Entity/Data Representation in Different Contexts, Frames of Reference, and Context-Changing Events

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Why can’t we all get along?

• All data is a representation of some “reality”
  - Data is about some entity, in some context (s) for some purpose(s)
  - Requires a frame of reference for representation

• Systems capture and represent data
  - For some context(s), purpose(s), and scope
  - Often using institutional frames of reference

• Examples of data about entities
  - The Prime Meridian (zero degrees longitude)
  - My email address, location, weight
  - Your customer ID, retirement plan, or car color
Because we are all different

• Different systems embed different contexts, purposes, and scope decisions by different institutional sponsors

• The Internet revolution exposes these implicit context/scope decisions (e.g., the IOT)

• The surprising thing should be how much commonality there actually is

  - Non-standard data representation should be viewed as the norm

  - Common data standards reflect broad institutional frame of reference and scope overlaps – not universality (e.g., GPS/WGC-84 Geode)

Commonality only makes sense in the context of differences across which the commonality is, in fact, common
Key Definitions

**Operational Context:** The attributes which characterize an entity’s purpose & state, within some scope

**Perspective:** a particular system’s or individual’s version/view of some context/entity for its purposes

**Frame of reference:** The representational convention used to describe some entity along one or more attribute dimensions, including context attributes

**Scope:** the portion of possible real world and conceptual entity space a given system, context, perspective, or frame of reference includes

**State:** The value of context and other variable attributes for an entity at some time in some frame of reference

**Domain:** A named, shared, subset of functional/operational space with specified scope and specialized perspectives and frames of reference for describing operational context and state – a type of community perspective
Context Shifting Events

• Bring systems into unexpected/unplanned contact
  - E.g., Katrina, Afghanistan, corporate mergers, legacy upgrades, plan vs actual, composite simulations, etc.

• Root cause of most interoperability “problems”
  - Others are either errors or due to resource limitations

• Usually violate context and scope assumptions of system designers
  - These are rarely explicitly represented in system data
  - Are more pervasive than designers imagine or realize

The Internet Makes Context Shifting Events an Everyday Occurrence
Thought Experiment 1 – “Saving Private Ryan”

Interaction among systems, institutions is constrained by different perspectives, scope and frames of reference.
Thought Experiment 2 – Tsunami Relief

Country B Context
Military Force Awareness

Civil Force Awareness
Country C Context

NGO Force Awareness
Transnational Context
Disaster Relief Force Awareness System of Systems

Context Shifting Event

Country A Context
Military Force Awareness

Civil Force Awareness
Commercial Force Awareness


Global Level Event – All Domains
Multi-national Disaster Relief
Some Specific Data Representation Issues in Thought Experiments

- **Thought Experiment 1 – Force Development Context vs Force Employment Context**
  - Individual soldiers identities? SSN? Name? Service#?
  - Soldier to platform mapping, platform to unit mapping
  - Unit identities in both contexts (Name, UIC, TF ID)
  - Unit location representation (mailing address, geoloc)
  - Military Service scope, Skill representation

- **Thought Experiment 2 – Multiple Country and NGO contexts, data variability across countries**
  - Granularity of force representation, national scope
  - Force identification, capability representation
  - Location representation by granularity level
  - Composite unit representation (task forces)
Key observations

• There are very few “near-universal” data representations (e.g., location, time)
  - Even these have many variants and context dependencies
  - Assume a geo-centric context and ISO/WGC frame of reference

• Most non-phenomenology data has an institutional frame of reference and implicit scope
  - Unit ID, personal ID, skill codes, facilities, features

• Identities are particularly key in this regard
Key observations

• The same entity may have different roles and identities in different contexts and perspectives
• Even if the identities are the same, other values may be different for different contexts
  - E.g., location, equipment, fuel level, etc.
• Identities have different degrees of specificity in different contexts and may represent different levels of aggregation
• Roles, identities and other important entity attributes have value ranges constrained by scope assumptions of sponsoring institutions

Explicit representation of context, scope, and frame of reference needed
What You Can Do

• **Recognize the diversity of perspectives, contexts, and scope**
  - Where practical, incorporate key context/scope assumptions in the ontology itself
  - Provide network-discoverable and machine-processable context/scope descriptions for ontologies when not included in the ontology itself

• **Consider developing common context/scope attributes or ontologies for your domain**
  - Work with emerging domain communities of interest
  - Look at NCOIC SCOPE model for context attribute concepts
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