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# Interoperable Common Maneuver Networks for M&S and C2

73<sup>rd</sup> MORS

21 June 2005

**Presented by:**

**Burhman Gates, ERDC**



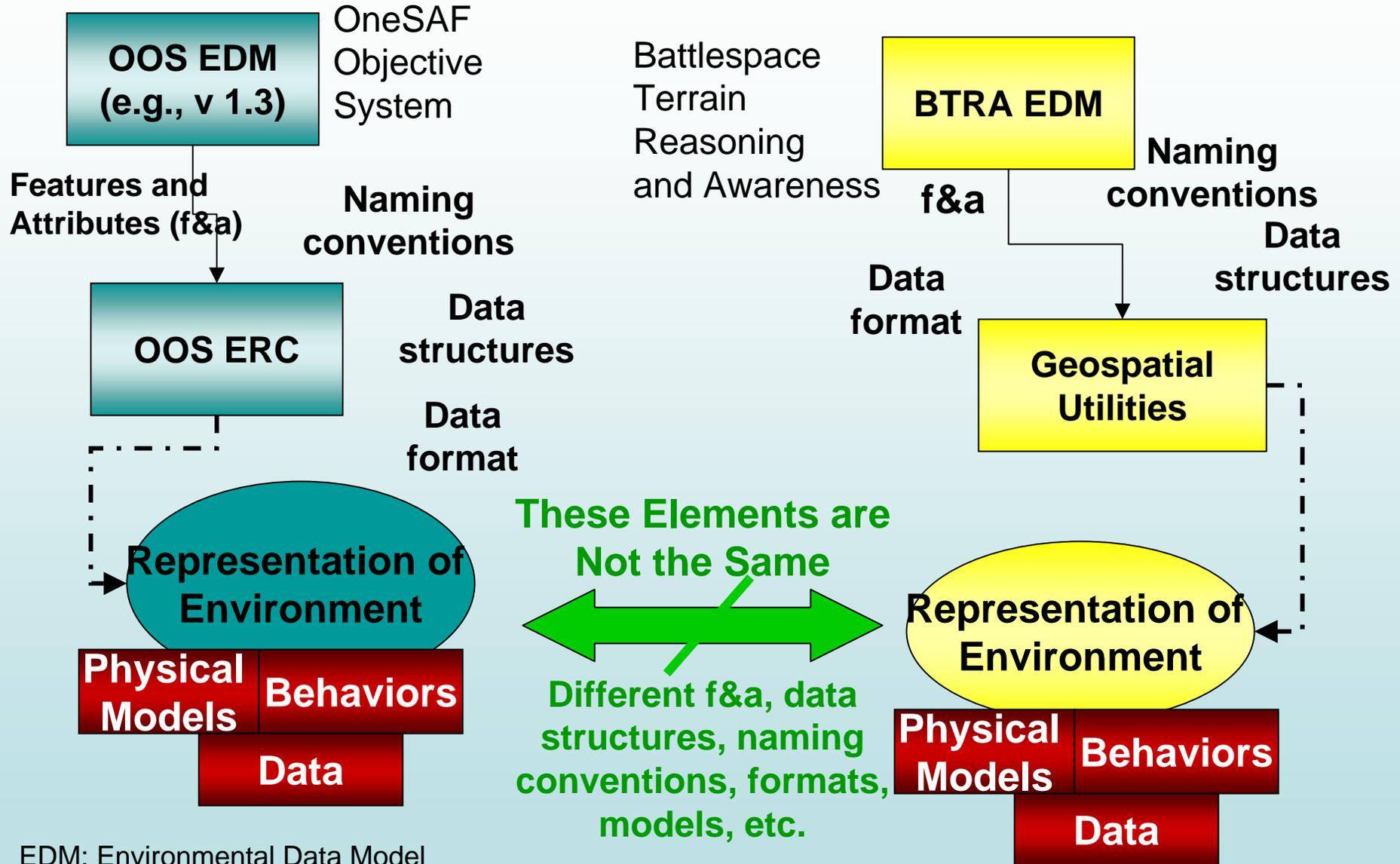
# Outline

- Concept
- Approach
- Path Forward
- Interoperability
  - CMN
  - M-COP
  - GeoBML

# Concept: Problem Statement

- The Future Force will require Battle Command (BC) and Embedded Training (ET) systems to interoperate seamlessly, pulling from and informing the Common Operational Picture (COP) for use in ET and enroute mission planning and rehearsal.
- Current ET and BC systems do not share tactical maneuver data. The battlespace COP is inconsistent between these systems, potentially leading to incorrect decisions about maneuver potential during training, planning, and execution.

# Example: Lack of Commonality



EDM: Environmental Data Model  
 ERC: Environmental Runtime Component

# Goal

Develop a common, consistent capability  
for assessing **mobility**  
and  
**dynamic maneuver potential**  
across C4I and M&S systems

# CMN Project Scope

- Concerned with Army Universal Task List (AUTL) in three Battlefield Operating Systems (BOS):
  - the maneuver system
  - the mobility, countermobility, and survivability system as it pertains to mobility and countermobility
  - the command and control system as it pertains to the common operational picture
- Limited to ground vehicles conducting tactical, and to some extent, operational maneuver
- Limited to interoperability for M&S and C2 systems using OneSAF Objective System and BTRA as platforms

# Long-Term Objectives

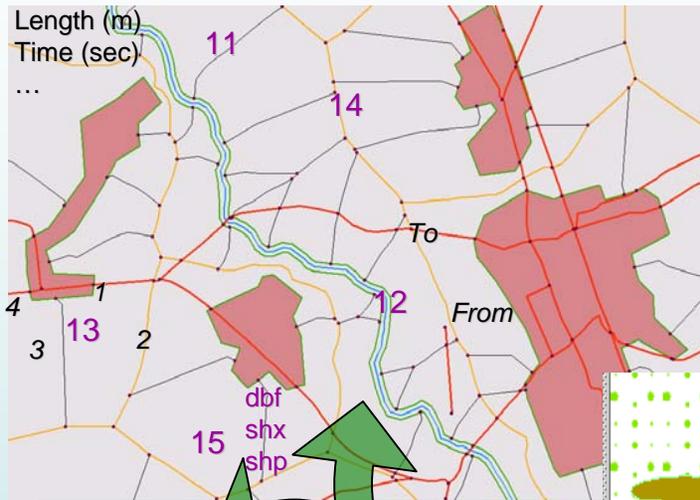
- Create M&S to C4I maneuver network data interchange language and mechanism
  - XML, XSLT, robust schemas → common data model
  - Environment: maneuver networks with associated features and attributes
- Achieve interoperability and correlation of entity performance and behaviors for M&S and C4I maneuver
  - XML, XSLT, robust schemas → common semantics
  - Behaviors/battlespace functions: tactical maneuver
- Produce adaptive and scaling methodologies for maneuver networks
  - echelon issues
  - geospecific location resolution
  - aggregation and deaggregation

# Approach

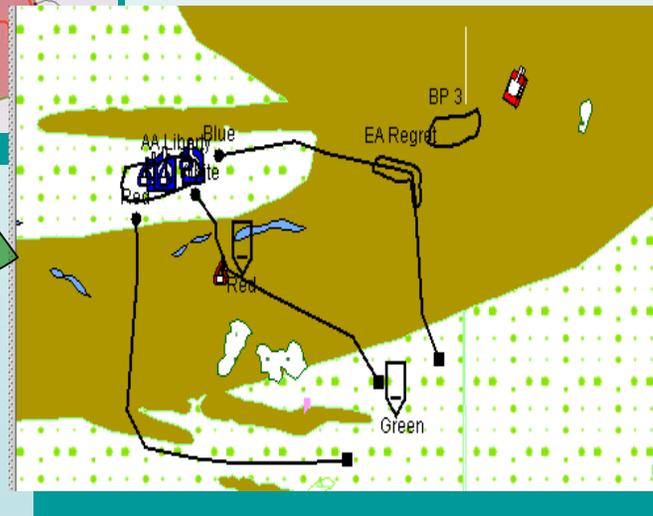
- Develop a means of inserting BTRA maneuver networks and maneuver products into OOS
- Develop a recommended schema for broad community use
  - Examine BTRA and OOS maneuver network data models
  - Derive individual generic XML representations of the data models
  - Examine data interchange issues across the representations
  - Derive a generic common XML representation, including due diligence through evaluation of various existing/emerging data models
- Experiment with BTRA networks in support of SAF behaviors and functions and recommend path forward
- Develop scaling and adaptive algorithms between entity and aggregate level maneuver networks
- Develop a methodology for providing results of OOS courses of action, etc., to C4ISR applications

# Initial Investigation

## Sample BTRA Maneuver Network



**Substitute Products  
into OOS**



**Provide Results as Info  
Products to C4ISR  
Applications (e.g., from COA)**

**Sample OOS Simulation Run**

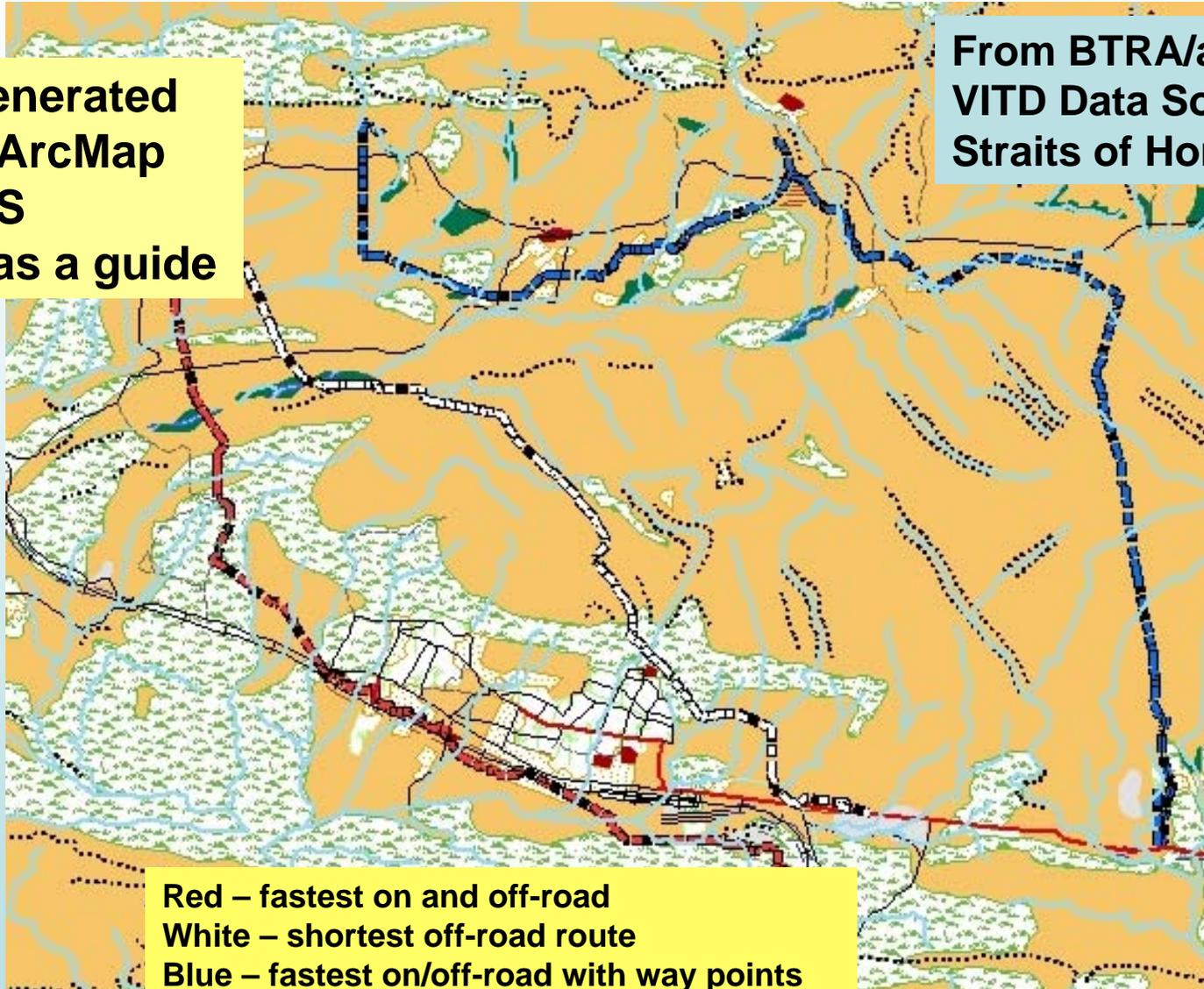
# Example: Inserting BTRA Vehicle Route in OOS: Prototype Capability

- Using BTRA/ArcMap generate a maneuver network (*function of: terrain, ground state, vehicle*)
- Using this maneuver network, generate a route feature (start, end points, way points, minimum distance or time) and export as a shape file
- Read and translate the route shape file segment end points (Lat, Lon) to GCC coordinates using open source and ERDC developed code
- Write out a file in OOS control measure (XML) format using ERDC code
- Manually insert the control measure into an existing OOS scenario file

# Example, Cont.

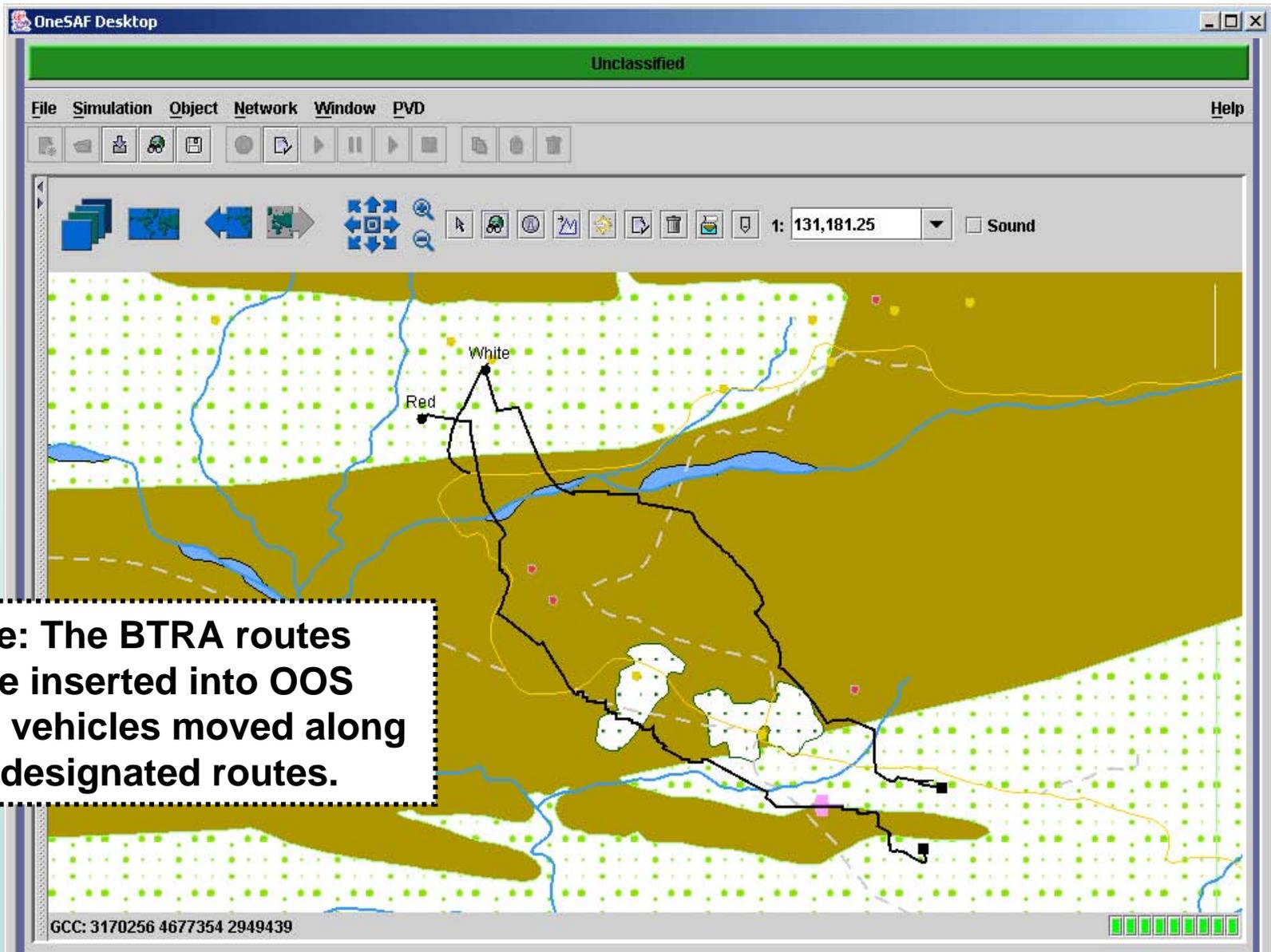
Routes generated by BTRA/ArcMap using OOS scenario as a guide

From BTRA/arcMap  
VITD Data Source -  
Straits of Hormuz



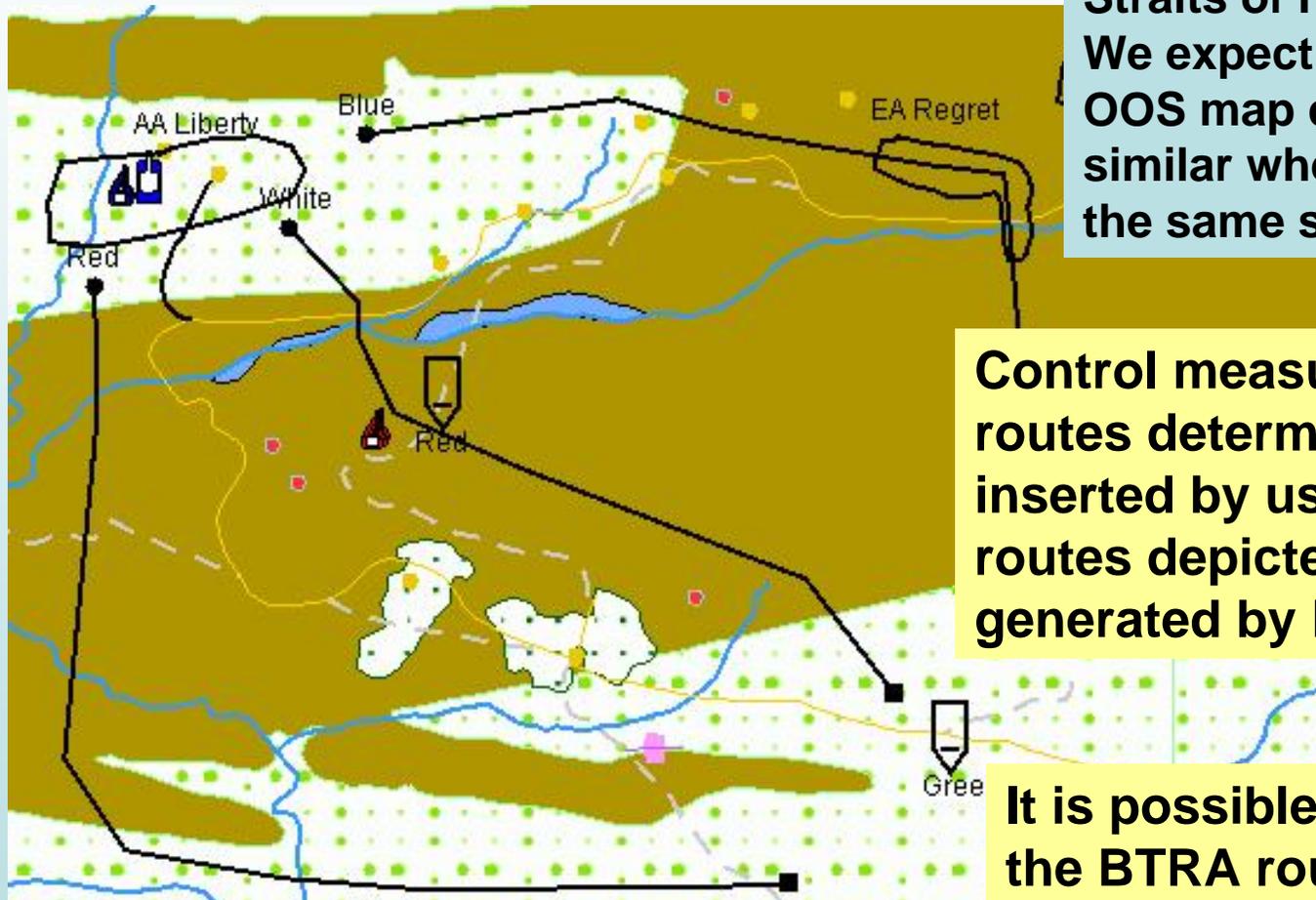
Red – fastest on and off-road  
White – shortest off-road route  
Blue – fastest on/off-road with way points

# BTRA Routes inserted into OOS



# Example, Cont.

## OOS Scenario Snapshot

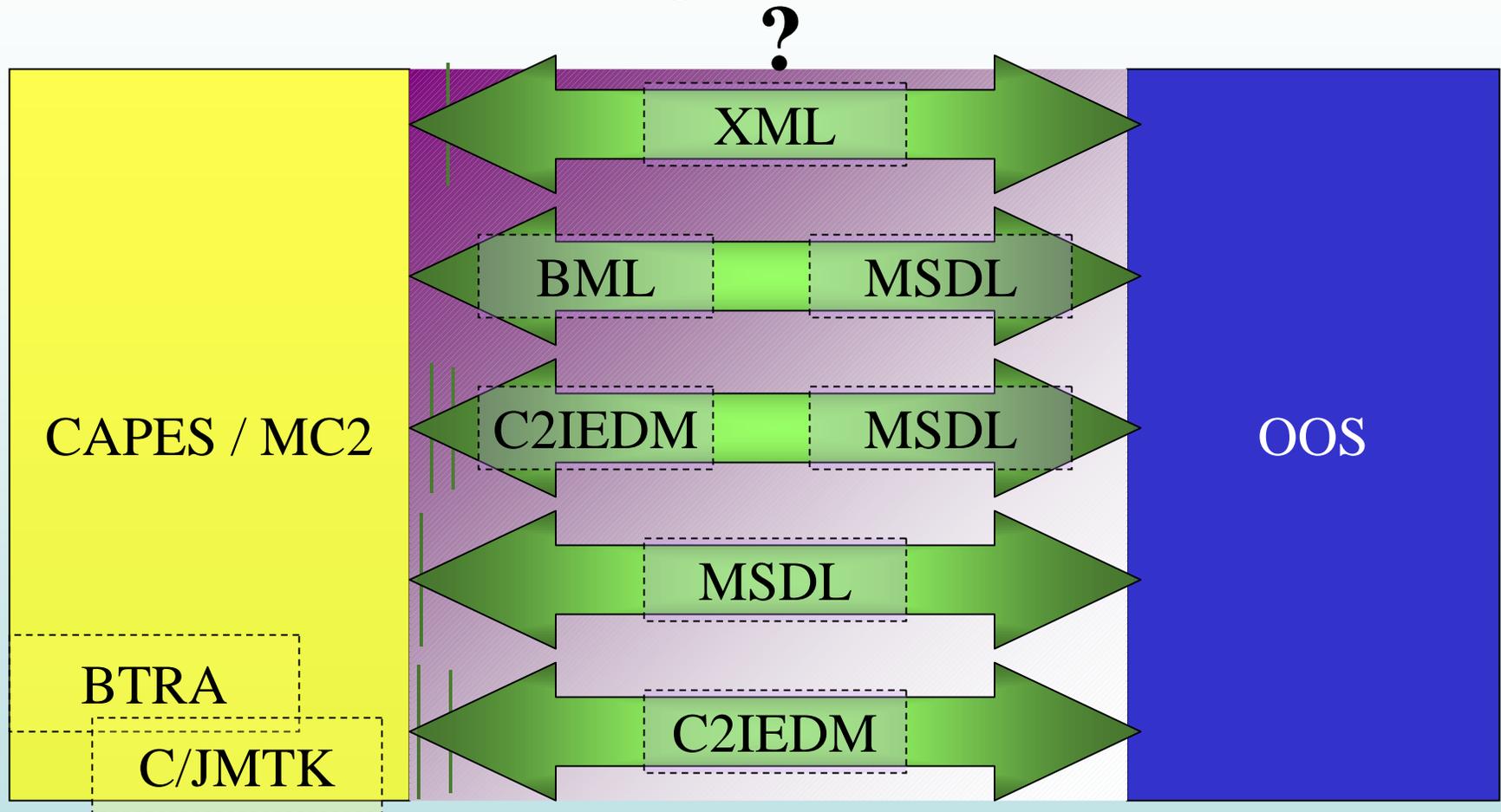


**VMAP 1 Data Source at WARSIM resolution – Straits of Hormuz. We expect BTRA and OOS map displays look similar when using the same source data**

**Control measures and routes determined and inserted by user (the routes depicted were not generated by BTRA)**

**It is possible to insert the BTRA routes into OOS scenario**

# Data Representation and Interchange Alternatives

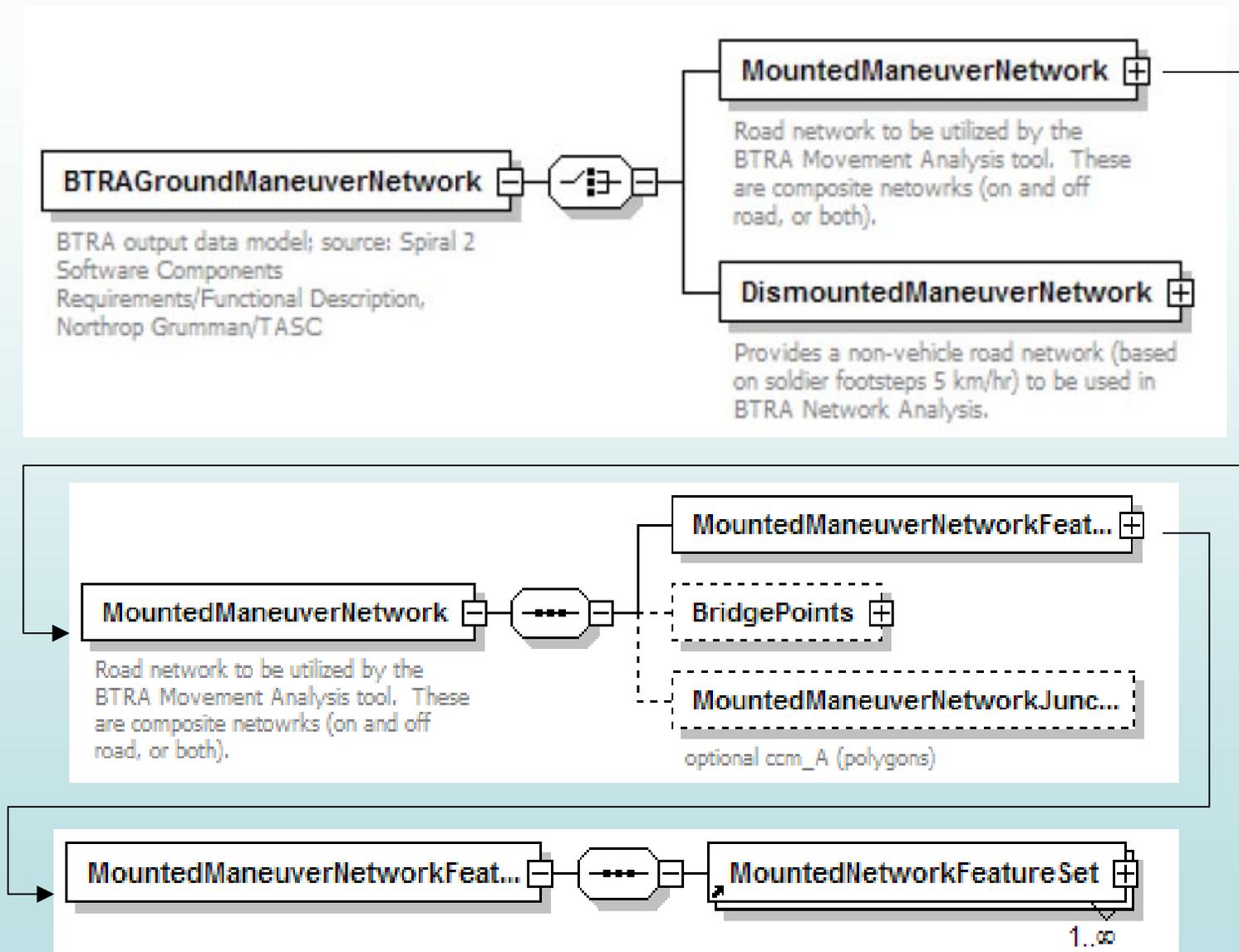


Others? SEDRIS, GML, registered ontologies? Some combination?

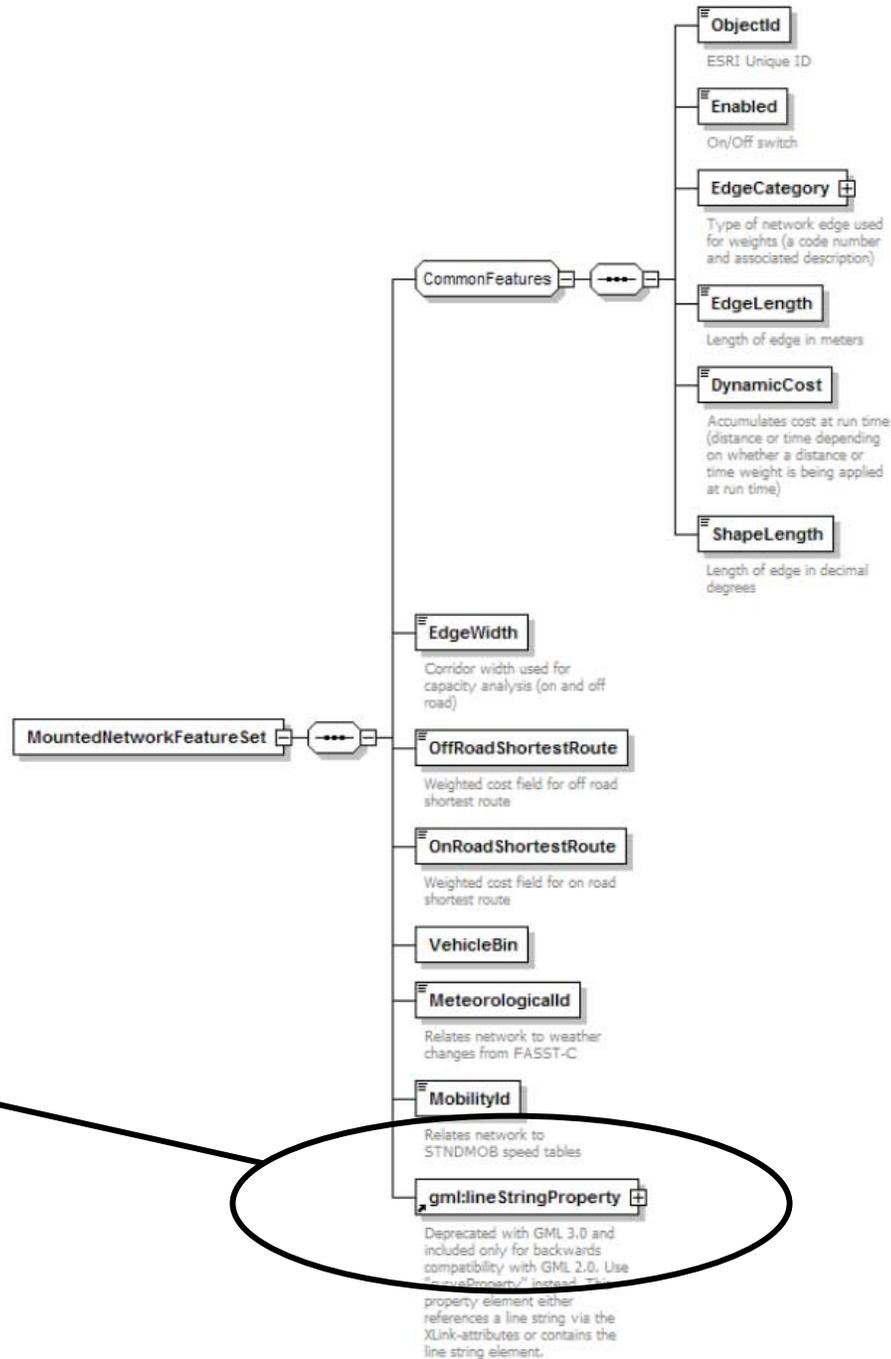
# Starting Point

- Understand the current data models in context
  - Create descriptions in a common representation syntax: e.g., XML Schema
  - Compare data structures with existing XML representations for possible reuse through name spaces

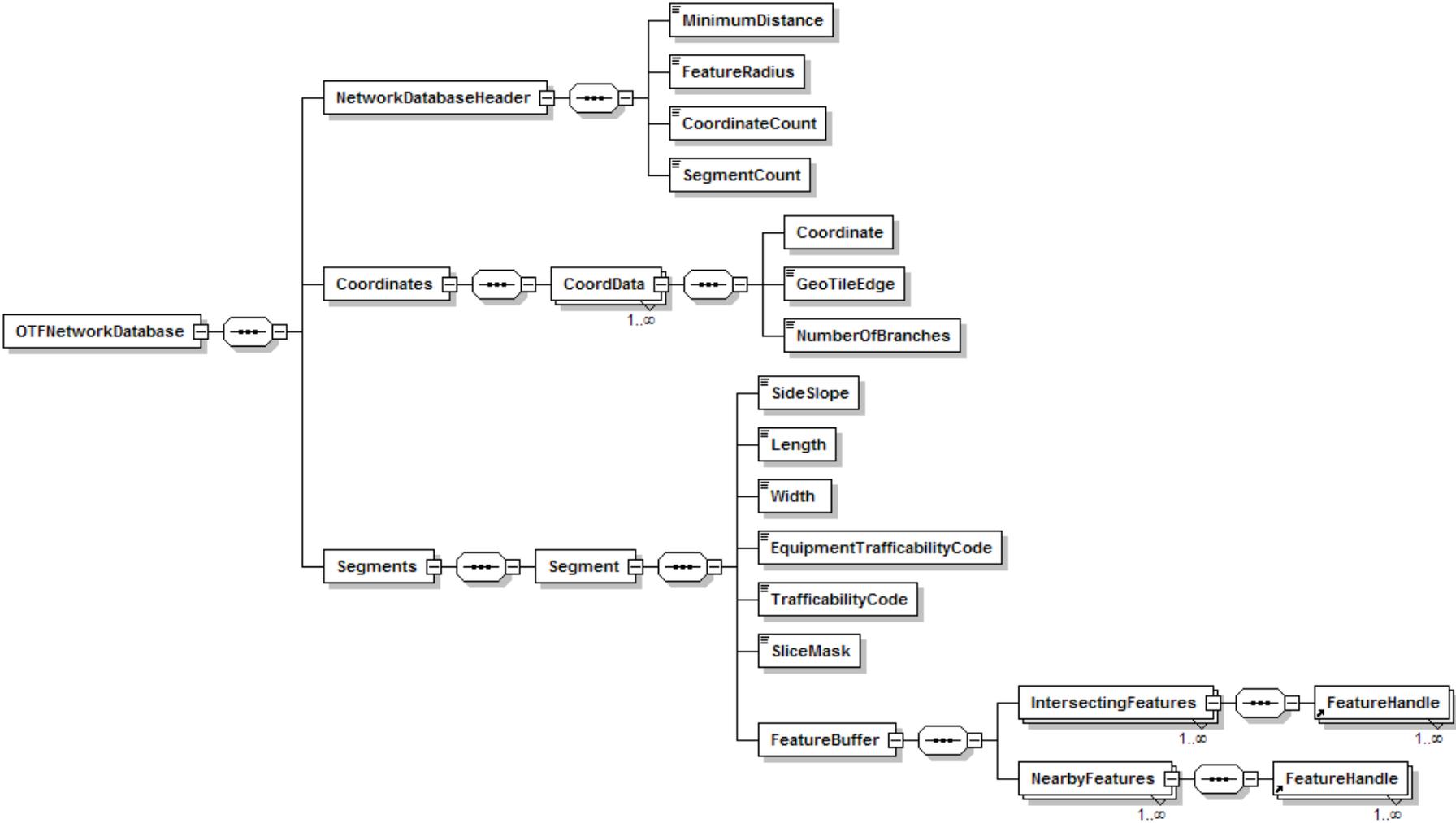
# Schema Design for BTRA Network



Geography Markup Language (GML)  
gml:lineStringProperty



# Schema Design for OOS Network



# Mapping Data Models

- Tools exist to assist in mapping one schema model to the other (e.g., Altova MapForce) and auto-generating XML Stylesheet Language Transformations (XSLT)
- Problem: Where is the knowledge about what the data elements really mean (semantics)?
  - Code
  - Documentation
  - Engineers
  - Such knowledge needs to be embodied in the data in a way that enables software to assist or perform the mappings (purpose of formal ontology development for a domain of interest)

# Challenge

- Fundamental conceptual mismatches exist in the models
  - e.g., different descriptive data ...but both BTRA and OOS (and other data models) are describing *maneuver networks* and for very similar purposes!
- Perhaps the mapping needs to be accomplished through a more complete description of the *concepts* involved in deriving and describing maneuver networks.
  - This is the goal of a *domain ontology* and associated logical system.

# Alternative Interchange Languages

- Military Scenario Definition Language (MSDL)
  - Used by OOS
  - Mil-Std-2525B Military Symbology: Tactical Graphics – limited representation
  - Initialization only
- Battle Management Language (BML)
  - Well-researched, extensive doctrinal basis
  - SISO Study Group in progress for specifying Coalition BML
  - Early discussions of a geoBML extension
- Command and Control Information Exchange Data Model (C2IEDM)
  - Location structure for geospatial syntax
  - Established processes for language extension
- Others: SEDRIS EDCS, GML, NaGML, registered languages

# Maneuver Behavior Investigations

# Levels of War and CMN Scope

2-12. *Tactics* is the employment of units in combat. It includes the ordered arrangement and maneuver of units in relation to each other, the terrain, and the enemy to translate potential combat power into victorious battles and engagements.

-- FM 3-0

CMN products principally apply here – interoperability of maneuver networks at the tactical level with some application at the operational level

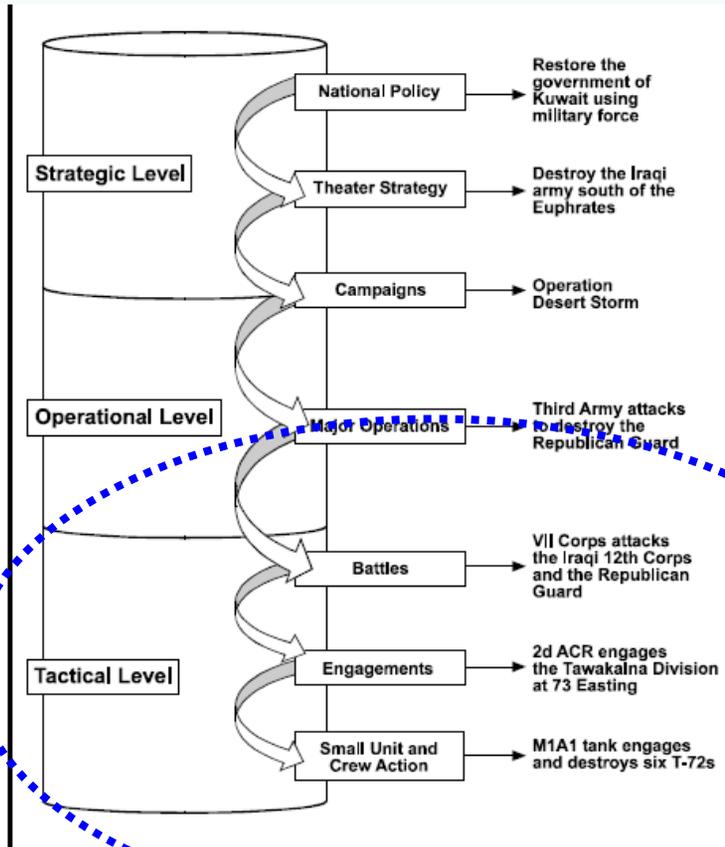
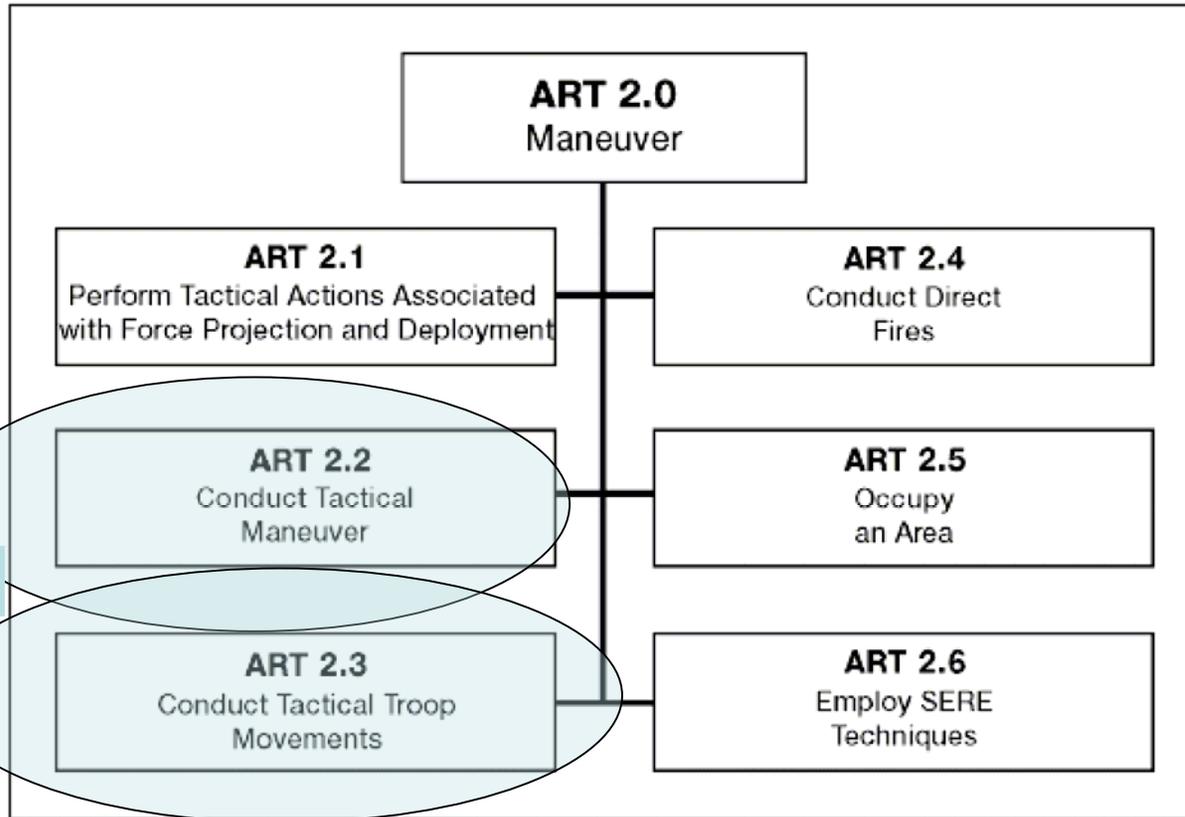


Figure 2-1. The Levels of War

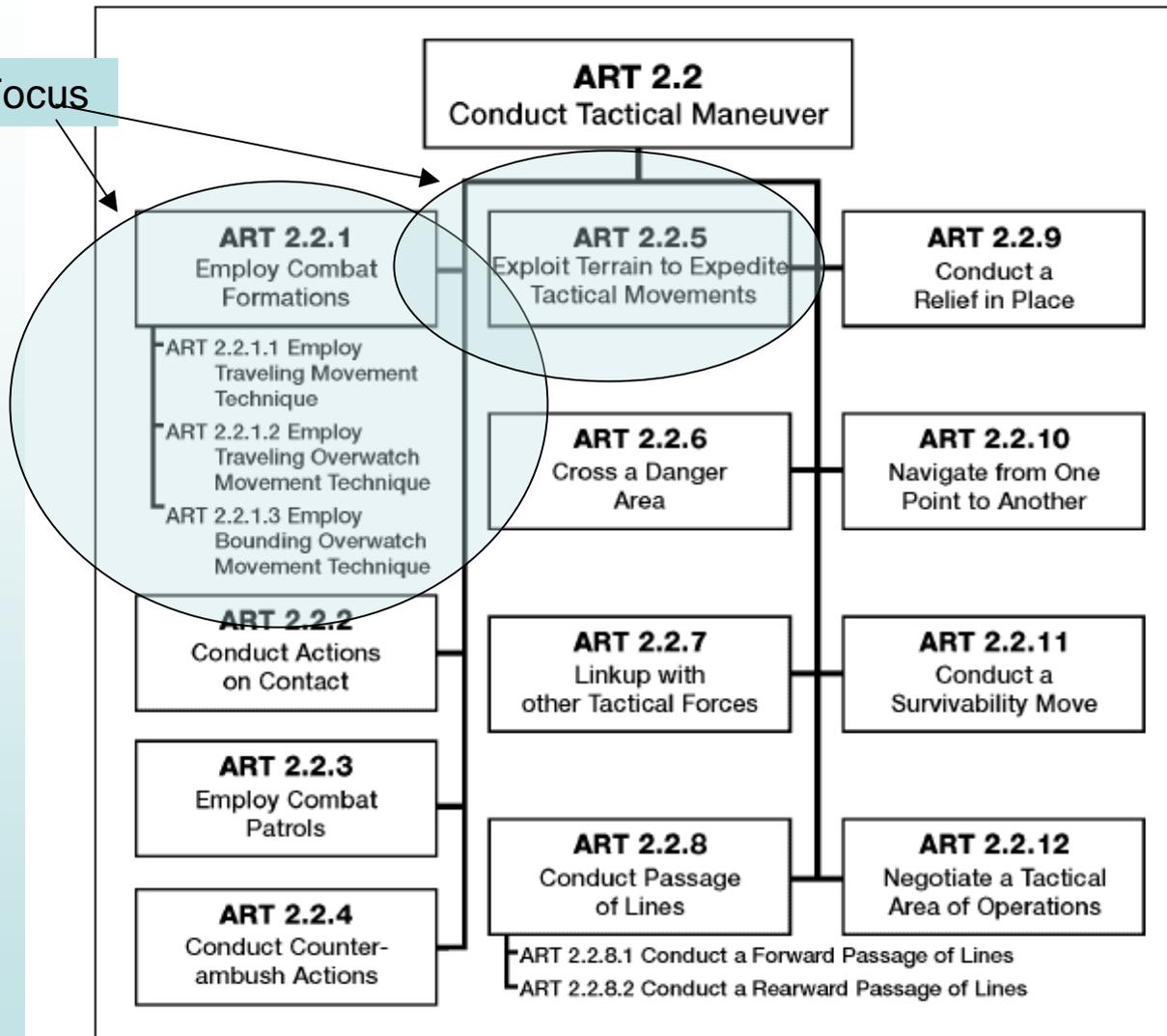
Taken from FM 3-0

# AUTL Tasks/Subtasks

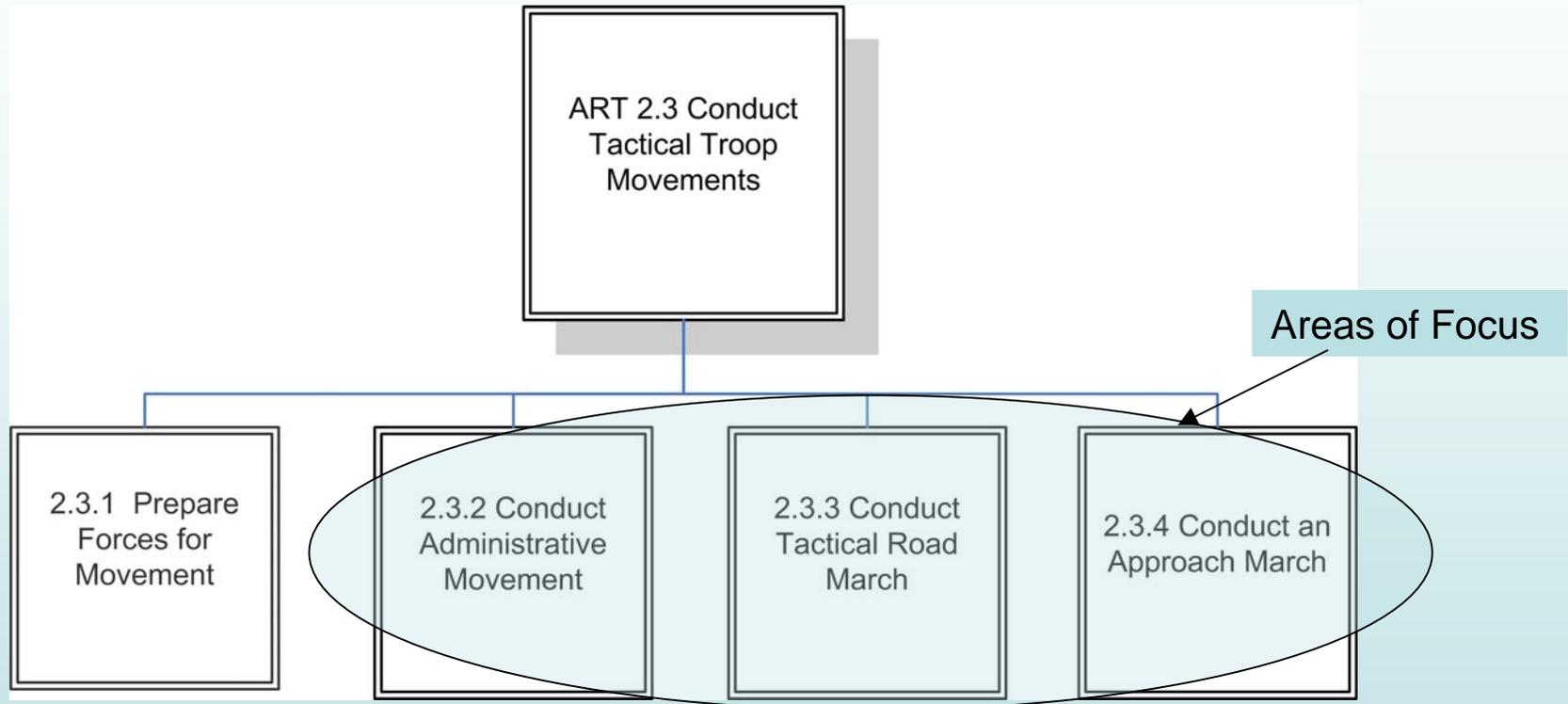


Areas of Focus

Areas of Focus



# AUTL Tasks/Subtasks



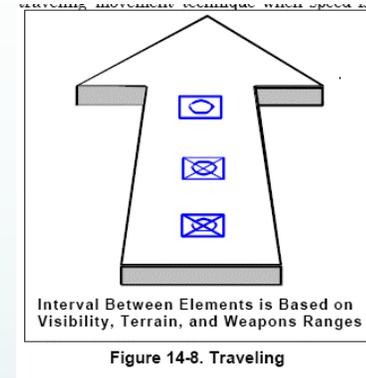
## **AUTL Task 2.3 Conduct Tactical Troop Movements and Subtasks**

Reference: Headquarters, Department of the Army: "Field Manual 7-15 The Army Universal Task List," August 2003.

# Movement Techniques

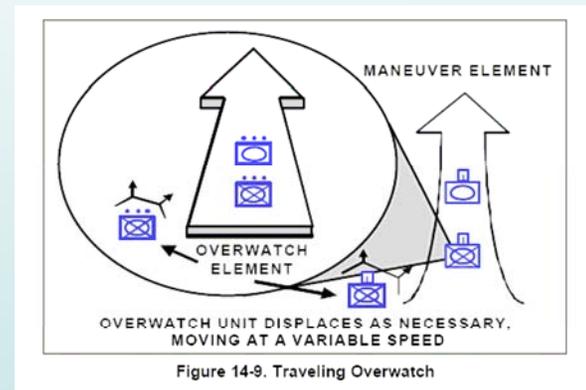
## Traveling

- Speed necessary
- Enemy contact not likely



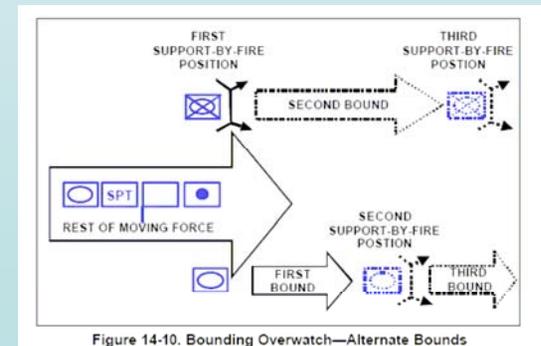
## Traveling Overwatch

- Speed important
- Enemy contact possible



## Bounding Overwatch

- Enemy contact expected



# Path Forward CMN: FY05

- Obtain consistent database for use with BTRA and OOS
- Derive actionable data schema regarding maneuver networks
- Obtain OOS Block C and complete network insertion
- Develop studies and analysis (designed experiments) concerning maneuver nets and OOS course of action analysis
- Qualify / Quantify effectiveness of inserted network and its use
- Compare OOS behaviors for routing, maneuver behaviors, etc., in Block C release against routing and maneuver network generation in BTRA –
  - Perform studies related to C4ISR and M&S
    - Tactical road march
    - Tactically traveling overwatch
    - Follow route
    - Move to Location
    - Move tactically traveling
    - ...

# M-COP

Standards for the Mobility Common Operational Picture  
(COP): Elements of Ground Vehicle Maneuver  
BSCE project: SIMCI-2005-007

**Objective** - Develop standards that describe ground vehicle parameters for the Mobility COP from/for C4SIR and M&S that will enable Future Force, assured mobility (TP 525-66). The standards will address data, common terminology, concepts, and information formats/conventions for ground vehicle movement.

**Capability Provided From The Project** - XML, BML standard names and conventions that will allow transfer of ground vehicle maneuver data (planned routes, trafficability assessments), and other parameters associated with assured mobility between M&S and C2 systems.

***Focus is on the vocabulary and necessary conceptual relationships***

# GeoBML

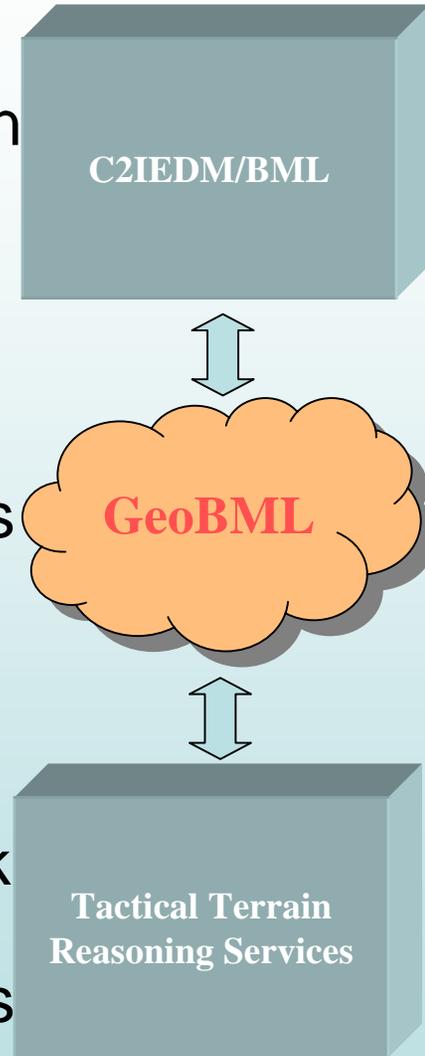
Tactical missions/tasks/activities from Planner or Planning S/W system should be able to be analyzed into and composed from Tactical Terrain Reasoning Information Structures

- Guided, iterative process with Planner or Planning S/W
- Aided by automatic tools that generate and quantify options

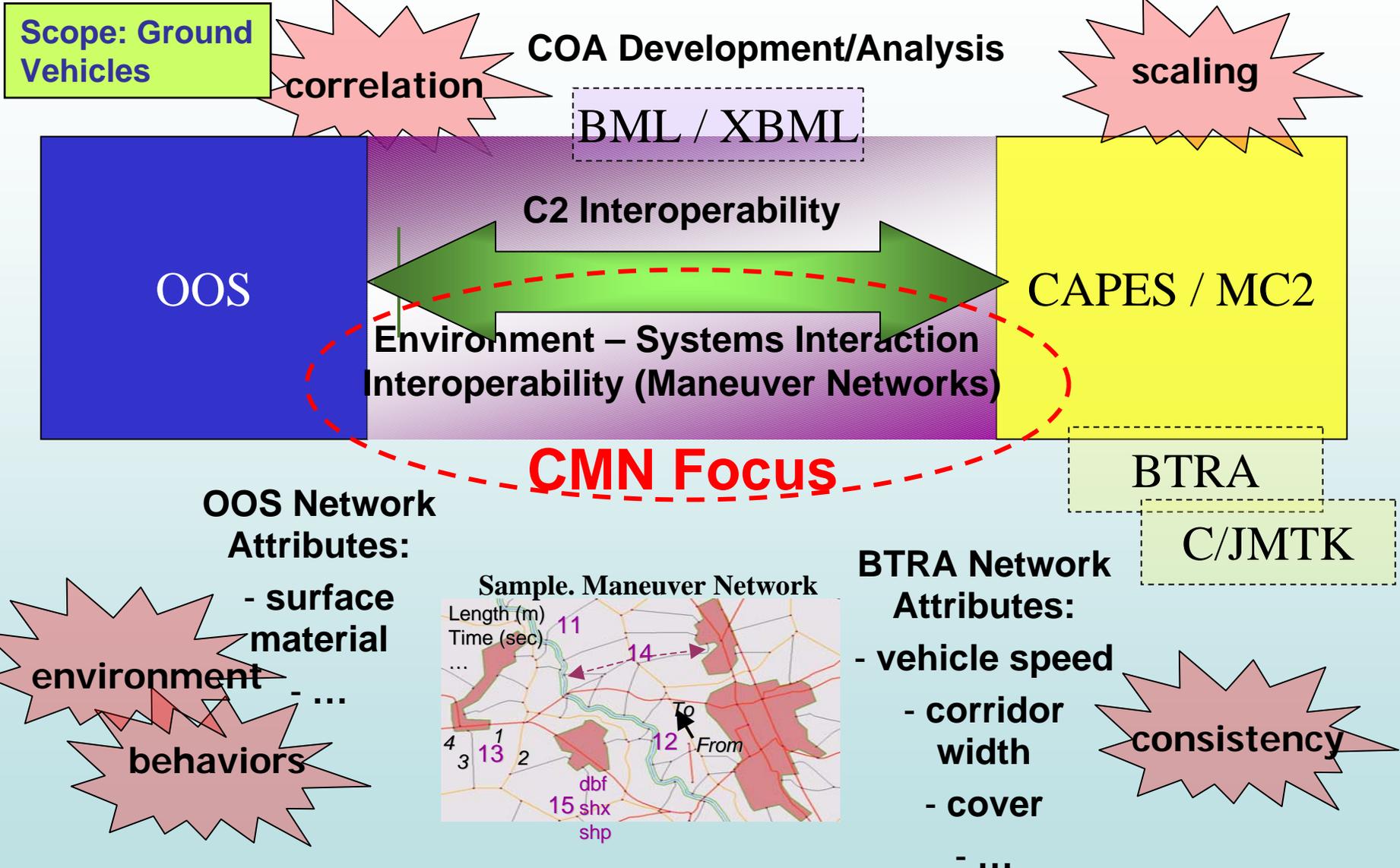
Tactical Terrain Reasoning Information Structures will have direct geospatial content

- Represent a tactical-terrain relation
- Relate abstracted tactical regions
- Allow direct graphical representation

Need Ontology/Grammar to convert Tactical Task level Plan (i.e. with tactical tasks as literals) to Tactical Terrain Reasoning Information Structures



# CMN Perspective on Interoperability



# M-COP Perspective on Interoperability

## Scope: Ground Vehicles

M-COP perspective for mobility-related elements of the Common Operational Picture ----->

Interoperability between C2 and M&S will be enabled by the ability to “communicate”

- Where do I maneuver
- What are the impediments
- How can I deal with them
- What actions must I take to both humans and automated entities

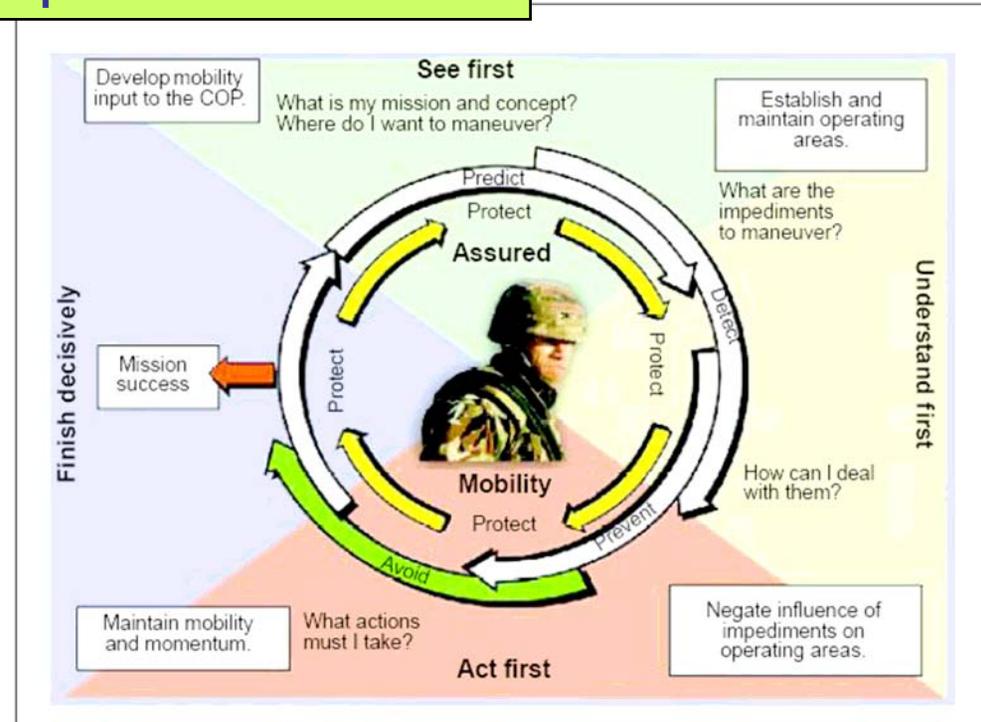


Figure 3-2. Assured Mobility and the Engineer Fundamentals

- Think Intelligence Preparation of the Battlefield/ Engineer Assessment of the Battlefield Processes / Products pertaining to maneuver

Figure from FM 3-34 Engineer Operations

- Includes info on mission, enemy, troops, terrain, weather factors, ... Modified Combined Obstacle Overlay (MCOO) development...beyond mvr network

# GeoBML Perspective

- GeoBML is a proposed research project to extend BML to map the tactical tasks to geospatial and temporal aspects of tactical information and activities
- GeoBML is broader than M-COP in that it includes not just (ground vehicle) mobility-related components but the ability to enable interoperability for the other Battlefield Operating Systems (BOS)
- As with M-COP, ontology(ies) development is a focus for enabling unambiguous communication (human-to-human; human-to-automated entity, automated-to-automated entity)

**- Think Intelligence Preparation of the Battlefield/ Engineer Assessment of the Battlefield Processes and Products**

**- Includes info on mission, enemy, troops, terrain, weather factors, ... Modified Combined Obstacle Overlay (MCOO) development...beyond M-COP**

# CMN – M-COP – GeoBML

## Inter-relationships

- Common terrain
- Common environment
- Common effects
- Consistent semantics
- Shared products
- Informing “agents” (live, constructive, robotic)
- Participation in MSDL, C-BML standards
- Influence on GIG M&S COI Focus Groups (metadata, data mediation, services)

# CMN Team

- Burhman Gates, ERDC, FY05–07 WP Manager
- Dr. Niki Goerger, ERDC, FY04 WP Manager
- Dr. Paul Richmond, ERDC
- Mike Pace, ERDC
- MAJ John Willis, TRAC-Monterey
- Curtis Blais, NPS MOVES Institute



WP = Work Package

Questions?