Distributed UDEF Architecture
The Global Enabler for Semantic Interoperability

Arnold van Overeem
IT Architecture Practitioners Conference, Amsterdam, Oct 18-22 2008

Semantic Interoperability, Open Members Meeting on Wednesday 20 October 2010

http://www.opengroup.org/amsterdam2010/

- UDEF objectives and vision
- Current status
- Distributed UDEF developments
- Towards wholistic semantic interoperability
Boundaryless Information Flow™ requires compatibility and available standards on all layers of interoperability.

The Architecture Forum Interoperability Workgroup is describing what is needed in which case.

Standards for the “Network & Media” layer (TCP/IP) and for the Technical layer (XML) are well understood and widely deployed.

A semantic standard is among the needs; process layer standards are emerging (e.g. SVBR).

Other semantic standards (OWL, RDF) are semantic languages and fail to solve the business problems of enterprises who need interoperability.

UDEF has been promoted by The Open Group as a framework and standard to address semantic interoperability requirements.
UDEFs unique Value Proposition

- First version published in 2006, continuous to be extended
- Multilingual capability first introduced in 2008
- Latest version 1.22 (October 2010)
Many industry specific concepts not modeled
- Open Group lacks in depth expertise in many industry domains
- Open Group only models “vendor neutral” data element concepts

Many enterprise specific concepts not modeled
- Individual enterprises would want to model certain areas differently

Governance process not agile due to quality procedures
- Some required extensions do not exist in other languages
- Enterprises want to try some extensions now

UDEF assumes the context of an Enterprise for all data to be modeled
- For some required concepts the enterprise concept is not known, not applicable or not relevant
- Enterprises want flexibility to describe data in multiple contexts

UDEF is public domain in its entirety
- Sometimes the understanding of data conflicts with security requirements
The Vision:

The UDEF-semantic infrastructure will be a distributed set of registries (like the DNS) each managed by its own registrar, using common standards and common and collaborative, partly shared, governance processes.

The global (root) UDEF-registry is managed and maintained by the Open Group, who as well has the authority to assign registrars of descendant registries and the authority to define the governance processes.

Every system owner can freely use the UDEF on a royalty free basis and can submit extension proposals.

Future extensions of the UDEF trees, including descendant registries will enable all systems around the world the exchange data in a semantically consistent manner, without requirements for system managers to make any prior arrangements beyond being UDEF-compliant.

National language versions of UDEF extend this vision across language barriers.
Boundaryless Information Flow™
Consists of:
✓ Connectivity (TCP/IP)
✓ Technical & syntactical interoperability (XML)
☐ Semantic interoperability
☐ Procedural interoperability

Semantic interoperability requires:
✓ Controlled vocabularies
✓ Multilingual extensions
☐ Distributed vocabularies
✓ Controlled valuesets
✓ Cryptographic extensions
✓ Controlled classifications
✓ Controlled relations
The “Key” for a Controlled Vocabulary of Structured Data
UDEF version 1 is established as a standard in 2006 (originally 1030 Objects, 983 Properties)

Multilingual support added as of 2008 (version 1.1); now available in English, Dutch and French, more languages planned

Several vocabulary extensions (current version 1.22 has 1254 Objects, 1277 Properties), more extensions planned

First tools are coming to market

Industry and Enterprise vocabularies as next upgrade
UDEF Objects Establish Context

Entity

Enterprise B

Program

Enterprise A

Place

Laws-Rules

Process

Product

Document

Environment

Person

Asset

Liability

Condition

Resources

Animal

Plant

Substance

Basic Objects Applicable to Any Enterprise

UDEF Naming Convention

ISO 11179

UDEF Data Element Name

Object Class Term

0...n qualifiers + 1 or more required Object Class

Property Term

0...n qualifiers + 1 required Property

Arnold van Overeem – Global Architect – Capgemini NL sector Private

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UDEF Basic Data Type Properties

- Amount - **Amount**
- Binary Object (Graphic, Picture, Sound, Video) - **Graphic, Picture, Sound, Video**
- Code - **Code**
- Date Time (Date, Time) - **Date, Date Time, Time**
- Identifier – **Identifier**
- Indicator – **Indicator**
- Measure – **Measure**
- Numeric (Value, Rate, Percent) – Value, Rate, Percent
- Quantity – **Quantity**
- Text (Text, Name) – **Text, Name**

Agreement on Basic Data Types is Fundamental to Interoperability
The Universal Data Element Framework (UDEF)

ISO/IEC 11179-5 Naming Convention

Data Element Concept Name

Object Class Term

0..n qualifiers +
1 or more required
Object Class

Property Term

0..n qualifiers +
1 required Property

Example UDEF-Based Data Element Concept Names

Document Abstract Text
Enterprise Name
Product Price Amount
Product Scheduled Delivery Date
Engineering Design Process Cost Amount
Patient Person Family Name
Patient Blood Body Substance Glucose Concentration Measure

UDEF names follow the rules of the natural language -- each language has its own syntax rules
Registry linkage visualised

- Connectors represent root of descendant tree in parent tree
- Root concept in descendant tree matches extension position in parent tree
- Root of descendant tree and connector in parent tree are aliases whenever the context of the parent tree applies
- Descendant tree registrar has received accreditation by parent registrar
- Concept domain of descendant tree agreed with parent registrar
- Parent registrar defines roots of descendant trees; descendant registrars define branches in their trees
Scope of DDEF trees

- Not the same data element concepts in different trees
- Not a replication of what already is in UDEF
- Not an unlimited freedom to use some of the UDEF principles with a different flavour of your own choice
- Not (yet) a complete and ultimate solution for universal semantic interoperability

- Many more data element concepts not modeled in UDEF today or in future
- The possibility to define data element concepts in some other context than a generic enterprise
- Full integration of UDEF / DDEF definitions in an integrated semantic environment
- A major step forward to overcome the hurdles of universal semantic interoperability
Multiple Layers of Distributed Vocabularies

Main (Global /Root) vocabularies

Distributed Vocabularies

2nd Level Distributed Vocabularies

Scope of the current Registry Switching Workgroup

UDEF

3rd Level Distributed Vocabularies

Ambition level of UDEF version 1.5 restricted to a single layer of distribution and only SDEF and PDEF. Multiple layers of distribution and other types of distributed registries will be developed in future versions of UDEF beyond version 1.5

Types of distributed vocabularies:

- **SDEF** – Satellite Data Element Framework: Public vocabularies for a specific knowledge domain, managed by an neutral authority in that branch of industry
- **PDEF** – Private Data Element Framework: Private vocabularies for a specific enterprise domain, managed privately by each UDEF certified enterprise
- **LDEF** – Language-specific Data Element Framework: Public vocabularies for a specific language, managed by a lexicographic authority for that language (group of languages)
- **XDEF** – Cryptographically-concealed Data Element Framework: Vocabularies for secure semantics managed by a UDEF certified trusted 3rd party
- **MDEF** – Merged Enterprise Private Data Element Framework: Vocabularies for post merger integration of UDEF certified enterprises
Flexibility with multiple object and property tree sources

Combine any object tree with any property tree

ISO/IEC 11179-5 Naming Convention

Data Element Concept Name

Object Class Term

0...n qualifiers + 1 or more required Object Class

Property Term

0...n qualifiers + 1 required Property

Registry switching allows to combine different vocabularies on the fly, even within a data element concept

- UDEF object
- SDEF object
- PDEF object
- SDEF-extended UDEF object
- PDEF-extended UDEF object
- PDEF-extended SDEF object

- UDEF property
- SDEF property
- PDEF property
- SDEF-extended UDEF property
- PDEF-extended UDEF property
- PDEF-extended SDEF property
Knowledge Domains are key for creating a satellite vocabulary

- Aerospace. This knowledge domain includes civil and military aviation, aviation industry and astrophysics.
- Medical. This knowledge domain will include both medical industry and proper healthcare, including veterinary health care.
- Energy and Utilities (including nuclear industry and power conversion).
- Telecom, Internet and Media (including broadcasting, publishing and entertainment industry).
- Oil and Mining. This knowledge domain includes geology, gas, offshore drilling, chemical and heavy industry.
- ICT (programming, business analysis, architecture methods, testing).
- Engineering and construction.
- Travel & Transport (including lodging, tourist industry and entertainment).
- Social security and taxes.
- Education, science and literature (including mathematics, physics and arts).
- Finance. This knowledge domain includes banking (both private banking and investment banking), insurance, monetary services and global economics.
- Automotive, travel and transport (including parts industry).
- Manufacturing (including fashion) and high tech industry.
- Nautical (both commercial and naval).
- Retail, logistics and distribution (including postal services).
- Tax, social security, customs.
- Legal, police, civil security.
- Local government, housing, geo planning, surface waters.
- Meteo (climate, geology (overlaps with oil& gaz).
- Agriculture, (marine) biology.
- Entertainment, tourism, exhibitions, mass events.

- Enterprises in one area of business are likely to share a knowledge domain-specific set of additional Data Element Concepts, that is rarely used outside that knowledge domain.
- Enterprises in a specific knowledge domain have a need to interoperate and exchange data on topics that are specific to their knowledge domain.
- Enterprises in the knowledge domain already have identified the need for a common standards organization. This organization already has or is likely to consider an information reference model in scope of their activities.
- Enterprises in the knowledge domain also have interoperability requirements with enterprises outside their knowledge domain.
- Enterprises in the knowledge domain have noticed that other enterprises do not implement their standards, moreover, the "external" standards are relatively useless in the knowledge ICT domain of this enterprise.
- Enterprises typically have their legacy systems, often in native language, that has to interoperate with package software.
A single DDEF root object can have multiple connection points in UDEF

Example: Medical_Observation (supposed to be SDEF object tree starting from s4)

### As a Health.Record.Document

<table>
<thead>
<tr>
<th>V 1.00</th>
<th>c.l.2</th>
<th>As-Built</th>
<th>Wie-gebaut</th>
<th>Tel que construit</th>
<th>作為建</th>
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<tbody>
<tr>
<td>V 1.00</td>
<td>d.l.2 #Release</td>
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<td>Version</td>
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<td>de Santé</td>
<td>健康</td>
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### As an Assessment.Process

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<th>de Découverte</th>
<th>發現</th>
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<td>des Changements</td>
<td>改變</td>
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<td>Medisch-SDEF-obj104</td>
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### As a Medical.Condition

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<th>Umstand</th>
<th>Condition</th>
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<td>Long</td>
<td>Lunge Anfälligkeit</td>
<td>Pulmonaire</td>
<td>肺癌</td>
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<td>Vatbaarheid</td>
<td>Anfälligkeit</td>
<td>Problematique</td>
<td>問題</td>
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<td>Medisch-SDEF-obj104</td>
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<td>Risiko</td>
<td>Risque</td>
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<td>Préventive</td>
<td>準備就緒</td>
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<td>Wetter</td>
<td>Météo</td>
<td>天氣</td>
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</tbody>
</table>
Some potential example data element concepts enabled by SDEF trees

Aerospace example
- A380-Compliant.Docking-Position_Departure-Gate.Identifier

Mining example
- Yellow-Cake.Mining-Product_Radiation-Level.Measure

Healthcare example
- Limbal.Stem-Cell.Disorder_Clinical-Finding

Energy example
- High-Voltage.Powerline_Length.Measure

Telecommunications example
- Option.Bundled.Offering.Product_Activity.Indicator
- 3G.Radio-Coverage_Density.Measure

Disaster response example
Registry linkage visualised

UDEF-tree

Descendant tree

Registered descendant tree registrar

connectors

Registered descendant tree registrar

Descendant tree
Some example data element concepts enabled by PDEF trees

- DSS-P.Employee
  CSS.Employee
  DSS-A.Employee
  Architect.Employee
  Certified.Architect.Employee
  Engagement.Manager.Employee
  Programmer.Employee
  Young.Professional.Employee

- Drilling.Engineer.Employee
  Geology.Engineer.Employee
  Relocated.Employee
  Nigeria.Relocated.Employee
  Alaska.Relocated.Employee
  Refinery.Maintenance.Employee

- Nurse.Employee
  Clinical.Secretary.Employee
  Surgeon.Employee
  Cardiac.Surgeon.Employee
  Orthopedic.Surgeon.Employee
  Technical.Staff.Employee

- Group.Leader.Employee
  Sales.BSS.Employee
  Wholesale.Sales.BSS.Employee
  Retail.Sales.BSS.Employee
  Radio.Coverage.Monitoring.OSS.Employee

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2008 Registry Switching Workgroup objectives

- to define one or more aerospace industry specific object trees that are descendant from the UDEF objects
- probably some aerospace industry specific property trees that are descendant from UDEF properties
- define principles for the formation of a descendant tree
- define connection points in UDEF for these descendant trees
- define the governance structure and processes for a decendent SDEF
- setup an aerospace descendant registrar (as part of an existing aerospace industry acknowledged organisation)
- define and implement the interfaces between that organisation and the Open Group as owner of the global UDEF
- define and implement principles to assign extension proposals to either the global UDEF or to the aerospace descendant SDEF
- to provide proof of concept for registry switching during semantic conflict resolution
- to make this all sufficiently generic to be also applicable for other industry specific descendant SDEFs, eg for the medical domain
- to do all of the above for a private descendant PDEF
- to establish principles for defining UDEF extensions as either global, industry specific or private.

You can still join the workgroup about registry switching at https://www.opengroup.org/projects/undef/protected/mailinglists.tpl?CALLER=index.tpl

This week we will jointly:
- Review the work of the past 2 years
- Define the way forward

Join the Semantic Interoperability Members Meeting on Thursday!
**Different types of semantic conflicts**

<table>
<thead>
<tr>
<th>Conflict type</th>
<th>Description / example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Value conflicts</td>
<td>In order for values to be comparable and/or to derive summary or aggregate data from it, they must share metadata about how they were determined: e.g. blood glucose levels obtained by the same procedure; engine power measured under the same conditions; chemical process yields at the same temperature and pressure, etc.</td>
</tr>
<tr>
<td>Data Precision conflicts</td>
<td>The mass of a vehicle in one system may be defined in multiples of 100 kg, whereas another system stores more precise weights in units of kg, or employ different rounding rules. Another example is the calculation of a supply of spare parts: does it include the parts that left the warehouse but are still in possession of service technicians that may or may not ever use these, or is this unspecified.</td>
</tr>
<tr>
<td>Spatial Domain conflicts</td>
<td>Data defined in one system has legal implications which are dissimilar from and potentially incompatible with corresponding data in another system. In Spain, part of the identification of people is derived from referral to the identification data of his parents, whereas in Germany privacy protection prohibits links from children to parents (links from parents to children are allowed).</td>
</tr>
<tr>
<td>Labeling conflicts</td>
<td>Both homonyms (different concepts described by the same word depending on context), and synonyms (multiple alternative words describing the same concept) belong to this category.</td>
</tr>
<tr>
<td>Confounding conflicts</td>
<td>Data defined in a way that makes their actual meaning dependant on the content (value) of other data: the meaning of “today’s” weather depends on some temporal and geographical data stored or assumed elsewhere. Similarly the “first appointment” of the day in a diary changes meaning when a new appointment is scheduled on an earlier hour. “My wife” changes meaning when referred to by “You”.</td>
</tr>
<tr>
<td>Schema isomorphism conflicts</td>
<td>Schema-isomorphism conflicts occur when the same concept (entity class) is described by a dissimilar set of attributes, that is: the same concept is represented by a number of different attributes and, therefore, the sets of entities are not setoperation-compatible.</td>
</tr>
<tr>
<td>Integrity conflicts</td>
<td>Data, correctly and legitimately stored in one system as occurrences of a concept, violate integrity constraints enforced by other systems that hold and exchange data on the same concepts. E.g. marital status that in on system implies married or previously married people to be of opposite gender, whereas other systems are compatible with concepts of gender change and gay marriage.</td>
</tr>
<tr>
<td>Generalisation conflicts</td>
<td>Data defined in one system may be a subset or superset of the data defined in another system; the system defining the subset may hold mandatory attributes that are invalid for some occurrences of the superset system.</td>
</tr>
<tr>
<td>Aggregation conflicts</td>
<td>Data stored in one system are defined such that collective (aggregate) data in another system cannot be derived (and vice versa). For example: a group of children is classified in one system by age groups, whereas another system, that doesn’t have access to age data classifies the same group of children by their school advance levels, which cannot be accessed by the first system.</td>
</tr>
</tbody>
</table>
### Semantic solution matrix

<table>
<thead>
<tr>
<th></th>
<th>Vocabularies</th>
<th>Properties</th>
<th>Objects</th>
<th>Values</th>
<th>Security</th>
<th>Classification</th>
<th>Relations</th>
<th>Representation</th>
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</table>
Subsequent versions of UDEF will ultimately solve all semantic interoperability conflicts.
Semantic Interoperability and UDEF evolution – distributed vocabularies

- Registry Switching workgroup addresses working with multiple vocabularies
- Distributed vocabularies are organised in a tree, with UDEF as root.
- Existing vocabularies may be imported into a DDEF; adding DDEF tags to the elements of the vocabulary doesn’t restrict its capability
- Develop strategies to import existing vocabularies with maximum reuse of efforts expended by other bodies
Semantic Interoperability and UDEF evolution – next major version

- Expand the scope of UDEF to include value semantics on individual Data Elements
- Address Data Base normalization issues
- Address Data Value conflicts, Data Precision conflicts and Confounding conflicts
- Some cleanup of UDEF v 1.x trees may be proposed
- Will be fully backwards compatible with UDEF v 1.x as a minimum requirement
Semantic Interoperability and UDEF evolution – secure UDEF

- Extend the UDEF trees and the governance processes to support secure semantics
- Extend the UDEF trees and the governance processes to apply semantic interoperability on secure data
- Develop security processes around UDEF together with Security Forum / Jericho Forum
Semantic Interoperability and UDEF evolution

- Add support for classification and relation semantics
- Add support for controlled representation
- Add business rules to steer missing semantic data
- Provide a wholistic solution for unrestricted semantic interoperability
- Develop the Semantic Gateway together with SOA workgroup
Semantic Interoperability and UDEF evolution

- Add support for universal context
- Add support for controlled representation
- Add business rules to steer missing semantic data
- Provide a wholistic solution for unrestricted semantic interoperability
- Develop the Semantic Gateway together with SOA workgroup
Semantic solution matrix evolution

<table>
<thead>
<tr>
<th>Domain</th>
<th>Vocabularies</th>
<th>Properties</th>
<th>Objects</th>
<th>Values</th>
<th>Security</th>
<th>Classification</th>
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</table>

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Next Version of UDEF (1.5)

- Produce white paper on registry switching
- Find and involve registrars for knowledge domains
- Create UDEF certified enterprises
- Develop descendant trees
- Extend UDEF with connection points to descendant trees

Future UDEF (v 2 and beyond)

- Develop working mechanisms for concepts other than object and property
- Develop semantic security and secure semantics
- Design proofs of concept for various semantic conflicts
- Maintain backward compatibility

Existing tasks have to be continued or even extended:
- Evaluate extension proposals, and add extensions to UDEF
- Develop new language versions
- Maintain / Update documentation and collateral
Contribute to UDEF?

**Functional development**
- Value Domain
- Security
- Classifications
- Relations
- Representation

**Maintenance**
- Updates of Documents
- Updates of Website
- Registrar management
- Enterprise Certification

**Content development**
- Extension process
- Descendant registry knowledge domains

**Language teams**
- German
- Chinese
- Spanish
- South African
- Other languages to be chosen

**Documentation**
- Website
- White paper(s)
- Book
- Webinars
- Roadshow
- Flyers

**Marketing**
- Position relative to ontology based approach
- Conduct PoC projects and distribute success stories

**Tools development**
- Develop Maintenance Tools
- Develop Public Registry