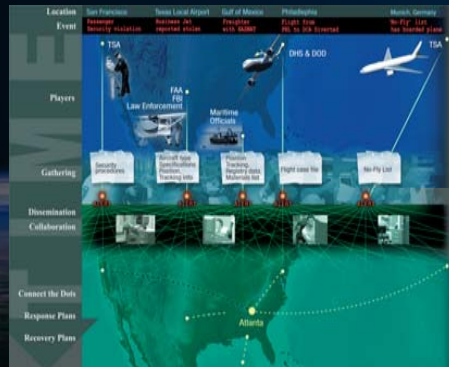




Overview of Net-Enabled Operations (NEO) Spiral 1 Activities

Robert Avjian, John Zuna

Lockheed Martin
Transportation and Security Solutions



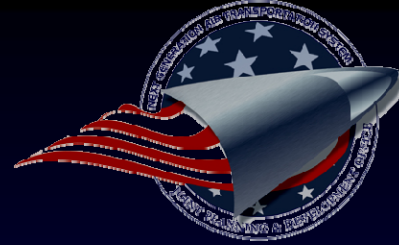
ICNS Conference and Workshop
Bethesda, Maryland
May 5, 2008

Agenda



- *What is NEO?*
- *NEO Project Evolution*
- *NEO Data Types*
- *NEO Spiral 1 Architecture*
- *Spiral 1 Enhancements*
- *NEO Relation to NextGen*
- *Summary*

What is NEO?



- *The Network Enabled Operations (NEO) program is a series of spirals of a joint effort to improve interoperability in airspace surveillance and airspace security systems*
- *NEO is a FAA contracted program sponsored by the Joint Planning and Development Office (JPDO). The government agencies involved are FAA, NASA, DHS, DOD, law enforcement and other agencies*
- *NEO program objectives are to demonstrate assimilation of multiple air surveillance automation systems used by various government agencies into a network-centric service oriented architecture that supports enhanced interagency communications, collaboration and coordination*

NEO Is About Shared Situational Awareness

Companies Participating in NEO Spiral 1



Joint NEO Industry Team



LOCKHEED MARTIN



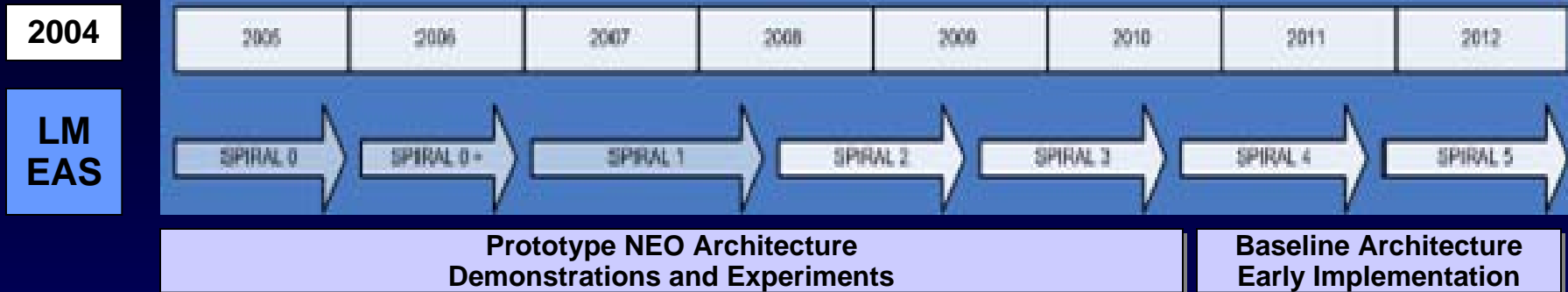
Raytheon

Sub-Contractors



- *NEO is a government-funded program led by the Boeing Corporation with industry partnership of Computer Sciences Corporation, Lockheed Martin and Raytheon*
- *Each partner brings the skills and legacy systems used in airspace surveillance and security*

NEO Project Evolution



- *EAS (Lockheed Martin)* *Mar 04 to Aug 07*
- *NEO Spiral 0 (NEO Govt/Industry Team)* *May 05 to Sep 06*
- *NEO Spiral 0+ (NEO Govt/Industry Team)* *Oct 06 to Mar 07*
- *NEO Spiral 1 (NEO Govt/Industry Team)* *Apr 07 to May 08*

NEO Uses a Spiral Development Approach to Evaluate Operational Improvements

NEO Automation Systems (Lockheed Martin)



- **FAA Terminal Airspace – Common ARTS (CARTS)**
 - Terminal Radar Approach Control (TRACON) - typically 50 miles around busy airports
 - Airspace Spans Surface – 18,000 feet
 - EAS Adapted for Pensacola TRACON Area
- **FAA En Route Airspace – MicroEARTS (MEARTS)**
 - En Route Airspace – typically 18,000 feet or greater
 - Typically controls aircraft in transit between TRACON areas
 - Adapted as Jacksonville Center – expanded to include Miami and Houston
- **FAA Security - Automatic Detection and Processing Terminal (ADAPT)**
 - Adapted for NEO use as expanded Jacksonville ARTCC
- **CBP Airspace – Air Marine Operations Surveillance System (AMOSS)**
 - Customs and Border Protection area encompassing the entire country
 - Has sensors unique to the CBP mission – Aerostats
 - NEO uses unclassified version
- **AOC FltWinds**
 - Airline Operation Center Flight & Weather Information Decision Support System
- **DoD - Battle Control System Fixed (BCS-F) (from EAS and NEO Spiral 0)**
 - Representation of Northeast Air Defense Sector (NEADS)



NEO Data Types

- **Tracks**
 - **All-Purpose Structured EUROCONTROL Radar Information Exchange (ASTERIX)**
 - **ASTERIX CAT 1 - Multicast**
 - Eurocontrol standard for Radar data
 - EAS uses radar simulator for Target Reports
 - **ASTERIX CAT 21 - Multicast**
 - Current International Standard for ADS-B Messages
 - **ASTERIX CAT 33 - Multicast**
 - Expected Upgrade to International Standard for ADS-B Messages
 - **ASTERIX CAT 62 - Net-Shared**
 - Eurocontrol Standard for aircraft System Tracks
 - Automation systems modified to publish/subscribe Tracks in this format
 - **ASTERIX CAT 62 –to- NATO Link-16**
- **Pointouts**
 - **ASTERIX Cat 62 - Net-Shared**
 - **Automatic and Manually Set – three types**
- **Geographic Point/Airspace Volume of Interest (GPOI/AVOI)**
 - **NEO AVOI Message ICD - Net-Shared**
 - **Latitude and longitude points defining shape are based on North American Datum**
- **Common Alerting Protocol (CAP) Alerts**
 - **Version 1.0, 1.1**
- **Instant Messages/Whiteboard/Webcam – Collaboration Suite**
 - **IBM ® Lotus ® Sametime ®**
- **Weather Products**
 - **Satellite Visible/Infrared, Radar Reflectivity per National Weather Service (NWS) format**
 - **Winds Aloft per NWS format**

NEO Pointout

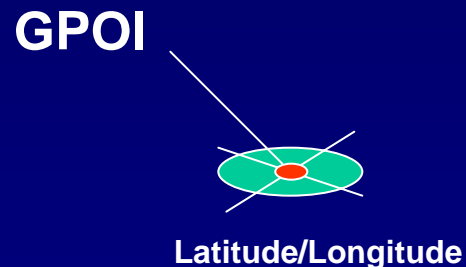


- **A Pointout is the means by which an operator can highlight an aircraft and share the highlighted data with another operator or watchstander**
 - Highlight is indicated by symbology and textual indication in native system
 - May be accompanied by audible alert
 - Optional text field to indicate additional information
- **Types of Pointouts**
 - **Manual** → Set by an operator
 - **Automatic** → Set by the system in response to an airspace violation
 - **Suspect** → Indicates the aircraft is suspicious requiring further investigation
 - **Track of Interest (TOI)** → Aircraft whose intentions are unknown that requires interception by responding aircraft
 - **Responding Asset (RA)** → Identifies friendly responding aircraft
- **Hierarchy of Pointout**
 - Suspect pointout can be manual or automatic
 - TOI pointout higher priority than a Suspect pointout
 - TOI Pointout can ONLY be manually set by operator

Geographic Point Of Interest



- *Means by which data about a geographic point can be shared among systems*
- *Can be used as position reports for slow moving objects*
- *Dynamically defined using latitude and longitude*
 - **Examples of what an GPOI could Represent :**
 - *Evacuation point, Nearest Hospital, Landing Zone, Ship Position, etc.*



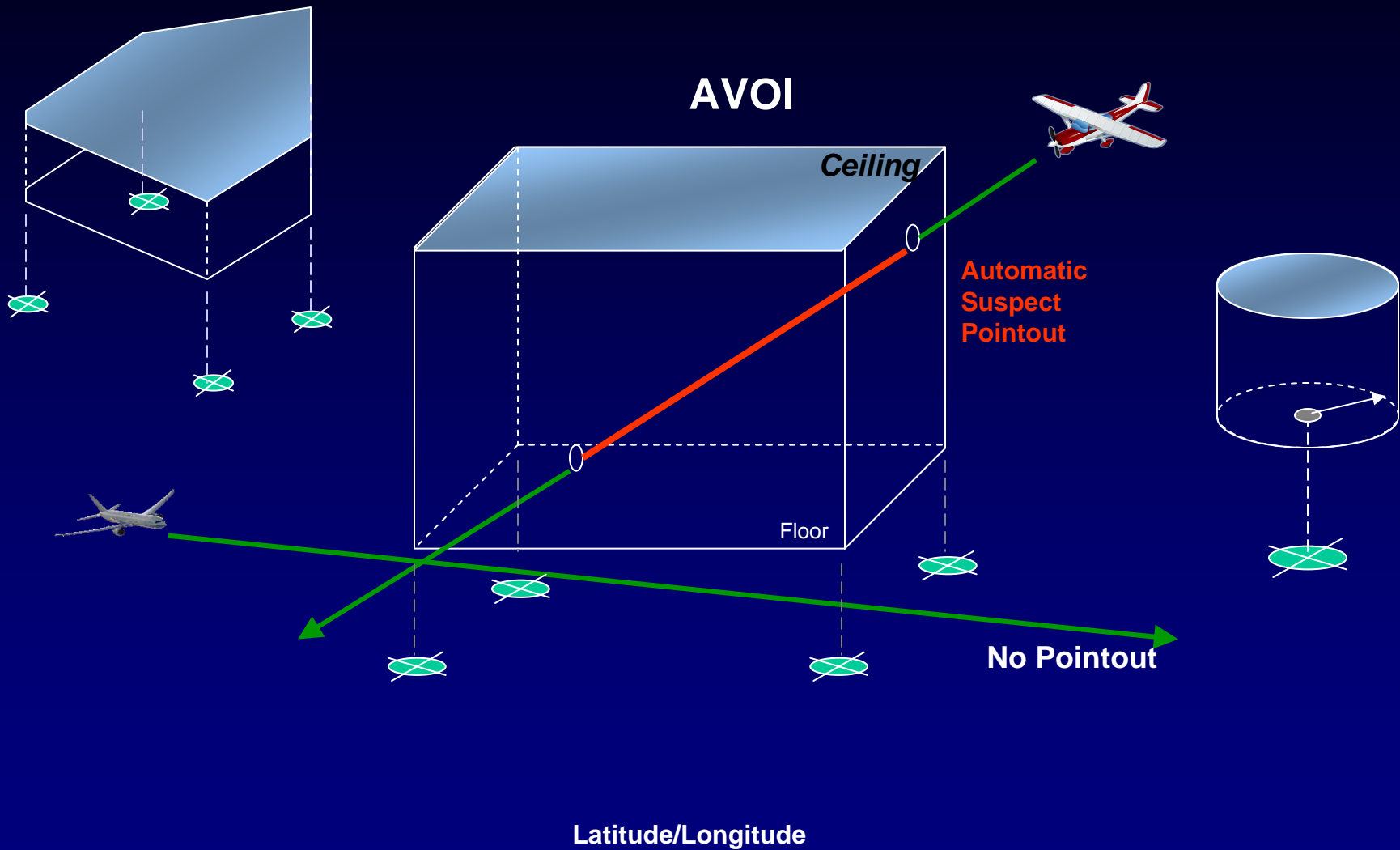


Airspace Volume of Interest

- *Means by which an airspace volume can be designated and shared among systems*
- *Typical Shapes include Cylinders and Polygons*
- *Dynamically defined using latitude and longitude of vertices, radius, floor and ceiling altitude, Time in Effect*
- *Automatically generates Suspect pointout of any aircraft that flies into the AVOI*
- **Examples of what an AVOI could Represent:**
 - *Special Use Airspace (SUA) including Military Operations Area (MOA), Prohibited Areas, Restricted Areas, Warning Areas, Alert Areas and National Security Areas*
 - *Air Traffic Control Assigned Airspace (ATCAA)*
 - *ETMS Flow Evaluation Area (FEA) and Flow Constrained Area (FCA)*
 - *Temporary Flight Restriction (TFR) covered under CFR 91.143 including Security Zones, Super Bowl, Volcanic ash zone, Nuclear incident area, etc.*



Airspace Volume of Interest Shapes

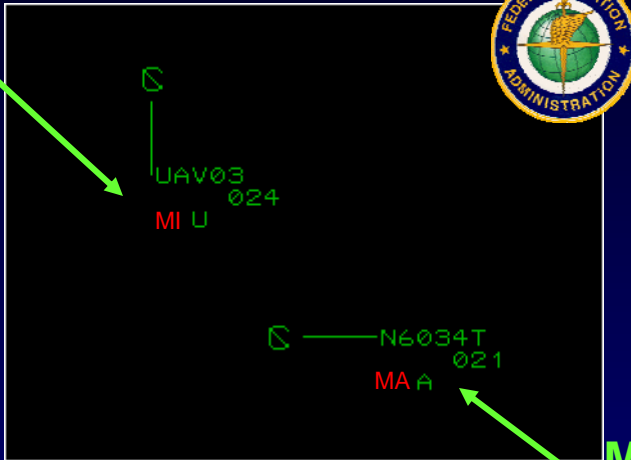


Pointout Detail



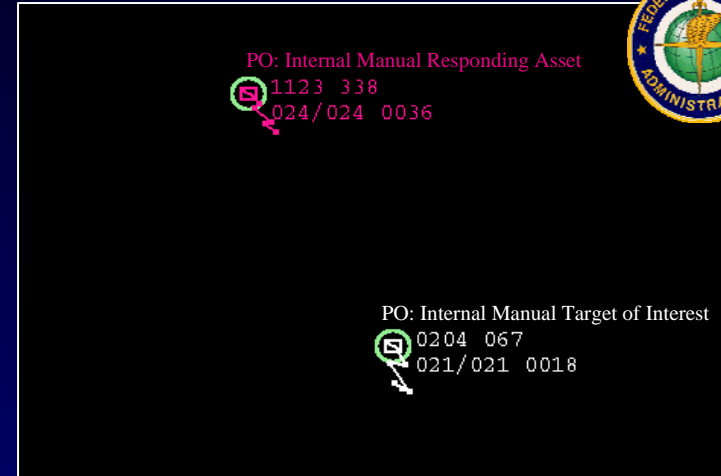
Manual TOI
POINTOUT

MicroEARTS

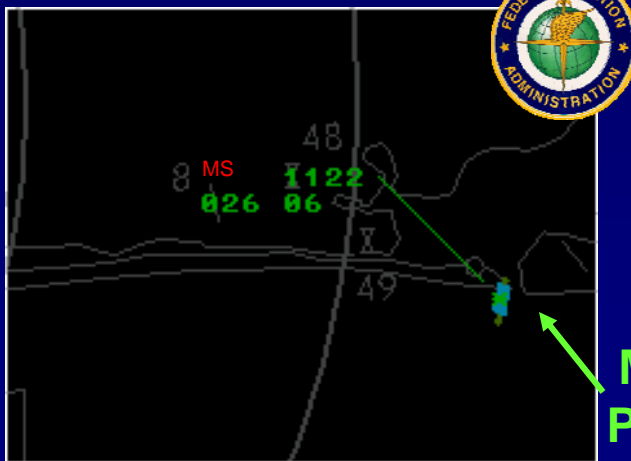


Manual RA
POINTOUT

ADAPT

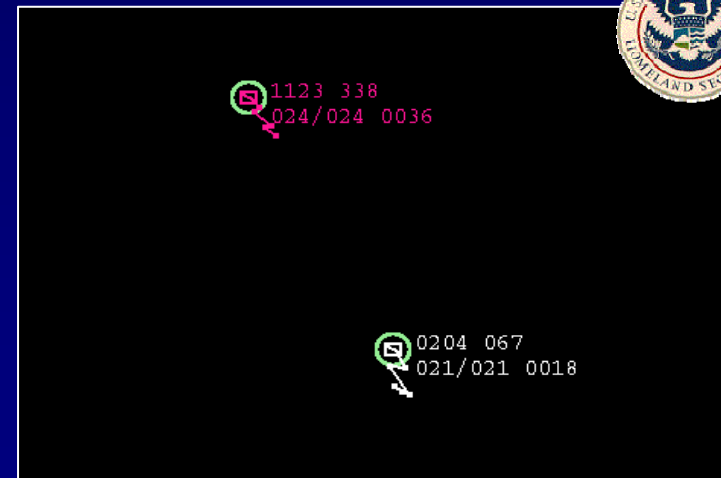


Common ARTS

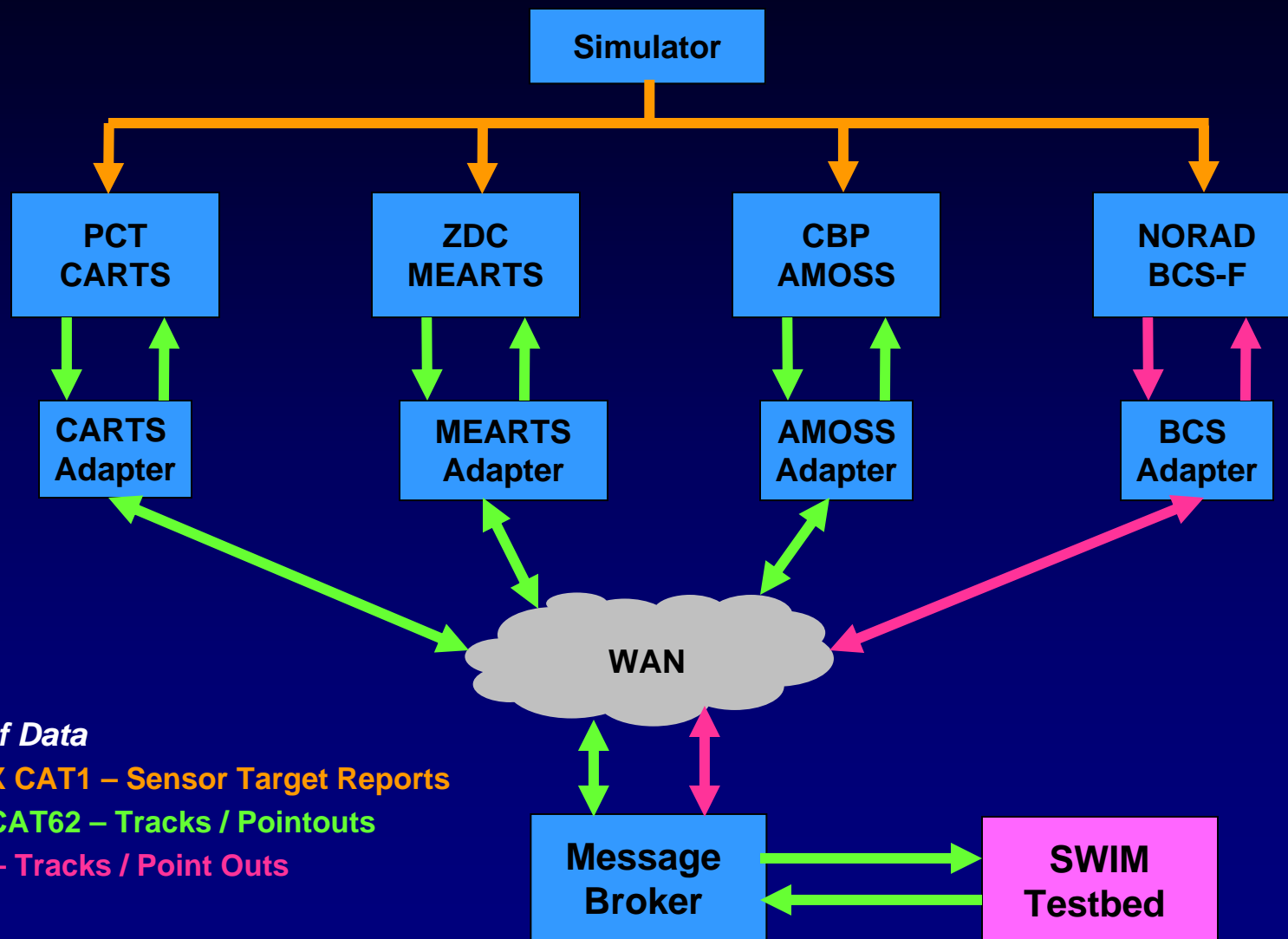


Manual S
POINTOUT

AMOSS



EAS System Data Flow 2006



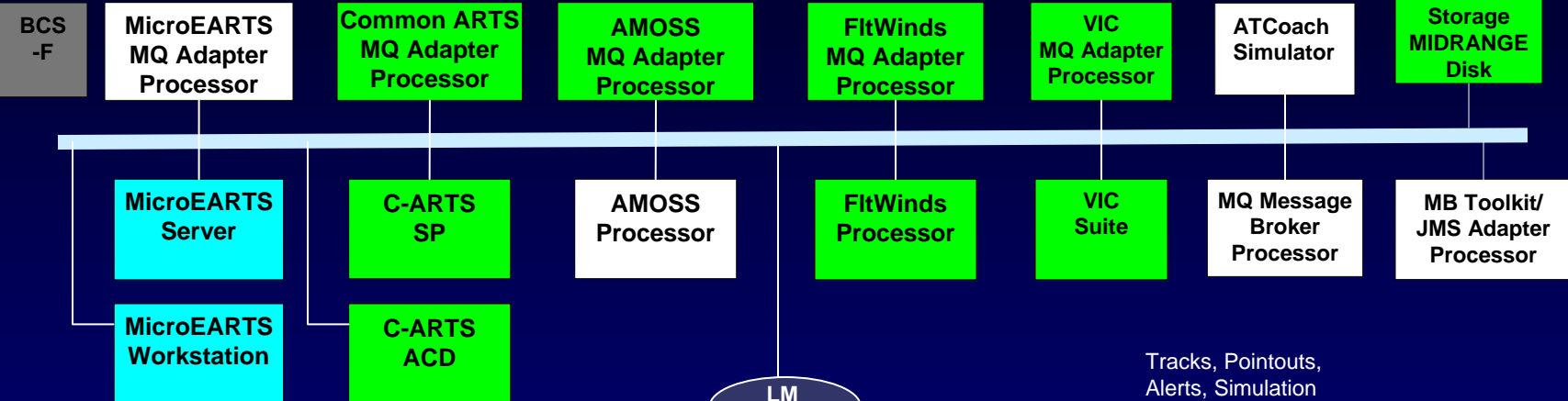
Types of Data

ASTERIX CAT1 – Sensor Target Reports

Asterix CAT62 – Tracks / Pointouts

Link-16 – Tracks / Point Outs

NEO Spiral 1 System Architecture – Lockheed Martin NEO Lab 2008



Tracks, Pointouts, Alerts, Simulation

T1



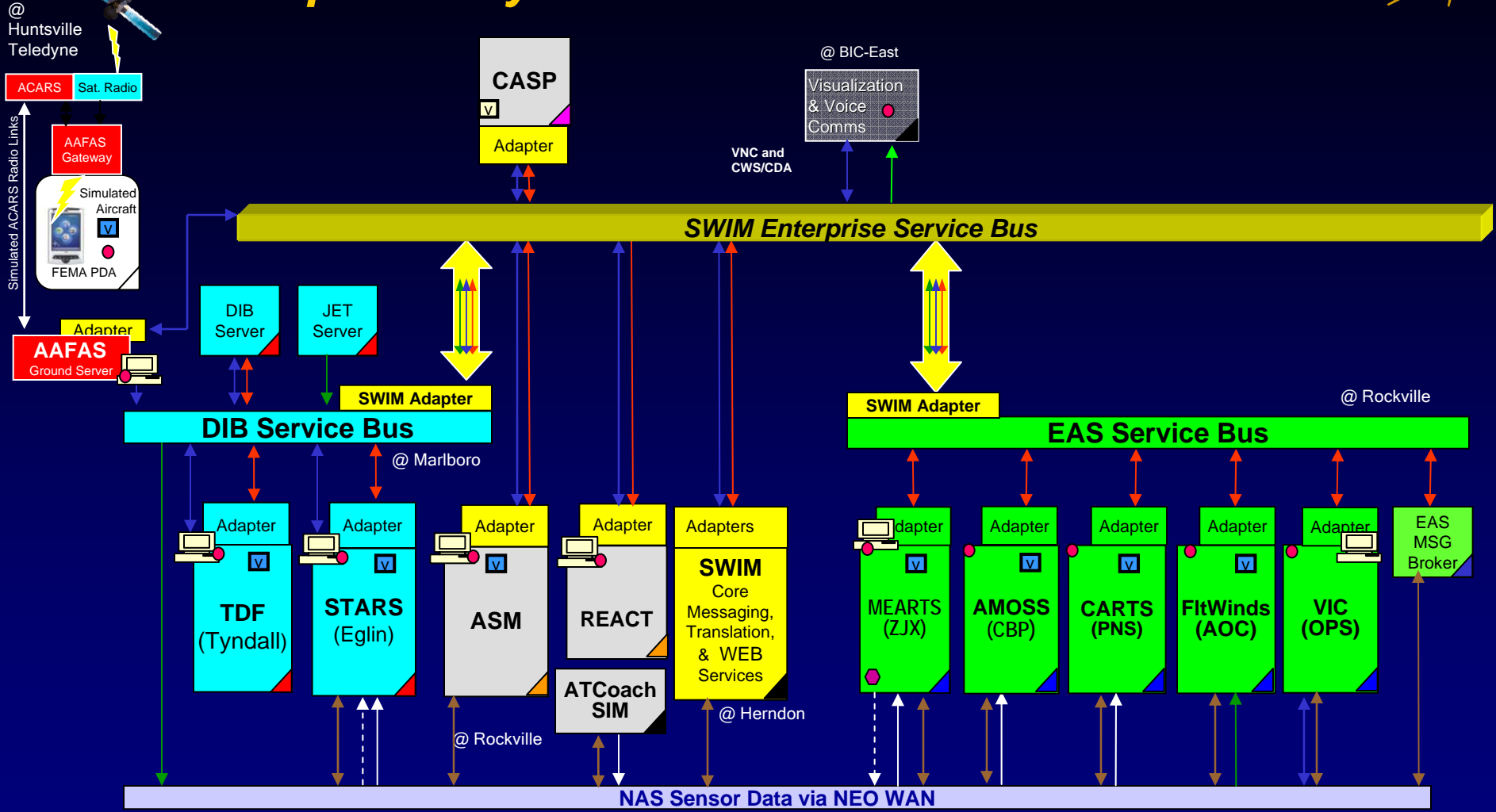
Imagery for VIC



- New
- Unchanged
- Modified
- Removed

Microsoft Virtual Earth DB

NEO Spiral 1 System Architecture



Legend:

- Color Coding:**
 - EAS (Green):** EAS components.
 - SWIM (Yellow):** SWIM components.
 - AAFAS (Red):** AAFAS components.
 - DIB (Cyan):** DIB components.
- Icons:**
 - V:** Operational Display remoted to BIC-E
 - V:** Operational Display remoted to CWS
 - ⬆️⬆️:** Radio/microwave
 - ⬆️:** CAP, IM
 - ⬆️⬆️:** CAT-62(XML, Tracks, AVOIs or PointOuts)
 - ⬆️:** Other (e.g., Wx)
 - ⬆️:** Cat 01,33,etc Target Reports
 - ⬆️:** IFDT FP Data
 - ⬆️:** Local LAN Data
 - ⬆️:** SOA Information Exchange Via IP Connection:
 - ⬆️:** Operator Position(s)
 - ⬆️:** Collaboration Wkstrn (CWS) or Collaborative Decision Aid (CDA)
- Text:**
 - Pre-Stored Flight Plans (FP) or FP-derived Data from single master file for each Vignette

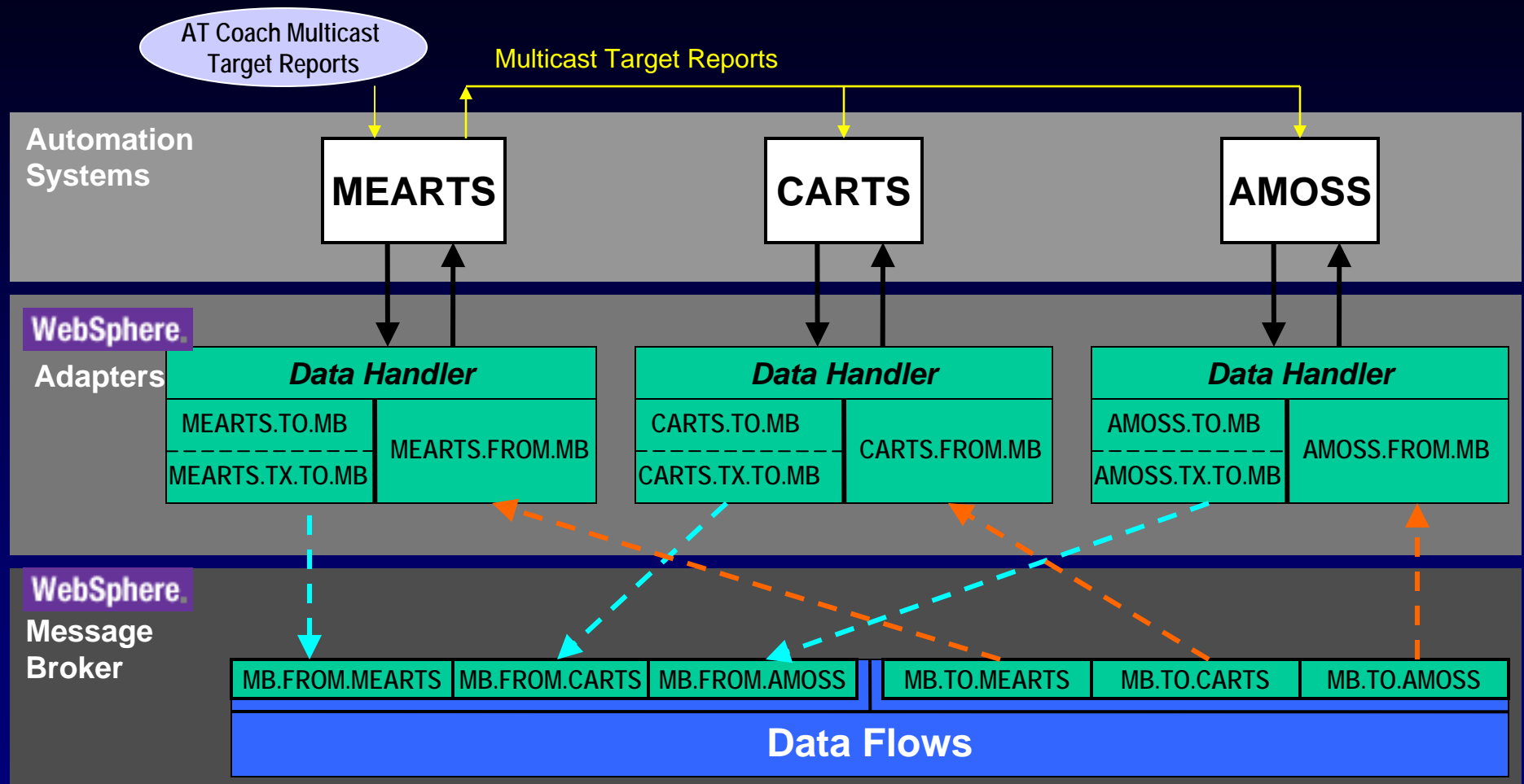
Logos: LOCKHEED MARTIN, Raytheon, BOEING, CSC, ERAU

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Lockheed Martin NEO

WebSphere

Architecture



Base 64 - - -

Asterix Cat 62 _____

*** FltWinds™, ADAPT and VIC Have Similar Structures**

NEO Spiral 1 Enhancements



- **Performance Enhancements**

- Computing hardware that hosted the SOA products was upgraded to address sluggish application response under heavy traffic loads

- **AVOI Enhancements**

- AVOIs were limited to areas shaped as cylinders in Spiral 0
- In Spiral 1, **Polygon AVOIs** were developed to better realize practical applications (TFRS, SUAs, FEAs, FCAs, and so forth)
- A **Selective AVOI** capability was developed to allow an operator or watchstander to designate any published AVOI as a selective AVOI by specifying specific aircraft via their beacon codes or flight IDs to be “selected” as authorized to operate within the AVOI
- The **Draft AVOI** capability was developed to allow the controller, specialist or watchstander to create an AVOI and designate it as a Draft AVOI. The authorizing agency, such as the FAA Wash Ops, could then approve the draft AVOI and publish it as is or as modified before publishing it

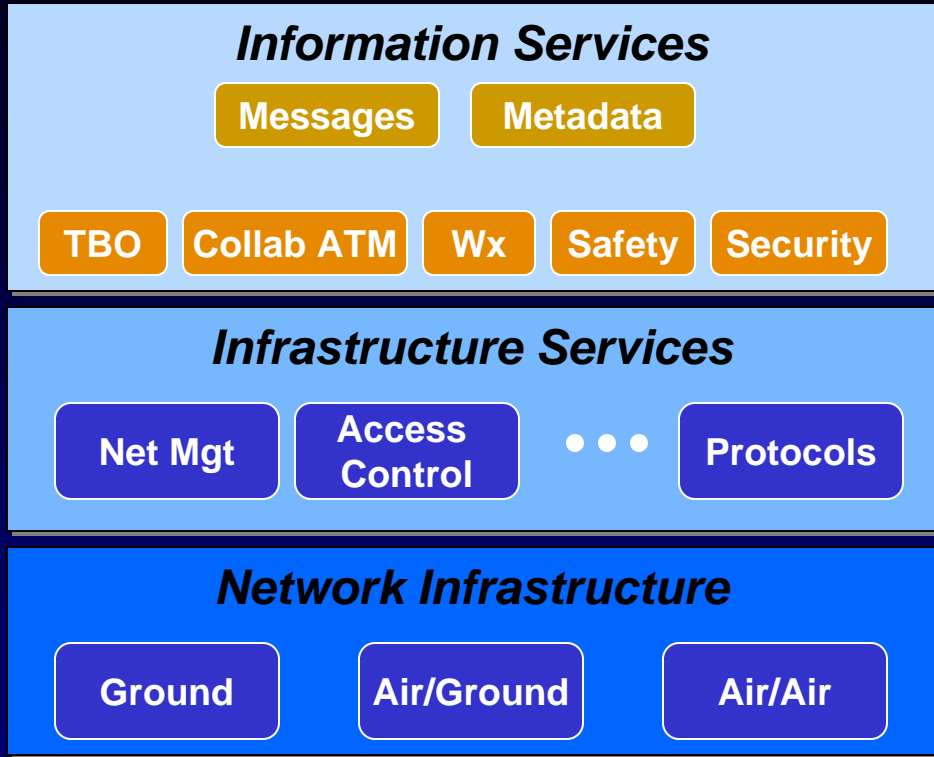
- **Security Enhancements**

- MEARTS implemented the means to quickly interrogate the FAA aircraft registry and airman database
- In a networked interagency environment not every user will have access to every other user’s data. Data access needs to be restricted on a “need to know” basis (see Federated Identity Management paper by K. Traw et al)

- **Weather Data Integration**

- Started development of capability to feed Wx data from JET to FltWinds™

NEO Relation to NextGen



- Collaborative Air Traffic Management
- Net-Centric Infrastructure Services with focus on Information Sharing Services
- Shared Situation Awareness with focus in Aeronautical, Surveillance and Weather Information Services
- Layered Adaptive Security with focus in Secure Airspace Services

from NextGen Conops v2.0

NEO Is a Net-Centric Infrastructure Services Enabler for JPDO NextGen Ops Concept

Possible Future NEO Spiral Enhancements



- **Additional Surveillance Sensor Types**
 - ADS-B, Multi-Lat, passive and laser-based sensing systems
 - See *Enhancing Distribution of Radar Surveillance Data* paper by Bliesner et al....)
 - Enhance sensor fusion and failover techniques
- **Further Experimentation**
 - Exercises with government agencies and subject matter experts (SMEs)
 - UAV/UAS operations in NAS scenarios
 - Scenarios involving impact on airspace because of hazardous event (e.g., earthquake, flu pandemic, hazmat, and so forth)
- **Direct Data Link of Messages**
 - Federal Air Marshals (FAMs)
 - Electronic Flight Bag (EFB)
 - Flight Management System (FMS)
- **Dynamic AVOIs**
 - Dynamic Alert Area tagged to an aircraft available now on AMOSS – develop into a networked capability
- **Additional Data Conversion**
 - Converting CAP alerts into AVOIs
 - Develop 3-D AVOIs on visualization systems
- **Weather Prediction Impact**
 - Impact to NAS Traffic Flow Management (TFM) using NEO artifacts