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10th INTERNATIONAL COMMAND AND CONTROL RESEARCH AND TECHNOLOGY SYMPOSIUM
THE FUTURE OF C2

Applying Multi-Agency Executable Architectures to Analyze a Coastal Security Operation

Homeland Security Track
#297

Dr. Tom Pawlowski

The MITRE Corporation

pawlowst@mitre.org

(913) 684-9139

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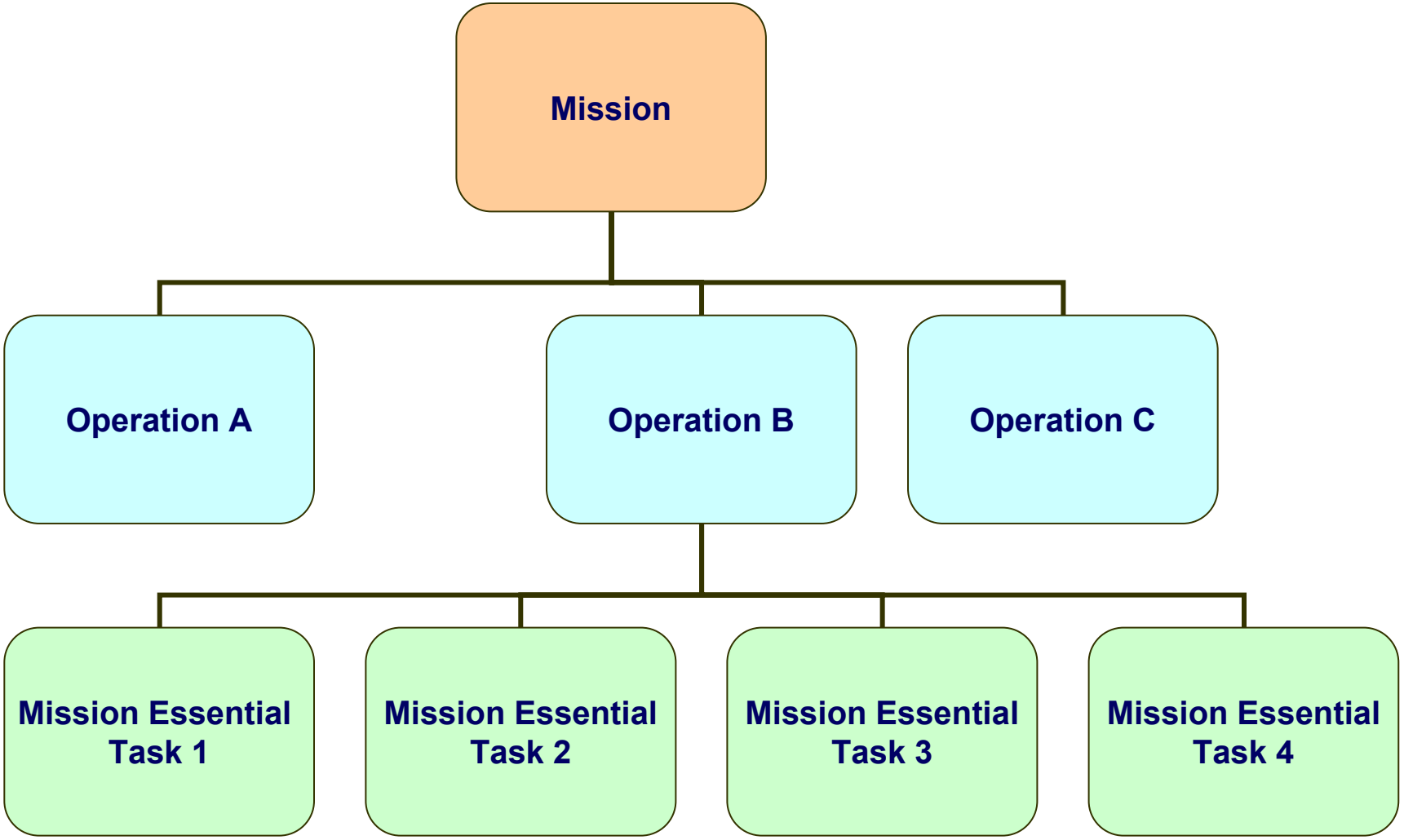
Project Objectives

- Examine multi-agency architecture issues thru a case study where multiple agencies must function together supported by a federation of executable architectures to accomplish a common mission.
  - Identify challenges associated with building a multi-agency Operations-Centric Architecture by combining architectures developed in different architecture frameworks (Static Phase).
  - Identify technical issues associated with developing an executable version of the Operations-Centric Architecture (Dynamic Phase).
- Use homeland security scenario in the case study

Technical Approach – Static Phase (1 of 3)

- Apply insights and lessons learned from previous research on Multi-Agency Enterprise Architecture Planning Framework & Executable Architecture Methodology for Analysis
- Use a selected scenario – Coastal Security
- Walk thru the process of integrating architectures from each participating agency to create an Operations-Centric Architecture for the selected scenario
  - Build a generic Activity Model that captures the main set of activities for a general case of the selected scenario
  - Map appropriate parts of individual organizational architectures to activities in generic Activity Model
  - Conduct Gap Analysis to identify which parts of the mission-oriented architecture are missing (i.e., individual organizational architectures do not fill gaps)
  - Conduct Overlap Analysis to identify where parts of each individual organizational architectures describe same activities or processes

Generic Activity Model Construct for Operations-Centric Architecture



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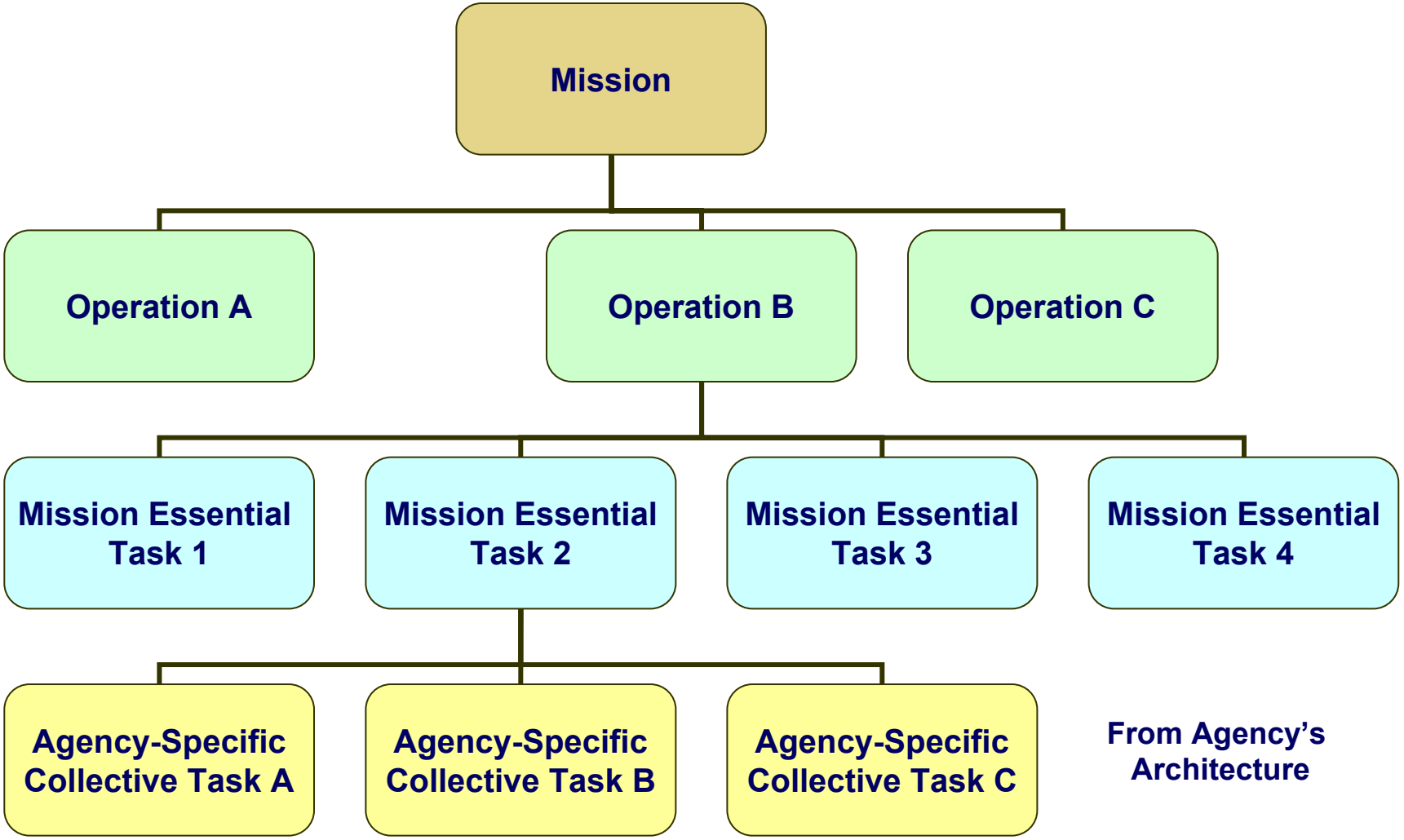
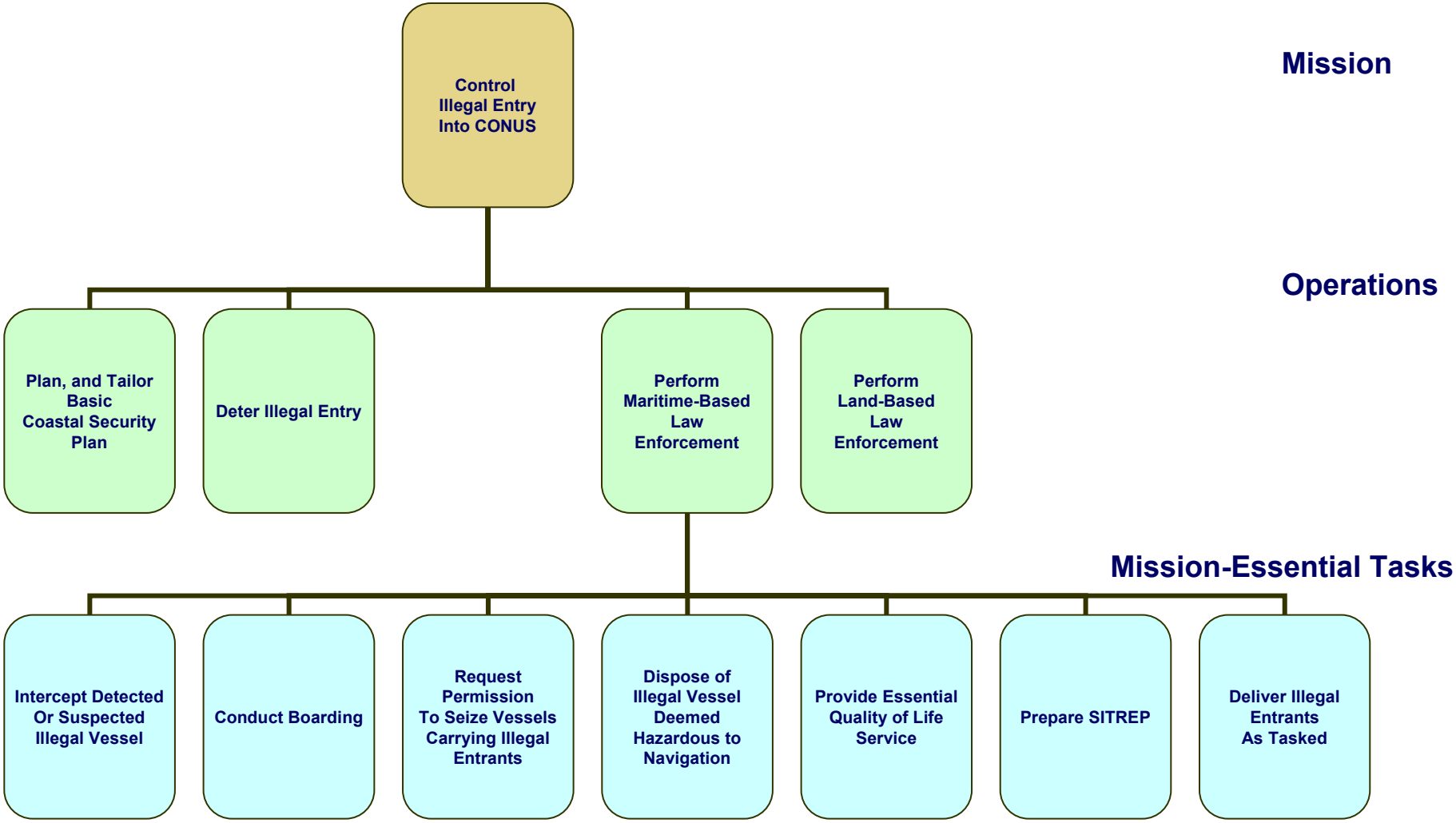
Extending the Generic Activity Model to include Agency-specific Activities



Activity Model for Coastal Security Mission



CONUS – Continental United States
SITREP – Situation Report

Static Phase
Conduct Gap and Overlap Analysis

- **Gaps – Activity is missing or no Agency is performing a Listed Activity**
  - Hole must be filled to achieve mission success
  - Resolve gap while still in planning stage
  - Can an available Agency fill the gap?
  - Is a new Agency needed to fill the gap?
  - Make changes to Agency's architecture to reflect new Activity
- **Overlap - More than one Agency performing Activity**
  - Is it necessary for these Agencies to conduct same Activity?
  - Are different procedures being used to perform Activity?
  - Will differences in Agency procedures create problems?

Technical Approach – Dynamic Phase (2 of 3)

- **Model scenario in operational environment simulation – i.e., scenario driver (JMACE).**
  - Import maps
  - Import entity icons
  - Develop routes for key entities (vessels, aircraft, vehicles, people)
  - Develop actions for key entities (detection, interdiction, apprehension, . . .)
- **Import key business processes from operations-oriented architecture into process modeling tool (Bonapart).**
- **Develop model of communications networks in network modeling tool (NS-2).**
- **Complete and test federation of simulations.**
  - Identify interactions between scenario driver and process modeling tools.

JMACE – Joint Military Art of Command Environment
NS-2 – Network Simulator 2

Joint Military Art of Command Environment (JMACE)

- **Developed by the National Simulation Center (NSC) as a requirements prototyping tool that identifies and defines new approaches and requirements for:**
  - Training and exercise simulations
  - Decision support tools in military operations
  - Command Decision Modeling
- **JMACE is built on Gensym's G2 environment. This environment assists developers in simplifying complex functions into easily understood, concise code that can run on multiple platforms and operating systems.**
- **Used by the NSC in 2001 and 2002 to support US Army Command and General Staff College, US Central Command (Operation Iraqi Freedom), and US Joint Forces Command.**

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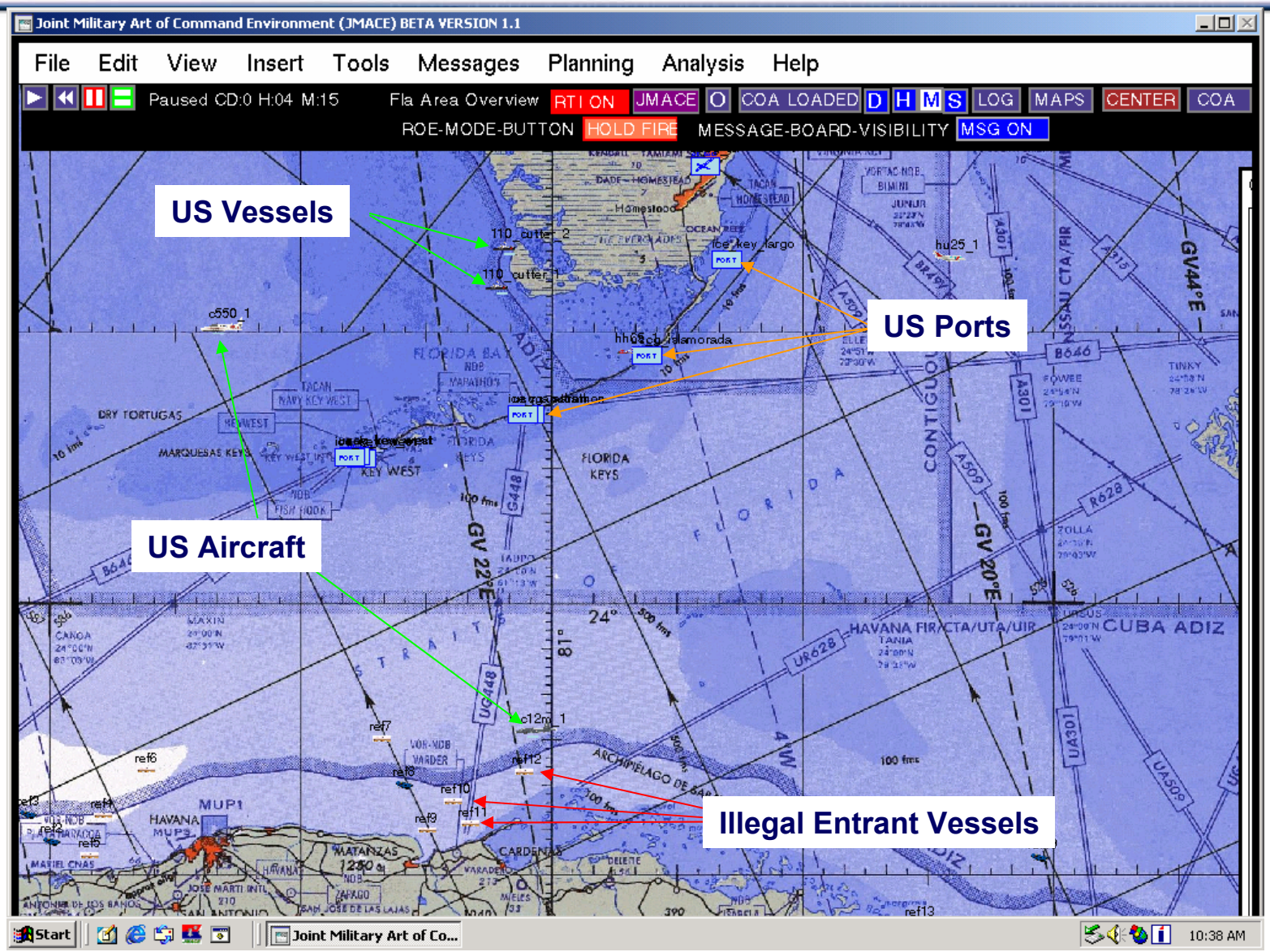
JMACE Sample Screen Shot



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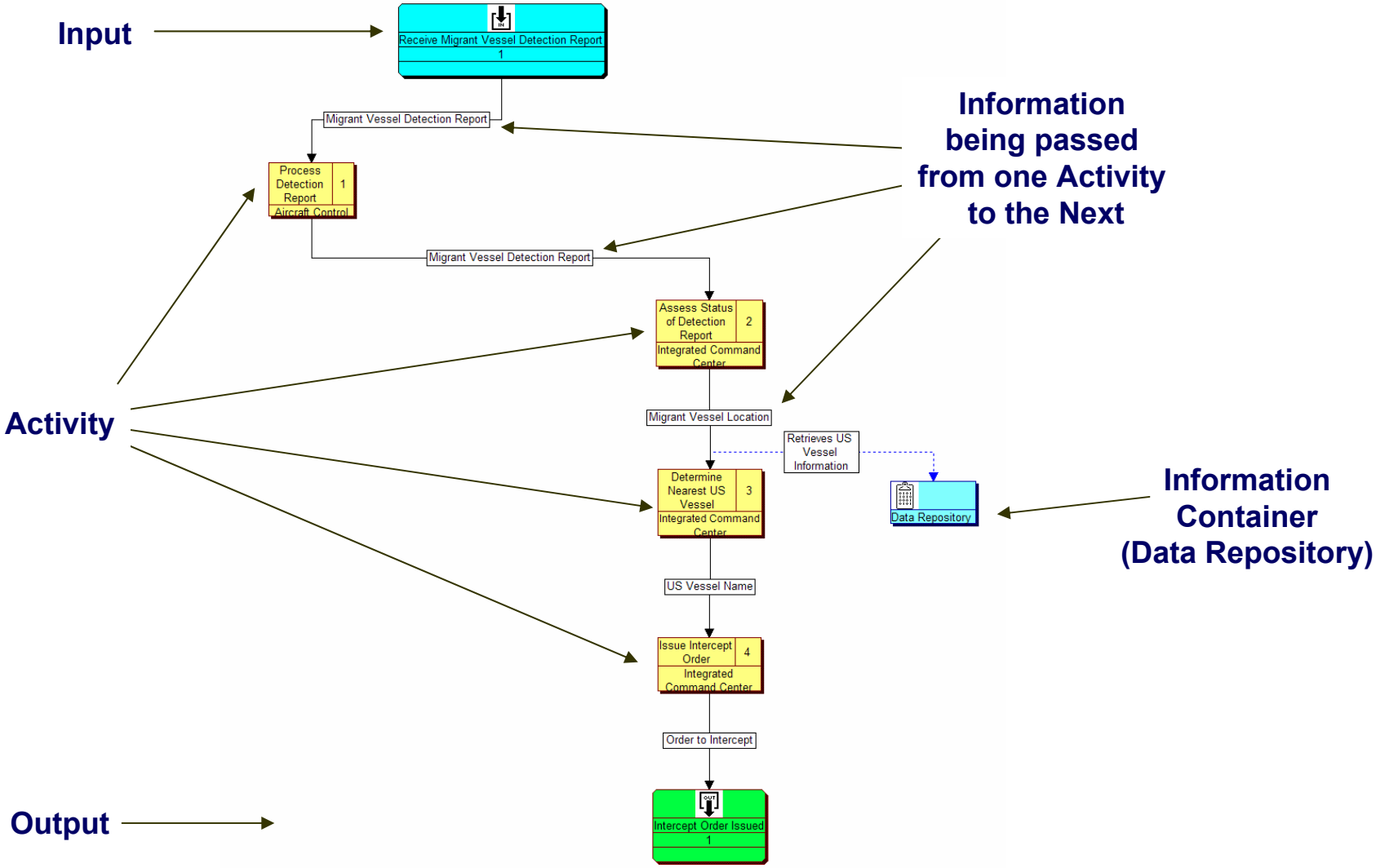
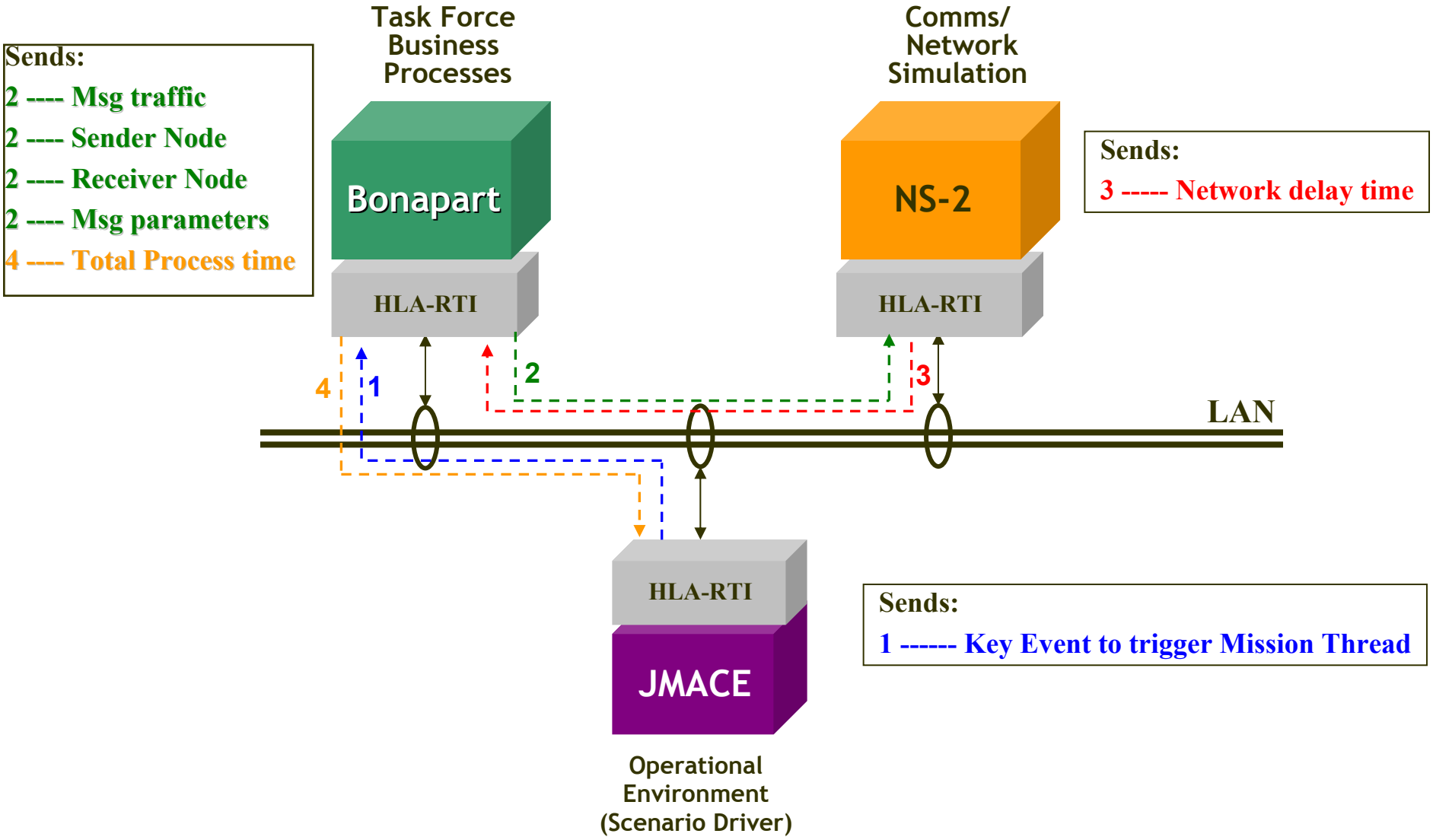
Simple Business Process Modeled in Bonapart



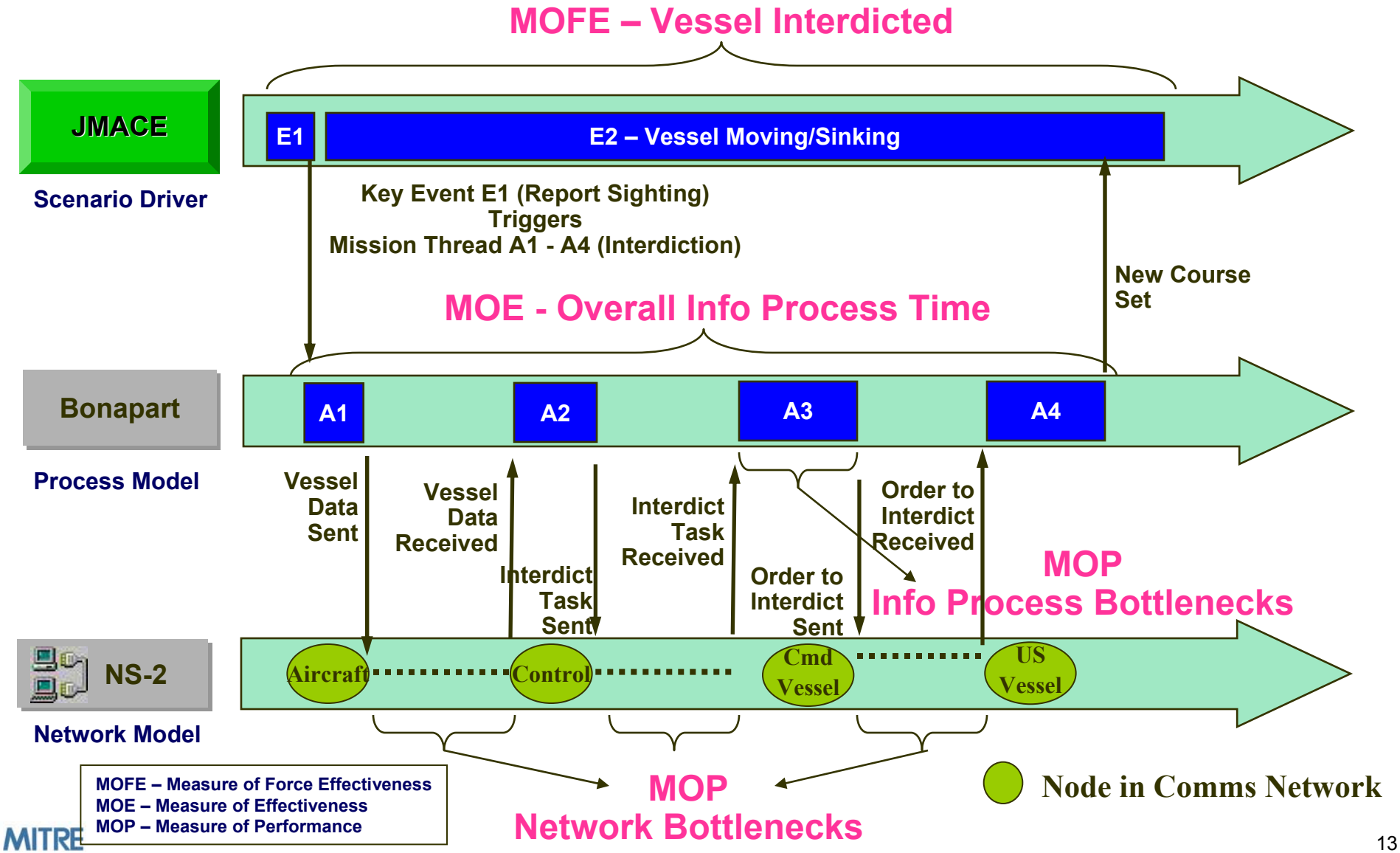
Multi-Agency HLA Federation



Technical Approach – Dynamic Phase (3 of 3)

- **Run federation in simulation mode**
- **Conduct analysis of results**
- **Document technical issues and lessons learned for both the static phase and dynamic phase**
  - Improvements to Enterprise Architectures
    - Activity Descriptions, Task Lists
    - Technical features (Services, Data, Infrastructure)
  - Improvements to Operational Plans and Scenarios
  - Development of Federated Simulation Models

Model Interactions & Sample Measures of Merit



Emerging Insights & Lessons Learned (1 of 2)

- **Multi-agency modernization environment adds significant complexities**
  - Requires more specific detail in Architectures
  - Requires more precise and uniform definitions
    - Activities
    - Business and Decision Rules
    - Business Services
    - Information Services
  - Requires strong analytical capabilities
- **Most architectures we examined were not mature enough to use in operations-centric architecture**
  - Architecture product formats widely differ among agencies
  - Among the architectures, activities had most commonality, but:
    - Activities poorly defined or too general to be usable
    - Activities related to specific scenario not complete

Emerging Insights & Lessons Learned (2 of 2)

- **No clear set of simulation tools to support analysis using homeland security scenarios**
  - DHS reviewed 100 simulations for training & exercises
  - Must modify simulations from other domains to support homeland security analysis
- **Federated simulations are effective way to provide dynamic analysis capability**
  - EAMA approach offers potential method to conduct performance analysis as addressed in OMB-FEA Performance Reference Model
  - Allows testing of proposed operations-centric architecture "as used"
  - Supports coalition and individual agency strategic and operational planning
  - Facilitates performance measurement, management, and improvement

DHS – Department of Homeland Security
EAMA – Executable Architecture Methodology for Analysis
OMB-FEA – Office of Management & Budget Federal Enterprise Architecture

Summary

- This work will improve the utility of architectures across the government by allowing architectures to be examined in an integrated and dynamic mode
  - An approach to implementing the OMB-FEA Performance Reference Model in a multi-agency environment
- Architectures can be assessed for completeness, connectivity, information flow, and performance in support of their operational environment
- Organizations with multi-agency missions will be able to identify any shortcomings in their operational structure and processes
- Cost and performance factors (for enterprise architectures, mission performance, operational procedures, etc.) can be examined to facilitate resource allocation
- These capabilities will benefit agencies trying to
  - Plan for multi-agency missions
  - Determine their investment strategies and justify their budgets and investments to OMB and Congress