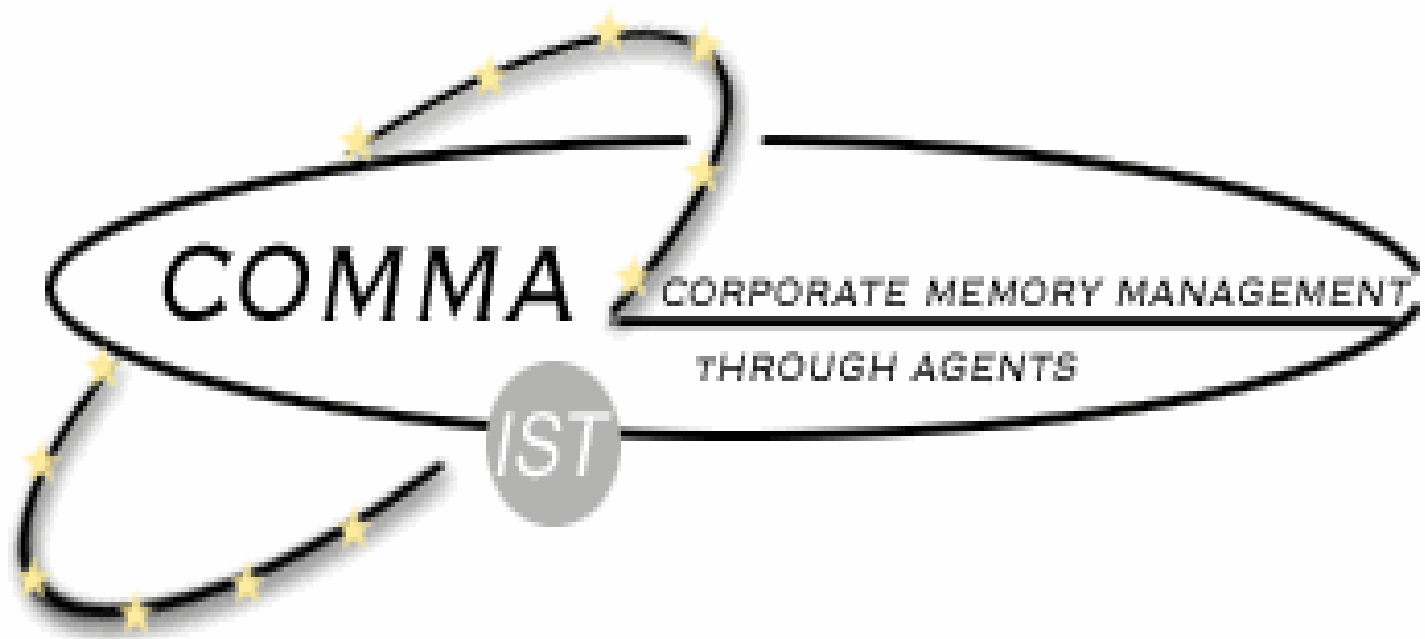


Experience in Ontology Engineering for a Multi-Agents Corporate Memory System



❖ **What is it ?** IST Project - Funded by E. C.

❖ **Who ? & Where ?**

- ▶ ATOS - Origin (FR)
- ▶ CSELT - Telecom Italia (IT) *leaving*
- ▶ CSTB - (FR) *joining*
- ▶ LIRMM - University of Montpellier (FR)
- ▶ T-Nova - Deutsch Telekom (GE)
- ▶ University of Parma (IT)
- ▶ ACACIA Project- INRIA Sophia Antipolis (FR)

❖ **When ?** February 2000 - February 2002

❖ **What for ?** Provide a corporate memory management framework (2 scenarios)

- ▶ Assist integration of newcomers
- ▶ Support technology monitoring process

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.

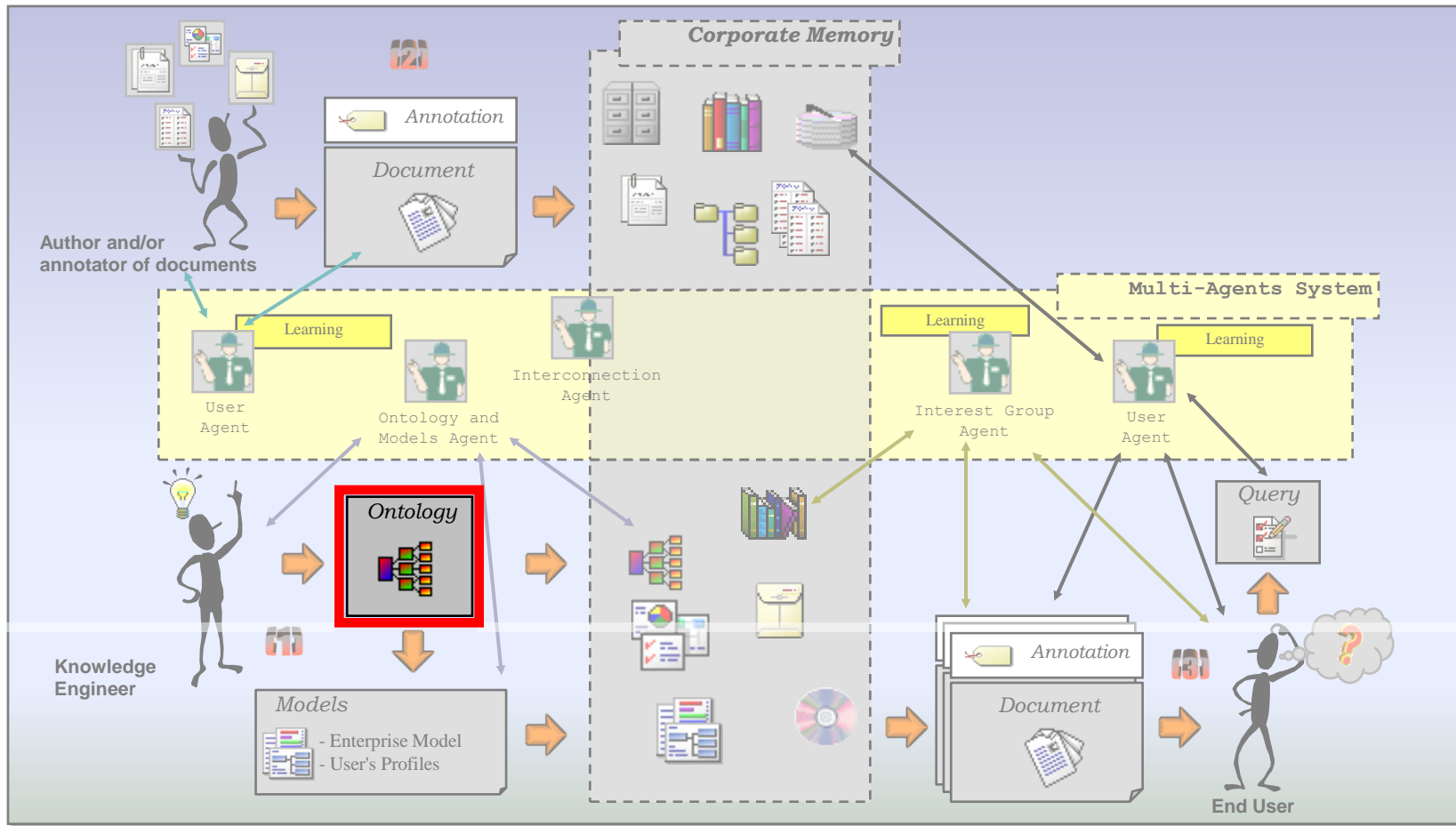
Management Framework:

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

❖ How ?

- ▶ Corporate memories are *heterogeneous and distributed information landscapes*
- ▶ Stakeholders are an *heterogeneous and distributed population*
- ▶ Exploitation of CM involves *heterogeneous and distributed tasks*

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



- ❖ **CoMMA Ontology**: explicit partial specification of corporate-memory-relevant concepts carefully defined with their corresponding terms and relationships.
- ❖ **Context = Enterprise**
 - ▶ Delimited scope & Community identity
 - ▶ Ontology & Ontological commitment
- ❖ **RDF** : Resource Description Framework
 - ▶ Describe Web resources and their relations
 - ▶ Internal/external annotation of documents
 - ▶ RDF Schema (to formalize the ontology)
 - ▶ RDFS is Limited - Extension *iff* necessary
- ❖ Toward a **Corporate Semantic Web**

❖ Use of an ontology in CoMMA :

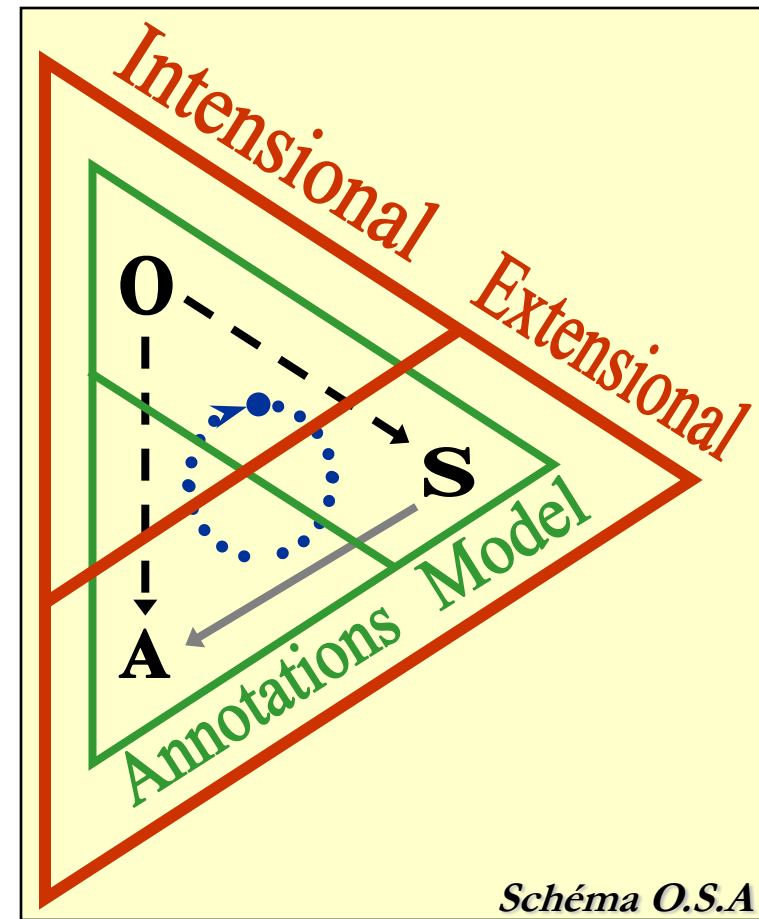
- Component of the memory
- Models, annotations and queries
- Agent communication

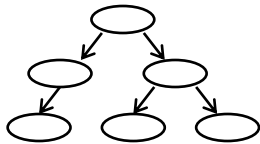
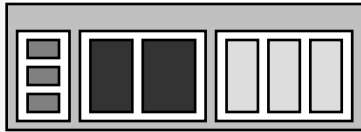
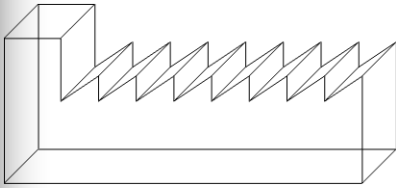
❖ **O**ntology in RDFS

❖ State of affairs in RDF

- Users' profile
- Corporate Model

❖ **A**nnnotations in RDF to describe resources





Organizational Entity (X) :

The entity X is or is a sub-part of an organization.

Person (X) : The entity X is living being pertaining to the human race.

Include (Organizational Entity: X, Organizational Entity / Person Y) :

the organizational entity X includes Y as one of its members.

Manage (Person: X, Organizational Entity: Y) :

The person X watches and directs the organizational entity Y

Person (Rose)

Person (Fabien)

Person (Olivier)

Person (Alain)

Organizational

Entity (INRIA)

Organizational

Entity (Acacia)

Include (INRIA, Acacia)

Manage (Rose, Acacia)

Include (Acacia, Rose)

Include (Acacia, Fabien)

Include (Acacia, Olivier)

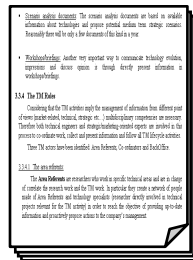
Include (Acacia, Alain)

a - Reality

b - Ontology

c - State of Affairs

(a) Scenarios and data-collection



Scenarios

Characteristics	Representation	Facets	
Goal	Textual Graphical Informal Formal (UML)	Actors	Profile Role Individual goal Task Action Interaction
Scenario Before Scenario After		Resources	Nature Services Constraints
Scope		Logical & Chronological	Processes Decomposition Sequential / Parallel / Non deterministic Loops & Stop conditions Alternatives & Switches Compulsory / Optional
Scenario / Sub-Scenario		Flows	Inputs Outputs Paths
Generic / Specific Example, Illustration		Functionalities & Rationale	Functionalities description Motivation, necessity Advantages & Disadvantages
Relevance life-time		Environment	Internal Organisation Acquaintance External
Exceptions Counter examples			

End-Users → Report

- Scenario analysis documents: The scenario analysis documents are based on available information about technologies and propose potential medium term strategic scenarios. Reasonably there will be only a few documents of this kind in a year.
- Workshops/briefings: Another very important way to communicate technology evolution, impressions and discuss opinion is through directly present information in workshops/briefings.

3.3.4 The TM Roles

Considering that the TM activities imply the management of information from different point of views (market-related, technical, strategic etc...) multidisciplinary competencies are necessary. Therefore both technical engineers and strategic/marketing-oriented experts are involved in this process to co-ordinate work, collect and present information and follow all TM lifecycle activities.

Three TM actors have been identified: Area Referents, Co-ordinators and BackOffice.

3.3.4.1 The area referents:

The Area Referents are researchers who work in specific technical areas and are in charge of correlate the research work and the TM work. In particular they create a network of people made of Area Referents and technology specialists (researcher directly involved in technical projects relevant for the TM activity) in order to reach the objective of providing up-to-date information and proactively propose actions to the company's management.

Document Event Role Functionality ...

(a) Scenarios and data-collection

• **Transmit audio documents** The various audio documents are based on available information about technology and projects related within this strategy. Contents forwarded from the TV only a few documents of the last 10 years.

• **Background** Another very important way to communicate technology evolution, experience and discuss topics is through develop present information in technology/technology.

3.3.4 The TV idea

Considering that the TV content might be managed in different ways, different types of content-related technology strategy are considered: responses on strategy. Therefore, the technical experts and technology-related experts are involved in the process to produce work, which can present information and ideas of TV content creation.

Then TV content has been identified. Some documents, TV content and field/field.

3.3.5 The new content

The new documents are generated into a specific technical area and are in charge of content for research work and the TV work. In particular, they contain a series of people, which is the technical and technology specialists. Therefore, they present a technical project along the TV content in order to make the direction of providing a new document and presenting project within the company's management.

• **Interviewer (1) :** (laughing) Well, to start with, could you ... uh ... explain what is uh ... your role at the agency?

• **Employee (1.1) :** ... Well uh right ... In fact I am, I work as a consultant in C and S. So I have to report what they do themselves and ...

• **Interviewer (2) :** Who are these two persons?

• **Employee (1.1) :** So, in the director's assistant, and S, is a management assistant. In fact we work the three of us in the good working order of ATOS, then everything which is in administration, research, new projects, etc. ... and myself I essentially take care of, of all the commercial side, a bit less interesting may be ...

• **Interviewer (2) :** And what is the exact title of the position, of your position?

• **Employee (1.1) :** About, I describe myself as an commercial assistant. Uh, yes, so, or else, what do I do exactly ... no, you I take care of everything which is administrative. At first I'm in, well I take care of all the side of people who come to the agency ... to each one comes at ATOS ... and then everything which is papers, technical forms ... uh, and so on ... Loads and loads of things, the other things that neither C nor S do ... (silence)

Scenarios

Interviews

❖ Semi-structured (individual / group) guide for end-users

- **Interviewer (1) :** *[laugh]* Well, to start with, could you , uh... explain what is uh... your role at the agency ?
- **Employee (L):** ... Well uh right... In fact I am, I work in complement to C and S. So I have to reread what they do themselves and...
- **Interviewer (2) :** Who are these two persons ?
- **Employee (L) :** So C, is the director assistant... and S is a management assistant. In fact we work the three of us uh for the good working order of ATOS, thus everything which is uh administration, papers, new person entry... and myself I essentially take care of, of all the paperwork side, a bit less interesting may be...
- **Interviewer (2) :** And what is the exact title of the position, of your position ?
- **Employee (L) :** Myself I describe myself as uh commercial assistant... Uh, yes, so, or else, what do I do exactly : so yes I take care of everything which is administrative. At first I reply to, well I take care of, of CVs of, of people who come to the agency post-... to apply for coming at ATOS ... and then everything which is papers, vacations forms, uh, and so on ... Loads and loads of things, the other things that neither C nor S do... *[Silence]*

Definition of role (\neq ^{nt} tasks)

Position :
Personal definition
 \neq Official definition

- **Screen reader programs:** The screen reader documents on based on available information about technology and prepare content within more manageable format that will only display a few documents at the time in a screen.
- **Web browser:** Another more specialized way to communicate technology evidence, gathering and discuss topics as though they provide present information a web browser.

3.54 The TIM Files

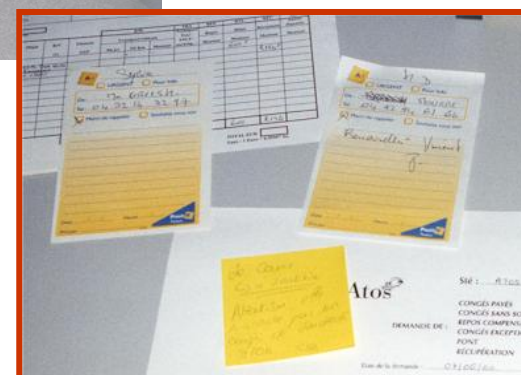
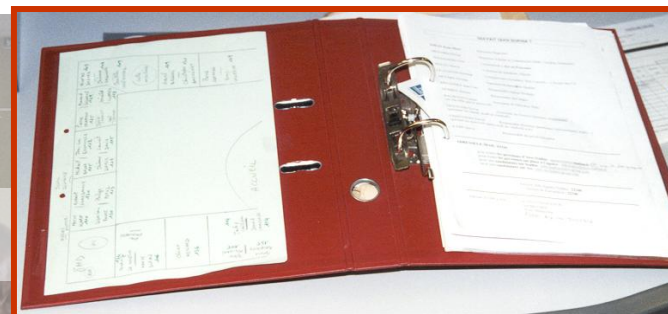
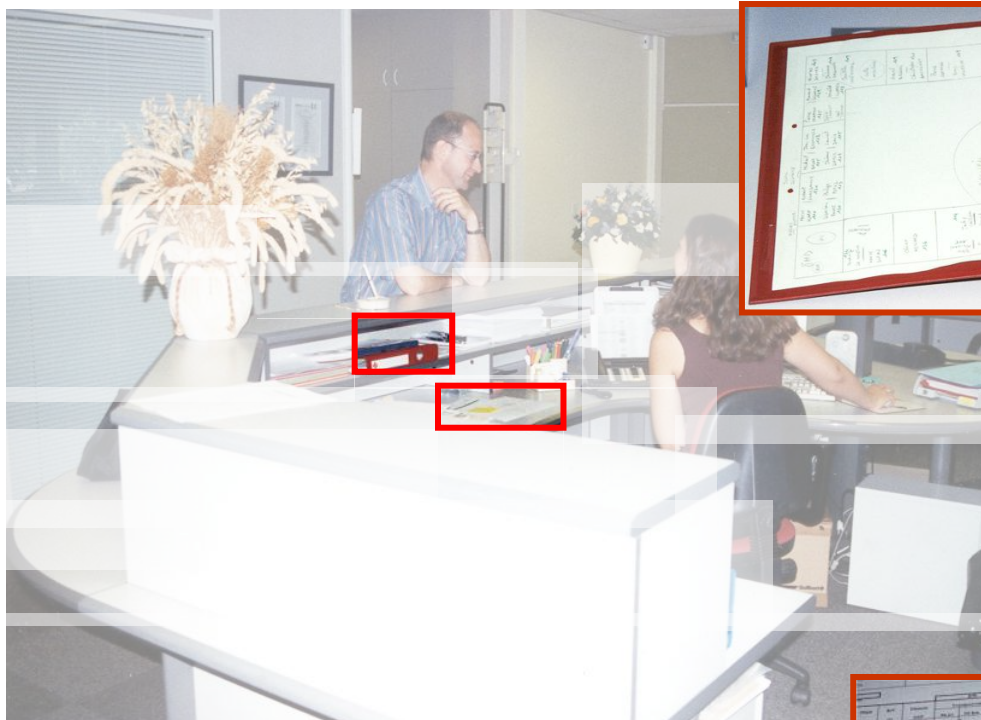
Considering that the TIM activities involve the management of information from different pool of knowledge including technical, strategic, and a "collaborative" component are not always available in the same format, the TIM activities are designed to be performed on a variety of TIM documents to enhance work and present information in a TIM file. The TIM documents are:

- The TIM notes between identified areas, documents, or documents and related files.

3.54.1 The area documents

The area documents are materials used to enhance a specific technical area or an in-depth of content the research work and the TIM. It is important that the team create a variety of types of documents between and including ongoing projects directly involved in technical projects within the TIM context in order to reach the objective of providing up-to-date information and practically provide when the company's management.

- * Interviewer (H): (*laugh*) Well, so start with, could you explain what it is... your role at the agency?
- * Employee (A): ... Well uh right... In fact, I work as consultant to the S.O.. So I have to tutorial the new employees and...
- * Interviewer (D): Who are those new employees?
- * Employee (A): So C is the director assistant, S is a management specialist, in fact we work the three of us uh for the good working order of AOTOS, thus, especially which is an administration, entirely, not a person entry, and myself I essentially take care of one of all the paperwork daily, a bit less interesting may be...
- * Interviewer (D): And what is the exact title of your position?
- * Employee (A): Ah yes! I describe myself as uh administrative assistant, Uh yes, so, or else, what do I do exactly... so I take care of everything which is related to AOTOS first, like the management of the % of people who come to the agency specifically, for example at AOTOS... and then everything which is coming papers, various forms, uh; and so on... Lords and loads of things, the other things that neither C nor S do... (*Prolonged*)



- **Screen reader programs:** The screen reader documents on based on available information about technology and prepare content within new image formats. Accordingly they will only show a document that is not a screen.
- **Text-to-speech:** Another more sophisticated way to communicate technology enables, rendering and document content through device present information a word-by-word.

3.54 The TIM Forum

Considering that the TIM forum studies the importance of information from different point of view like political, technical, strategic, etc., a multidisciplinary cooperation is necessary. Therefore the TIM forum studies and analyzes management strategies are analyzed in the perspective to enhance work and present advanced information in TIM4 knowledge centers.

The TIM forum focuses on identified issues like, Intellectual, On education and Real-life.

3.54.1 The area relevant

The area relevant are concerned with issues in specific technical areas or in a change of content the research work and the work. It supports their work across a variety of needs of users behavior and technology supporting knowledge directly involved in technical projects related to the TIM forum in order to reach the objective of providing up-to-date information and practically precise when the company's management.

[illegible][illegible]

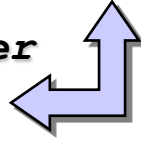
The diagram illustrates a three-layered structure. The top layer is light blue with a smooth texture and is labeled 'Top Layer'. The middle layer is medium blue with a wavy texture. The bottom layer is dark blue with a bumpy texture and is labeled 'Bottom Layer'. The layers are separated by thin black lines.

Name, Vorname:		Dr. Müller, Heinz Jürgen		
Einstellungsdatum:		01.05.98		
DSt:		TZ FE14k		
PSZ-4 ✓	Angestellte, Gehaltskonten, Vermögensw. Leistungen	Herr Kottke	54/425	Tel.: 3780
PSZ-8 ✓	Umzugskosten, Trennungsgeld, Reisekosten, Kindergeld, Kindertagesstätte	Frau Deml	54/529	Tel.: 2724
PSZ-3a ✓	Personalbuchführung	Herr Graf	54/418	Tel.: 2718
PSZ-3b ✓	Urlaub	Thomas Mohr	54/418	Tel.: 2719
PSZ-1 PSZ-2	Personaleinsatz	Herr Schröder Frau Hierer	54/420 54/418	Tel.: 2711 Tel.: 2716
PSZ-5a ✓	Arbeitszeitregelung	Frau Maul-Gottaut	54/340	Tel.: 5954
PSZ-10	Wohnungsfürsorge	Herr Halfen	54/511	Tel.: 2733
PSZ-9a ✓	Krankenkasse, Post-, Spar- und Darlehnsverein	Frau Polzer <i>M. Polzer</i>	54/510	Tel.: 8252
PSZ-6b ✓	Unternehmensausweis	Frau Weingart	54/438	Tel.: 1238
P183DA-1a	Vorübergehende Unterbringung BZ/FH Dieburg	Frau Möller	36/251	Tel.: 8291. ✓
PSZ-9b	Sozialbetreuung	Frau Loos	54/531	Tel.: 2728
P183-DA-11b ✓	Parkerlaubnis	Herr Scior	34/123	Tel.: 6623
P184DA-2	Brandschutz	Herr Harsch	36/227	Tel.: 6620
P184DA-1	Arbeitsschutz	Herr Anders	36/226	Tel.: 7697
PSZ-4	Sonstige Fragen zu Tarifangelegenheiten	Herr Kottke	54/425	Tel.: 3780
01.05.98				

- ❖ What to do
- ❖ Where to go
- ❖ Who to contact
- ❖ How to contact
- ❖ In what order

- ▶ Multi-lingual
- ▶ NLP and Gra.

(a') Reuse & other sources



Scenarios

Interviews



Documents

❖ State of the Art and Reuse :

- Enterprise Ontology (AIAI)
- TOVE Ontology
- Cyc Ontology
- PME Ontology
- CGKAT & WebKB top ontology
- Not automatically included (NLP Tools)

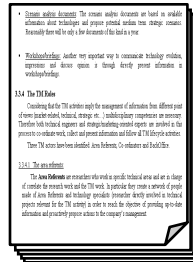
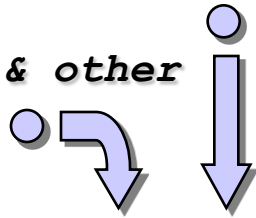
❖ Other sources :

- “Using Language” H.H. Clark
Expertise in semiotic (not in data-col.)
- MIME: list electronic formats
- Dublin Core: Initial global prop. of docs

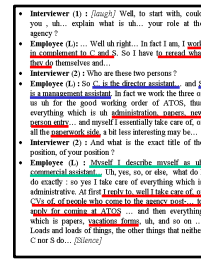
❖ Scenarios to prune (r. ownership)

❖ Meta-dictionaries

(b) From semi-informal
to semi-formal



Scenarios



Interviews



Observations

[illegible]

Documents

Relation	Domain	Range	View	Super Relation	Other Terms	Natural Language Definition	Sy	Tr	Re	Pr
Manage	Organizational Entity;	Organizational Entity;	Organization	Relation	;	Relation denoting that an Organizational Entity		Tr		EO
<div><div>Attribute</div><div>Designation</div><div>Family Name</div><div>Mobile Number</div><div>Title</div><div></div></div>	Domain	Range Type	View	Super Relation	Other Terms	Natural Language Definition				Pr
	Thing	Class	View	Super class	Other Terms	Natural Language Definition				Pr
	Person	Thing	Top-Level;	;	;	Whatever exists animate, inanimate or abstraction.				Us
	Person	Event	Top-Level; Event;	Thing;	;	Thing taking place, happening, occurring; usually recognized as important, significant or unusual				Us
	Domain	Gathering	Event;	Event;	;	Event corresponding to the social act of a group of Persons assembling in one place				Us

❖ Candidate terms :

- ▶ Proposition definitions (ac.)
- ▶ Proposition extensions (in.)
- ▶ Start & Iterations

❖ Terms and notions :

- ▶ Work on terms: synonymous/ambiguous
Formal Label (// Uschold & Gruninger 96)
- ▶ Need for tools (NLP) & terminological level

❖ Three approaches :

- ▶ Top-Down / Bottom-Up / Middle-Out
- ▶ Level/Granularity & interactions
- ▶ Three complementary perspectives

❖ Structuring :

- ▶ Extended Aristotelian Principles (Bachimont, 2000)
- ▶ Genus/Differentia/Semantic Axis (Kassel et al, 2000)
- ▶ Attributes & Constraints (Guarino et Welty, 2000)
- ▶ Very good for the top / impossible on the whole ontology without assisting tools

❖ Continuum Informal → Formal :

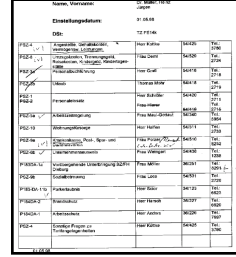
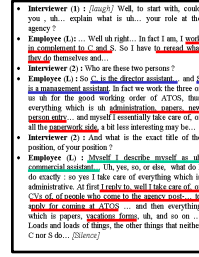
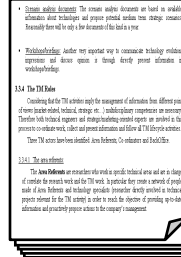
- ▶ Textual (Informal)
- ▶ Tables (semi-informal → semi-formal)
- ▶ RDF-RDFS (formal, use taxonomy)
- ▶ Process of enriching (terms & Nat. Lang.)

(a) Scenarios and data-collection

(a') Reuse & other sources

(b) From semi-informal to semi-formal

(c) RDFS



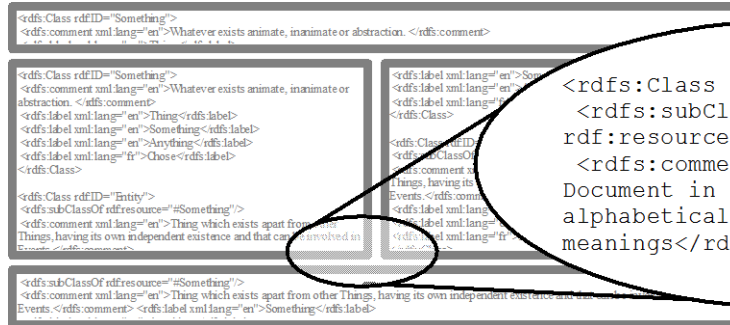
Scenarios

Interviews

Observations

Documents

Relation	Domain	Range	View	Super Relation	Other Terms	Natural Language Definition	Sy	Tr	Re	Pr
Manage	Organizational Entity;	Organizational Entity;	Organization	Relation	;	Relation denoting that an Organizational Entity		Tr		EO
	Attribute	Domain	Range Type	View	Super Relation	Other Terms	Natural Language Definition			Pr
	Designation	Thing	Class	View	Super class	Other Terms	Natural Language Definition			Pr
	Family Name	Person	Thing	Top-Level;	;	;	Whatever exists animate, inanimate or abstraction.			Us
	Mobile Number	Person	Event	Top-Level; Event;	Thing;	;	Thing taking place, happening, occurring; usually recognized as important, significant or unusual			Us
	Title	Document	Gathering	Event;	Event;	;	Event corresponding to the social act of a group of Persons assembling in one place			Us

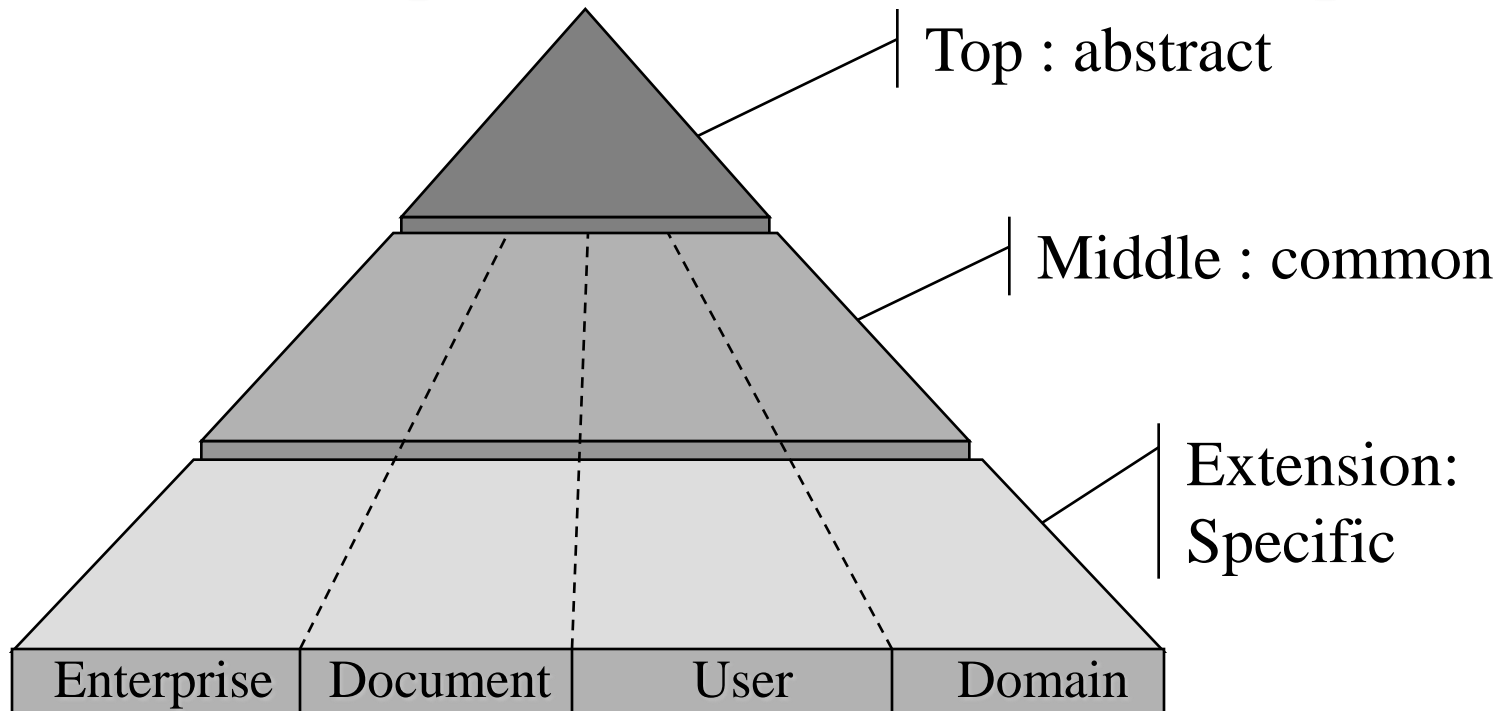


```

<rdf:Class rdf:ID="Dictionary">
  <rdf:subClassOf
    rdf:resource="#ReferenceDocument"/>
  <rdf:comment xml:lang="en">Reference
    Document in which words are listed
    alphabetically and their
    meanings</rdf:comment>
  
```

❖ Three Layers :

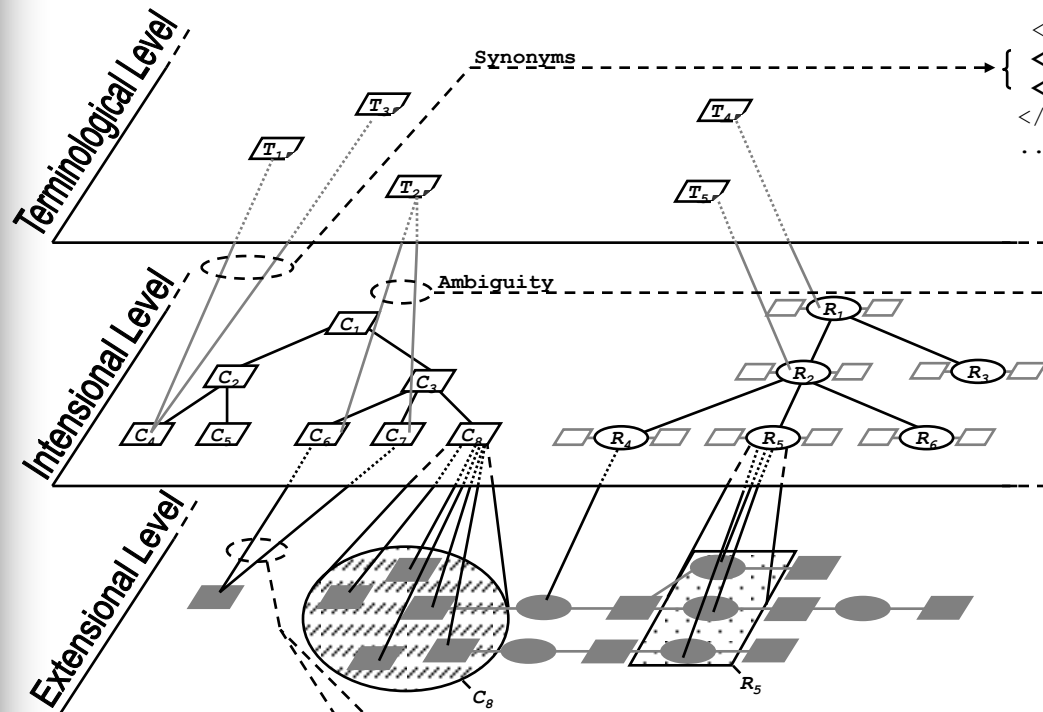
- ▶ ~**400** concepts, ~**50** relations, **12** hops



- ▶ Top : reusable/not really usable ; coherence
- ▶ Middle layer :
 - Documentary corporate memory (r. memory)
 - Domain Topics (r. domain)
- ▶ Extensions : usable/not really reusable

❖ Appropriateness of RDFS :

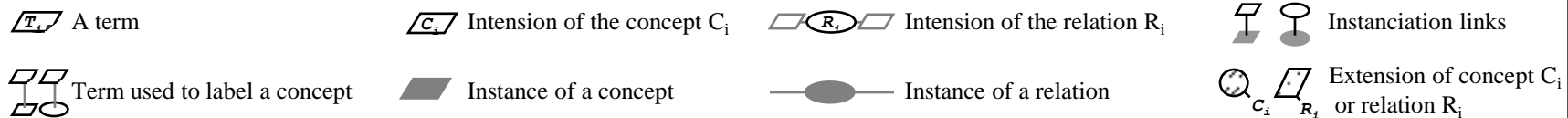
```
...
<rdfs:Class rdf:ID="Department">
  <rdfs:subClassOf rdf:resource="#OrganizationPart"/>
  <rdfs:comment xml:lang="en">
    Organization part which is a sub division of of a
    Research Direction, corresponding to sub interest
    field e.g mobile transmission
  </rdfs:comment>
  <rdfs:label xml:lang="en">department</rdfs:label>
  <rdfs:label xml:lang="en">division</rdfs:label>
</rdfs:Class>
...
```



```
...
<rdfs:Class rdf:ID="E-Mail">
  <rdfs:subClassOf rdf:resource="#Mail"/>
  <rdfs:comment xml:lang="en">
    Mail sent in electronic format over a
    computerized world-wide communication system
  </rdfs:comment>
  <rdfs:label xml:lang="en">e-mail</rdfs:label>
  <rdfs:label xml:lang="en">electronic mail
    </rdfs:label>
  <rdfs:label xml:lang="en">mail</rdfs:label>
</rdfs:Class>
...
<rdfs:Class rdf:ID="PostMail">
  <rdfs:subClassOf rdf:resource="#Mail"/>
  <rdfs:comment xml:lang="en">
    Mail transmitted via the post office
  </rdfs:comment>
  <rdfs:label xml:lang="en">mail</rdfs:label>
  <rdfs:label xml:lang="en">post mail</rdfs:label>
</rdfs:Class>
...
```

Multi-Instanciation

```
<CoMMA:Memo rdf:about="http://www.inria.fr/comma.rtf"/>
<CoMMA:E-Mail rdf:about="http://www.inria.fr/comma.rtf"/>
```



❖ Need for extension :

formal definitions for concepts / properties

- ▶ Multi-modal (redundancy / common know.)
- ▶ Newcomer (fuzzy / tunable)
- ▶ Colleague (term, concept, property, defined)
- ▶ XML Rules for CORESE

❖ Need for interfaces :

- ▶ Hide top: not interest. & p.b. of commitment
low levels = day-to-day consensus
- ▶ Profiles and terminology in browsing
- ▶ Terminology & several languages/jargons

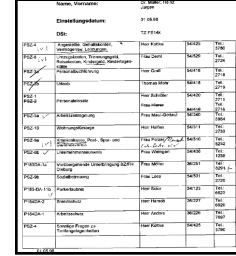
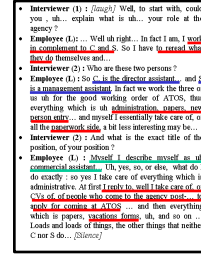
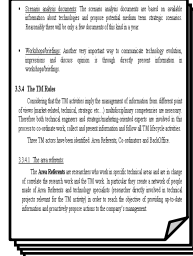
(a) Scenarios and data-collection

(a') Reuse & other sources

(b) From semi-informal to semi-formal

(c) RDFS

(d) Browsing and using



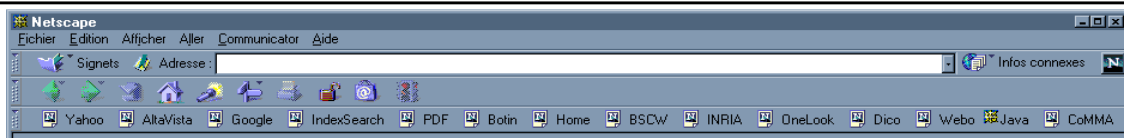
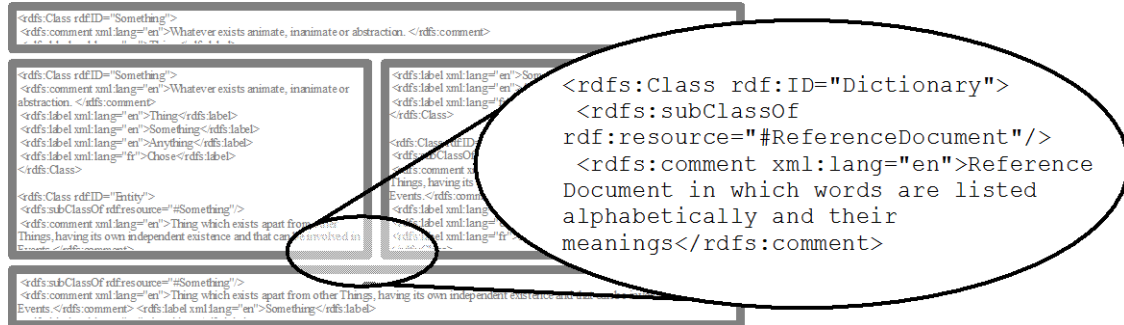
Scenarios

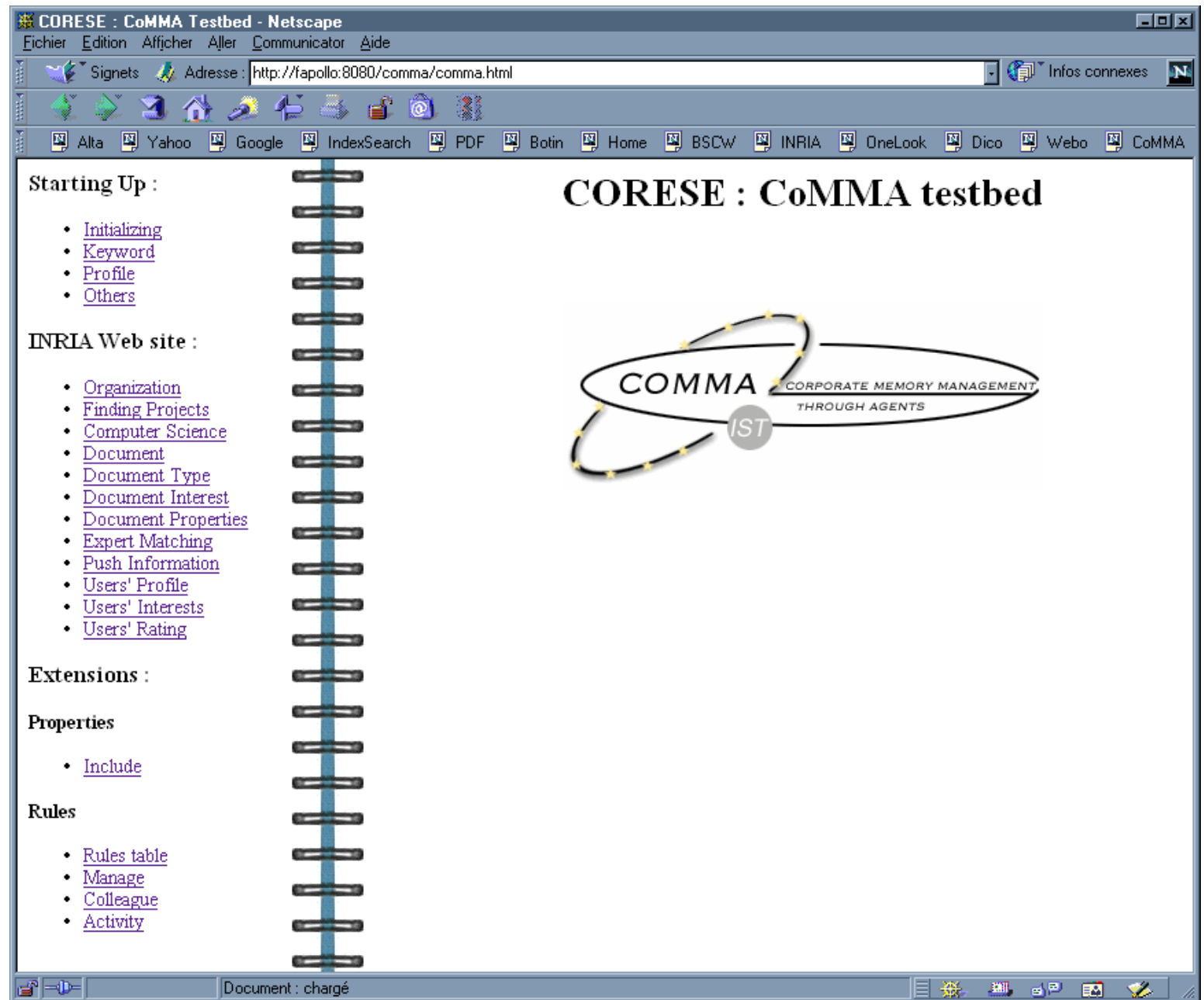
Interviews

Observations

Documents

Relation	Domain	Range	View	Super Relation	Other Terms	Natural Language Definition	Sy	Tr	Re	Pr
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Family Name	Person	Thing	Top-Level;	;	;	Whatever exists animate, inanimate or abstraction.				Us
Mobile Number	Person	Event	Top-Level; Event;	Thing;	;	Thing taking place, happening, occurring; usually recognized as important, significant or unusual				Us
Title	Document	Gathering	Event;	Event;	;	Event corresponding to the social act of a group of Persons assembling in one place				Us





❖ Navigating the ontology through Style sheets :

Searching for a concept :

Look for terms :

❖ Querying annotation bases :

Using the ontology when exploiting the annotations:

```
xmlns:CoMMA='http://www.inria.fr/acacia/comma#'
```

```
<CoMMA:OrganizationGroup CoMMA:Designation='? '>  
  <CoMMA:IsInterestedBy><CoMMA:ComputerScienceTopic/></CoMMA:IsInterest  
</CoMMA:OrganizationGroup>
```

Schema ☐ Trace ☐ Generalize ☐ Global

❖ Examples of extensions of RDFS :

include : include,

Inherits from :

Relation ID : Include - [See Intances](#) -

Switch to

English



[[© organizational entity](#) : [organizational entity](#), [organisational entity](#),]--([include](#),)--[[© groupable entity](#) : [groupable entity](#),]

Properties : Transitive Reflexive

Natural Language definition :

Relation denoting that an Entity has as a part another Entity.

More general relation :

More precise relations :

New search on terms

that contain

in English

Go!

❖ Using profiles to filter an ontology :

User Profile in the Interface :

❖ APROBATION : Web-Based Query Interface

Rechercher un : Document Intervenant Projet

 **Selection d'un(e) Document**

 Sélectionnez un objet **Document** en navigant au travers l'arborescence.

Cliquez sur le lien **<Selectionner>** en bas de l'arbre pour confirmer la selection

Arborescence de Document
Sont representes ci-dessous les specialisations d'un(e) Document

[Document]

- +  [Document graphique](#)
- +  [Document textuel](#)
- +  [Dossier](#)

 [Selectionner \[Document\]](#)

Etat de la requete en cours
Ce diagramme montre la requete en cours de construction sous la forme d'un arbre.
Lorsque le texte apparait en gras, il est possible de dupliquer une branche d'un simple clic.
Cliquez sur une croix pour supprimer la branche correspondante.

Retour au menu 

❖ Shopping metaphor : Using a 'notion cart' for query building

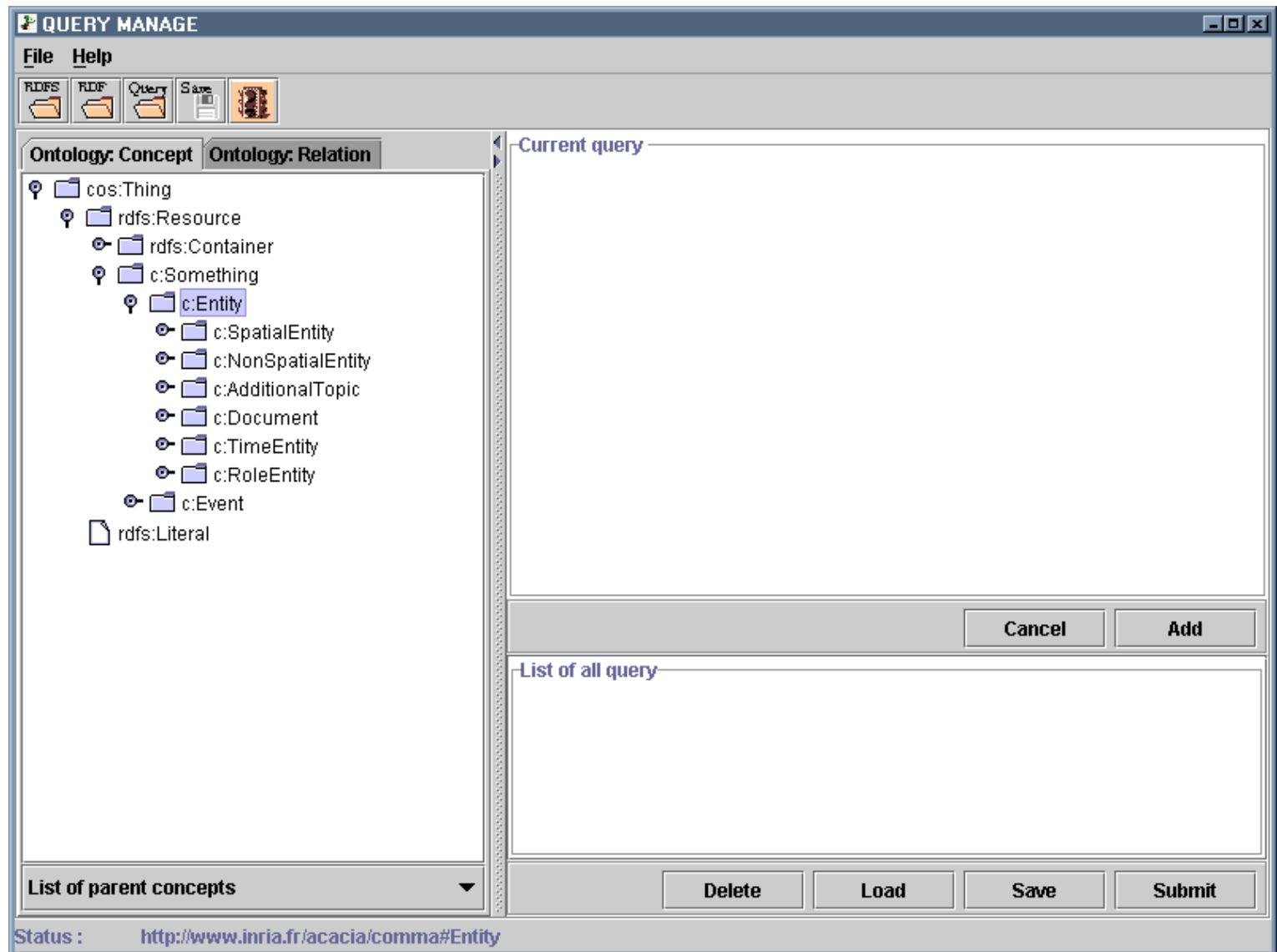
The screenshot displays a web application titled "Terminology Search". At the top, there is a search bar with the placeholder text "Search a term which :". To the right of the search bar is a dropdown menu currently set to "Contains". Further right is a green circular button labeled "Real-Time". Below the search bar are two buttons: "Clear" and "Look it up".

Below the search section, there is a "Select view mode :" dropdown menu set to "All (C&R)". To its right is a text instruction: "Hold down ctrl key for multiple drag and drop". Further right is a checkbox labeled "Ontology-related" which is checked.

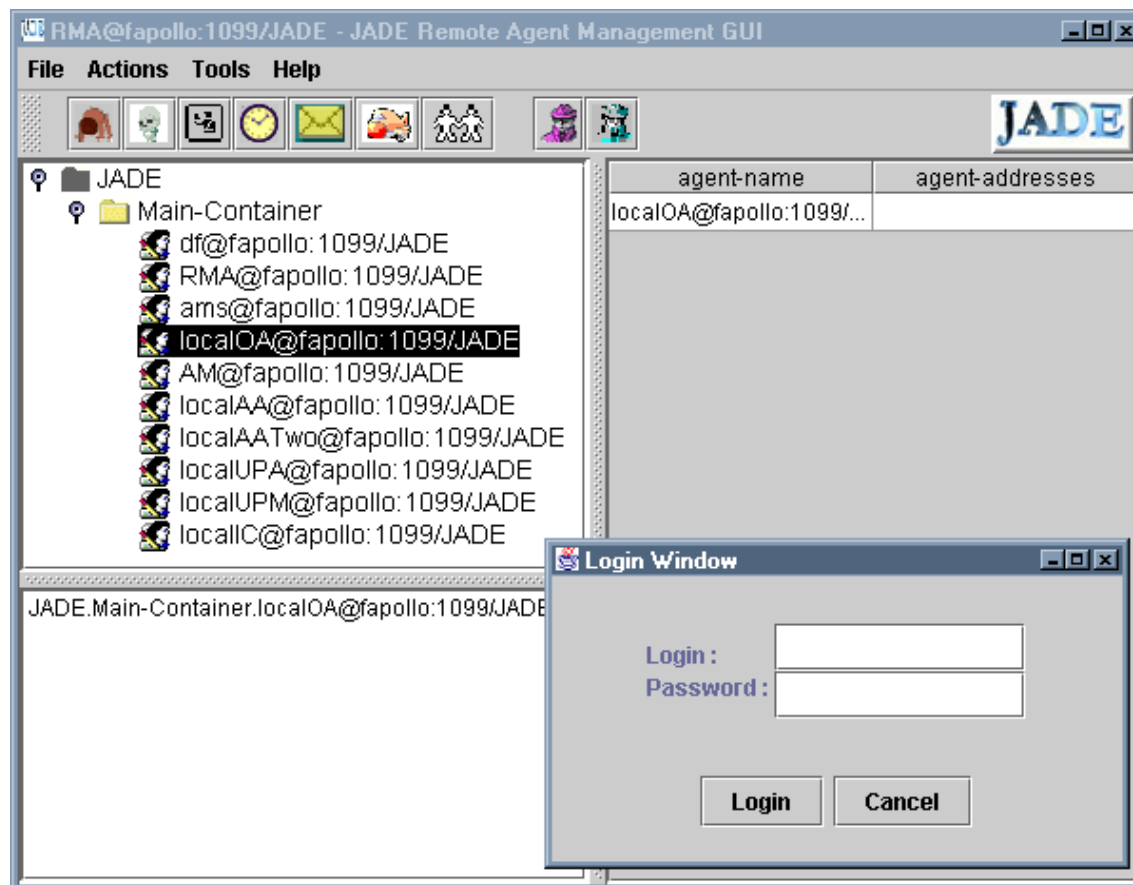
The main area of the interface is divided into three vertical panels. The left panel is labeled "C Terms :" and has a button labeled "All" next to it. The middle panel is labeled "R Terms :" and also has a button labeled "All" next to it. The right panel is labeled "Drop ter..." and has a button labeled "Cle..." next to it. Each panel contains a large, empty rectangular area for displaying results or terms.

At the bottom right of the interface, there is a button labeled "Submit Query".

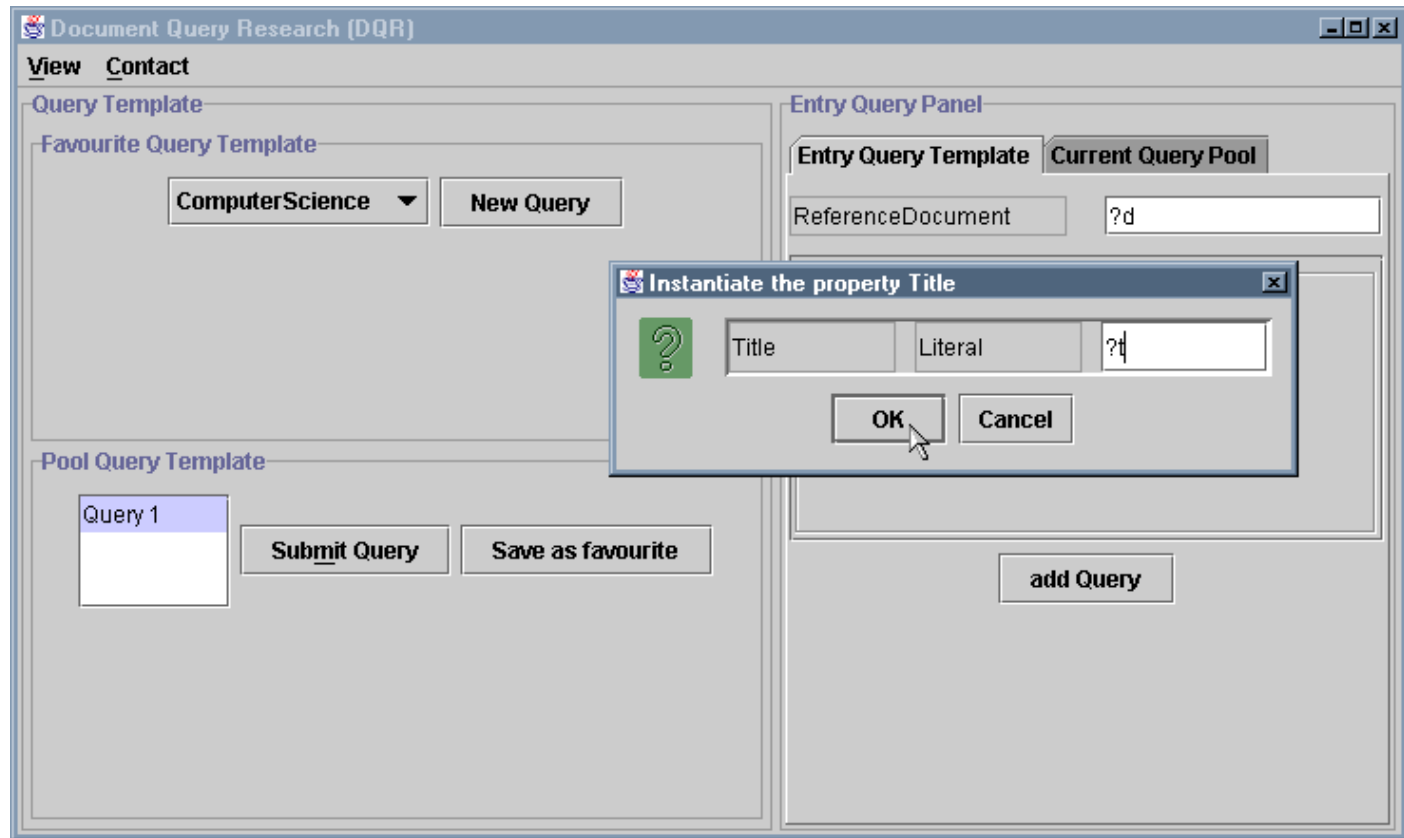
❖ Complex queries : expert interface



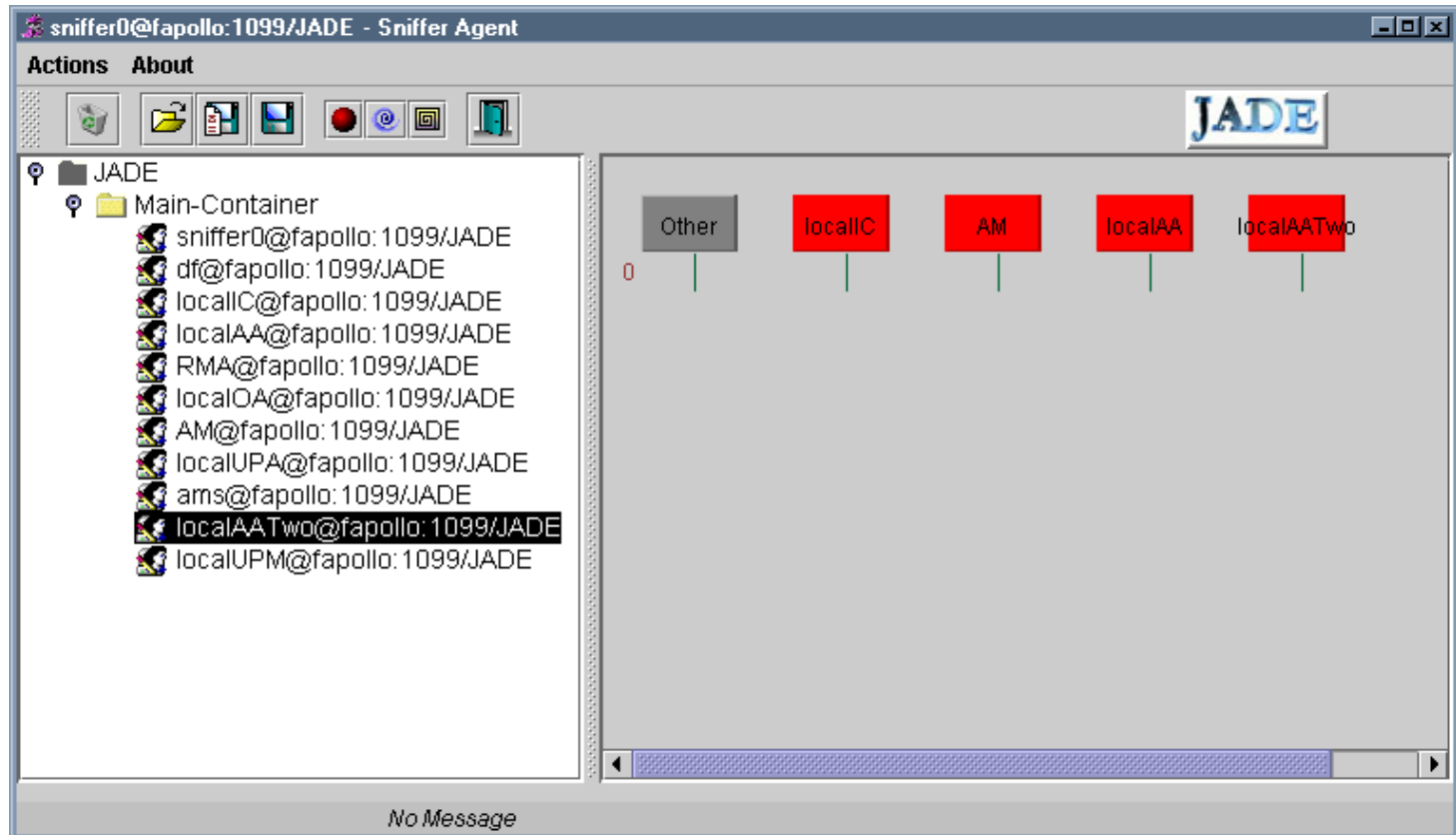
❖ Integration in CoMMA : identify the user

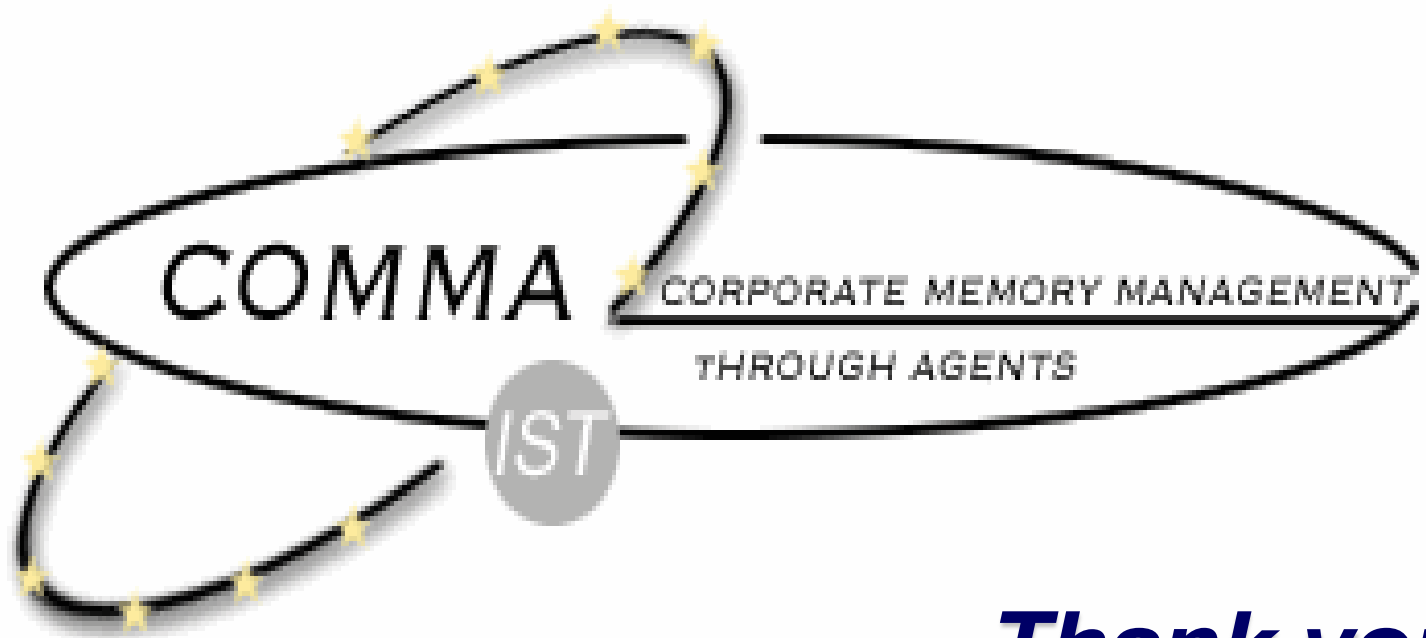


❖ Integration in CoMMA : express a query



❖ Integration in CoMMA : agent collaboration





Thank you !