



***Defensive Counterspace (DCS)
Test Bed (DTB)
for
Rapid Spacecraft Attack/Anomaly Detection,
Characterization, and Reporting***

Fifth Ground Systems Architecture Workshop
February 21-23, 2001

Chris Tschan

**Space Operations Support Office
The Aerospace Corporation
Phone: 719-550-5656
Fax: 310-563-7749**



DCS Test Bed

Overview

- Basic Components & Functions
- Dual Approach
- Development Environment
- Results to date
- Implications for Ground System Architectures

DCS Test Bed

Why do we think it's important?

The Rumsfeld Commission to Assess US National Security Space Management and Organization, released Jan 11, 2001, made point of avoiding a “Space Pearl Harbor.”

- »»» Page 32. “Providing active and passive protection to assets that could be at risk during peacetime, crisis or conflict is increasingly urgent.”
- »»» Page 70. “The DoD should focus its space technology investment strategy on: Promoting...artificial intelligence to reduce human operator costs and the burden of high data volume on the communications infrastructure.”
- »»» Page 97. “Appropriate investments in space-based capabilities would enable the DoD to pursue: Improved space situational awareness and attack warning capabilities (as well as) enhanced protection/defensive measures...”

➤ Space System Protection is AFSPC's #1 need in the near and far term.

DCS Test Bed

Background

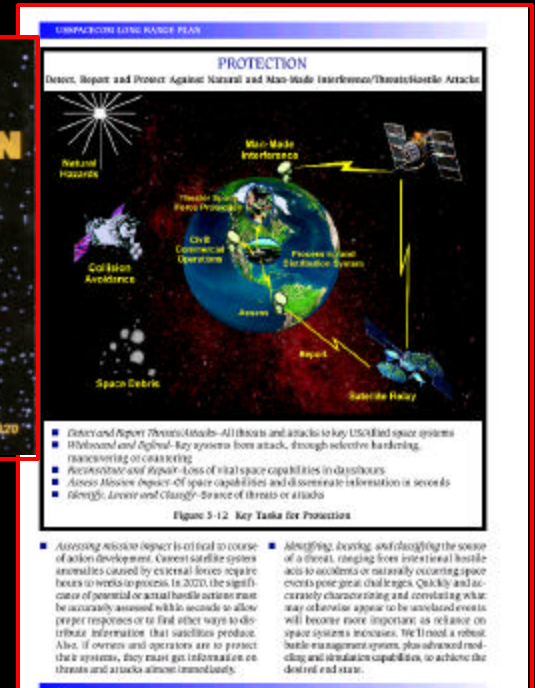
➤ **Concept Basis:** U.S. need for enhanced space situational awareness and need for operational use of space environment information

➤ **Sponsors:**

- HQ AFSPC
- SMC
- SMIO
- The Aerospace Corporation

➤ **Overall Goal:** Provide a test bed environment to assist requirements development and acquisition processes

➤ **FY01 Objective:** Demonstrate the feasibility of enhanced situational awareness by exploiting “satellite as a sensor” and other concepts to improve near real time detection, characterization and reporting of attacks and anomalies



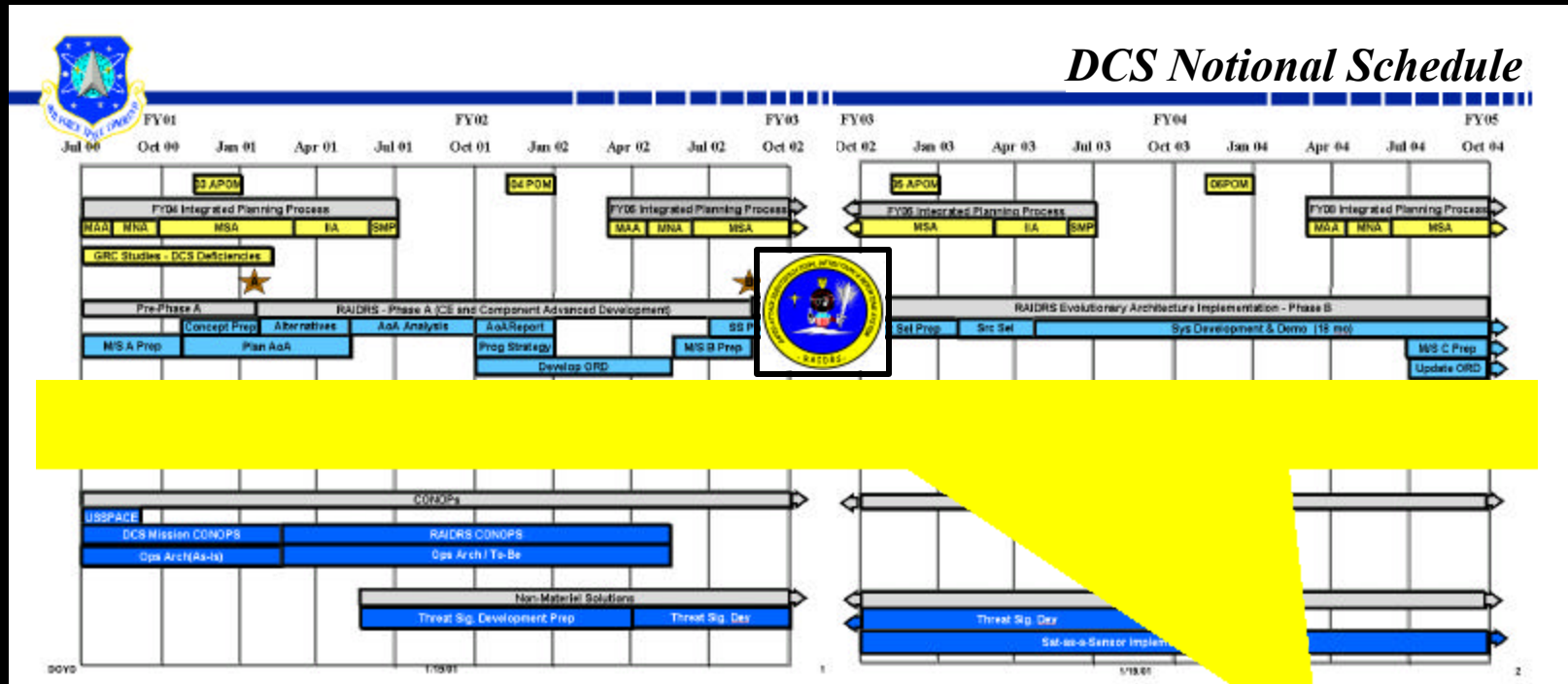
Near-Term (2000-2007)	Mid-Term (2009-2013)	Far-Term (2014-2025)
• Improve Battlespace Situational Awareness	• Improve Battlespace Management	• Provide Global, Real-time Situational Awareness
• Integrate Aerospace Forces	• Evolve Global, Conventional Strike	• Provide Prompt, Global, Conventional Strike
• Evolve Space Superiority	• Gain Space Superiority	• Maintain Space Superiority
• Evolve Information Superiority	• Gain Information Superiority	• Maintain Information Superiority
• Maintain Strategic Deterrence • Leverage Partnerships • Reduce the Cost of Doing Business • Protect and Sustain Forces • Support Installations and People		

Reprinted with permission of



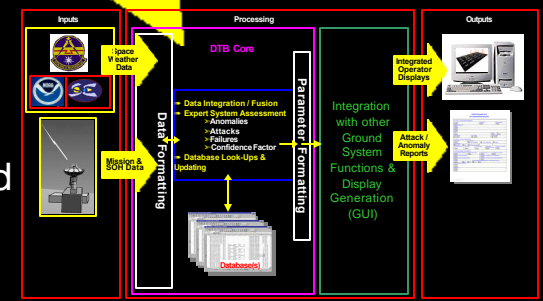
DCS Test Bed

Critical Path for DCS Mission Area



➤ DCS Test Bed is a “High Interest” Project

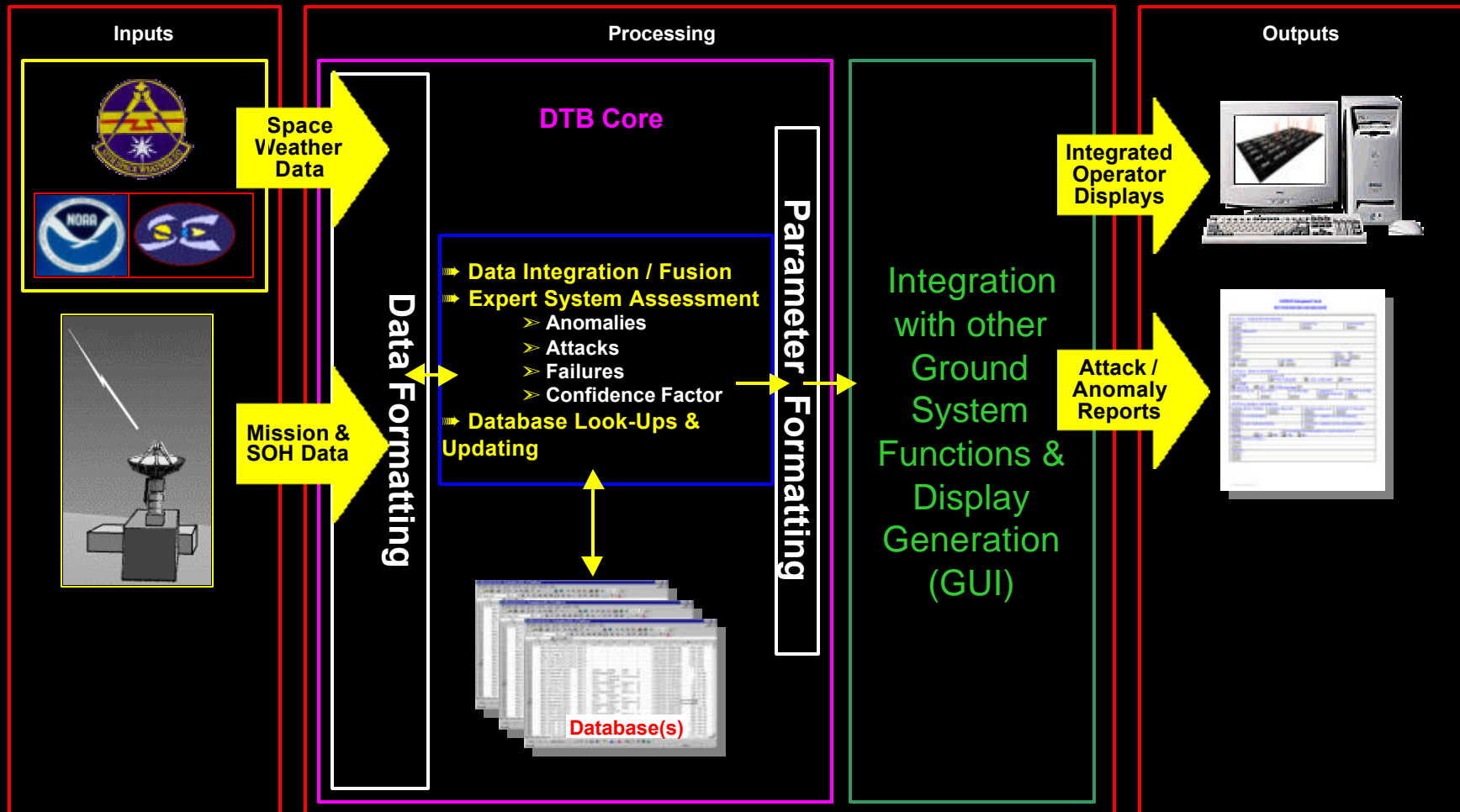
- Briefed to Air Staff in Pentagon
- Briefed to OASD/C3ISR&Space (Space Systems)
- Primary component of “Rapid Attack Identification, Detection, and Reporting Solution” (RAIDRS)
- Will support RAIDRS Concept Exploration & Analysis of Alternatives



Reprinted with permission of HQ AFS

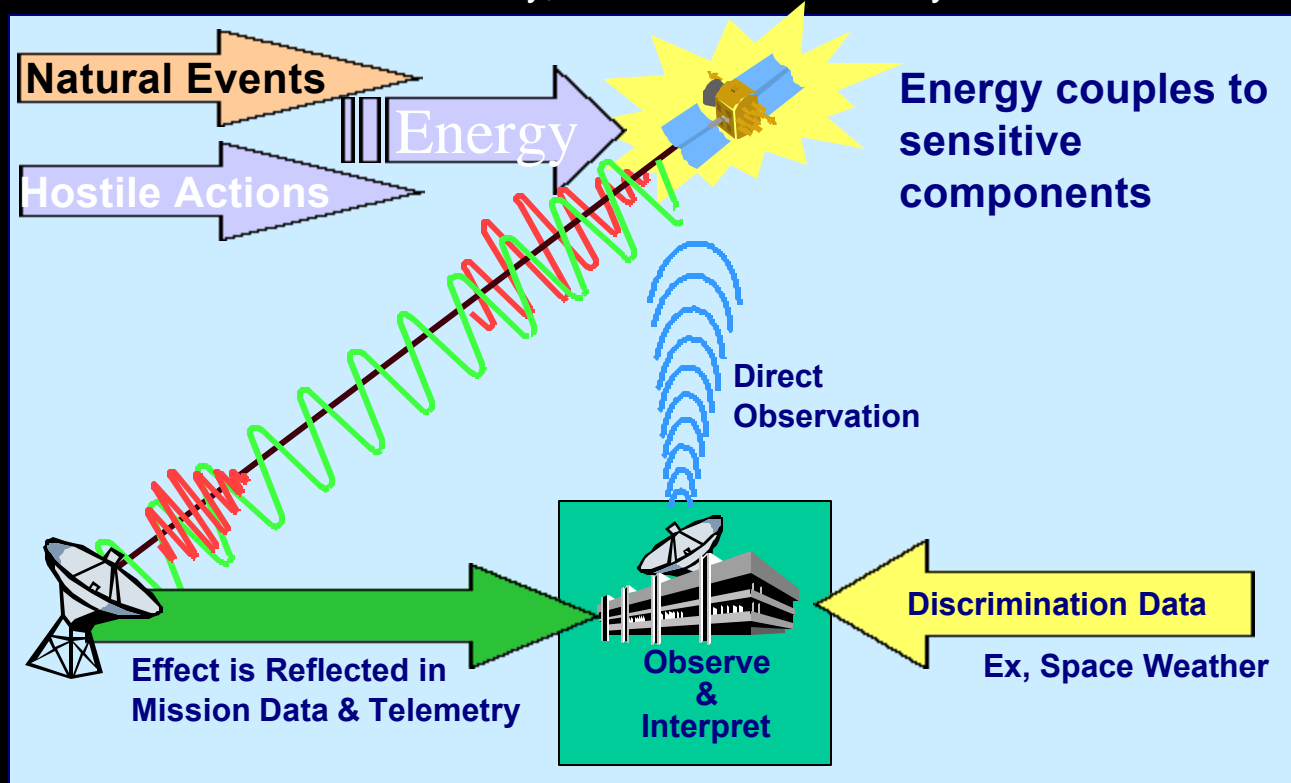
DCS Test Bed

Basic Components & Functions



The Satellite as a Sensor

- Enables Attack/Anomaly Detection, Reporting, and Characterization with little or no change to spacecraft
 - Provides data to new anomaly resolution architecture
 - works for military, civil and commercial systems



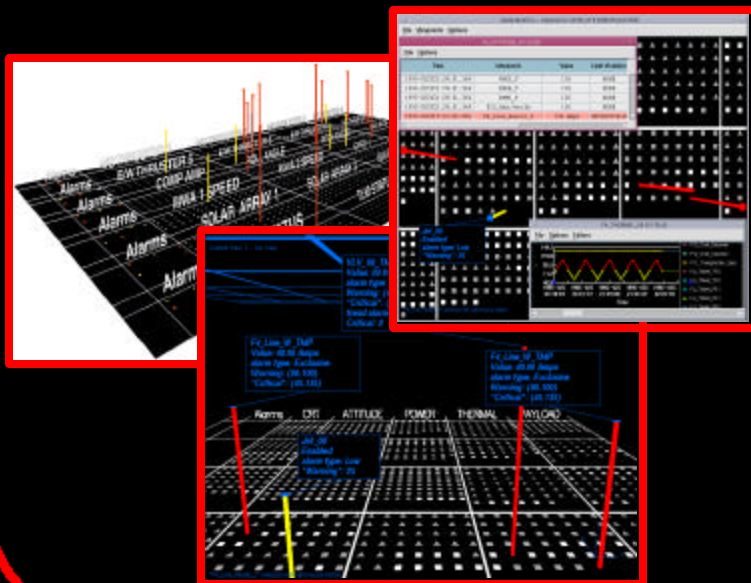
- The DCS Testbed Supports Concept Development

DCS Test Bed

Dual Approach--Both Using Sat-as-a-Sensor

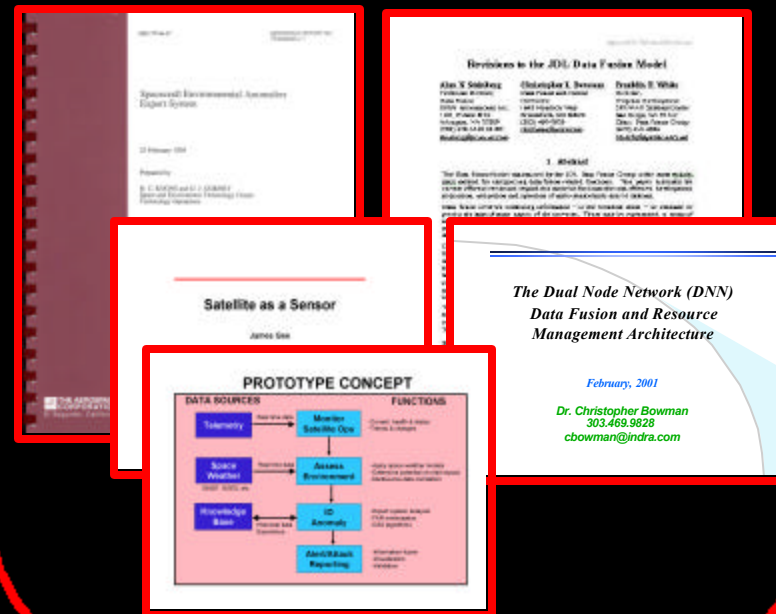
Low Cost, Low Risk to Implement

- Visualize Sat-as-a-Sensor Data
- Improved Situational Awareness
- Detects Out-of-Limits Events



Higher Cost & Risk to Implement

- Digest Data Under-the-Hood
- Look for In-Limits Abnormalities
- Detect Out-of-Class Events



Reprinted with permission of High Tower Software

Reprinted with permission of Harry Koons and James Gee, Aerospace, as well as Christopher Bowman, Data Fusion & Neural Networks



THE AEROSPACE CORPORATION

DCS Test Bed

Development Environment



Reachback



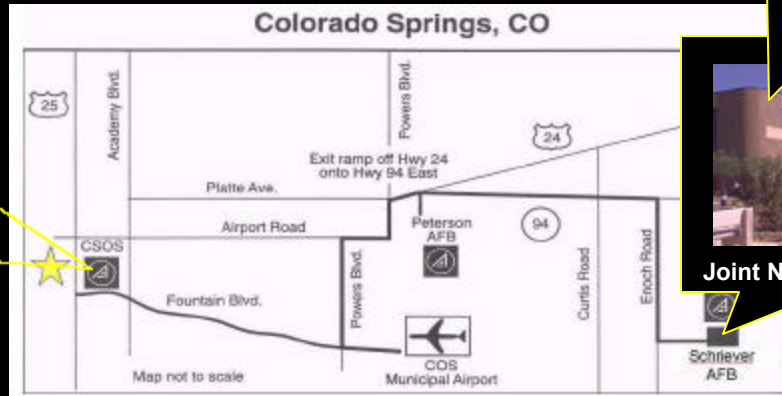
Aerospace, El Segundo

Ops Demo Node



Center for Research Support

R&D Node



Joint National Test Facility

Reprinted with permission of HQAFSPC



THE AEROSPACE CORPORATION

DCS Test Bed

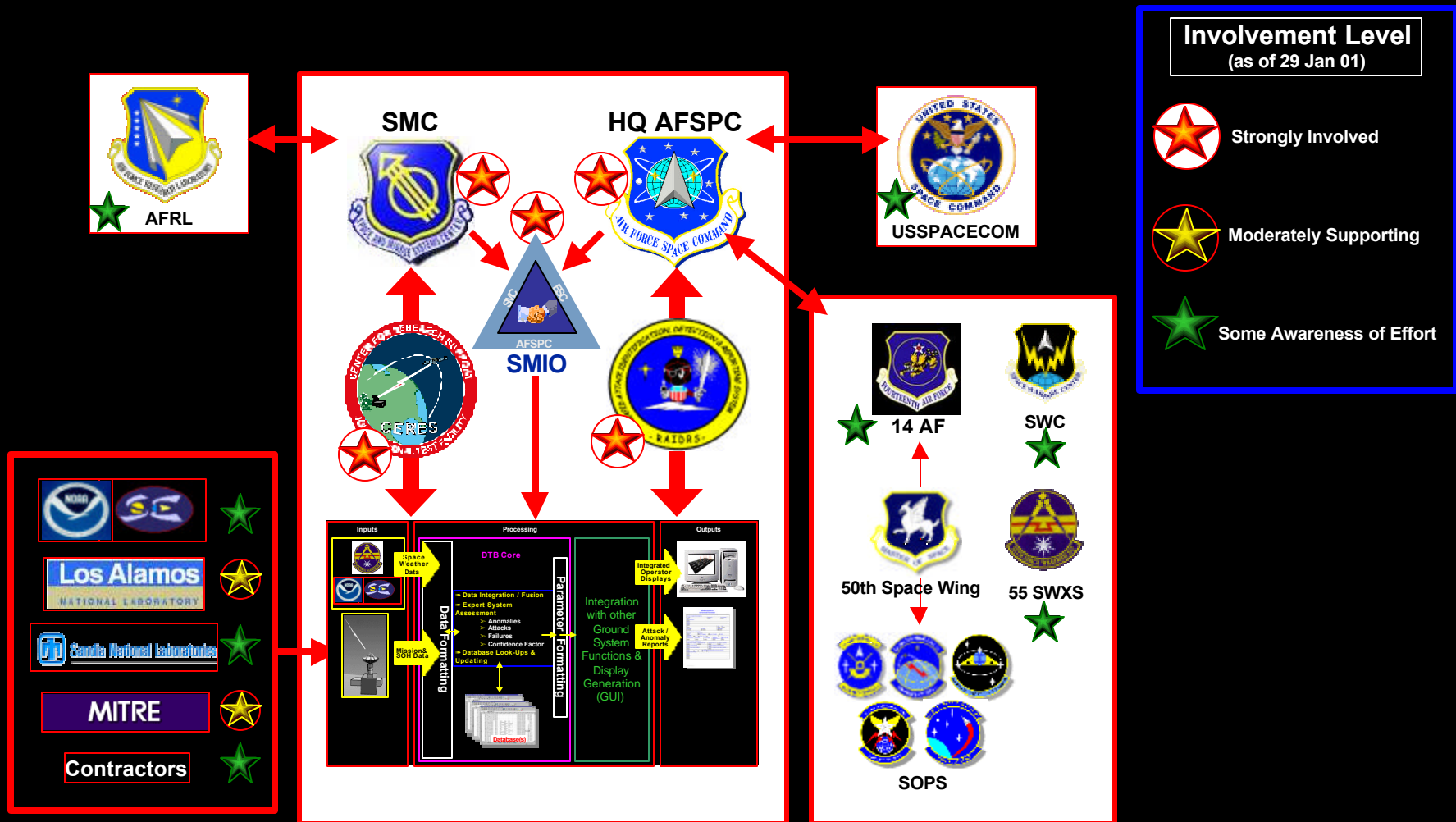
Progress To Date

- **Ops Demo Node Platform Configured and Transported to CERES**
 - Tower View installed, 1000+ parameters displaying representative telemetry data
 - Neural Network development and real time libraries installed
- **R&D Node Established in Atrium Facility**
 - Sybase & SSED installed with remote development capability
 - Tower View and Neural Network software loaded
- **Domain Experts Identified and Work Underway**
 - Satellite as a Sensor (Aerospace, SPO, LANL)
 - Neural Net / Data Fusion (Aerospace, Consultant)
 - On-Platform and Off-Platform Data and Connectivity (CERES, 55 SWXS, LANL)
- **Connectivity Issues Being Addressed**
 - Working breakout and delivery of DoD EP data from operational constellation to CERES
 - Working space weather data/product delivery from AFWA (55 SWXS) to CERES
 - Added benefit may be that we enable delivery of CEASE data to CERES, which could also be used for DTB
- **Assessment Engine Progress Shown**
 - Neural Net/Data Fusion expert on contract
 - Three TIMs held to coordinate Expert System and Neural Net development activities
 - First draft of Neural Net architecture completed



DCS Test Bed

Players & Level of Involvement



DCS Test Bed

FY01 Objectives

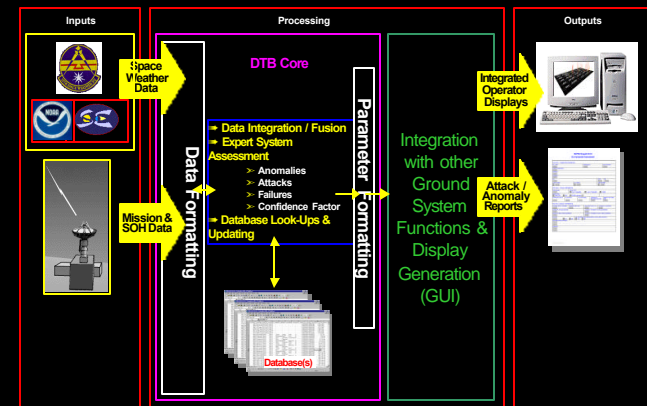
- Validate “satellite-as-a-sensor”
- Improved situational awareness for satellite operators
- Automate attack/anomaly assessment
- Bring existing R&D investments to operations
- Apply proposed DoD data fusion standards
- Proof-of-concept demonstration with realistic scenarios in a live DoD satellite environment
- Examine potential short-term capabilities
- Support Air Force Space Command requirements definition and acquisition
- Support Air Force Space Command analysis of alternatives



DCS Test Bed

FY01 Tasks

- Canvas/select “Golden Nuggets”
 - Satellite As a Sensor (Real-time Satellite Telemetry)
 - Off-platform Data (Space Environment, Historical Look-ups, Other)
- Develop Assessment Engine
 - Leverage Existing Space Systems Engineering Database (SSED) Data and Architecture
 - Exploit/modify Space Environment Anomaly Expert System
 - Expand Architecture to Include, Accept and Assess Threat Indicators
 - Include Neural Network Processing/learning Capability
 - Focus on Demo, but Include Modular Expansion Capability
- Integrate With CERES Ground System Environment
 - Establish Ops Demo Host Environment
 - Resolve Connectivity/data Feeds
 - Integrate New Data Output With Existing Displays & Reporting Formats
 - Prepare and Execute Proof-of-concept Demo
- Coordinate/interact With Related DCS Tasks



DCS Test Bed

FY01 Schedule

Golden Nugget Selection

- Golden Nuggets for Prototype 1
- Golden Nuggets for Prototype 2

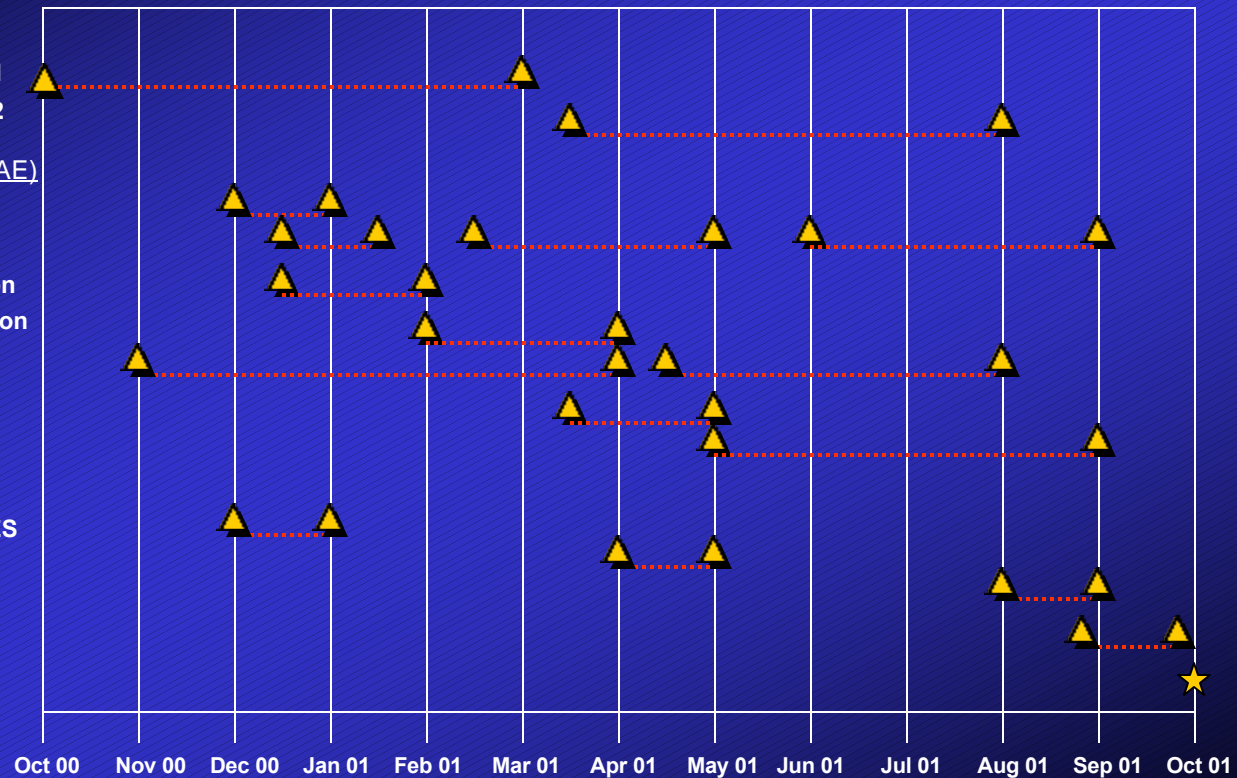
Adaptive Assessment Engine (AAE)

- Task 1: CONOPS developed
- AAE Data Collection
- Task 2: Component Optimization
- Task 3: Fusion Node Optimization
- SEAES modifications
- Task 4: Prototype 1 developed
- Task 5: Prototype 2 developed

CERES Integration & Testing

- DTB Platform Installed at CERES
- AAE Version 1 to CERES
- AAE Version 2 to CERES
- Final Ops Demonstration

Final Report



**THE AEROSPACE
CORPORATION**

DCS Test Bed

Summary

- While Our Knowledge and Understanding of Attack Effects and Space Environment on Satellites Are Still Growing, There Are Things We Can Do **Today** to Demonstrate Operational Utility
- Aerospace is playing a key role
 - Concept Generation & Technical Lead for Unique Capability
 - Aerospace IR&D Forms DTB Core
 - Addresses Top AFSPC Near, Mid and Long Term Needs
 - Improves SMC / AFSPC Collaboration on DCS Requirements Definition and Acquisition Process
- Ambitious Schedule for FY01...Must Focus on Highest Confidence Contributions to the Proof-of-Concept Demo
- The DTB Effort Has Significant Implications for Improvements to Legacy, As Well As Future, Ground System Architectures.

