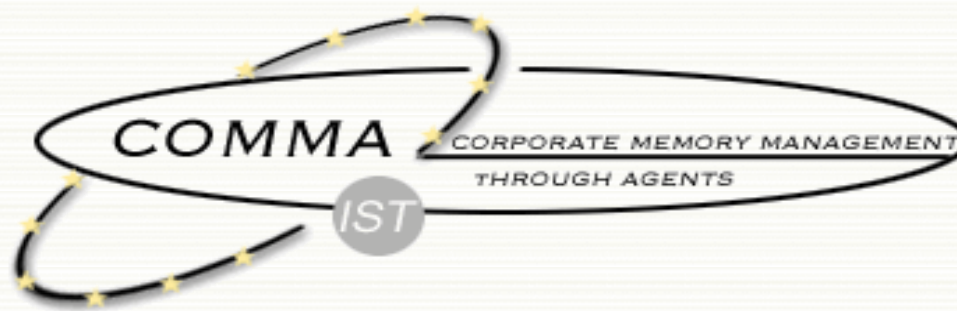


# A Multi-Agents System for a Corporate Web Semantic



# ▶ What ?

IST European project : Provide a corporate memory management framework.

## ▼ Corporate Memory:

An explicit, disembodied and persistent representation of knowledge and information in an organization, in order to facilitate their access and reuse by members of the organization, for their tasks.

## ▼ Management Framework:

provide supporting structure around which one can build a system insuring coherent integration and exploitation of the dispersed knowledge

## ▶ Why ?

- ▼ New Employee insertion
- ▼ Technology Monitoring support

## ▶ Who ? & Where ?

- ▼ ATOS - Origin (France)
- ▼ CSELT - Telecom Italia (Italie) *beginning*
- ▼ CSTB (France) *end*
- ▼ LIRMM - University of Montpellier
- ▼ T-Nova - Deutsch Telekom (Germany)
- ▼ University of Parma (Italy)
- ▼ Projet ACACIA - INRIA Sophia Antipolis

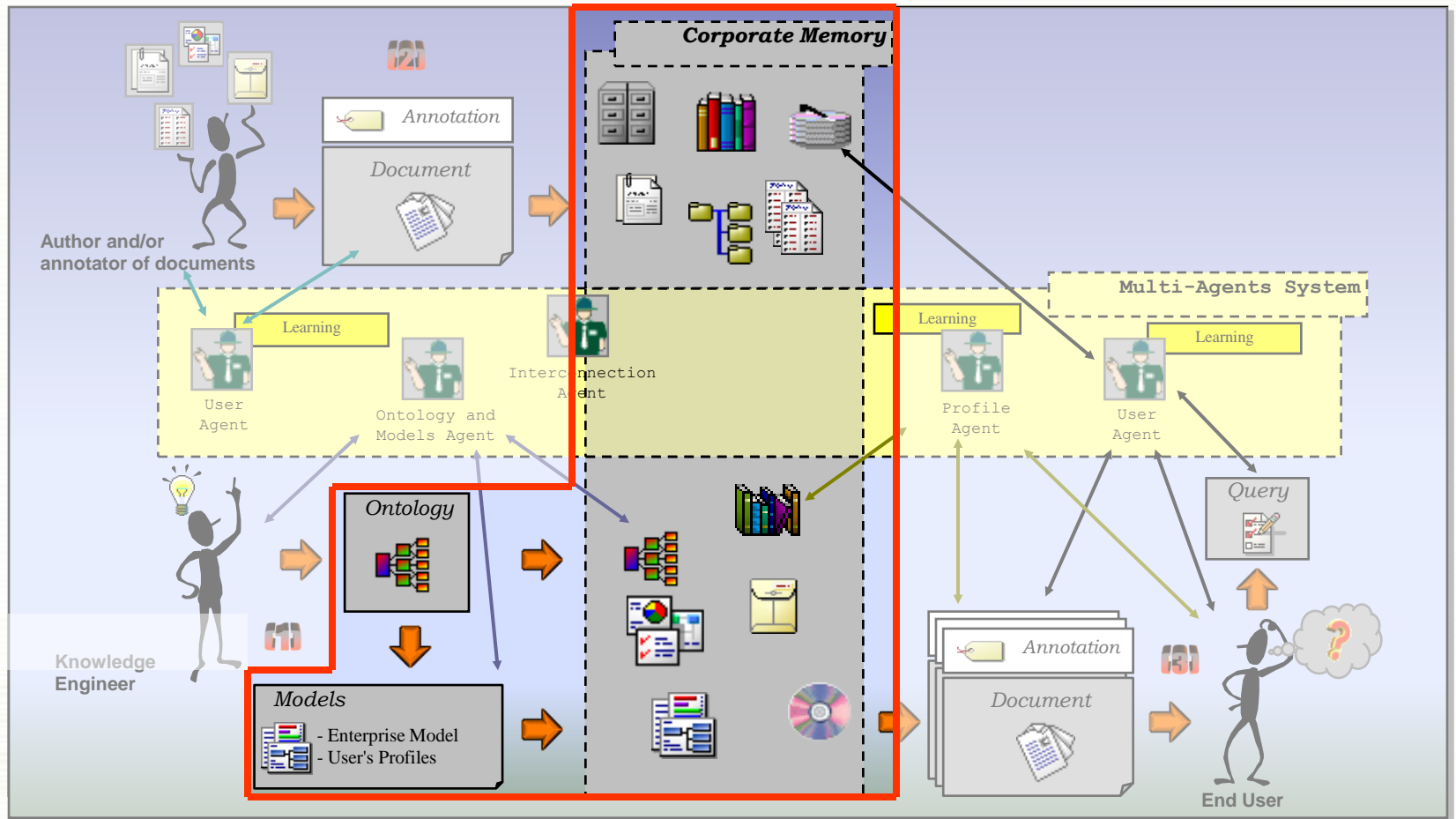
## ▶ When ?

De February 2000 à February 2002

## ▶ How ?

- ▼ Corporate memories as *heterogeneous and distributed* information landscapes
- ▼ Stakeholders are a *heterogeneous and distributed* population
- ▼ Exploitation of CM involves *heterogeneous and distributed* tasks

<u>CM Materialization</u>	<u>CM Exploitation</u>
<b>XML:</b> Standard, Structure, Extend, Validation, Transform	<b>Multi-Agent System:</b> Modularity, Distributed, Collaboration
<b>RDF:</b> Annotation, Schemas	<b>Machine Learning:</b> Adaptability



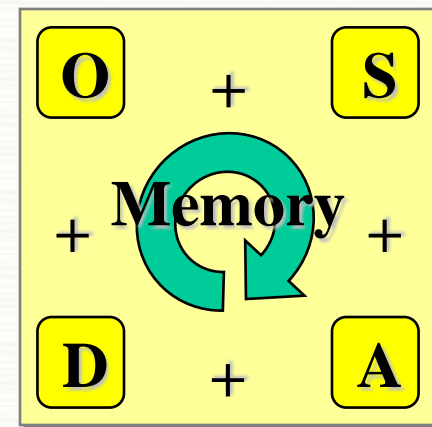
- ▶ Collaboration → Global Capitalization
- ▶ Autonomy & Individuality → Local Adaptation

# ▶ RDF : Resource Description Framework

- ▶ Describe Web resources
- ▶ Internal/External annotation of documents
- ▶ RDF Schema (to formalize the ontology)
- ▶ RDFS Limited - Extend *iff* necessary

## ▶ Approach :

- ▶ Ontology in RDFS
- ▶ Description the Situation in RDF:
  - User Profiles
  - Organization model
- ▶ Annotations in RDF describing Documents



## ▶ Toward a corporate semantic Web annotated memory based on models

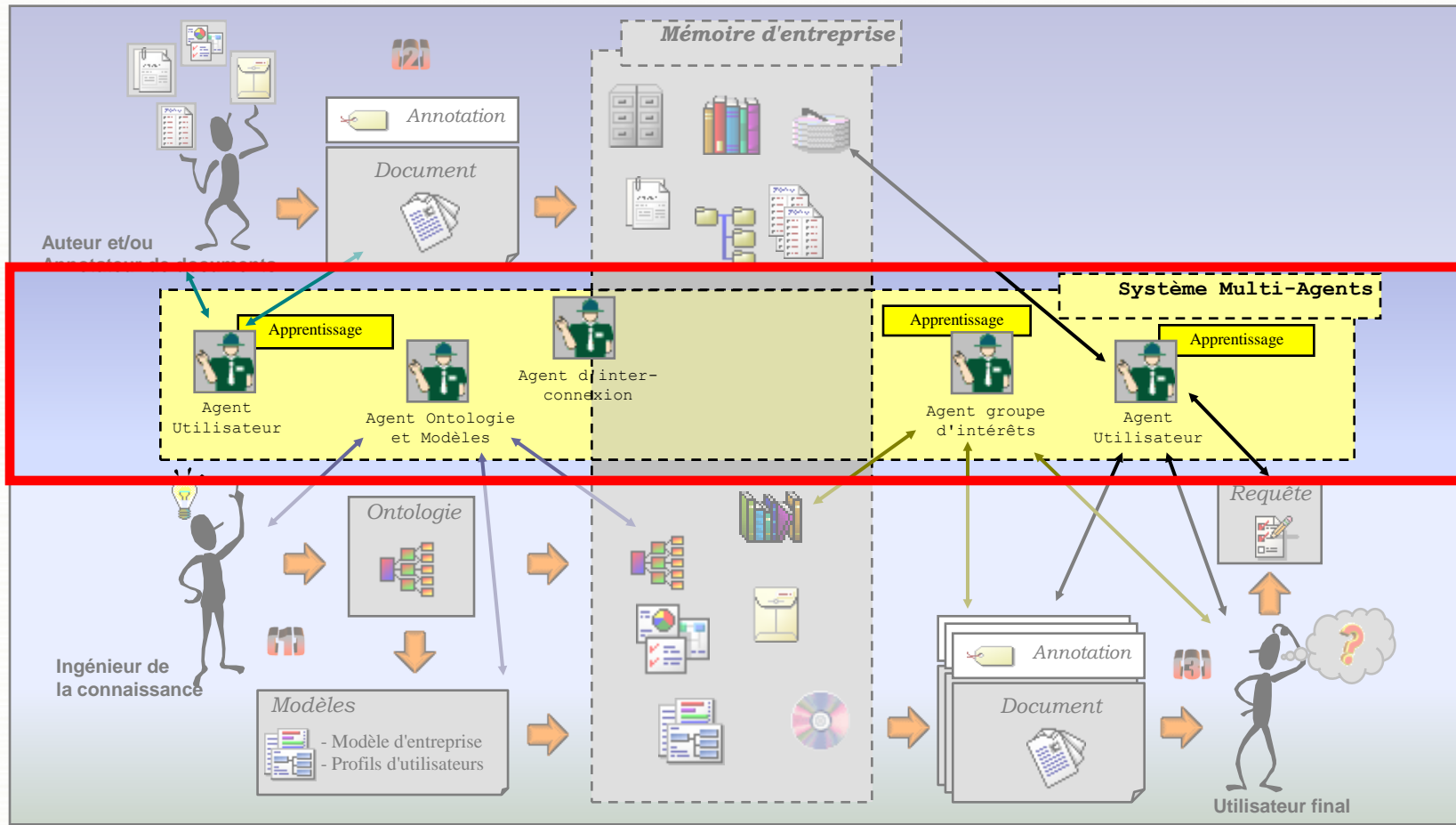
## ▶ CORESE

- ▶ **C**Onceptual **R**Esources **S**earch **E**ngine
- ▶ RDF(S) ↔ Conceptual Graphs
- ▶ Semantic search engine for tests
- ▶ API for agents behavior implementation

▶ **Ontology**: explicit partial account of concepts used in the corporate memory management scenarios and their relations

### ▶ **3 needs for an ontology**

- ▶ Component of the memory
- ▶ Description of models and annotations
- ▶ Communication between agents





## ▶ Agent assets

- ▶ Loosely-coupled software components (design, integration, deployment) (👁 Paola)
- ▶ Semantic-level message passing, natural in a KM environment

## ▶ CoMMA = Heterogeneous Multi-Agents Information Systems

- ▶ Not heterogeneous sources (≠InfoSleuth): documents are heterogeneous but annotations are in RDF and based on a shared RDFS schema
- ▶ Deal with information 'distribution':
  - scattered data, information & knowledge
  - diffuse captured information and knowledge

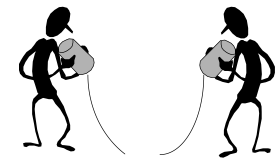
# ▶ From Macroscopic-level to Microscopic-level

- ▶ Problem: Engineering interaction & organization of the MAS to match the societal requirements

- ▶ Start [Sabas *et al.*]

onto Methodology Dimension:

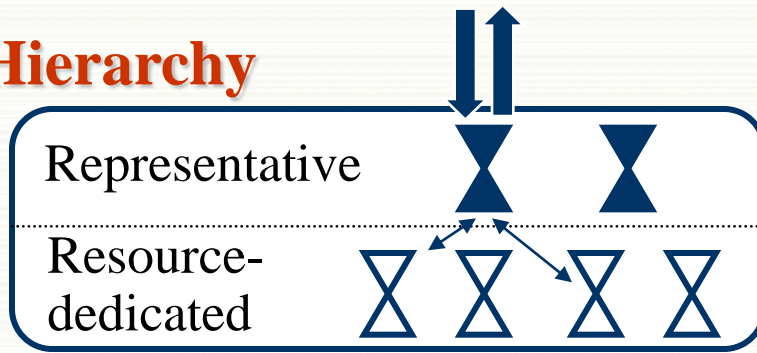
- ▶ Role
  - Scenario analysis & reports [Carroll, 1997]
  - Prototypical development cycle
  - two trials (intermediate one)



 Connection-dedicated sub-society

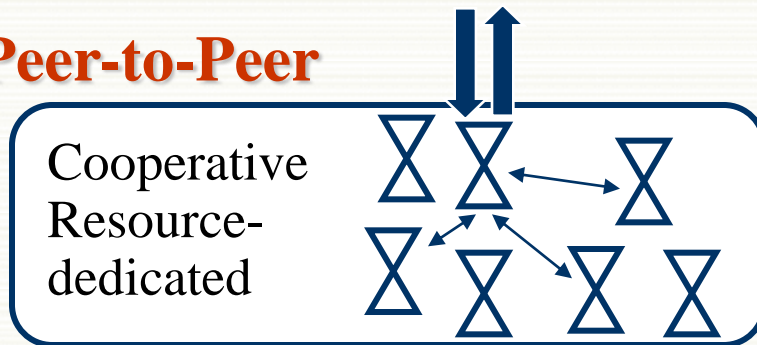
 User-dedicated sub-society

## Hierarchy



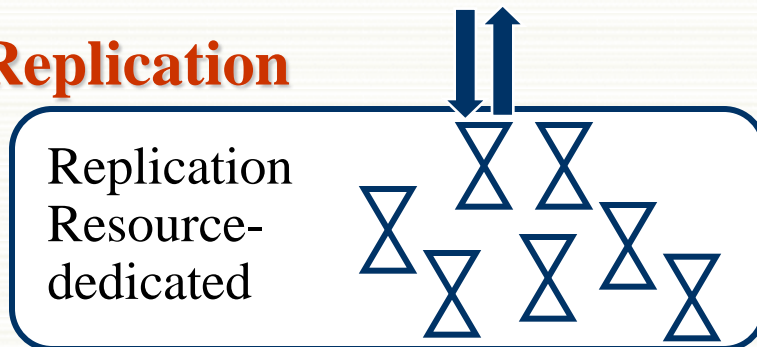
- Distribute roles
- ☺ Distribute WL
- ☹ Increase NL

## Peer-to-Peer



- Distribute only content
- ☹ WL & NL
- ☺ Redundancy

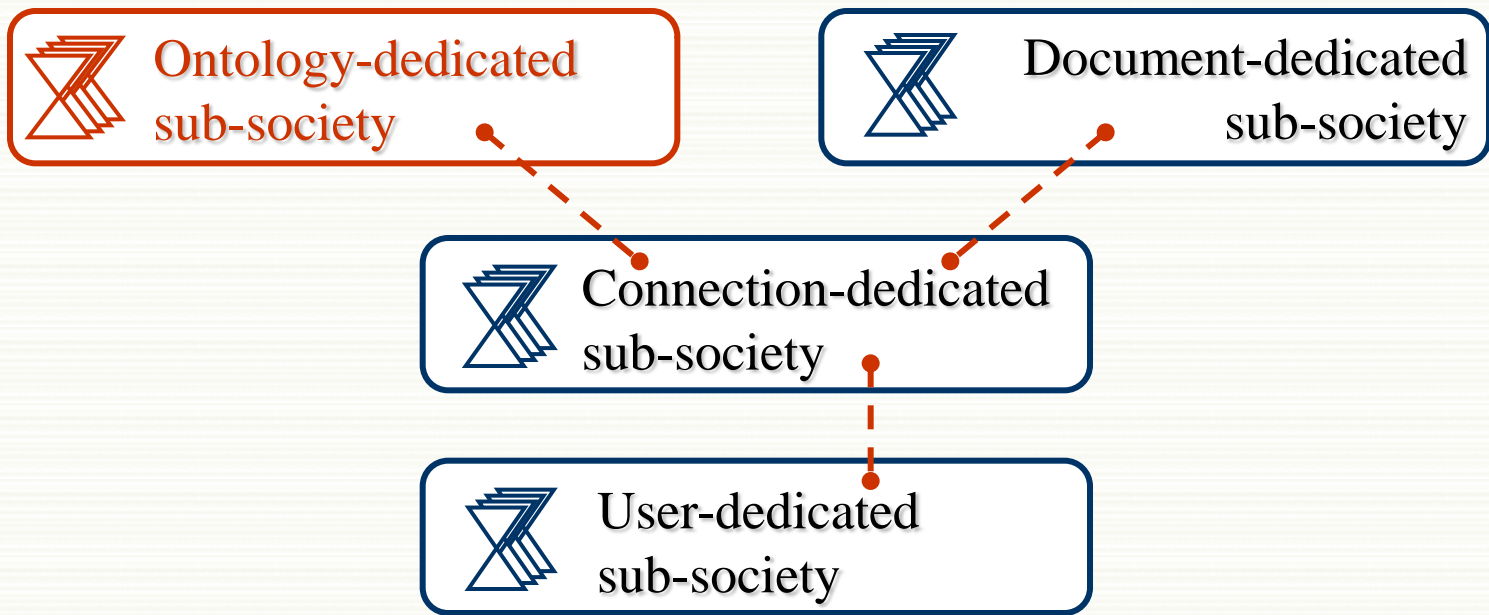
## Replication



- Complete replication
- ☺ Redundant & less NL
- ☹ Content replicated

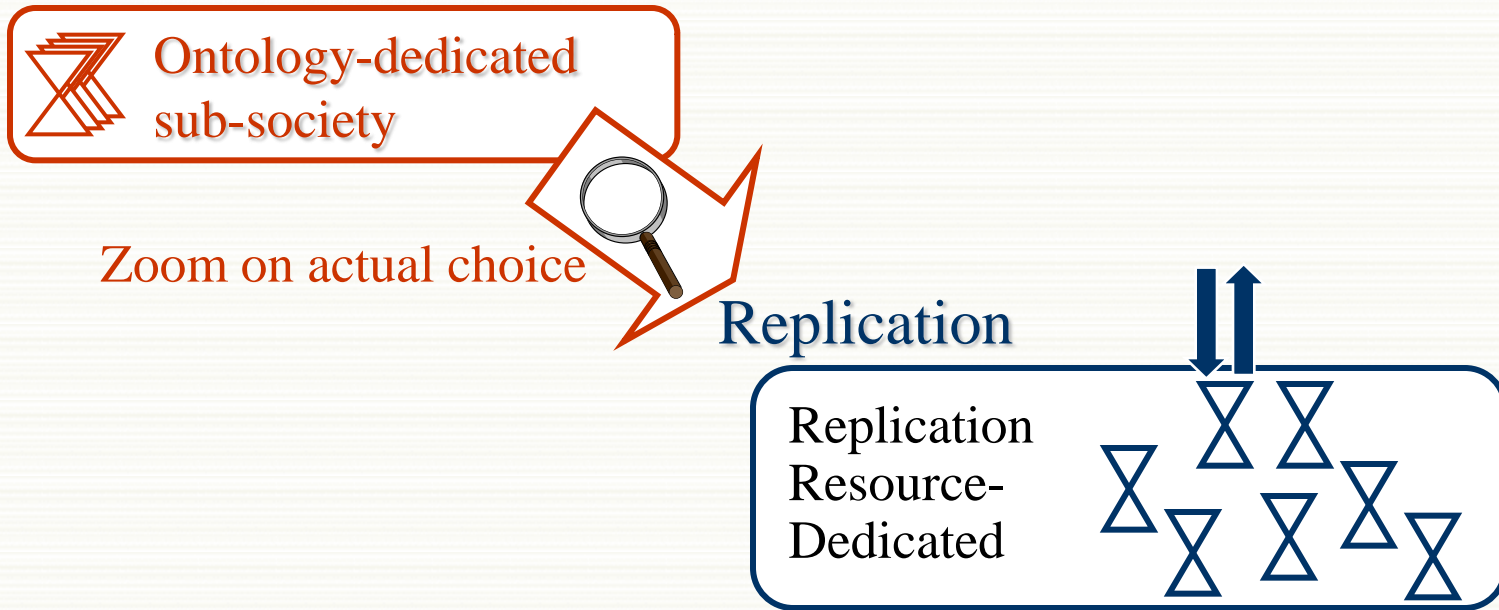
# ▶ The Ontology-dedicated sub-society :

- ▶ Queries on hierarchy of concepts & relations
- ▶ Queries on terms, synonyms, possible views



# ▶ The Ontology-dedicated sub-society :

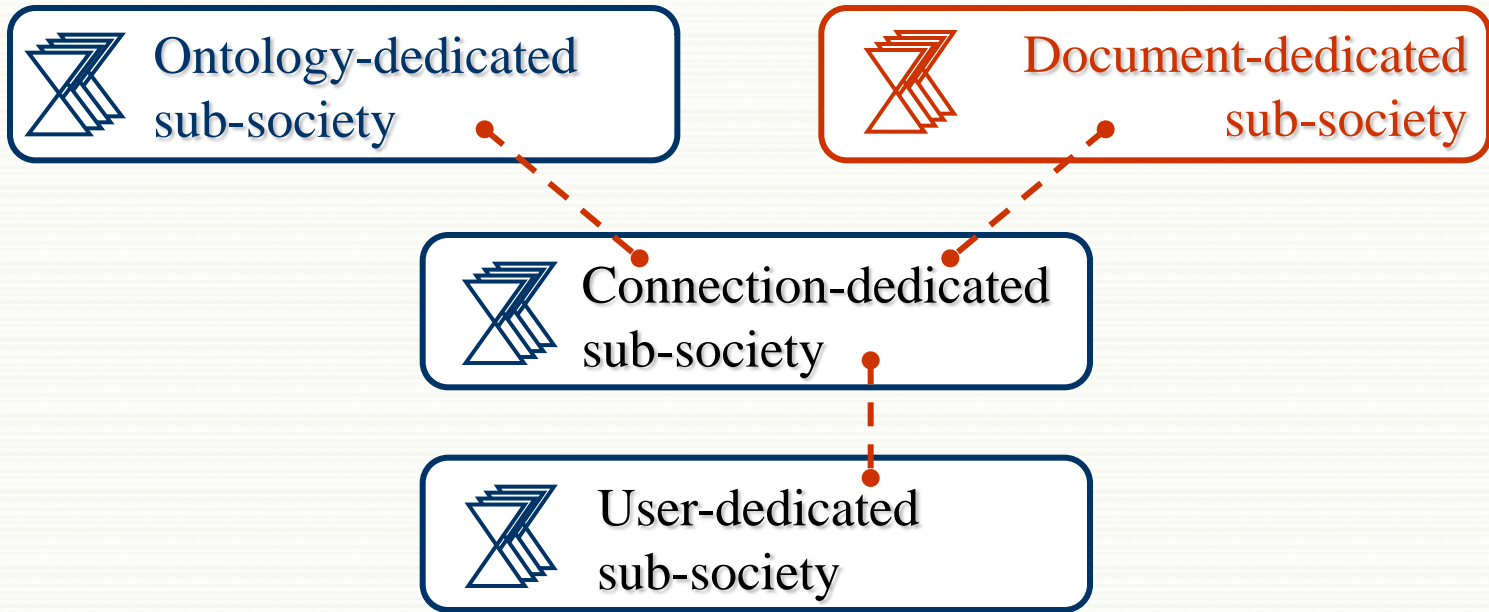
- ▶ Queries on hierarchy of concepts & relations
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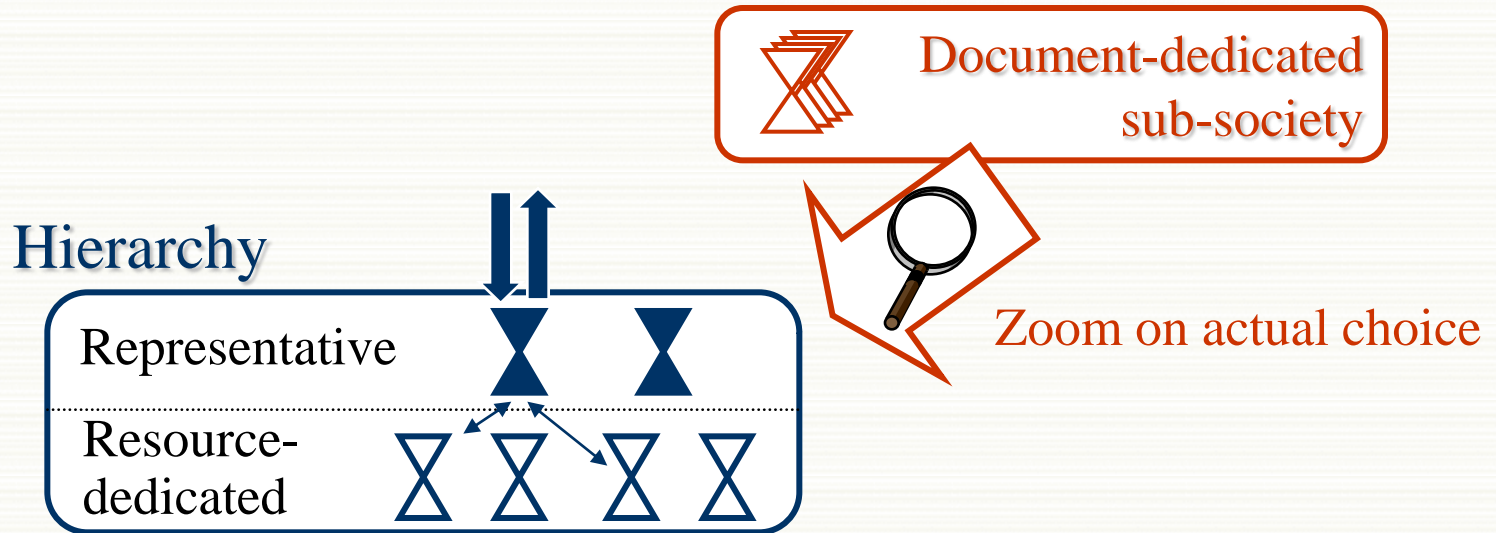
- ▶ Prototype choice because 'ontology stable'  
Other choices to maintain and support the ontology consensus (ex. FRODO project)

# ▶ The Document-dedicated sub-society :

- ▶ Archive annotations on documents of the OM
- ▶ Search & retrieve references matching queries



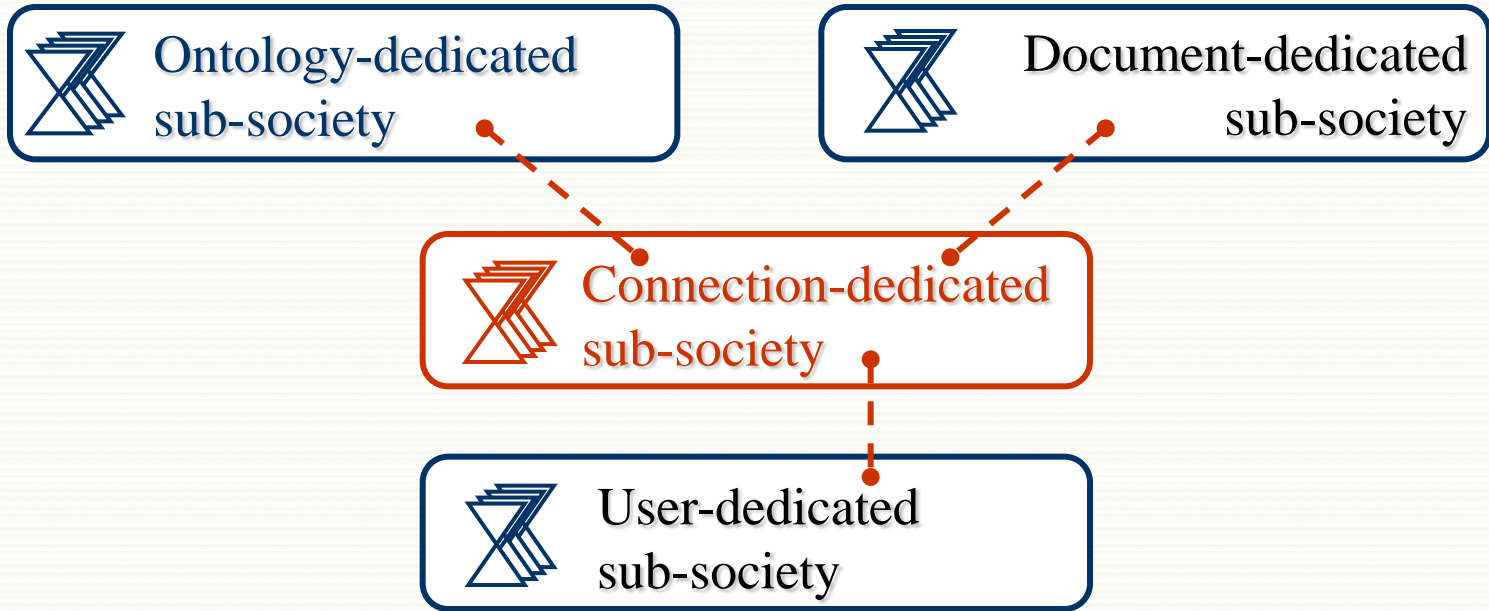
- ▶ The **Document**-dedicated sub-society :
  - ▼ Archive annotations on documents of the OM
  - ▼ Search & retrieve references matching queries



- ▶ Archivist: attached to & exploiting local base
- ▶ Mediator:
  - ▼ distributed query solving
  - ▼ allocation new annotations

# ▶ The Connection-dedicated sub-society:

- ▶ Yellow pages service management
- ▶ Federable to allow us to configure the MAS





# ▶ The Connection-dedicated sub-society:

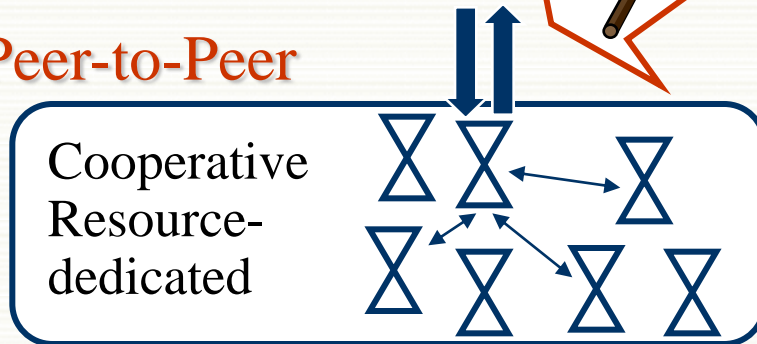
- ▶ Yellow pages service management
- ▶ Federable to allow us to configure the MAS



Zoom on actual choice



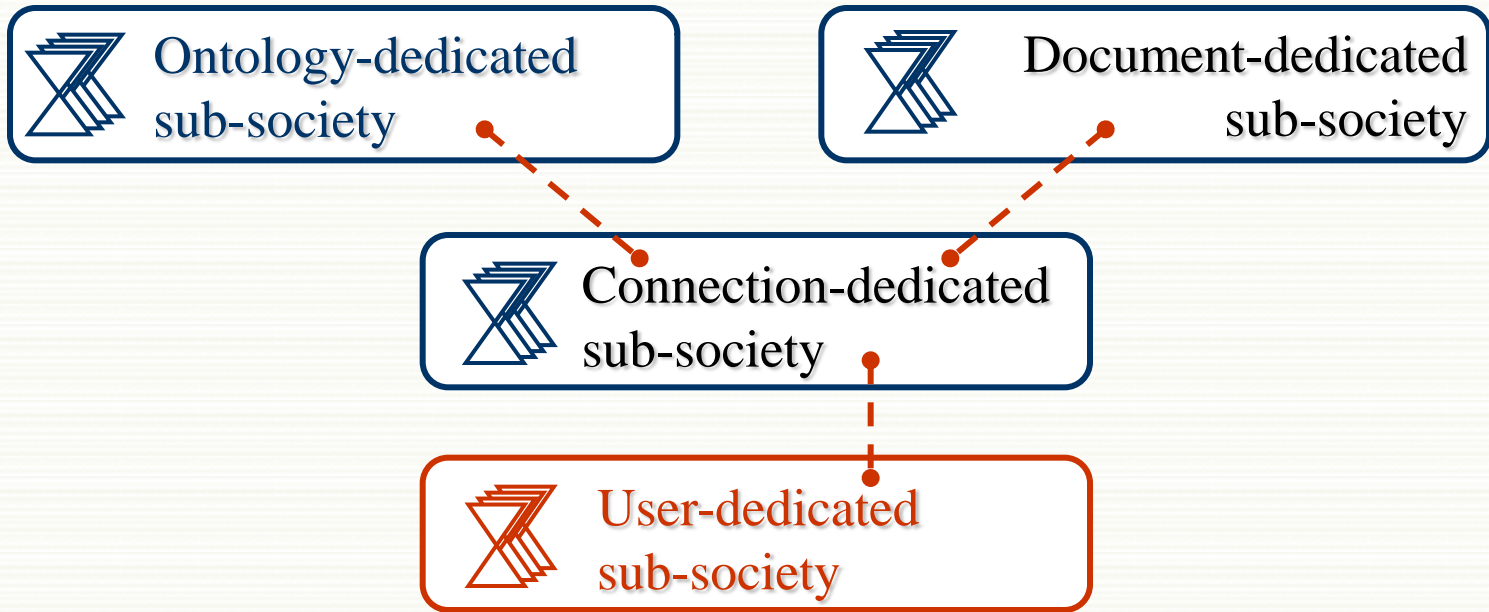
Peer-to-Peer



- ▶ Cooperating matchmakers (DF)

# ▶ User dedicated sub-society:

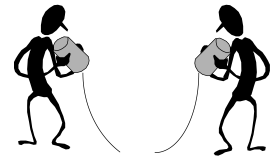
- ▶ Not related to one resource type
- ▶ Two main roles : GUI Mgnt & User Profile Mgnt



## ▶ User dedicated sub-society:

- ▼ Not related to one resource type
- ▼ Two main roles : GUI Mgnt & User Profile Mgnt
- ▼ Symbolic learning techniques
- ▼ Introduce new roles for customization
  - Collaborative filtering
  - Automatic annotation generation

[Sabas *et al.*]



Organization Dimension:

- Sub-societies with different organization rules
- Closed system
- Active environment (if user included)
- Symbolic environment: ontology-based

- ▼ IC, UPI annotated world.

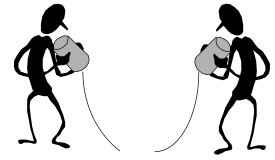
# ▶ Roles

- **Ontology Archivist:** maintains and accesses the ontology.
- **Enterprise Model Archivist:** maintains and accesses the enterprise model.
- **Annotation Archivist:** maintains and accesses the annotation repositories.
- **Annotation Mediator:** manages and mediates among a set of Annotation Archivists.
- **Directory Facilitator:** maintains and accesses the yellow pages.
- **Interface Controller:** manages and monitors the user interface.
- **User Profile Manager:** manages updates of profiles of users logged nearby and learns from the session
- **User Profile Archivist:** stores and retrieves users' profile

# Roles characteristics

	Ontology Archivist	Enterprise Model Archivist	Annotation Archivist						
Reactive	N	N	N						
Complex Mental State	N	N	N						
Graceful Degradation	Y	Y	Y						
Temporally continuity	Y	Y	Y						
Autonomy									
Goal-oriented	N	N	N						
Collaborative	Y	Y	Y						
Flexible	N	N	N						
Proactive	N	N	N						
Personality	N	N	N	N	N	N	N	Y	N
Communication	Y	Y	Y	Y	Y	Y	Y	Y	Y
Adaptability									
Learning	N	N	N	N	N	N	N	Y	N
Customizable	N	N	N	N	N	N	Y	Y	N
Mobility	N	N	N	N	N	N	N	N	N
Visual representation	N	N	N	N	N	N	Y	N	N
Veracity	v	v	v	v	v	v	v	v	v
Benevolence									
Rationality									

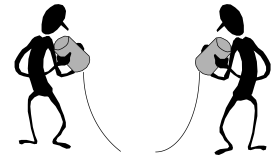
[Sabas et al.]



Agent Dimension:

- Heterogeneous agents
- Roles for information agents
- Table gives agent attributes

[Mercer & Greenwood]



Machine learning:

- Applied to people preferences to learn an order relation to rank the documents and sort the answers list.
- Learning on the fly
- Profile = initial stereotype + self description + learning

# Interactions

- ▼ Acquaintance
- ▼ Messages exchanged

## Ex: Annotation

- ▼ Use cases and annotations
  - annotation search
  - query solving
  - (new annotation event)

### ▼ Corresponding interactions:

- discuss best place to archive → contract-net proposal: semantic pseudo-distance(annotation,base)
- cooperate to solve a query → multi-stage query-ref statistic description of archives (service precision) decomposition and sub-queries
- (inform new annotation → subscribe)

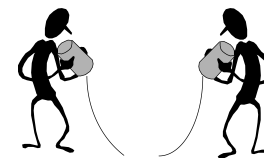
[Sabas *et al.*]

Representation Dimension:

- Protocol diagram (AUML)

Cooperation Dimension:

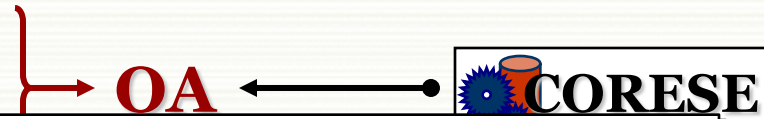
- FIPA ACL + Speech acts + O'CoMMA
- Human-Agent : IC (☛)
- Control ( depends sub-society)
- Interactions (?)



a)

# Types & Behaviors of Agents

Ontology Archivist



Enter

[Sabas *et al.*]

Anno

Technology Dimension:

Anno

- Asynchronous / Multi-threaded

Fede

- GUI: adaptation by machine learning

Inter

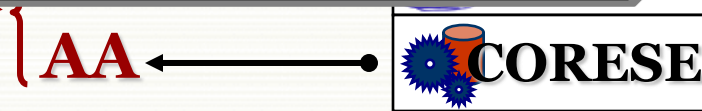
- Programming: object-oriented + Agent API & platform

User

- Application: information management and integration

User

- Environment: JADE + CORESE + WEKA + XALAN +  
XERCES + SIRPAC + NOTIO



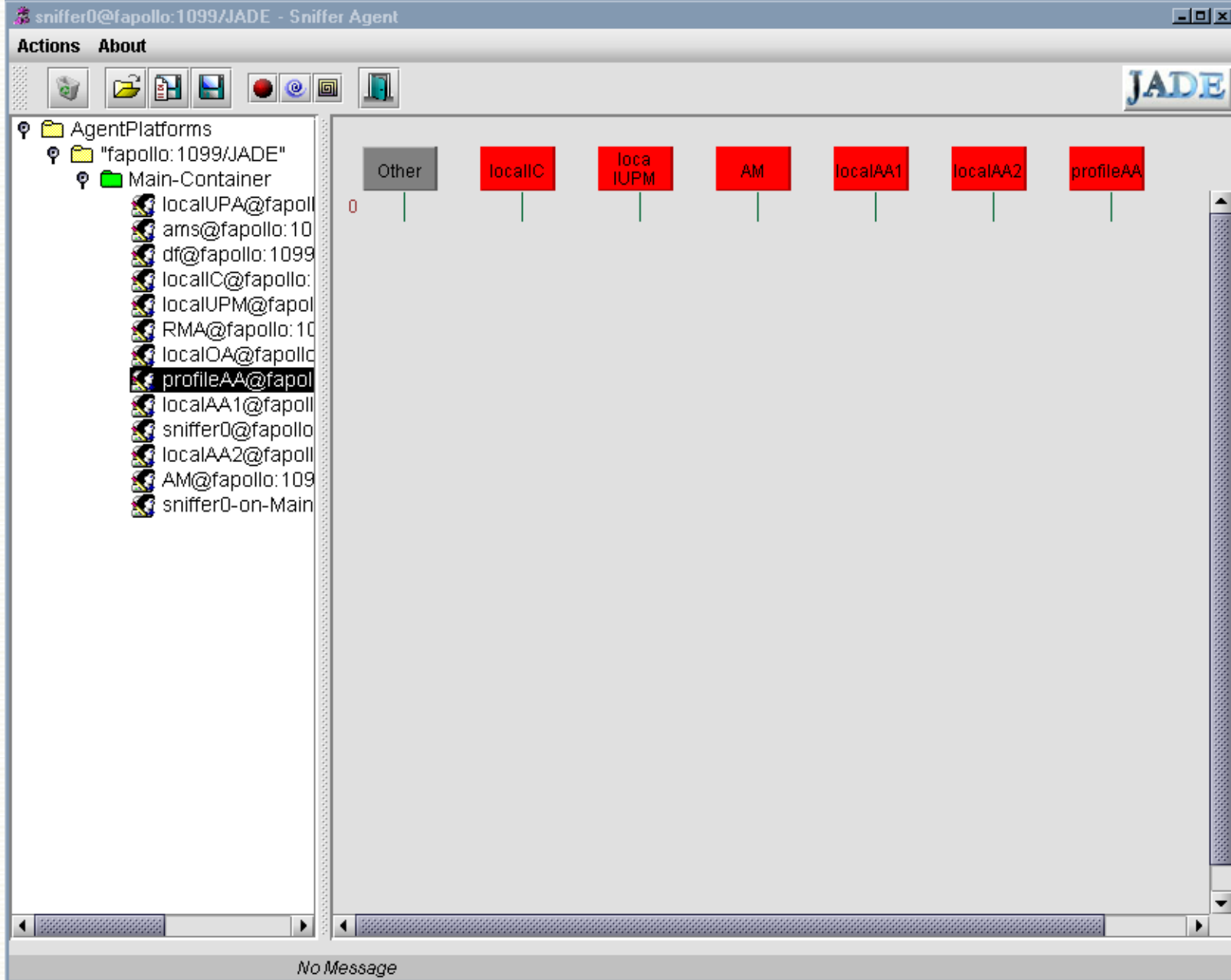
**Architecture + Roles + Protocols +  
Behaviors + Competencies = MAS**



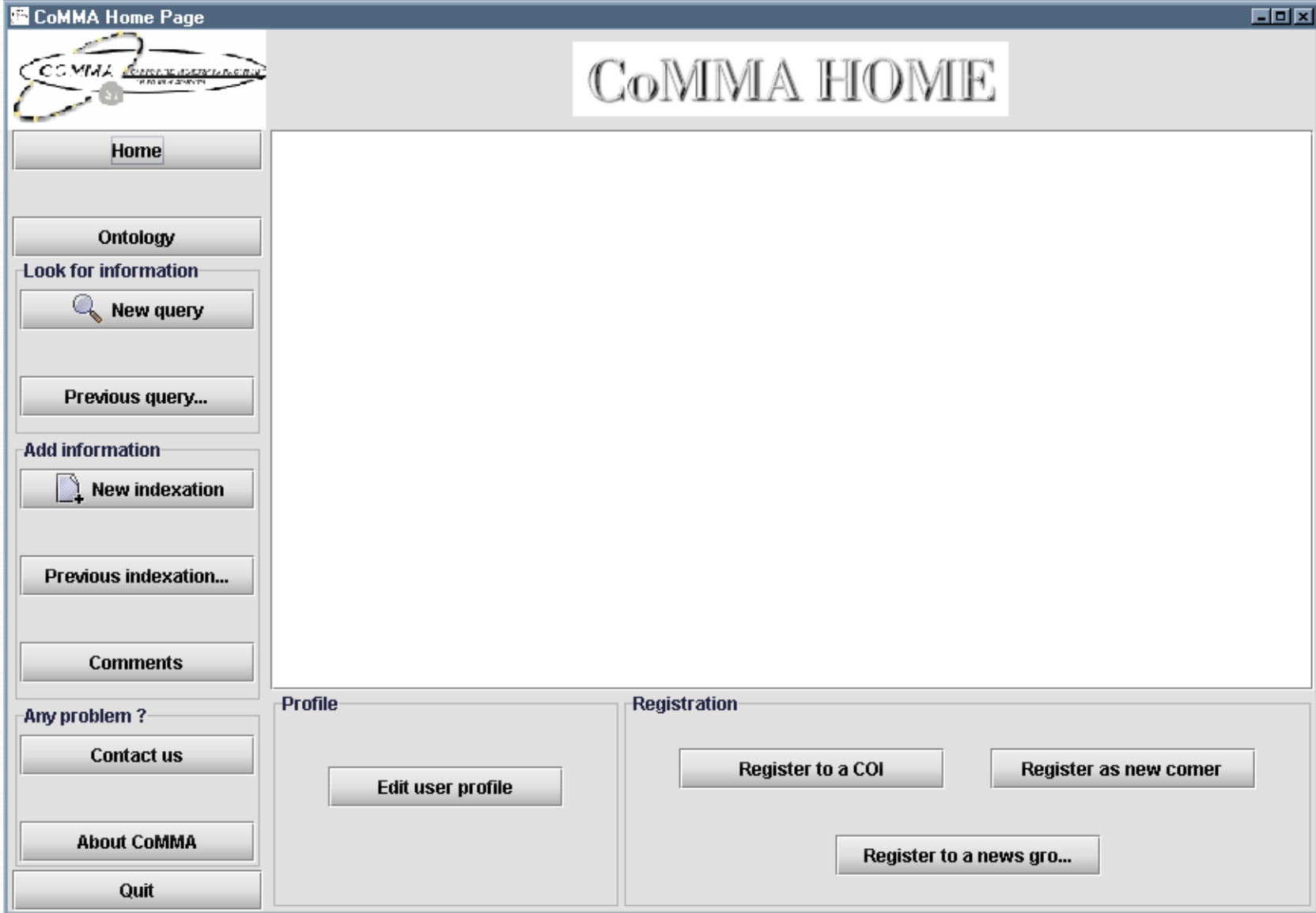
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# ▶ Interface Agent: ontology-guided annotation

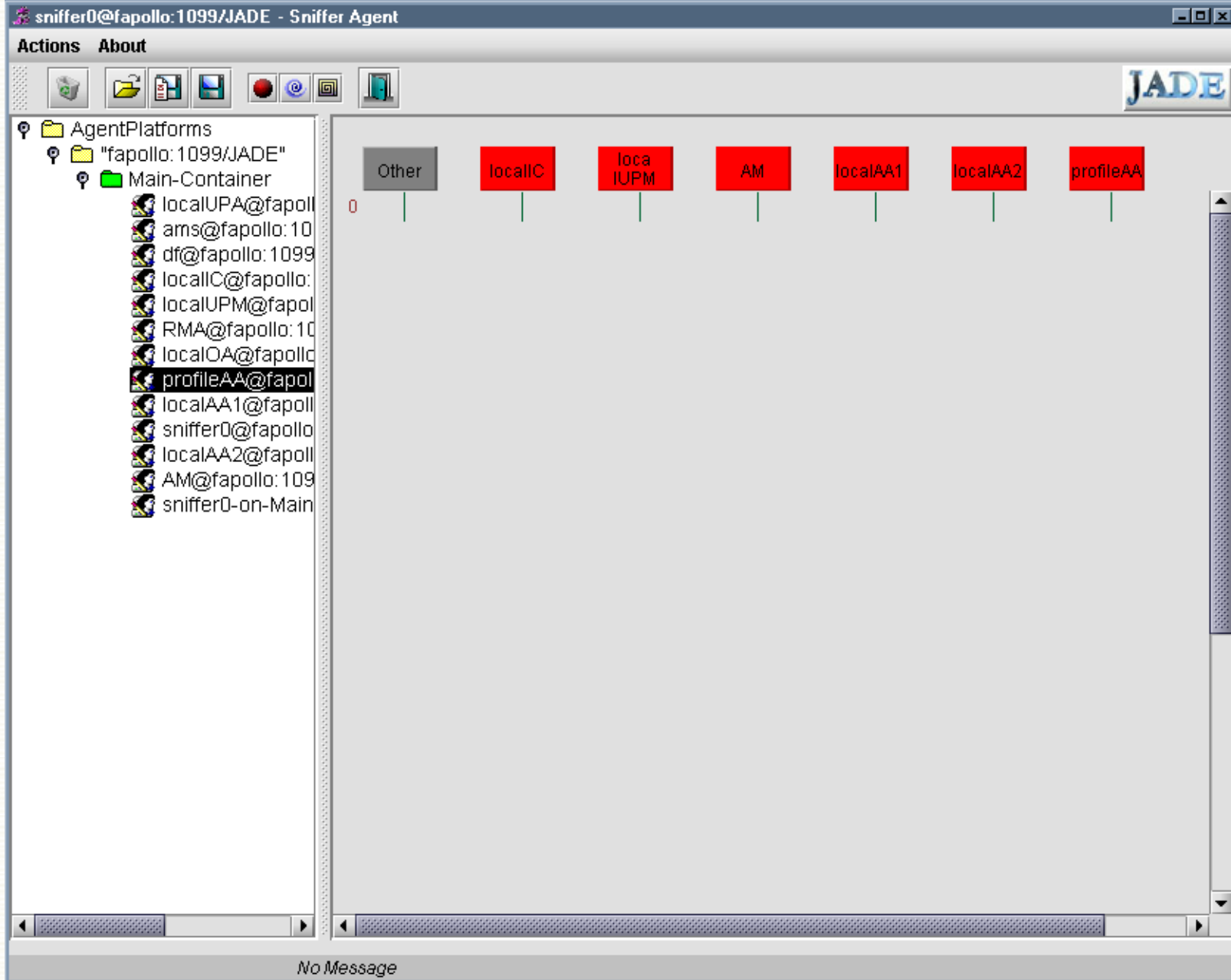




## Semantic pseudo distance for contract-net



## ► Interface Agent: ontology-guided query



## Multi-stage Query-Ref



## ▶ Agent Approach

☹️ Complex software wrapping (not too concerned)

😊 In [Bergenti *et al.*]

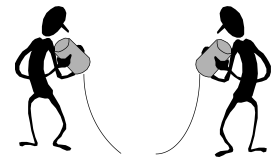
▶ Orga Complex (multi-recursive) algorithm:

☹️ No - too much classes and methods involved

☹️ No - keep the code readable

try - two threads and reify the dialog between them:

▶ Seco synchronized objet playing the role of an automata



☹️ Ergonomics problems

☹️ Complete solution evaluation problem

😊 Usability and Usefulness recognized

😊 Industrial interest in the dvpnt of the prototype

**Thank you!**