Community-of-Interest (COI) Model-based Languages enabling Composable Net-centric Services

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Presentation Outline

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• A Framework for COI Model-based Languages
  – Defining the Problem Space
  – Implications for COI Model-based Languages
• The Top-Down/Bottom-Up Approach to Derive a COI Model-driven Solution
  – Overview of the Process
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  – Homeland Security Use Case
  – From Common Data to a Common Language
• Summary
Introduction

Challenge for SOA Languages:
How to use the COI Agreements?
Premises – Working Hypotheses (Part I)

• **Efficient Collaboration** is based on effective and efficient communication between participating organizations and individuals

• ** Efficient communication** between organizations and systems required to understand the overall context – or the business process that will be supported – of the information exchange

• Participating organizations will use their IT systems to support their business process contributions, so it is necessary to **Assess Existing Solutions** in the affected domains with respect to their usability in other domains
Premises – Working Hypotheses (Part II)

• This presentation introduces a **Framework** that allows one to specify a domain, analyze existing solutions, and show how they can play together in support of a more general solution.

• It is strongly motivated by the NATO Code of Best Practice for Command and Control Assessment:
  – Do not rely on one model or tool to solve a complex problem, but apply an **Orchestrated Set of Tools** to evaluate the different relevant aspects and facets of a problem

  Diversity is good, but each solution comes with its own viewpoint and vocabulary
The Challenge in the Net-centric Environment

How to support

– Many viewpoints
– Implemented in heterogeneous IT systems
– In systems that were not designed for net-centric operations
– That come with their own data and object models

And combine them

– Into a semantically homogeneous support system
– Based on a common language
Introducing a Common Information Exchange Model
A Framework for COI Model-based Languages

Defining the Problem Space
Implications for COI Model-based Languages
Community of Interest (COI)

- COI is defined as the collection of people that are concerned with the exchange of information in some subject area
  
  Scott A. Renner: A Community of Interest Approach to Data Interoperability. Proceedings Federal Database Colloquium '01

- The community is made up of the
  - users/operators that actually participate in the information exchange
  - the system builders that develop computer systems for these users
  - the functional proponents that define requirements and acquire systems on behalf of the users

- Renner stresses the importance of COI data panels and their task to support Common Data Representations (CDR) to be used within the COI for data exchange
Human-to-Human Communication

- Includes organization-to-organization communication and human-to-human communication
- Most important domain
  - All other domains are only supporting
- Challenges
  - Linguistic differences
  - Cultural differences
  - Common awareness
  - Etc.
Human-to-Machine Communication

• Bridges two very different linguistic worlds:
  – Spoken language of humans/natural languages
  – Language of machines
• Characteristics of NL
  – Ambiguous
  – Ill-structured
  – Requires a rich context for interpretation
• Characteristics of Machines
  – Logic
  – Unambiguous
• Translates the human-oriented view into the machine-oriented view.
Machine-to-Human Communication

• Translations from machine-oriented view into the human-oriented view
  – Challenging, but much easier than the other way around

• Challenges
  – Presentation of data (Edward Tufte)
  – Generating of reports
  – Spoken reports (“virtual humans”)

• Very good solutions have been identified and are applied in various domain (incl. Military Training, Serious Gamins, etc.)
Machine-to-Machine Communication

- IT-centric communication (although may be human readable)
  - USMTF/ADatP-3
  - Federated Databases
  - Data Replication Mechanisms
  - Military XML Schemas
- Both systems represent their knowledge in a finite set of data or objects
  - Regular expressions
    - Inductive techniques (data model, XML schema)
    - Productive rules (grammars)
  - Closed world (with extension rules or configuration layers)
  - Logic
  - Unambiguous representation
Implications for COI Model-based Languages

- The COI (human-to-human) drive the data definition and information exchange requirements
  - System-to-System Interoperability
    - Identify elements that can be mapped to each other
    - Identify gaps (but closing is not in this domain)
  - Sufficiency of an IT Solution for an Operation
    - Sufficiency can only be answered by the operational domain
    - Machine-to-machine can only support
  - Ambiguities in Expressions
    - There are no ambiguities in regular expressions
    - Ambiguities are captured in an unambiguous way
  - Defining a Common Language for System Interoperability
    - Take all information elements needed (human-human)
    - Map them to unambiguous data elements of the COI model
The Top-Down/Bottom-Up Approach to Derive a COI Model-driven Solution

Overview of the Process
Top-Down Approach
1. Identify Organizations and the common operational ideas
2. Identify Conceptual model and who is doing what
3. Specific data vocabulary supporting doctrine from business rules

Bottom-Up Approach
4. Identify systems and data models supporting organizations
5. Apply Model-based Data Engineering to allow common interchange of systems through CRM
6. Adapt Atomic, Composite, and Aggregate access from business rules-derived vocabulary to CRM

Result can be used to configure XML-Based Mediation Layers
XML Data Mediation Services based on the CRM

1. Data Modeling and Data Documentation
   - XML Document

2. Data Administration

3. Data Management
   - Mapping to CRM
   - Extending CRM
   - Enhancing CRM

4. Data Alignment

5. Data Transformation
   - Generate XSLT (+)
XML Data Mediation Services based on the CRM

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Application Use Cases

The NATO Use Case
Homeland Security Use Case
From Common Data
to a Common Language
Use Cases in the C2 Domain

• NATO
  – Multilateral Interoperability Programme (MIP)
  – JC3IEDM as the CRM
  – Data Exchange based on operational needs defined by data model experts

• Homeland Security
  – 22 previously disparate agencies
  – XML schema defined on common operations

• Department of Energy
  – Power generators and consumers are interconnected via the Power Grid
  – Systems are under federal management
  – Effects are not limited to management domain

• Coalition Battle Management Language
  – A common language for real forces, virtual forces, and robotic for tasking and reporting
  – Digital Battlefield enabler
C-BML enabling Web Services

NATO MSG-027
PATHFINDER Integration Environment
Experiment C2-M&S Coupling
November 9, 2006
Summary

So what – for C2 and NECC?
Net Enabled C2 Capability

Service/Organization Specific Extensions

COI Extensions

Domain Common Core

Universal Core

When

Where

Info Sharing Need

Drives

Service Needed

Drives

Data Needed

Drives

Capability Delivery

Enables

Service Implementations

Enables

Community Information Exchange Vocabulary

Drives

ICCRTS 2008
CRM must be the Core model

- Don’t start with the clean plate all-over again
- Capture information exchange as
  - Information exchange requirement
    (what the system should talk)
  - Information exchange capability
    (What the system can talk)
- Gradually capture agreements across individual solutions
- Don’t solve the wrong problems with the right solutions
  (problem domains of communications)
Questions?

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