Transitioning Applications to Ontologies

Methodologies & Tools

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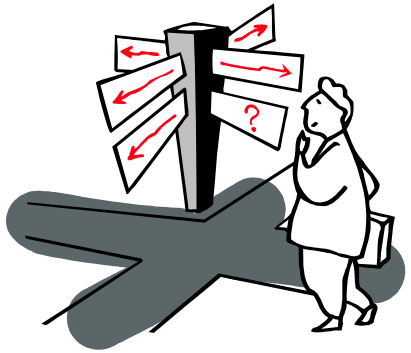
Talk Outline

- **Introduction**
  - TAO project overview
- **TAO Methodology**
  - Detailed Revised Methodology
  - TAO cookbook
- **TAO Suite**
  - Ontology Learning
  - Semantic Content Augmentation
  - Semantic Web Services
- **Example: Amazon web services**

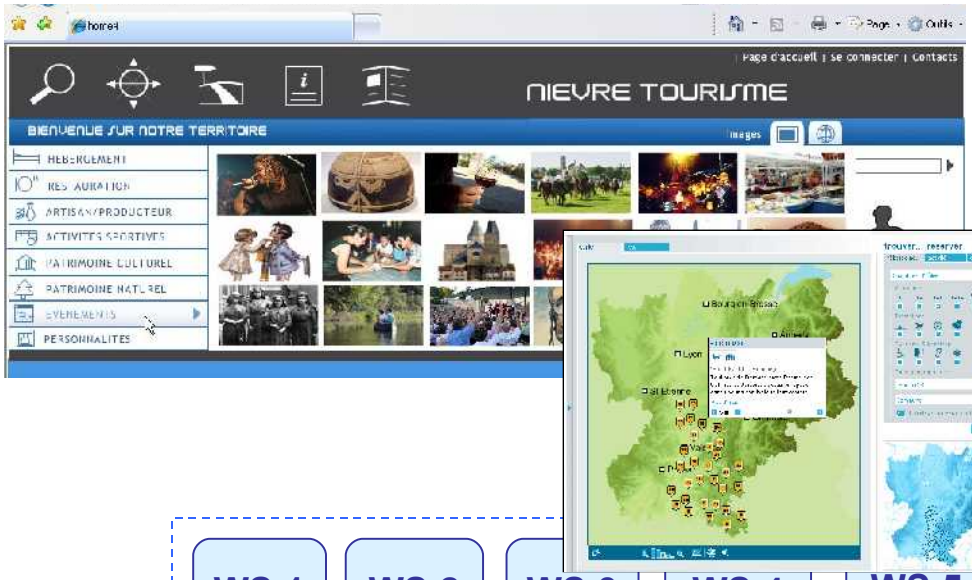


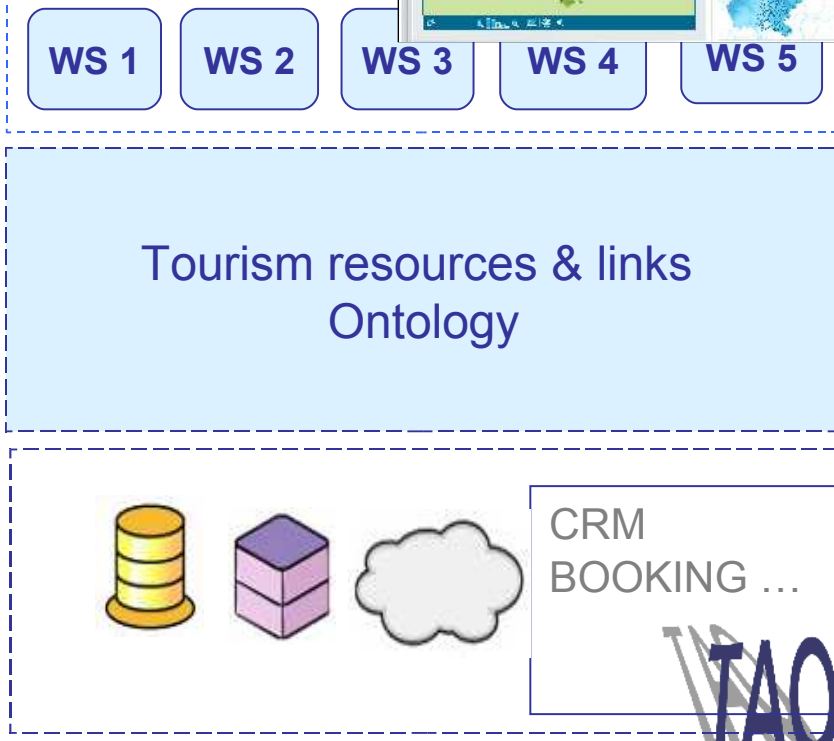
TAO project overview

- Addressing the problem of transitioning legacy applications to ontologies
- What is a legacy software system:
  - "A large software system that is vital to [an] organisation, but resists modification and evolution to meet new and constantly changing business requirements"
- Towards semantic-assisted software engineering

Transitioning Applications

- Legacy application:
  - database driven
  - no interoperability
- Ontologies + SOA:
  - **Learn ontologies**
  - Manage **complex resources** (multi-terminologies, multilingual) and **knowledge links**
  - Use Service Oriented Architecture to **integrate added value services** from other suppliers: cartography, translation, booking services…





Goal of TAO
from the Methodology perspective

- **Support the creation of semantic web services**
  - Engineer starts with:
    - Existing legacy system
    - Domain knowledge is generated from several sources
      - *Documentation generated by service provider*
      - *Domain information*
      - *User forums / blogs / community*
  - Needs to generate:
    - Service / Domain Ontologies
    - Annotated Web Services Semantically
    - Annotated Documentation to support
      - *User access to Services*
      - *Subsequent Development/Refinement*
- **Challenge**
  - To develop a methodology that describes (abstractly) how to transition from existing legacy system to Semantically Rich Service Environment

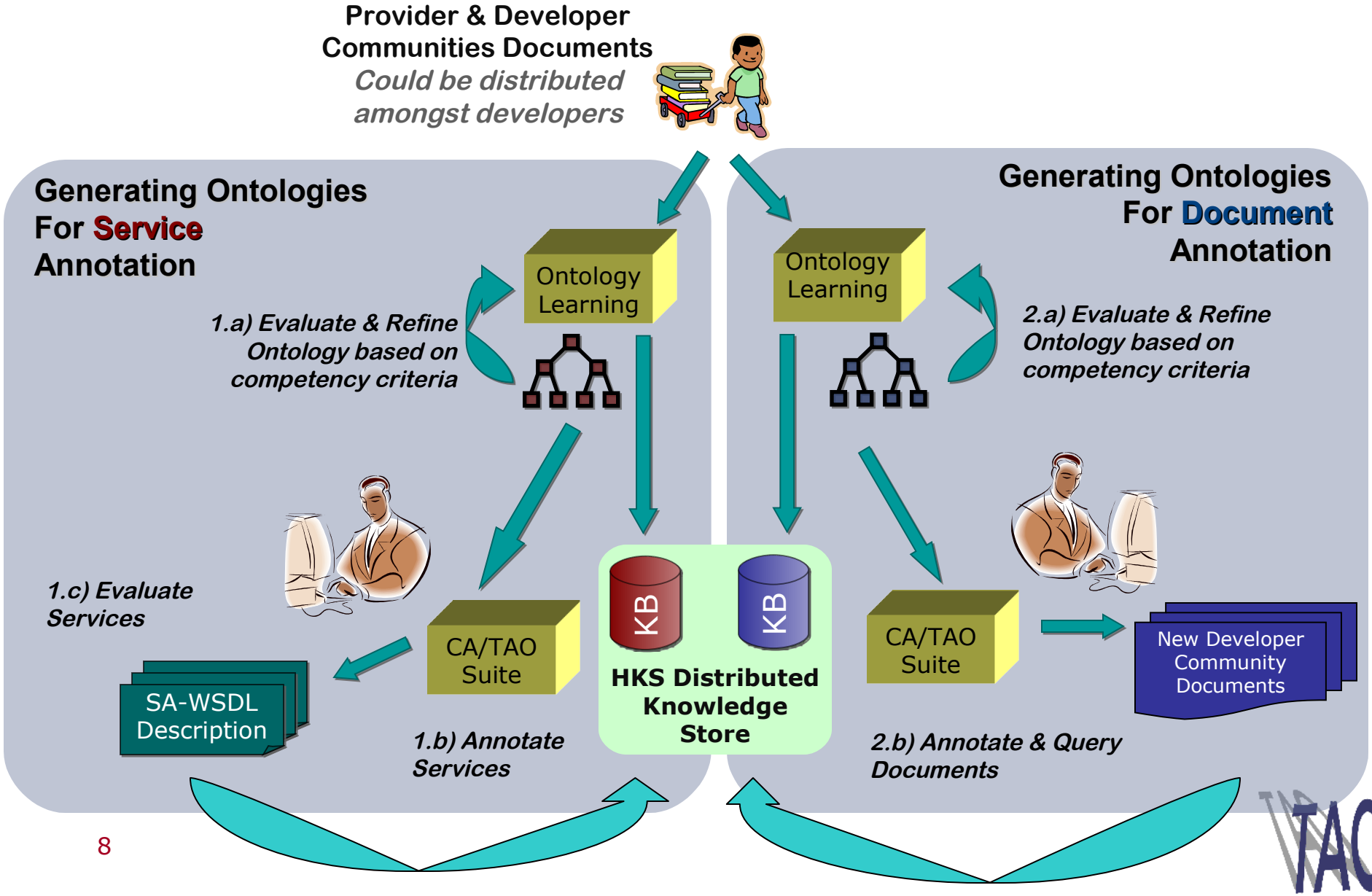
Methodology Challenges

- Methodologies for supporting service developers
  - Improving Document Search
  - Annotating services
- Two individual threads are being considered:
  1. **Generate** and **utilise ontology** for supporting the **annotation of user documentation**
     - Ontologies should support the search and retrieval (question / answer) of documentation by user/developer community
  2. **Generate** and **utilise ontology** for supporting the **annotation of services**
     - Ontologies should support service-based activities (e.g. search, composition) with business/service community
  - Should generate a **single** ontology for both

Achievements so far

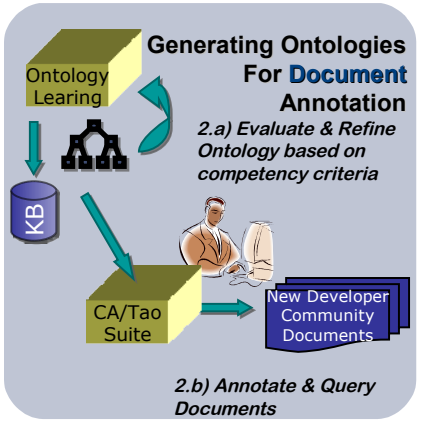
- **Continual refinement** of the **methodology**, adapting to the other tools within the TAO suite
  - Identify usage guides as part of the methodology
- Provide a grounding for converging on a choice of ontology representation (choice of OWL-S or WSMO)
- Make the methodology more accessible
  - Cookbook-style guideline
  - Complemented with many tips and notes
- Examine **alternate recommendations** for transitioning at the service level
  - Formal approaches for transitioning legacy code
  - Evaluating intermediate representations

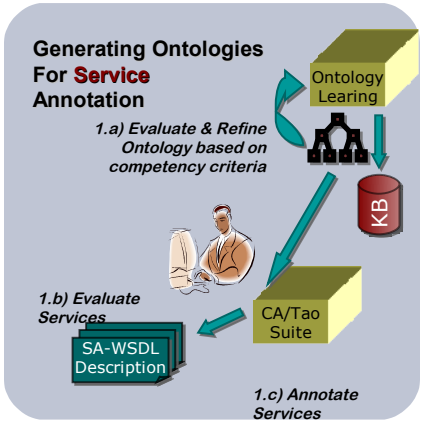
Overview of Methodology



Initial Methodology Key Steps

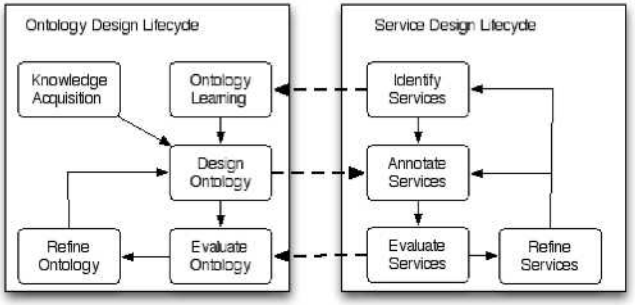
- **Key Stages** within Evolving Methodology
  1. Source Document Identification
  2. Training Data Elicitation
  3. Learning the Ontology
  4. Annotating…
     - **Developer Resources**
       - a) *Supporting Annotation of user documentation*
     - **Services**
       - a) *Creating Service*
       - b) *Annotating Service*
       - c) *Evaluating resulting service*
  5. Ontology Evaluation



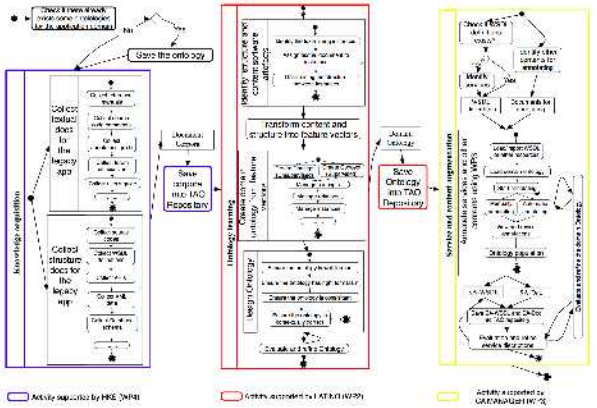


Various formats for different usages

Abstract methodology



UML diagram



Quick reference cook-book

TASK 1. Create a new project in TAO Suite (Section 4.1)
TASK 2. Knowledge acquisition (Section 4.2)
TASK 3. Save the document corpuses to TAO Repository (Section 4.3)
TASK 4. Ontology learning (Section 4.4)
- 4.1 Identify content and structure of software artifacts (Section 4.4.1)
- 4.2 Transform contents and structures into feature vectors (Section 4.4.2)
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TASK 5 Service and content augmentation(Section 4.5)
- 5.1 Identify the contents to be annoated(Section 4.5.1)
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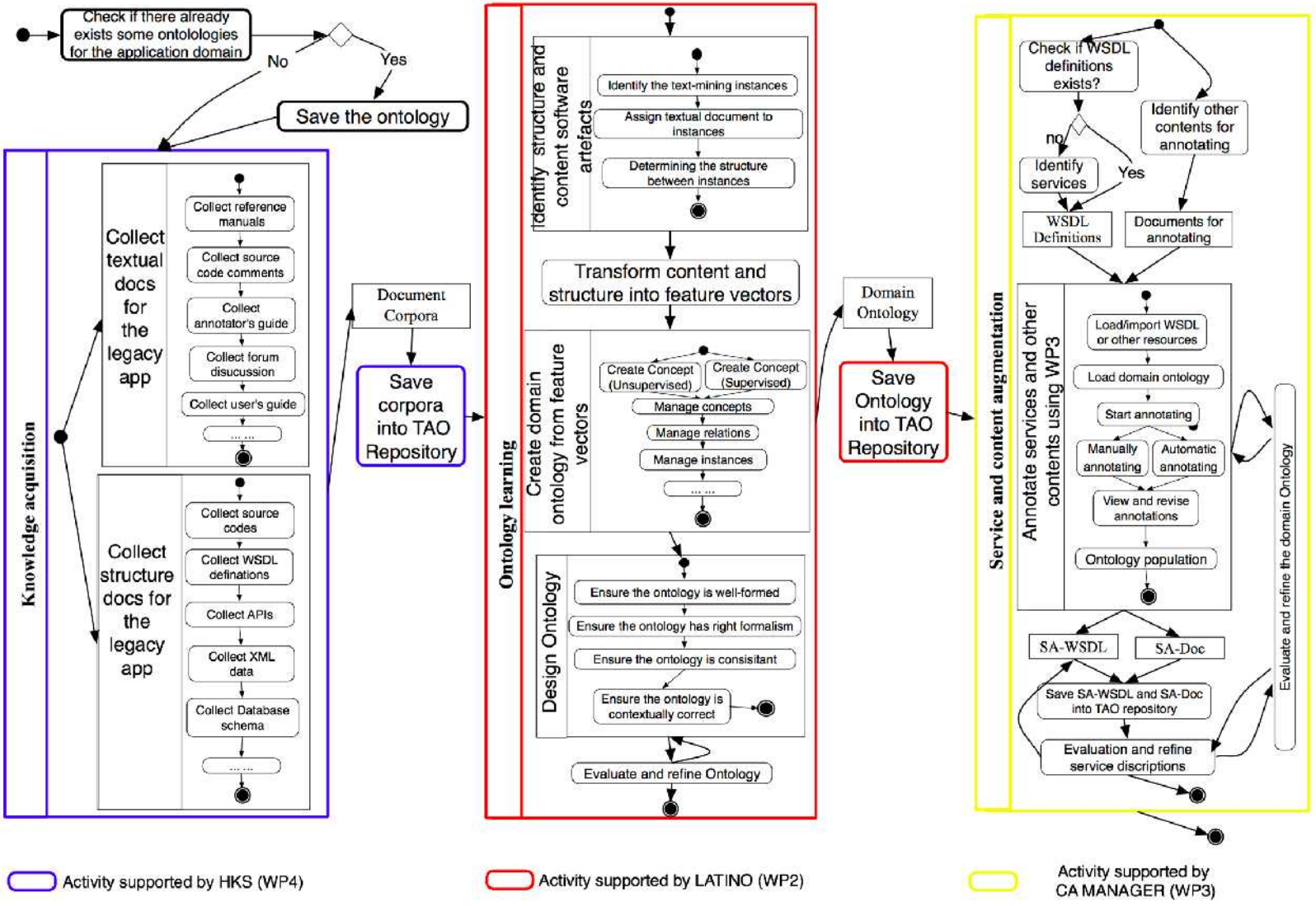
- 5.5 Ontology population (Section 4.5.5)
- 5.6 Save Annotations(Section 4.5.6)
- 5.7 Deploy, evaluate and refine services (Section 4.5.7)

Overview of revised Methodology



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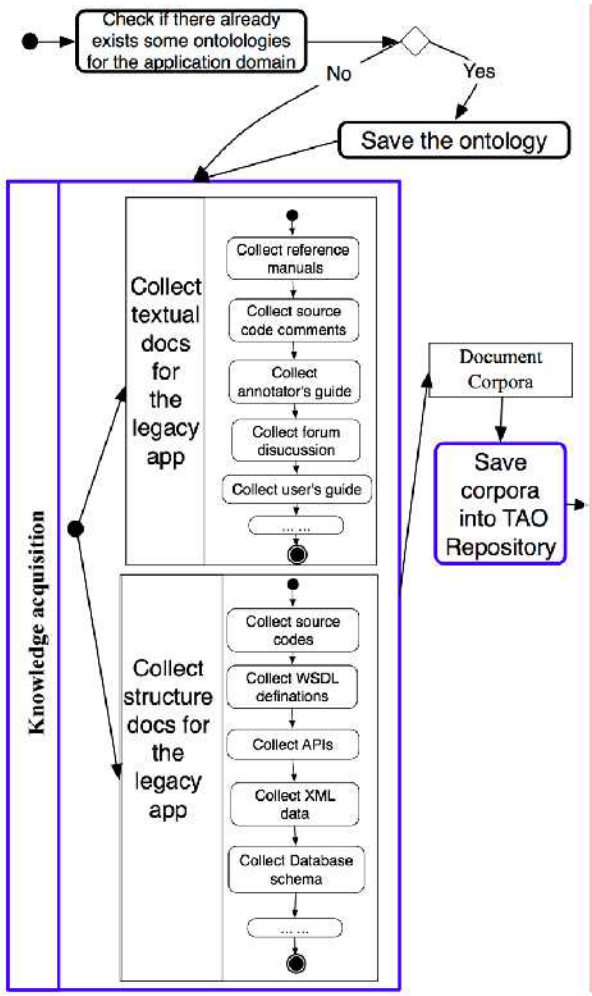


Knowledge Acquisition

2. Documents and service definitions are identified, including:
   - *Reference Manuals*
   - *Forum Discussions*
   - *Source Code*
   - *WSDL & API defns*
   - *DB & XML schemas*

3. *Produce a corpora in the TAO repository*

Activity supported by HKS (WP4)

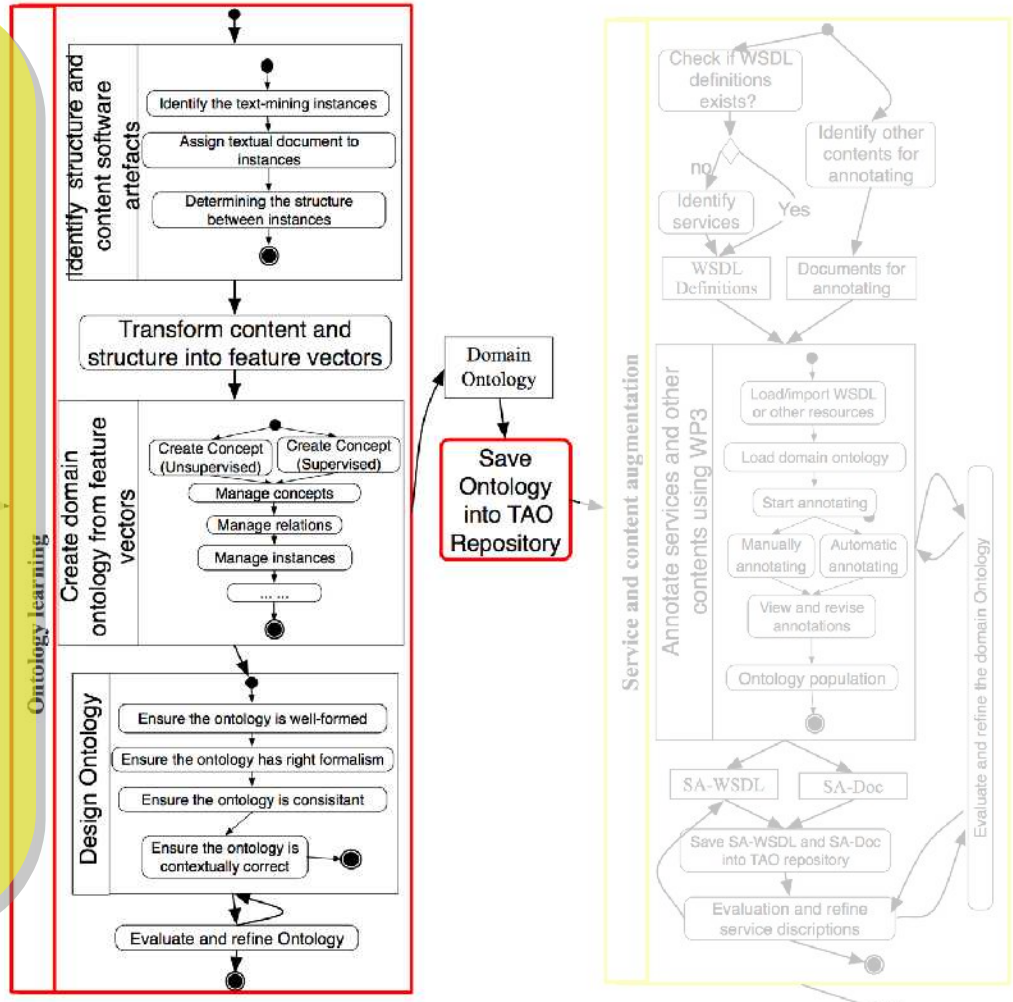
Activity supported by LATINO (WP2)

Activity supported by CA MANAGER (WP3)

Overview of revised Methodology

Ontology Learning

2. Identify textual & service artifacts:
   - *Construct Feature Vectors*
   - *Map resources to training instances*
3. Identify concept clusters and weightings
4. Generate & Refine ontology, ensuring:
   - *Consistency*
   - *Good formalism*
   - *Context relevance*



Activity supported by HKS (WP4)

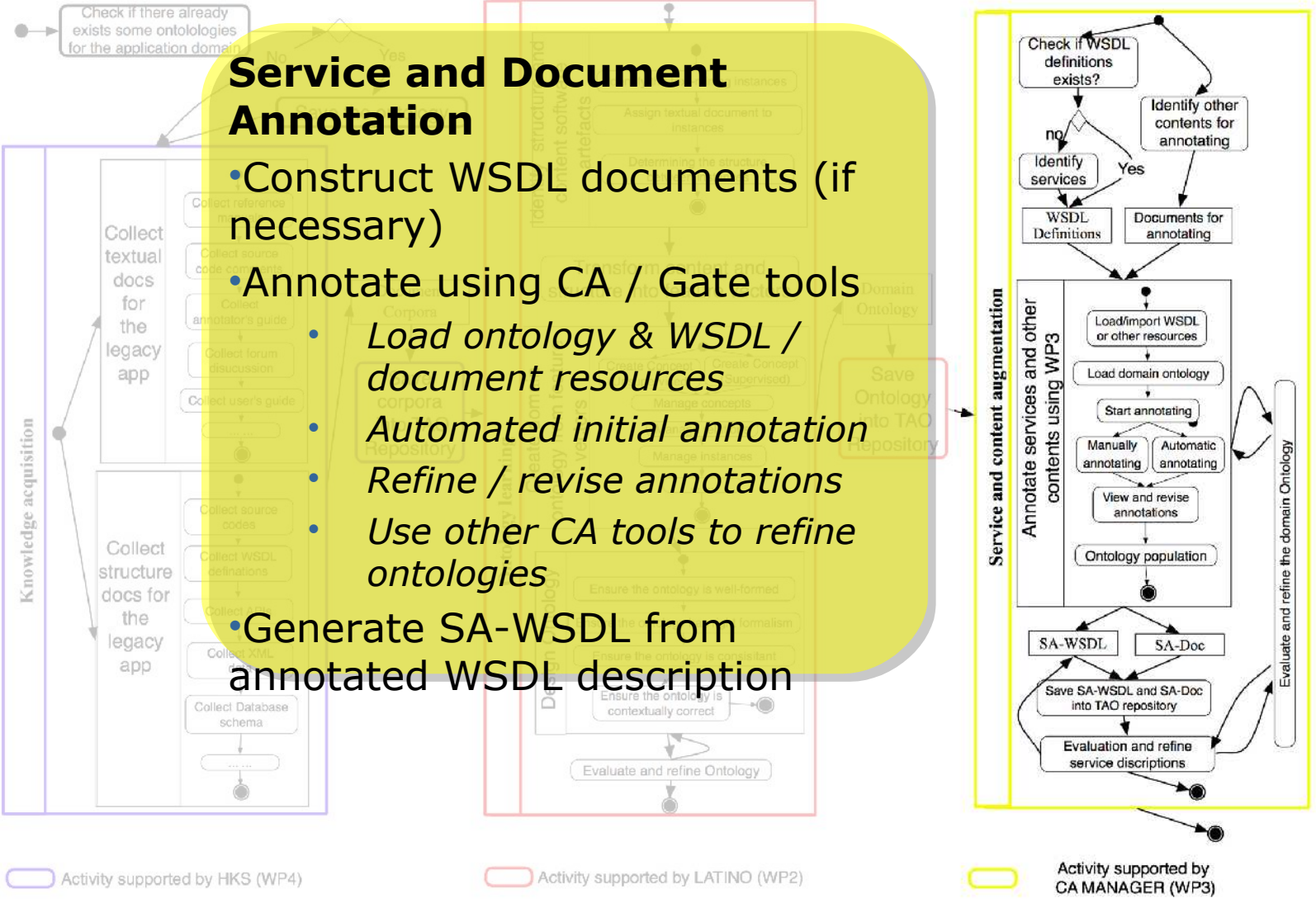
Activity supported by LATINO (WP2)

Activity supported by CA MANAGER (WP3)

Overview of revised Methodology

Service and Document Annotation

- Construct WSDL documents (if necessary)
- Annotate using CA / Gate tools
  - *Load ontology & WSDL / document resources*
  - *Automated initial annotation*
  - *Refine / revise annotations*
  - *Use other CA tools to refine ontologies*
- Generate SA-WSDL from annotated WSDL description



Converging on SA-WSDL

- Converged on using SA-WSDL for semantically annotating Web Services
  1. Neutral with respect to current ontology representation languages (RDF, OWL, WSML,…)
  2. SA-WSDL adequately fits with TAO requirements better than WSMO and OWL-S frameworks
  3. Choreography and Orchestration issues are being put aside (focus is on ontological issues)
  4. Convergence on a single ontology for both service and documentation annotation

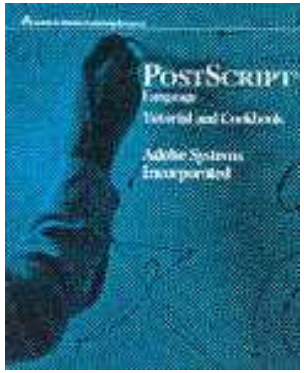
Motivating the CookBook

- Resulting Methodology needs to be communicated to practitioners in a usable way

  - Using the cookbook metaphor
    - Several examples given with step-by-step instructions
    - Each example illustrates a different challenge problem

Cookbook Design

- The ***Cookbook*** metaphor has been taken from:
  - **PostScript Language Tutorial and Cookbook**
- Include a set of walk- through examples using the different tools of the TAO suite
  - *Illustrates parameter settings, steps in using tools, and expected results.*
  - *User should be able to reproduce the generated ontologies themselves*
- To cover:
  - *Amazon Services*
  - *Gate Services*
- *Also as a Web-based guide (Wizard)*



Includes:

- *Steps in gathering text sources (assets)*
- *Steps in preparing assets*
- *Determining parameters and objectives using tools*
- *Using tools for annotating Documents and SA-WSDL service*

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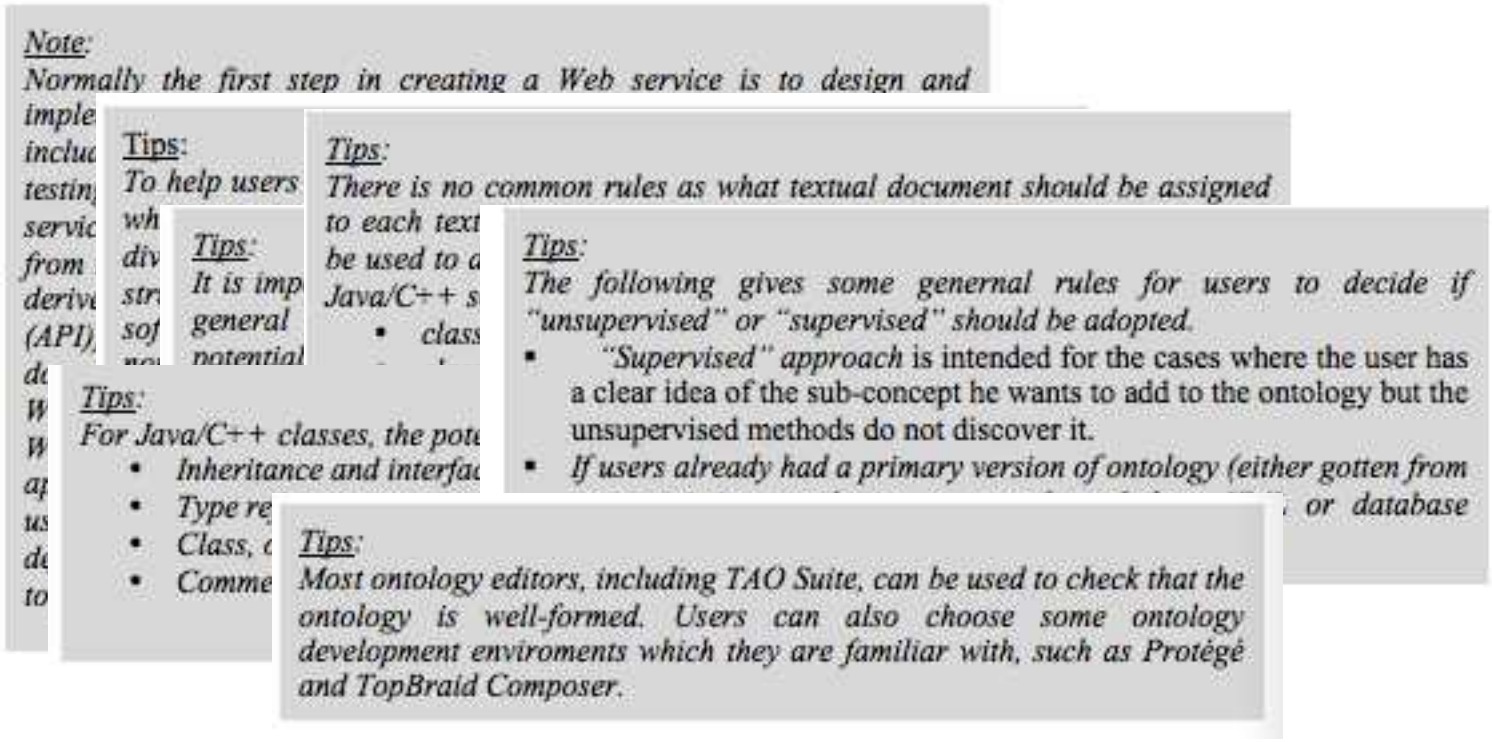
More accessible

- Many tips and notes to help users make choice



More accessible

- Quick references to the major tasks

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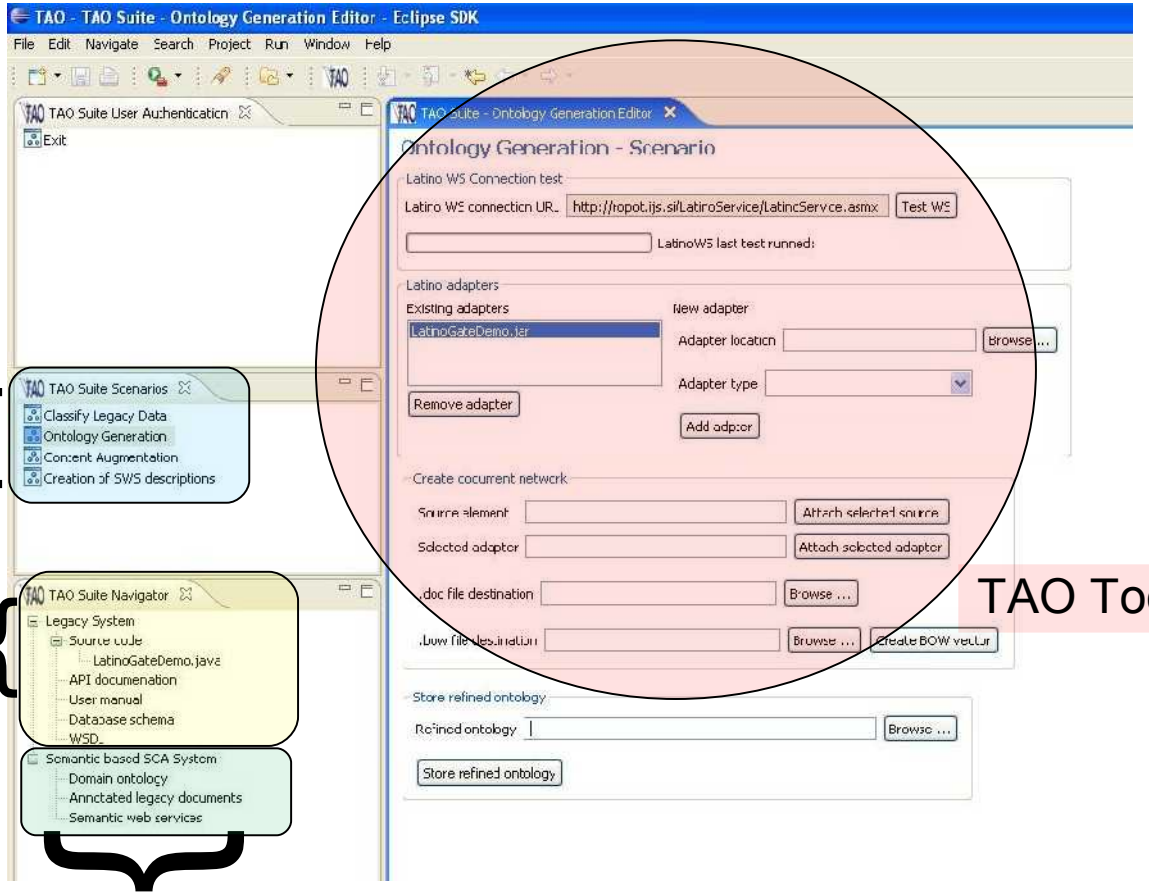
The TAO web-based wizard

- Demo of TAO Suite wizard

TAO Suite & Methodology

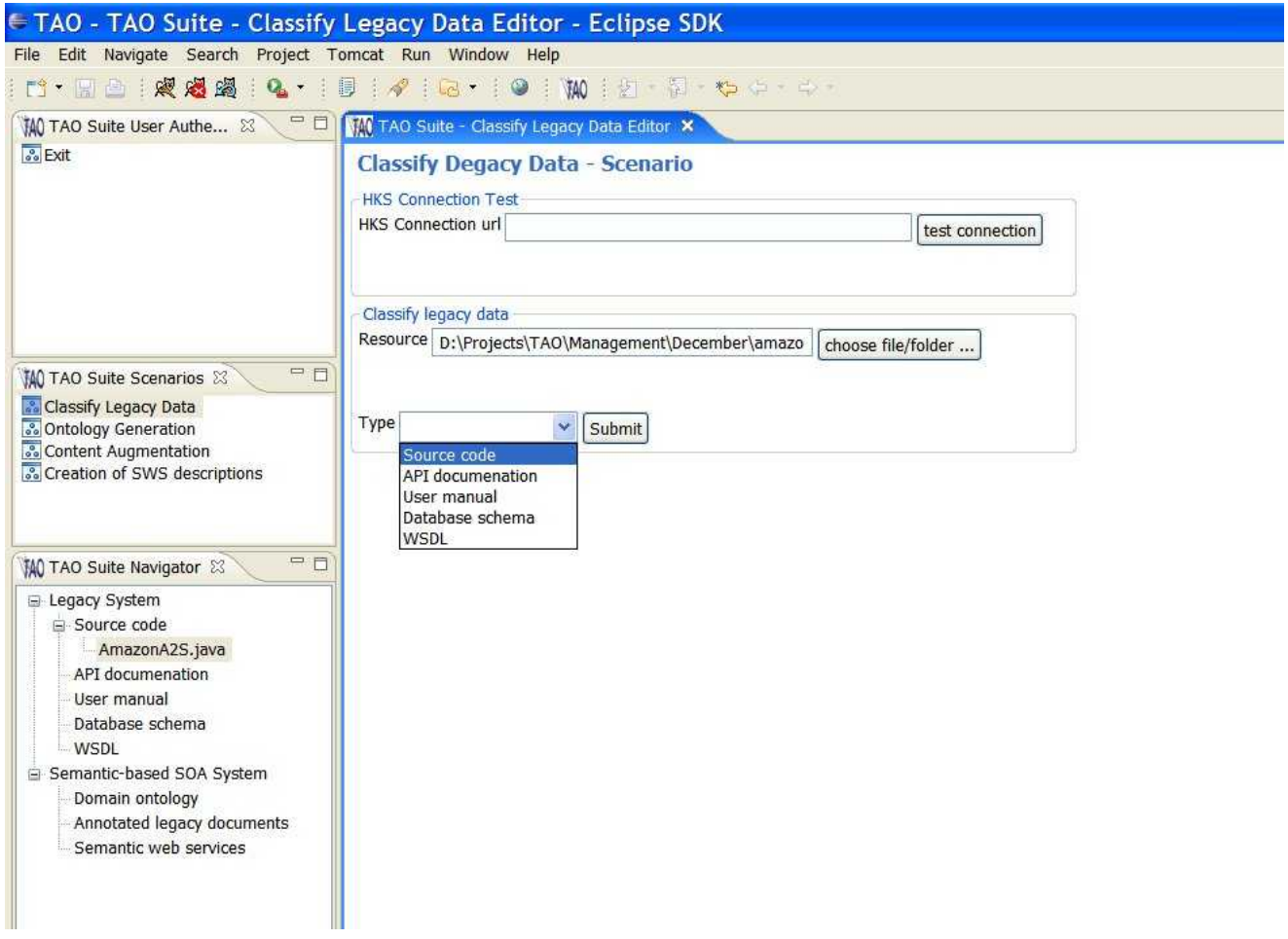
- A comprehensive support of the TAO methodology



- Demo available on TAO web site

TAO Suite – putting it all together

- A complete transitioning environment
- Manage all transitioning processes and tools within a uniform interface

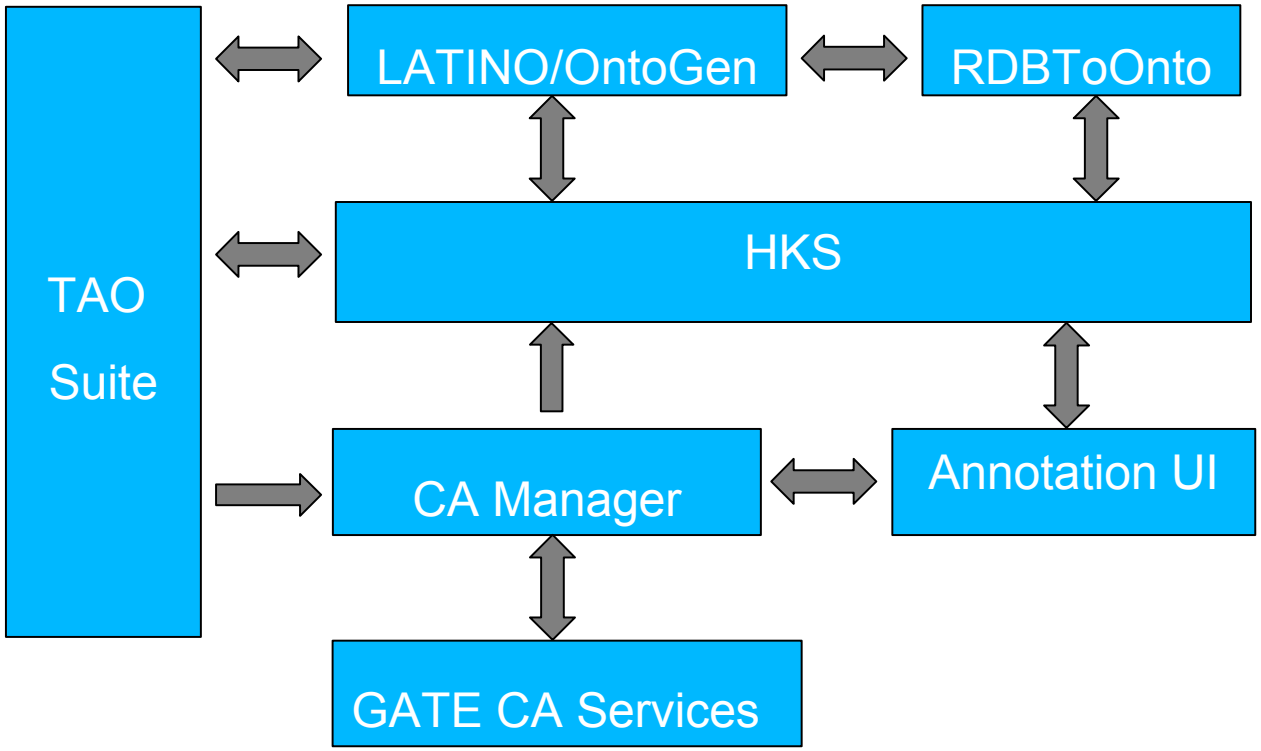


TAO Suite Components

- Architecture as integration mechanism
  - **Ontology generation**
    - TAO Suite
    - LATINO
    - HKS
    - Exporting/Importing with external GUI tools
  - **Content Augmentation**
    - TAO Suite
    - CA MANAGER
    - HKS
    - Exporting/Importing with external GUI tools
  - **Creation of SWS descriptions**
    - TAO Suite
    - CA MANAGER
    - HKS
    - Exporting/Importing with external GUI tools

TAO Suite - architecture

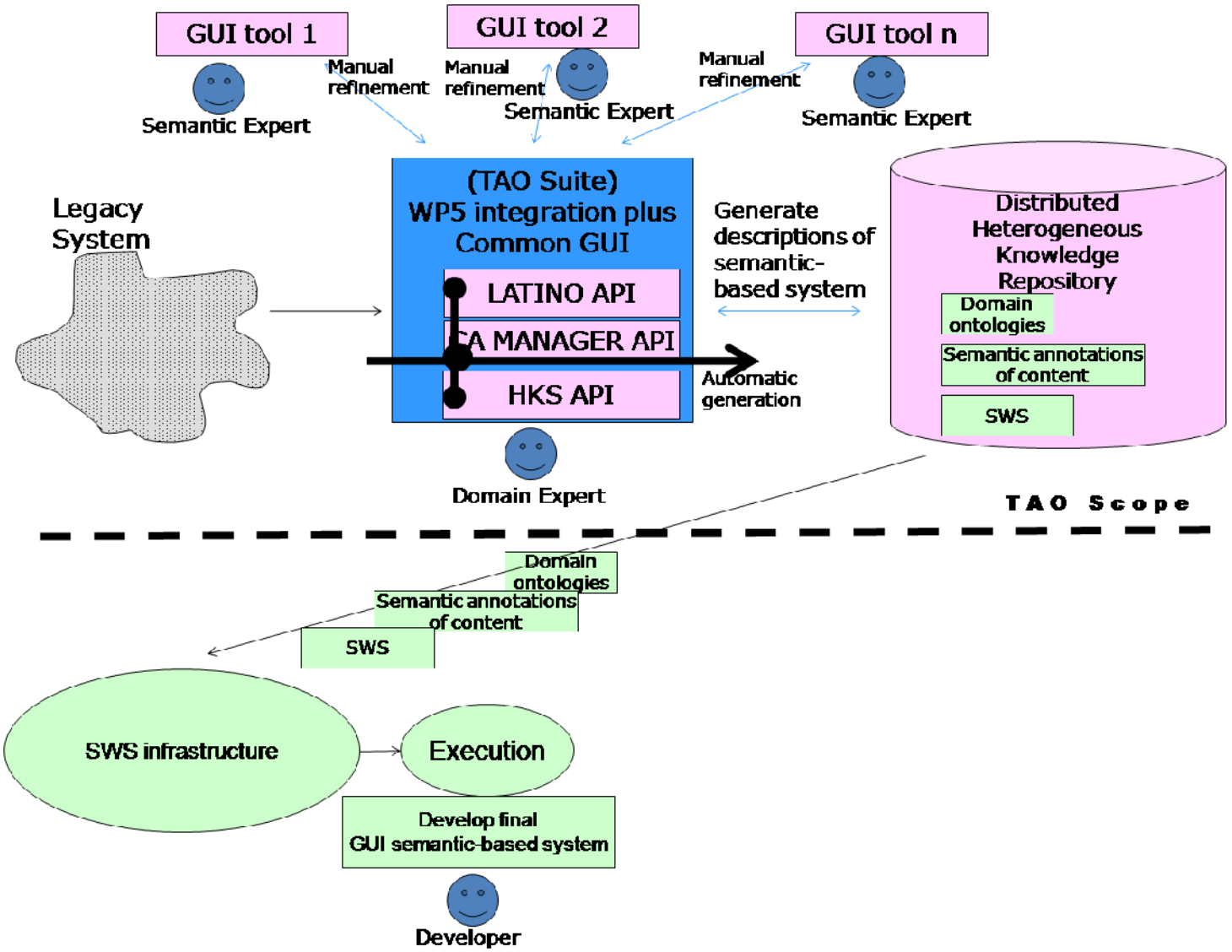
- Components integration and communication in TAO Suite



Achievements so far

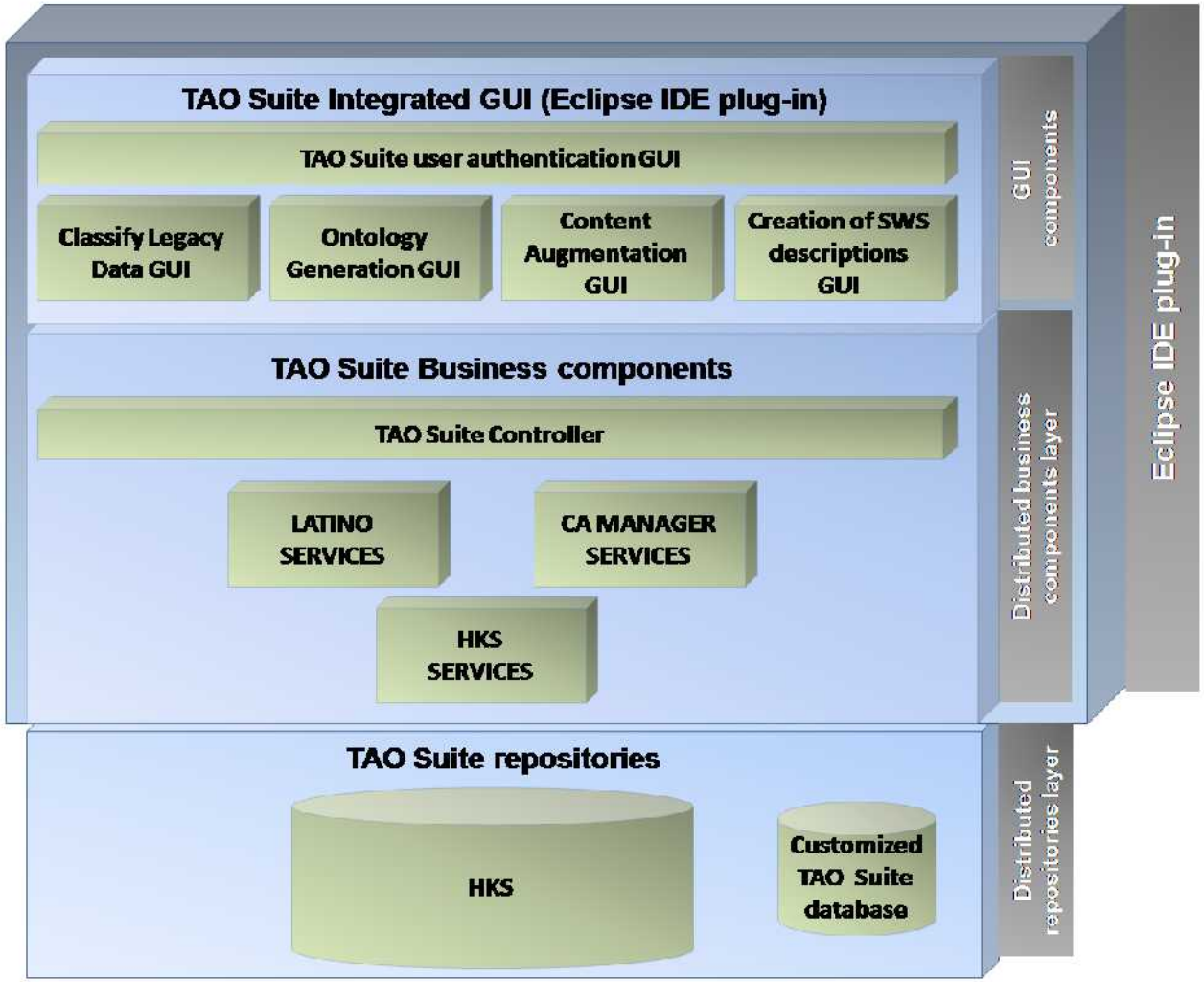
- Architecture and integration requirements and specifications
- Functional aspects of TAO Suite:
  - Integrating into an IDE the TAO components:
    - LATINO
    - CA MANAGER
    - HKS
  - Interacting with TAO components for performing a first automatic generation of semantic-based system
  - Exporting/Importing the generated semantic descriptions (user can manually refine them)
  - Whole transitioning process supported by TAO Suite is semi-automatic

TAO Suite objectives



TAO Suite Architecture

- General architecture



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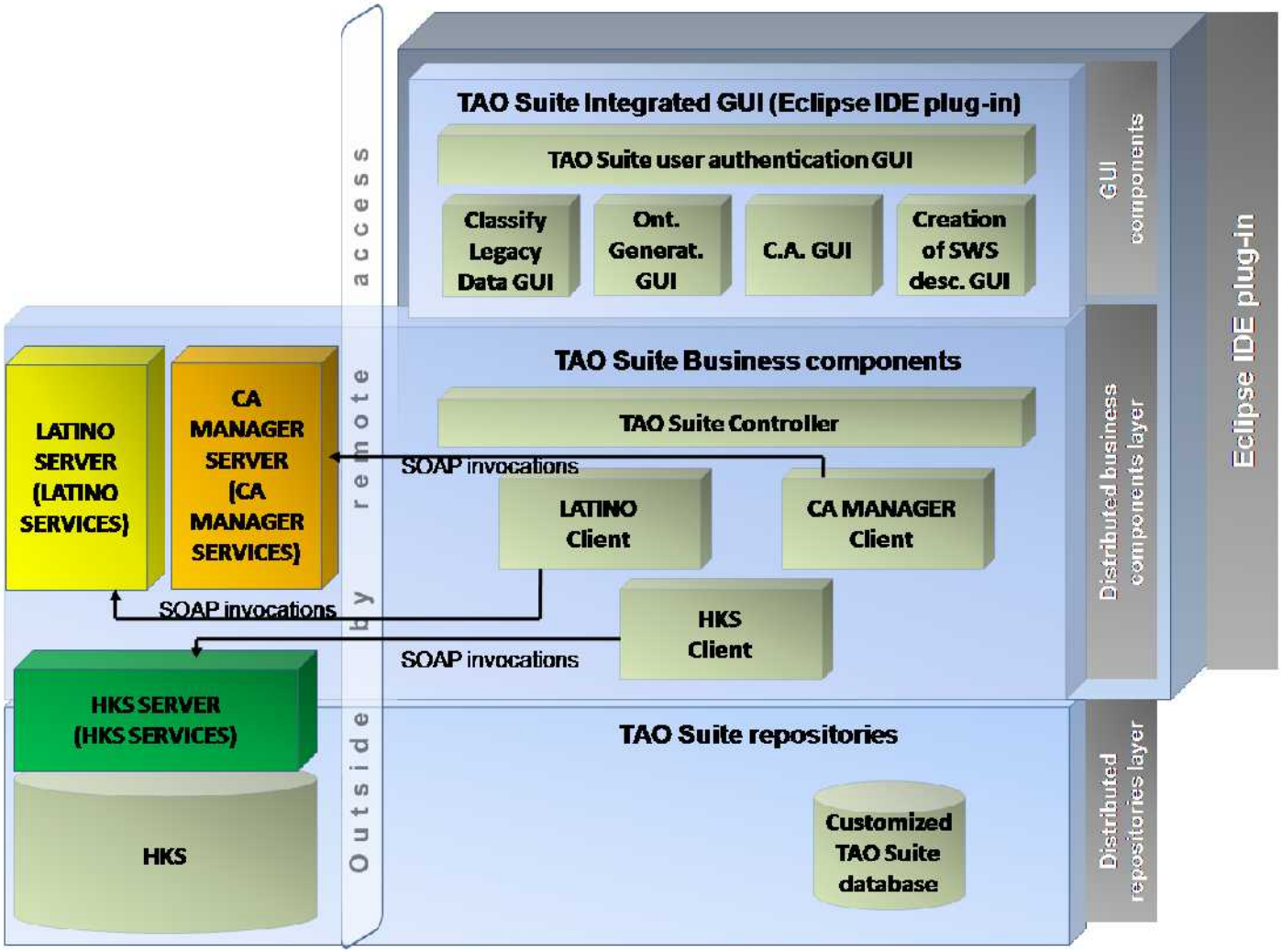
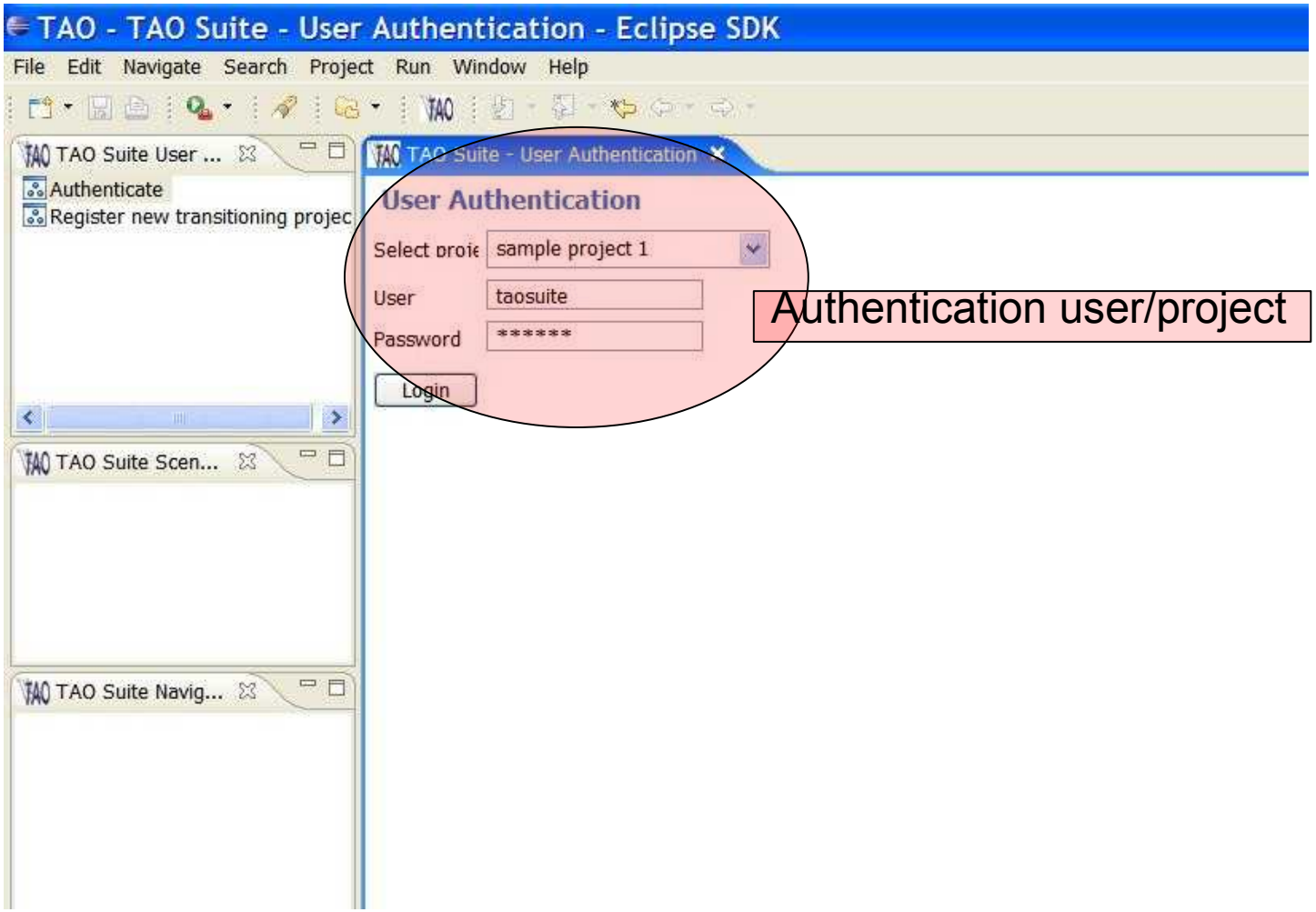


TAO Suite Prototype

- Demo of TAO Suite pre-prototype

TAO Suite - features



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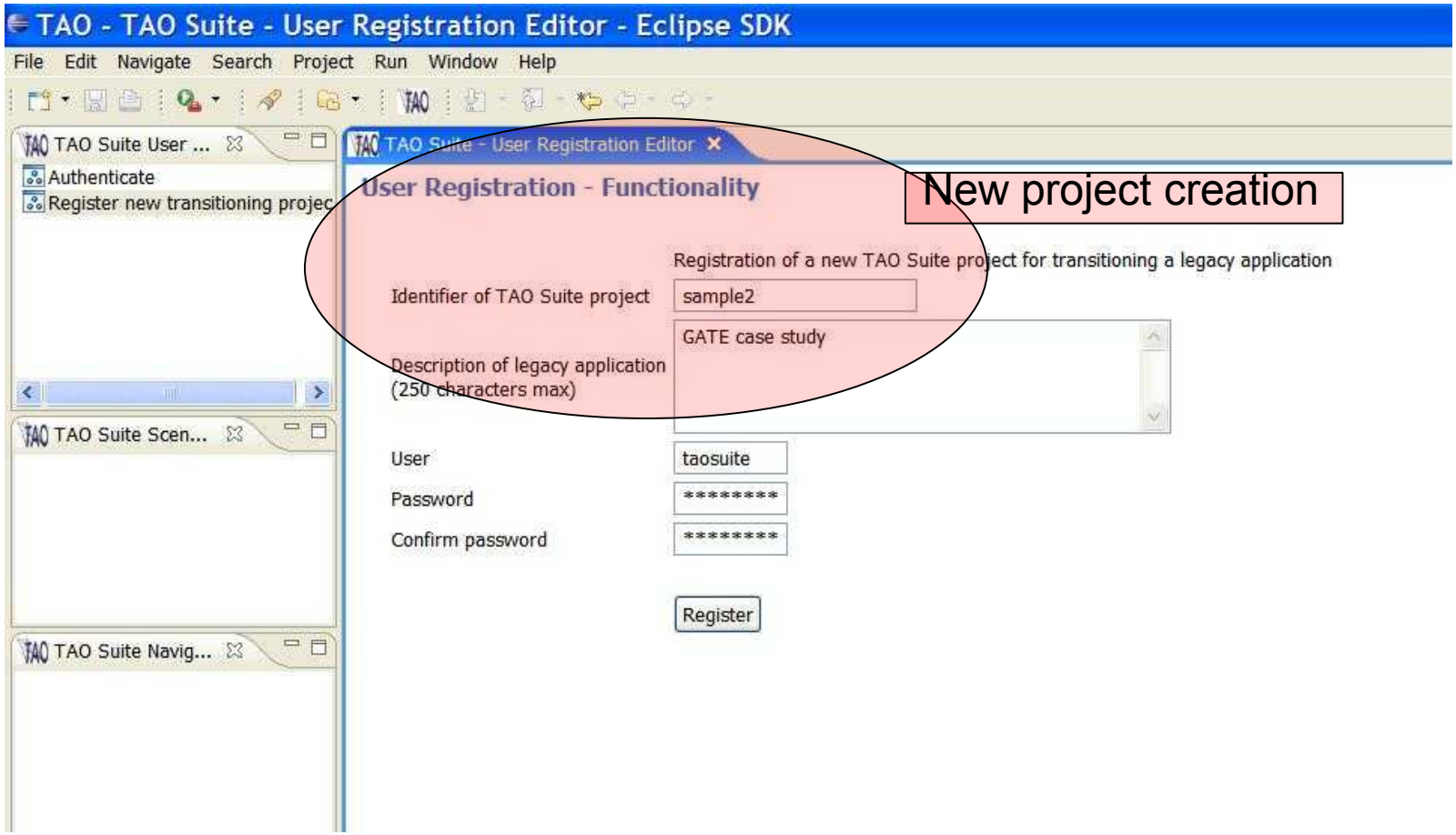

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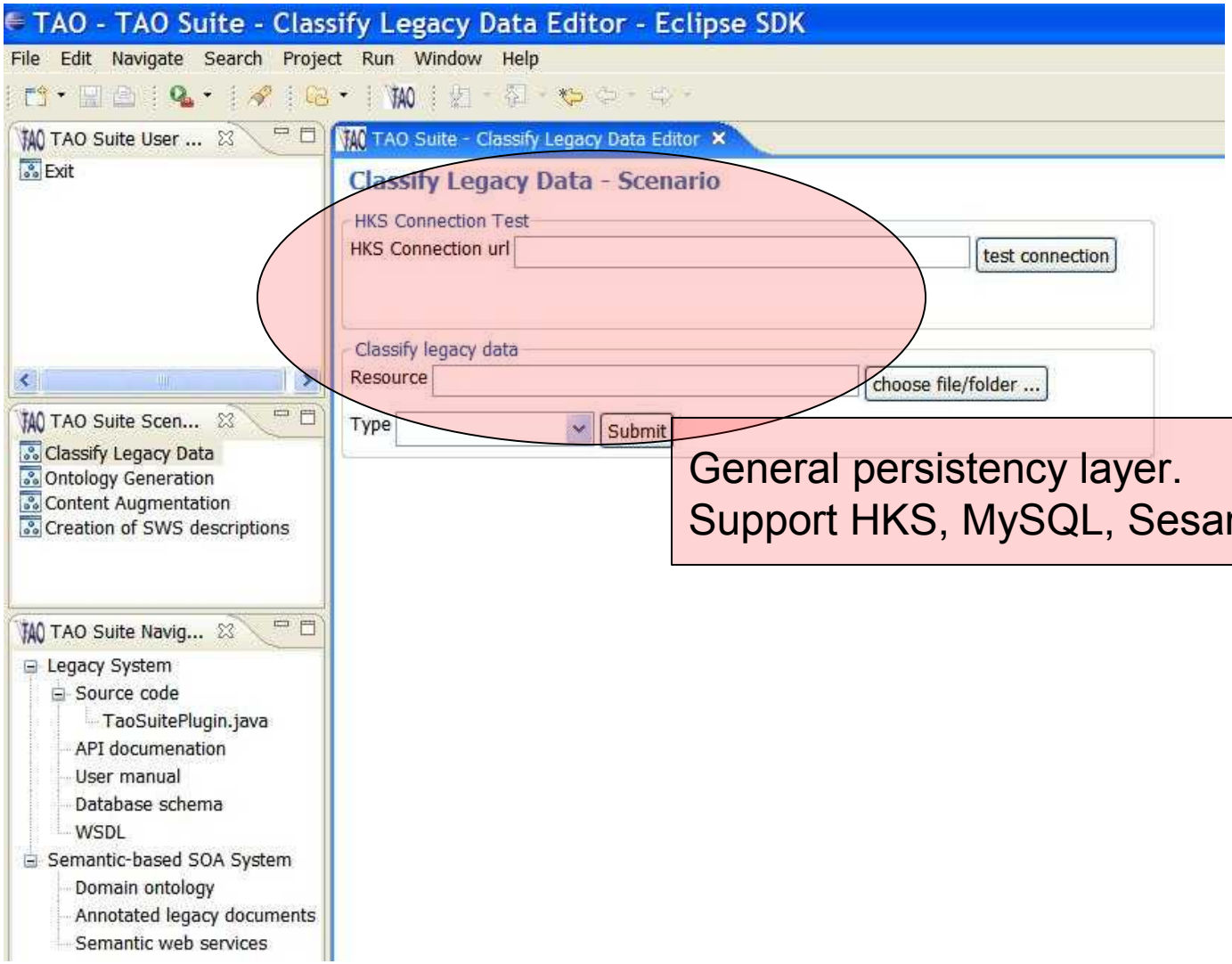
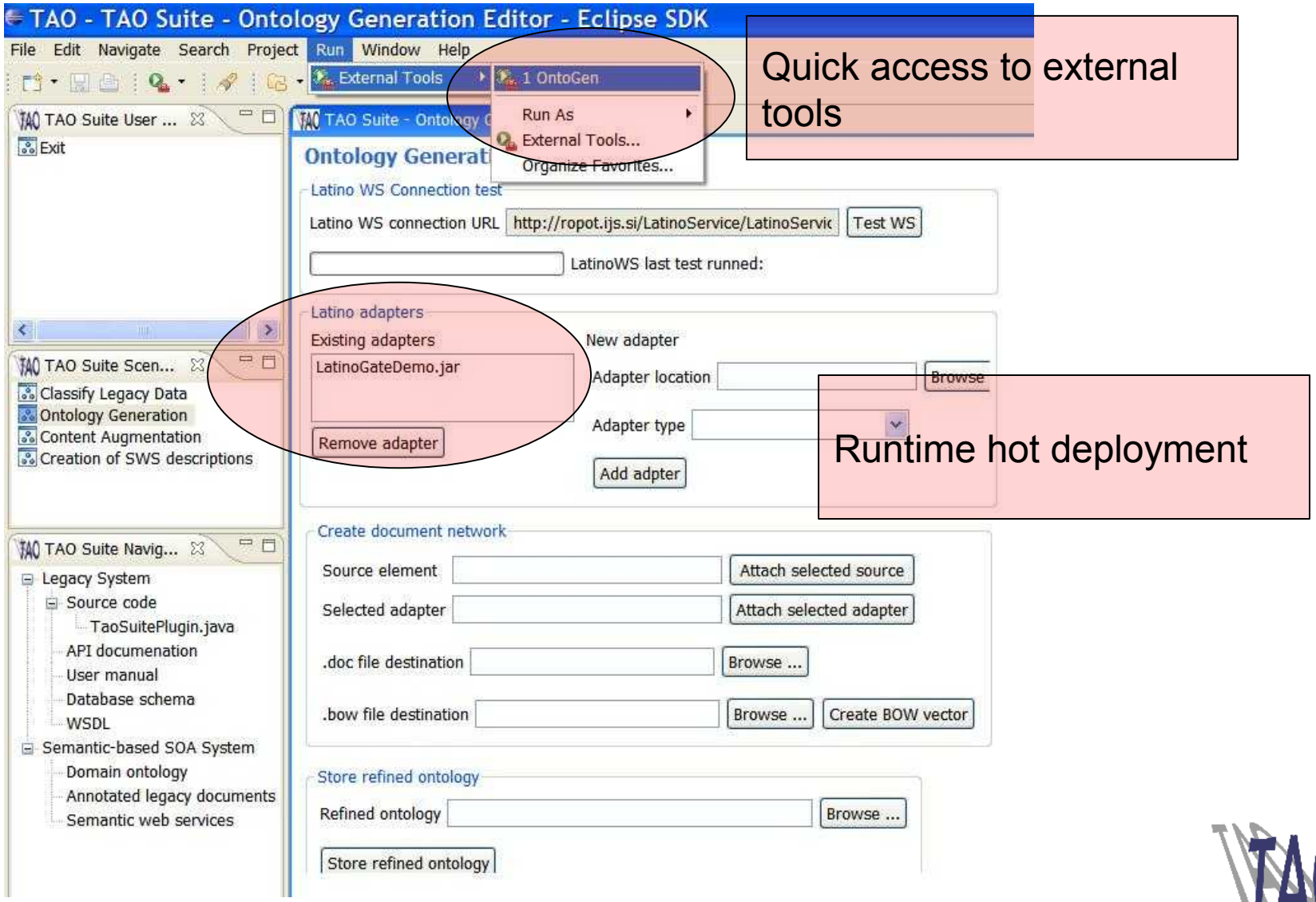


General persistency layer.
Support HKS, MySQL, Sesame…

TAO Suite - features



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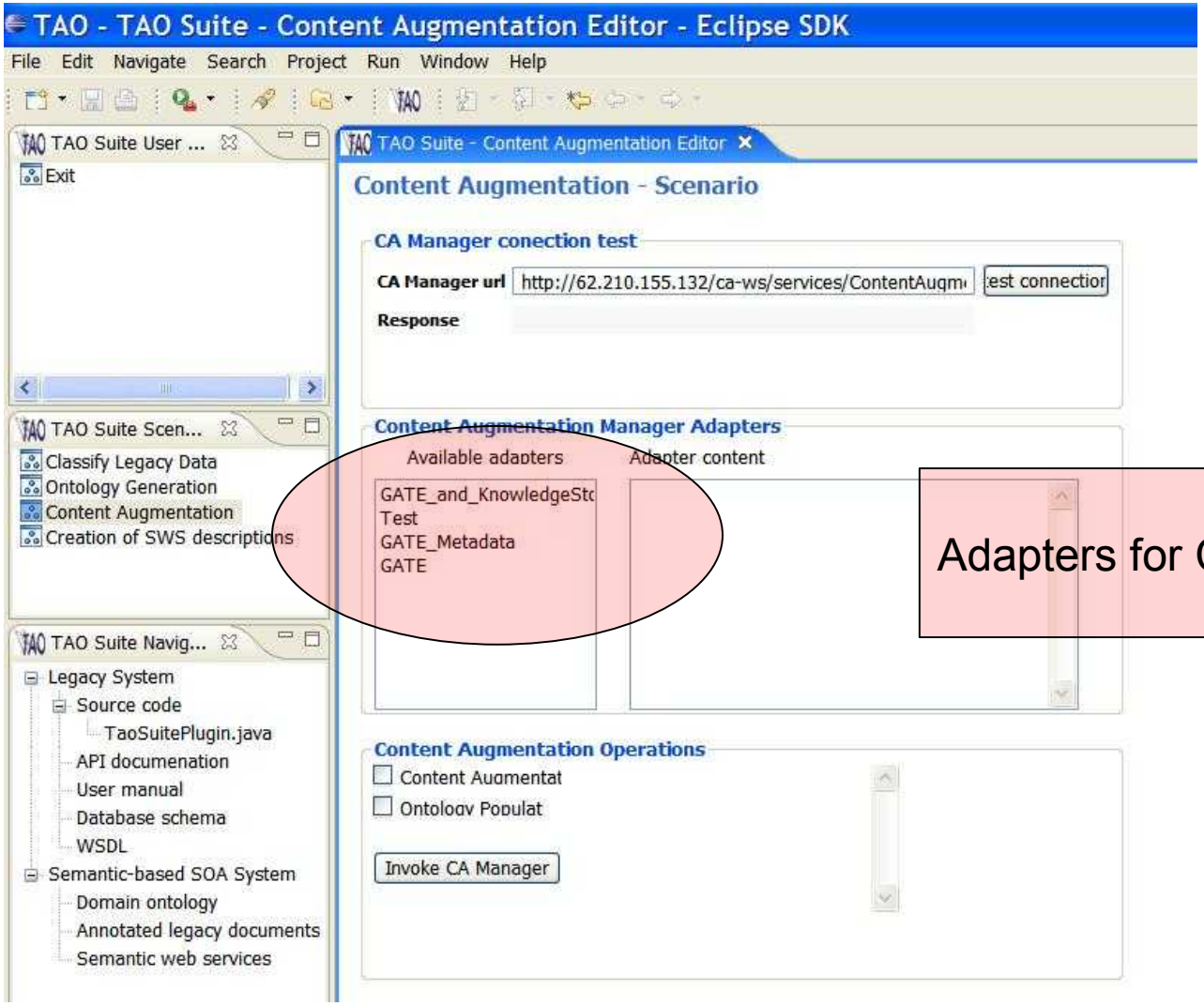

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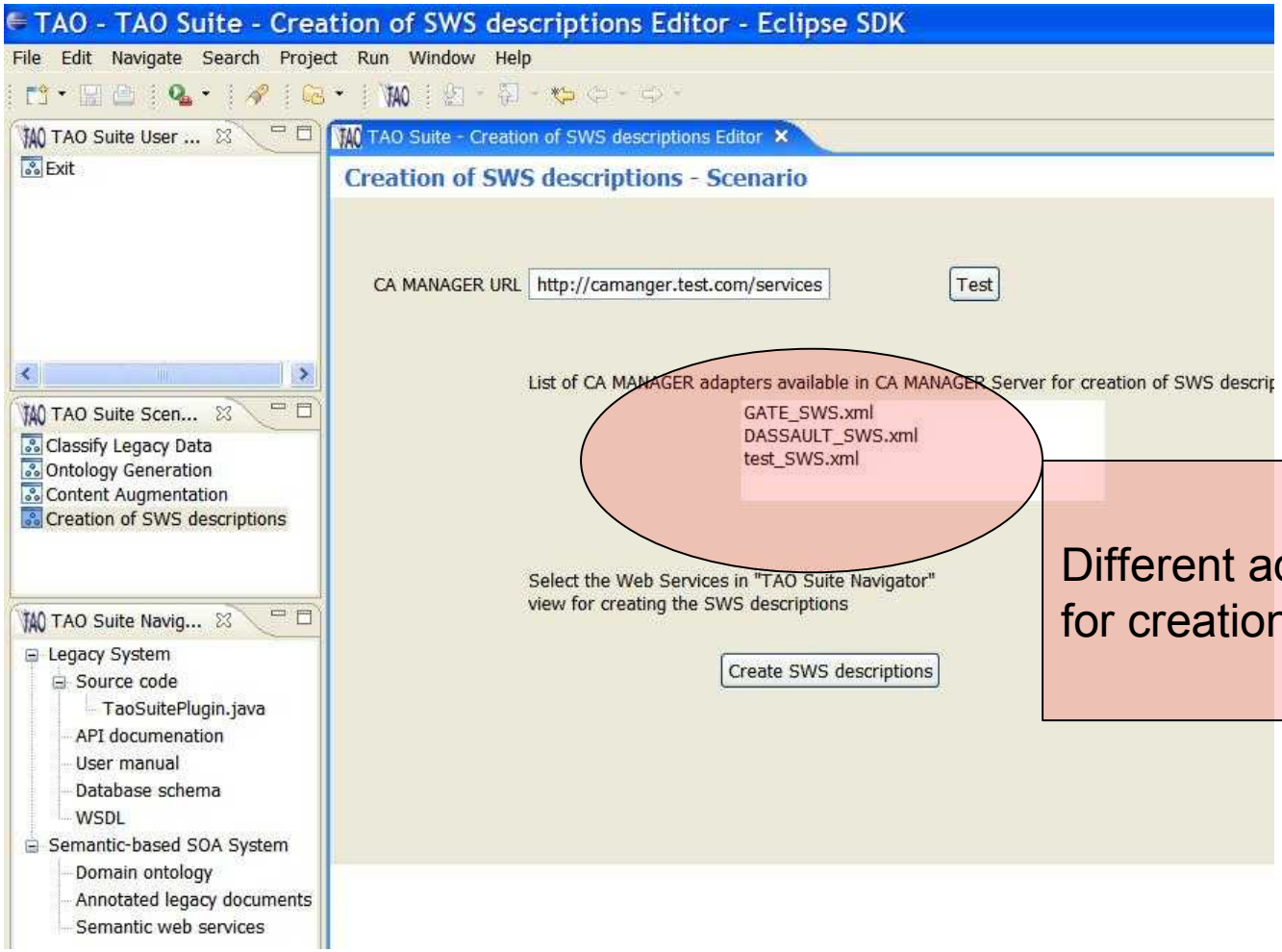
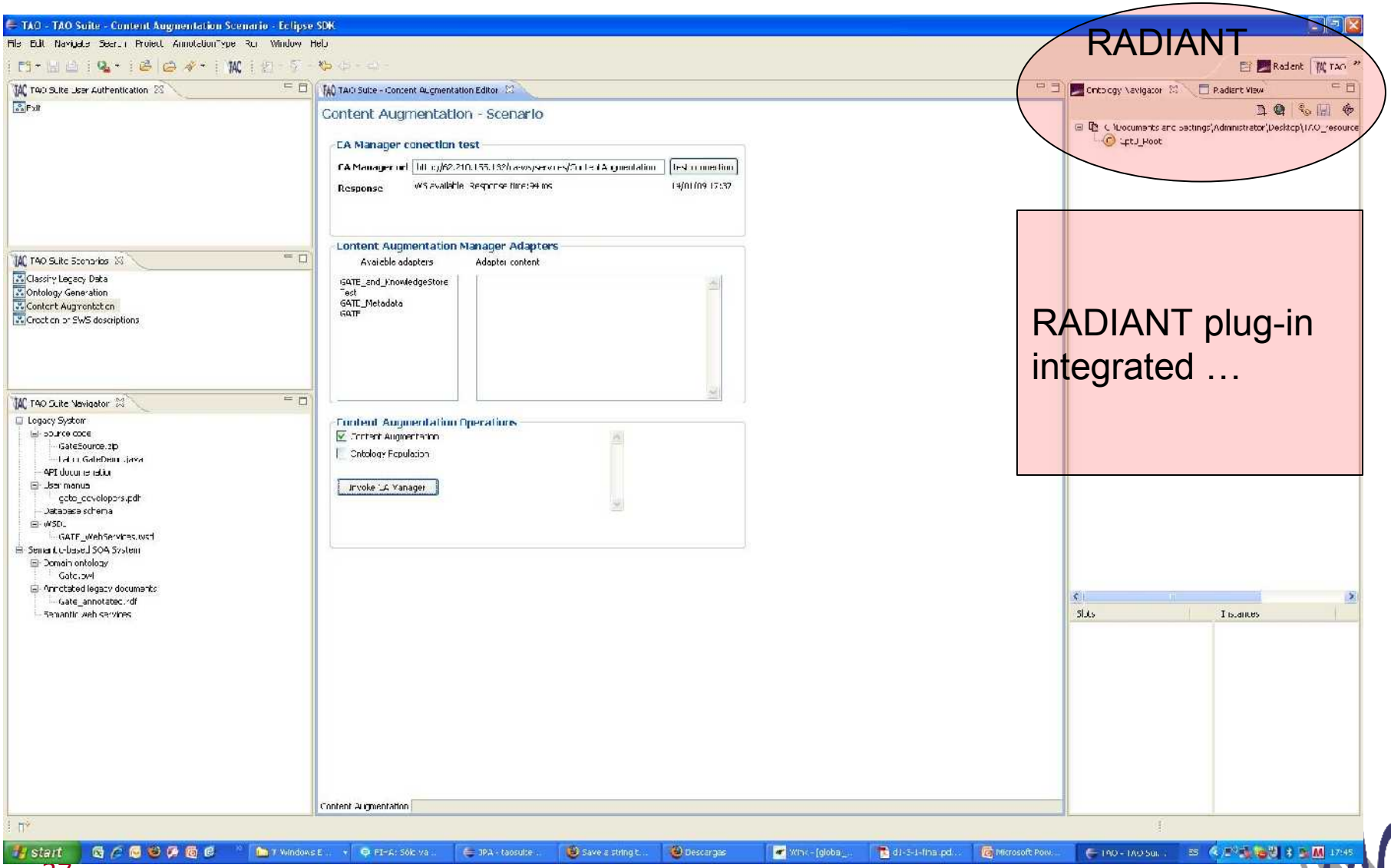


Different adapters for creation of SWS

TAO Suite - features

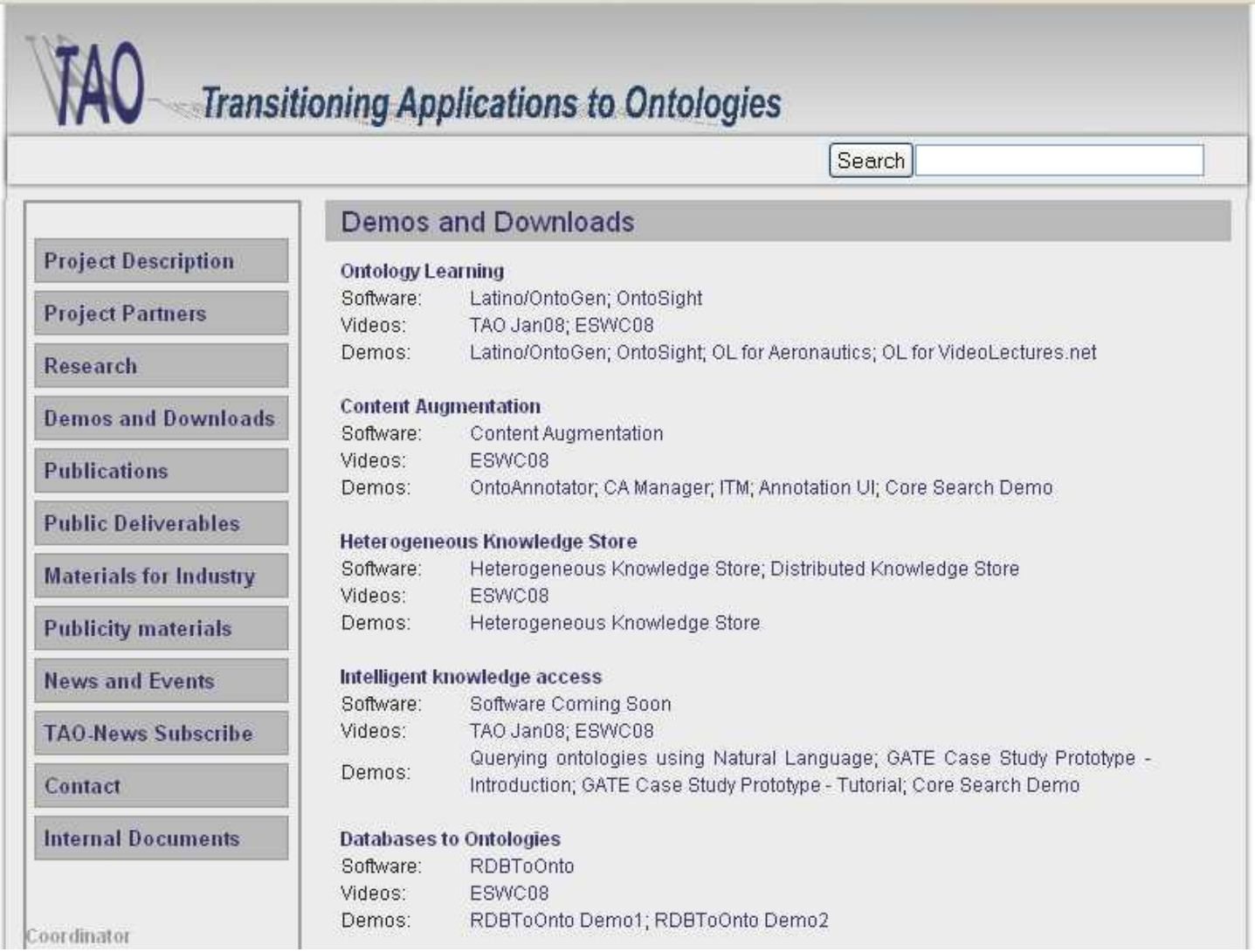


RADIANT plug-in integrated …

Annotation User Interface

- Demo of Annot UI Prototype

TAO Suite – Downloads



TAO Suite – Downloads

Coordinator
Kalina Bontcheva
University of Sheffield UK

Aircraft Maintenance Case Study
Software: Confidential Prototype
Demos: Ac Maintenance Case study

TAO Suite
Software: TAO Suite
Demos: TAO Suite

GATE Data
GATE Code and Documentation
GATE Web services

Amazon Case study
Demos: Amazon Case Study

Other Related Materials

Tutorials

WSMO tutorial
ESWC'08 Tutorial
Video Tutorials
SWESE'08 Workshop

"Call 3 in Motion" workshop at EC

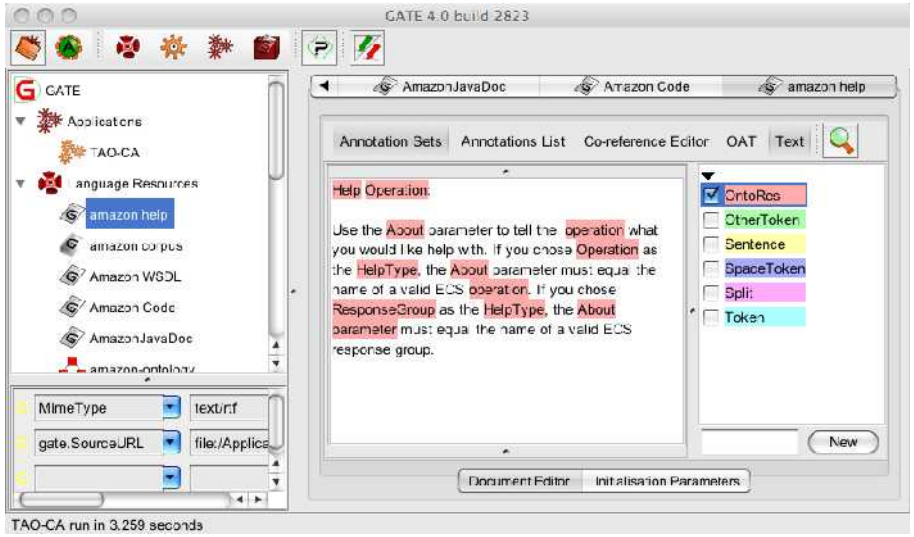
TAO demos
TAO Publicity Materials
TAO Public Deliverables
TAO Project presentation
TAO Project Demo

End

Questions? Discussion welcome!

Amazon Service Introduction

- Provides developers with direct access to Amazon's robust technology platform.
  - Built from Amazon's suite of web services.
- 11 solutions catalog.
  - **Associates Web Service (formerly Amazon E-Commerce Service (ECS))**
  - Simple Queue Service
  - Simple Storage Service
  - Flexible Payments Service
  - … …
- WP1 has generated:
  - **Amazon ECS ontology**
    - Nearly 300 named classes
    - 700 Properties

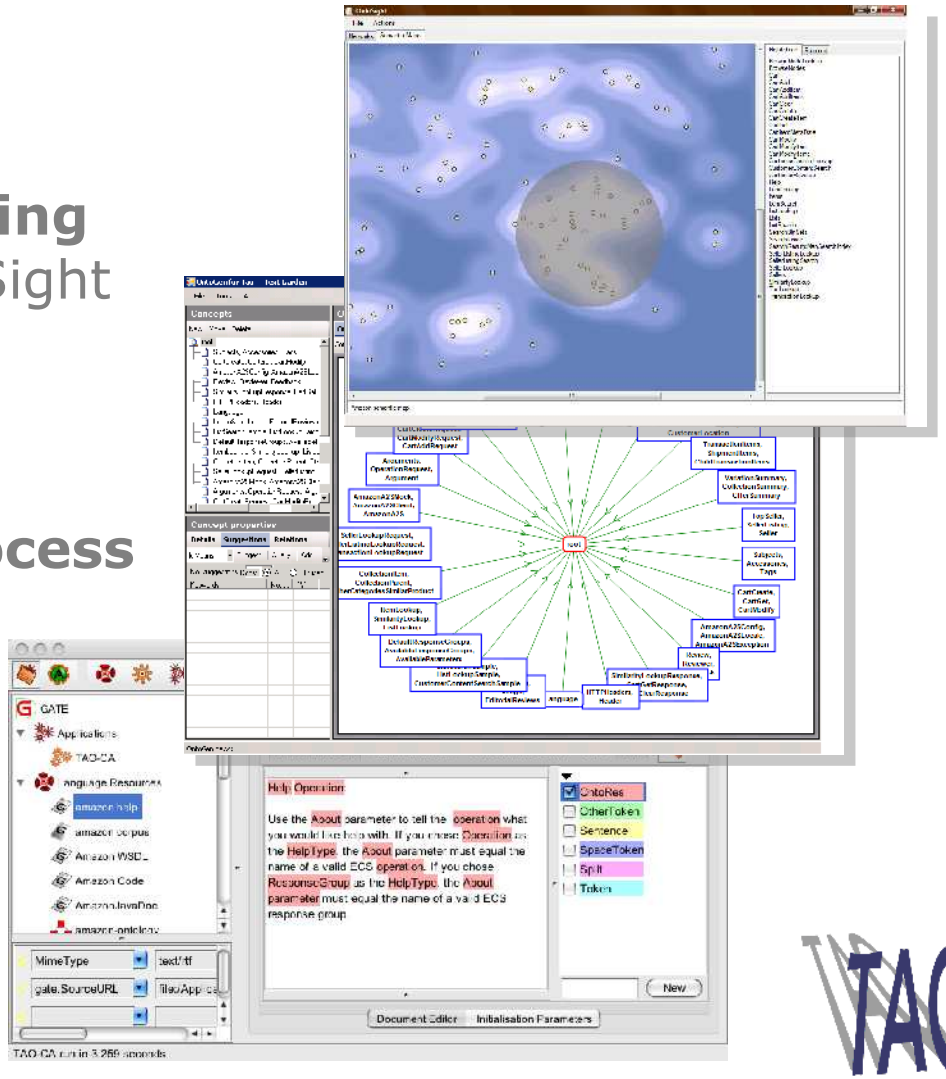


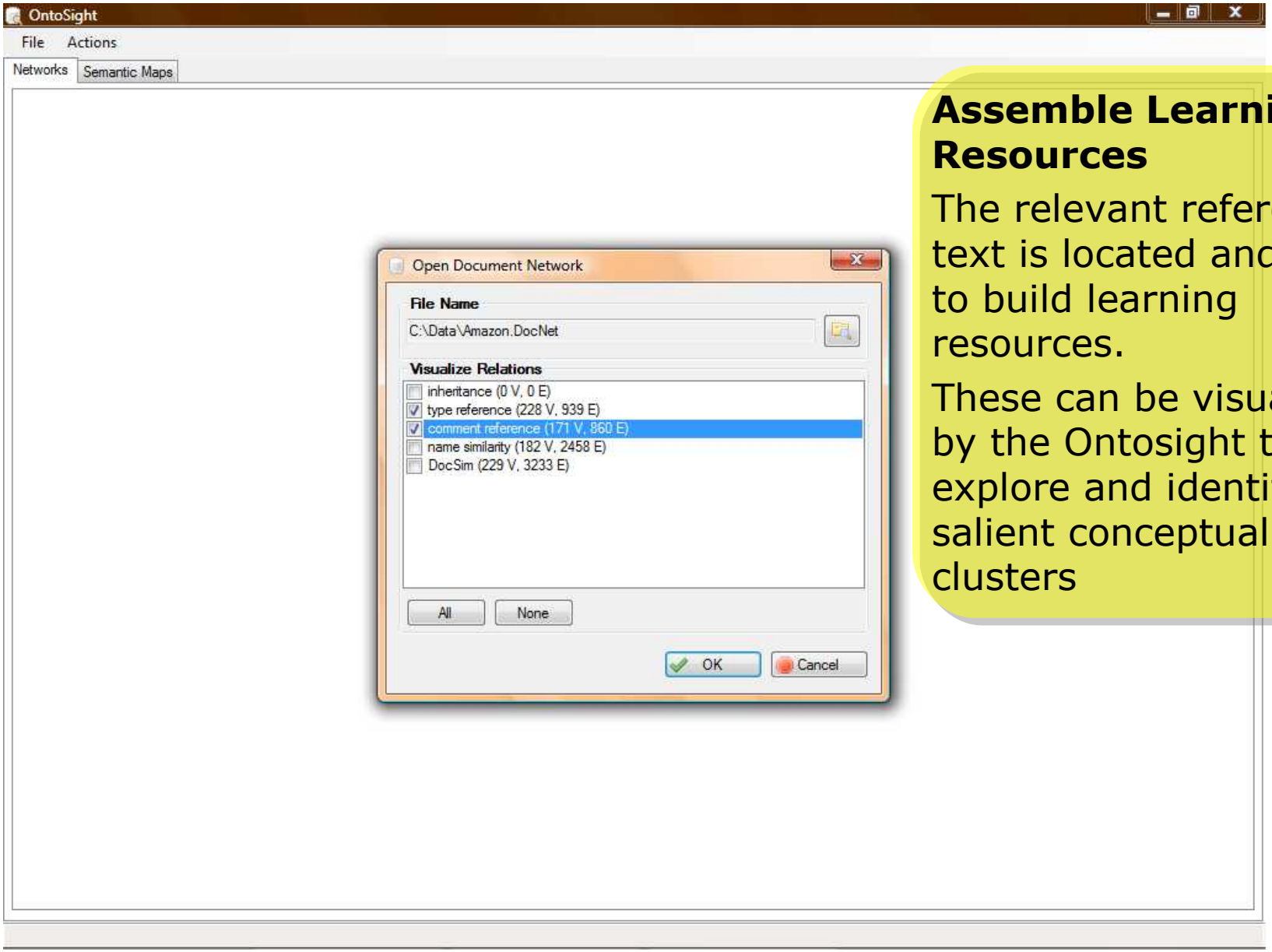
Amazon Associates Web Service

- Exposes Amazon's product data
- For developers to applications that merchandise Amazon products.
- Development environment
  - Complete API and Java library
  - Developer documents,
    - e.g. tutorial, Code samples, Developer Forums
  - Based on WSDL

Amazon Demo

- Demonstration of the Methodology using the Amazon Services
- Illustrates:
  - **The ontology learning process** using OntoSight and OntoGen over Amazon data (*screenshots*)
  - **The annotation process** using Gate (*video*)

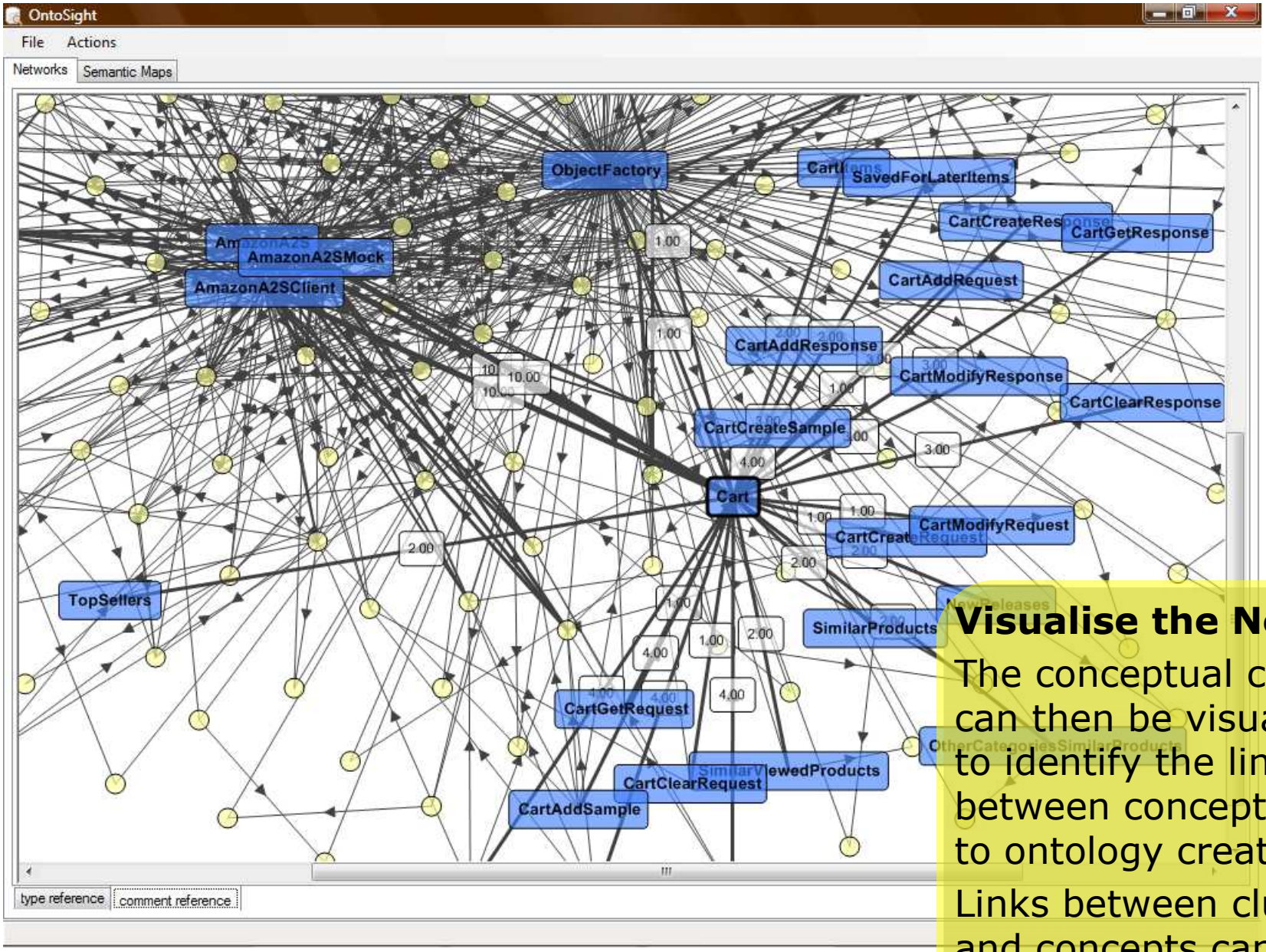




Assemble Learning Resources

The relevant reference text is located and used to build learning resources.

These can be visualised by the Ontosight tool to explore and identify salient conceptual clusters

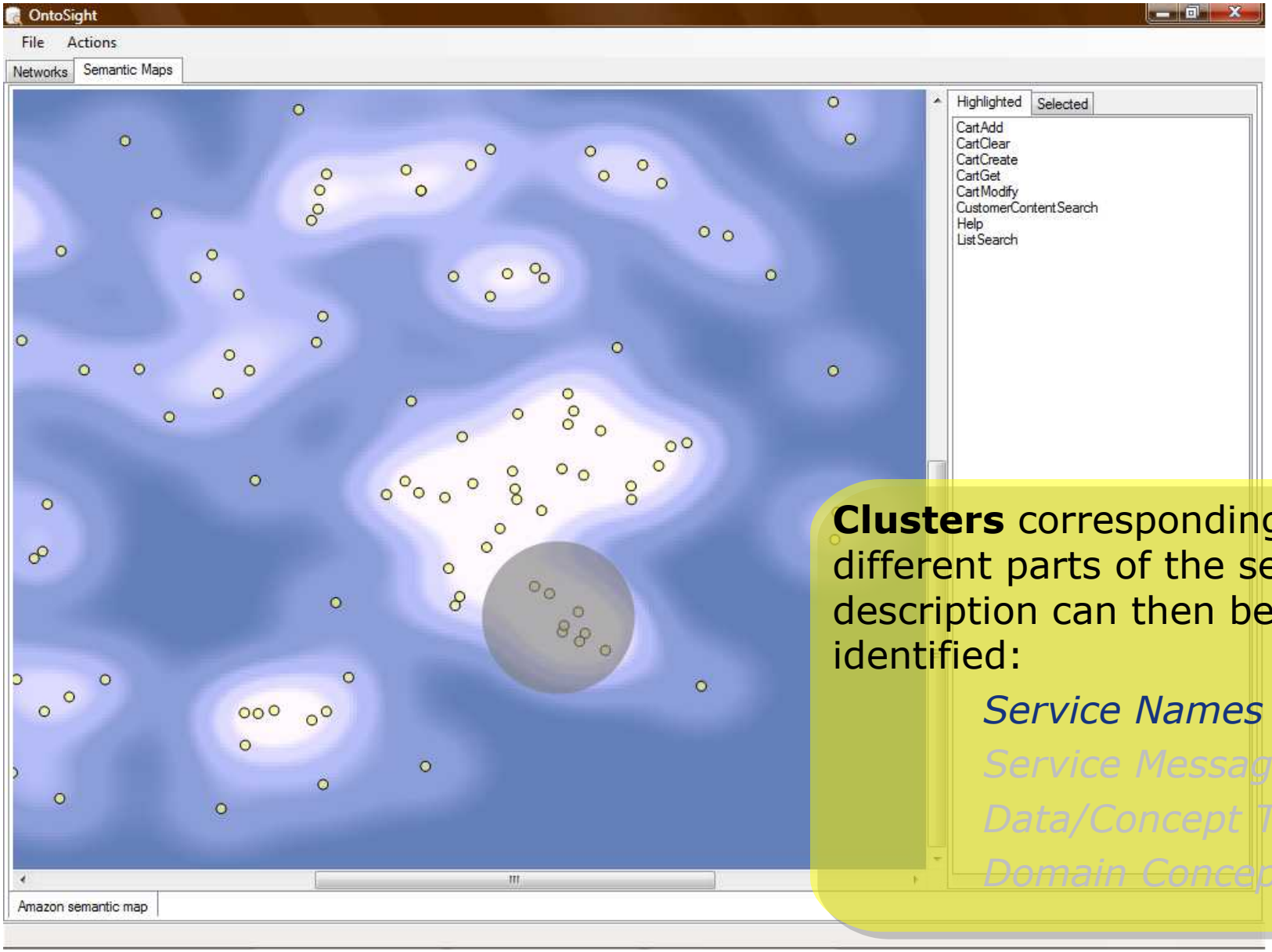


Visualise the Network

The conceptual clusters can then be visualised to identify the links between concepts prior to ontology creation.

Links between clusters and concepts can be weighted.

The visualization of a semantic space and the use of the context tool for exploring the space



Clusters corresponding to different parts of the service description can then be identified:

Service Names

Service Messages

Data/Concept Types

Domain Concepts

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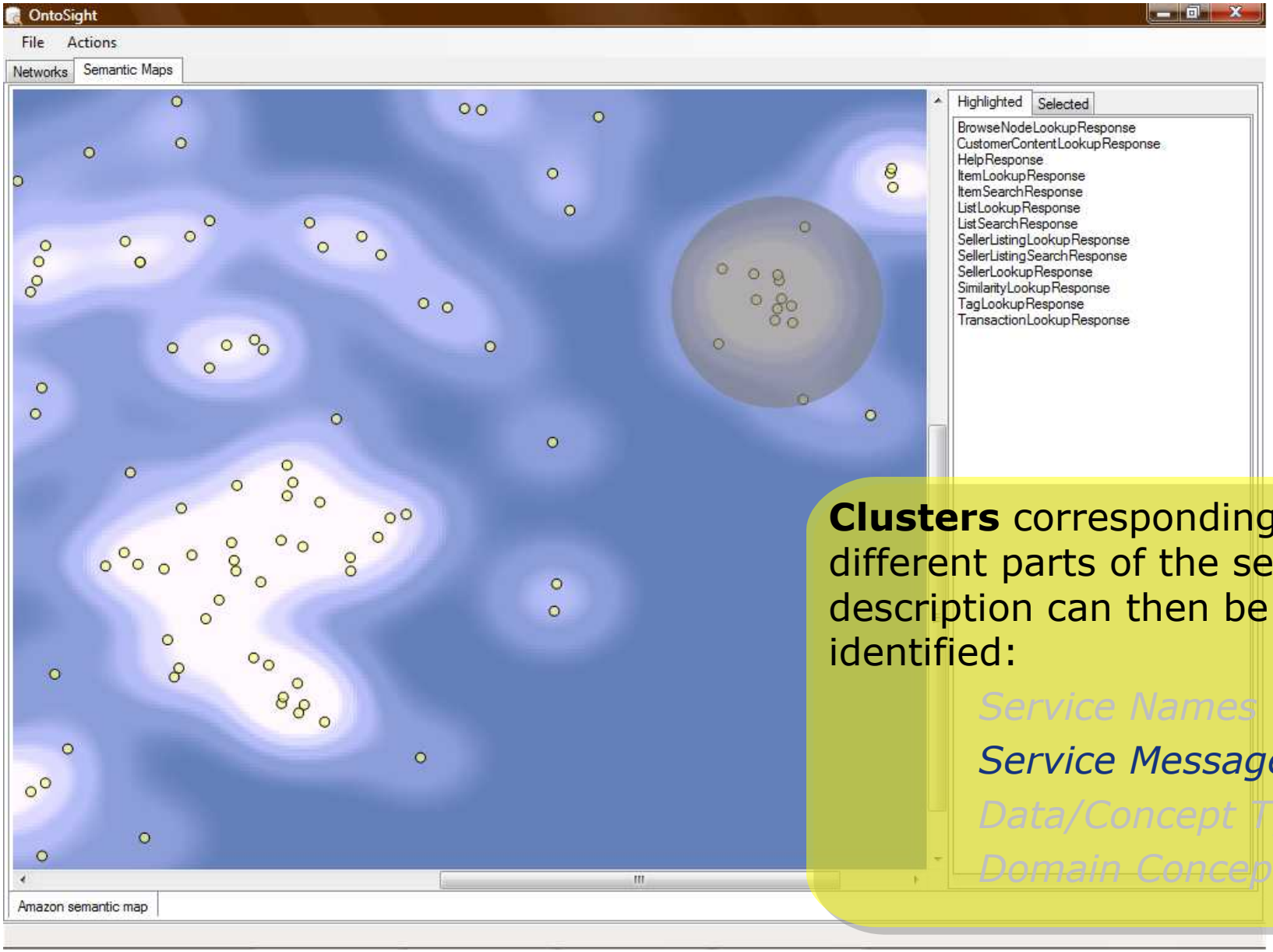

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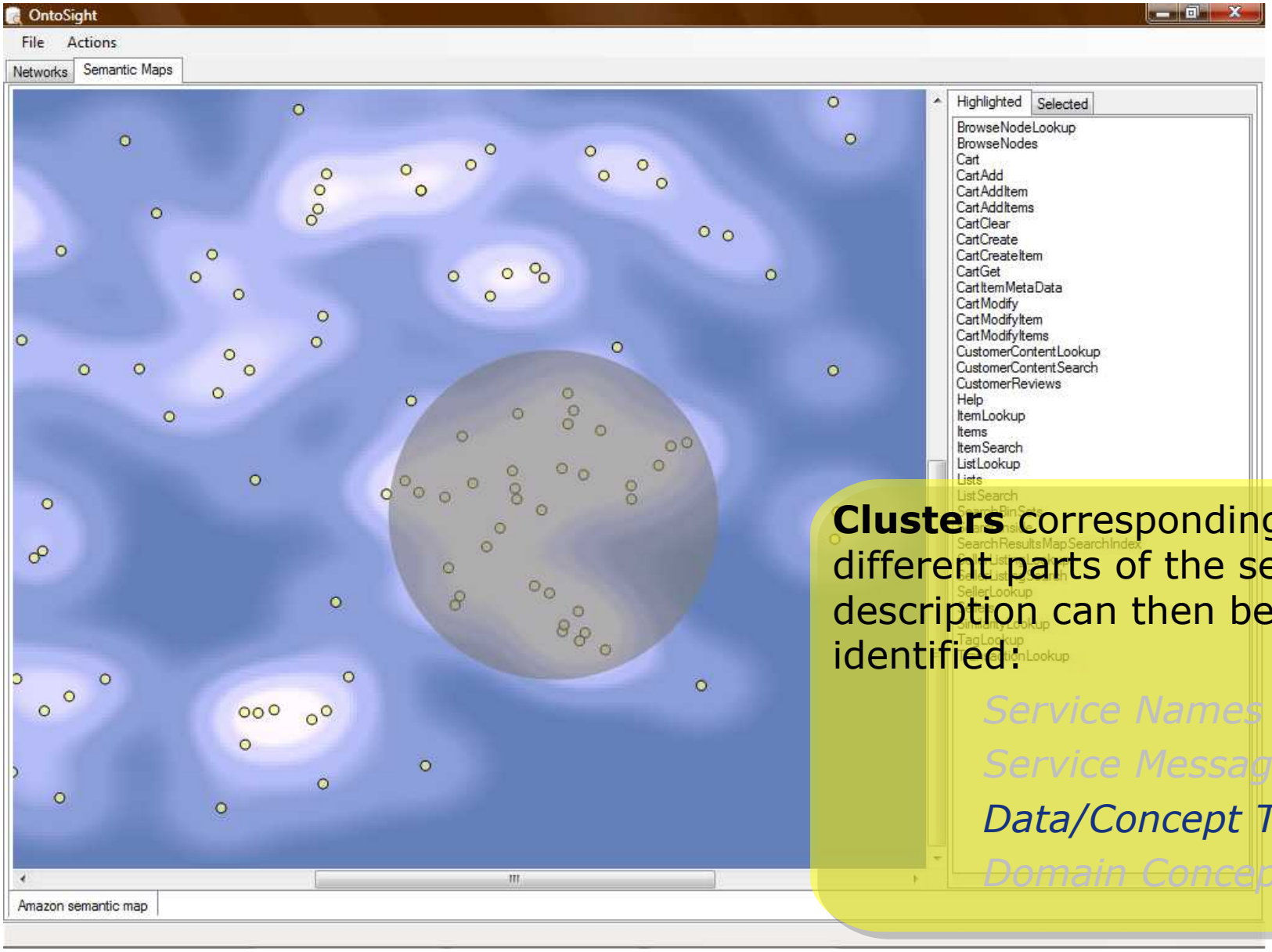
- *Domain Concepts*

The visualization of a semantic space and the use of the context tool for exploring the space



Clusters corresponding to different parts of the service description can then be identified:

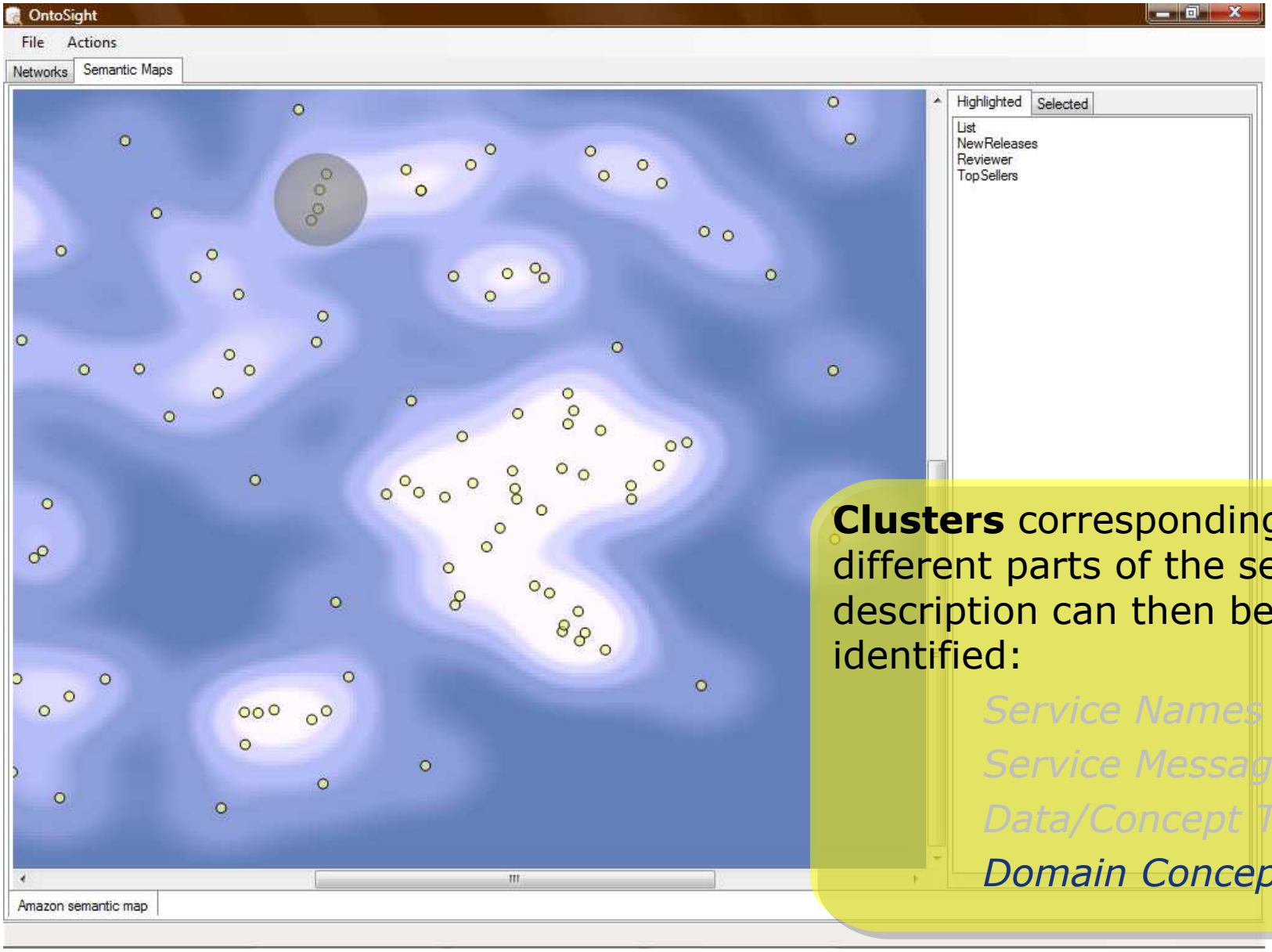
Service Names

Service Messages

Data/Concept Types

Domain Concepts

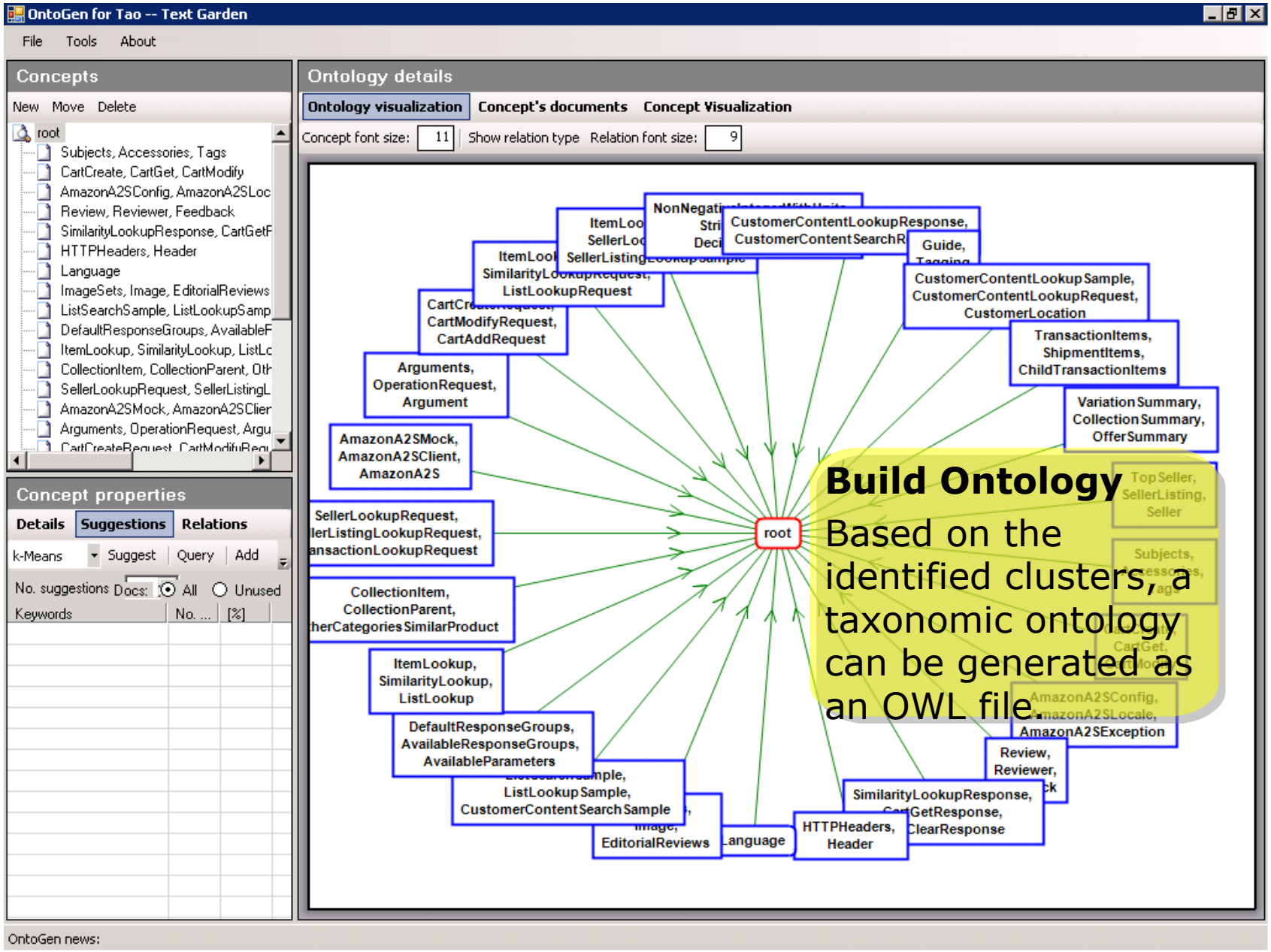
The visualization of a semantic space and the use of the context tool for exploring the space



Clusters corresponding to different parts of the service description can then be identified:

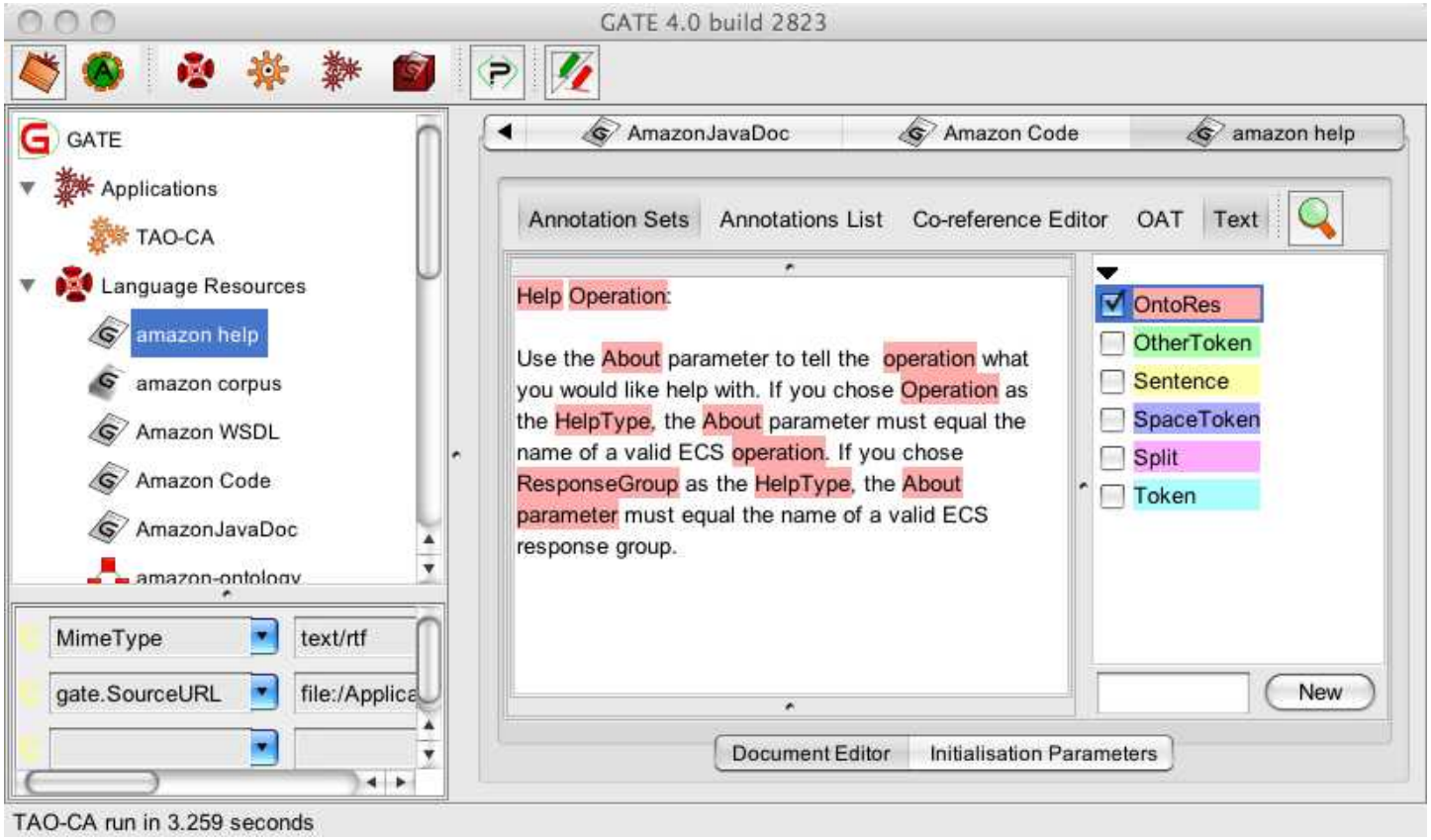
- *Service Names*
- *Service Messages*
- *Data/Concept Types*
- *Domain Concepts*

Load Feature Vector to OntoGen and create ontology



Amazon ECS Ontology

- Amazon ECS ontology
  - Nearly 300 named classes
  - 700 Properties
- Annotate Amazon Documents

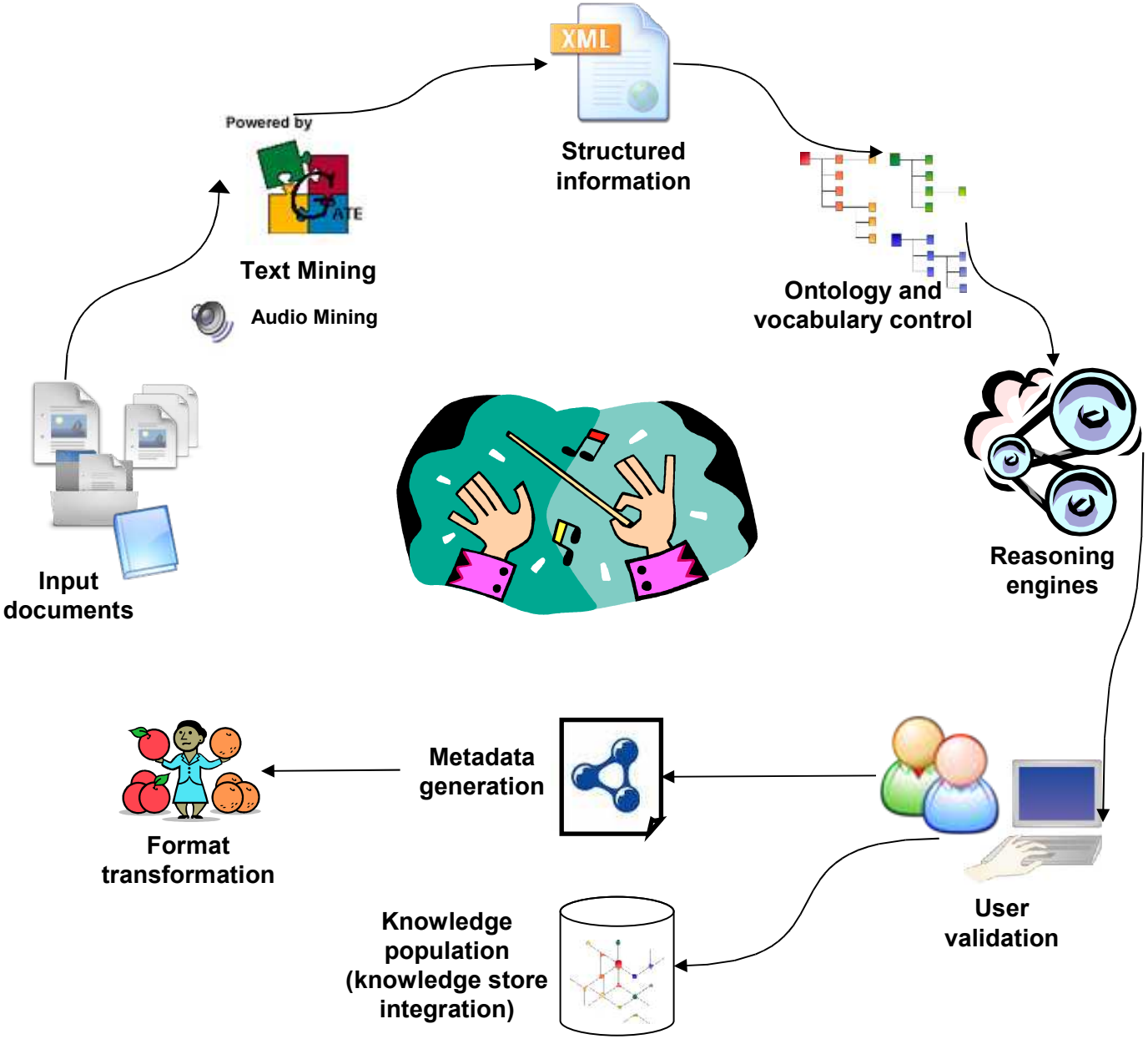


End

Questions? Discussion welcome!

Achieved in second year : CA-Manager specifications

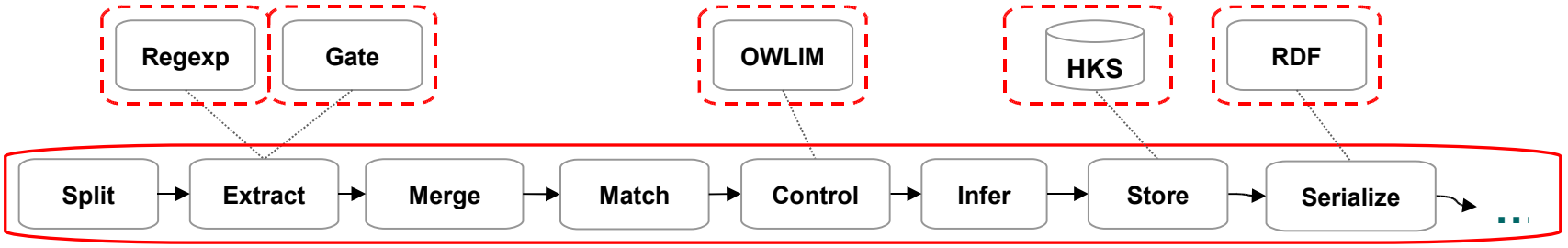
- CA-Manager : middleware used by TAO suite that connects text-mining, knowledge repository, + other components if needed
- Must be able to address :
  - Automatic metadata generation
    - Generate a set of metadata about the processed document
    - Ex : create a searchable database of document metadata (lifescience industry)
  - Automatic knowledge extraction
    - Populate an ontology with extracted entities
    - Ex : populate a competitive intelligence knowledge base (publishing)
  - Automatic text annotation
    - Insert specific metadata at particular offsets in the original document
    - Ex : generating SA-WSDL from original WSDL files + text-mining
- Must be able to integrate with ontology aware text-mining AND legacy text-mining tools


XML
Structured information
Powered by
GATE
Text Mining
Audio Mining
Ontology and vocabulary control
Input documents
Reasoning engines
Format transformation
Metadata generation
User validation
Knowledge population (knowledge store integration)

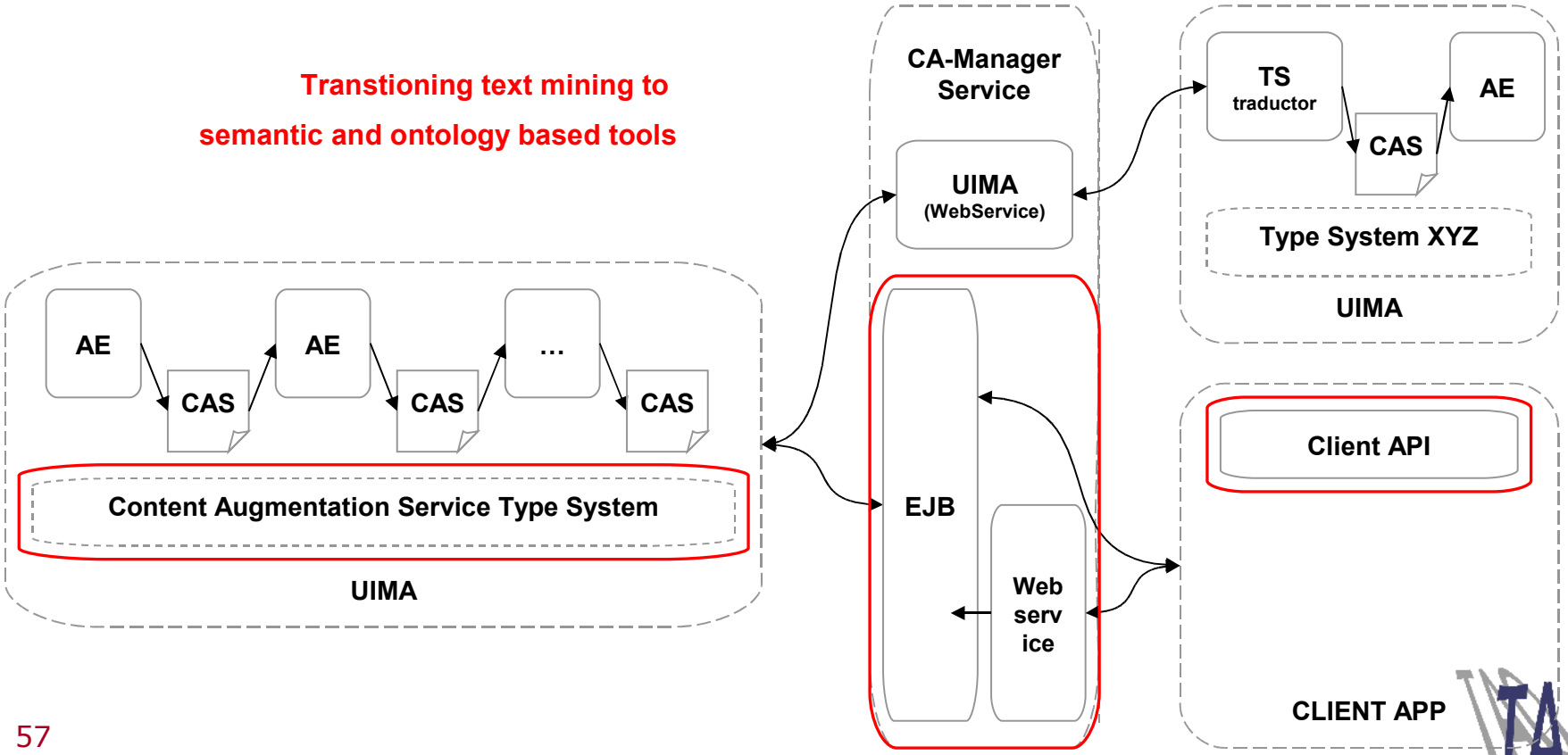
Achieved in second year : CA-Manager architecture

- Choice of UIMA as CA-Manager backbone.
  - IBM open-source framework
  - « UIMA supports the development, discovery, composition and deployment of multi-modal analytics for the analysis of unstructured information and its integration with search technologies »
  - Benefits :
    - Ability to define flexible processing flows
    - distributed & pluggable components
    - XML configuration of components
    - A common data structure between components
    - Sharing & reusing open-source components
- Other solution : 100% webservices
  - No need to have webservices inside internal components of TAO
  - Potentially slow & hard to maintain
  - Lots of things to reimplement

Achieved in second year : CA-Manager architecture



Transtioning text mining to semantic and ontology based tools



Achieved in second year : CA-Manager architecture

- The architecture
  - Is a specialized UIMA pipeline
  - Focuses on transioning text-mining results to semantic tools
  - Is meant to hide UIMA complexity if not required
  - Provides a _service_ (simple, remote)
  - Benefits from UIMA framework (process configuration, distributed architecture, connection to other UIMA based tools, etc.)
  - Is pluggable (possibility to write a connector to a new external tool)

- Added value (how is it better than just UIMA ?)
  - Definition of a generic Common Analysis Structure
  - Mapping language to map IE results to CAS
  - Specialization of UIMA pipeline
  - Connectors to various external tools
  - Hide UIMA complexity

Achieved in second year: CA-Manager

- Demo of CA-Manager

CA-Manager : Coming next

- OK so far :
  - Specifications and architecture
  - KCIT integration
  - Working prototype
- Coming next :
  - HKS integration
  - Ontology-based controls
  - SA-WSDL generation
  - Integration with annotation GUI
  - Open-sourcing