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Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

Mission Data Center Software

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Topics

- **Development Strategy**
- **Areas of Development**
- **Progress**
- **Software Development Approach**

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Software Development Strategy based on Evolutionary Builds

Applicable when:

- **All requirements cannot be defined up front.**
- **User needs and system requirements can be partially defined, then refined in each succeeding build.**
- **Requirements and interfaces "evolve" as developers and users become more knowledgeable of the need.**

REFERENCE: MIL-STD-498 Application and Reference GUIDEBOOK, 1996

MDC Software Delivered in Four Builds

1. Early Capability Build: initially a prototype build for operational concept demonstration. Redefined as the Mini-MOC build to be used to support bench level subsystem testing. Needed at start of bench testing (late 1997).

2. Integration and Test (I&T) Build: direct support for spacecraft Integration and Test. Needed at start of I&T (Fall 1998).

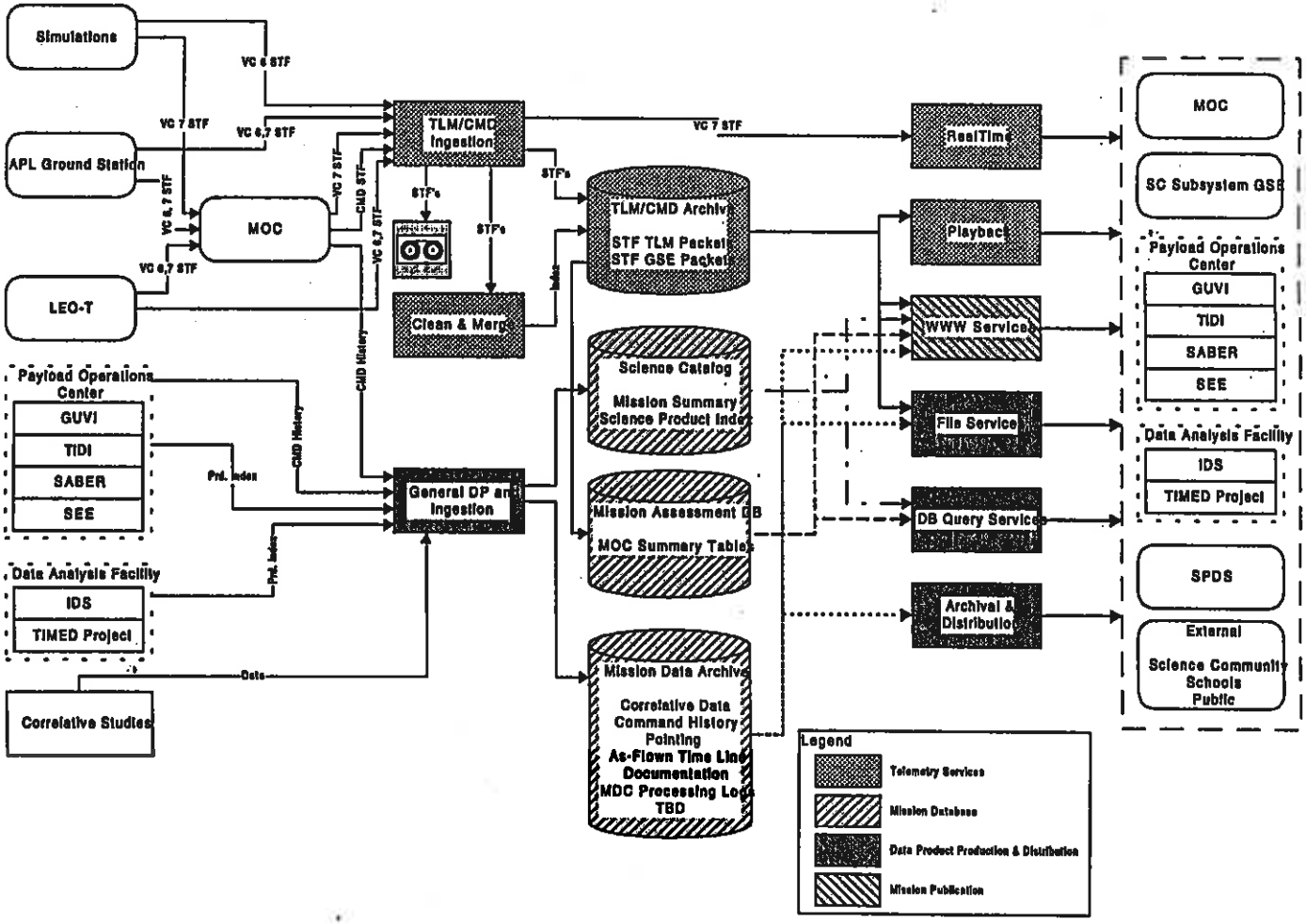
3. Launch Ready Build: support launch and on orbit data processing. Needed by mission simulation tests (Six months before launch - Summer 1999).

4. Mission Close-Out Build: support final data archive. Needed first archive delivery mission (2001).

REFERENCE: TIMED Mission Data Center Software Development Plan

Components of the MDC

- Telemetry Server (TS)
- Mission Database (MD)
- Data Product Production and Distribution (DPPD)
- Mission Publication (MP)


Simulations
APL Ground Station
LEO-T
MOC
VC 6 STF
VC 7 STF
VC 6,7 STF
TLM/CMD Ingestion
STF's
CMD STF
CMD History
Clean & Merge
TLM/CMD Archive
STF TLM Packets
STF GSE Packets
Index
Payload Operations Center
GUVI
TIDI
SABER
SEE
Prd. Index
General DP and Ingestion
Science Catalog
Mission Summary
Science Product Index
Mission Assessment DB
MOC Summary Tables
Data Analysis Facility
IDS
TIMED Project
Data
Correlative Studies
Mission Data Archive
Correlative Data
Command History
Pointing
As-Flown Time Line
Documentation
MOC Processing Logs
TBD
RealTime
Playback
WWW Services
File Service
DB Query Service
Archival & Distribution
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

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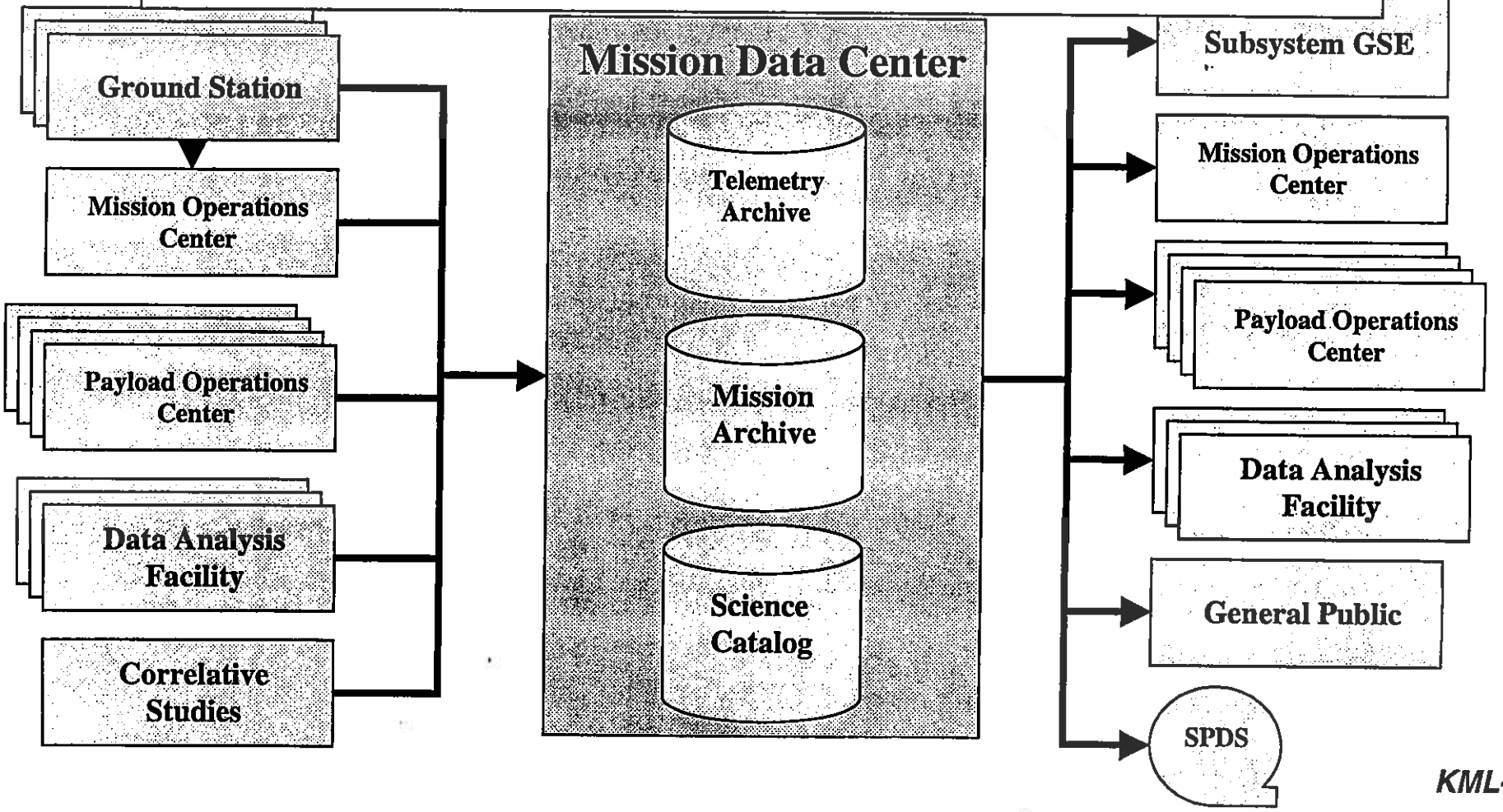
MDC Operational Data Flow



KML-6

Telemetry Server

- **Capture telemetry from the Ground Station**
- **Build Telemetry Archive**
- **Serve Telemetry over network connections**
  - **Near Real time**
  - **Play Back from Archive**
- **all software developed by MDC**

Mission Database

- **Comprised of several databases**
  - **Telemetry Archive Status**
  - **Spacecraft ephemeris and attitude (as received from spacecraft)**
  - **Timelines, planned and as-flown**
  - **Science products and correlative data**
  - **Use DDS for Catalog**
- **Mission Assessment Database**
  - **no longer a software development task for MDC**
  - **administration only**
  - **Use commercial RDBMS**

Data Product Production and Distribution

- **Generation of MDC data products**
  - **Software developed by MDC**
- **Distribution of all data products except telemetry**
  - **DDS**
    - **automated retrieval, cataloging and distribution**
    - **MDC will add enhancements as needed**
- **Mastering data for NASA Space Physics Data System**
  - **Software developed by MDC**

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Mission Publication

- **Public access to TIMED information at MDC**
- **Conform to the Common Interface defined by the Science Data System**
- **World Wide Web site**
  - **Site administer by MDC**
  - **Web pages developed by MDC**
    - **HTML**
    - **Java Applets**

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Build 1

- Design and Build the Mini-MOC version of Telemetry Server
  - Deliveries
    - Partial - Spacecraft Emulator, July 97
    - Partial - Mini-MOC, Oct 97
    - Full - Mini-MOC, Dec 97
- DDS Evaluation Completed
- Mission Assessment Database Feasibility Study Completed

Telemetry Server Requirements

- Archive all received telemetry
- Receive real-time telemetry via a TCP/IP stream
- Receive telemetry as files via FTP
- Convert input data to STF format (Offsite Ground Station)
- Deliver Telemetry Real-time
  - 25 simultaneous connections, 1Mbit/s aggregate output rate
- Playback Archived Telemetry
  - 50 simultaneous connections, 825 kbit/s aggregate output rate
  - two MOC reserved connections, 88 kbit/s output rate each

Telemetry Server Requirements (cont.)

- Delivery in user selected format
  - Packets
  - Transfer Frame
  - Supplemented Telemetry Frames
  - Supplemented Telemetry Packets
  - POC Telemetry Packet
- Filter by
  - Source of Data and Ground Station Front End
  - CCSDS Virtual Channel and Application IDs
- Playback Ordered by
  - Ground Receipt Time
  - Spacecraft Clock (available for Builds 3 & 4)

Telemetry Server Processes

- **Real Time Router**
  - **accepts connections from Ground Stations and receives telemetry**
  - **accepts connections from clients and provides real-time filtered stream of telemetry**
  - **forwards stream of telemetry merged from all input sources to another "router compatible" server downstream**
- **Spooler -**
  - **writes telemetry received from router to disk**
- **Ingest**
  - **reads telemetry files created by spooler or received via FTP and build play-back archive**
- **Play-Back Server**
  - **accepts connection from client and provides filtered streams of telemetry from archive**

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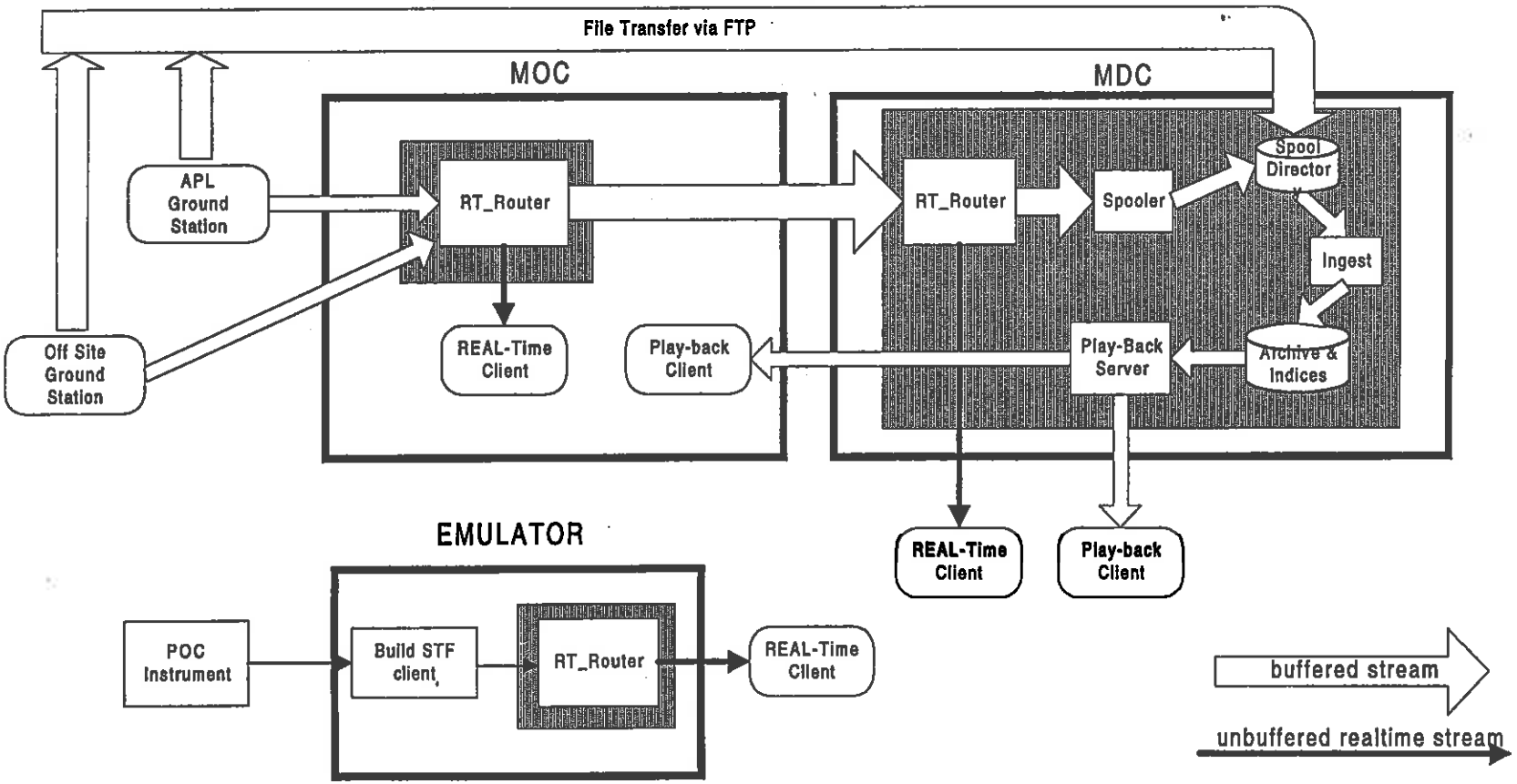
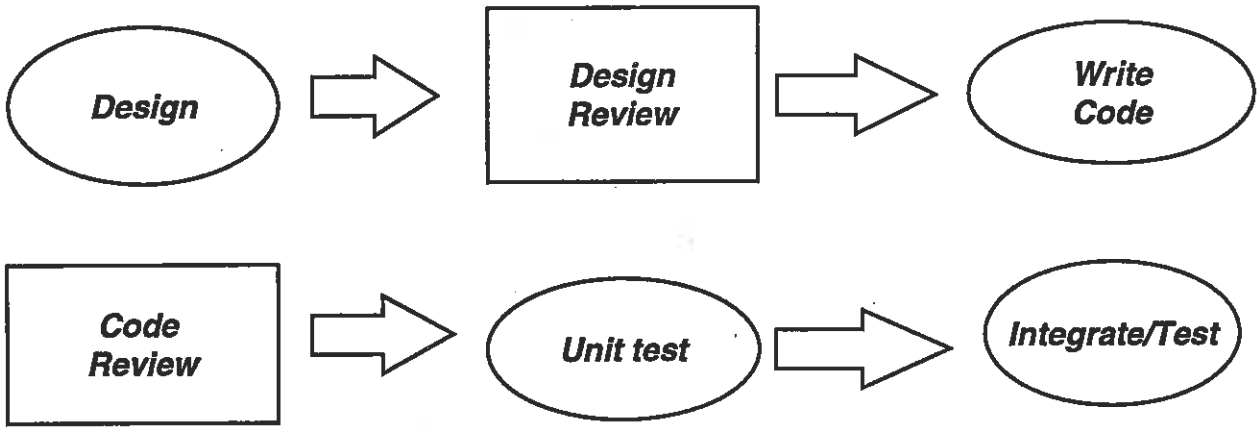
TELEMETRY SERVER DATA FLOW



Software Development Approach

S/W Development Process



Object Oriented Analysis & Design Methodology

Object Modeling Technique (OMT) Rumbaugh

- **Widely documented**
- **UML standard based on OMT**
- **in-house CASE tool, StP, includes OMT component**

Reviews

- **PDL and Class definitions of the design**
  - **Developer, MDC Lead, Software Lead, Software Segment Engineer and External Interface Representatives**
- **Code**
  - **Developer, Software Lead, Software Segment Engineer and External Interface Rep.**

Testing

- **Each class - responsibility of programmer**
- **Component test - responsibility of s/w lead**
- **Integration with Ground System - coordinated by Software Segment Engineer**

Configuration Management

- Build 1&2
  - informal control by Software Lead
- Builds 3&4
  - Software controlled by Configuration Control Board

Documentation

- **Software Development Plan (status - complete)**
- **System Requirement Specification (Draft, 2nd Version)**
- **Interface Control Document (in-progress)**
  - **all interfaces documented or referenced**
- **Software Design Documents (planned)**
  - **one for each component**
- **Test Plan and Test Report**
  - **one for each component**
  - **Telemetry Server (draft)**
- **Operation/User Guide for Telemetry Server**