

System Overview

*Center for Research Support
(CERES)*

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Overview

What is CERES ?

- **Complete Telemetry, Tracking and Commanding System**
- **Located at Joint National Test Facility (JNTF), Falcon AFB**
- **Owned by SMC/TEO & BMDO/AQT**
- **Activated and Operated by SMC/TEO**

- Genesis
- Architecture
- Future

Genesis

- **TEO Move to Research Support Complex (RSC) at Kirtland AFB in 1997**
- **Limitations of Current System for RDT&E Mission**
 - **Complex CMD & TLM Formats; > 1 Mbps TLM**
 - **Mission Unique Component Proliferation**
 - **High Maintenance Costs; Limited power & flexibility**
- **Aerospace Technology Survey**
 - **Powerful workstations; inexpensive LAN equipment**
 - **COTS Products available to meet basic requirements**
- **Use COTS Strategy for new RSC System**

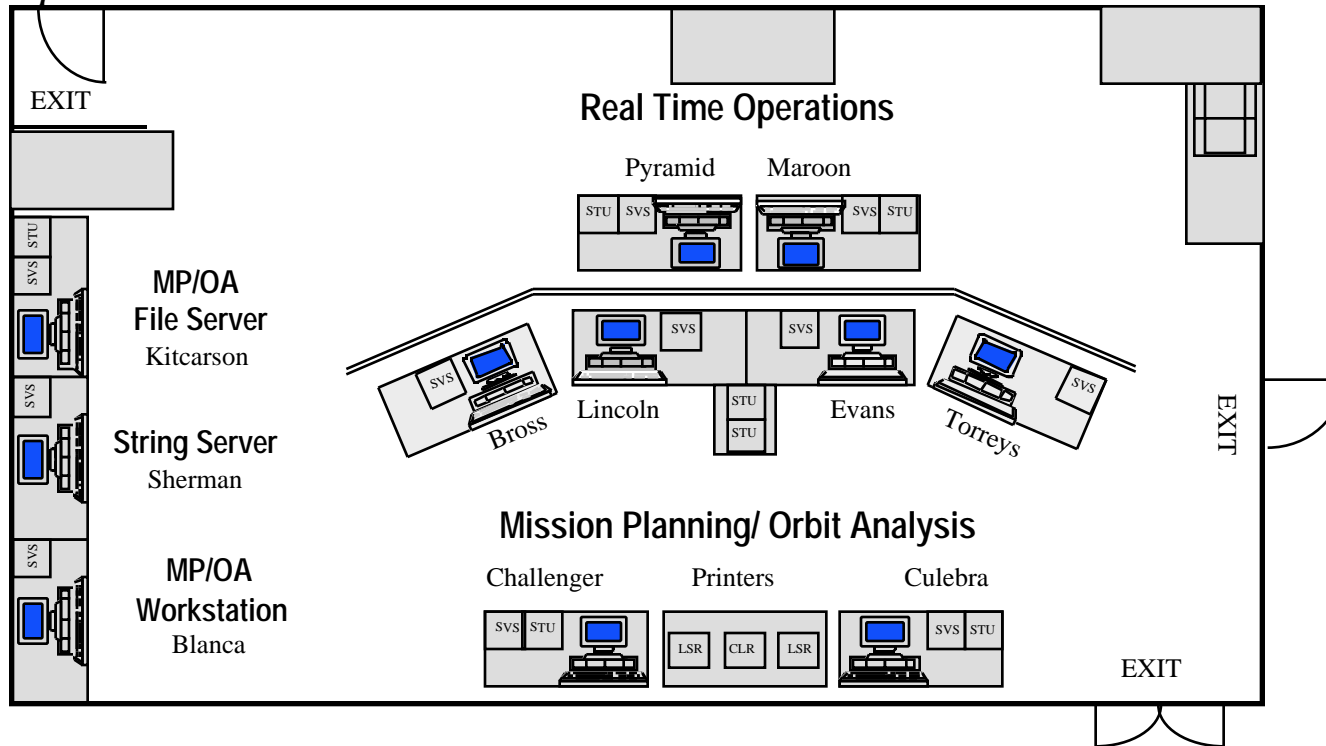
CERES Facility at JNTF

CERES is a facility -- CERES is a system architecture

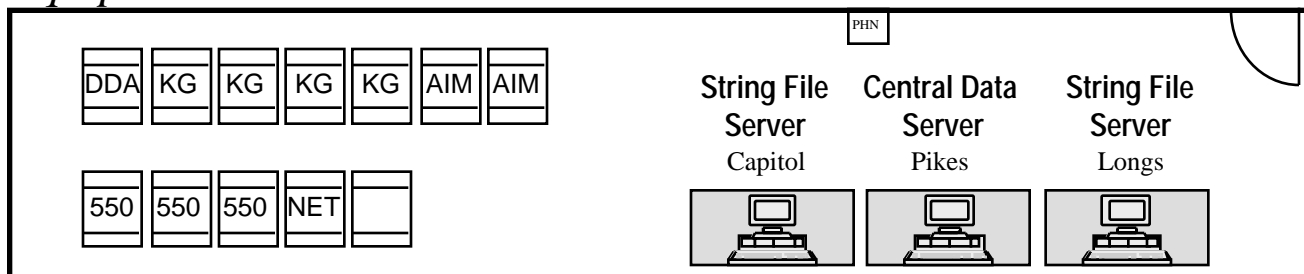
- **BMDO asked TEO to fly Brilliant Eyes JNTF**
- **TEO Offered to Build CERES as well**
- **CERES is shared Satellite Ops Center for BMDO**
 - **Research & War Gaming at JNTF**
 - **Fly SMTS (SBIRS Low) in 1999**
- **CERES is Prototype System for RSC**
 - **3 Equipment Strings Installed at RSC**
 - **Preparing for STEP Mission 4 Launch**

CERES Operations Room

Operations Room



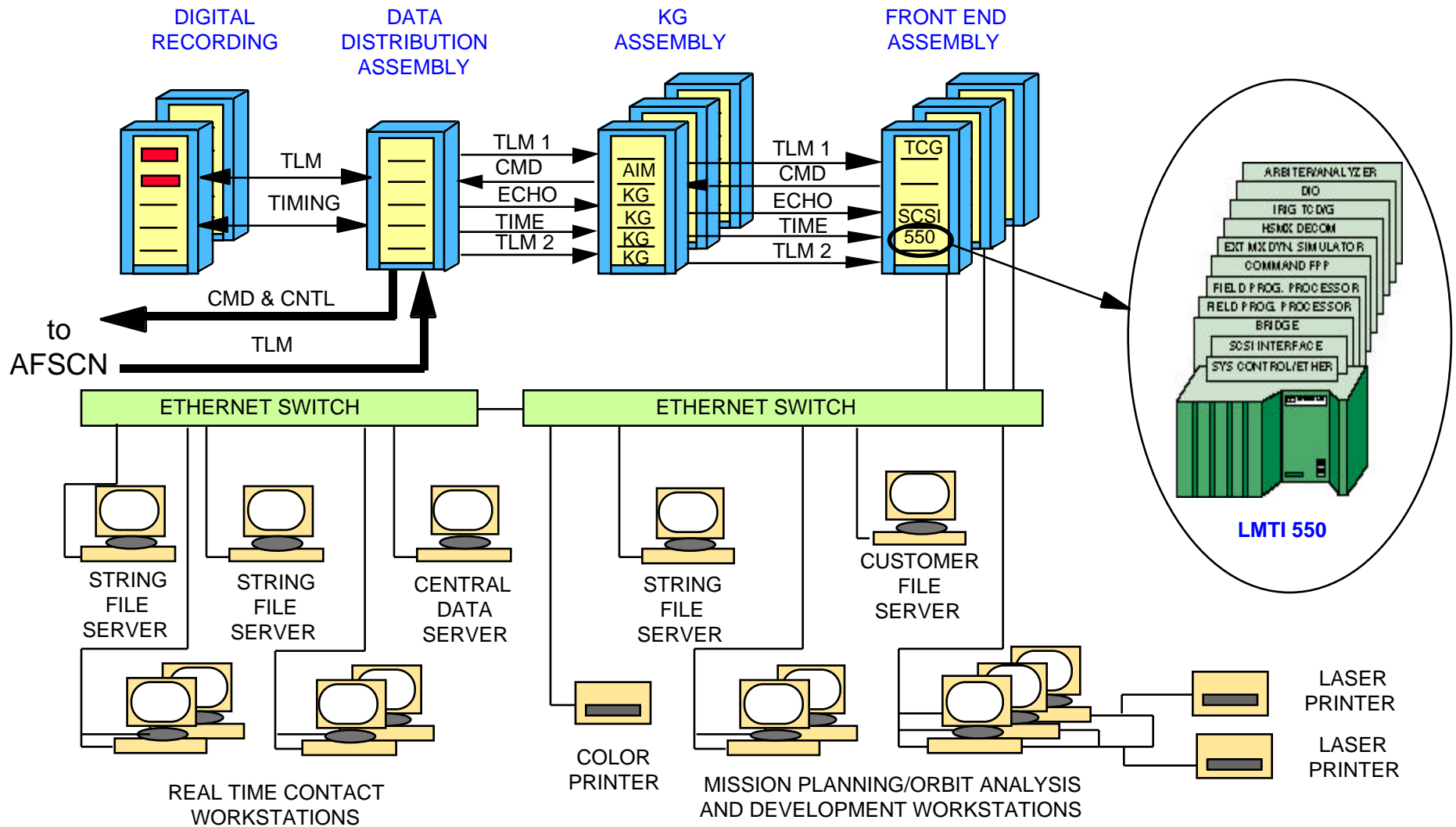
Equipment Room



System Features

- **Full TT&C with AFSCN Connectivity**
 - **TLM Rates up to 20 Mbps**
 - 50 Mbps CCSDS card available
 - **CMD Rates up to 256 Kbps**
- **Multi-mission Capability**
 - Demonstrated with MSTI-3, MILSTAR, and ARGOS
- **Easily Customized Toolkit-type Products**
- **99.44% COTS**
- **Middleware (RTSmartSockets)**
- **Expert System (Gensym G2)**

CERES Hardware



CERES Software is COTS

TLM DISPLAY & ANALYSIS

- LMTI*: Sys 500 Mod 550
- Talarian*: RThci
- Visual Numerics*: PV Wave
- Wolfram Res.*: Mathematica

COMMAND/ CONTROL

- Storm*: IMT CMD System
- Storm*: AIM / ACM
- Gensym*: G2 Expert Sys

SYSTEM & GUI

- Sun*: SPARC Stations
- Talarian*: RTSmartSockets
- Sybase*: Database
- B&W*: UI/MX GUI Builder

ORBIT

- Analytical Graphics*: STK
- Analytical Graphics*: PODS
- Integral Systems*: OASYS

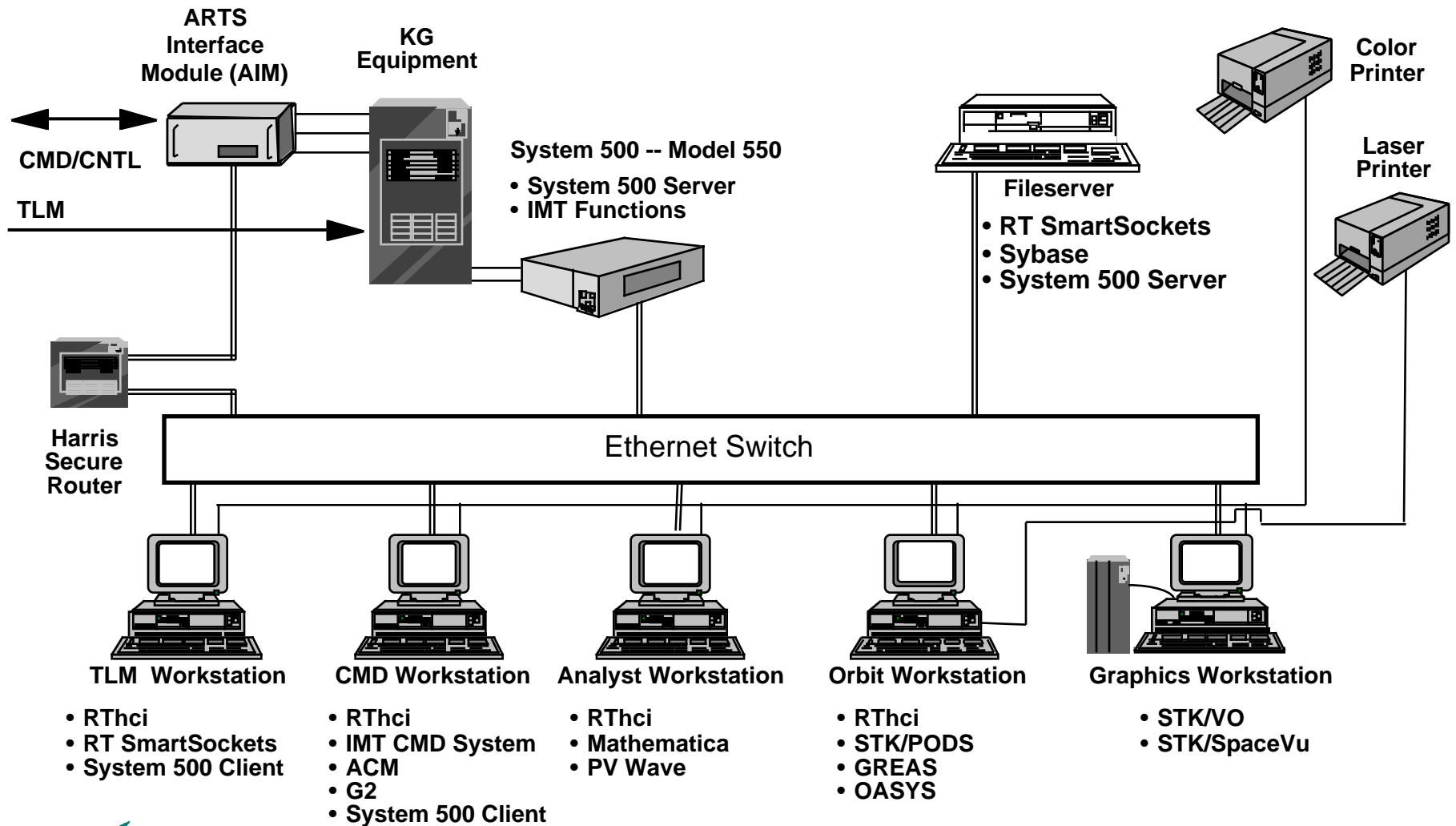
SCHEDULING

- Pacific-Sierra*: GREAS
(Generic Resource
Event & Activity Scheduler)

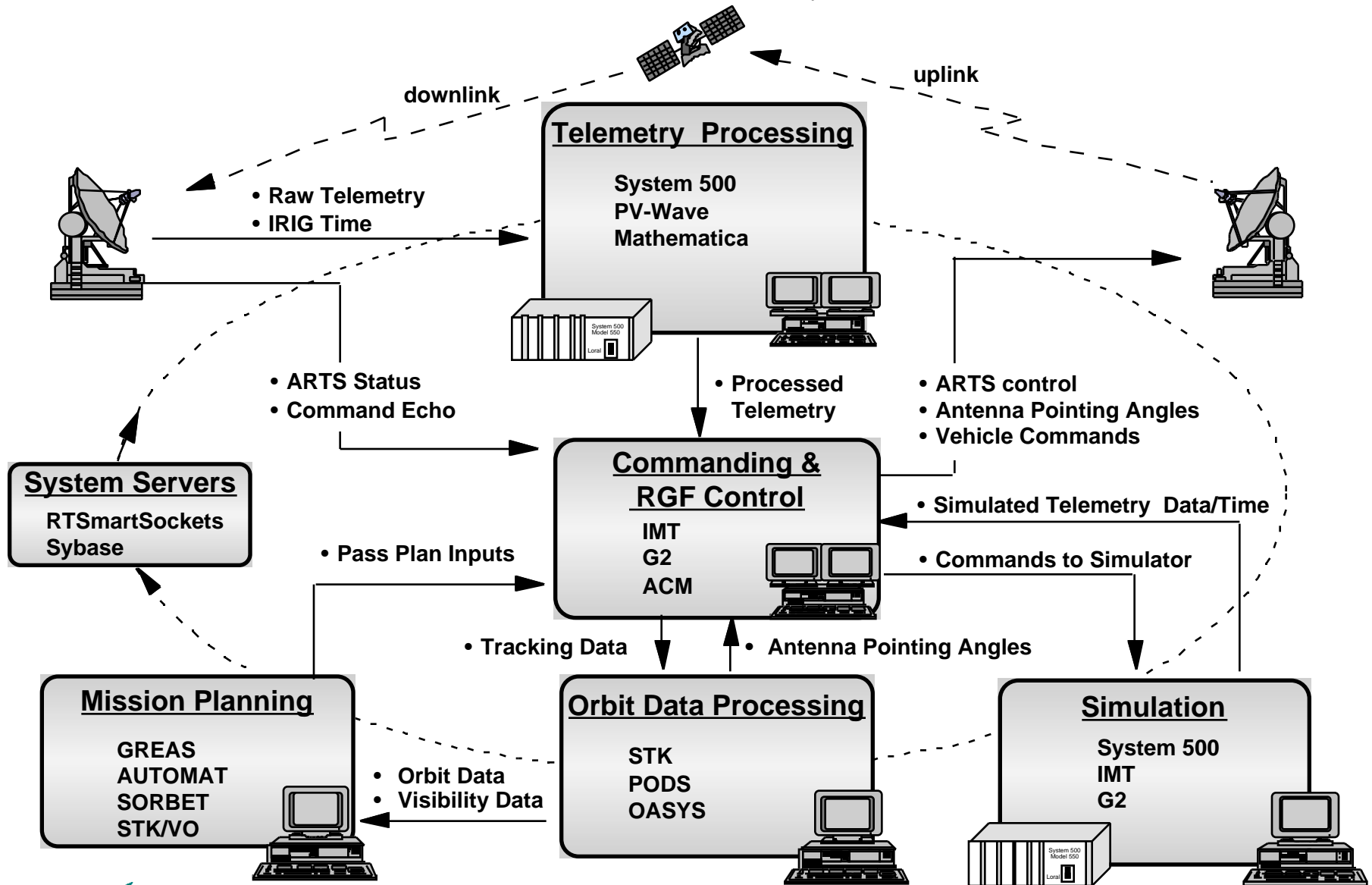
Open Architecture Technology

- **Industry Standard Interfaces**
 - **Unix (Solaris)**
 - **X-Windows, OSF/MOTIF GUI**
 - **Internet Protocols (TCP/IP)**
 - **COTS Middleware (RT SmartSockets)**
- **Benefits**
 - **Scaleable Hardware Architecture**
 - **Choice of Vendors and Systems Integrators**
 - **Easy to Enhance to Meet New Requirements**

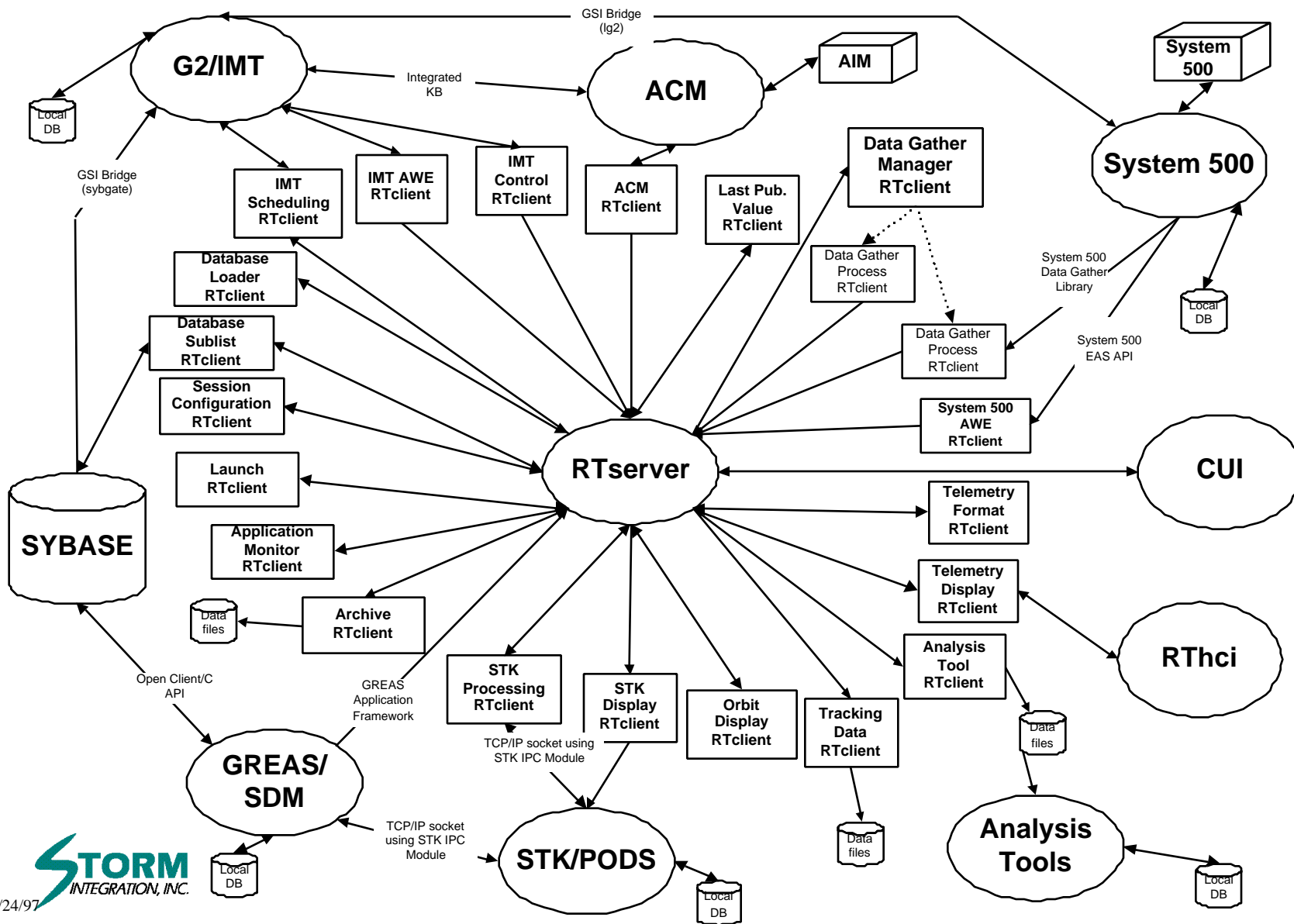
Distributed Architecture



Functional View



Upgraded Middleware Interfaces



CERES Acquisition

- **Unique Co-operative Team Effort**
 - Air Force SMC/TEO & Aerospace
 - Lockheed-Martin Technical Operations (LMTO)
 - Lockheed-Martin Space & Range
 - Storm Integration
 - 13 Commercial Vendors
- **Evolving Configuration — Spiral Acquisition**
 - **Ph1 (9/93 - 2/94)**
 - Primary Command & Telemetry Capability
 - **Ph1E (9/94 - 3/96)**
 - Orbit Management, Scheduling, RTS control, Middleware
 - **Blk 3 (6/96 - 3/97)**
 - Central User Interface, RThci, Improved middleware, Limit Checking

COTS Lessons Learned

- **Pro's**
 - **Choice of Vendors/Products for Open, Distributed, Client-Server Architectures**
 - Could Replace LMTI 550 with PC-based Front End
 - Degree of Openness depends on Integration Approach
 - **Vendors Maintain/Enhance Products (lower costs)**
 - e.g. New API for OASYS Orbit package
- **Con's**
 - **Schedule Conflicts — Upgrade Dependencies**
 - Working to Eliminate Multi-Layer Dependencies
 - **Increased Integration Complexity**
 - Lack of Standard Database & File Formats
 - Lack of Standard Application Program Interfaces (API)
 - Mitigated by use of Middleware

Application Lessons Learned

- **New Acquisition Paradigm**
 - **Govt Contractor Integrates — Vendors Build Code**
 - **Toolkit vs Turnkey Paradigm**
 - Used Functional Description vs. System Spec
 - Plan for Evolving Operations Concept
- **New Maintenance Paradigm**
 - **Continual Product Improvements (18 Month Cycle)**
 - User Feedback Drives Vendor Product Upgrades
 - Software Upgrades Drive Hardware Upgrades
 - New Sparing Concepts Needed, e.g., Lease vs. Buy
 - **Integration Effort Dominates Maintenance Costs**

Experience Beats Study: JUST DO IT !!