Enabling Interoperability in Space Situational Awareness (SSA)

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Overview

- MITRE maintains an SSA modeling, simulation, and analysis (MS&A) environment as part of the **MITRE Enterprise for Space Analysis (MESA)**
  - Supports analysis of portions of the operational Space Situational Awareness (SSA) Enterprise for numerous customers
  - Includes components representing the Space Surveillance Network (SSN) sensors and Command and Control (C2) systems
  - Standards-based, net-centric infrastructure leverages flexible, adaptable, and scalable technologies common throughout industry and the DoD
  - Common interfaces and mediation services enable interoperability across the SSA enterprise

Net-Centric Interoperability and Standardized Data are Key to Evolving the SSA Enterprise
Space Catalog Processing
Overall Data Flow

Sensors
- Sensor Recordings
- Recorded Data Injector
- Sensor Simulation
- Live Sensors

Command and Control
- Mediation Services
- Observation Processing
- Catalog Processing
- Sensor Tasking
- Space Catalog
- Maneuver Processing
- Conjunction Processing
- Event Notification
- Mediation Services

Consumers
- External Users

External Users
Space Catalog Processing
Overall Data Flow

Sensors
- Sensor Recordings
- Recorded Data Injector
- Sensor Simulation
- Live Sensors

Catalog Maintenance
- Mediation Services
- Sensor Tasking
- Event Processing
- Event Notification
- Mediation Services

Space Catalog

Mediation Services

Observation Processing

Catalog Processing

Conjunction Processing

Event Notification

Live Sensors

External Users

Consumers

External Users

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Vignette: Maneuvers and Conjunctions

Original Orbit
Vignette: Maneuvers and Conjunctions
Vignette: Maneuvers and Conjunctions

- Other Satellites
- New Orbit
- Original Orbit
- Potential Conjunctions Identified

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Space Catalog Processing
GSAW Vignette

Sensors
- Sensor Recordings
- Recorded Data Injector
- Sensor Simulation
- Live Sensors

Command and Control
- Mediation Services
- Observation Processing
- Catalog Processing
- Sensor Tasking
- Space Catalog

Conjunctions Identified
- Simulated Maneuver Event
- Catalog Updated
- Maneuver Processing
- Conjunction Processing

Consumers
- Conjunction Notification
- CCSDS Message Published
- Event Notification
- Mediation Services

External Users

CCSDS = Consultative Committee for Space Data Systems
Consultative Committee for Space Data Systems
Sample Conjunction Data Message

- Maneuver Events, whether internally generated or externally provided, whether observed or based on future planning, can initiate Conjunction Analysis.

- Our MS&A environment required only simple mediation services to expose conjunction data to external users using common data models, i.e. CCSDS Conjunction Data Message.
Summary and Lessons Learned

- Net-Centric interoperability and standardized data (syntax and semantics) are critical to evolving the SSA Enterprise
- Enables a broad range of capabilities
  - Rapid integration of new data sources and systems
  - Experimentation with new CONOPS
  - Analysis of new technologies
  - Integration of capabilities across the community

Early Investments in Net-Centricity are Paying Dividends for the SSA Enterprise
Consultative Committee for Space Data Systems

- The Consultative Committee for Space Data Systems (CCSDS) is a multi-national forum for the development of communications and data systems standards for spaceflight (www.ccsds.org)
- Goal is to enhance governmental and commercial interoperability and cross-support, while reducing risk, development time and project costs
- Membership consists of the major space agencies of the world, including 11 member agencies, 28 observer agencies, and over 140 industrial associates
  - Agenzia Spaziale Italiana (ASI) - Italy
  - Canadian Space Agency (CSA) - Canada
  - Centre Nationale d’Etudes Spatiales (CNES) - France
  - China National Space Administration - China
  - Deutsches Zentrum fur Luft- und Raumfahrt (DLR) - Germany
  - European Space Agency (ESA) - Europe
  - Instituto Nacional de Pesquisas Espaciais (INPE) – Brazil
  - Japan Aerospace Exploration Agency (JAXA) – Japan
  - National Aeronautics and Space Administration (NASA) – USA
  - Russian Federal Space Agency (RFSA) – Russia
  - UK Space Agency – United Kingdom