NeOn - Lifecycle Support for Networked Ontologies
Case Studies in the Pharmaceutical Domain

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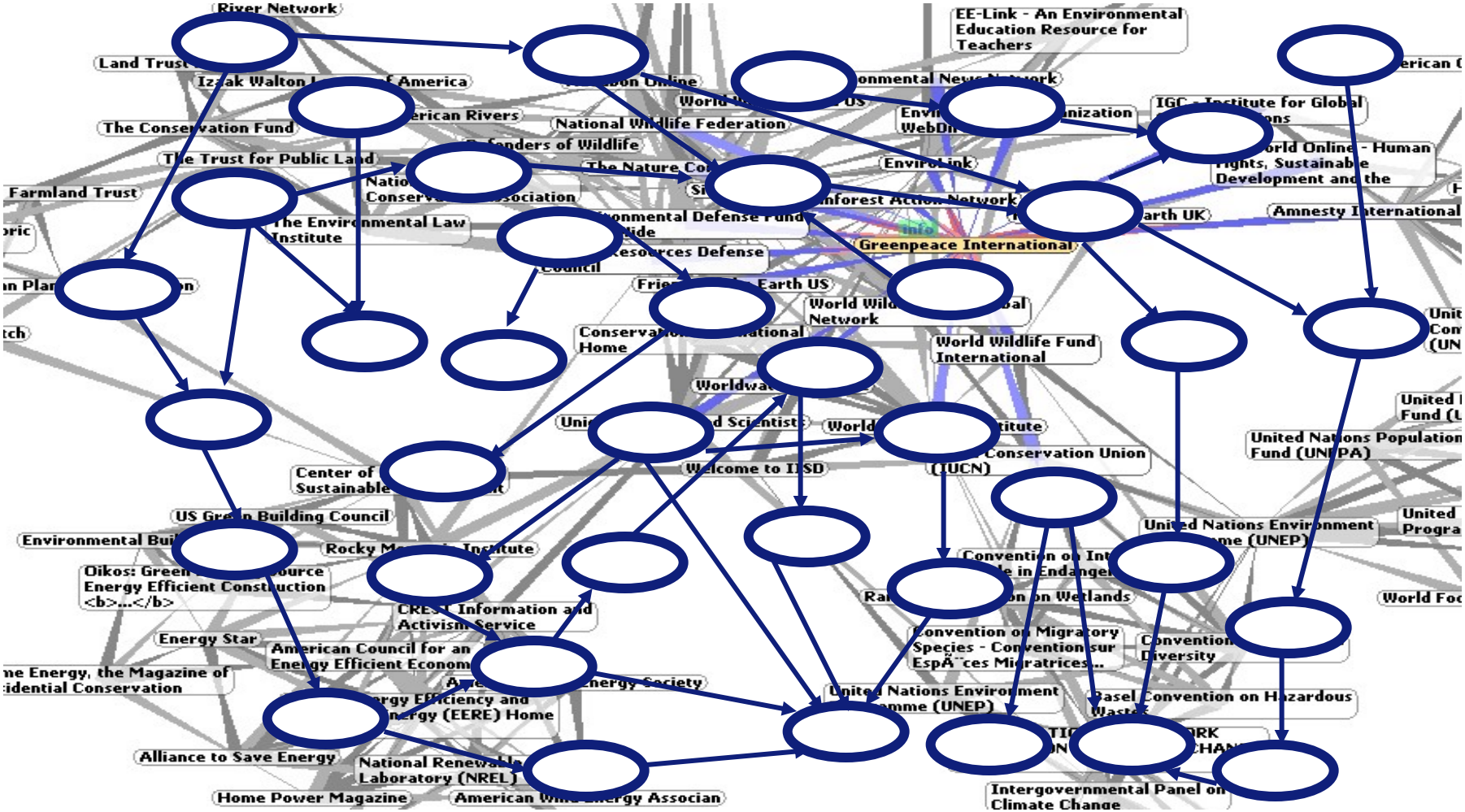
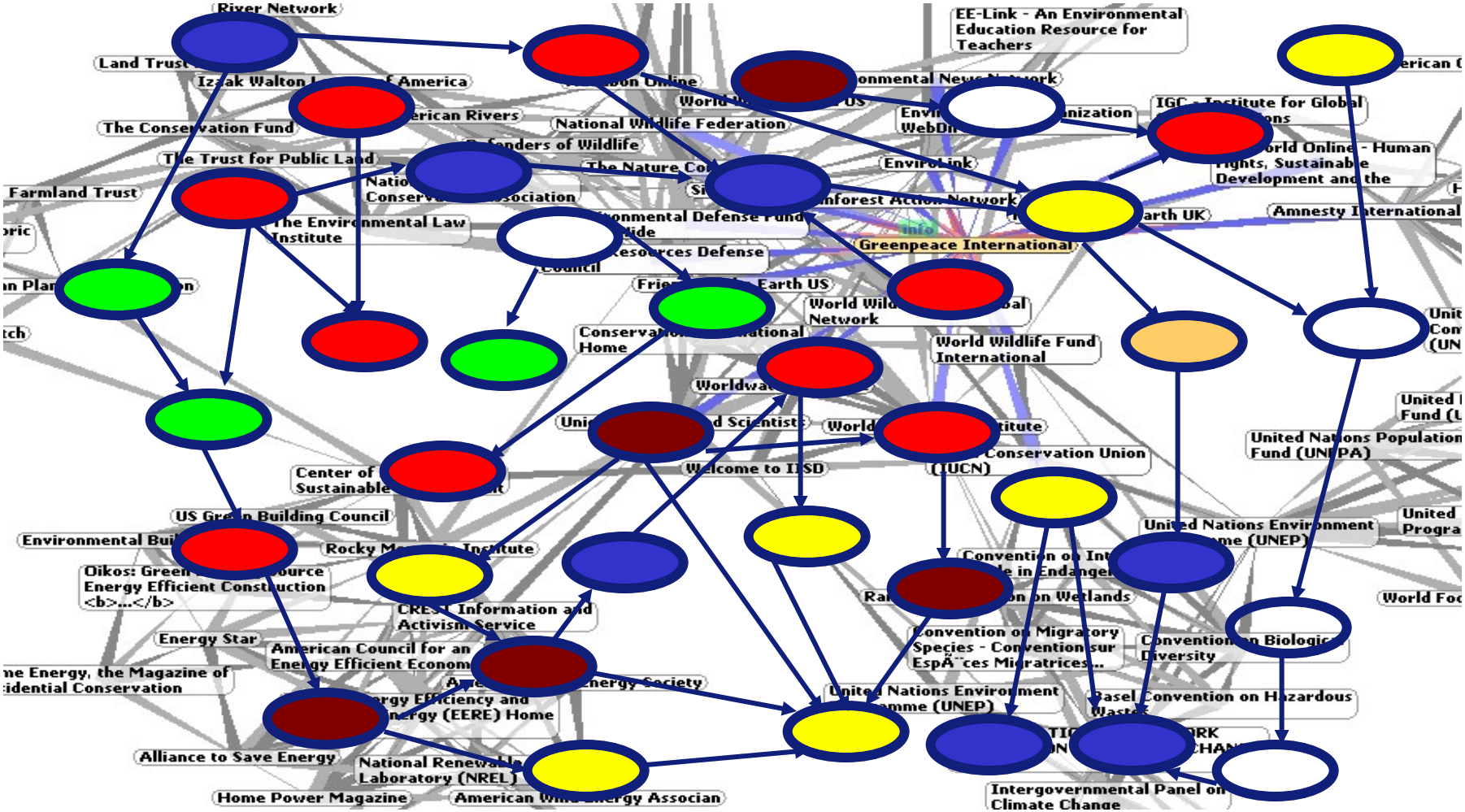
Agenda

- New Generation Semantic Applications
  - The Need for a Supporting Infrastructure
- The NeOn Toolkit
  - Lifecycle Support for Networked Ontologies
- Applications in the Pharmaceutical Sector
  - Supporting information dissemination about pharmaceutical products
  - Financial transactions with heterogeneous electronic invoices

Semantic Web Research: Putting a conceptual layer over the web

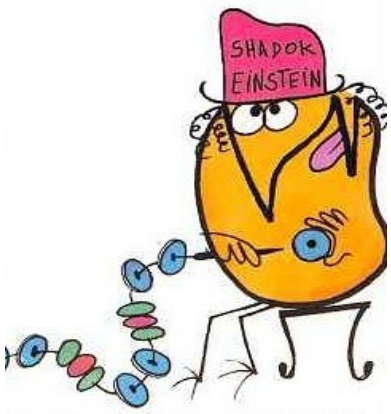


Semantic Web Research: Putting a conceptual layer over the web



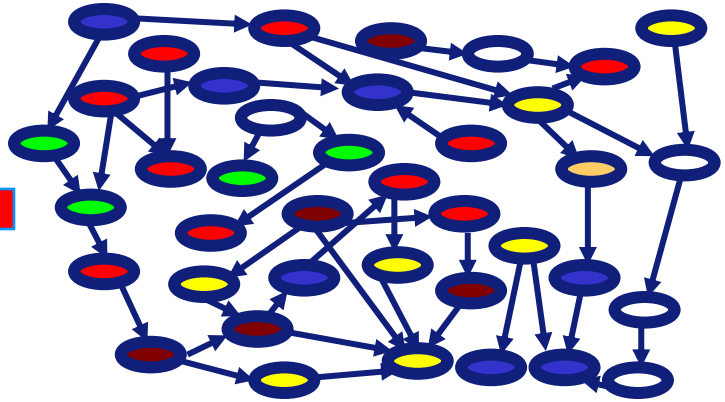
Next Generation Semantic Web Applications

Smart Features



NG SW Application

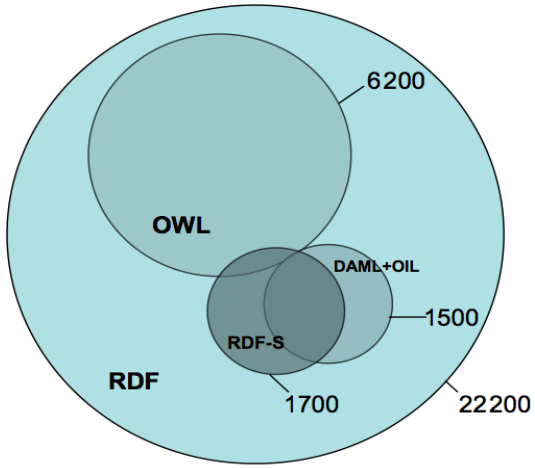
Semantic Web

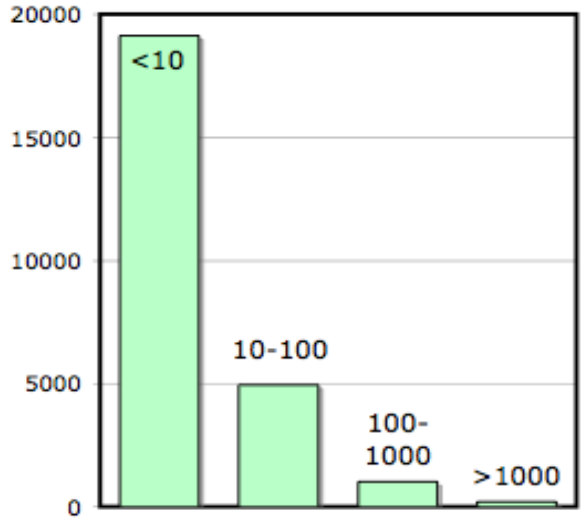


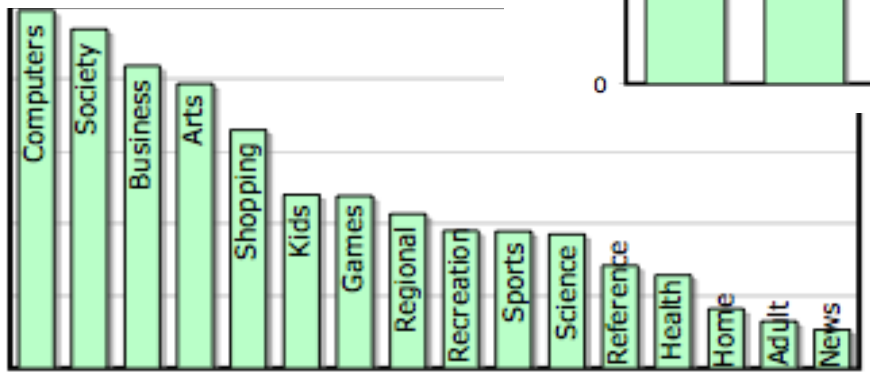
- Able to **exploit the Semantic Web at large**
  - **Dynamically retrieving the relevant semantic resources**
  - **Combining several, heterogeneous Ontologies**

Key Challenges: large scale, heterogeneous, distributed, contextualized and dynamic semantics

- **Millions** of semantic documents.
- **Hundreds of Millions** of RDF entities.
- **New sources of knowledge** are constantly created







Total			OWL			OWL Full		
DL	*Nb Documents*		*DL*	*Nb Documents*		*DL*	*Nb Documents*	
$\mathcal{AL}$(D)	21375	(84%)	$\mathcal{AL}$(D)	3644	(59%)	$\mathcal{AL}$(D)	3365	(78
$\mathcal{AL}$	2455	(10%)	$\mathcal{AL}$	1406	(23%)	$\mathcal{AL}$	281	(6.5
$\mathcal{ALH}$(D)	293	(1%)	$\mathcal{ALCF}$(D)	105	(1.5%)	$\mathcal{ALCF}$(D)	68	(1.5
$\mathcal{ALCF}$(D)	105	(<1%)	$\mathcal{ALC}$	94	(1.5%)	$\mathcal{ALH}$(D)	44	(1
$\mathcal{ALH}$	102	(<1%)	$\mathcal{ALH}$(D)	54	(<1%)	$\mathcal{ALCOF}$(D)	28	(<1
$\mathcal{ALC}$	101	(<1%)	$\mathcal{ALCOF}$(D)	43	(<1%)	$\mathcal{ALC}$	27	(<1

Key Challenges: Technological Limitations

- No adequate infrastructure for the whole **application development lifecycle** of the envisaged applications

- Specifically, current infrastructures **not effective**
  - Do not **scale** up
  - Poor support for **rapid development** of large applications by **reuse**
    - Reuse typically so expensive that people prefer to re-build from scratch
    - Problem concerns both the **lack of methodologies** as well as tools/techniques
  - Poor support for **managing the evolution** of an application
  - Poor support for **collaborative development**
  - Limitations of current **user interfaces**
    - E.g., support for navigating several large ontologies at the same time

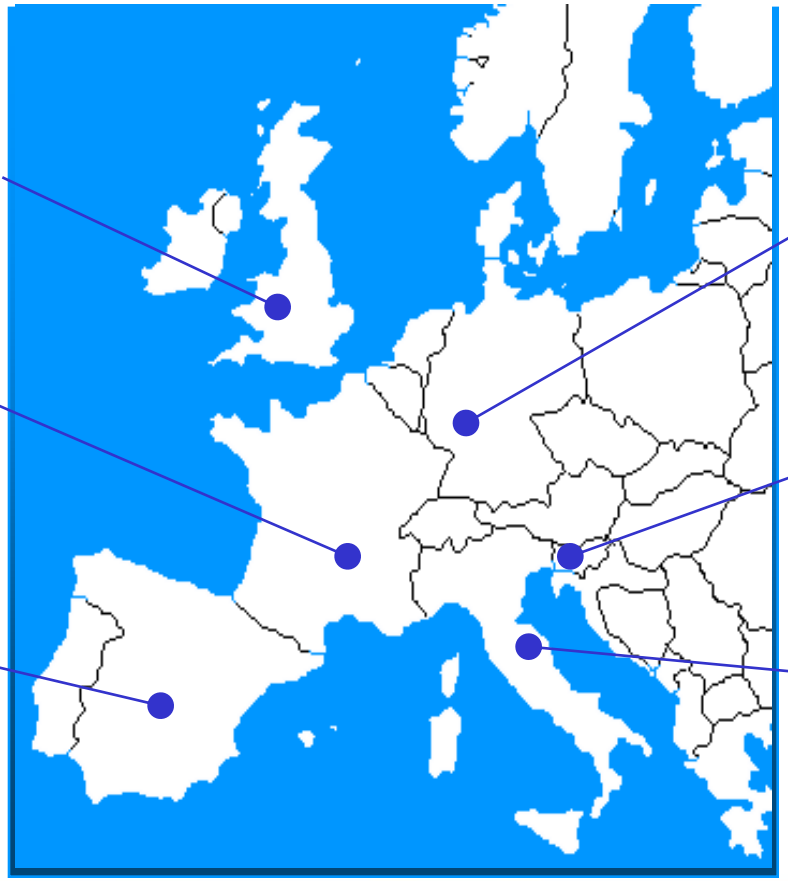
NeOn - Lifecycle Support for Networked Ontologies

- Funded by EU:
  - FP6 Integrated Project under “Semantics-based knowledge and content systems”
  - € 14.7 mil project budget over 4 years

The Open University
(co-ordinator)
University of Sheffield

INRIA Alpes

Universidad Politecnica Madrid,
iSOCO,
pharmaInnova,
Atos Origin



Universität Karlsruhe,
Software AG,
ontoprise,
Universität Koblenz

Institut ‘Jozef Stefan’

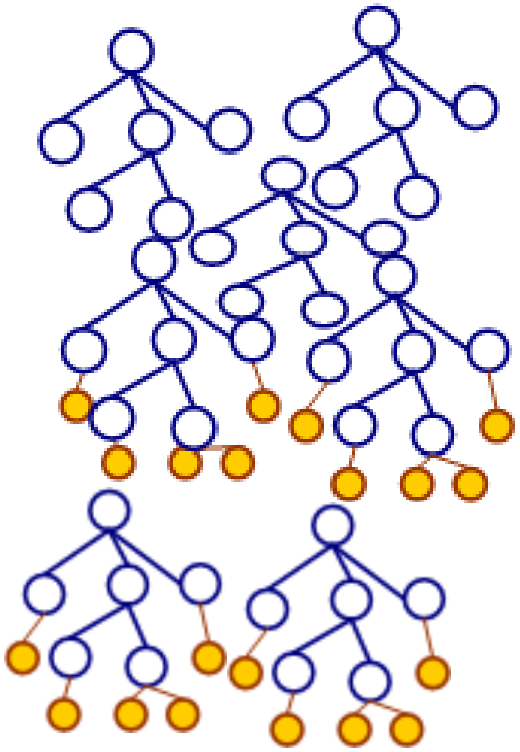
FAO of the UN
CNR-LOA

NeOn: Key Outputs

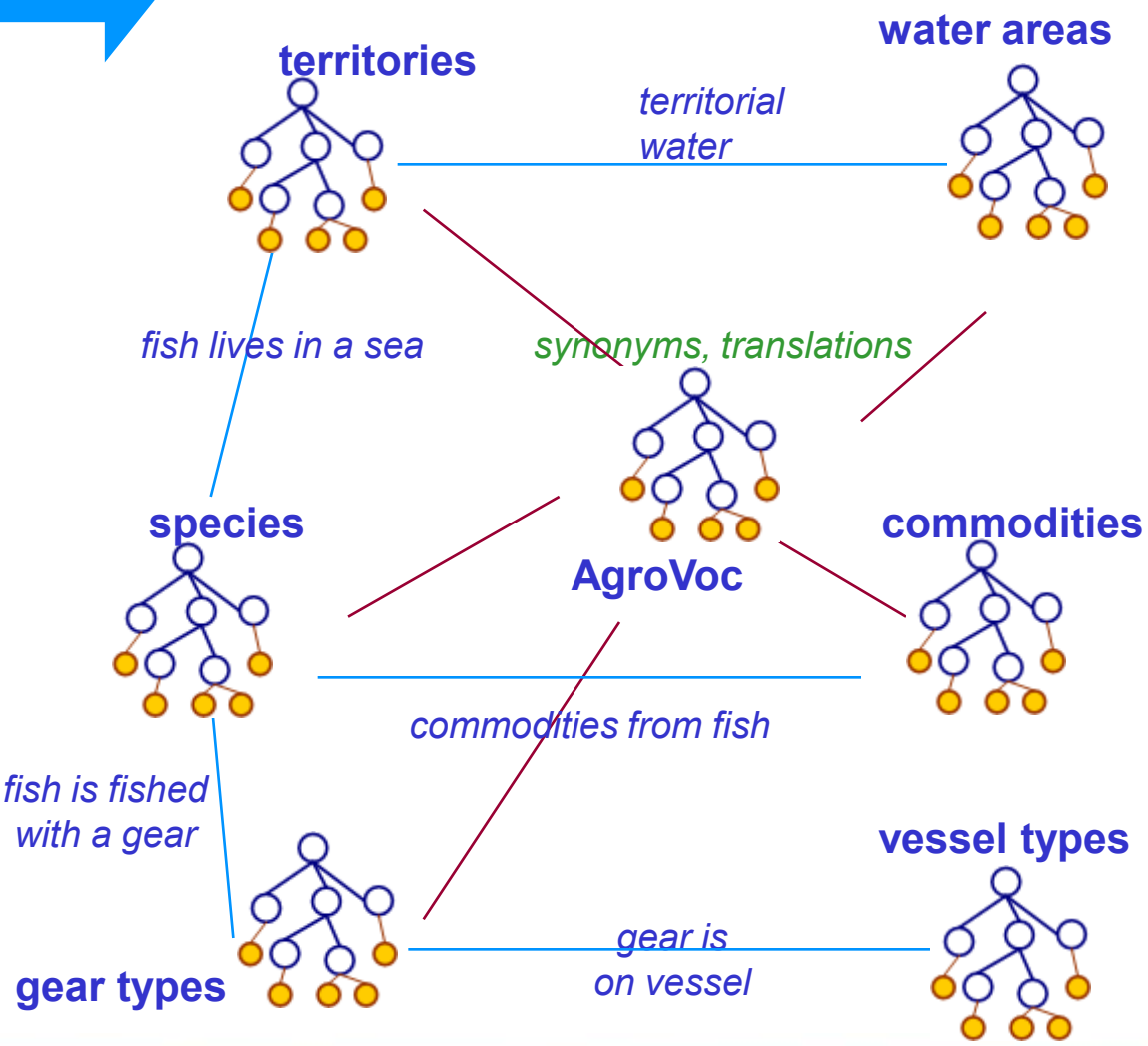
- System-level contributions
  - An open, service-centered ***reference architecture*** for managing the complete lifecycle of ***networked ontologies*** and meta-data
  - The ***NeOn Toolkit*** for ontology engineering and lifecycle management
  - The ***NeOn methodology*** for ontology and application development
- Sector-level
  - Three innovative ***case studies*** in two sectors
- Community-level
  - Creation of an ***active community*** of users and developers

Networked Ontologies: An Example

Fisheries ontology

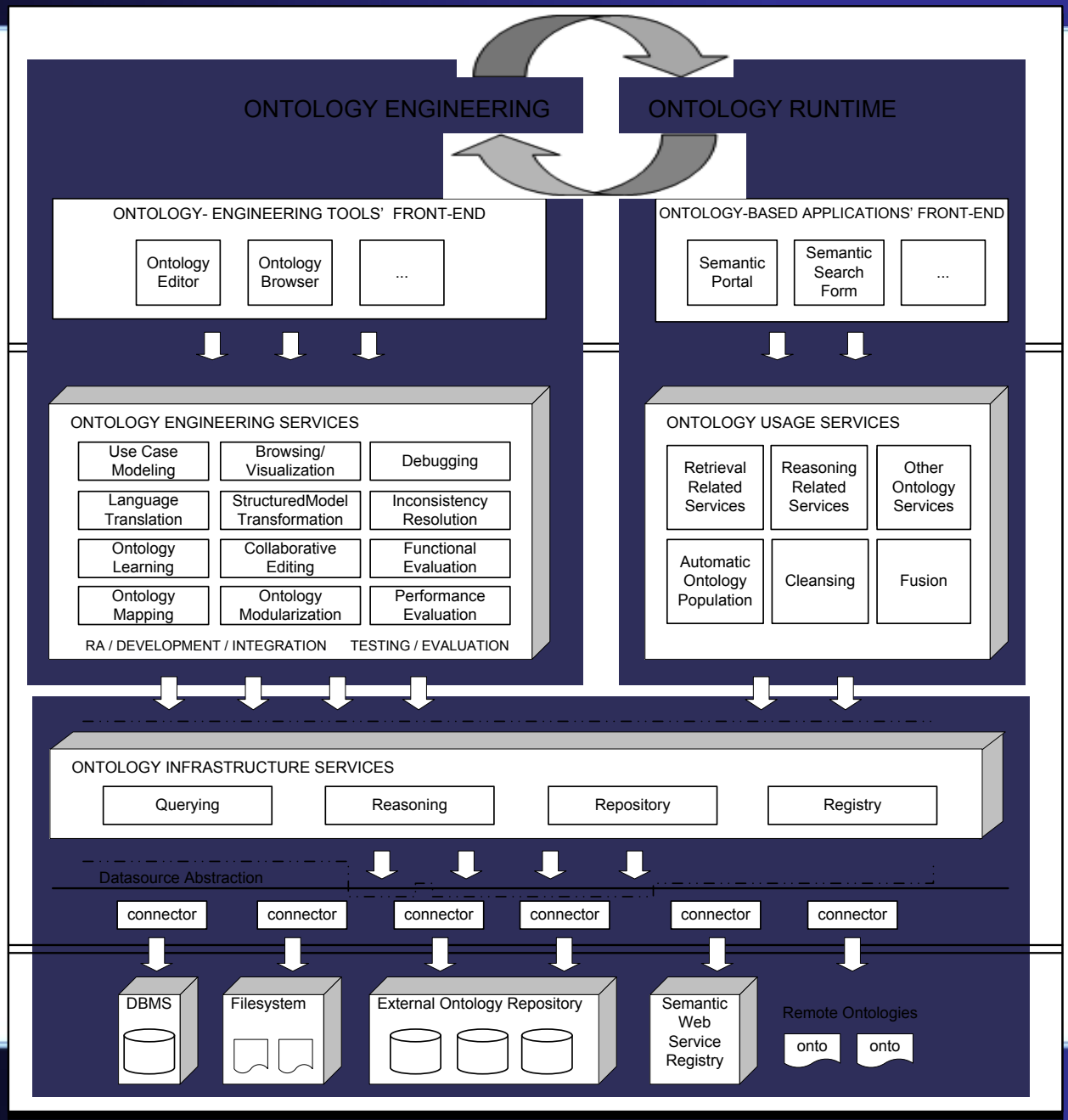


Fisheries networked ontologies



The NeOn reference architecture

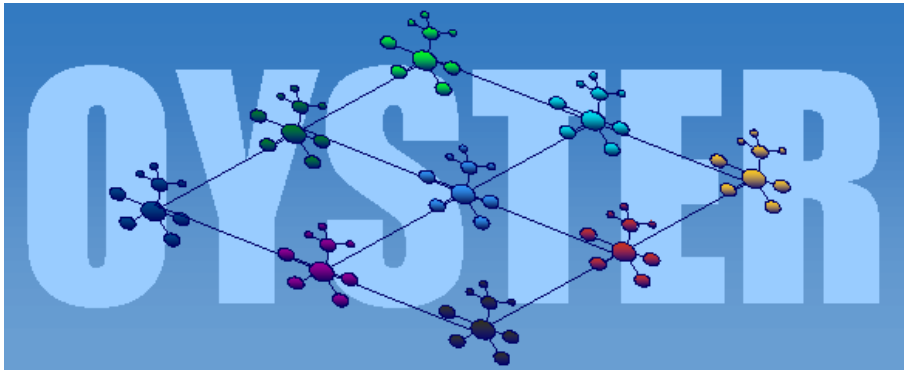
- Lifecycle requirements: Dynamic interaction of **engineering** and **runtime** activities
- Extensible on all layers of the architecture



Infrastructure components and tools

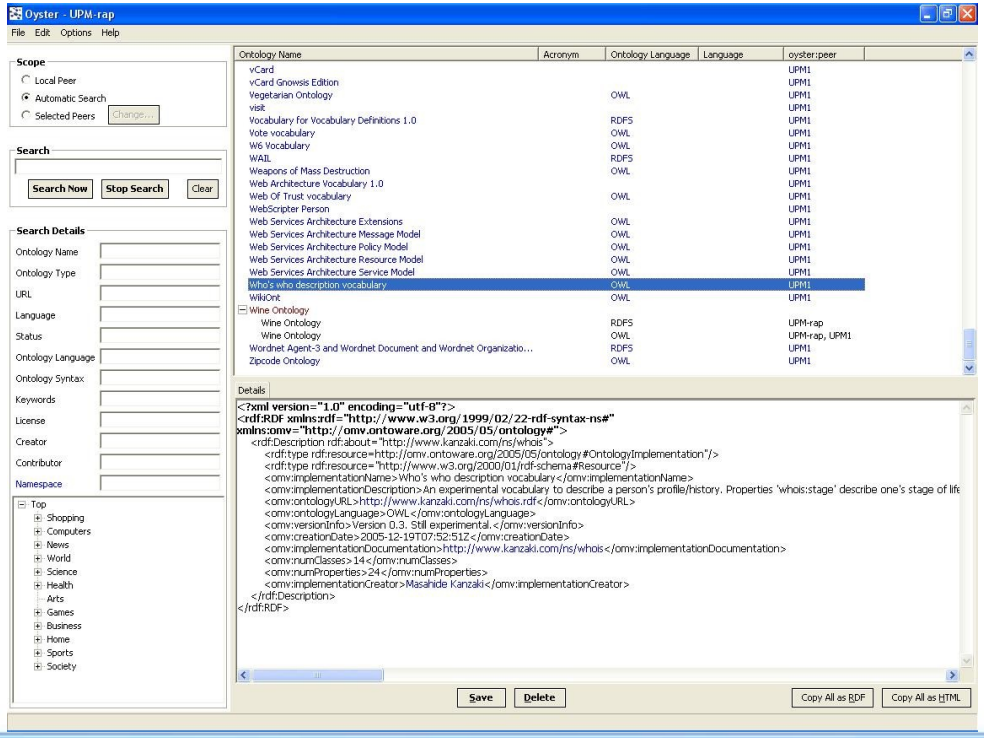
- Ontology Storage and Querying (KAON2, Ontobroker)
- Ontology Alignment Management (INRIA's Alignment server)
- Ontology Registry (**Oyster**)
- Ontology Search and Exploitation (**Watson**)
- Ontology Collaborative Design (ontologyDesignPatterns.org)
- …

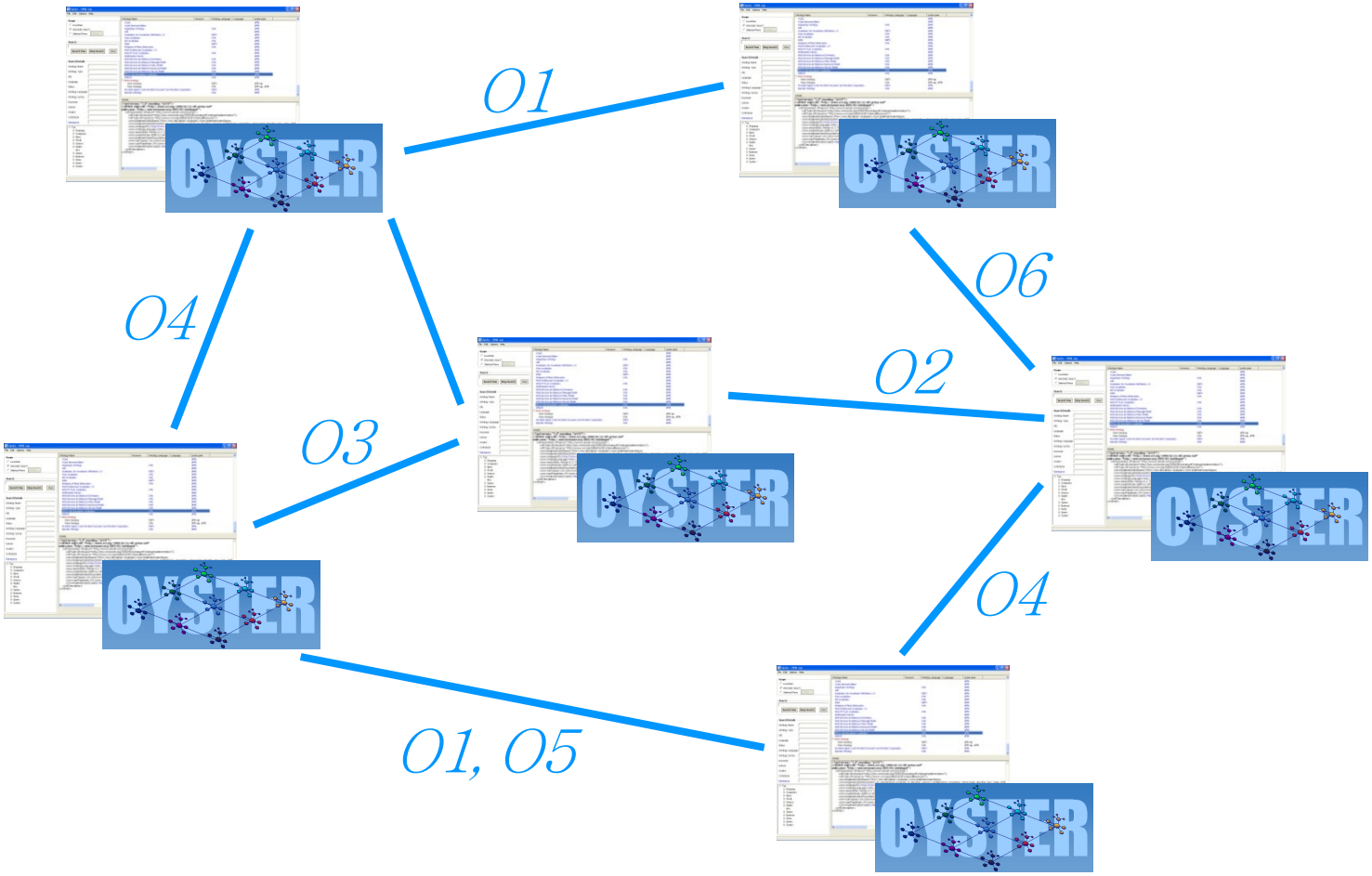
Highlight: Oyster



- The NeON ontology registry system

- Allows ontology designer to share ontologies by describing their metadata and….
- … distribute them over a peer-to-peer network

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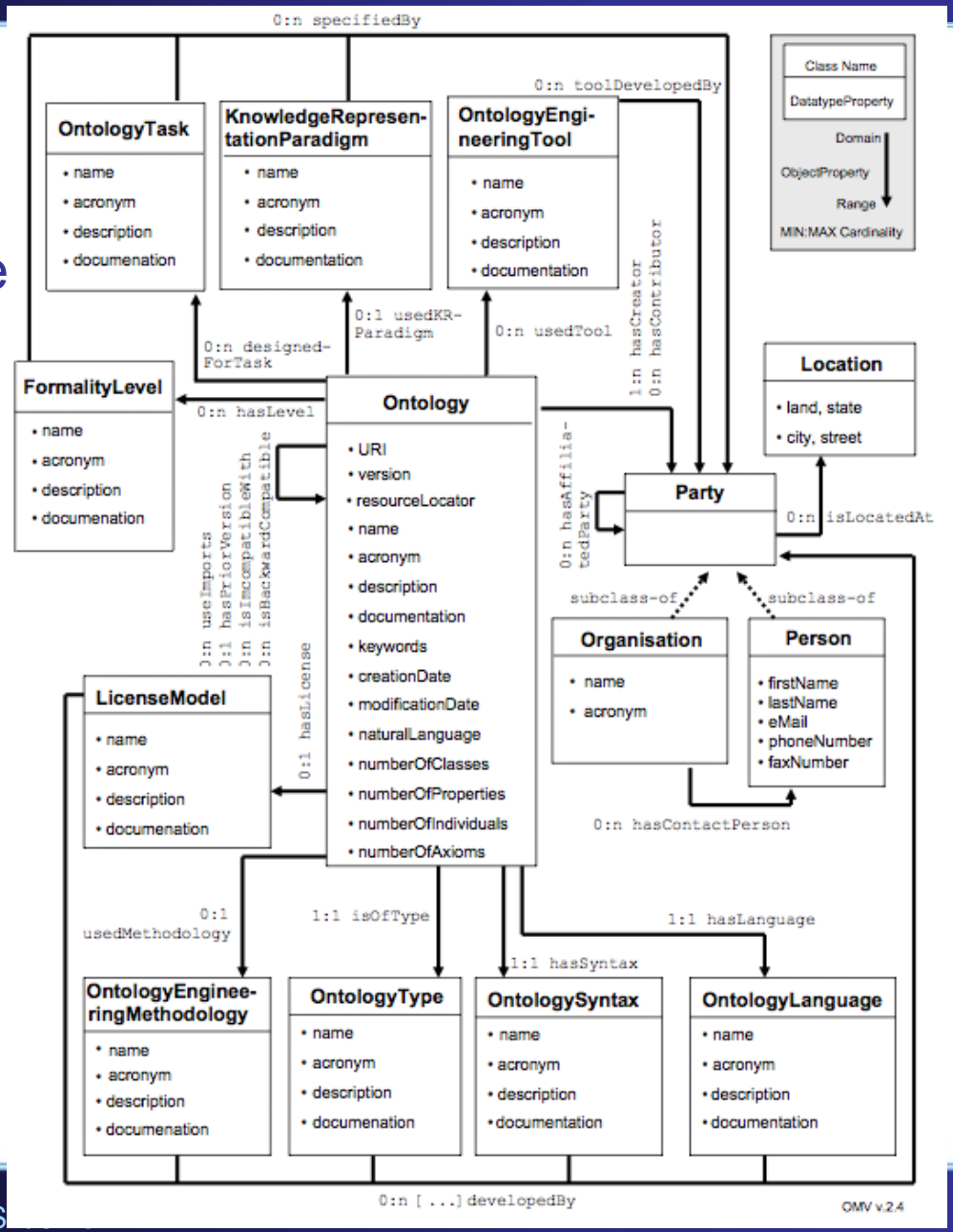
OMV: The Ontology Metadata Vocabulary

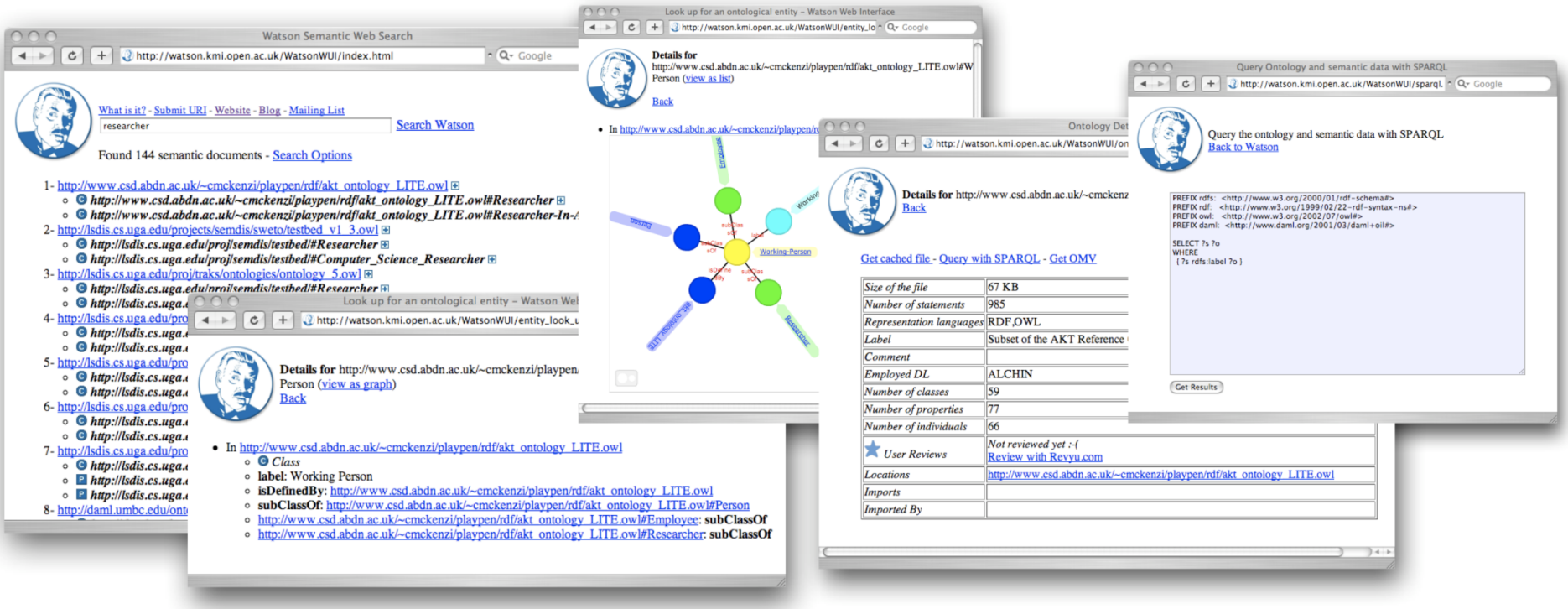
- For Oyster to work, there is a need for a common format to be used by peers to **represent and exchange information about the registered ontologies**.
- **OMV** (the Ontology Metadata Vocabulary) is a machine readable representation of ontology metadata using Semantic Web technologies: it is "**an ontology about ontologies**"



Highlight: Watson

- Watson is a **Gateway to the Semantic Web**
- It collects (through web crawling), analyses, indexes and gives access to semantic information and ontologies on the Web
- At first sight: a **search engine for the Semantic Web**

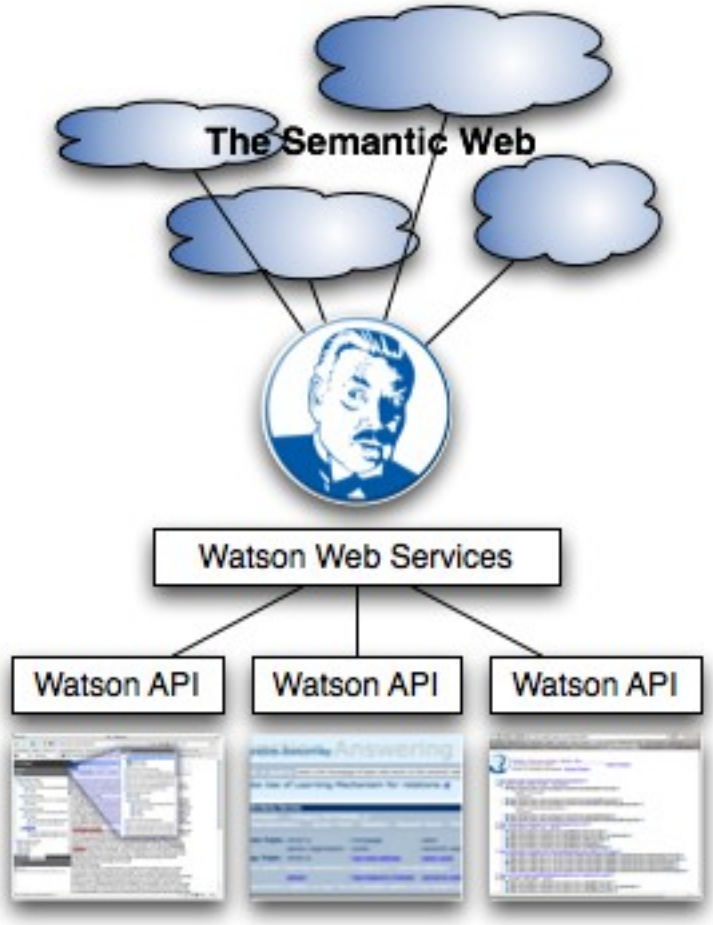
Watson



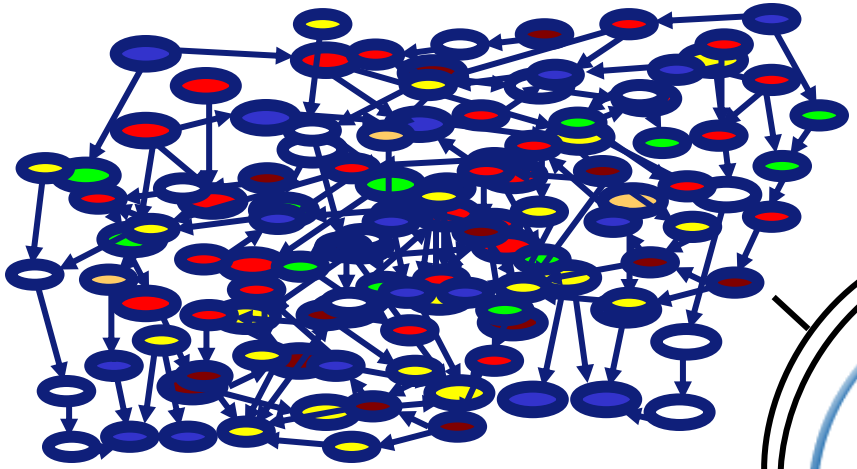
http://watson.kmi.open.ac.uk

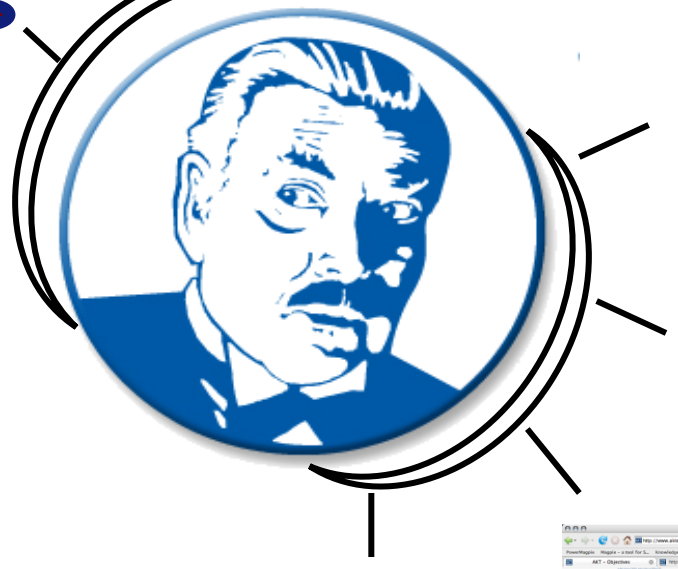
Watson APIs and Web Services

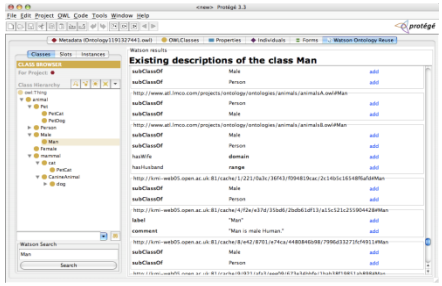
- But Watson is more than an interface for users to find, select and explore online ontologies
- It is an infrastructure so that (next generation) Semantic Web application can **exploit the Semantic Web as a whole**

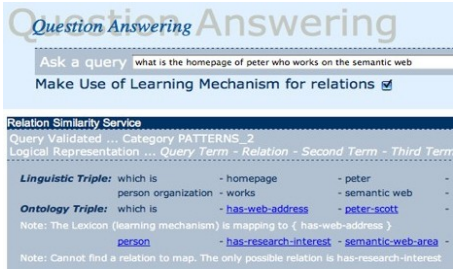


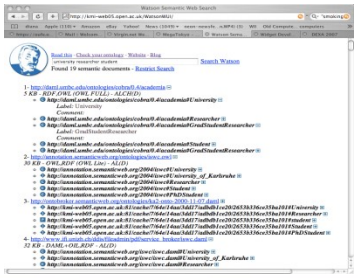
A Gateway to the Semantic Web

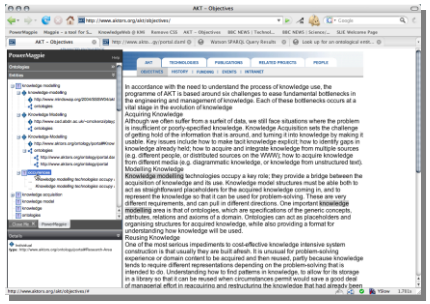






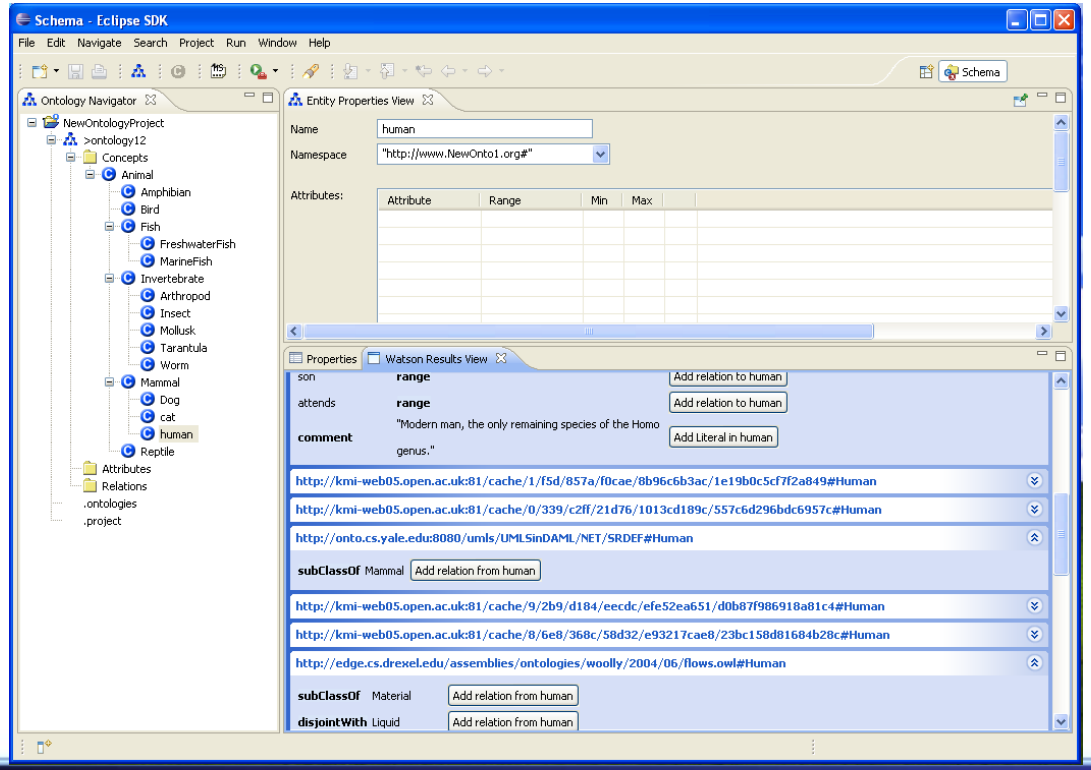






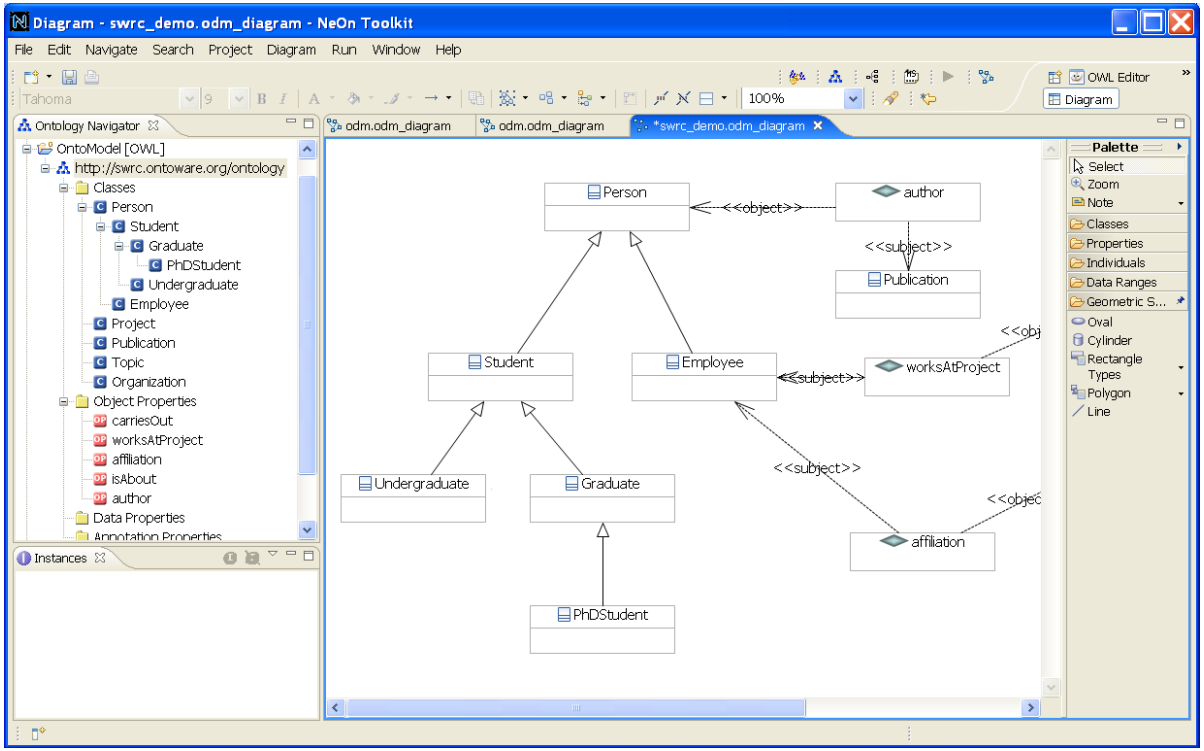
What is the NeOn Toolkit?

- Reference implementation of the NeOn architecture
  - Support ontology engineering and management
  - Support for complete ontology lifecycle
  - Support for different languages (OWL, F-Logic)
  - Support for networked ontologies (modules, mappings)
- Built on the Eclipse platform
- Extensible architecture
  - Via Eclipse plugin mechanism
  - Via Web Services



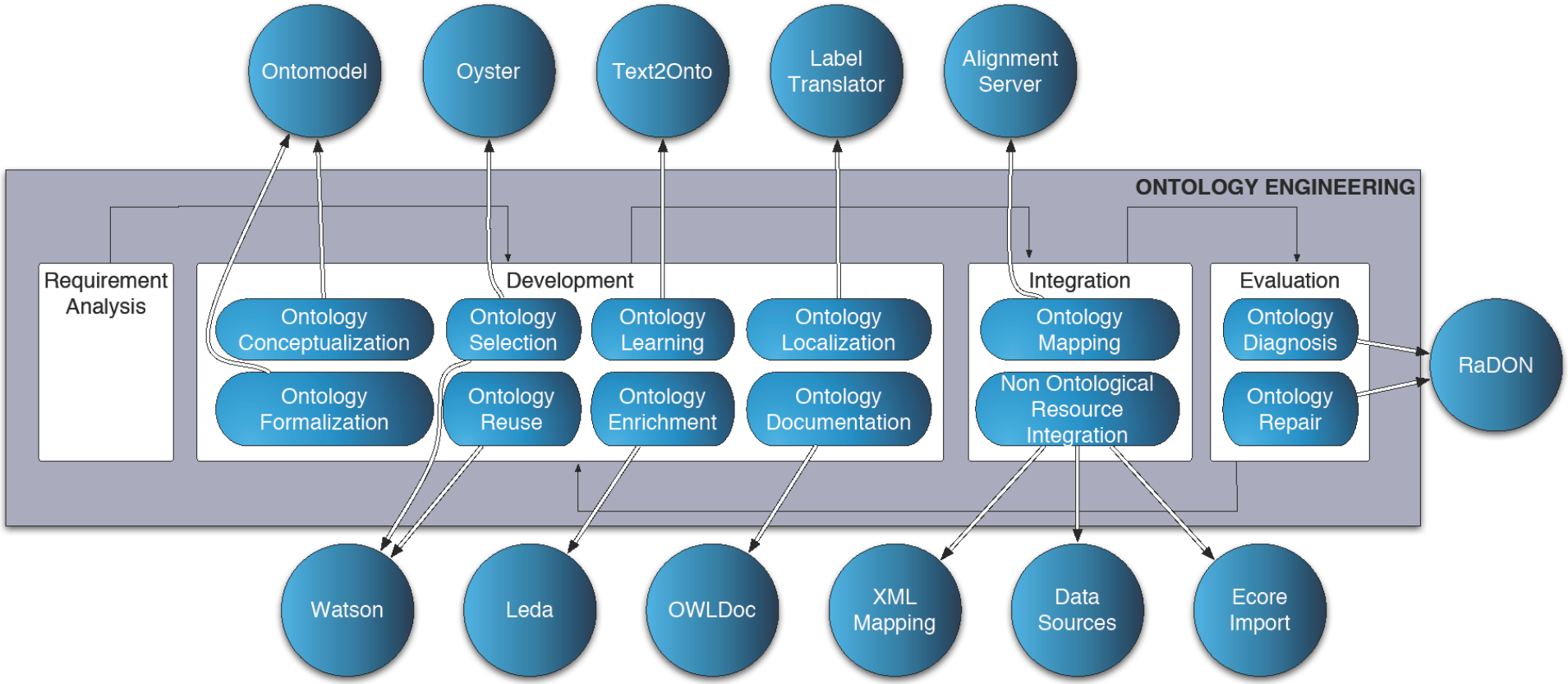
Availability

- Basic configuration
  - Completely free
  - Open source
- Extended configuration
  - Commercial version
  - Free for academic use
- Community support
  - For users and developers
  - Tutorials, mailing lists

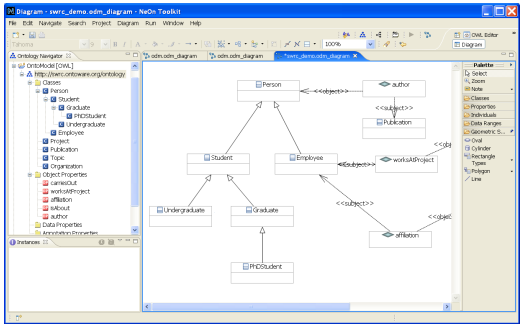


- Activities coordinated by the NeOn Foundation
  - Opportunity to contribute!
- NeOn Toolkit Portal: http://www.neon-toolkit.org/
  - Download of the toolkit, plugins, online resources, wiki, …

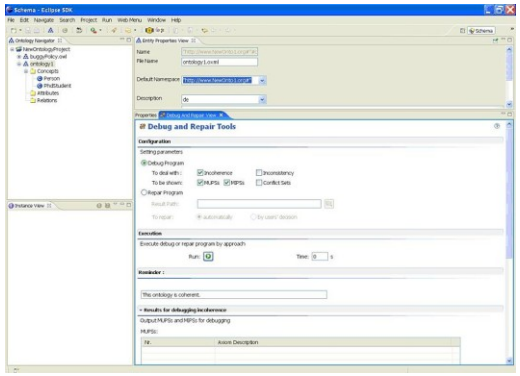
Plugins Supporting Lifecycle Activities



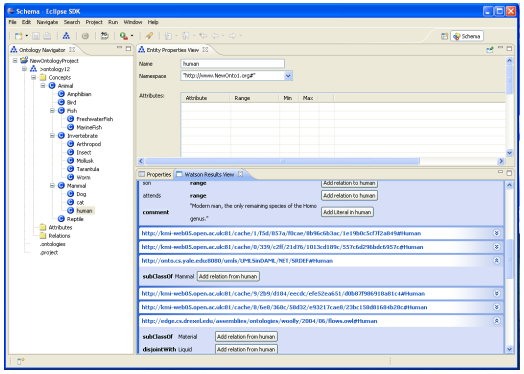
Plugin Examples



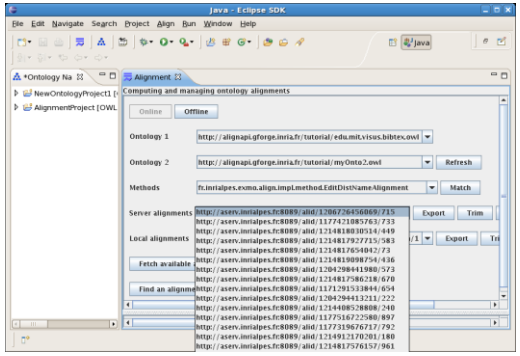
OntoModel: Meta-modeling for ontologies



Radon: Diagnostic and repair for inconsistent networked ontologies



Watson: Reusing knowledge from the Semantic Web



The Alignment Server: Producing and managing ontology alignments

Testbeds

- Managing fishery knowledge to support automatic alert mechanisms
- E-Invoice management in the pharmaceutical sector
- Integration and management of information about pharmaceutical products

Applications in the pharmaceutical sector

- The Pharmaceutical Industry provides NeOn with a testbed for Networked Ontologies in several fields of application
  - Dynamics of the pharmaceutical supply chain
  - Management of nation-wide knowledge on chemist products

Main objectives:

To facilitate invoice **interoperability** between organizations exchanging electronic invoices in different formats and models

Invoice management

Integration and update of heterogeneous, distributed sources of information on chemist products

Semantic nomenclature

The pharmaceutical industry in Europe

Pharmaceutical production in the European Union and other countries

País Country	Producción farmacéutica (mill. €) Pharmaceutical production (millions of €)	Producción per cápita (€) Production per capita (€)	Producción por empleado (mill. €) Production per employee (millions of €)	
Alemania Germany	20.671	250,59	0,18	
Austria (1) Austria	1.548	191,42	0,17	
Bélgica Belgium	3.814	369,11	0,15	
Dinamarca Denmark	5.334	992,19	0,21	(1)
España Spain	8.818	210,58	0,23	
Finlandia Finland	682	131,13	0,10	
Francia France	30.438	511,68	0,31	
Grecia (1) Greece	337	31,92	0,03	
Holanda Netherlands	5.742	355,56	0,36	
Irlanda Ireland	16.605	4.223,04	0,83	
Italia Italy	17.508	301,89	0,21	
Portugal Portugal	1.469	141,69	0,13	
Reino Unido United Kingdom	27.144	458,27	0,33	
Suecia Sweden	5.249	588,12	0,25	
TOTAL UE Total EU	145.359	382,51	0,26	
Noruega Norway	579	127,59	0,13	
Suiza Switzerland	12.913	1.771,33	0,44	(2)
Turquía (2) Turkey	2.069	30,16	0,10	
TOTAL EFPIA Total EFPIA	160.920	348,71	0,26	

Pharmacies and wholesalers in Europe

Number of pharmacies in the European Union and other countries

País / Country	Nº de oficinas de farmacia / Nº of pharmacies	Nº de habitantes por ofic. de farmacia / inhabitants per pharmacy	Indicadores de densidad / Density indicators: Farmacias por 10.000 hab. / Pharmacies per 10.000 pop	Indicadores de densidad / Density indicators: Farmacias por 100 km² / Pharmacies per 100 km²
Alemania Germany	21.465	3.843	2,6	6,0
Austria (1) Austria	1.071	7.542	1,3	1,3
Bélgica (2) Belgium	5.621	1.819	5,5	
Dinamarca (1) Denmark	288	18.406	0,5	
España Spain	20.098	2.125	4,7	
Finlandia Finland	799	6.509	1,5	
Francia (3) France	23.262	2.532	3,9	
Grecia Greece	9.350	1.134	8,8	
Holanda Netherlands	1.631	9.901	1,0	
Irlanda Ireland	1.250	3.146	3,2	
Italia Italy	16.642	3.485	2,9	
Portugal Portugal	2.478	4.184	2,4	
Reino Unido United Kingdom	12.115	4.889	2,0	
Suecia Sweden	900	9.917	1,0	
Noruega Norway	508	8.933	1,1	
Suiza Switzerland	1.669	4.368	2,3	
Turquía (3) Turkey	21.210	3.151	3,2	

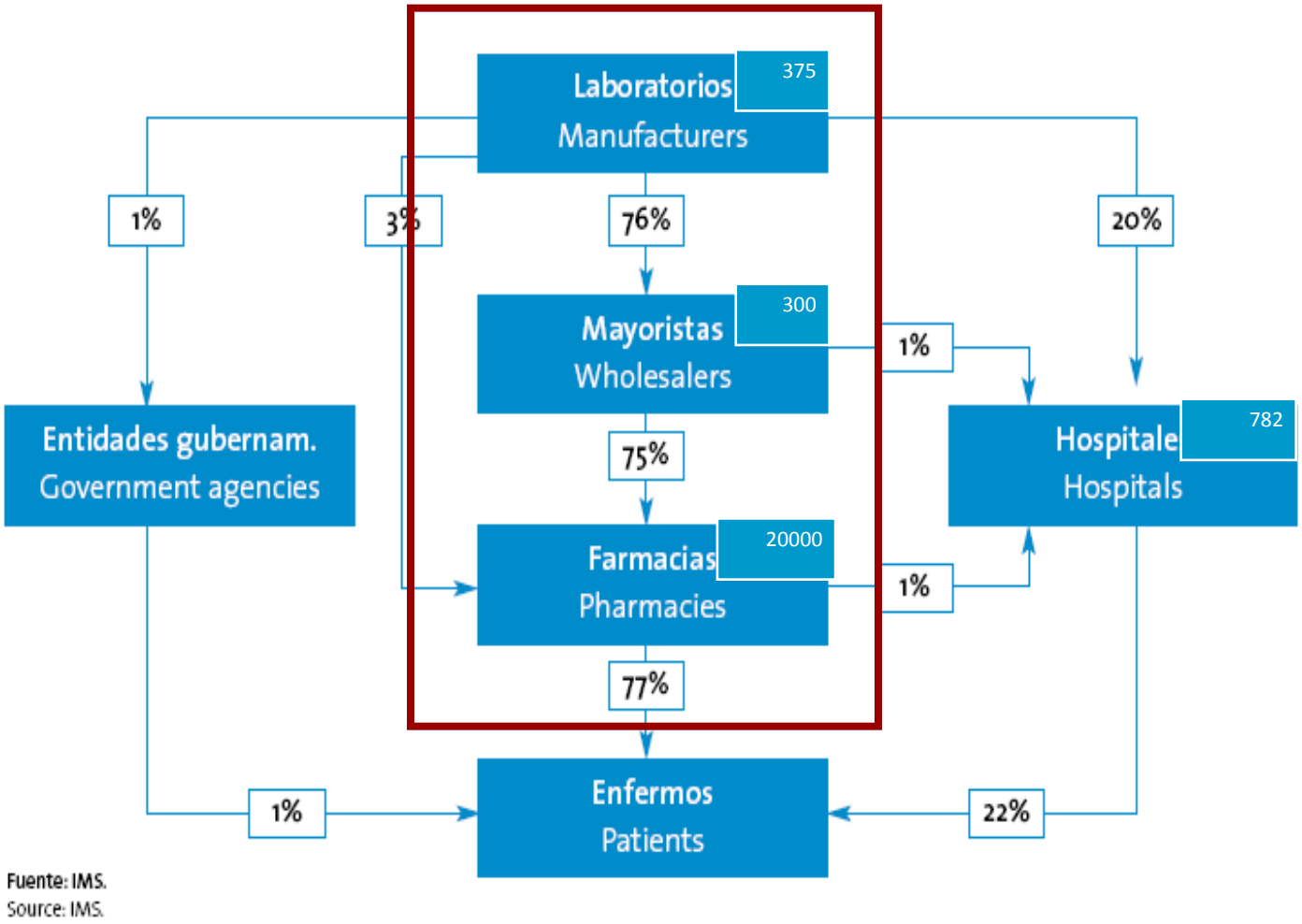
(1) Datos correspondientes a 1998.
1998 Data.
(2) Datos correspondientes a 1999.
1999 Data.
(3) Datos correspondientes a 2000.
2000 Data.
Fuentes: FARMAINDUSTRIA a partir de asociaciones de la industria farmacéutica de cada país, OCDE *(Health Data, 2004)* e IN
(Anuario Estadístico, 2004).
Sources: FARMAINDUSTRIA estimates based on data supplied by the pharmaceutical industry associations of each country, C
(Health Data, 2004) and INE *(Statistic Annuary, 2004)*.

Number of wholesalers in the European Community

País / Country	Número de empresas / Number of companies	Número de almacenes / Storage facilities
Alemania Germany	16	104
Austria Austria	9	23
Bélgica Belgium	13	28
Dinamarca Denmark	3	9
España Spain	99	191
Finlandia Finland	3	8
Francia France	10	180
Grecia Greece	120	131
Holanda Netherlands	14	36
Irlanda Ireland	5	11
Italia Italy	150	263
Luxemburgo Luxembourg	3	3
Noruega Norway	3	7
Portugal Portugal	17	50
Reino Unido United Kingdom	12	59
Suecia Sweden	2	7
Suiza Switzerland	6	14

Fuente: FEDIFAR.
Source: FEDIFAR.

Distribution channels of pharma labs in Spain



Fuente: IMS.
Source: IMS.

Pharmaceutical laboratories in Spain

Laboratories with proprietary medicinal products by Self-Governing Region

PHARMAINNOVA

Almirall

Boehringer Ingelheim

Ferrer grupo

KIN

NOVARTIS

Participating

Abbott Laboratories

ROVI

ALTER

Roche

ALCALA farma

Interested

MSD

GRUPO FARMASIERRA
Operador Global Farmacéutico

Lilly

Bristol-Myers Squibb Company

ESTEVE

Grupo Uriach

GRUPO MENARINI

sanofi aventis
L'essentiel c'est la santé.

Pharmacies in Spain

Number of pharmacies: 20.000
Population per pharmacy: 2.000

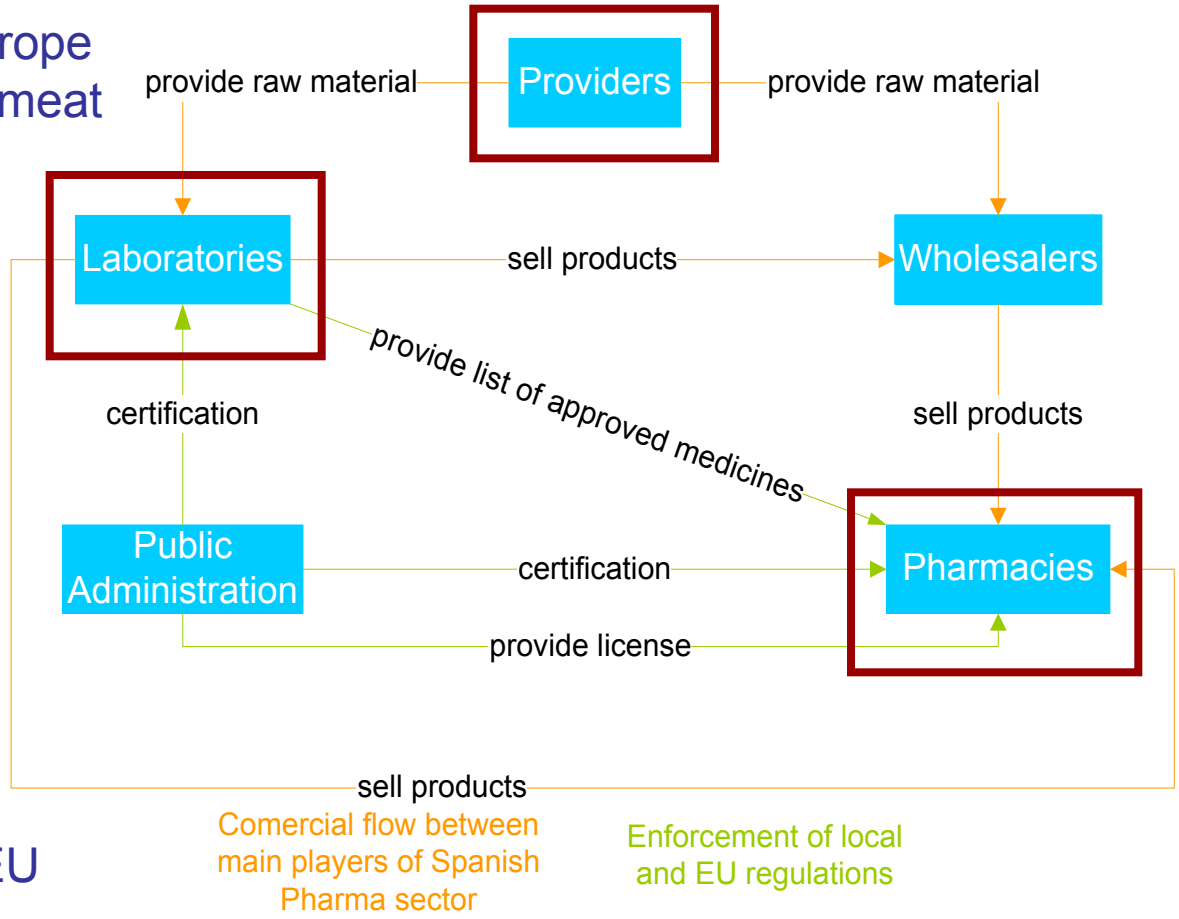
Densidad superior a la media nacional en más de un 5%
Density more than 5% above the national average

Densidad en torno a la media nacional
Density around national average

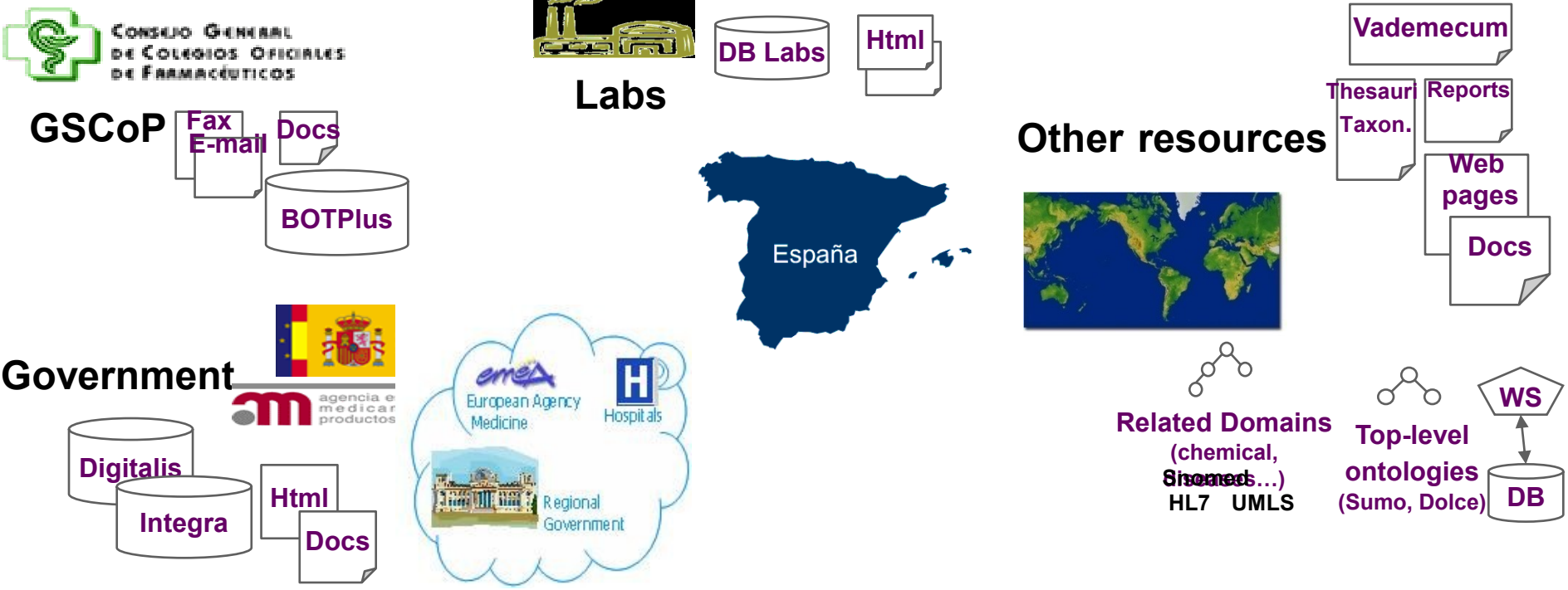
Densidad inferior a la media nacional en más de un 5%
Density more than 5% below the national average

The Spanish pharmaceutical sector

- 5th largest industry sector in Europe behind car, energy, petrol, and meat
- Main actors in Spain
  - Public administrations
    - Ministry of Health
    - Regional governments
    - AGEMED
  - Laboratories (375)
    - FarmaIndustria
    - PharmaInnova
  - Pharmacies (20000)
    - GSCoP
  - Providers (150)
  - Wholesalers (300)
- Tightly regulated by local and EU directives



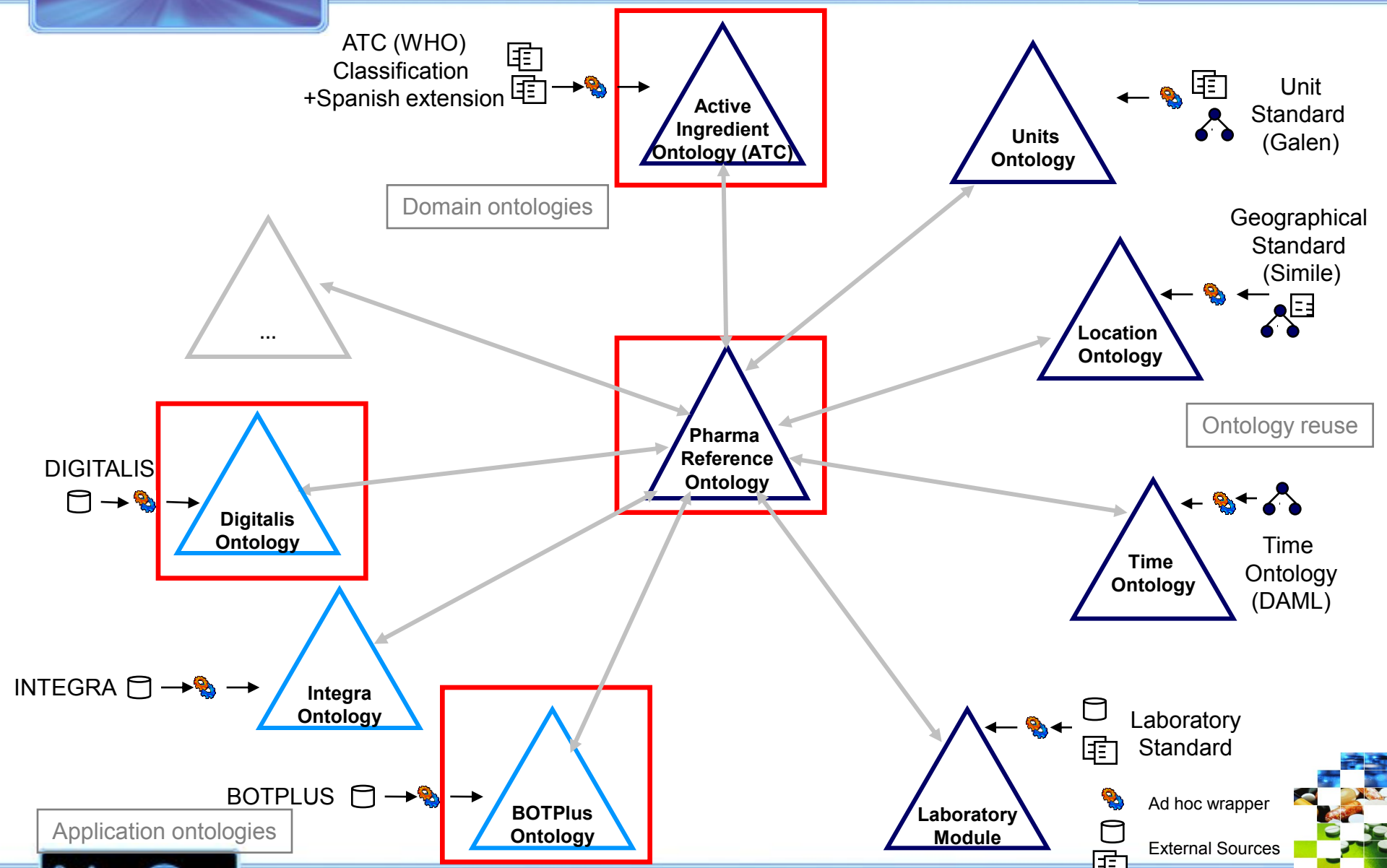
Testbed #1: semantic nomenclature (information integration in the pharmaceutical industry)

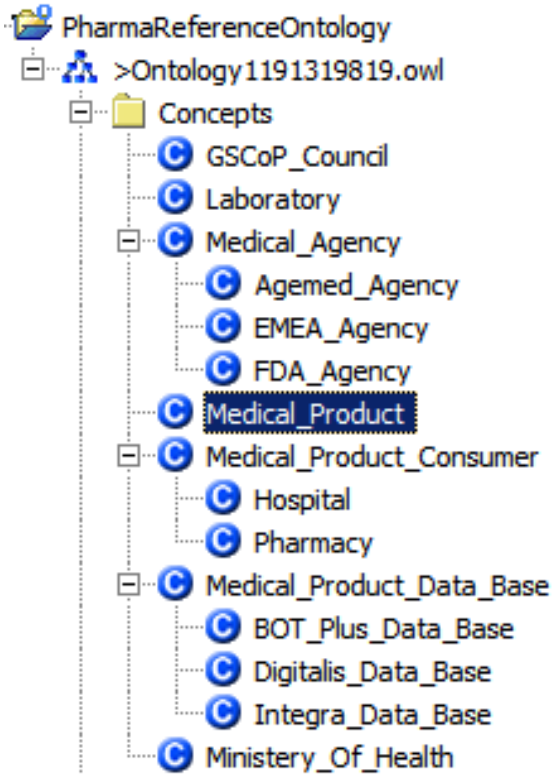


- Spanish Pharmaceutical sector
  - Knowledge intensive
  - Average of 100 new products per month approved, 20 withdrawal and more than 2.500 modified
  - Actors: Governmental bodies, GSCoP, Laboratories, Pharmacies…
  - Complex and heavily regulated

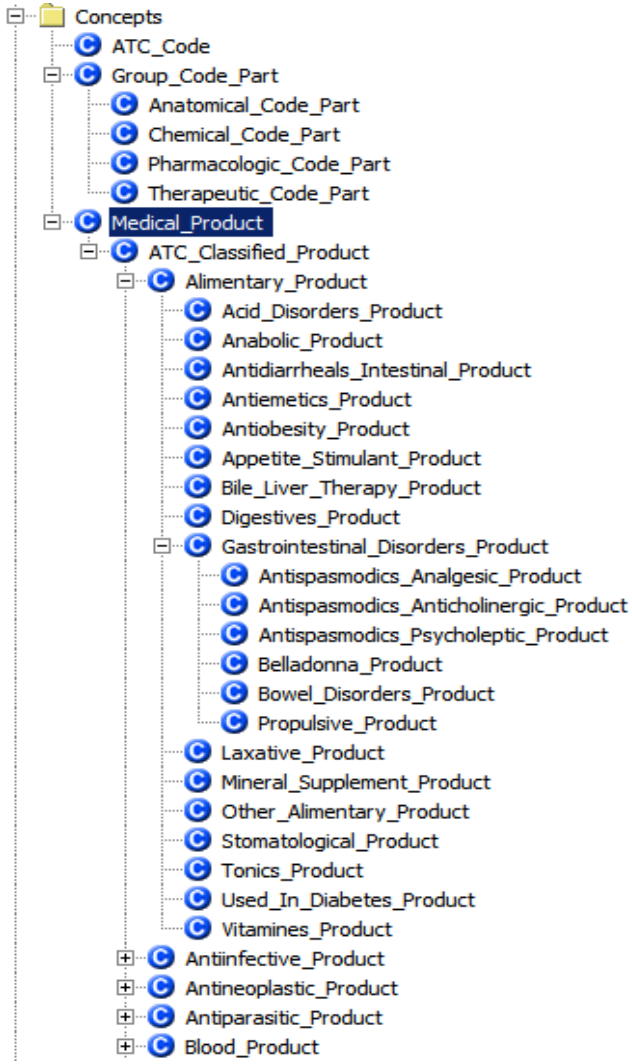
- Heterogeneous resources
  - Governmental databases (Digitalis, Integra)
  - BOTPlus
  - Labs info
  - Other resources (regional on-line resources, online Vademecum, international nomenclatures..)

Semantic Nomenclature Ontology Network



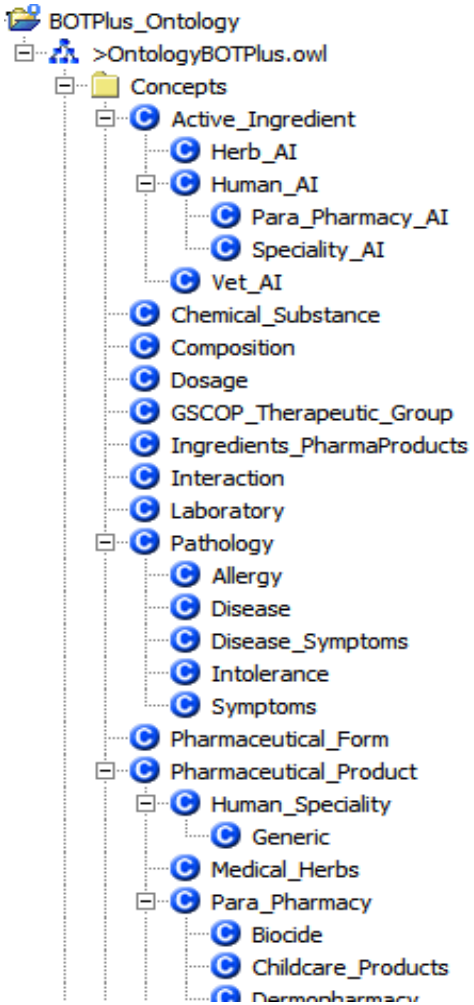


- Pharmaceutical Reference Ontology
  - Domain Ontology
  - Represents generic concepts (stakeholders, pharma product, etc.)
  - “Medical_Product” will be the hook (mapped to most of Semantic Nomenclature networked ontologies)
  - Inference and comparison of a product across different classifications (ATC)



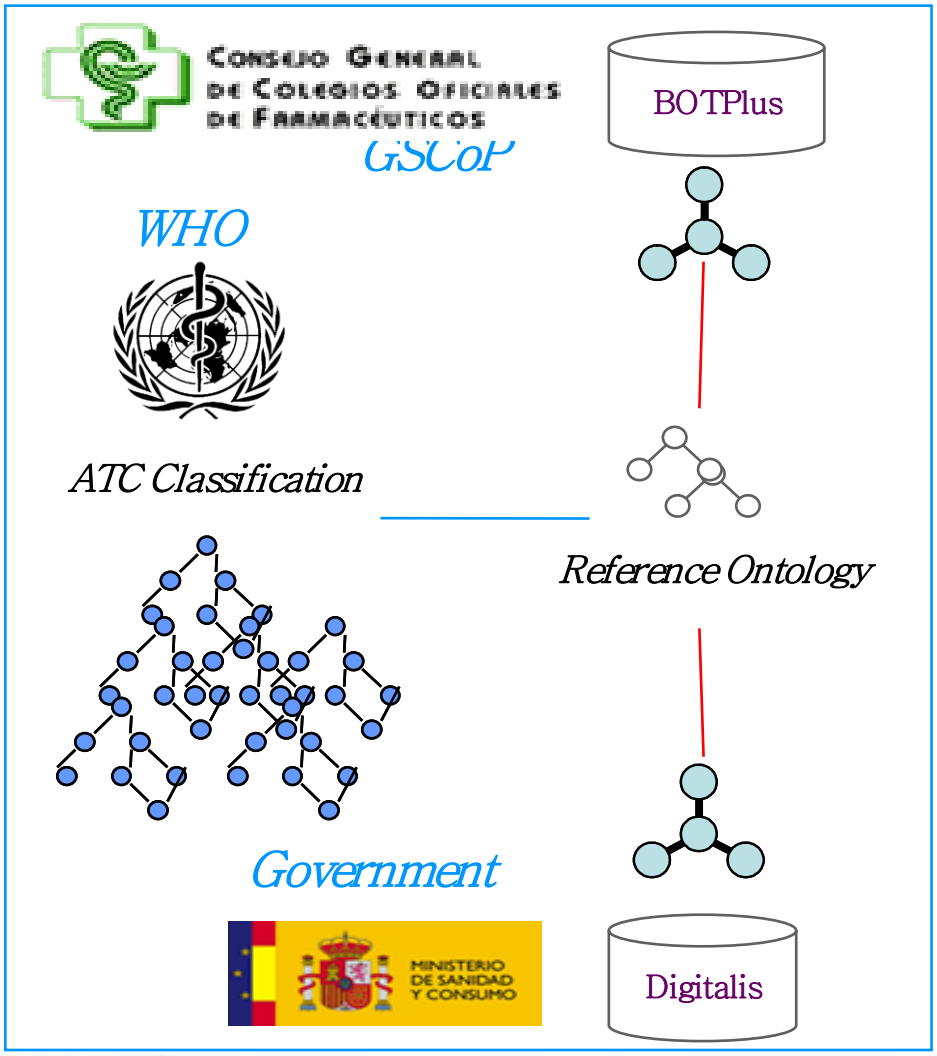
ATC Ontology

- Domain Ontology
- Two main branches: ATC description, ATC classification
- “ATC_Classified_Product” that represents all the pharmaceutical products classified through the ATC code
- Two initial levels of ATC code in the hierarchy (therapeutic and pharmacological subgroup)
- Ontology population using R2O / ODEMapster (from Digitalis ATC codes)
- 122 classes, 2 object properties 1 datatype property, more than 2.800 ATC codes -14.000 instances- (>2Mb)



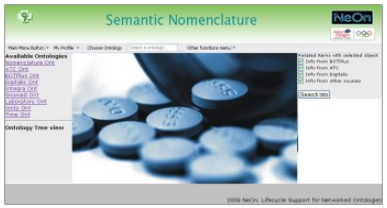
- BOTPlus Ontology
  - Application Ontology
  - knowledge represented in the schema of the BOTPlus database
  - Classification of pharmaceutical products based on a classification code and the specialty of the product:
    - Human
    - Parapharmacy
    - Vet
    - Medical Herbs
  - Ontology population using R2O / ODEMapster (only human and para-pharmacy products)
  - 37 classes, 12 object properties, 76 datatype properties, more than 30MB of instances

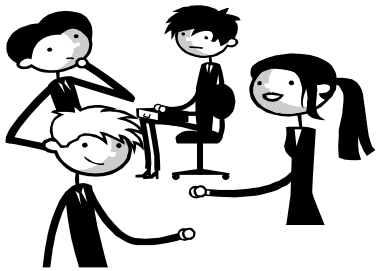
NeOn-powered semantic nomenclature prototype: Online vademecum



Semantic Nomenclature Web application

Queries

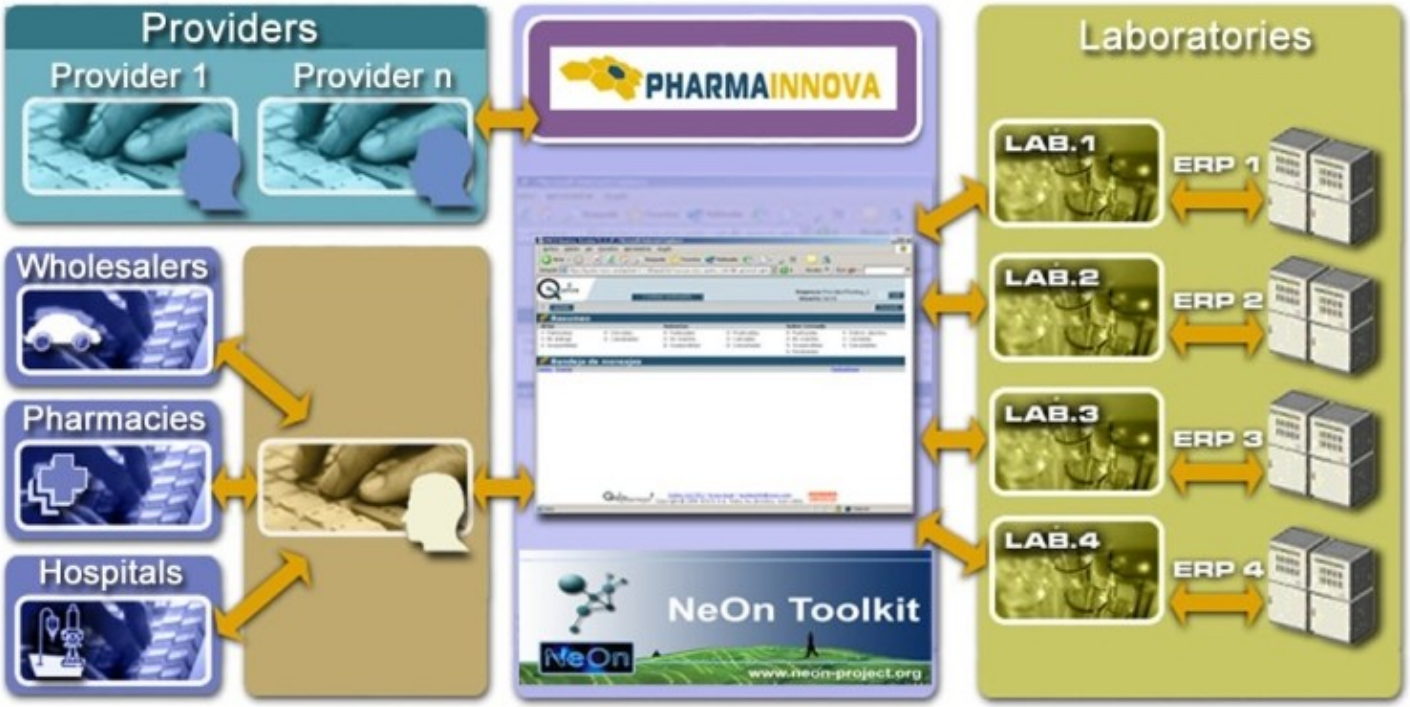




Value for the pharmaceutical sector

- Goal
  - Online vademecum based on networked ontologies
- Challenges
  - Heterogeneity of the distributed repositories of drug information
  - Information access integration across the Spanish market
- Users
  - Pharmacists (non-ontology experts)
- Main benefits
  - Integration of preexisting knowledge resources
  - Agile access to drugs information
  - Reducing latency for information update

Testbed #2: Addressing invoice interoperability in the pharmaceutical industry



KIN

Almirall

Boehringer Ingelheim

NOVARTIS

Ferrer grupo

- Sharing invoicing models and software platform save costs and reduces complexity
- However, entry barriers are high

Ontologies, users, and standards

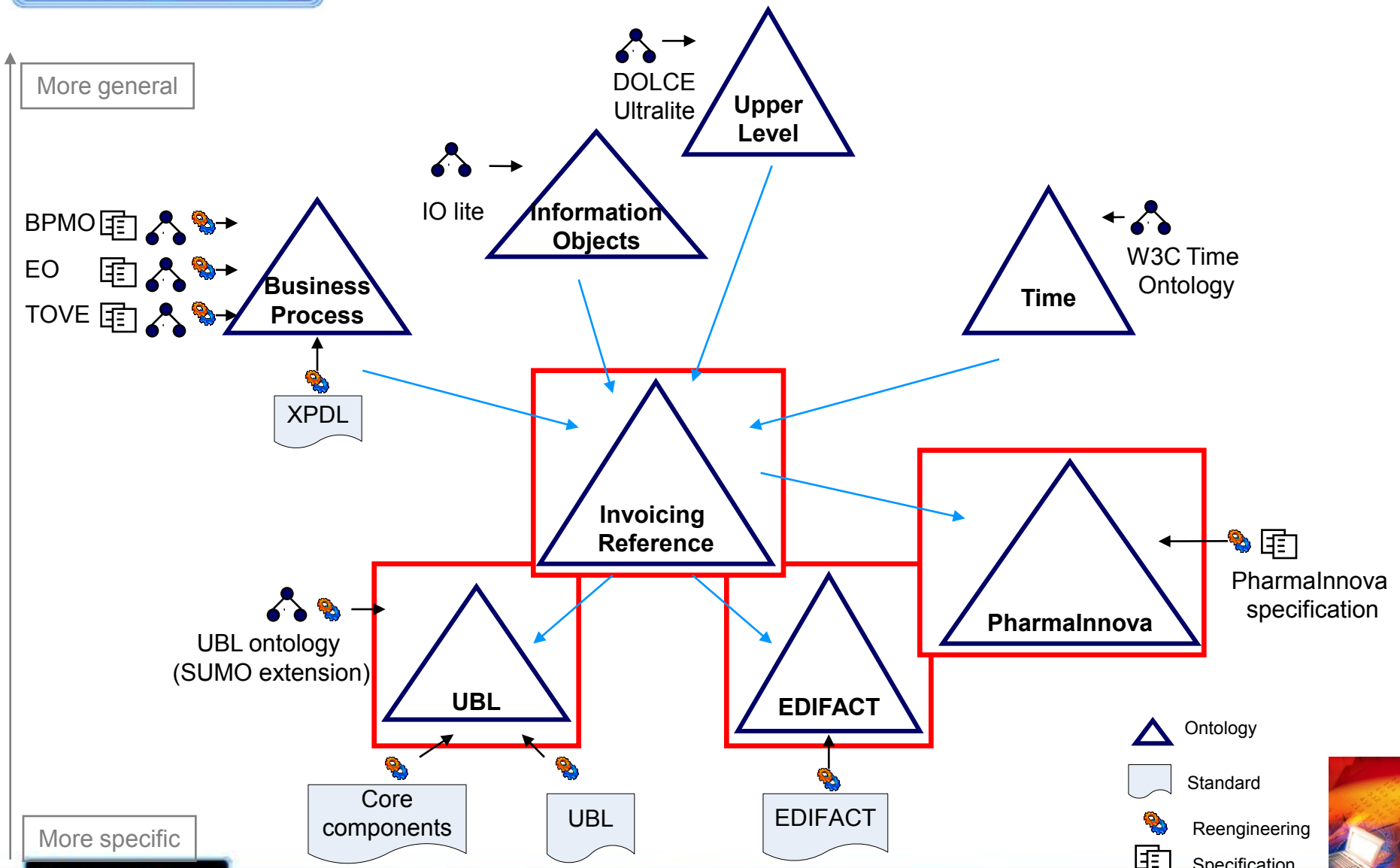
"An ontology is a formal, explicit specification of a shared conceptualization"

- Ask the electronic invoicing community: **Standards**
  - *"Standards establish explicit, shared specifications, criteria, processes, or practices"*
  - shared = accepted by a community
  - UBL, EDIFACT aspects relevant to invoicing
  - Some ongoing efforts, e.g. UBLOntology (ontolog.cim3.net)
- Ask the user community: **PharmaInnova**
  - Elicit knowledge from laboratories, providers, pharmacies, and wholesalers

The role of networked ontologies in invoice interoperability

- Networked ontologies provide a **formal model** of the knowledge related with invoicing, which embraces both
  - Current eBusiness standards (EDIFACT, UBL)
  - Sectorial specializations (PharmaInnova)
- Serve as a **semantic gateway** during invoice exchange
- Ensure **consistency** of exchanged invoice data with respect to the formal model of these ontologies
- Provide domain **navigation guidelines** during the process of relating individual invoice representations with each other

Invoicing networked ontologies



Invoicing networked ontologies (II)

Reference

- Concepts
  - Entity
    - Abstract
    - Event
    - InformationRealization
    - Object
      - Agent
      - Currency
        - CurrencyBill
        - CurrencyCoin
      - PhysicalObject
        - PhysicalAgent
        - PhysicalArtifact
        - PhysicalBody
        - PhysicalPlace
      - SocialObject
        - Collection
        - Concept
        - CurrencyMeasure
          - EuroCent
          - EuroDollar
          - UnitedStatesCent
          - UnitedStatesDollar
        - Description
        - InformationObject
          - Text-Abstract
            - TransactionEntity
              - StandardTransactio
              - ProprietaryTransact
            - TransactionRecordAbst
          - Code
          - DataStructure
          - Datum
          - FormalExpression
          - IconicObject
          - LinguisticObject

UBL

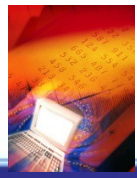
- DeliverToAddressType
- JurisdictionAddressType
- RegistrationAddressType
- SendFromAddressType
- BuyersItemIdentificationType
- CardAccountType
- CatalogueItemIdentificationType
- CommodityClassificationType
- ContractType
  - ForeignExchangeContractType
- CountryType
- CreditAccountType
- DeliveryRequirementType
- DeliveryScheduleType
- DeliveryTermsType
- DespatchedTransportHandlingUnitType
- DestinationCountryType
- ExchangeRateType
- FinancialInstitutionType
- HazardousItemType
- HazardousTransitType
- Invoice
- ItemMeasurementType
- ItemType
- LanguageType
- LineItem
- LocationCoordinatesType
- ManufacturersItemIdentificationType
- OrderChanges
  - AllowanceChargeType
  - BasePriceType
  - LegalTotalsType
  - TaxAmountsType
  - TaxTotalType
- OrderedShipmentType
- OriginCountryType
- PackageType
  - ActualPackageType

EDIFACT

- CurrencyMeasure
- non-agentive-social-object
  - Currency
  - concept
  - description
  - information-object
    - EDIFACTInvoice
    - EDIFACTSegment
      - EDIFACTAdditionalInformation
      - EDIFACTAdditionalPriceInformation
      - EDIFACTAdditionalProductId
      - EDIFACTAdjustmentDetails
      - EDIFACTAllowanceOrCharge
      - EDIFACTBeginningOfMessage
      - EDIFACTCommunicationContact
      - EDIFACTContactInformation
      - EDIFACTControlTotal
      - EDIFACTCurrencies
      - EDIFACTDangerousGoods
      - EDIFACTDateTimePeriod
      - EDIFACTDocumentMessageDetails
      - EDIFACTEquipementDetails
      - EDIFACTFinancialInstitutionInformation
      - EDIFACTFreeText
      - EDIFACTGoodsIdentityNumber
      - EDIFACTItemDescription
      - EDIFACTLineItem
      - EDIFACTLocation
      - EDIFACTMeasurements
      - EDIFACTMessageHeader
      - EDIFACTMessageTrailer
      - EDIFACTMonetaryAmount
      - EDIFACTNameAndAddress
      - EDIFACTPackage
      - EDIFACTPackageIdentification
      - EDIFACTPartiesAndInstruction
      - EDIFACTPaymentInstructions
      - EDIFACTPaymentTerms

PharmaInnova

- PharmaInnova
  - >"http://pharmaInnova.neon.org#"'#'""
    - Concepts
      - Address
      - Body
        - Emitted_Invoice_Body
        - Received_Invoice_Body
      - Company
        - Delivery_point
        - Emitting_company
        - Material_Receiver
        - Receiving_company
      - Expiry
      - Free_Bases
      - Header
        - Emitted_Invoice_Header
        - Received_Inoice_Header
      - Invoice
        - Emitted_Invoice
        - Received_Invoice
      - Name
      - Partial_Amounts
      - Payment_Mode
      - Place
        - City
        - Country
        - District
        - State
        - Street
        - Warehouse
      - Quantity
        - Delivered_Quantity
        - Received_Quantity
      - Summary
        - Emitted_Invoice_Summary
        - Received_Invoice_Summary
      - Term_of_payment
      - Traceability



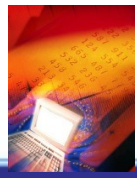
Invoicing networked ontologies: Some figures

	Local	Imported	Total
Classes	**439**	**130**	**569**
Datatype properties	**32**	**23**	**55**
Functional properties	**135**	**1**	**136**
Inverse functional properties	**0**	**1**	**1**
Object properties	**330**	**148**	**478**
Symmetric properties	**0**	**9**	**9**
Transitive properties	**0**	**7**	**7**

Invoice management prototype v1

Exploit user knowledge about their own invoices to solve the interoperability problem

- However, users (financial staff) are domain experts that lack any kind of knowledge engineering skills
- Usable tools are required that enable users to work with ontologies
- Users themselves define **mappings** between their invoice representations and a formal model based on networked ontologies
- Learn by example approach
  - The user annotates a sample electronic invoice with the ontology
  - Annotations define correlations between invoice data and ontology entities
  - All compliant electronic invoices are automatically imported as ontology instances (and then exported to other formats)
- Users must work at the **knowledge level**, without caring about how those mappings are implemented and the underlying formalisms



Application of NeOn technology (ongoing)

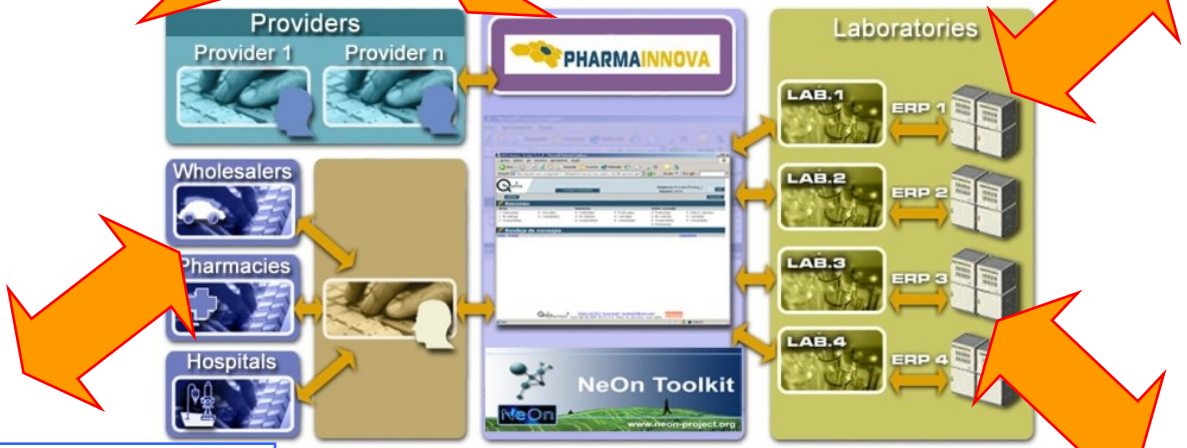
Ontology modularization

Ontology customization

Enhanced ontology navigation

Supporting collaborative processes for the definition of sectorial invoicing models

CICERO + WikiFactory



Evaluation and validation of pharmaceutical ontologies

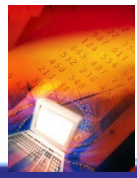
Social-oriented analysis of invoicing workflow

Value for the pharmaceutical sector

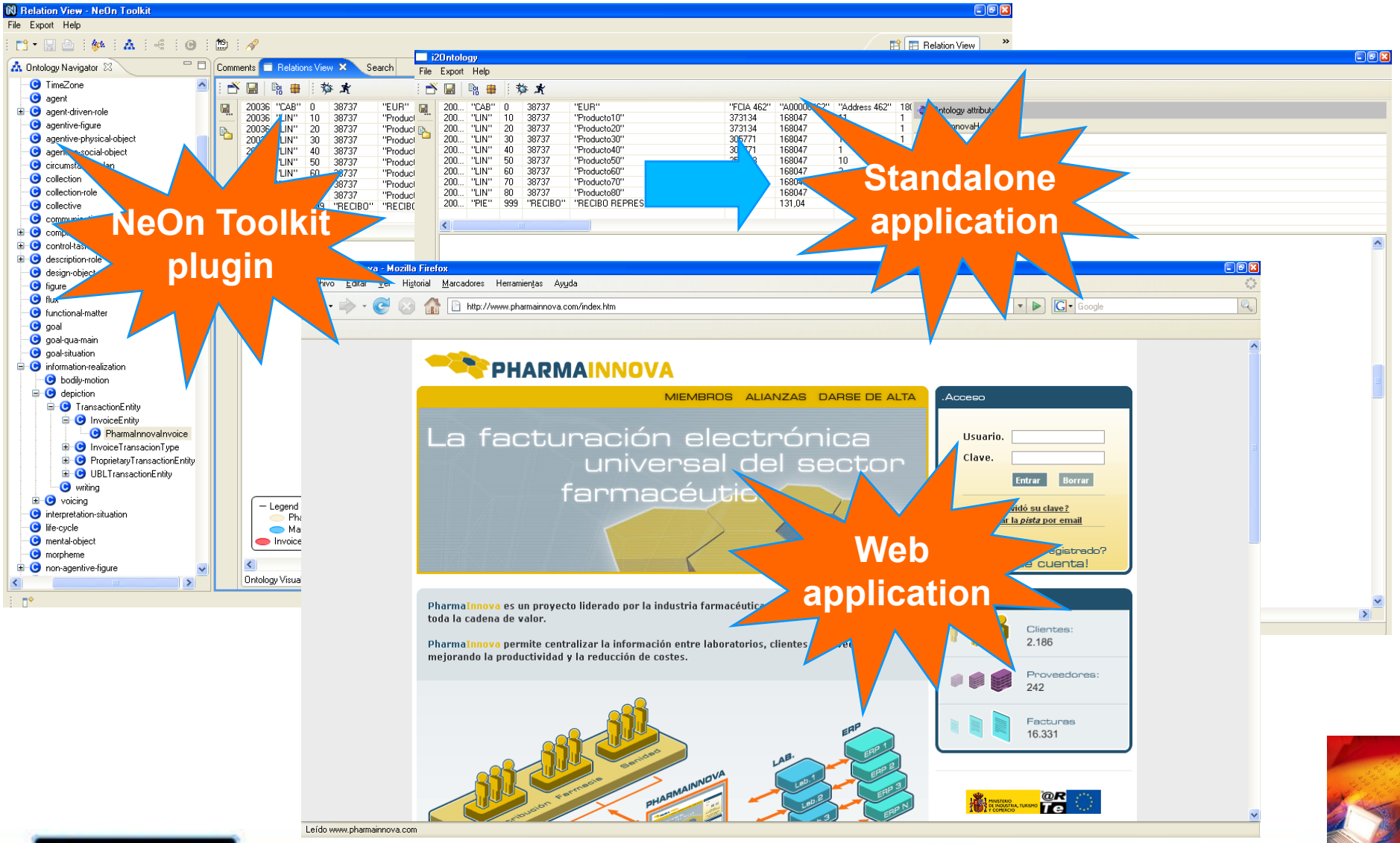
- Facilitate invoice **interoperability** between organizations exchanging invoices in different formats and models
- Reduce entry barriers in the PharmaInnova cluster
- Enable **users themselves** to define how their invoices should be interpreted
- Expected benefits
  - Save time and effort (hence, money) in the mapping process
  - Largely reduce manipulation time per issued invoice
  - Reduce the need of engineers and ad-hoc wrapper implementations
  - Deal with the invoice data confidentiality issue
- Additionally…
  - To be deployed and evaluated in PharmaInnova in the mid term
  - Expected to save additional 30% of current electronic invoice costs

Invoices issued	200.000
Invoices received	200.000

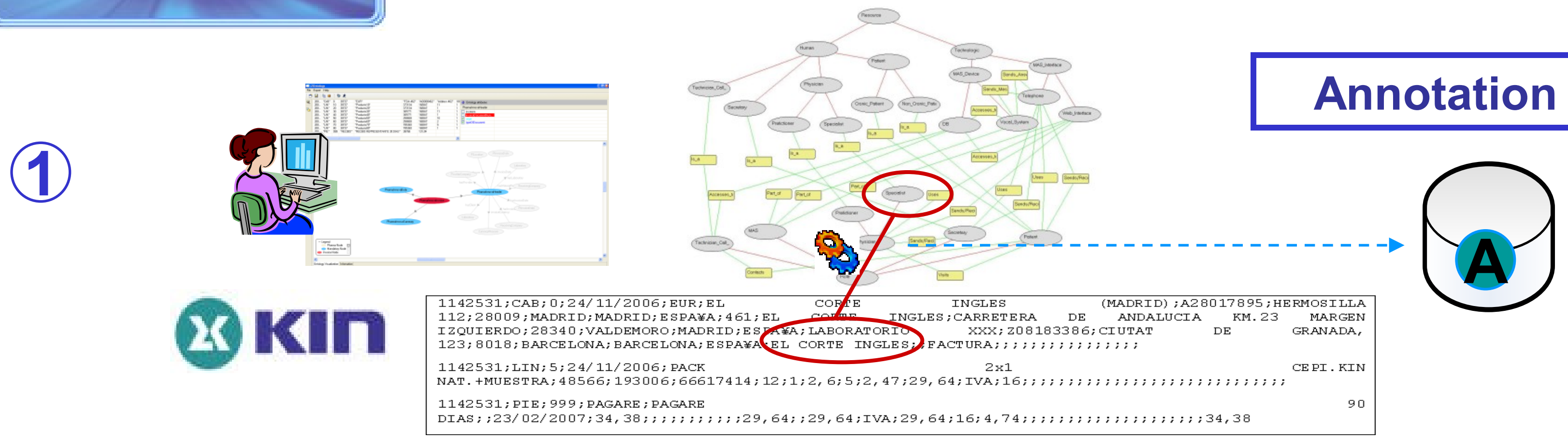
	Current	Digital
TOTAL COST	851,484.92 €	177,913.64 €
AVERAGE	3.21 €	0,47 ~~0,67~~ €

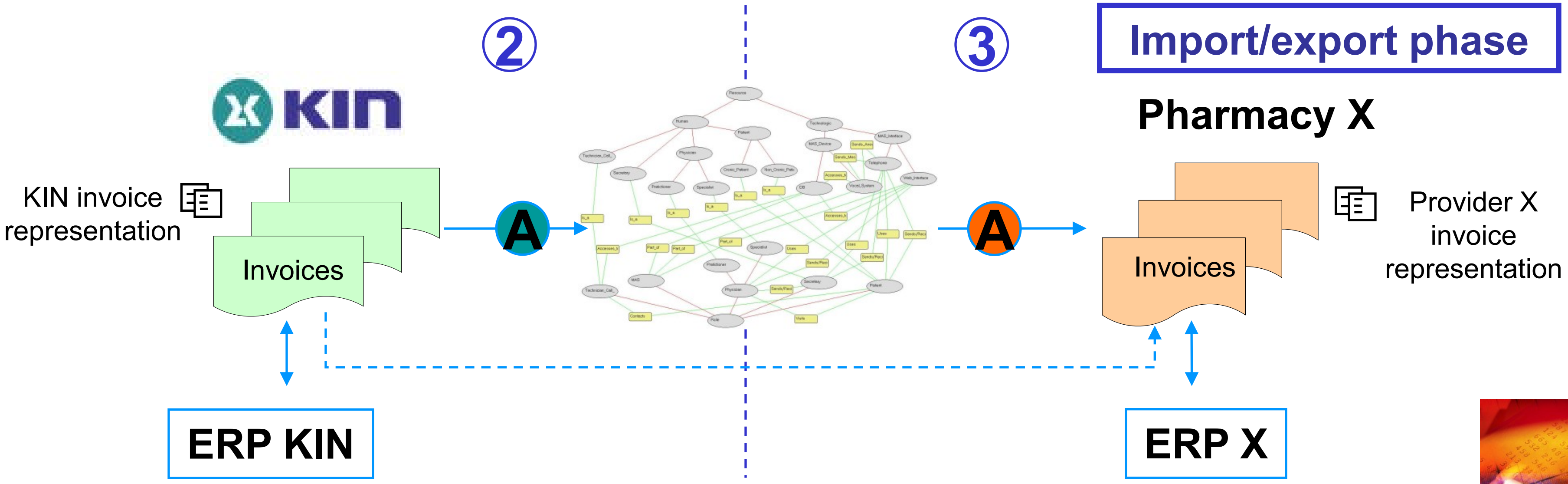


NeOn-powered invoice management prototypes



Demo outline





Conclusions

- Next generation semantic applications will build on large networks of ontologies

- NeOn provides an open infrastructure for engineering networked ontologies and building semantic applications
  - Open reference architecture
  - NeOn Toolkit as reference implementation
  - *Opportunity to contribute!*

- Example applications:
  - Supporting the dissemination of information about pharmaceutical products
  - Supporting financial transactions based on heterogeneous invoice formats
  - And also: Providing an homogeneous access to information about fisheries activities to monitor and assess the word fish stock

Thank You!

www.neon-project.org

www.neon-toolkit.org

And don’t forget to visit our booth at the exhibition!

Case Study in the Fisheries Domain

FAO and Fisheries

Food and Agriculture Organization of the United Nations

- Since 1945, FAO collects, analyzes and disseminates information in the area of Food and Agriculture (including Fisheries, Forestry and Natural resources).

- The possibility of monitoring fisheries stock depletion has an enormous economic and social impact.

Rationale for Networked Ontologies

- FAO has numerous information systems about the world's Fisheries:
  - Heterogeneous data:
    - statistics, documents, GIS, thesaurus...
  - Multilingual:
    - Arabic, Chinese, English, French, Spanish and Russian
  - Much of the data are 'structured', but not necessarily interoperable.

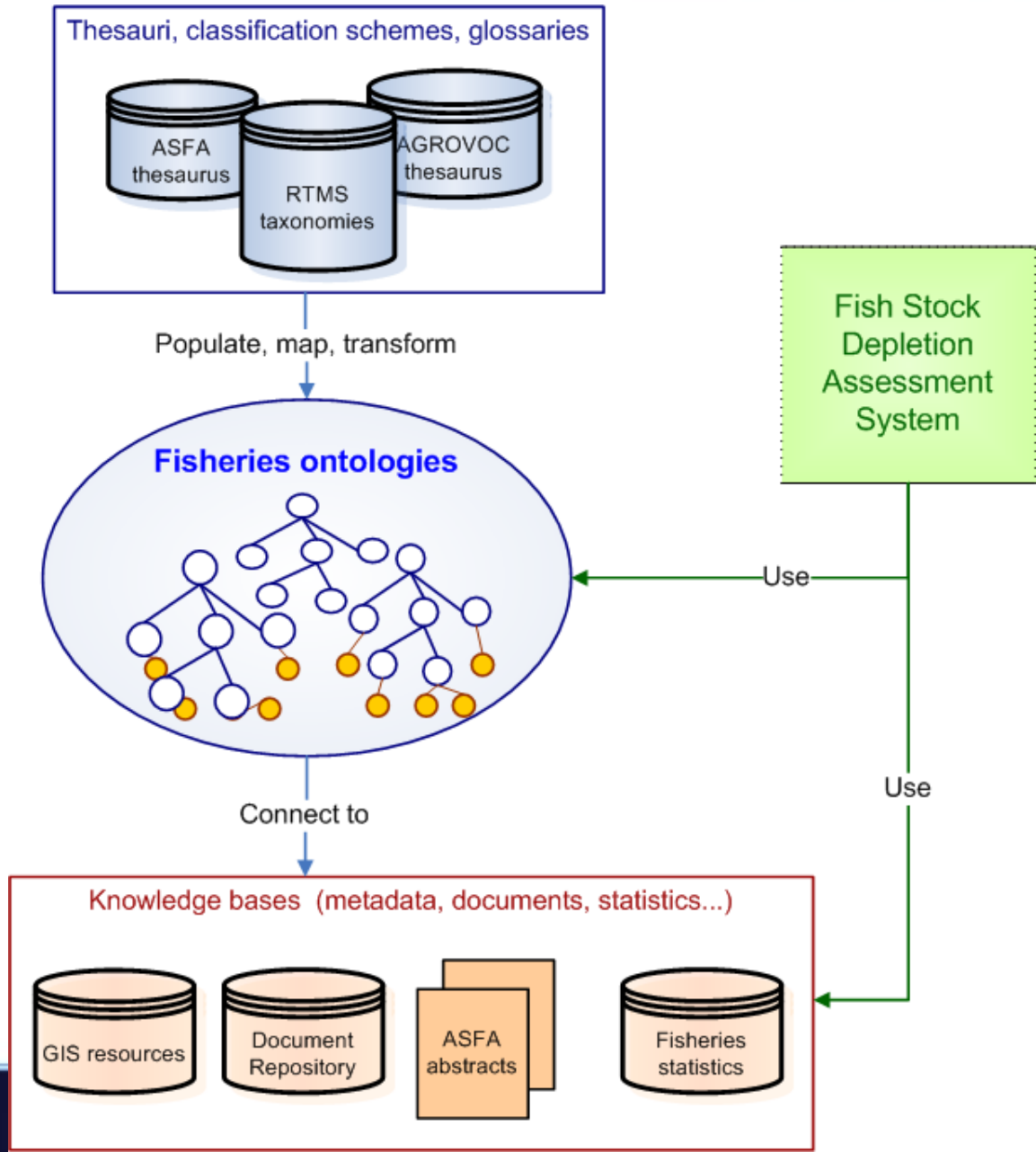
Better exploited using ontologies, by bringing together related information

- FAO's previous work (2003) to build a Fisheries ontology had drawbacks:
  - too big
  - un-manageable for maintenance
  - inefficient to be used by systems

- NeOn vision:
  - resources remain independent and they are networked by mapping them:
    - smaller ontologies
    - mapping them
    - effective maintenance of ontologies and mappings

Fish Stock Depletion Assessment System (FSDAS)

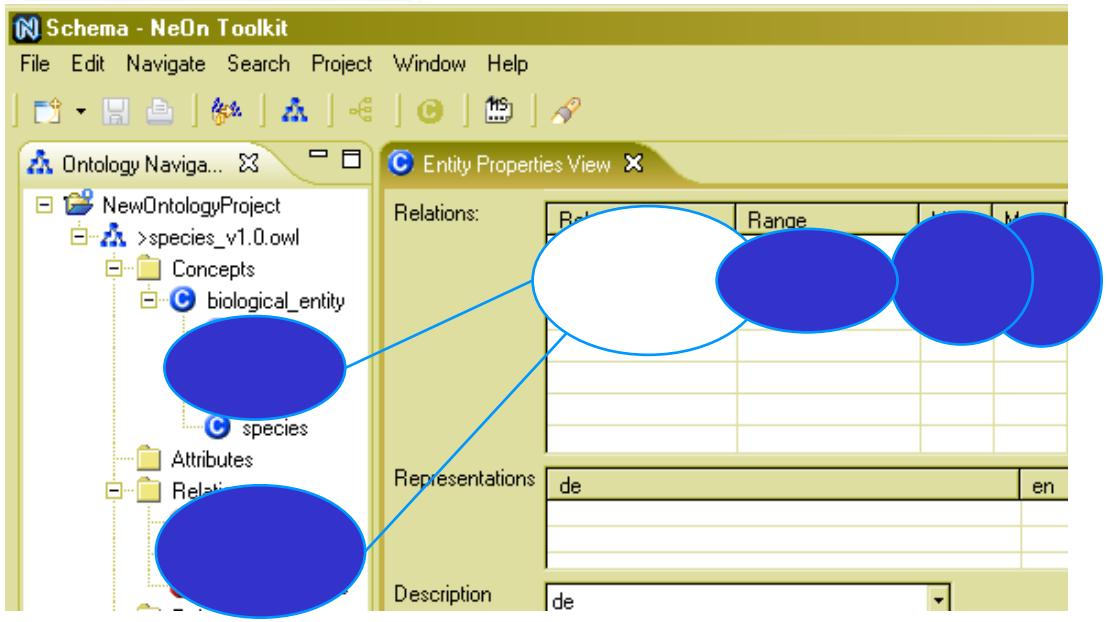
- FSDAS requirements:
  - Using NeOn Toolkit runtime functionality
- Fishery ontologies lifecycle requirements:
  - Using NeOn Toolkit design time functionality



Fisheries Lifecycle Management

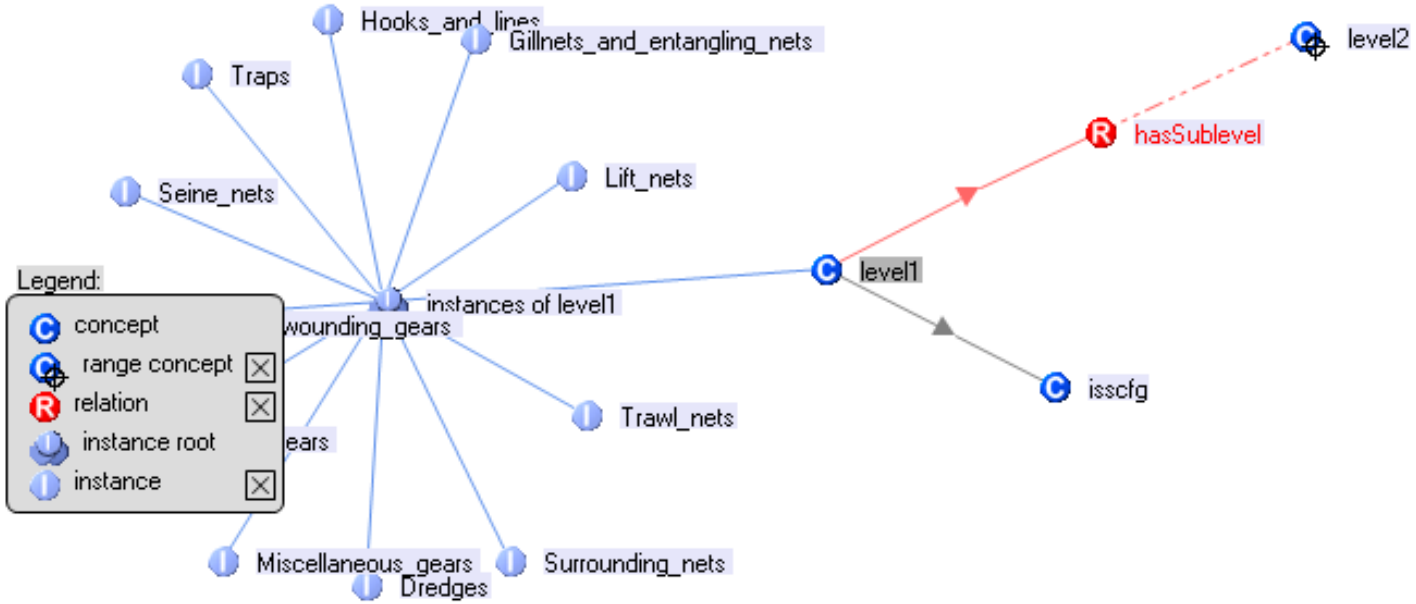
- Requirements:
  - Fisheries ontologies are:
    - medium-to-large multilingual ontologies
    - distributed / networked
  - NeOn Toolkit aims to provide support to ontology engineers and subject experts for:
    - modeling, populating, deploying, versioning ontologies
    - keeping them updated through an editorial workflow
    - managing mappings and relations between them

Ontology Conceptualization

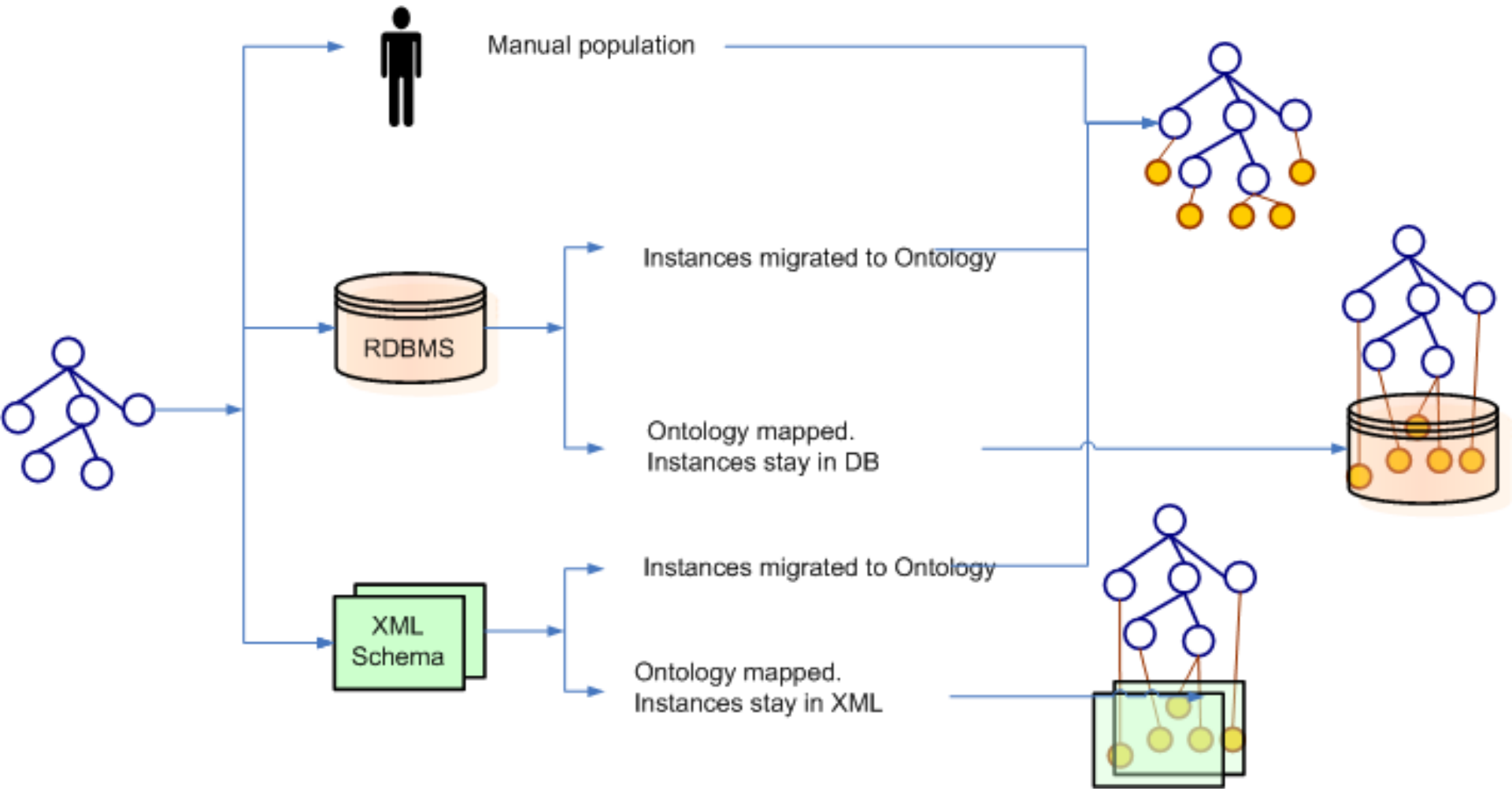


The NeOn toolkit provides visualization features

helping users editing and understanding models



Ontology Population

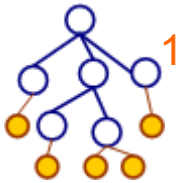


Ontologies Related to Create a Network

44,100

Common cuttlefish

lives in



1,500

Mediterranean

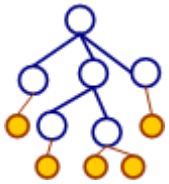
has shore with

25,000

Spain

originates from

Canned cuttlefish



6,000

is fished with

equivalent

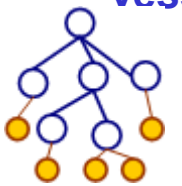
Sepia officinalis

300,000

Traps

used on

Trap setters



FSDAS

- The FSDAS is a decision support system that will help Fisheries experts analyzing the status and trends of world's fish stocks.

- Requirements (runtime):
  - query heterogeneous non-ontological resources
  - through
    - the exploitation of the Fisheries networked ontologies
    - integration ontologies
    - runtime components of the NeOn toolkit and infrastructure
  - return relevant results to the client
  - integrate with advanced annotation and visualization tools

FSDAS Architecture