

Jason-1 Telemetry, Command and Communications Subsystem (JTCCS)



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JTCCS Architectural Features

This Command and Control System is:

- Fully Operational
- Modular
- Plug and play
- Portable
- Distributable
- Open Architecture
- Easy to Use
- Very Easy to Learn (Low Cost Training)
- Ready for Lights Out Operation
- Very Low Cost

- Designed for a Twenty Year Lifetime
- Designed to Support Multiple Spacecraft
- Developed With a New Management Methodology

Impacts of Lifecycle Architecting Decisions



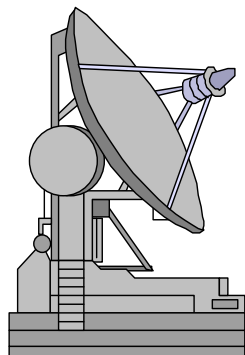
The Correct Application and Synthesis of Experiences In

- The Managers' Role as Systems Architect and Teacher
- Understanding Cognitive Dynamics
- The Importance of Verbal and Written Communications
- The Importance of Task Oriented Organizations
- The Selection and Tailoring of Software Standards
- Understanding Inferential and Traditional Architectures
- Selecting The Proper Development Methodology and Technique
- Selecting The Correct Control Points For Production
- Project Management in High Quality Low Cost Systems
- The Impact of Leadership in software Intensive Projects
- Estimating Software Development Cost Correctly

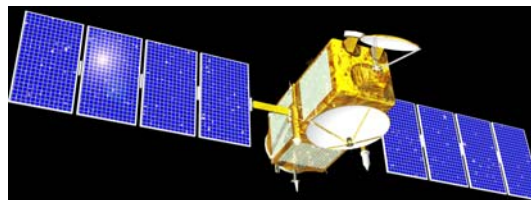
The Jason-1 Mission

- Follow-on to Topex-Poseidon
- Provide Higher Accuracy Radar Altimetry Measurements of Global Ocean Circulation (2.5 cm)
- Discover the Relationship Between the Oceans and Atmosphere, Improve Global Climate Predictions, and Monitor Events Such as El Niño Conditions and Ocean Eddies
- Provide Near Real-Time Data Service for Operational Activities Such as Marine Forecasting of Ocean Circulation and Weather (3 Hour Delay)

Jason-1 Project Elements



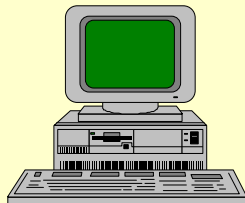
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- Poseidon 2 altimeter
- DORIS receiver
- Microwave radiometer
- Turbo Rogue Space Receiver
- Laser Retroreflector Array

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- Poker Flat, Alaska
- Wallops Island, Virginia
- Aussaguel, France

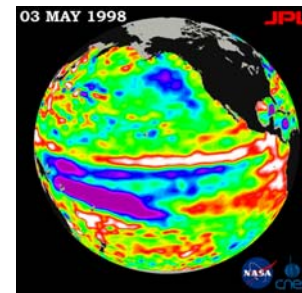


- JPL Project Ops Control Center, with JTCCS at its heart
- Toulouse, France, Ops Control Center

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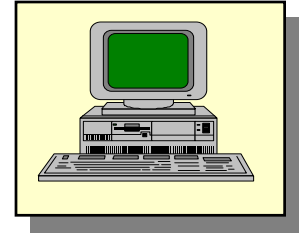


- Delta II from Vandenberg AFB

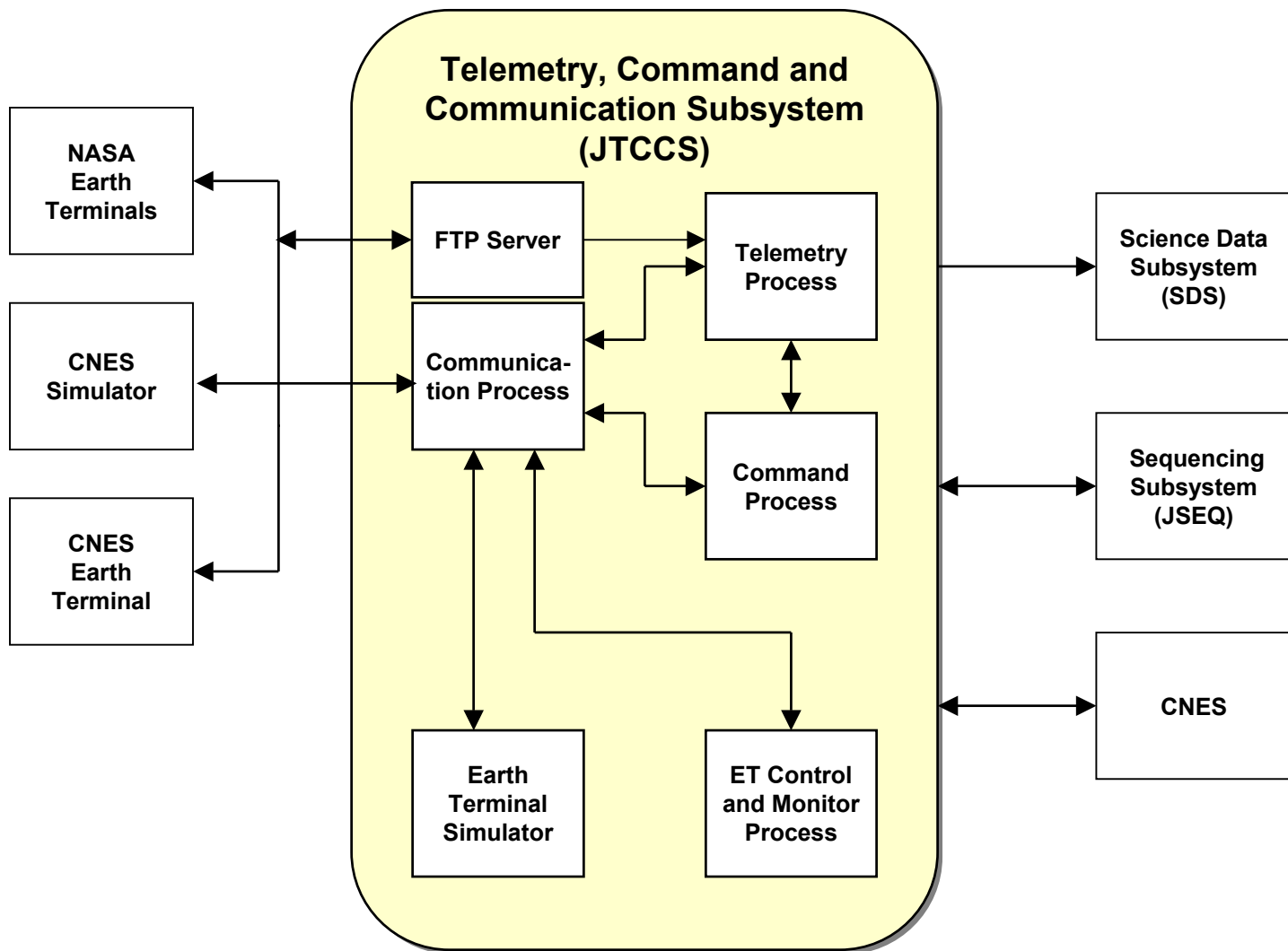
Jason-1 Project Operations Control Center (POCC) Tasks



- JTCCS - Performs All Real-Time Command and Telemetry Processing During the Routine Phase of the Mission
- Jason Sequencing Subsystem (JSEQ) - Generates the Sequence of Events for the Mission as Well as All Command Loads Sent to the Satellite for Execution
- Jason Science Data Subsystem (JSDS) - Generates the Science Data Products from the Raw Data Received from the Satellite
- Physical Oceanography Distributed Active Archive Center (PODAAC) - Archives and Distributes the Science Products to the US Science Community



The JTCCS Subsystem



JTCCS Functional Tasks

- **Control and Monitor Earth Terminals**
- **Receive, Store, Process and Display Real-time and Recorded Telemetry Data.**
 - HKTMR - Onboard Housekeeping Recorded Telemetry Data
 - HKTMP - Real-time Housekeeping Telemetry Data (During Passes)
 - PLTM1 - Payload Telemetry Data One
 - PLTM2 - Payload Telemetry Data Two
- **Command and Monitor Satellite Status**
- **Translate and Transmit Commands**
- **Decommutate and Distribute Telemetry Data**
- **Manage and Archive Data Files**

Management Approach

- **Small Highly Experienced Technical Team**
- **Very Close Team Work With Customer and Operational Users**
- **Incremental Delivery of Software (Early Show and Tell)**
- **Use of Technical Writers as Systems Engineers**
- **Selection and Tailoring of a Mature Software Development Standard (JPL-D-4000)**
- **Meticulous Articulation of Requirements and Design**
- **On Going Reviews**

JTCCS Server Platforms



**Windows XP/2000
on a PC Laptop**



**Windows XP/2000/NT 4.0
on a PC Workstation**



**Linux/UNIX on a
Sun/HP Workstation
(Not Implemented for JTCCS)**

JTCCS Client Platforms



**Windows XP/2000
on a
PC Laptop**



**Windows
XP/2000/NT 4.0
on a
PC Workstation**



**Linux/UNIX
on a
Sun/HP
Workstation**



**Mac OS 10
(UNIX)
on a
PowerBook G4**

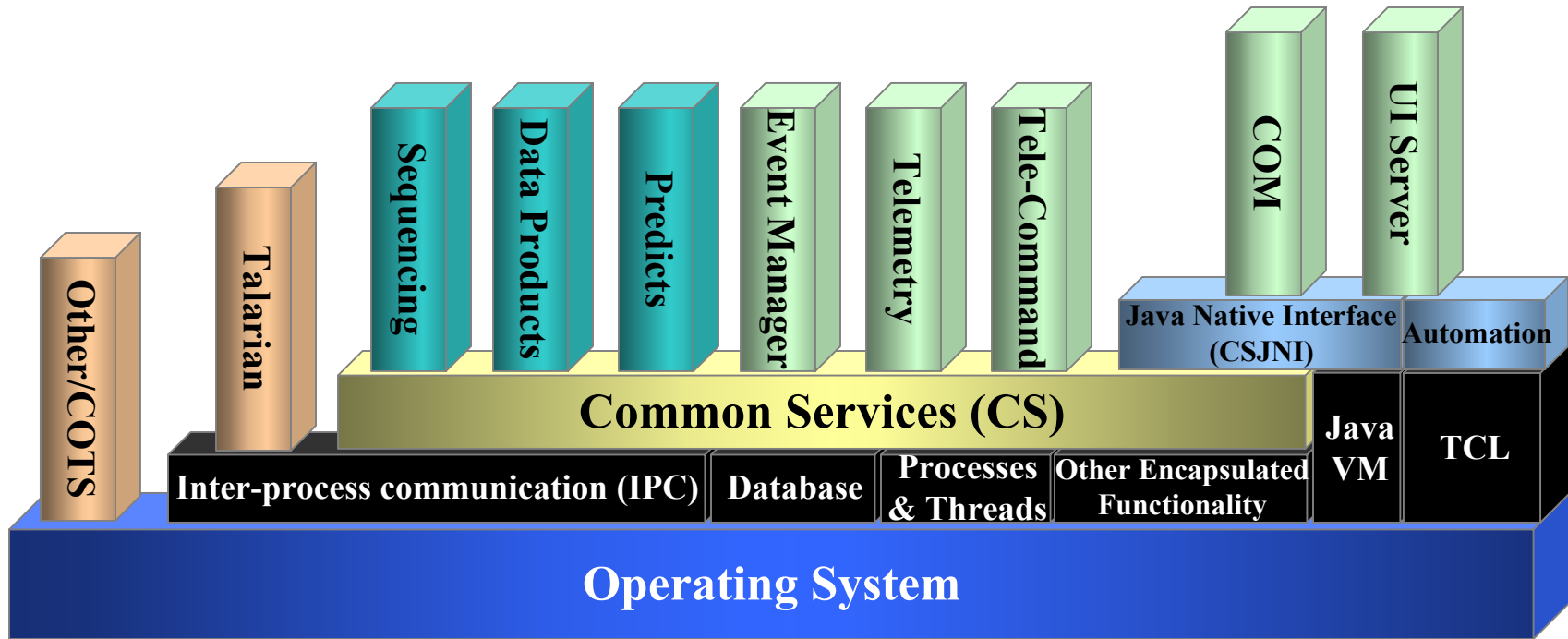


**Windows CE
on an iPAQ**

JTCCS System Elements

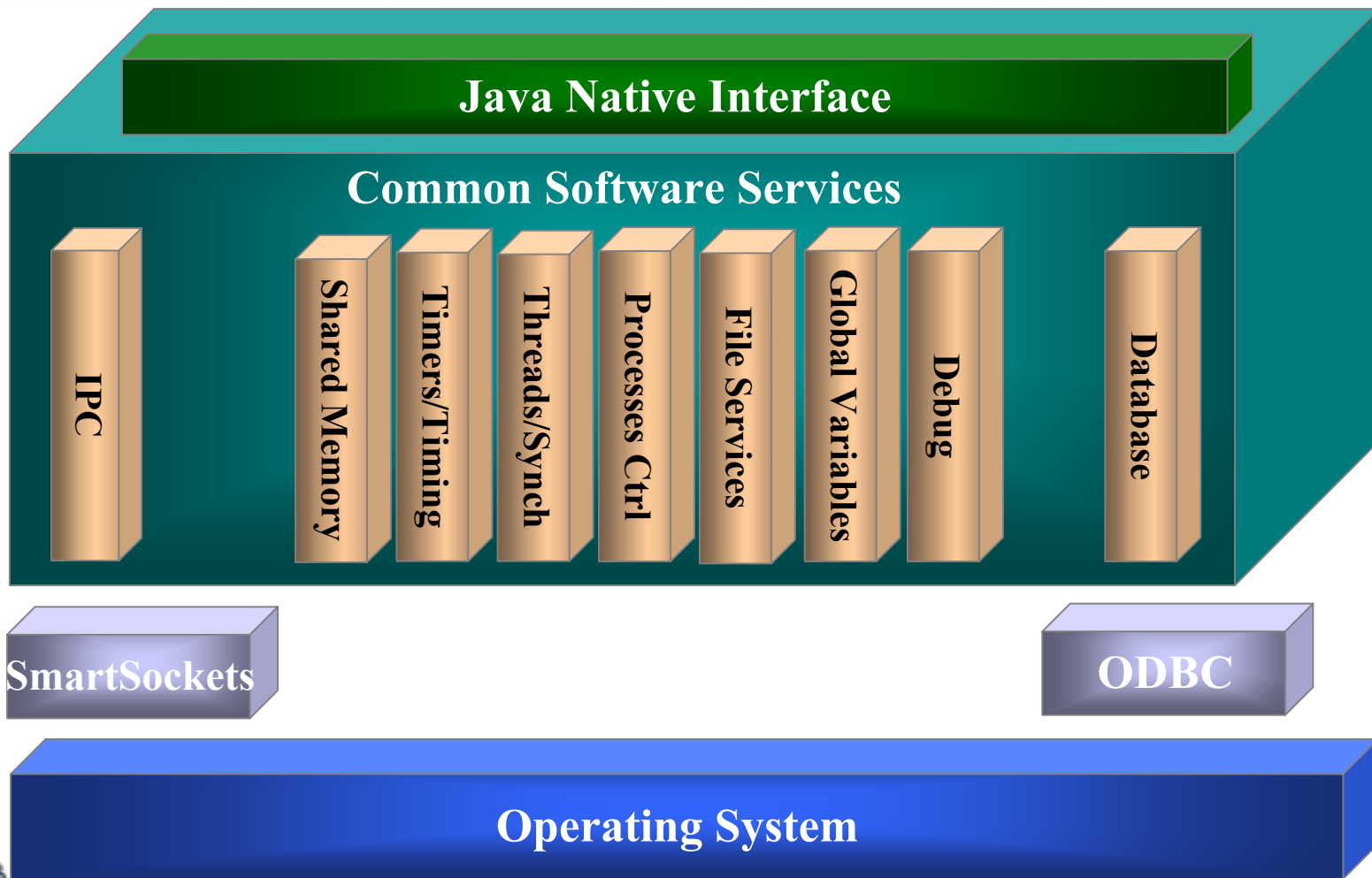
- **Size: 489,000 Lines of Code (LOC)**
- **Total cost: \$8.7 Million**
- **Documentation: Fully Documented to JPL Standards**
- **Software Languages: Java, C++ and TCL**
- **Operational Modes: Manual, Automatic and Unattended**
- **Designed to Support Four Generations of Jason Class Satellites Over a Twenty Year Life Cycle**
- **Wireless and Handheld Personal Digital Assistant Capability**

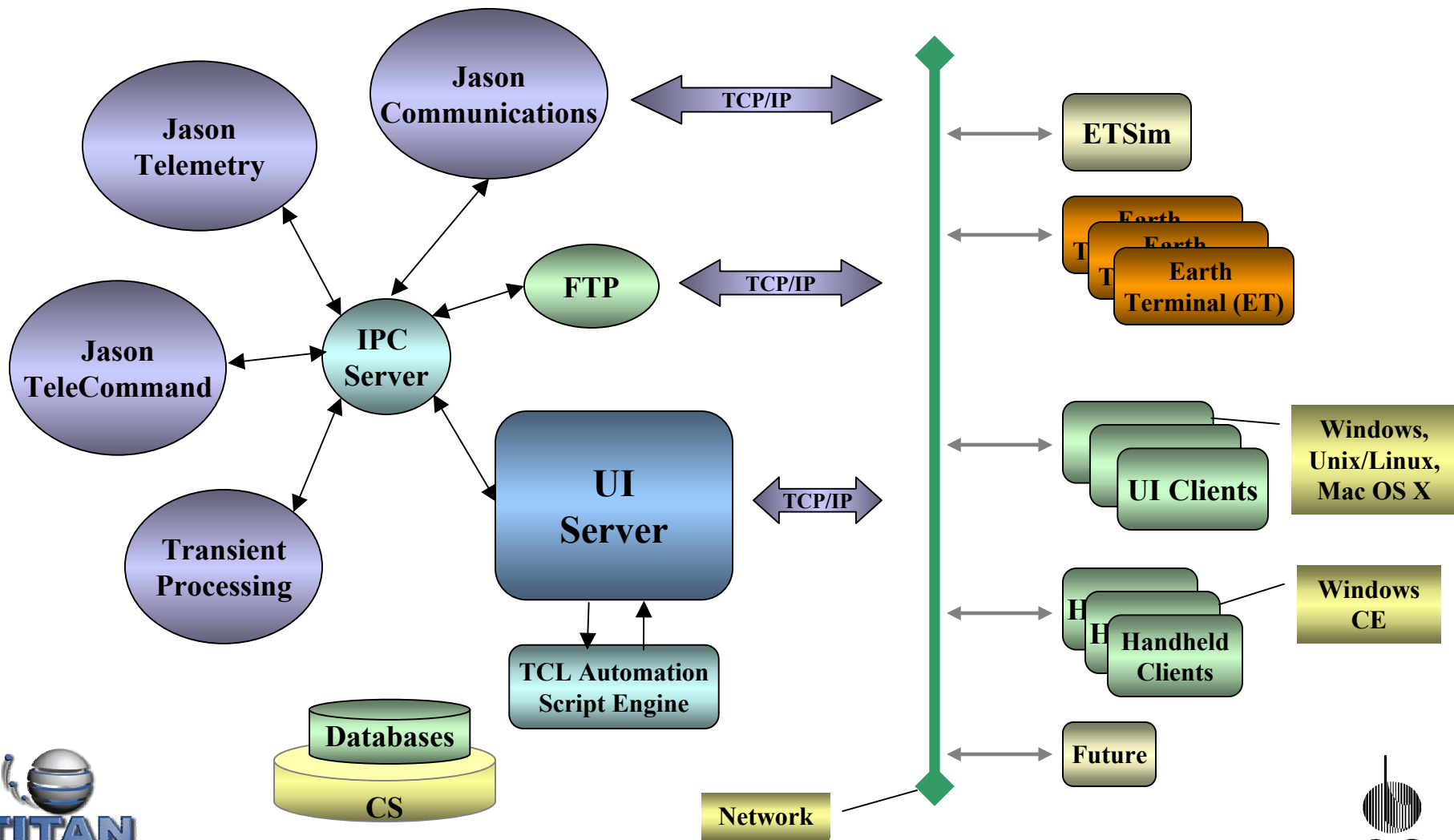
JTCCS Pluggable Architecture

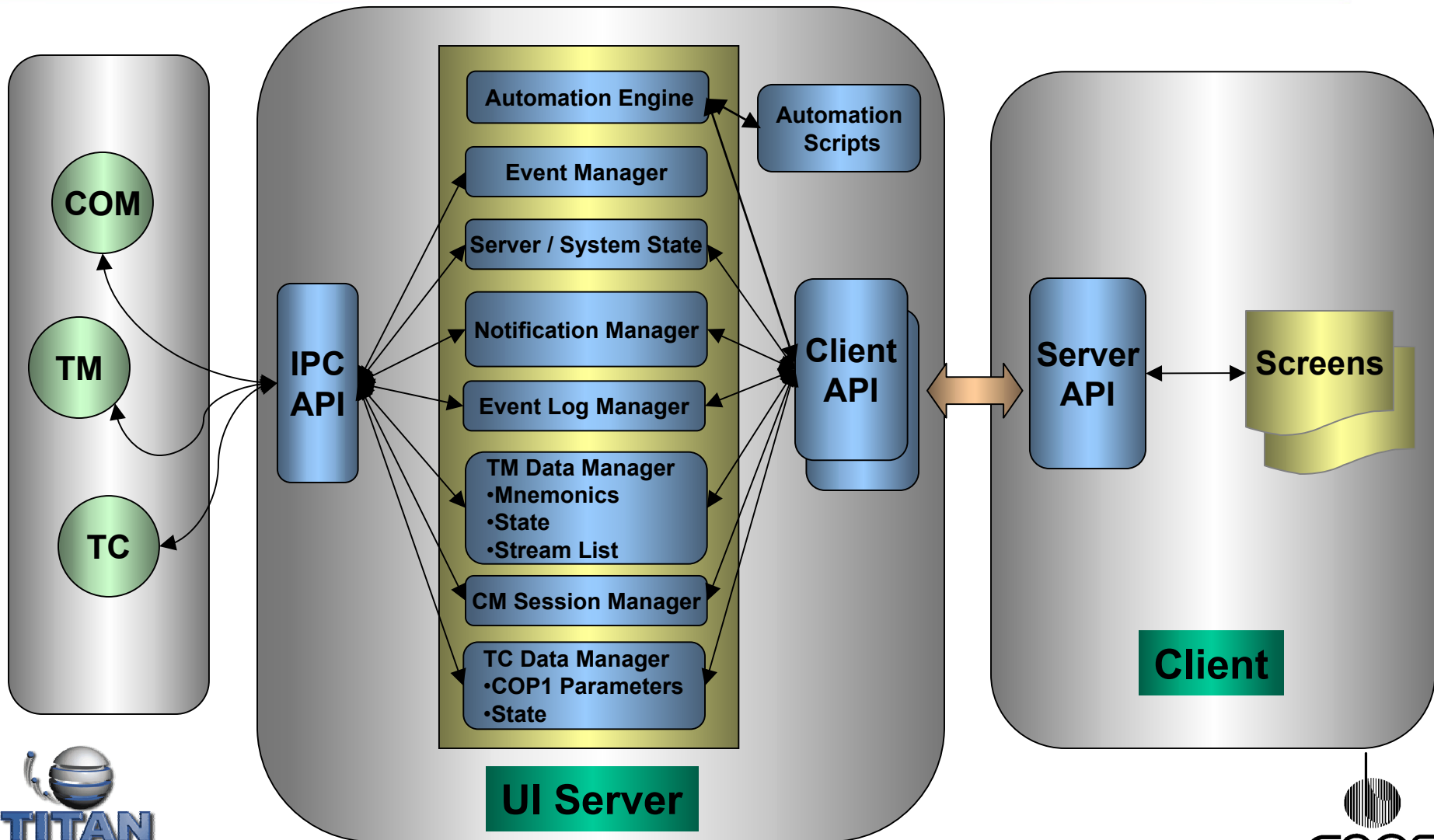


 = Potential Future Plug-ins

Common Software Service Architecture







- All Functions that can be Performed by an Operator can be Done by TCL (Tool Command Language) Scripts.
- TCL Scripts Interact With UI Server. Scripts Have Access to All Ground and Satellite Parameters.
- Simple Syntax:

```
set result [jtcc tc send "Commandfile"]  
if {$result != 0} {... Error Processing...}
```
- Scripts can be Modified and Tested Online. There are No Separate "Compilation" or "Build" Steps.

- **Pass Schedule Tells Automation When to Perform Functions.**
- **For Jason-1, Most Passes are Executed “Hands-Off” (No Operator Intervention). The Script Controls All Data Flows, Commanding, Data Receipt, Alarm Checking, Product Generation, etc.**
- **Additional Scripts Perform Other Data Processing Functions: Product File Processing, FTP to External Users, Checking for System Failures, Report Generation, File Maintenance, etc.**
- **Errors can Cause Audible Alerts, Emails or Pages/Phone Calls.**

JTCCS Key Architectural Features

- **Designed to Support Multiple Jason Follow-on Satellites (4 Jason Satellites - 20 Years)**
- **Common Software Provides Significant Common Functionality Shared Across All Application Modules**
- **Inter-process Communication Foundation on Proven, Reliable Middleware Technology - Talarian SmartSockets**
- **Platform Abstraction - “Ready to Run” on Other O/S Platforms (E.G., Windows NT, VMS, Unix)**
- **Common Debugging Services**
- **Use of TCP/IP and FTP Protocols for Communications**

JTCCS Key Architectural Features (Cont'd)



- **Event Manager Provides**
 - **Startup/Shutdown Process Synchronization**
 - **Transient Process Management - Resource Efficiency**
 - **Generic Event Scheduler and Script Processor for Automation**
 - **Dead/Hung Process Detection and Automatic Restart**
- **FTP Server Manages Retrieval, Storage and Distribution of Remote Files**
- **Command Translator is Shared by JTCCS and the Jason Sequencing Subsystem (JSEQ)**
- **UI Client Completely Portable - Runs on Any Wintel Workstation or Any Java Enabled OS Platform**
- **Decom Able to Perform Real-time (Pass) Monitoring and the Playback of Recorded Data Simultaneously**

Benefits We Have Realized With JTCCS



- This Command and Control System is:
 - Modular
 - Low Cost (Very)
 - Plug and Play
 - Portable
 - Distributable
 - Open Architecture
 - Easy to Use
 - Very Easy to Learn (Low Cost Training)
 - Capable of Fully Automated Operation