacker
    - Postscript Printer
- Cisco 5500 Switch Building 7
- Cisco 5500 Switch Bldg. 4
- Space Dept. NOC
  - Remote Access Server
  - POTS
- Distributed Development Equipment
  - tmdc-dev1
  - tmdc-dev2
  - tmdc-gse2
  - tmdc-gse1

KJH-9

MDC S/C Field Ops Configuration

The only change to support field ops will be that one of the MOC telemetry servers will be moved to the field location to support routing of the real-time telemetry. It will have local spooling capability in case of network failure.
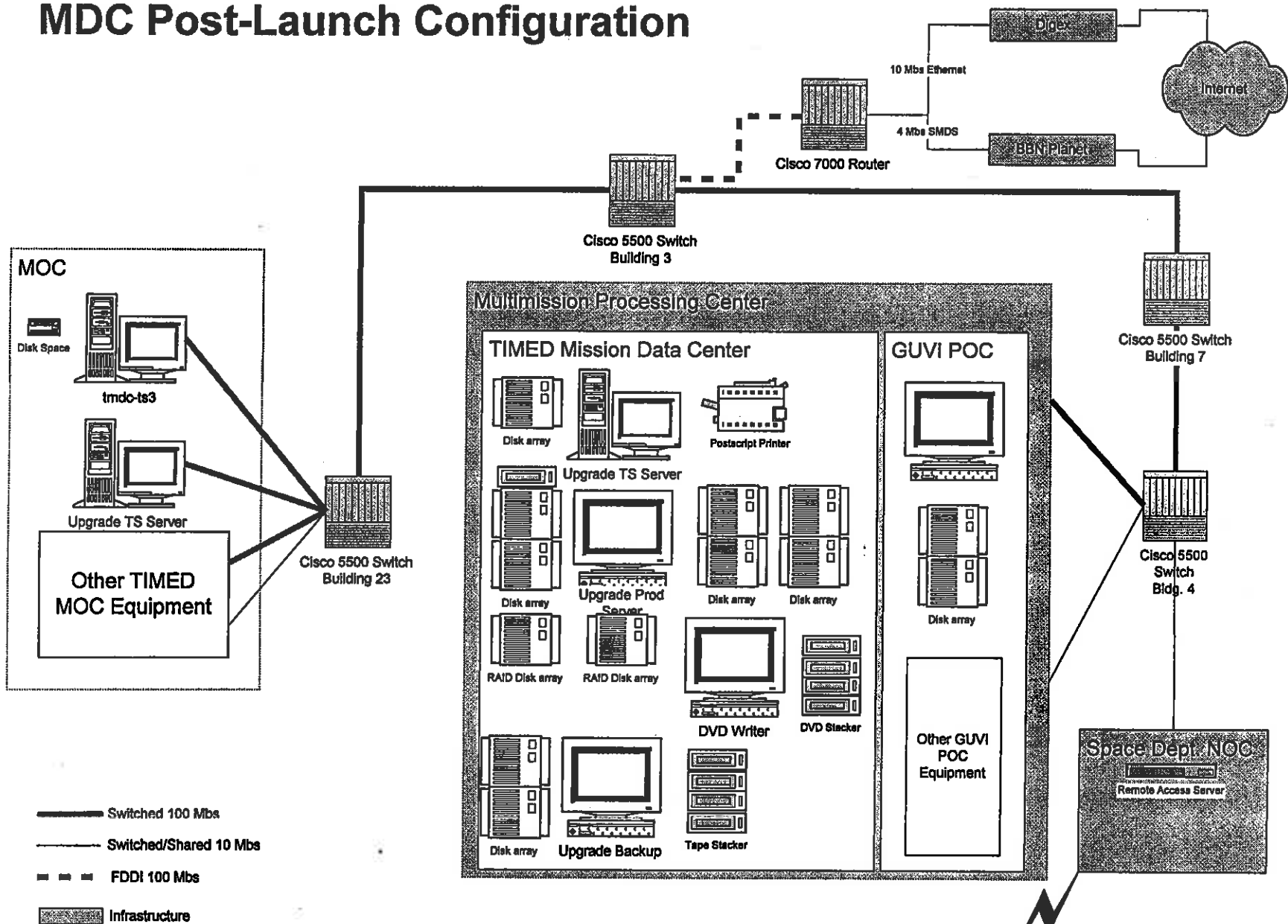
MDC S/C Field Ops Configuration

Legend:
- ▬▬▬ Switched 100 Mbs
- ─── Switched/Shared 10 Mbs
- ▬ ▬ ▬ FDDI 100 Mbs
- ▦ Infrastructure

KJH-10

MDC Post-Launch Configuration

The Post-Launch configuration includes an upgrade to most of the production systems, additional disk space to support until end of mission, and a system that can write archival media for the Space Physics Data System.

MDC Post-Launch Configuration

Digex

Internet

10 Mbs Ethernet

4 Mbs SMDS

BBN Planet

Cisco 7000 Router

Cisco 5500 Switch
Building 3

Cisco 5500 Switch
Building 7

MOC

Disk Space

tmdc-ts3

Upgrade TS Server

Other TIMED
MOC Equipment

Cisco 5500 Switch
Building 23

Multimission Processing Center

TIMED Mission Data Center

Disk array

Upgrade TS Server

Postscript Printer

Disk array

Upgrade Prod
Server

Disk array

Disk array

RAID Disk array

RAID Disk array

DVD Writer

DVD Stacker

Disk array

Upgrade Backup

Tape Stacker

GUVI POC

Disk array

Other GUVI
POC
Equipment

Cisco 5500
Switch
Bldg. 4

Space Dept. NOC

Remote Access Server

POTS

Switched 100 Mbs

Switched/Shared 10 Mbs

FDDI 100 Mbs

Infrastructure

KJH-11

This Page Intentionally Left Blank

Changes Since PDR

- **Telemetry Server written in C++ versus Java**
  - inadequate low level socket control in Java
  - ambiguous thread scheduling algorithm in Java
- **Incorporation of Data Distribution System (DDS) into the design**
- **Solaris/Intel only architecture abandoned**
  - NT needed to support emulator work
  - Solaris/Sparc needed by DDS

This Page Intentionally Left Blank

TIMED

Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

Data Distribution System(DDS)

- **DDS will be used to:**
  - Collect science data
  - Catalog science data
  - Distribute science data
  - Facilitate the building of the TIMED SPDS archive

- **Developed by NASA/Goddard to support Hubble, and X-ray Timing Explorer (XTE)**
  - DDF - Data Distribution Facility, a multi-mission data distribution system

- **Being used by International Solar-Terrestrial Physics (ISTP) to support multiple missions**
  - CSC is adding capabilities desired by ISTP

- **MDC is proposing using DDS to support TIMED**
  - Installed and evaluated DDS during August 1997
  - Will install and test ISTP version of DDS beginning January 1998
    - » Work with POCs on test products
    - » Evaluate cost of any proposed enhancements
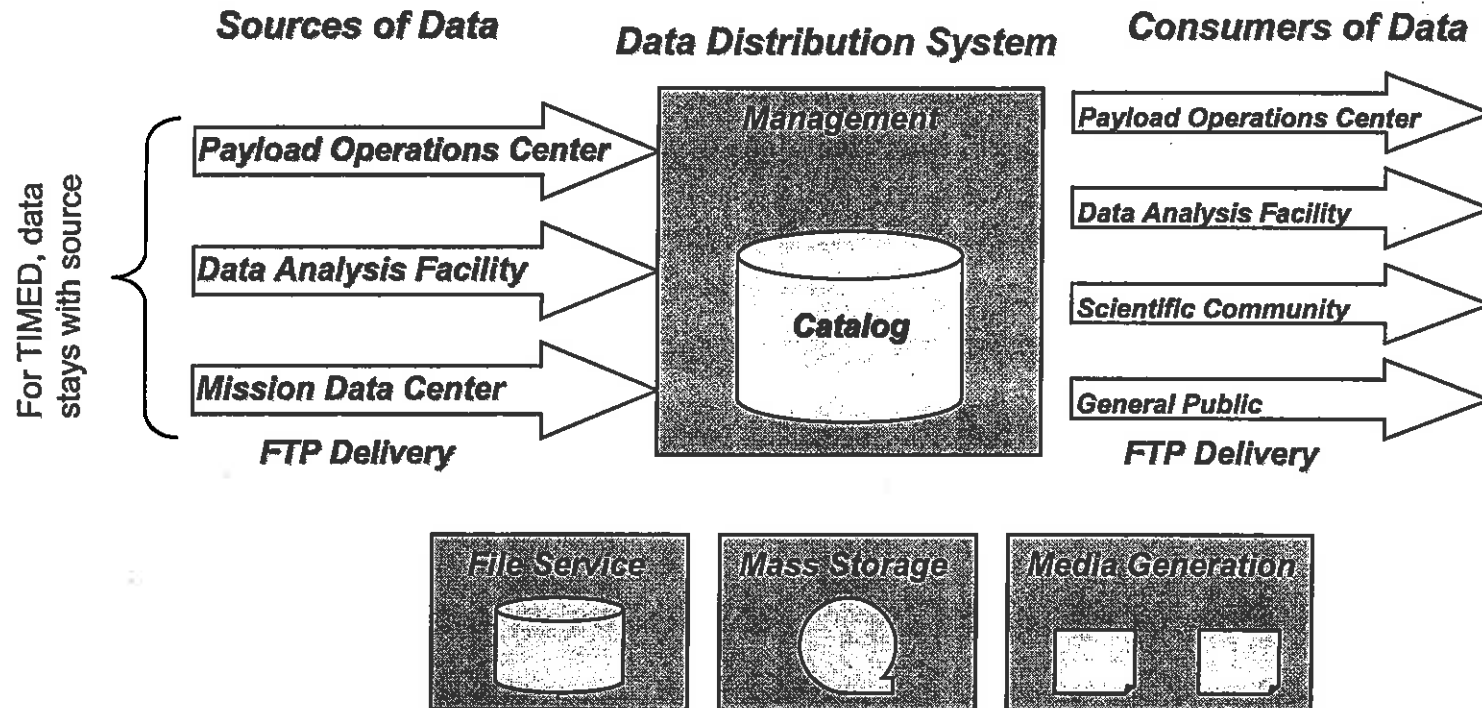
This Page Intentionally Left Blank

TIMED

Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

DDS Overview

Sources of Data

Data Distribution System

Consumers of Data

For TIMED, data stays with source

Payload Operations Center

Data Analysis Facility

Mission Data Center

FTP Delivery

Management

Catalog

Payload Operations Center

Data Analysis Facility

Scientific Community

General Public

FTP Delivery

File Service

Mass Storage

Media Generation

This Page Intentionally Left Blank

TIMED

Status

- **MDC PDR held in April**

- **Code to distribute real-time telemetry delivered to emulator task in July**

- **Code to distribute real-time telemetry for mini-MOC delivered in September**

- **Code to store and playback telemetry for mini-MOC will be delivered in December**