Panel: Future Directions in Space IT

SMC-IT Conference 2003

Norm Lamarra
16 July 2003

Overview

- Three Space and Ground IT domains of NASA interest
  - Deep Space Exploration
  - National Security
  - Air Transportation
- Comments/Observations...
Deep Space Exploration

Space Communications Context

More efficient use of space sensors and resources...  Simplified user access...
National Security and Space

NSSA Communications Architecture Vision

- Develop an integrated Space, Air, and Terrestrial Communications Architecture that supports all National Security Users, all information domains, and all levels of classification
  - Eliminate communications stovepipes
  - Eliminate capacity and connectivity as a mission constraint
  - Reallocate resources dynamically
  - Reduce funding burden on individual agencies and departments

- For DoD:
  - Improved reachback and greater capacity
  - Better connectivity during execute, early entry, and offensive operations
  - Reduced strategic lift and manpower
  - Improved joint allied and interagency interoperability

- For the IC:
  - Better connectivity for collection
  - Improved dissemination for last tactical mile

- For NASA:
  - Space station and shuttle accessible communications, earth sciences sensor
  - Higher capacity than commercial can currently provide

- For DoS:
  - Improved embassy connectivity
**NSSA Communications Architecture Scope**

**Options Being Explored**
- Wideband, Protected, and Narrowband
- Gateway
- RF or Optical Link
- Tactical Networks

Integrate IC, NASA, DoD, DoS Communications Systems
Synchronize Space, Air, and Terrestrial Transport Layers

**3 Layers - One Coherent Seamless Network**

- Far-Space
- Near-Space
- Airborne
- Deployable
- Permanent
- Terrestrial

Communications Embedded
In Weapon Platforms

JTRS compliment terminals that serve as nodes

HED/GEO Military and Commercial Satellites
LEO/LEO Commercial / Military Satellites and Manned Spacecraft
ACN Coasters
Mission Information Mgt (MIM) Architecture Scope - Timeframe

As-Is
Systems Determine Use/Operations
- Stovepiped
- Manual operations
- Not coherent
- Limited pathways (difficult access)

Evolved Baseline
User Specific Applications
Users Define Operations, Response-built Systems
- Interoperable
- Manual operations with automated assistance
- More integrated
- Easier access

Objective
Virtual Environment
Deliberate Definition of Operations and Systems
- Information-centric
- User focused
- Adaptable
- Interoperable
- Transparent access

10-100Gbps!!

Federal Aviation Administration (FAA) and NASA
Status of Air Traffic Management

Current Limitations
- Non-integrated pieces of a whole
- Independent performing computers
- Limited computing capabilities
- Centralized mainframe computer architecture performed from multiple globally remote facilities
- Functionally robust set of distributed communications, command, control, navigation, and surveillance and planning

Challenges
- Change from completely independent functioning systems into a distributed design architecture
- Implementation of a true integrated systems design architecture
- Integration of a scalable system-wide information management system for real-time decision-making that is extendable to accommodate future demand for air transportation
- Integrated system-level picture of the past, present, and planned state of the air transportation system to serve as a common basis for improved decision-making and a more safe and secure operation

Vision
- Wide-spread real-time distribution of NAS data
- Elimination of redundancies
- Integrated system of systems architecture

Solution Approach: SWIM
Evolution of SWIM in Concept

- NOTAMS Weather SUP
- NOTAMS FDP
- EML
- Full AIS
- DSTs
- Trajectory Flight
- NAS Assets
- Agents

SWIM

NASA Interest: T-SWIM

Objectives:
To develop technology to provide:
- Flexibility in reassignment of airspace and infrastructure resources
- Information at system-level... rather than at every subsystem
- Security integrity mgmt. for data communications
- Cost effective and integrated NAS information delivery
- Real-time access to NAS info as needed

Tasks:
- Reqs and Architecture
  - System studies to define requirements, IT architecture, gaps and benefits
- Technology Maturation
  - Develop NAS information mgmt tools
  - Develop SWIM system support tools
- Proof of Concept and Test
  - Tech. integration and simulations
  - Testing and verification, handover

Justification:
- FAA and RTCA's NAS Concept of Operations identified future need for info sharing between collaborative decision makers
- NAS information distribution inadequate
- Information updates not timely
- NAS information kept in inconsistent standalone databases
Today without SWIM:
One-to-one ad-hoc connections,
not enough standardization,
difficult to maintain, inflexible

Future with SWIM:
Improved real-time
coordination, open standards,
easy maintainability, flexible

KSC: Spaceport & Range Technologies

Technology Pipeline

Spaceport & Range

National Benefits
Operational Efficiency
Economic
National/Global Security
Improved Quality Of Life
Non-Government (industry & academia)
Comments/Observations...

Some Cross-Domain IT Themes

- Data Accessibility
  - Location, Access control, QoS, Bandwidth, ...
- Information Extraction & Integration
  - How to fuse sensors, sources
  - Integration of Space and Ground
  - Semantics and Ontologies
- Information Analysis
  - Situation Awareness (SA)
  - Decision Support Systems (DSS)
- Automation
  - Increased robustness/flexibility, reduced ops cost
  - Optimization
- Agents
  - Intelligent Assistant to Human Operator
  - Tactical (e.g., Course-of-Action); Strategic (e.g., data mining)
- Autonomy
  - Reasoning, Planning, Adaptability, Agent Negotiation

...Information Architecture that is Evolving, Enabling