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Interoperable Common Maneuver Networks for M&S and C2

73rd MORS

21 June 2005

Presented by:
Burhman Gates, ERDC



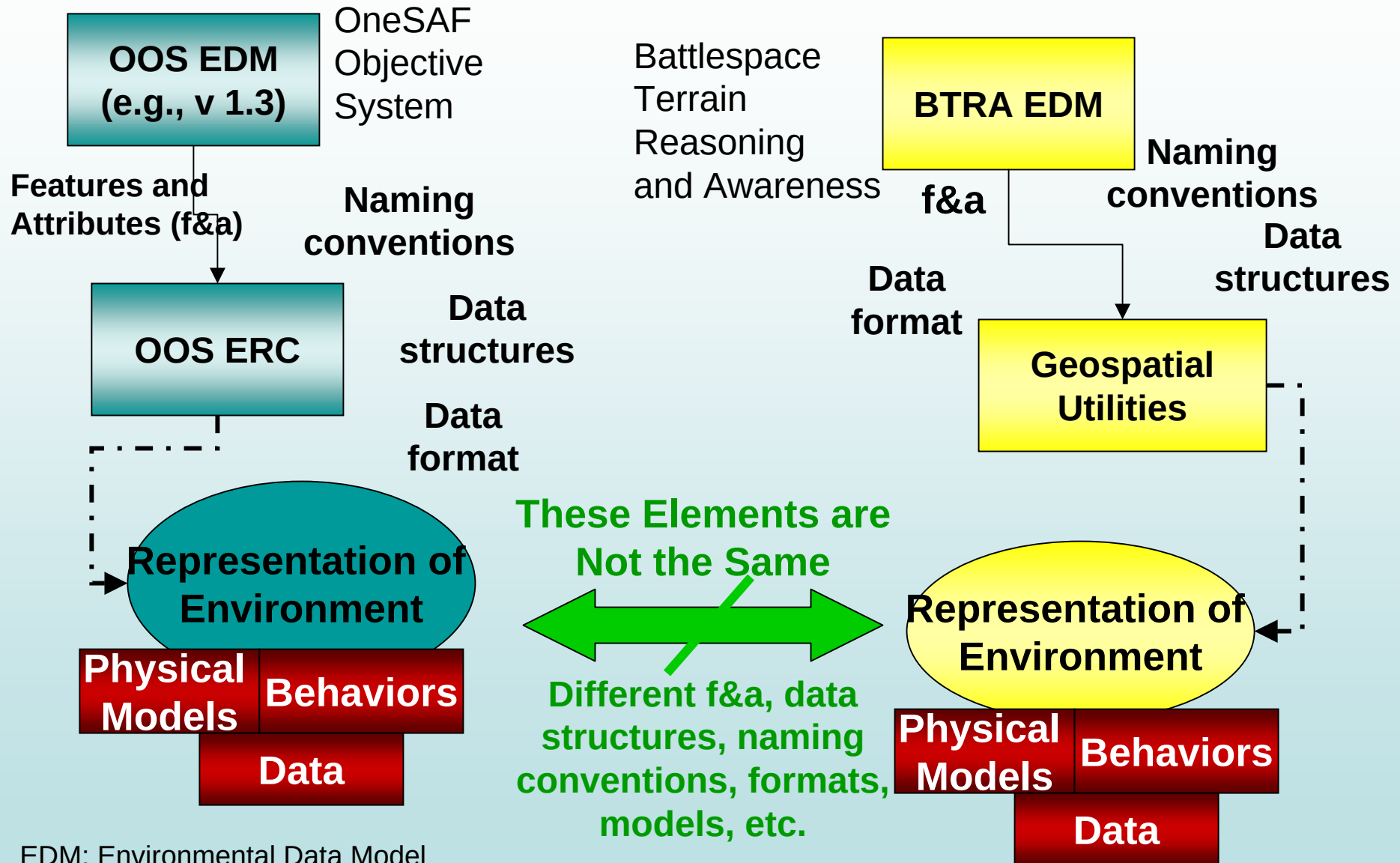
Outline

- 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

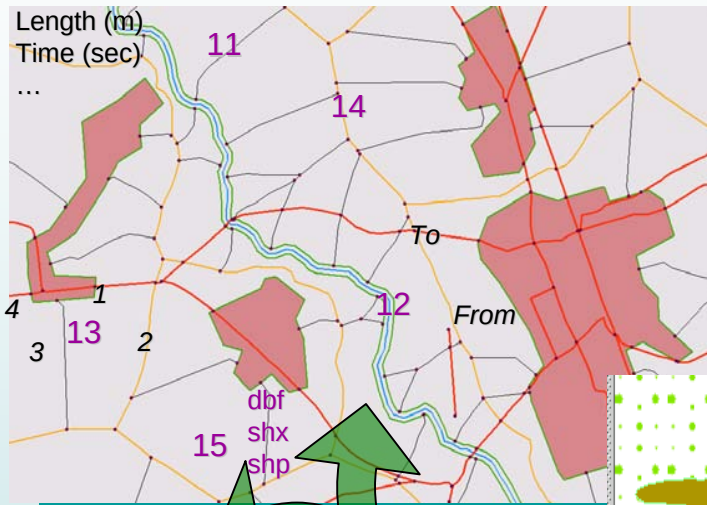
- Create M&S to C4I maneuver network data interchange language and mechanism
 - XML, XSLT, robust schemas → common data model
 - Environment: maneuver networks with associated features and attributes
- Achieve interoperability and correlation of entity performance and behaviors for M&S and C4I maneuver
 - 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

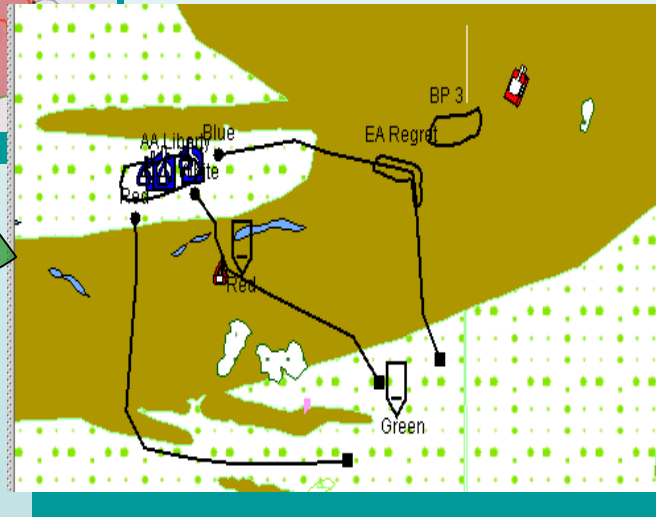
Initial Investigation

Sample BTRA Maneuver Network



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

**Substitute Products
into OOS**



Sample OOS Simulation Run

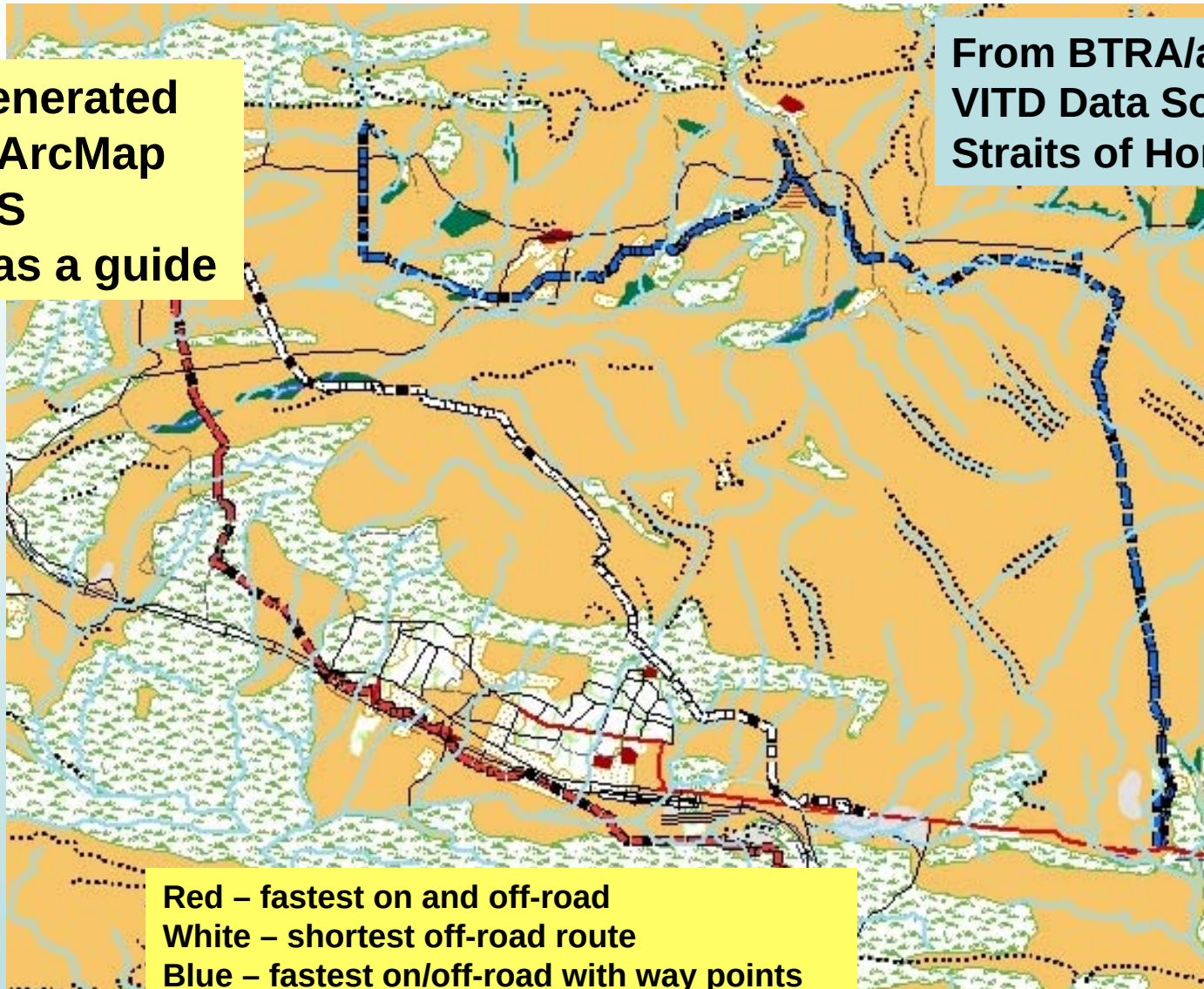
Example: Inserting BTRA Vehicle Route in OOS: Prototype Capability

- 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

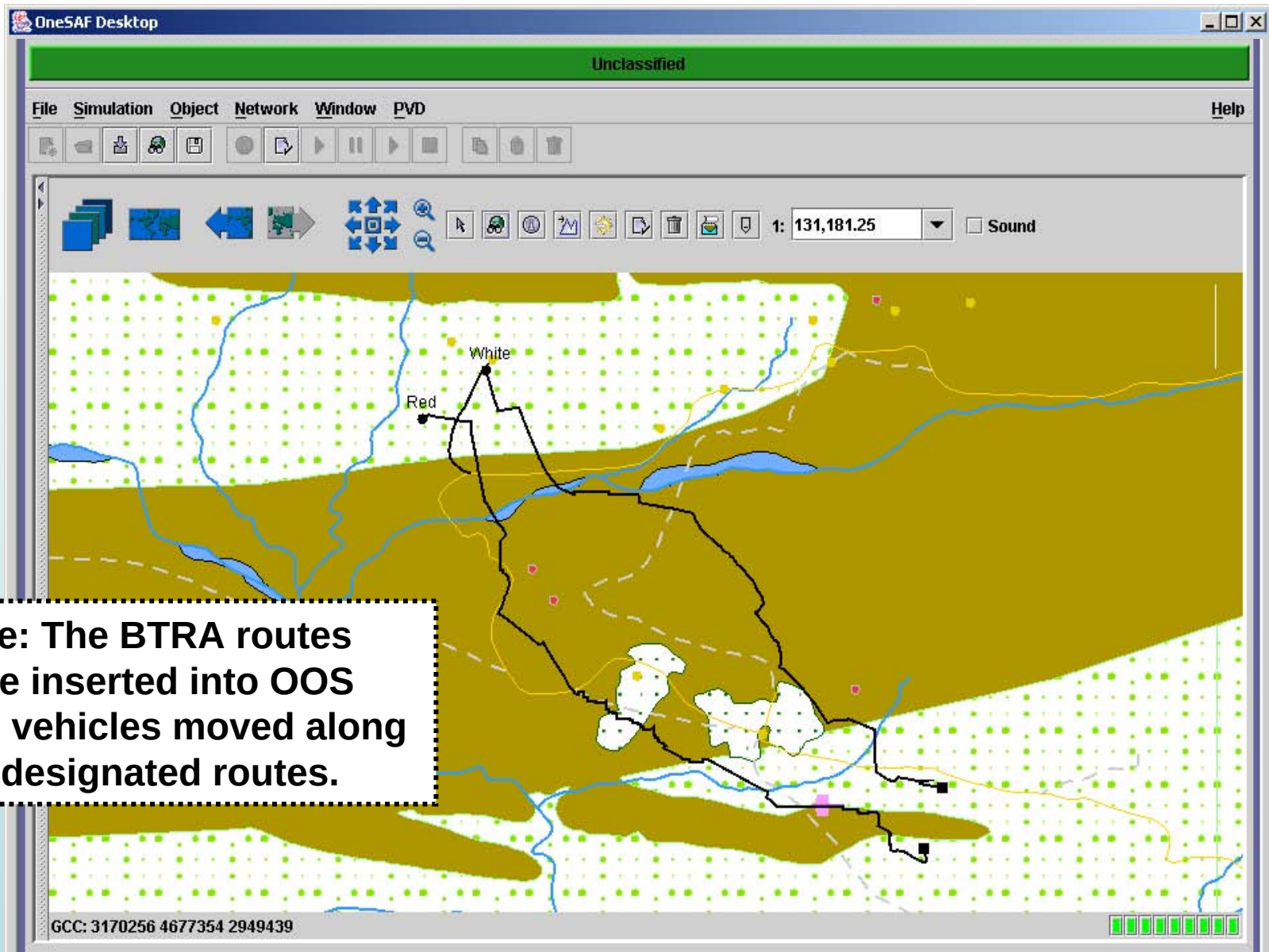
Example, Cont.

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

From BTRA/arcMap
VITD Data Source -
Straits of Hormuz

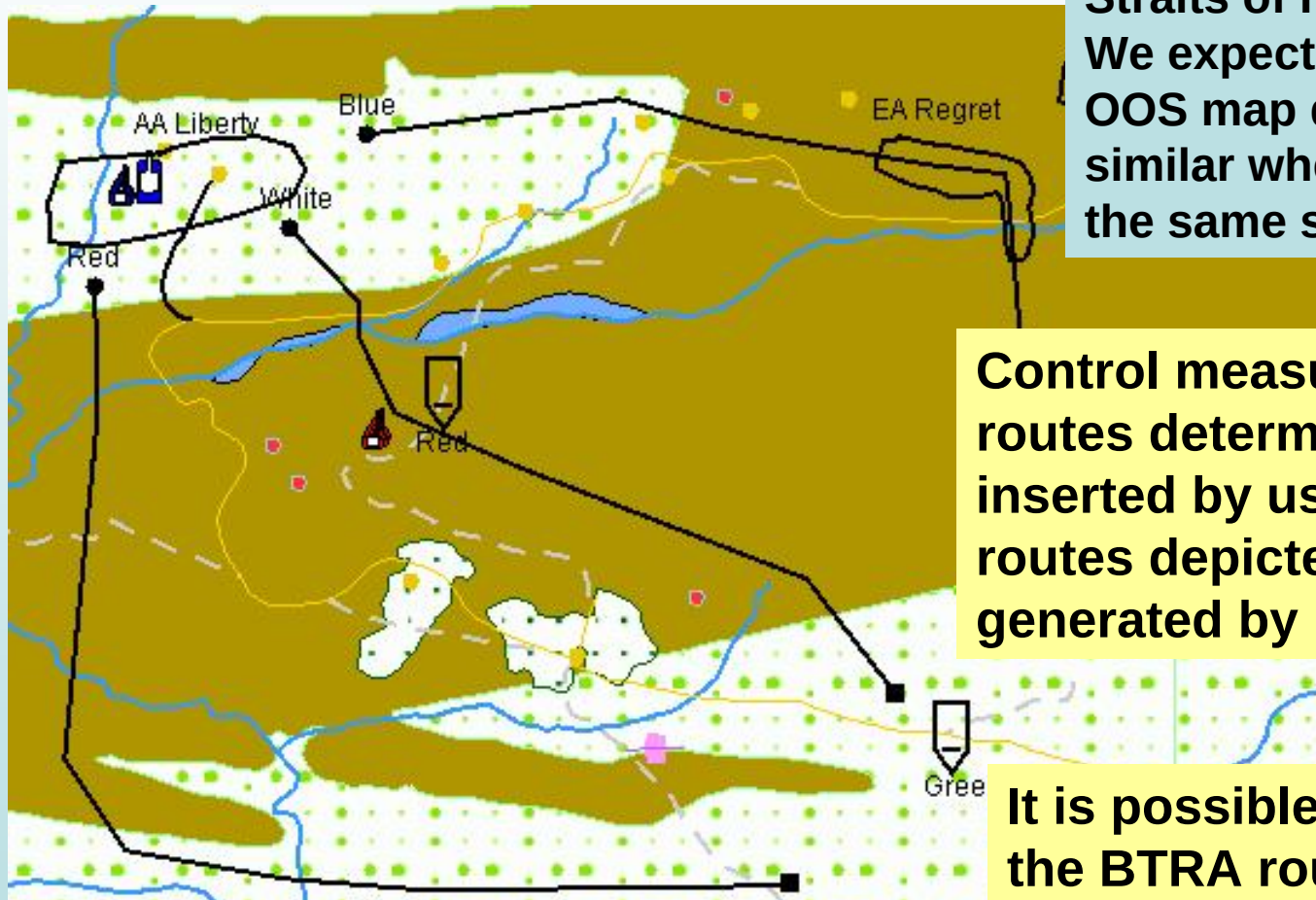


BTRA Routes inserted into OOS



Example, Cont.

OOS Scenario Snapshot

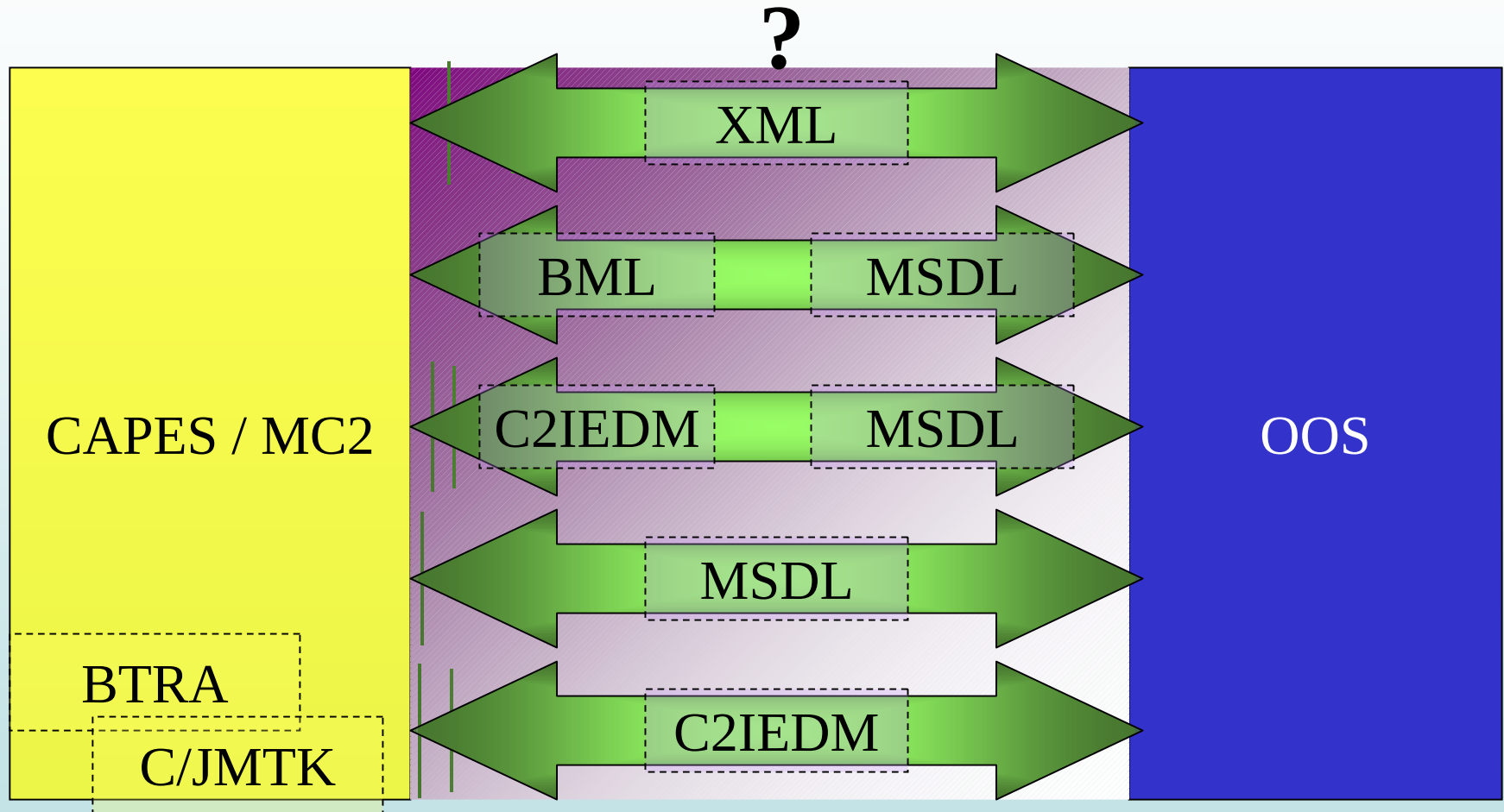


VMAP 1 Data Source at WARSIM resolution – Straits of Hormuz.
We expect BTRA and OOS map displays look similar when using the same source data

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

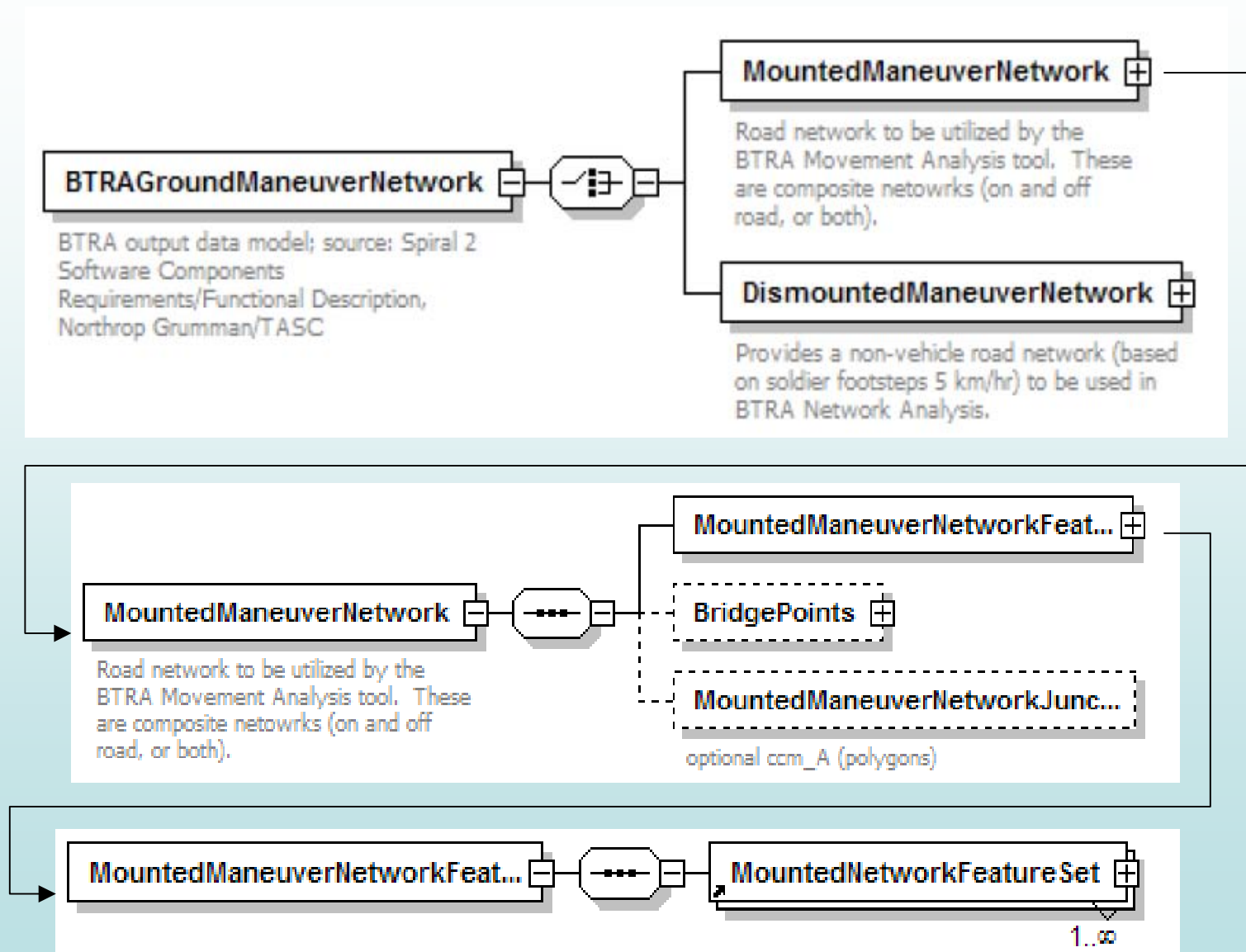


Others? SEDRIS, GML, registered ontologies? Some combination?

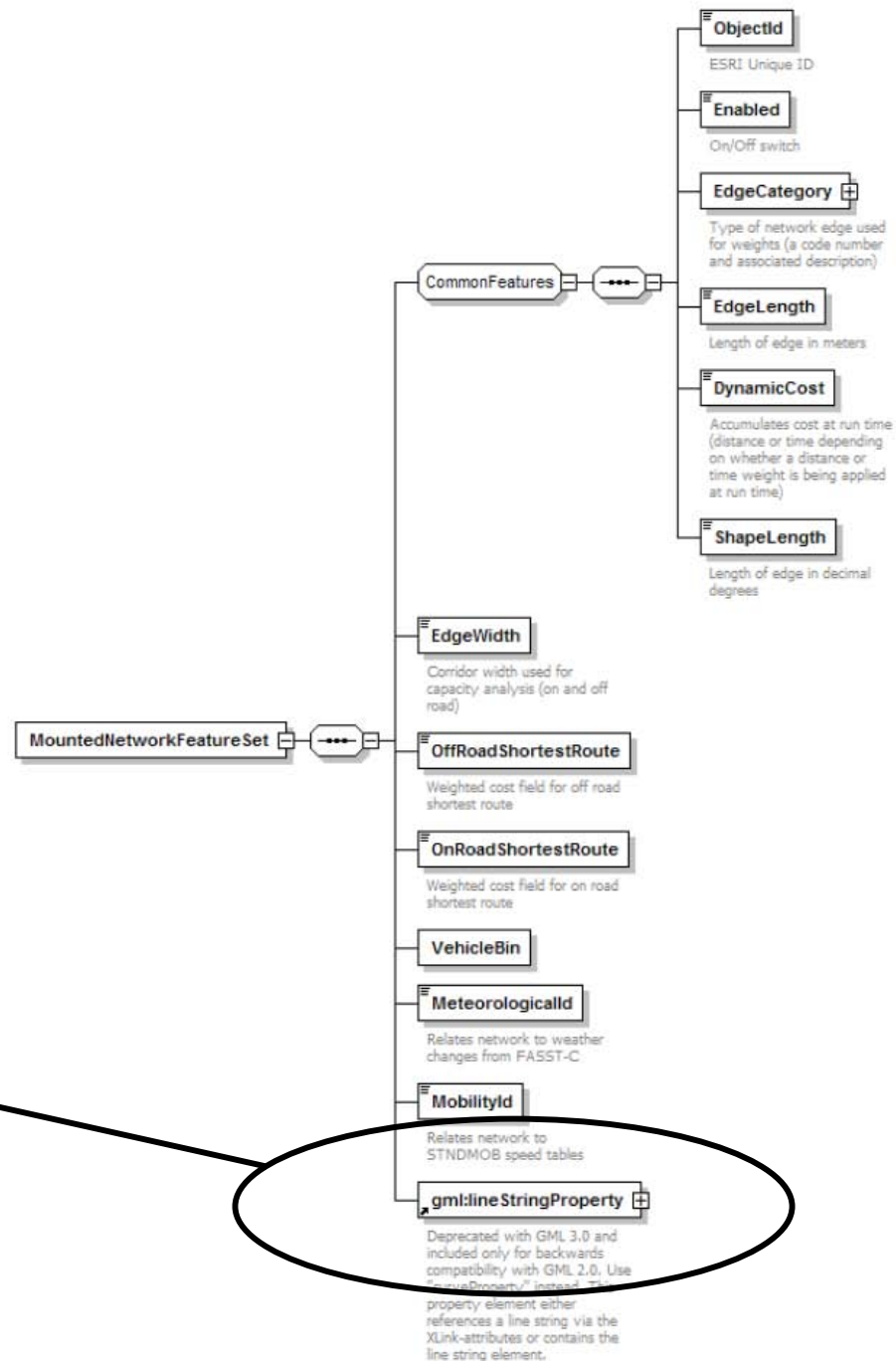
Starting Point

- 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

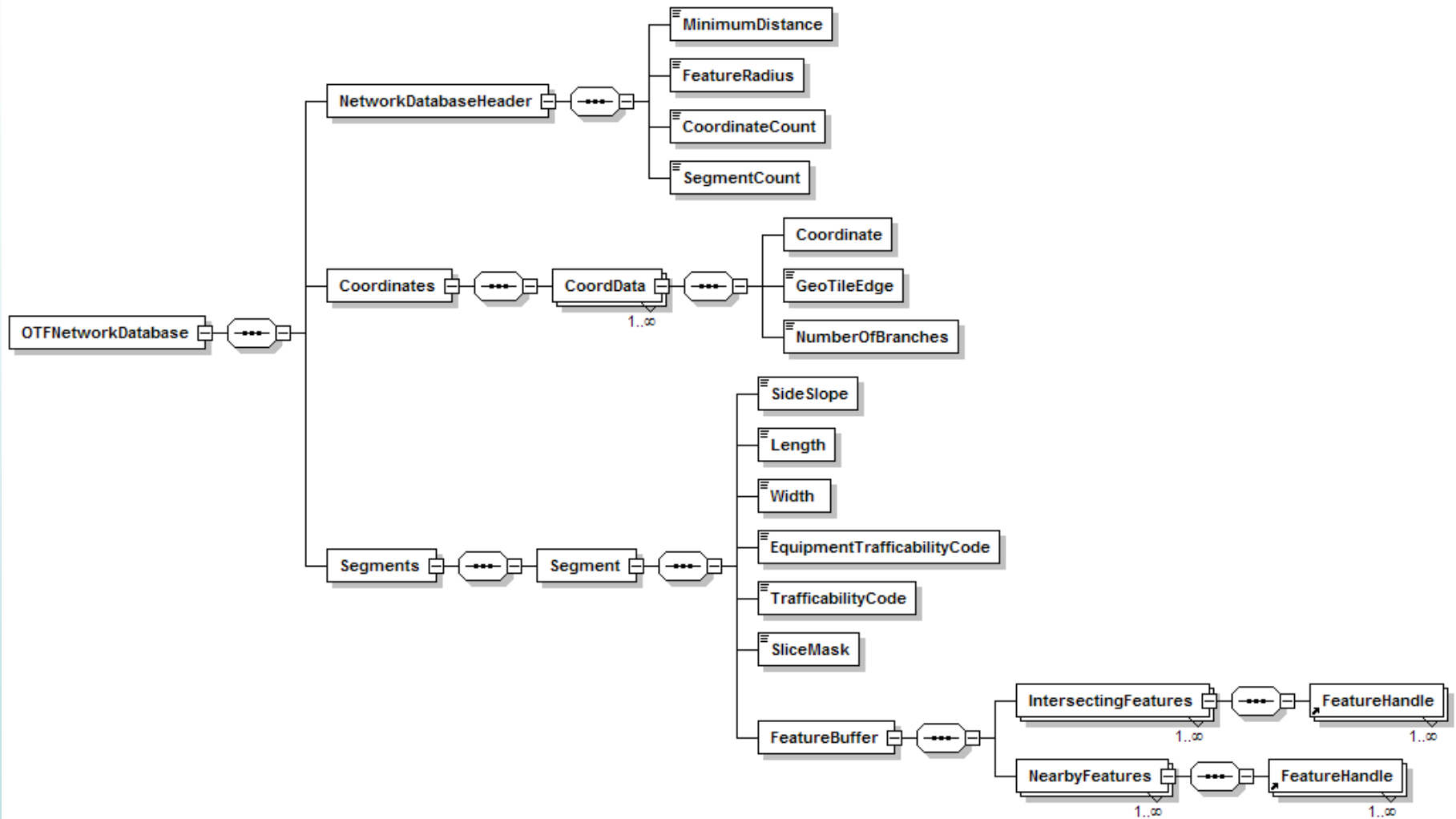
Schema Design for BTRA Network



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 Symbolology: 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

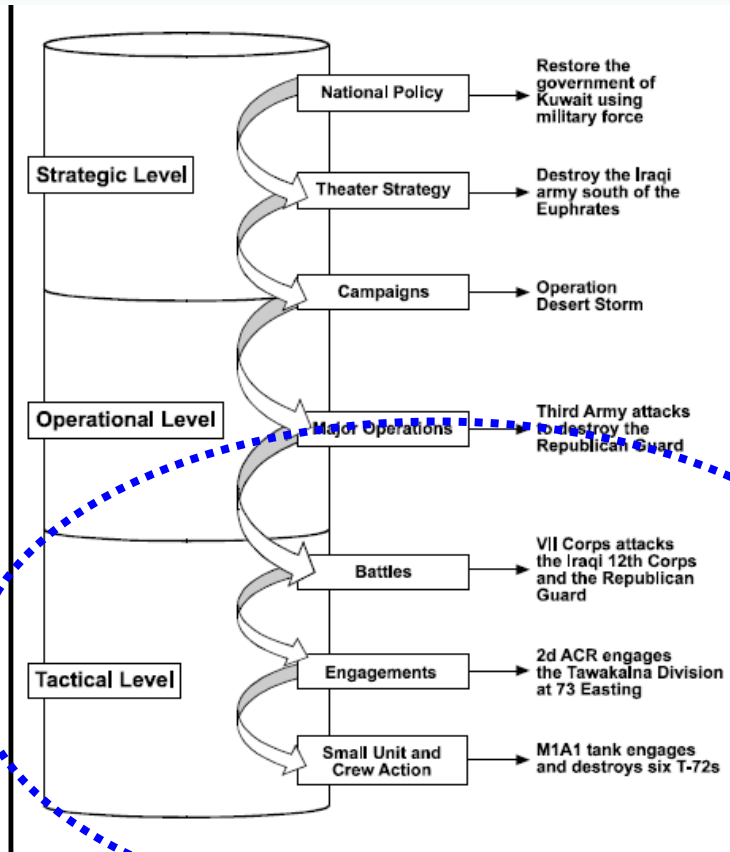
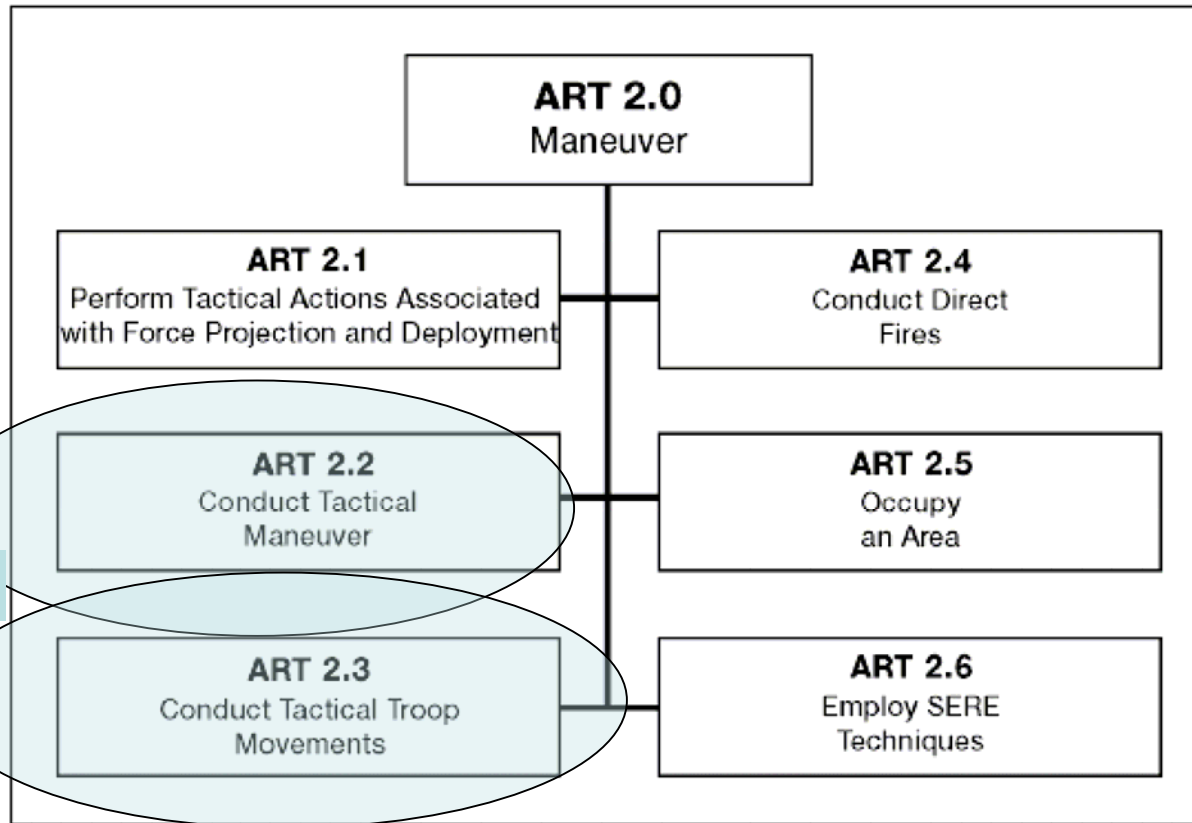


Figure 2-1. The Levels of War

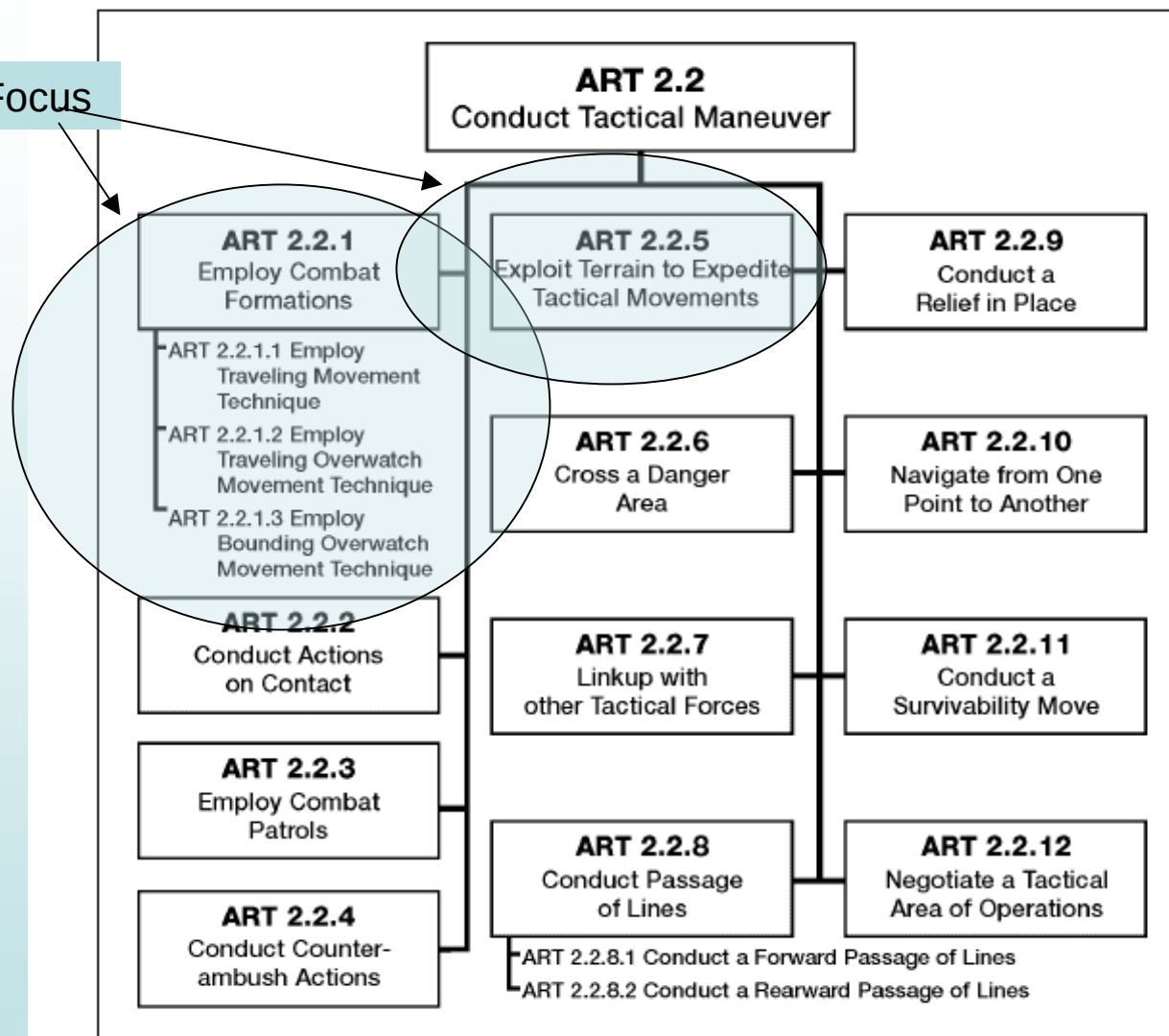
Taken from FM 3-0

AUTL Tasks/Subtasks

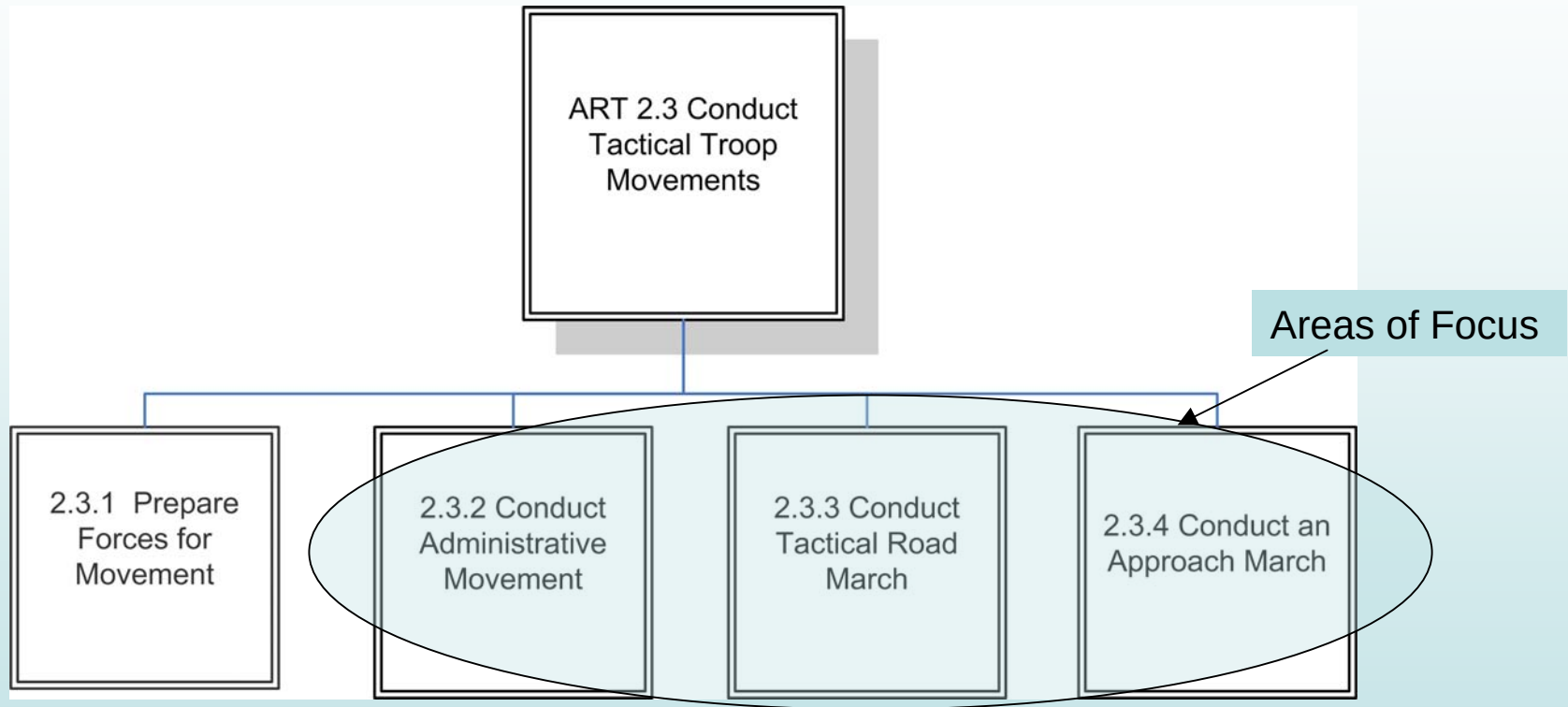


Areas of Focus

Areas of Focus



AUTL Tasks/Subtasks



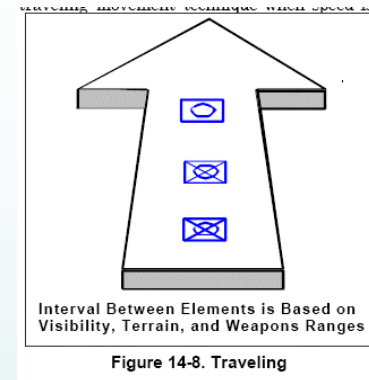
AUTL Task 2.3 Conduct Tactical Troop Movements and Subtasks

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

Movement Techniques

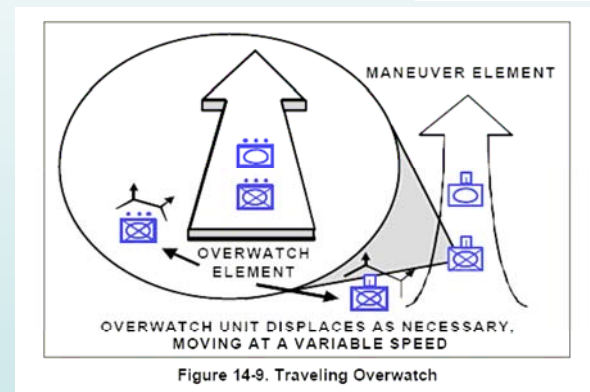
Traveling

- Speed necessary
- Enemy contact not likely



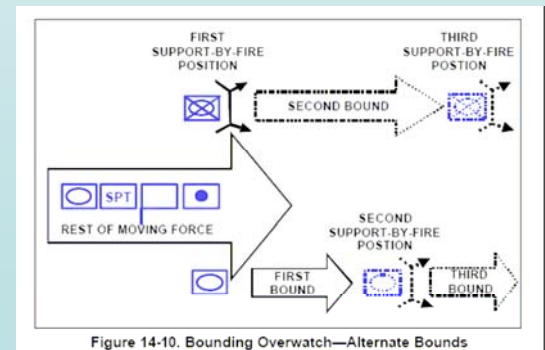
Traveling Overwatch

- 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

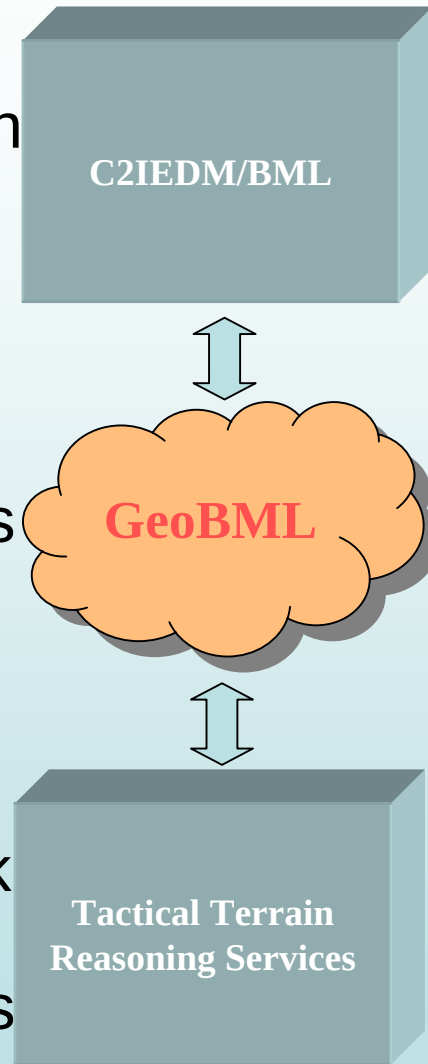
Tactical missions/tasks/activities from Planner or Planning S/W system should be able to be analyzed into and composed from Tactical Terrain Reasoning Information Structures

- 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

Scope: Ground Vehicles

correlation

COA Development/Analysis

scaling

BML / XBML

OOS

C2 Interoperability

CAPES / MC2

Environment – Systems Interaction
Interoperability (Maneuver Networks)

CMN Focus

BTRA

C/JMTK

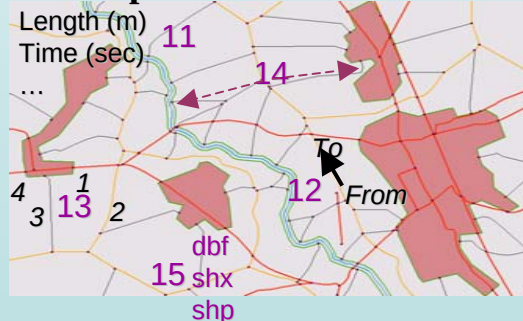
OOS Network
Attributes:

- surface material
- ...

environment

behaviors

Sample. Maneuver Network



BTRA Network
Attributes:

- vehicle speed
- corridor width
- cover
- ...

consistency

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

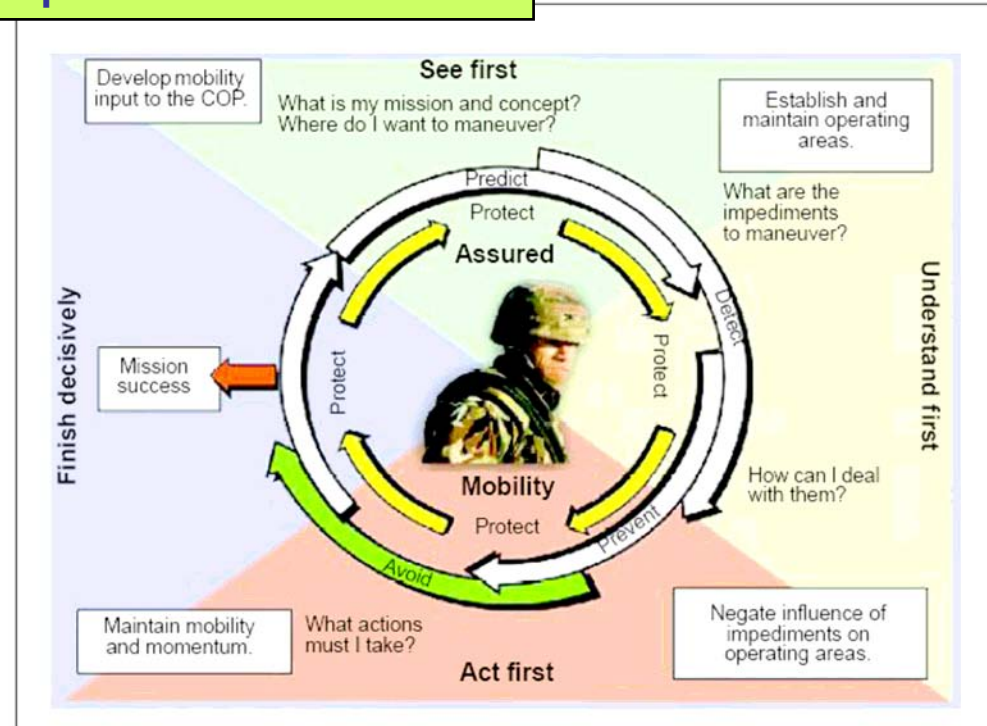


Figure 3-2. Assured Mobility and the Engineer Fundamentals

- 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

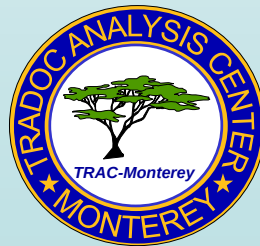
CMN – M-COP – GeoBML

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

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- 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?