
The NEAR Ground System

Evolutionary Development
using EPOCH 2000

Introduction

- ◆ Near Earth Asteroid Rendezvous (NEAR)
 - First NASA Discovery Mission
 - “Faster, better, cheaper”
- ◆ Built and operated by the Applied Physics Laboratory (APL) of Johns Hopkins University
- ◆ Command and control (C&C) system built by Integral Systems using EPOCH 2000

The NEAR Challenge

- ◆ How can you build a “faster, better, cheaper” ground system?

Start with a Flexible Architecture

- ◆ EPOCH “Stream”
 - Performs specific C&C function (T&C, playback, simulation, ground equipment C&C)
 - Table-driven for easy configuration
- ◆ EPOCH “Viewer”
 - Provides visibility into streams
 - File-driven for easy configuration

Use Standard COTS Hardware

- ◆ UNIX workstations
 - Graphical User Interface
- ◆ UNIX front ends
 - Deterministic real-time processing
 - Isolates C&C peripheral interfaces
- ◆ Ethernet
 - Local and Wide Area networking

Use Proven COTS Software

- ◆ EPOCH UNIX processes
 - Generic, configurable processes shared across EPOCH applications
 - Mission-specific processes consistent with the architecture
- ◆ EPOCH C libraries
 - Public APIs shared by EPOCH users
 - Private APIs shared by developers

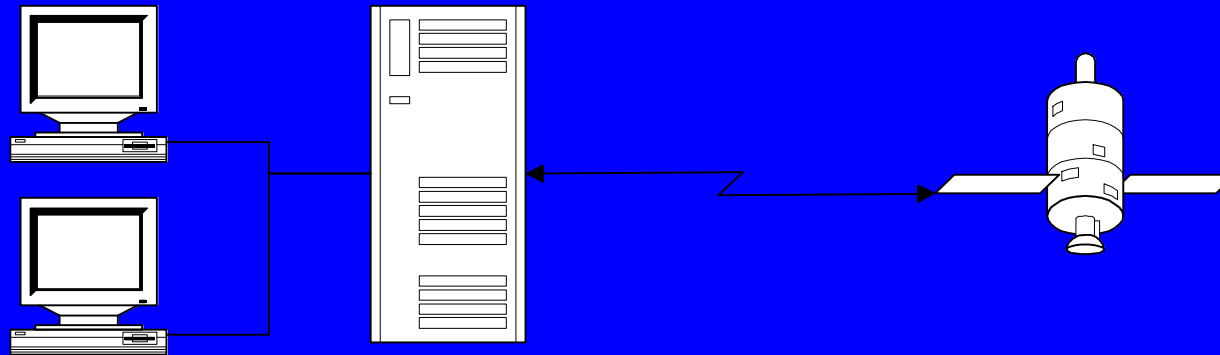
Make Evolutionary Deliveries

- ◆ Evolutionary approach is needed
 - C&C requirements evolve over the mission
 - Flexibility in the architecture is essential
- ◆ EPOCH enables evolutionary approach
 - Existing streams and processes may be reconfigured through database changes
 - New streams, hardware and software components can be added easily

NEAR C&C System Lifecycle

- ◆ One C&C system for the life of the mission
- ◆ Development milestones:
 - 6 months: NEAR satellite I&T at APL
 - 12 months: Deep Space Network tests at APL
 - 15 months: thermal vacuum testing at NASA
 - 18 months: launch operations at NASA
 - post-launch: mission operations at APL

Satellite I&T (6 months)



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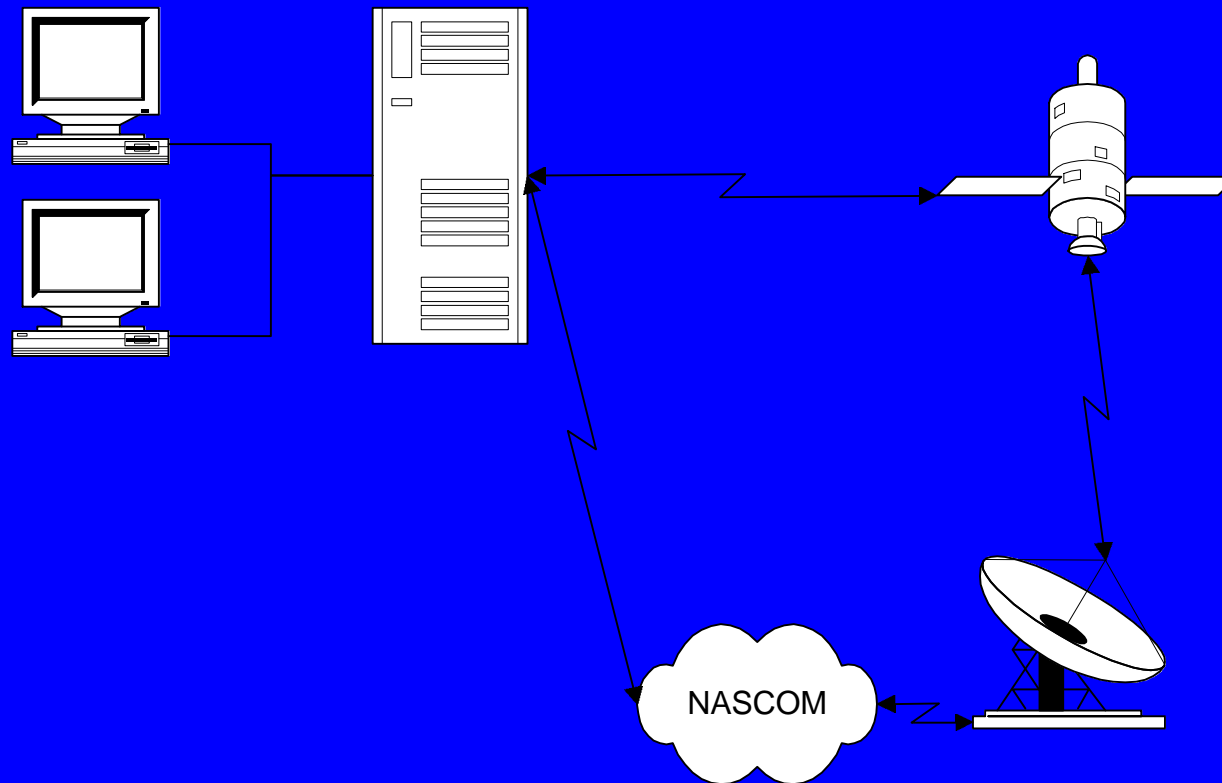
◆ COTS:

- Stream framework on HP and MODCOMP
- Local Area Network
- Baseband interface
- CCSDS T&C processing
- Oracle database and forms

◆ NEAR Extensions:

- Rate 1/6 convolutional encoder
- Database population
- Display definitions
- Test procedures

DSN Testing (12 months)



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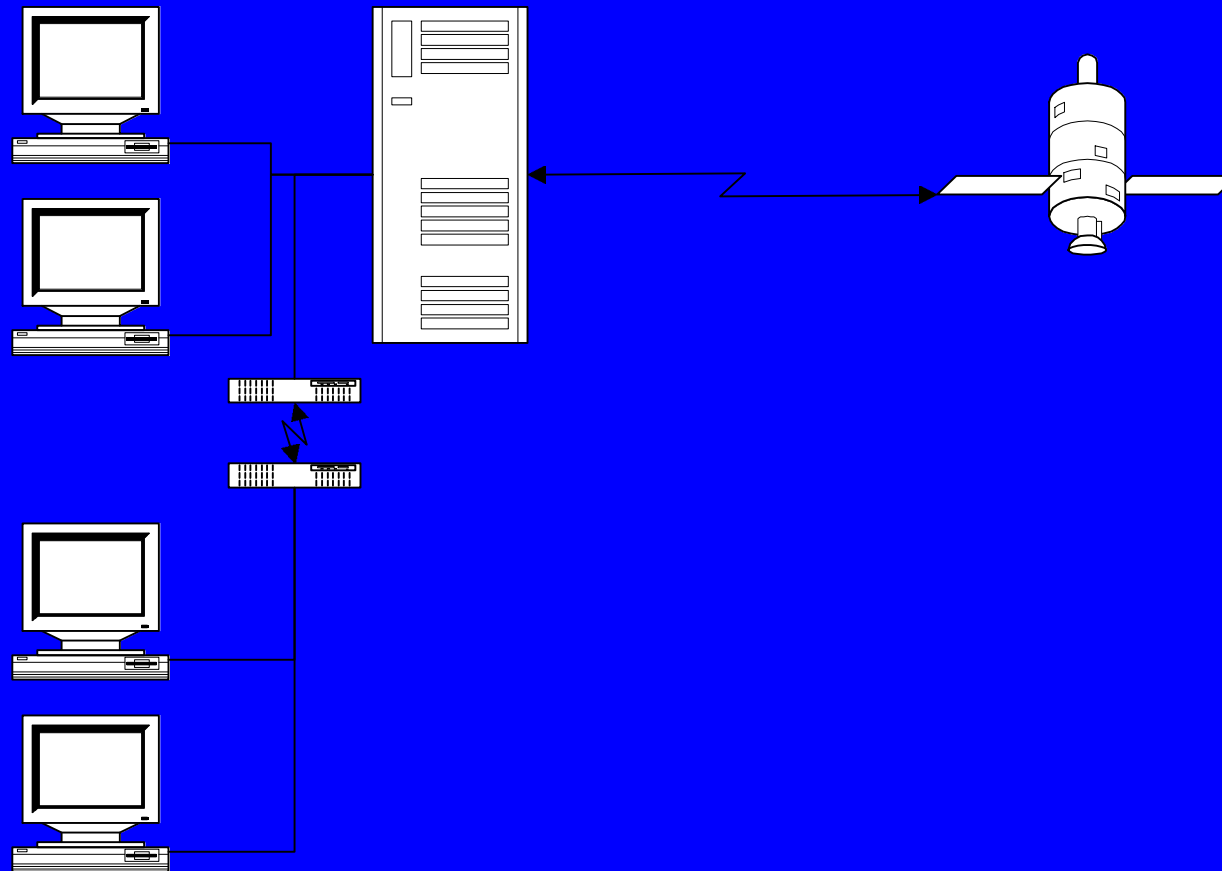
◆ COTS:

- NASCOM interface
- DSN Command Processing Assembly protocol
- DSN telemetry protocol

◆ NEAR Extensions:

- NASCOM and DSN display definitions

Thermal Vac (15 months)



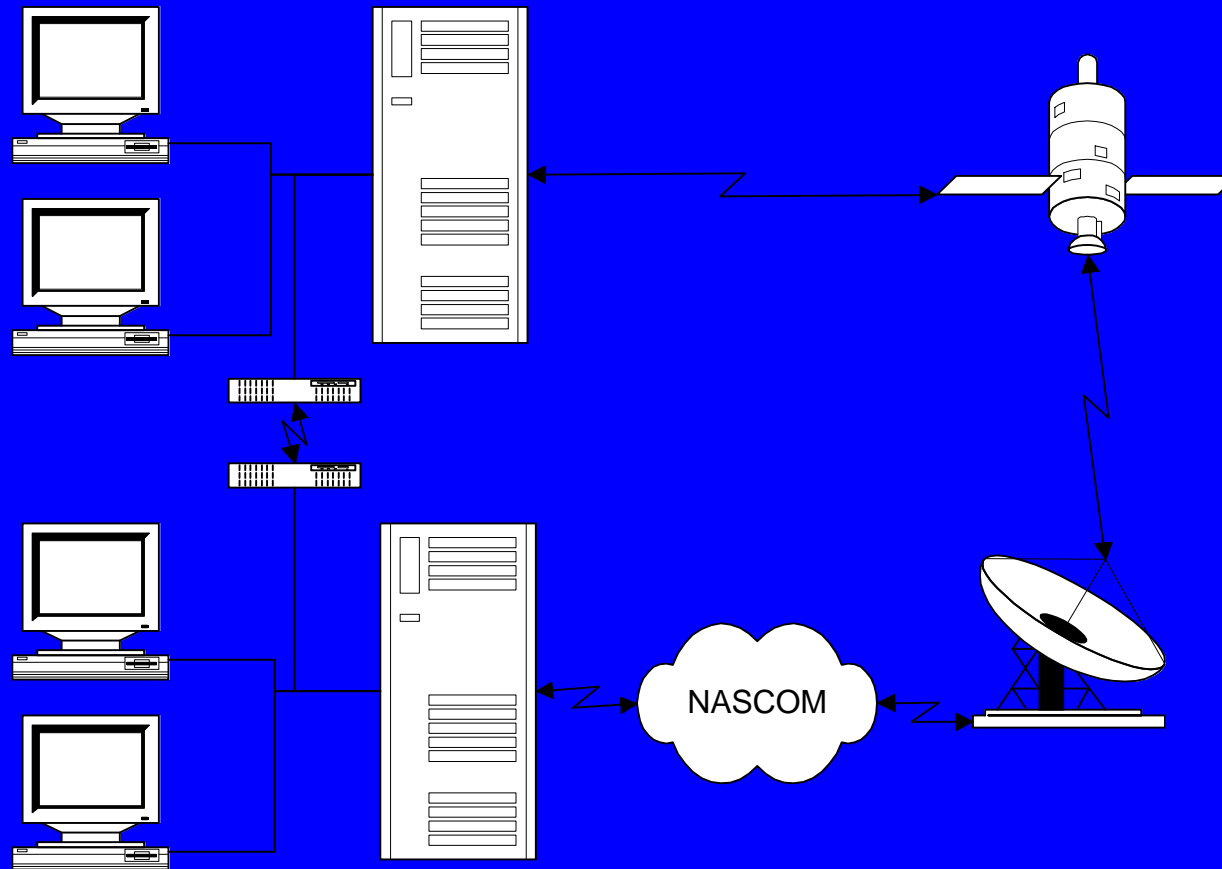
Thermal Vac (15 months)

◆ COTS:

- Stream framework on DEC
- Wide area network

◆ NEAR Extensions:

Launch Ops (18 months)



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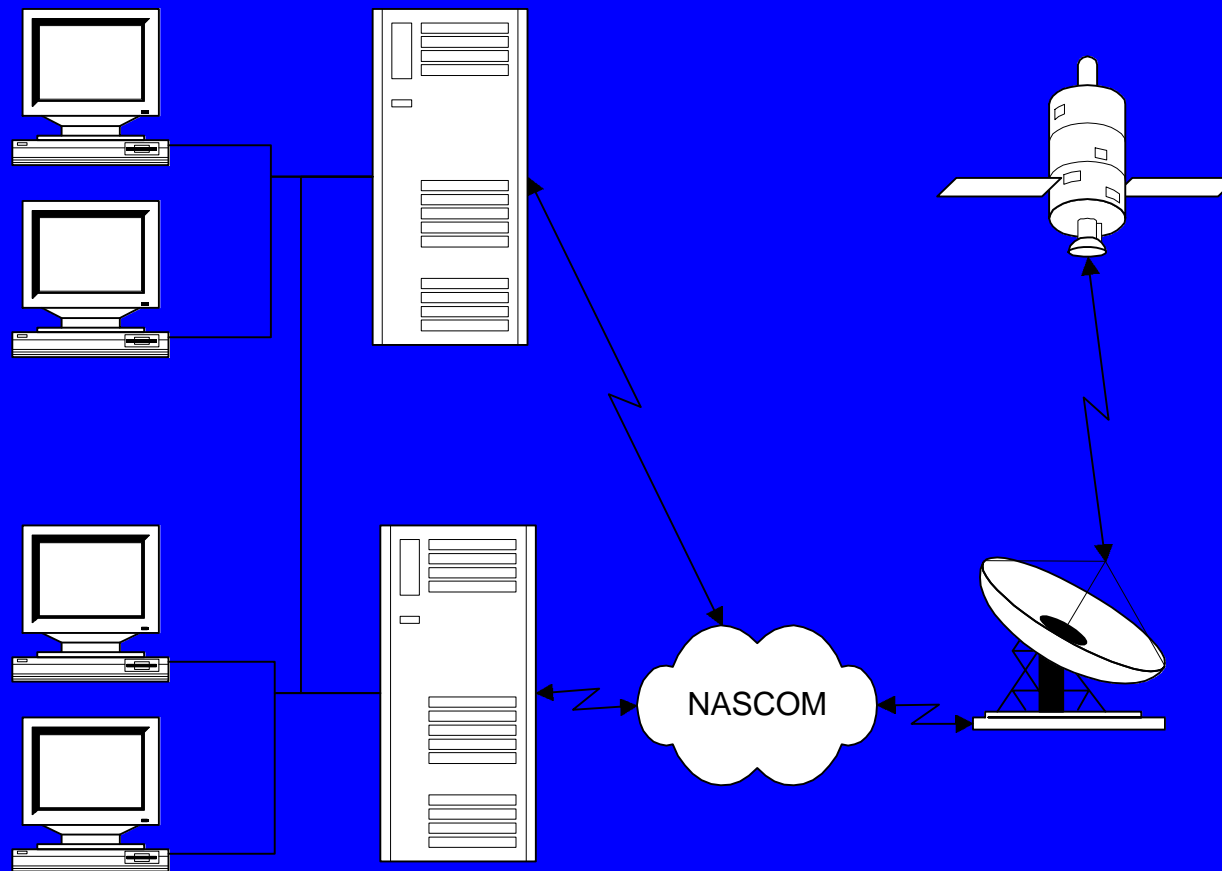
◆ COTS:

- Redundant front end

◆ NEAR Extensions:

- DSN NEAR monitor and tracking block processing and display definitions
- Science Data Center interface

Mission Ops (post-launch)



Mission Ops (post-launch)

- ◆ COTS:

- Firewall

- ◆ NEAR Extensions:

- Mission operations display definitions
- Mission operations procedures

NEAR C&C: The EPOCH Way

EPOCH Feature	Faster	Better	Cheaper
Standard Architecture	Existing framework	Field-tested design	Configurable framework
Flexible Components	COTS parts	Field-tested parts	Configurable parts
Evolutionary Development	Puts systems on-line ASAP	Includes end-users in the process	Just builds what is needed

Conclusion

- ◆ Ground systems can be built “faster, better, cheaper” the EPOCH way