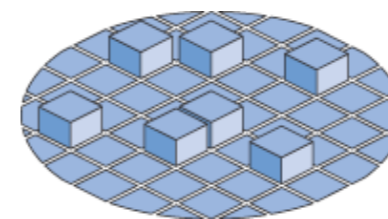


The Knowledge of the Grid: An Grid Ontology

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UniGrids

Overview

- Interoperability in Grids
- Background, motivation and approach this problem
- Extensible knowledge framework
- Foundational ontology and OGSA, S-OGSA ontologies
- Example concept from Unicore Ontology
- Current status and conclusions

Grid Interoperability

- There are two parties needed to make any Grid
 - Consumers (inc. applications) that want to use resources (inc. data)
 - Providers willing to share/sell resources
 - These have different perspectives on the resources required/offered
- Need to determine if two Grids are functionally equivalent
 - Not just that they run the same middleware
 - Needed when brokering across multiple Grids
- Requirement to describe ‘hybrid’ Grids
 - Two dissimilar Grids join: how do we describe the hybrid?
- **Mediation (interoperability) is required between these views**

Motivation for an Ontology of the Grid

- Existing glossaries and vocabularies not suitable for this task. E.g:
 - The GLUE schema models the abstract structure of the resources - “this is what we are, this is what we can do”
 - Unicore AJOs represent resources requests - “I want this work done in time for this event”
- All lack formality in their definitions, don’t express a shared point of view, are not explicit, don’t cover all the concepts and components that a Grid may have
- This work defines concepts at a higher level so that we can map to - and between - other work
- An ontology allows us to express a “formal, explicit specification of a shared conceptualization”

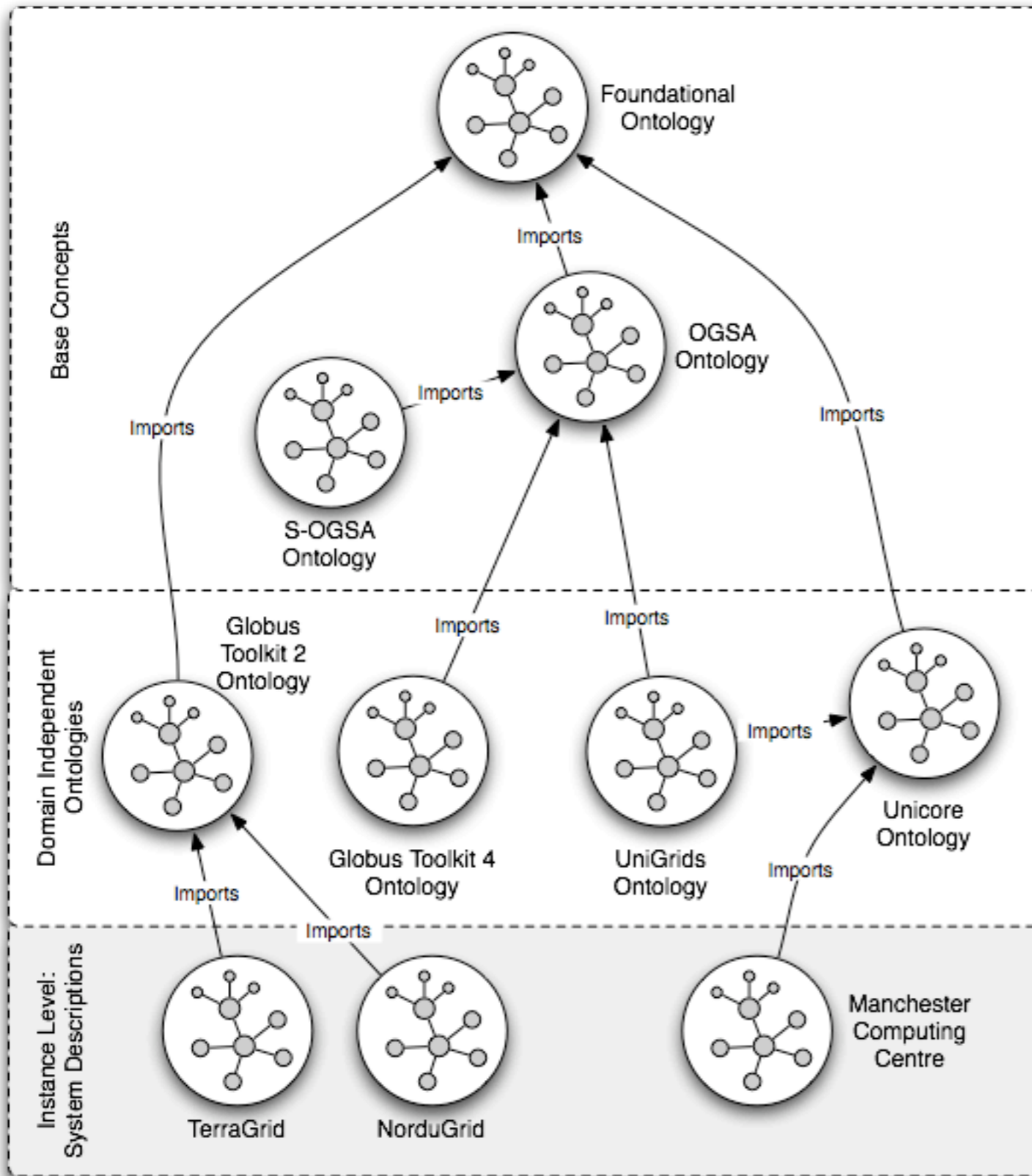
Knowledge of the Grid

- Building an ontology of Grid concepts allows us to [Noy 2001]:
 - To share common understanding of the structure of information among people or software agents
 - To enable reuse of domain knowledge
 - To make domain assumptions explicit
 - To separate domain knowledge from the operational knowledge
 - To analyze domain knowledge
 - Expose service metadata
- This is different to **knowledge on the Grid**

Methodology

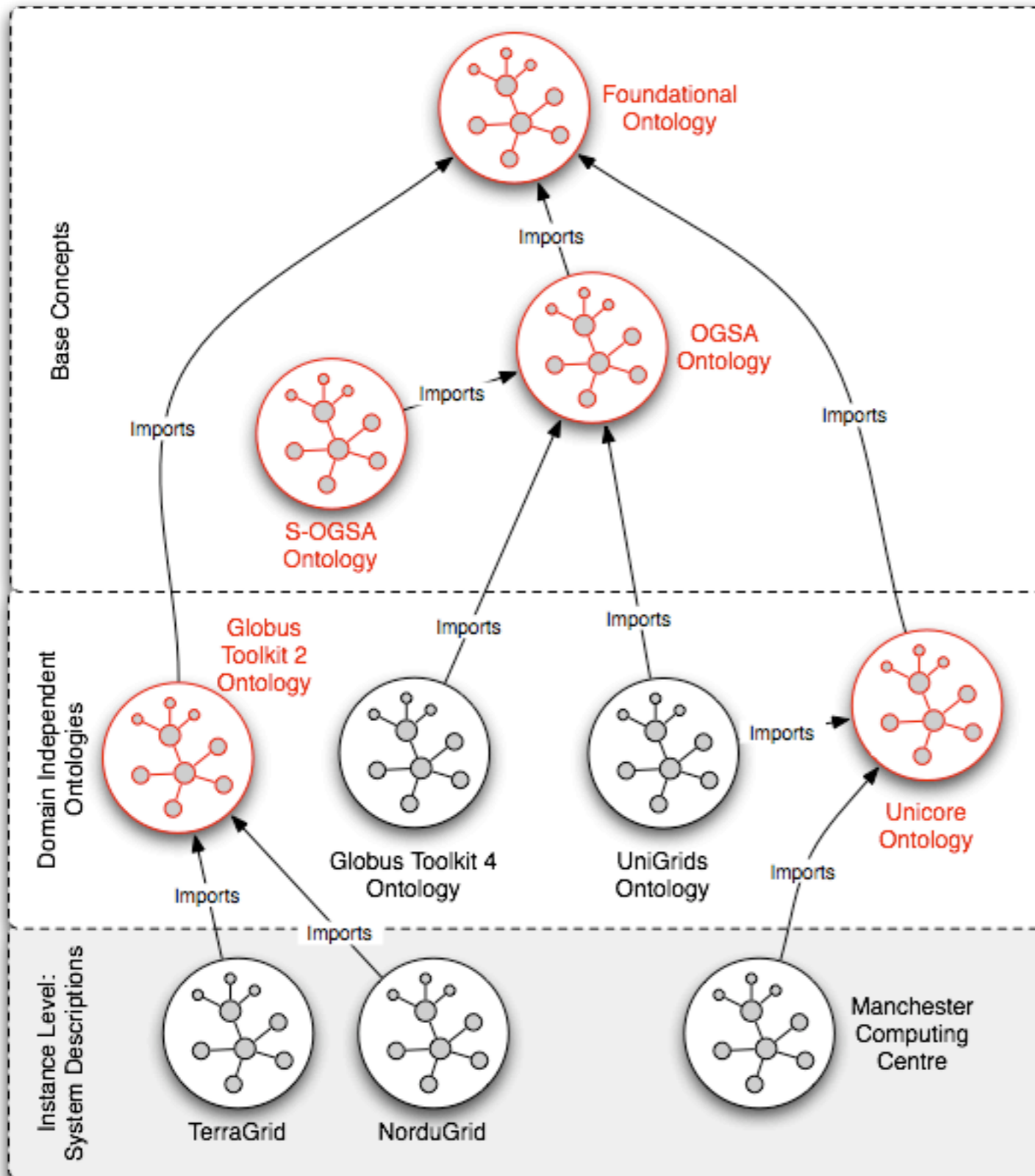
- A simple methodology developed as part of EU GRIP Project:
- The Grid idea is too general
 - Means many things to many people
- We abstract what is meant by ‘the Grid’
 - This has been done by observation, not theory
 - Looked at what people have successfully developed
 - Developed an ontology from these observations, extracting key concepts

Knowledge Architecture



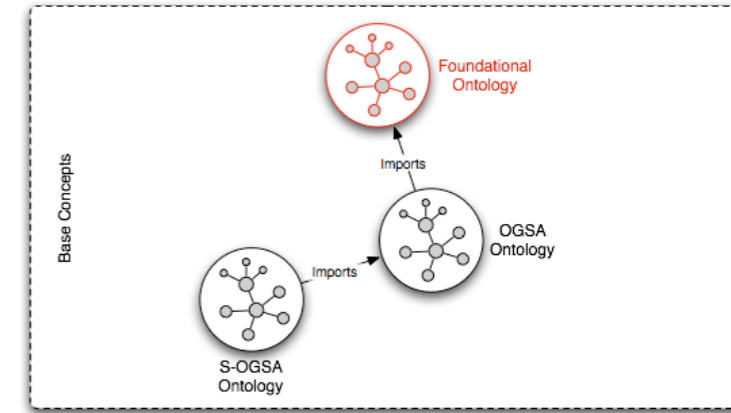
- Layered, modular model for maintainability, extensibility, and reusability.
- First tier: common, ‘base’ Grid concepts
- Second tier: domain-independent, middleware-specific concepts
- Third tier: domain ontologies describing Grid instances

Knowledge Architecture



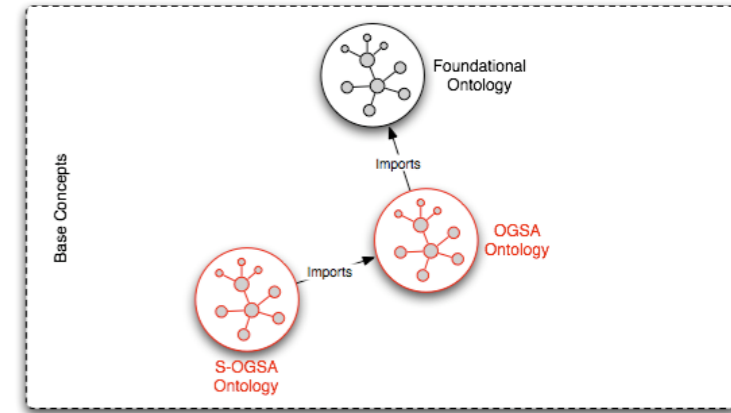
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Foundational Ontology



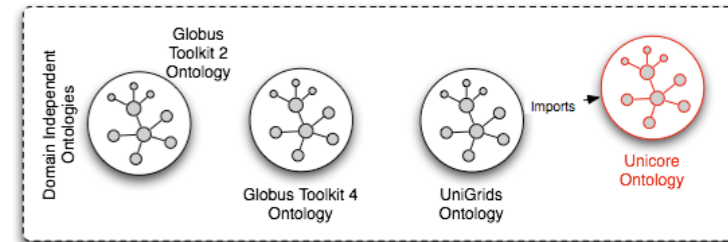
- Defines the high-level, common, general-purpose Grid concepts that can be re-used in the description of
 - Grid middleware, infrastructure, application, protocols, services, resources and Virtual Organizations.
- Contains ~100 concepts and ~150 relationships (properties)
 - Definitions and relationships taken from many sources, including dictionaries, glossaries, OGF docs, IETF RFCs...
 - Many concepts are from OGSA - e.g. Task (“a definable unit of work”) - as they are universal across all Grids
- Can be broken into several categories
 - Processes, Protocols, Infrastructure, User and Security, Actions and Tasks, Activities...

OGSA & S-OGSA Ontologies



- Separated out ontologies containing OGSA and S-OGSA concepts
- OGSA - service-orientation applied to Grid computing
- S-OGSA - semantic bindings and knowledge entities for OGSA
 - Describes how to expose the metadata of a resource
 - Concepts in S-OGSA Ontology include:
 - SemanticBinding, KnowledgeEntity

Unicore Ontology: Example Concept



Equivalent Class (Necessary & Sufficient Criteria)

- fo:authenticatesCredential some fo:X509_Certificate
- fo:supportsProtocol some uo:Unicore_Protocol_Layer

Subclass Of (Necessary Criteria)

- fo:Access_Point

Inferred/Inherited anonymous descriptions (Necessary criteria)

- fo:controlsAccessToAdministrativeDomain some fo:Administrative_Domain
- fo:performsAuthentication some fo:Authentication
- fo:supportsProtocol some fo:Protocol

Equivalent Class (Necessary & Sufficient Criteria)

Subclass Of (Necessary Criteria)

- fo:Credential
- fo:isIssuedByCredentialIssuer some fo:Certificate_Authority

Inferred/Inherited anonymous descriptions (Necessary criteria)

- fo:establishesIdentity some fo:Identity

Equivalent Class (Necessary & Sufficient Criteria)

- fo:performsAuthentication some fo:Authentication

Subclass Of (Necessary Criteria)

Inferred/Inherited anonymous descriptions (Necessary criteria)

Equivalent Class (Necessary & Sufficient Criteria)

Subclass Of (Necessary Criteria)

- owl:Thing
- fo:supportsProtocol some fo:Protocol

Inferred/Inherited anonymous descriptions (Necessary criteria)

- fo:Service
 - fo:Execution_Service
 - fo:Factory_Service
 - fo:Information_Service
 - fo:Logging_Service
 - uo:Unicore_Gateway
- fo:Authentication_Point
 - uo:Unicore_Gateway

- Unicore Gateway
 - Assert that it is an Access Point that authenticates X. 509 certificates and supports the UPL
- Anything performing authentication of an identity credential is an Authentication Point
- Any class supporting a protocol is a Service
- Reasoner can determine that a Unicore Gateway is a Service & Authentication Point

Current Status

- The Grid Resource Ontology is available from <http://www.unigrids.org>
 - Written in OWL, fully commented and proven as consistent
- Reasoners to enable us to deduce properties not explicitly entered
 - E.g. UNICORE Gateway is an Authentication Point
- Check for completeness of functionality, and to compare functionality across Grids that use different descriptive terms
- Already being used by OntoGrid
 - Barcelona Supercomputing Centre plan to use the ontologies
- Please let us know your comments!