TIMED

Thermosphere • Ionosphere • Mesosphere • Energetics and Dynamics

Mission Operations Center (MOC)

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Topics

- **Requirements**
- **Changes Since PDR**
- **Hardware Systems**
- **MOC Facility**
- **Emulator Roadmap**
- **MOC Configurations**

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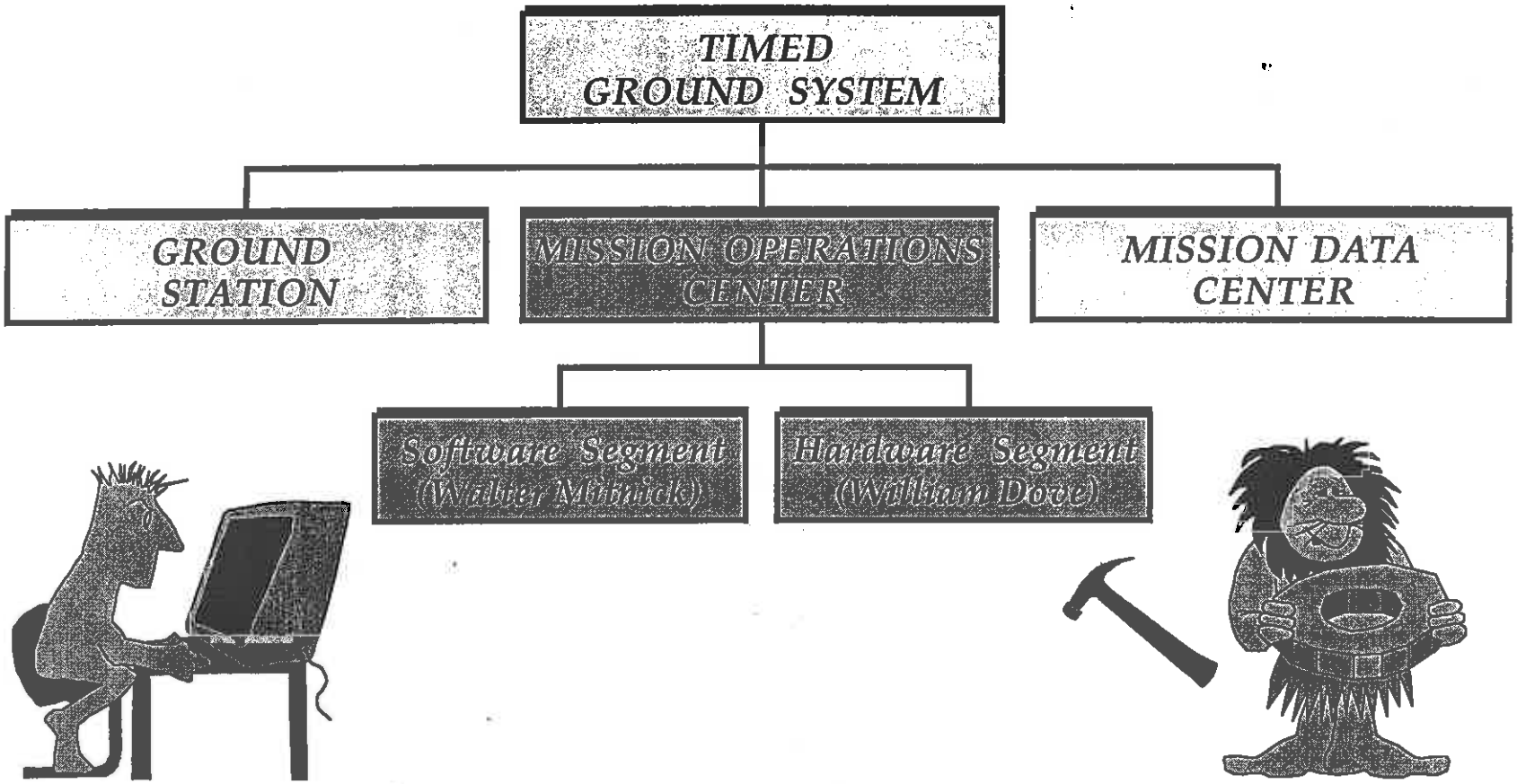


MOC Requirements

(Subsystem Development, Spacecraft I&T, Flight Operations)

- **Command the spacecraft (CCSDS compliant)**
- **COP-1 protocol verification**
- **Collect and authenticate commands from the Instrument POCs and provide POCs with Authentication Return Receipts (ARRs)**
- **Uplink instrument commands to respective instrument and provide POCs with Command Return Receipts (CRRs)**

MOC Requirements cont'd

(Subsystem Development, Spacecraft I&T, Flight Operations)

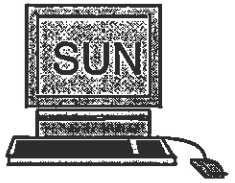
- **Receive, process, evaluate, and display spacecraft bus telemetry & instrument status words**
- **Serve real-time telemetry to POCs (backup to MDC)**
- **Remotely control Ground Support Equipment (GSE)**
- **Receive, process, evaluate, and display GSE telemetry**
- **Maintain Spacecraft & GSE command and telemetry dictionaries**

Changes since PDR

- **Using EPOCH 2000 version 2 instead of version 3**
- **Performing COP-1 verification in the MOC instead of the Ground Station**
- **Two Mini-MOCS for each subsystem instead of one**

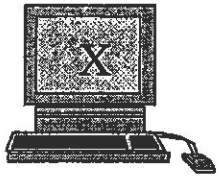
MOC Computer System

- **Workstations**
  - **Five SUN Ultra 1 Sparcstations**
    - » **model 200E (200MHz), 128MB memory, 2GB hard drive, 100Base-T ethernet I/F, Solaris OS.**



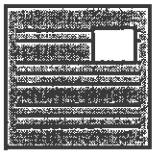
  - **Five SUN Ultra 2 Sparcstations**
    - » **model 1300 (300MHz), 128MB memory, 4GB hard drive, 100Base-T ethernet I/F, Solaris OS.**

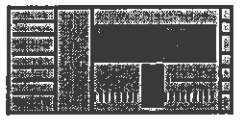
  - **Nine NCD X terminals**
    - » **model 1300 (300MHz), 16MB memory, 10Base-T ethernet I/F.**

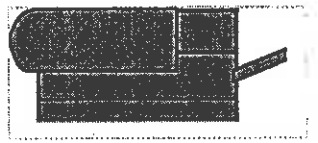


MOC Computer System cont'd

- **Peripherals**
  - **Two 4.3 Gbyte external hard drives**
    - » **Oracle database, user files, EPOCH software**
  - **Two 4mm DAT drives**
    - » **file transfers, software loads, backups**
  - **Two 12x CD ROM readers**
    - » **software loads, on-line documentation**
  - **Two DLT 4000 drives**
    - » **system backups**
  - **Four HP LaserJet 5 Printers**







Additional MOC Systems

- **Uninterruptable Power System (UPS)**
  - **provides uninterrupted AC power to critical MOC equipment**
  - **protects this equipment from transients introduced by surges, spikes, deep sags, momentary and complete outages**
- **Voice Communications System**
  - **20 communications stations**
  - **6 voice channels (2 internal, 4 external)**
  - **10 telephone lines (4 dedicated to POCs)**
  - **telephone is the primary MOC/POC voice interface**
    - » **DTMF signaling allows POCs remote access to voice channels**
  - **compatible with GSFC and VAFB voice systems**

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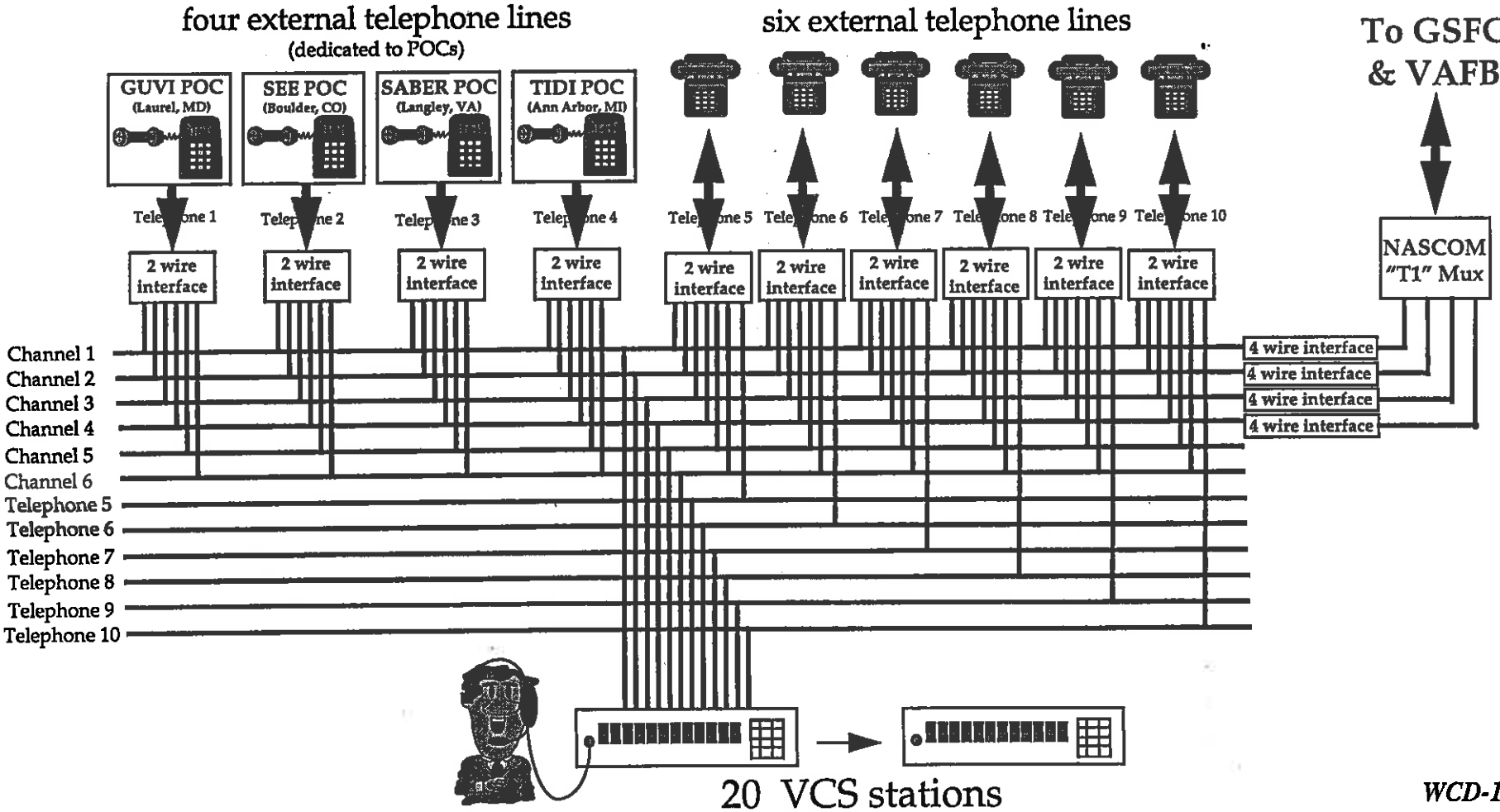
Voice Communications System (VCS)



Time Synchronization

- **MOC requires one second accuracy**
- **MOC Computer System synchronized to UTC via APL Network Time Protocol (NTP) server.**
- **Front End Processor requires 100 microsecond accuracy**
- **Front End Processor synchronized to UTC via APL atomic time source (IRIG-B)**
- **Field Equipment will use GSFC & VAFB time sources**

MOC Facility Status

- **The MOC will reside on the APL campus**
- **A permanent MOC location has not been identified**
  - **Space requirements submitted to APL management 10/97**
  - **MOC needs to be operational before Instrument Arrival 2/99**
- **Temporary MOC is currently located in 23-133 cleanroom**
  - **Will use until permanent MOC is operational**

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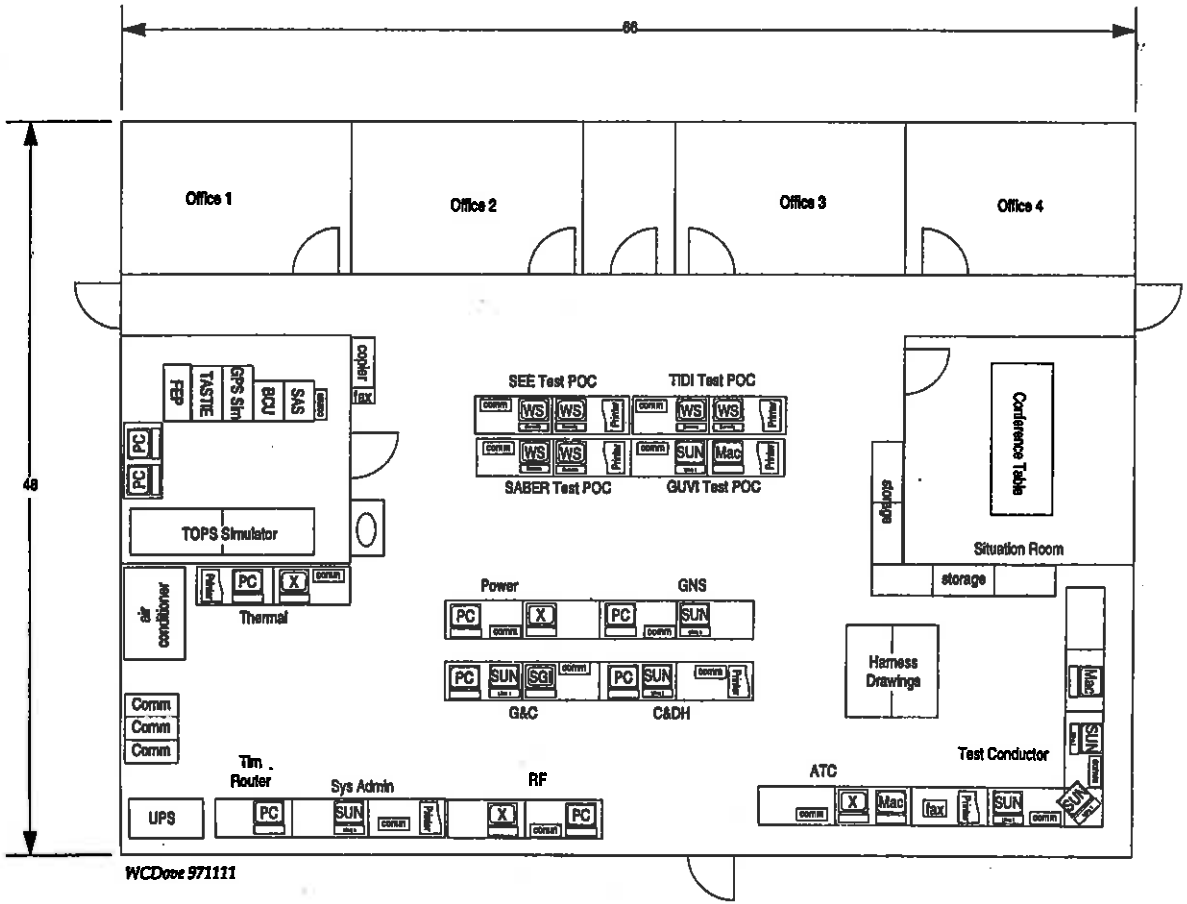
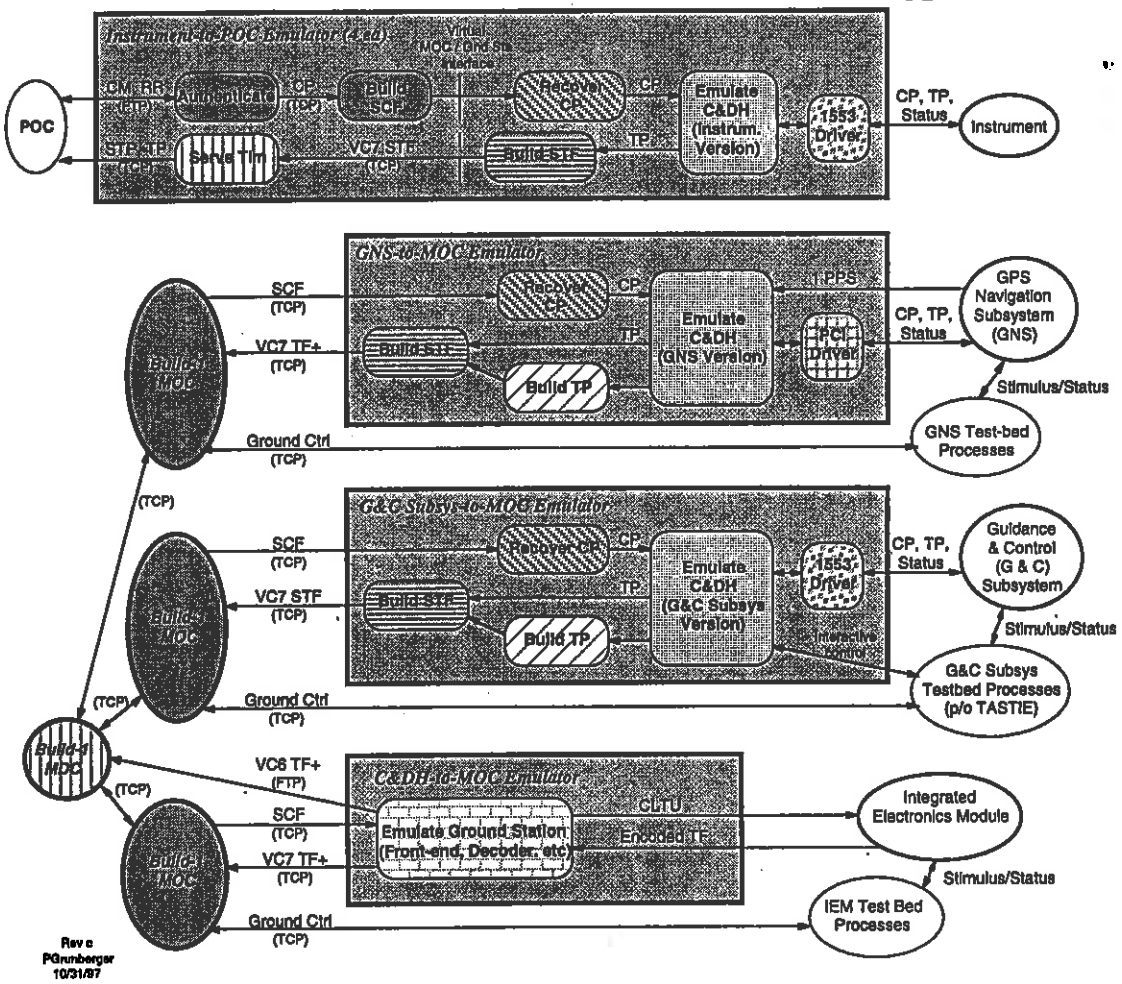
MOC Facility Layout (Tentative)



Emulator Roadmap



MOC Configurations

- **Mini-MOC: Spacecraft subsystem configuration (delivered)**
  - **subsystem development & qualification**
- **MOC: Spacecraft I&T initial configuration (4th quarter 1998)**
  - **s/c bus & instrument I&T**
- **MOC: Spacecraft I&T final configuration (2nd quarter 1999)**
  - **baseline performance testing**
- **MOC: Spacecraft Field Operations configuration (3rd quarter 1999)**
  - **environmental testing & launch operations**
- **MOC: Flight Operations configuration (launch + one day)**
  - **early ops & normal flight ops**

The Mini-MOC is a stripped-down version of the MOC, which is used for early subsystem bench testing and box level qualification. The TIMED subsystems utilizing the capabilities of the Mini-MOC are the Integrated Electronics Module (IEM), Guidance and Control (G&C), and GPS Navigation System (GNS). Traditionally, each subsystem team develops their own custom set of hardware and software tools in order to test their subsystem. However in the Mini-MOC paradigm, many of these custom tools are provided generically to the subsystem as a part of the Mini-MOC delivery.

The Mini-MOC provides the following capabilities:

- *Generation of both spacecraft subsystem and Ground Support Equipment (GSE) commands.*
- *Satellite Test Operations Language (STOL) scripting language*
- *Decommutation, display, and alarm of both spacecraft subsystem and GSE telemetry.*
- *Data logging, archive, and retrieval of commands and telemetry.*

This configuration shows the network connections between the Mini-MOC test facilities, the MOC, and the MDC. TIMED uses the APL network infrastructure to eliminate the cost of installing dedicated ethernet lines between these facilities.

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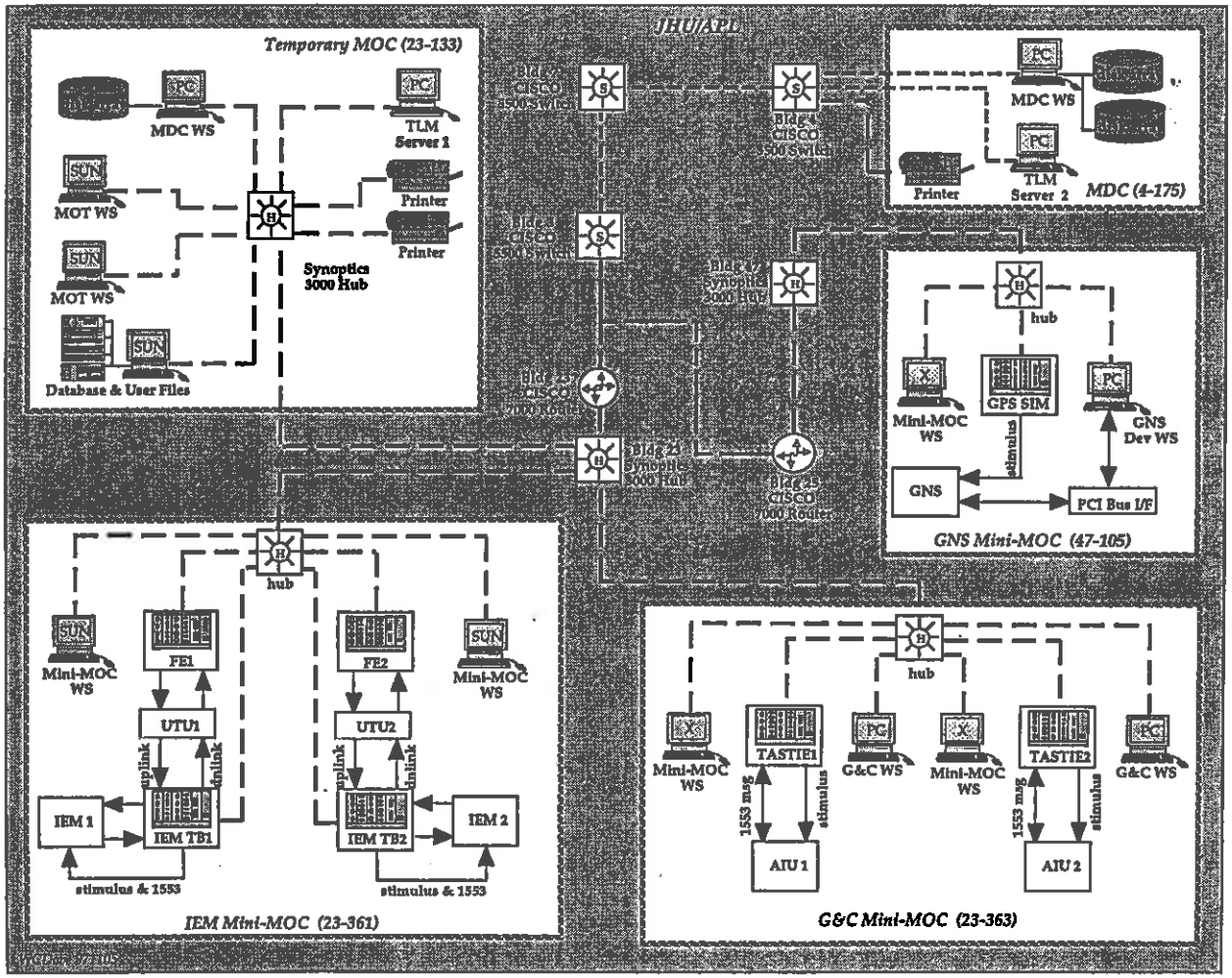
Mini-MOC configuration



This diagram shows the initial configuration for spacecraft I&T. This configuration is used for spacecraft I&T and functional testing. In this configuration, the APL building 23-133 cleanroom contains the spacecraft, spacecraft & instrument GSE, the four Instrument Test POCs, and the majority of the MOC Computer System.

Spacecraft tests are conducted from the Primary Command Workstation & Backup WS. Theses two workstations are located on the secure side of the TIMED network. The firewall prevents unauthorized commanding of the spacecraft. Command Frames are sent from the Primary Command Workstation to FE3 and packaged into Command Link Transfer Units (CLTUs) and uplinked to the spacecraft via RF GSE or Umbilical GSE.

The APL network infrastructure connects the MOC, MDC, Ground Station, and I&T facilities. The primary Flight POCs to MOC/MDC connections are via internet. The remote access server (modem) will be used for backup purposes.

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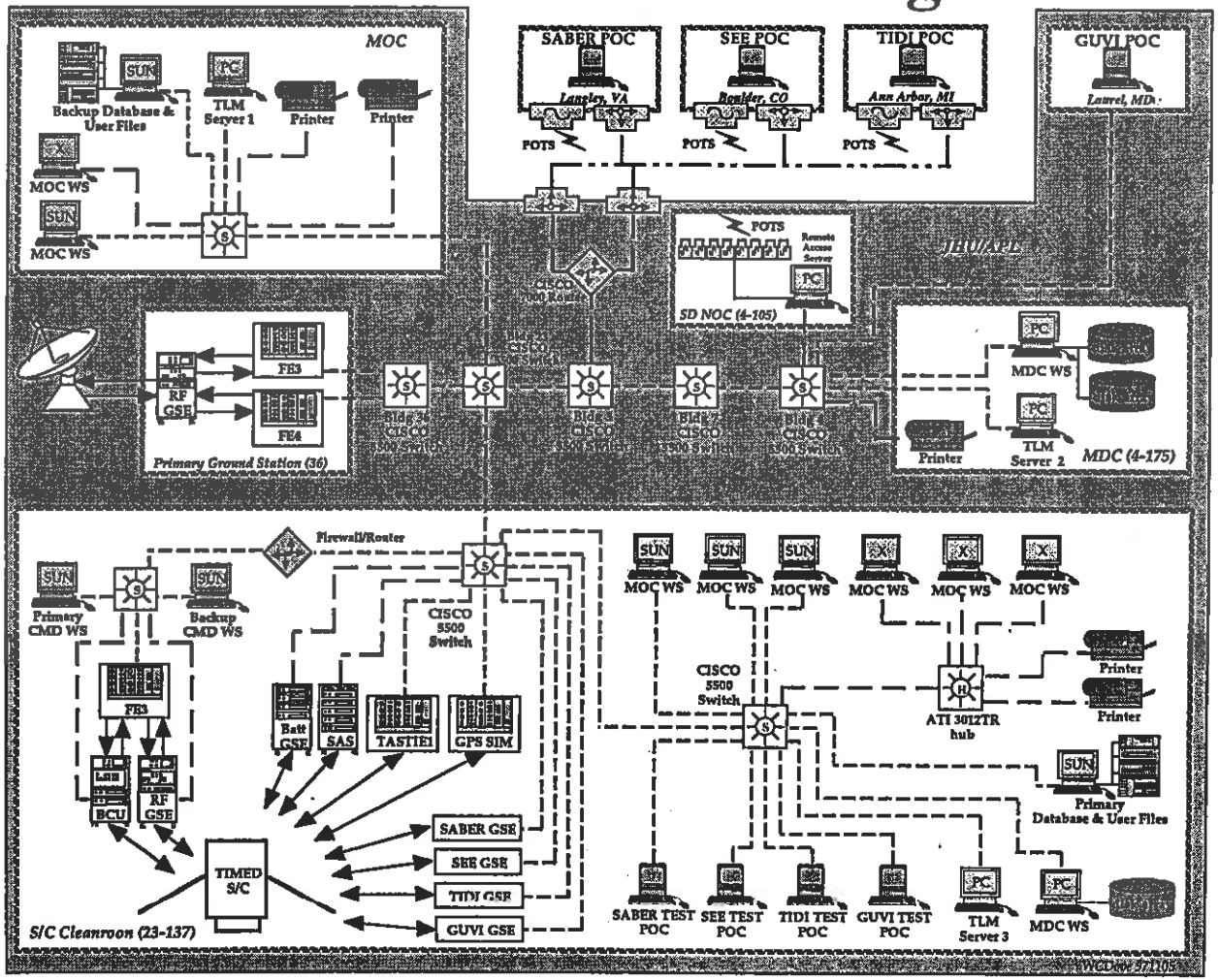
MOC S/C I&T initial configuration



This diagram shows the final configuration for spacecraft integration and test. This configuration is used for spacecraft baseline performance tests at APL. The spacecraft and GSE remain in the APL building 23-133 cleanroom, while the majority of the MOC Computer System and Instrument Test POCs move to the permanent MOC. Once in this configuration, the IT/ MOT will conduct all remaining tests and operations from the permanent MOC.

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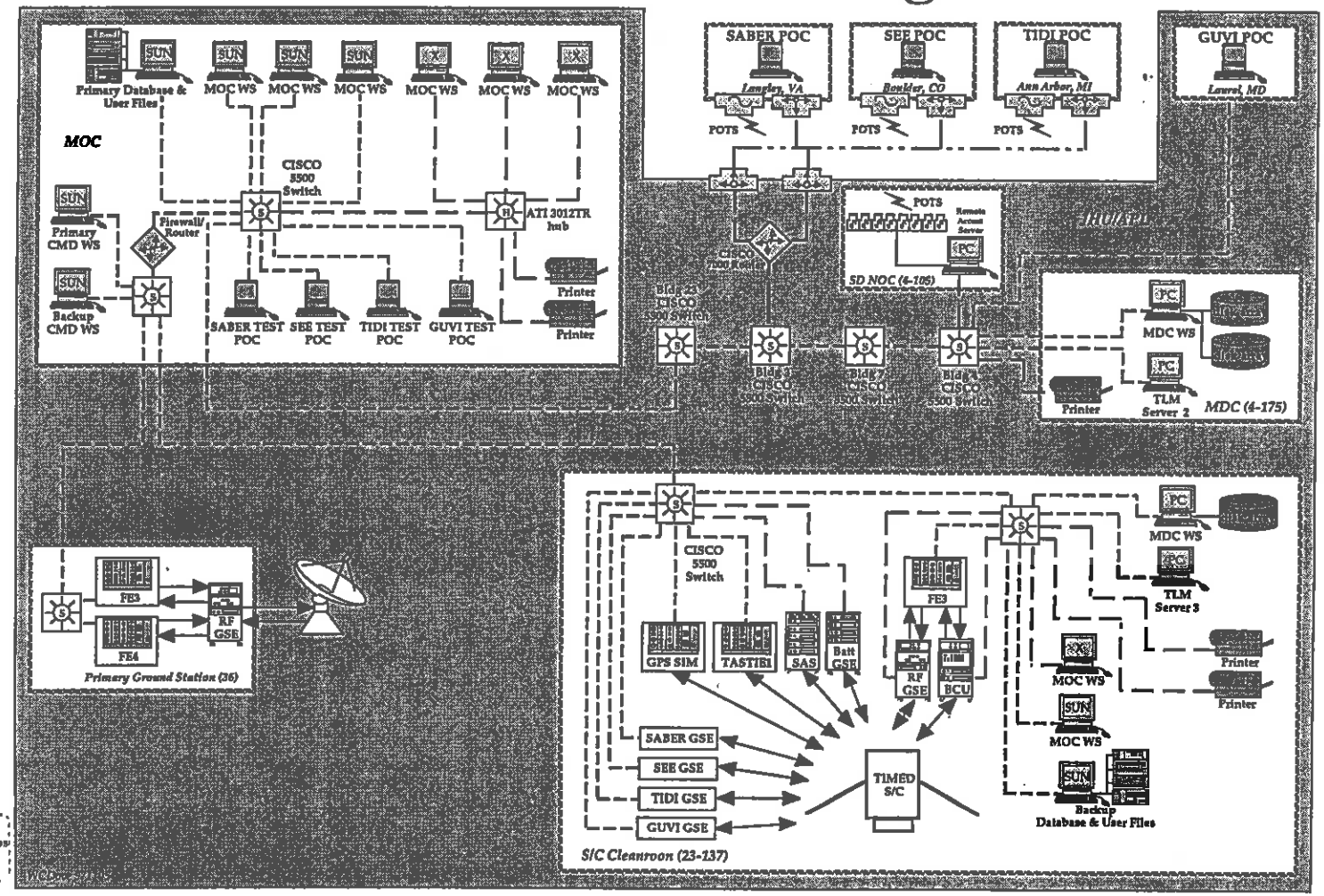
MOC S/C I&T final configuration



This diagram shows the Field Operations configuration. This configuration is used for spacecraft environmental testing at GSFC and launch operations at VAFB. The only difference between this configuration and the Spacecraft I&T final configuration is that the network connection between the MOC and spacecraft facility becomes a NASCOM "T-1" Link.

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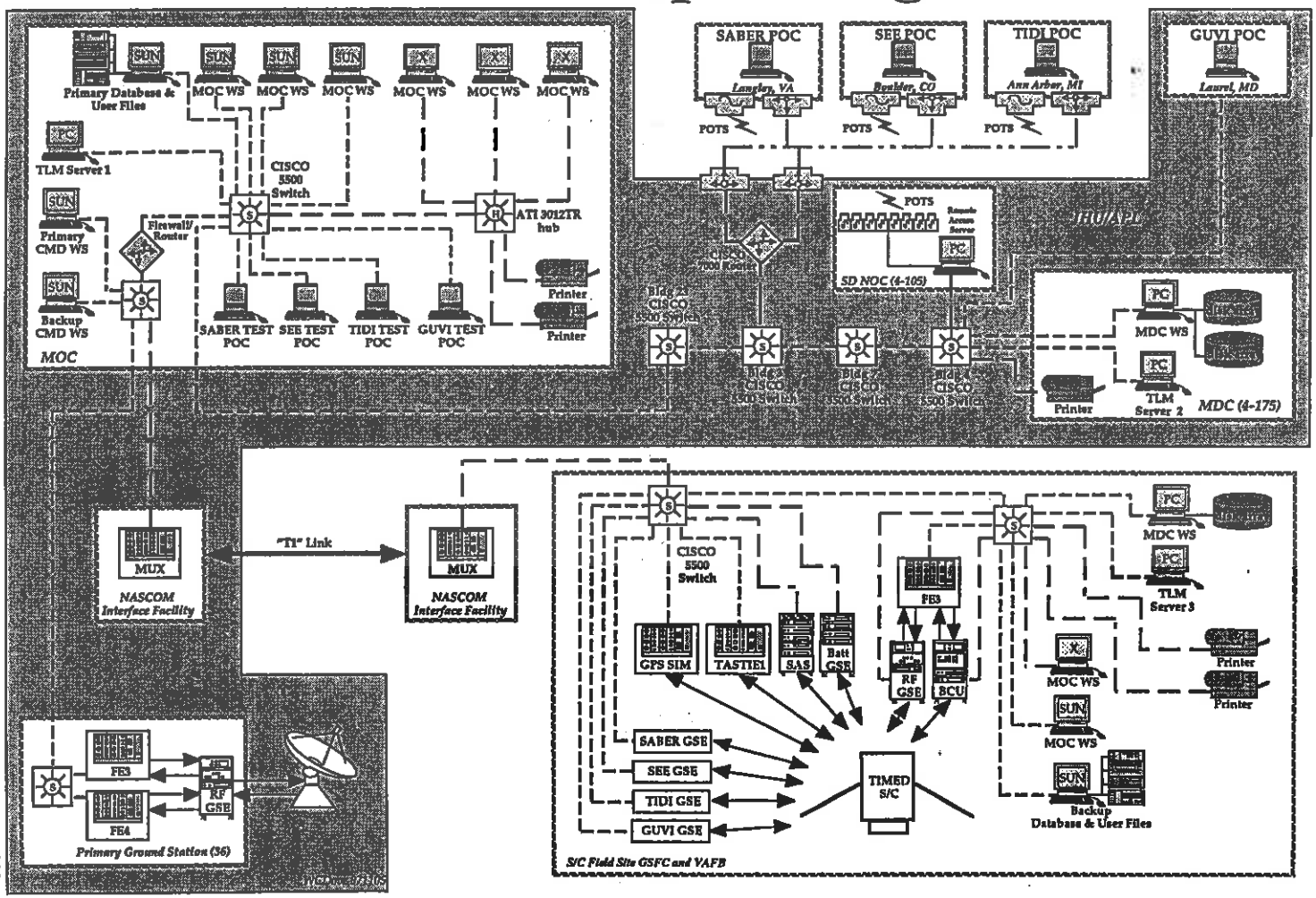
MOC S/C Field Ops configuration



This diagram shows the landline connections at VAFB. This configuration is used for spacecraft processing at building 1610. The MOC connects VAFB via NASCOM "T-1" Link. The VAFB infrastructure connects building 836 and building 1610. In this configuration, all GSE is located in building 1610, and building 836 is used as a network router.

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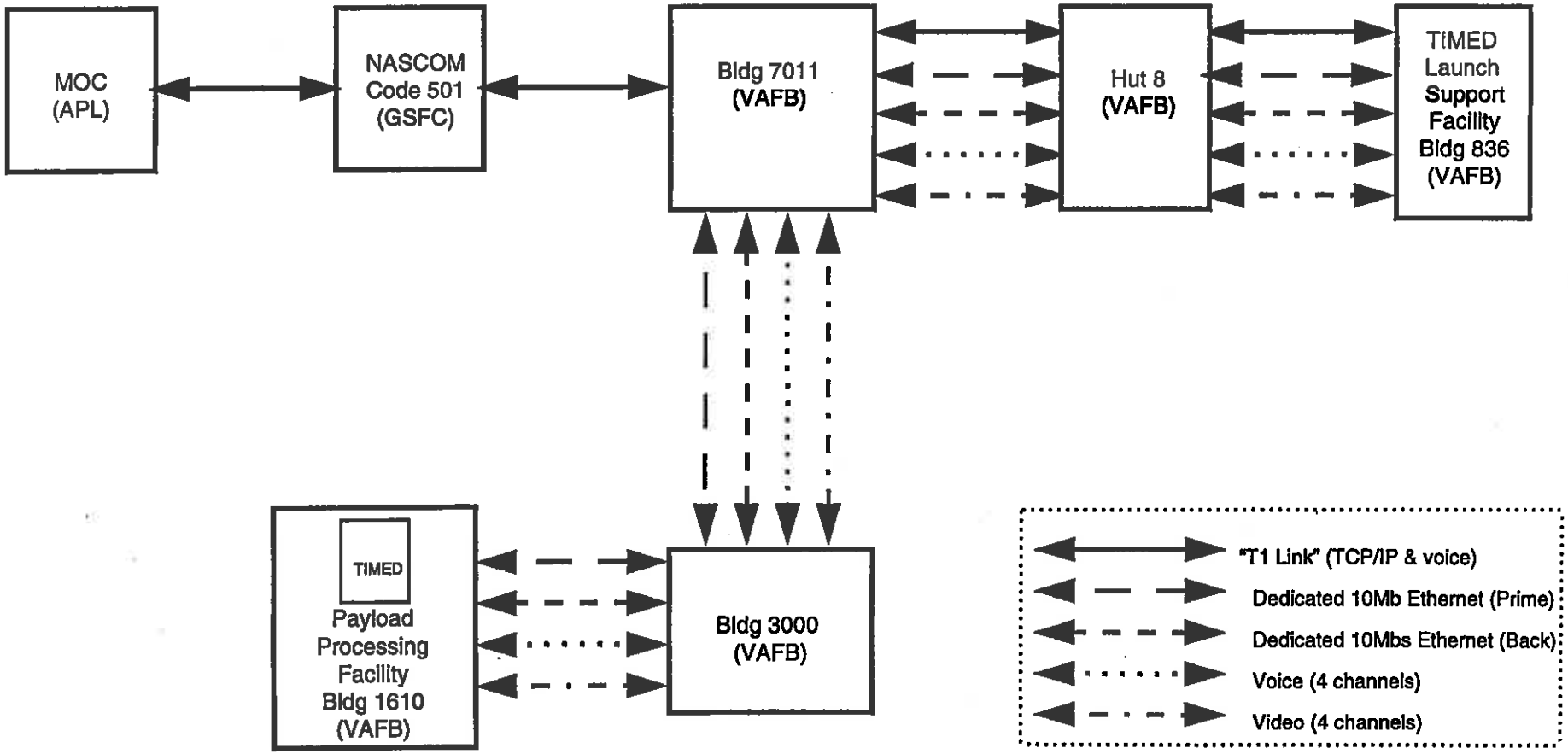
Communications at VAFB (S/C processing)



This diagram shows the landline connections at VAFB. This configuration is used for spacecraft launch operations at SLC-2W. The MOC connects VAFB via NASCOM "T-1" Link. The VAFB infrastructure connects building 836 and building SLC-2W. In this configuration, the field site MOC workstations are located in building 836 and the RF GSE, Blockhouse Control Unit (BCU) and Front End Processor are located in the SLC-2W EEB. While the launch operations are conducted from the MOC, the field crew can monitor the spacecraft health and status from building 836.

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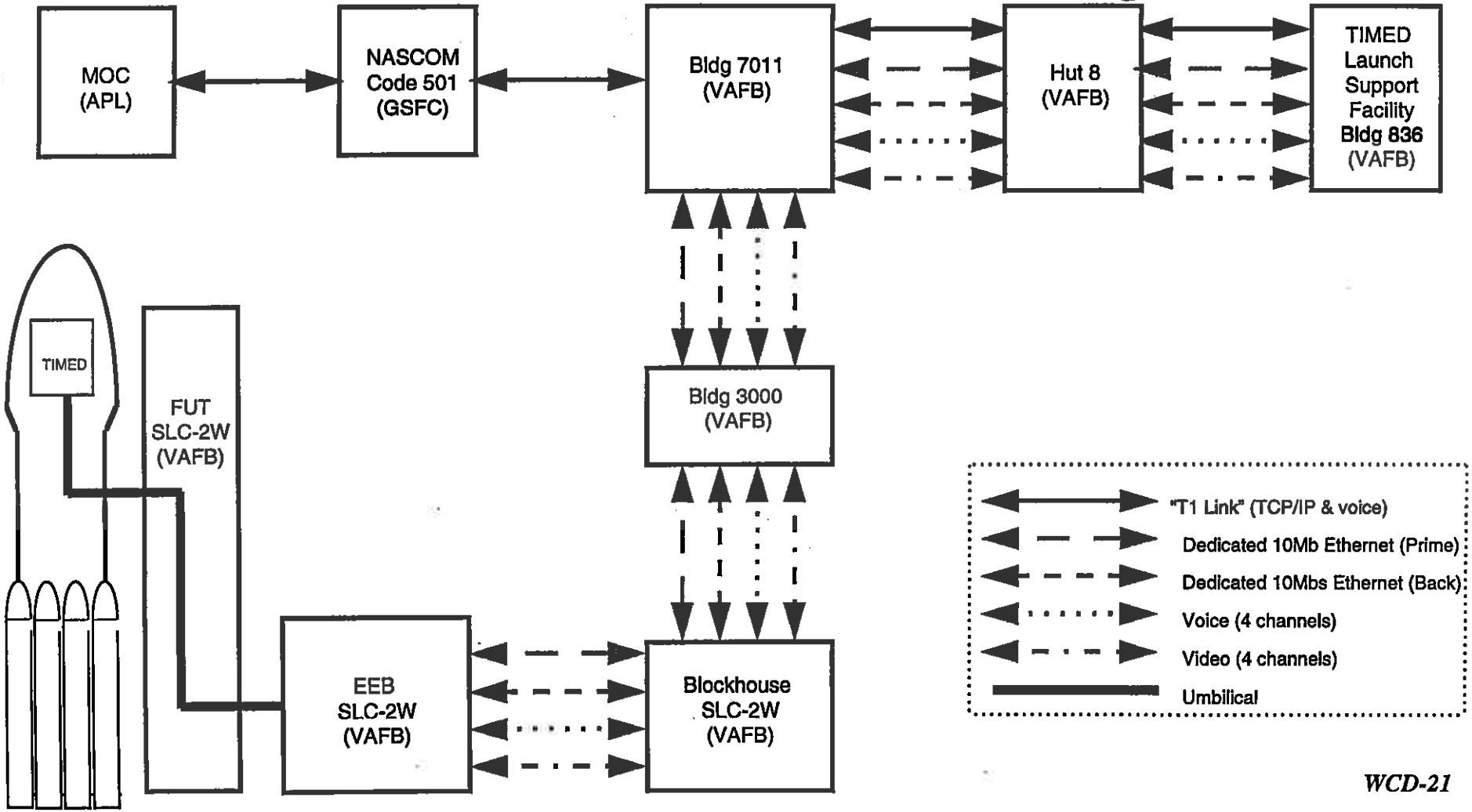
Communications at VAFB (launch configuration)



This diagram shows the Flight Operations. After launch, the MOC Computer equipment moves from the field site to the MOC. The primary means of communicating with spacecraft is through the APL Ground Station. A TBD Link will be available to connect the MOC to the Backup remote ground stations for early operations and contingency operations.

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MOC Flight Ops configuration