HUNTSVILLE OPERATIONS SUPPORT CENTER

presented by:

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MSFC/E033

HUNTSVILLE OPERATIONS SUPPORT CENTER (HOSC)

The HOSC is a multimission control and support facility designed to provide simultaneous support to several diverse missions, using a common set of processing equipment and facilities. The facility currently consists of:

- Two payload control area "front rooms", with associated support areas
- 12 online conference work areas, with data, audio, and video services
- Two science operations areas, totalling 6000 sq. ft. of raised floor space
  - — Data, audio, and video services; audio keysets can be configured to allow experimenters to converse directly with payload crew
  - — Access to high-rate science data interfaces
- 9000 sq. ft. computer room with central configuration monitoring area
- Redundant power and A/C
  - — Two power feeds from different areas of TVA grid, with automatic transfer
  - — Battery and generator backup for all power except overhead lights
- Conference areas with audio teleconferencing capability
- Lab space for enhanced development

MISSIONS SUPPORTED BY THE HOSC:

- 1960s:
  - — Saturn Launch Engineering Console Room

- 1970s:
  - — Skylab Engineering Console Room

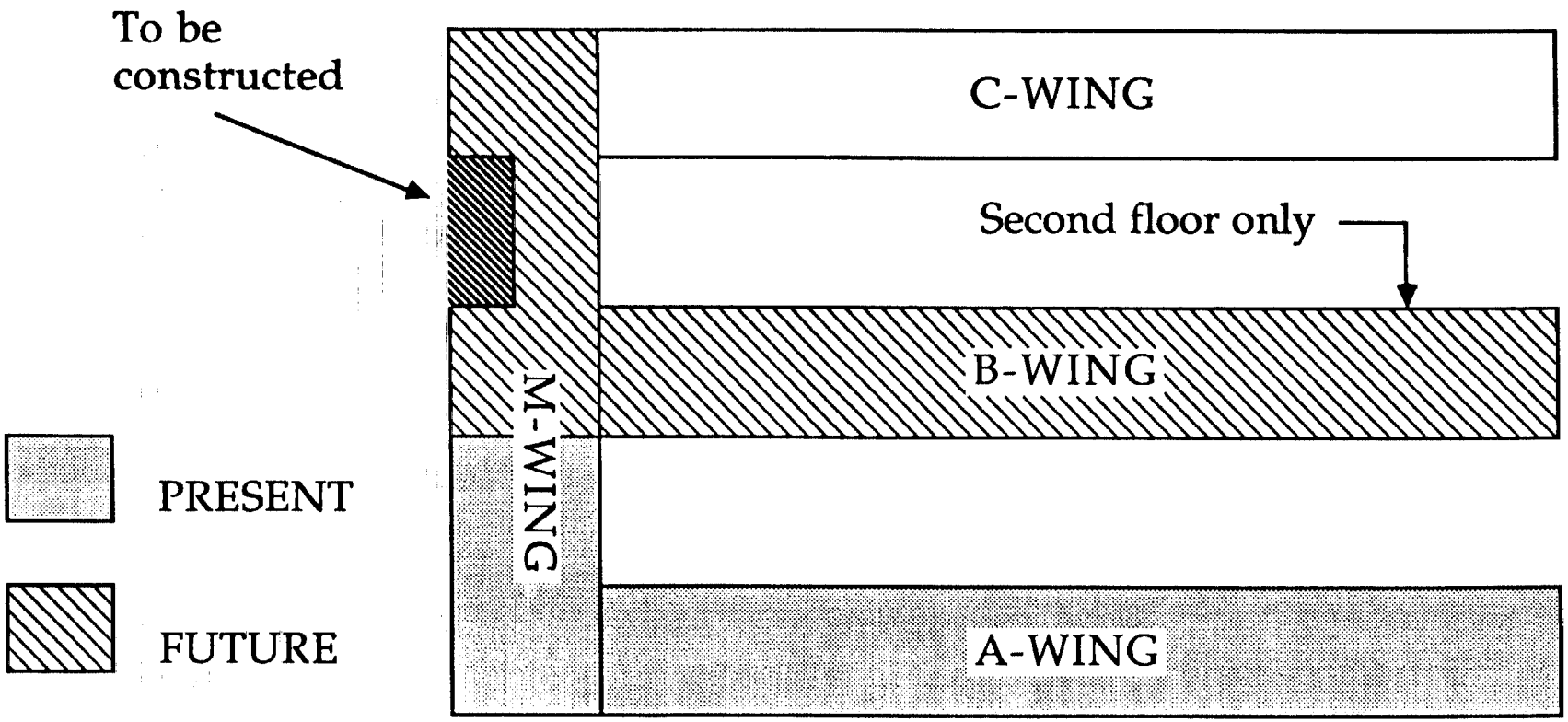
- 1980s:
  - — Shuttle Engineering Console Room
  - — Hubble Space Telescope Engineering Support Center (ESC)
  - — Intertial Upper Stage (IUS) ESC

- Present:
  - — Shuttle Engineering Console Room
  - — Spacelab Payload Operations Control Center (POCC)
  - — IUS ESC
  - — Propulsion test stand support

- Late 1990s:
  All of the present activities, plus:
  - — Space Station Freedom Payload Operations Integration Center (POIC)
  - — SSF Work Package 01 ESC
  - — SSF OSSA Integrated Science Operations Center (ISOC)
  - — Astronomical X-ray Astrophysics Facility (AXAF) POCC
  - — AXAF ESC

THE HOSC FACILITY

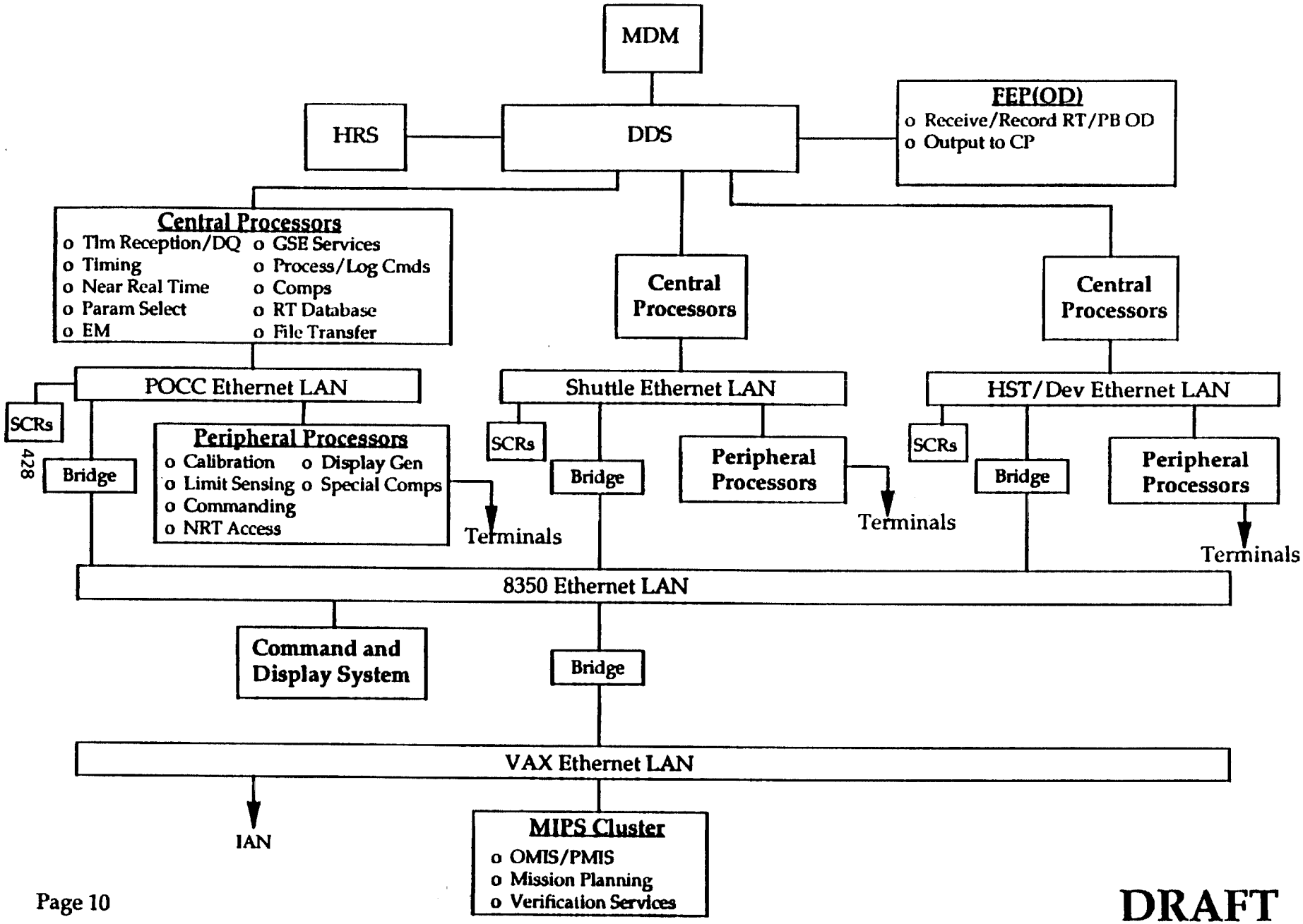
- Current facility occupies building 4663 A-wing and part of M-wing
- Future expansion to occupy upper floor of B-wing and remainder of M-wing



HOSC GENERIC SYSTEM GOALS

- To build and operate a generic system capable of multimission support
- To perform multiple mission supports simultaneously
- To be able to exchange components and share redundancy
- To build systems using COTS products when possible
- To allow for expansion and accommodation of new missions
- To use common data transfer protocols across projects, simplifying data exchange and eliminating need for protocol conversion

HOSC Existing Architecture



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CURRENT HOSC MISSION REQUIREMENTS

- Shuttle Engineering Console Room:
  - process Orbiter Downlink (OD) - non-standard stream
  - process redundant Launch Processing System (LPS) data
  - process redundant Engine Instrumentation System (EIS) data
  - total data input rate ~ 1.3 Mb/sec
  - extensive exception monitoring (drives C&W lamps)
  - post-launch ops recorder dump processing at 1 Mb/sec

- Spacelab POCC:
  - process Orbiter Downlink
  - process Experiment Computer and Subsystem Computer I/O
  - process experiment dedicated channels at up to 2 Mb/sec
  - perform payload commanding
  - payload ops planning and timelining; orbit prediction

- IUS ESC
  - process Orbiter Downlink
  - process IUS subset data inserted into OD by payload data interleave
  - process data from ARIA aircraft or other sources

CURRENTLY EMPLOYED HARDWARE AND SOFTWARE

- Data switching — custom hardware

- Front-end processors and central processors:
  Hardware — Concurrent 3200-series with custom telemetry interfaces
  Software — assembly and Fortran, no COTS except OS and compilers

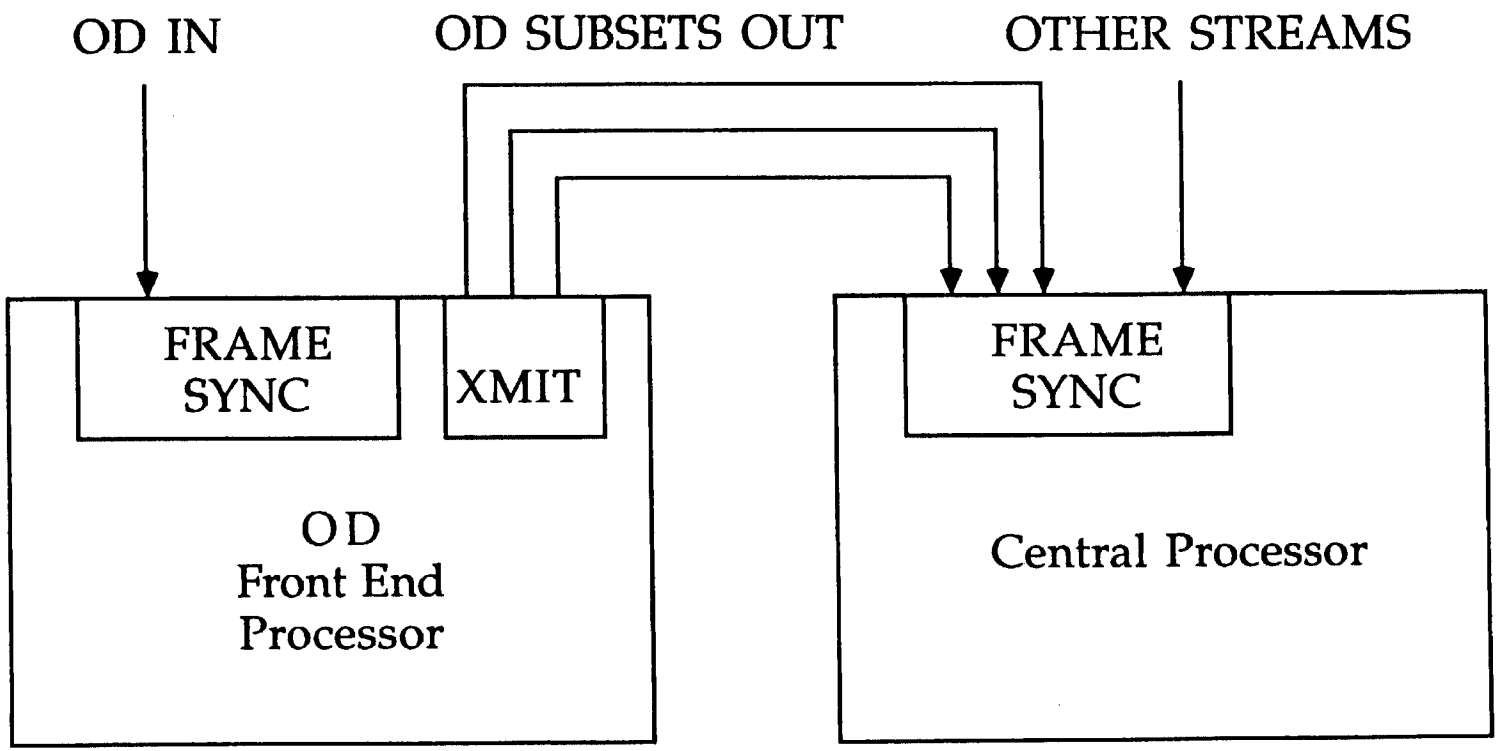
- Networking:
  Layers 1 and 2 — COTS Ethernet products
  Layers 3 and above — custom protocol, plus some DECnet

- Peripheral processors:
  Hardware — DEC Microvax
  Software — mostly Fortran, some DCL and assembly, little COTS
  Displays — DEC VT200 and 300 series, Regis graphics, no GUI

- Mission planning and database systems — Vaxcluster, access from VT terminals via T-switches and terminal servers

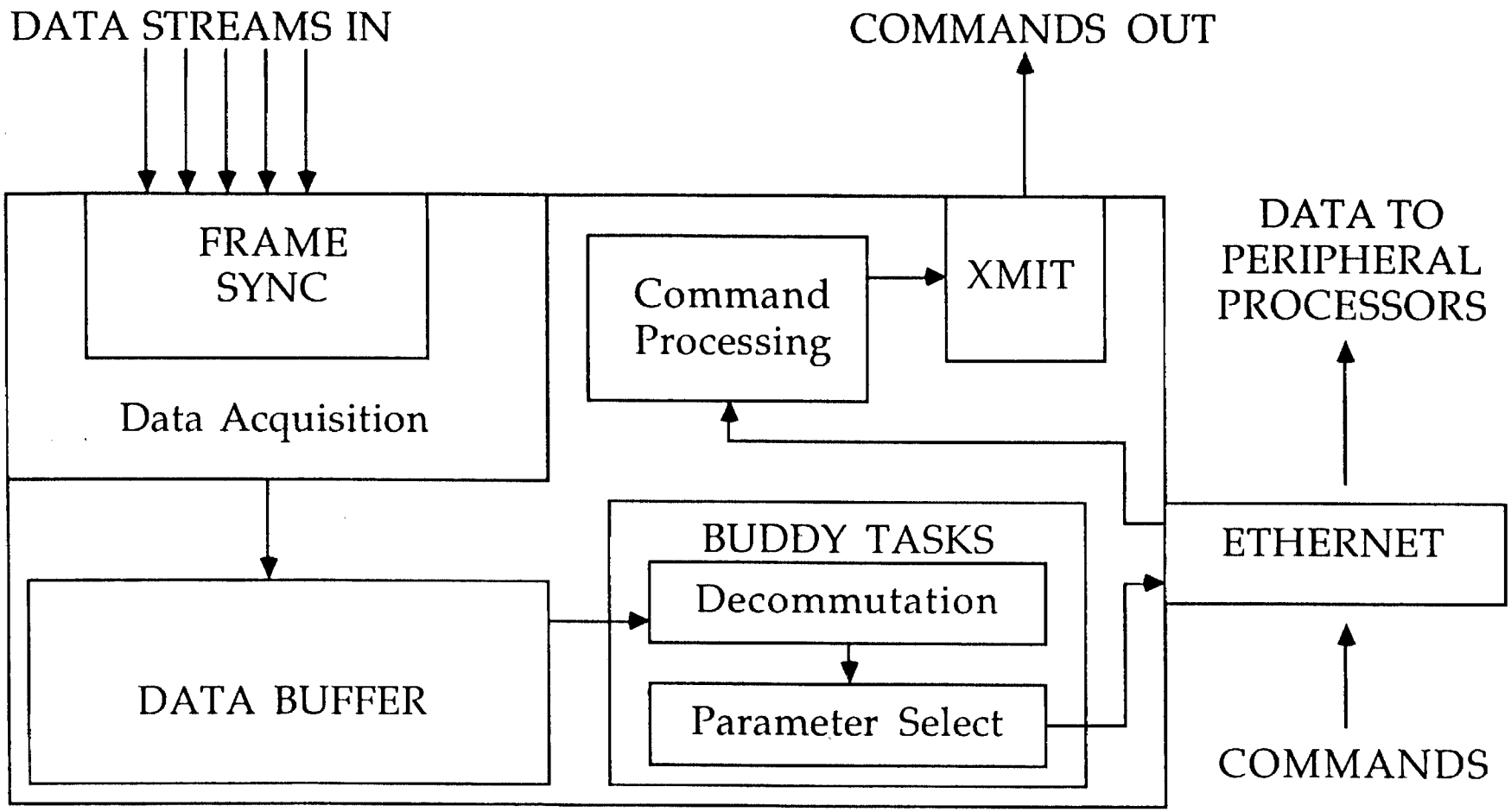
- Communications: Electrospace digital audio, Image Video video matrix, dual 9" B&W and single 13" color NTSC monitors at each console

FRONT END PROCESSING



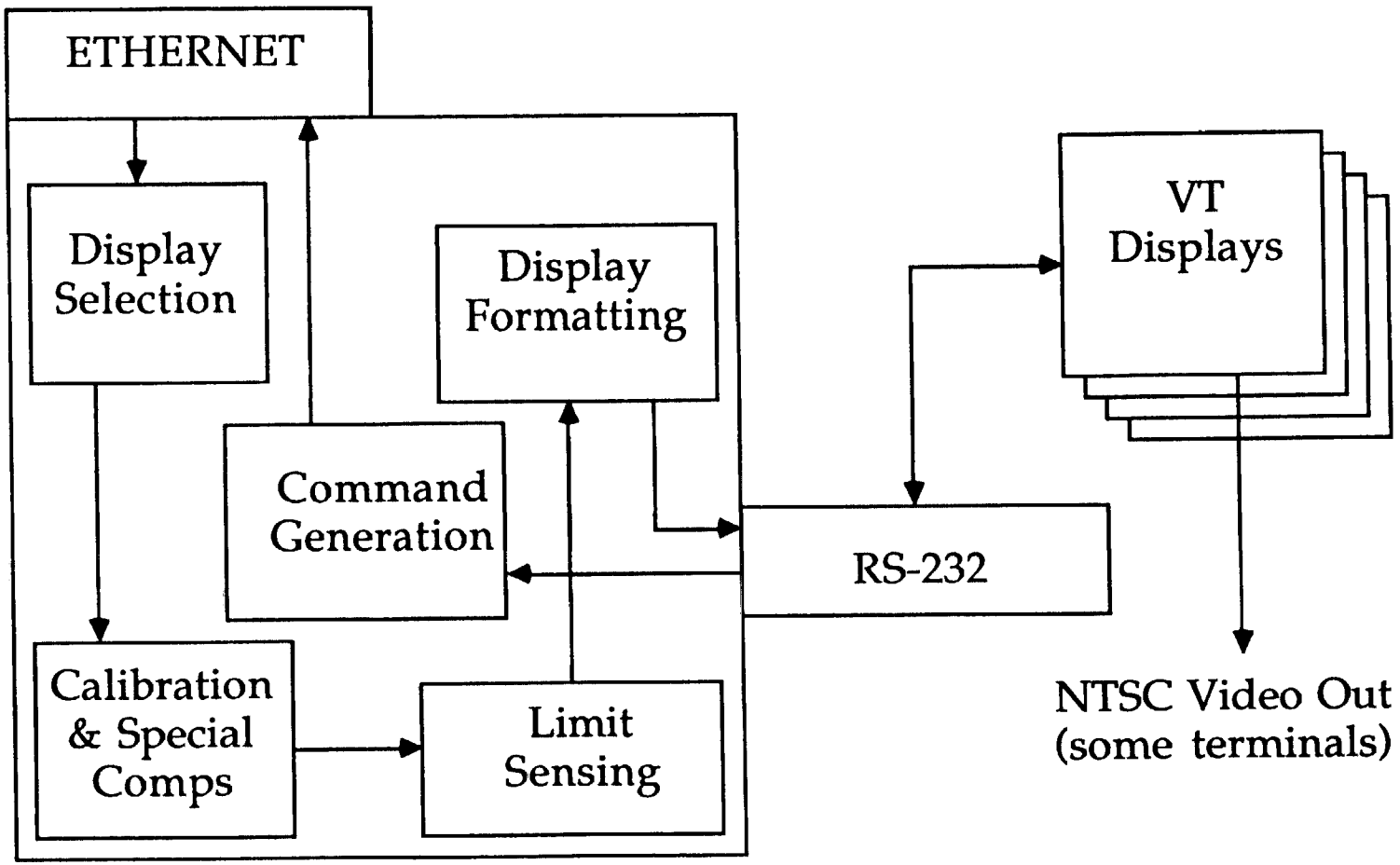
- OD Preprocessing performed by Front-End Processor
- All other acquisition and processing performed by Central Processor, with frame sync performed by custom input board

CENTRAL PROCESSING



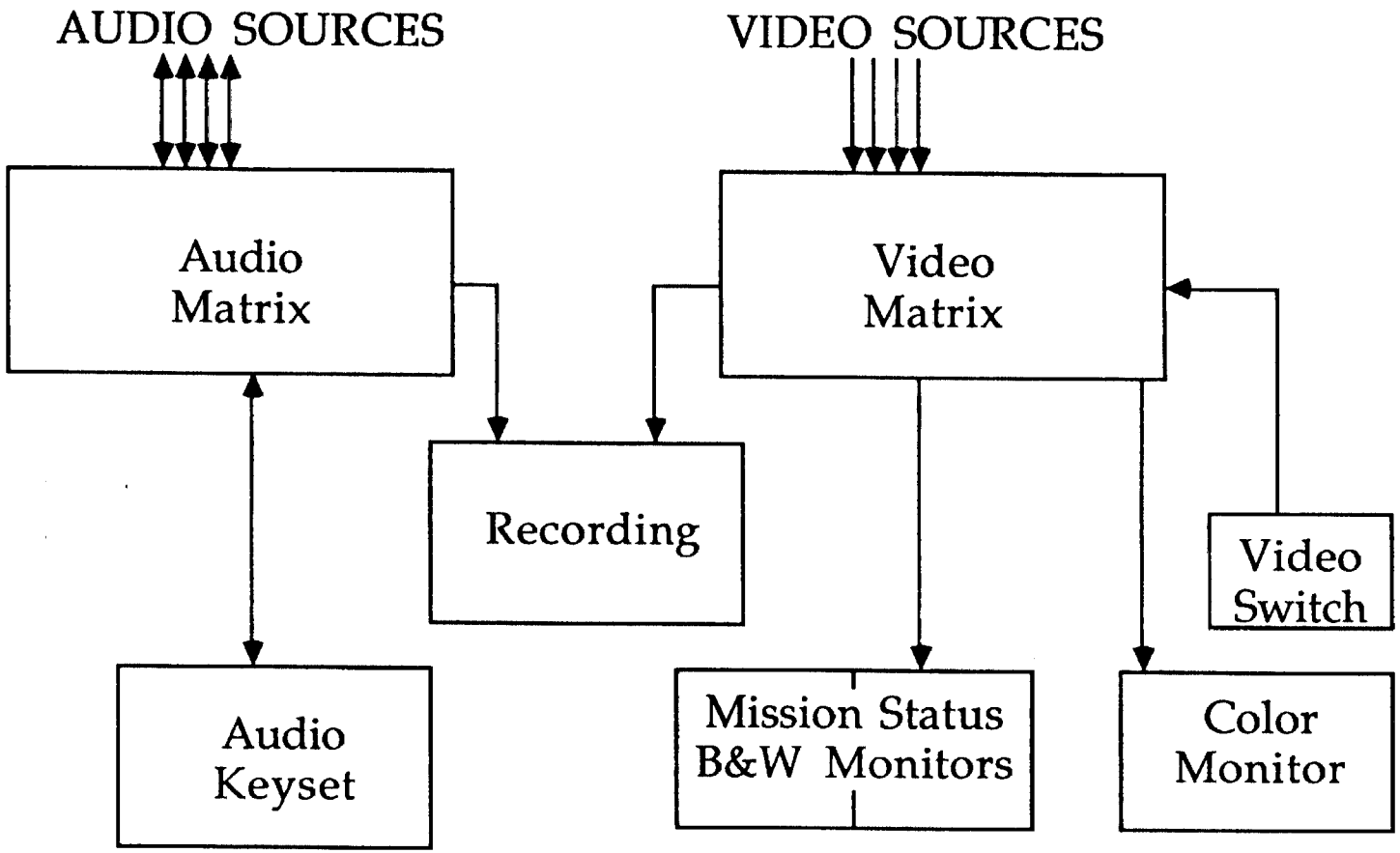
- Central processor performs triple-buffered acquisition, decommutation, and data selection, but not calibration (in most cases)
- CPs also perform command processing and system common services, including common use computations

PERIPHERAL PROCESSORS



- Peripheral Processors perform data calibration and formatting, sense limits and highlight limits exceeded, drive displays, and execute special comps
- Up to 4 displays per processor

COMMUNICATIONS



- Audio keysets provide 2-way internal and external audio, and access to telecom
  — Remote keysets possible using fractional T1 circuits
- Video used primarily for display sharing and mission status

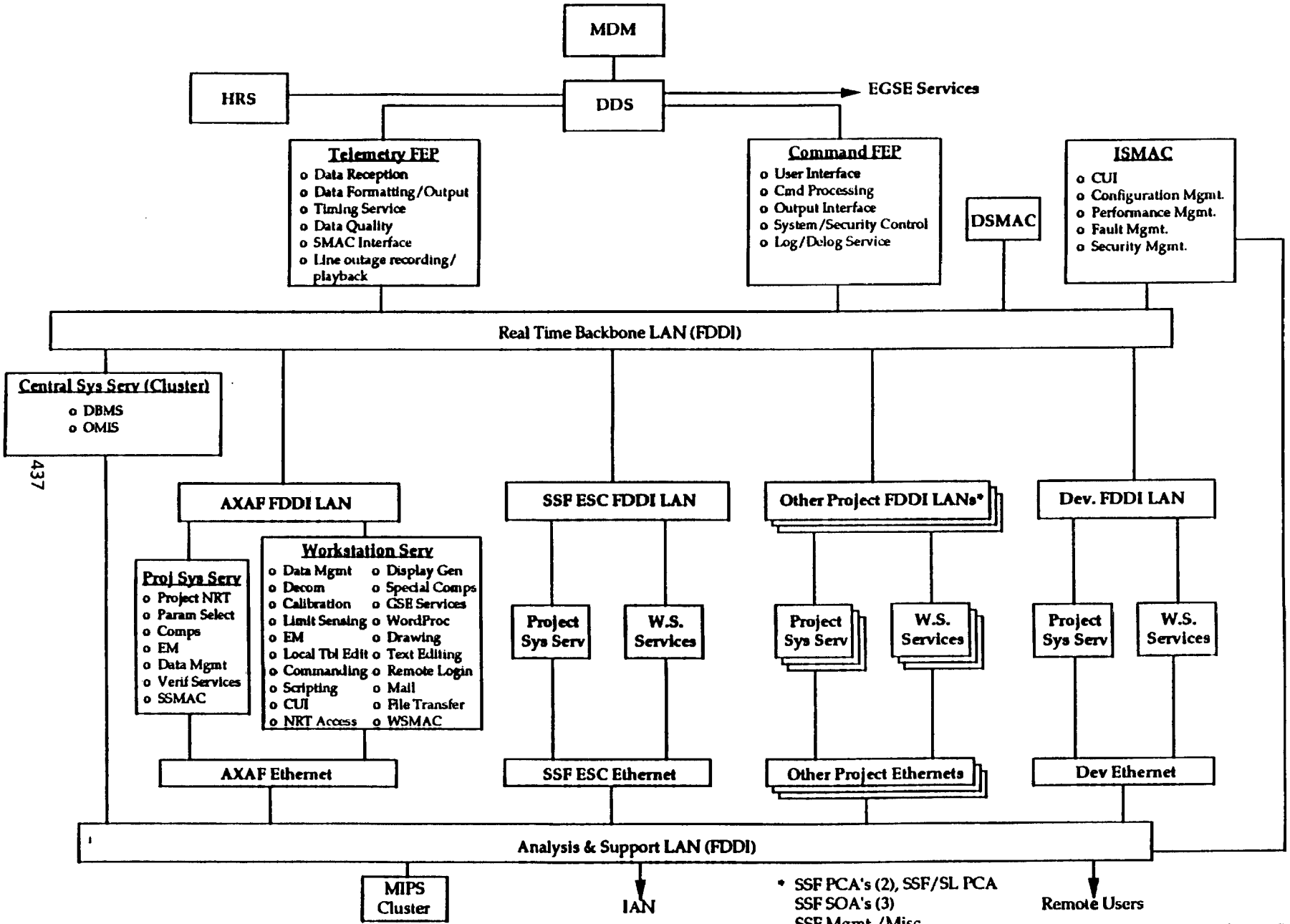
WHY ENHANCED DEVELOPMENT?

- Manpower-intensive systems result in rising operations costs
  — Personnel required for support is exponentially proportional to requirements
- Custom systems are difficult to maintain due to loss of knowledge via employee turnover
- Proprietary systems are expensive to upgrade; vendors eventually phase out support of obsolete systems
- Applications can't be maintained or easily ported to another platform
- Proliferation of network protocols for different applications
- Character-based dumb terminal interface, with minimal graphics
  — RS-232 interface severely limits graphics update ability
- Applications behave according to Parkinson's Law, but processing capabilities cannot easily be scaled up
- SSF and AXAF have requirements for 24-hour, 7-day, year-round support
  — Current system has some zero-fault-tolerant subsystems
- New interface requirements — NASCOM II, external users

ENHANCED DEVELOPMENT GOALS

- Upgrade hardware technology:
  - — Distributed processing with COTS workstations and minicomputers
  - — Higher-bandwith, longer-distance networks with built-in redundancy
- Upgrade software technology:
  - — Advanced programming languages (C, Ada, etc.)
  - — POSIX-compliant operating systems and portable applications
  - — GOSIP-compliant network protocols
  - — Standards-based COTS products such as relational database and GUI
- Reduced training, operations, reconfiguration, and maintenance costs
- Meet SSF and AXAF requirements for 24-hour, 7-day, year-round support
- Support SSF and AXAF external users while improving system access controls and availability assurance
- Eliminate zero-fault-tolerant subsystems
- Accommodate new missions with minimum modifications
- *Maintain continuous support of ongoing missions during upgrade process*

HOSC Enhanced Architecture



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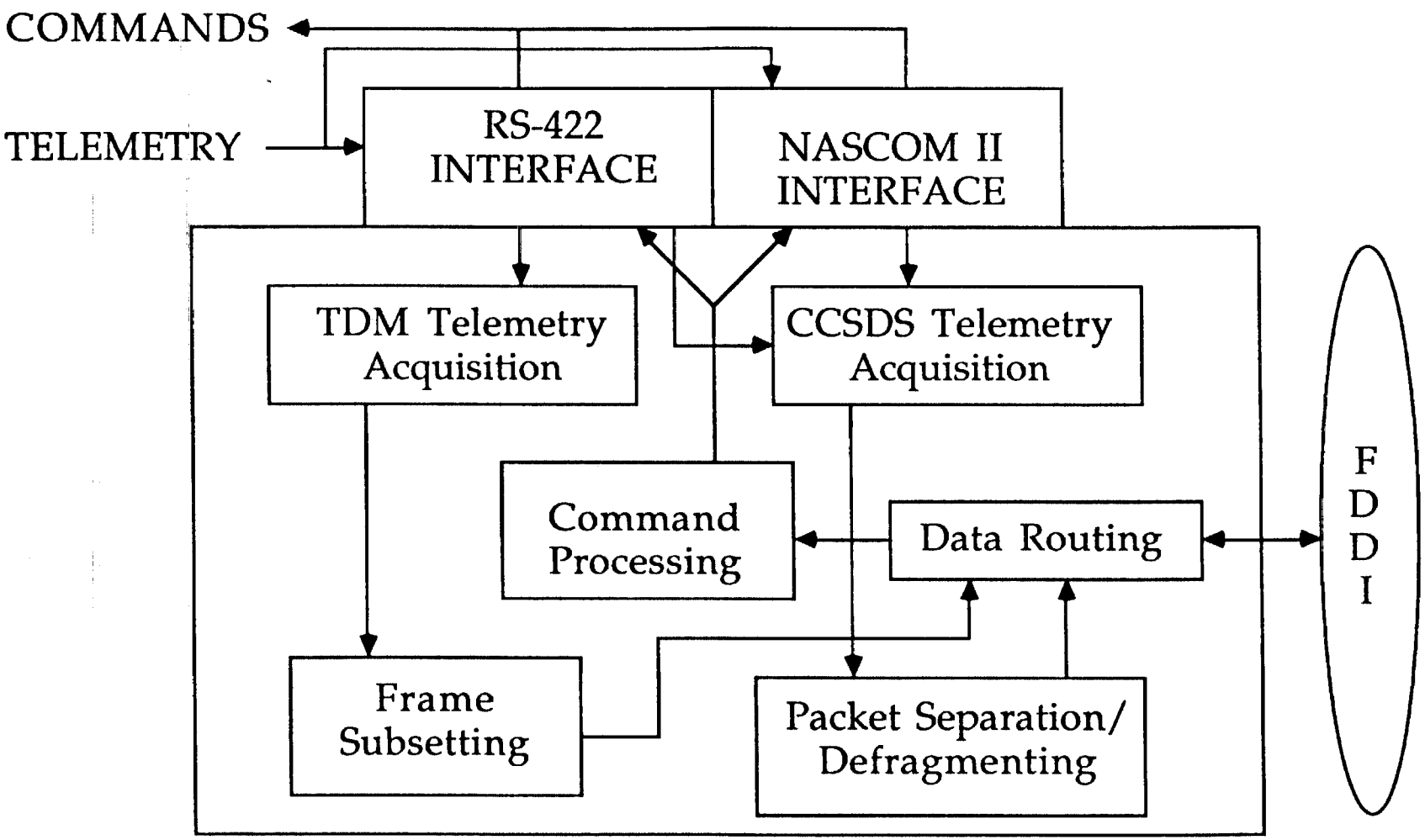
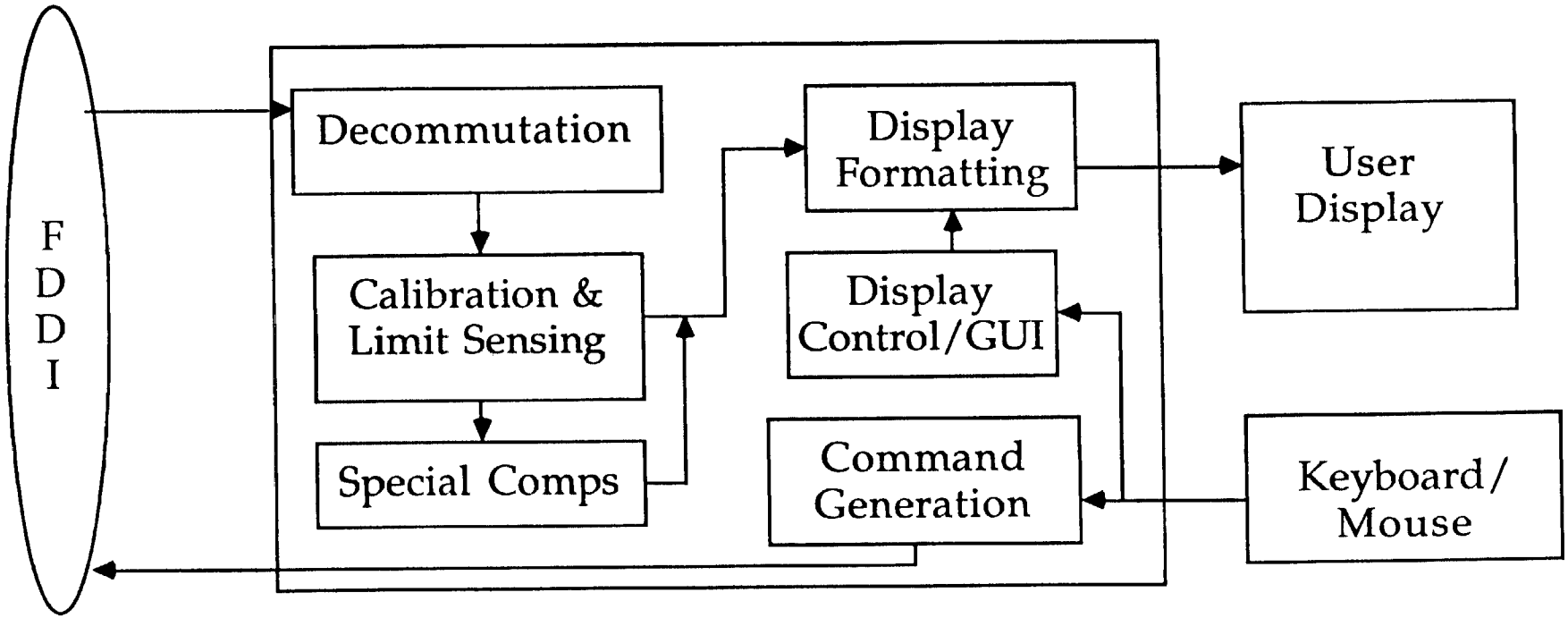
FRONT END PROCESSING



- FEP acquires and preprocesses all data; also performs command processing
- Raw telemetry sent directly to workstations in packet form

WORKSTATIONS



- Workstations process raw telemetry and extract needed data
- Display uses graphics user interface with menus, buttons, sliders, etc.
- Direct interface to project FDDI
- Alternate user input/output peripherals can be supported

SYSTEM SERVICES

System services machines will be attached to backbone net and to project nets for:

- Common use computations and mission status display generation
- Near-real-time data services
- Database and file services
- Project-specific commanding services
- Ground support equipment interface services
- Any other services requiring project-wide or system-wide access

INTEGRATED SYSTEM MONITOR AND CONTROL

Integrated system monitor and control consolidates status information and provides subsystem control in a centralized service with common display formats. Subsystems are:

- Data Acquisition and Distribution (FEPs, networks, NASCOM interfaces)
- System services processors
- Workstations
- Line outage recording and archiving
- External interfaces
- Facility (door monitoring, power, A/C, fire supression)

ENHANCED DEVELOPMENT SCHEDULE

- Preliminary design review — summer 1992
- Critical design review — summer 1993
- Enhanced data system operational — fall 1995
- SSF ESC operations begin 3/96, POIC operations begin 6/96
- AXAF operations begin 10/97
- Existing missions and users to be migrated to enhanced system in 1995-1996 timeframe
- All previous architecture subsystems out of service by end of 1998