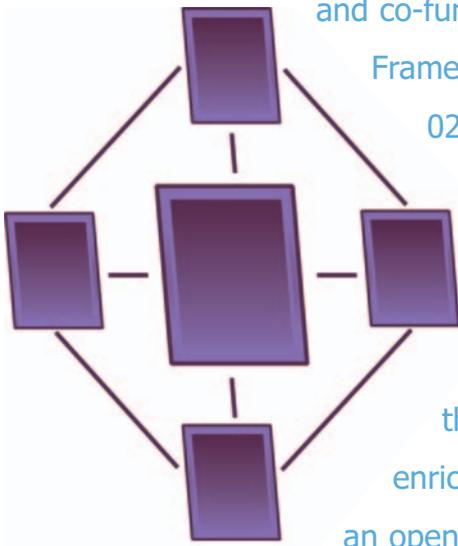


# Lifecycle Support for Networked Ontologies

**Annual Report 2007**

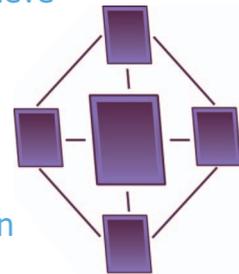
# Lifecycle Support for Networked Ontologies

NeOn is a 14.7 million Euros project involving 14 European partners and co-funded by the European Commission's Sixth Framework Programme through grant no. IST-2005-027595. 14 partners from 6 European countries are involved in the project, which started in March 2006 and has a duration of 4 years.



NeOn addresses the complete R&D cycle of the emerging new generation of semantically enriched applications, which exist and operate in an open environment of highly contextualized,

evolving and networked ontologies. NeOn aims to achieve and facilitate the move from feasibility in principle to concrete cost effective solutions, which can support the design, development and maintenance of large-scale, semantic-based applications. In a nutshell, NeOn aims to extend the state of the art with economically viable solutions.



## Our ambitions

As the amount of semantic information available online increases, semantic applications are becoming more and more ubiquitous, web centric and complex. The Semantic Web already contains millions of semantic resources and this number is rapidly increasing. As a result, applications can now draw knowledge from a wide variety of sources, which typically subscribe to a variety of ontologies. Hence, application design needs to reflect the fact that in this massively distributed and heterogeneous context, (i) any newly developed ontologies would be typically related to a network of already existing ones, and (ii) ontologies and metadata would evolve and would have to be kept up-to-date within the changing application environments.

## Our main innovations

NeOn sees as its main innovation to push the boundaries of semantic technologies, in particular, in the emerging new context of the Semantic Web. The process here is analogous to what was witnessed in mainstream software development, which in the past 15 years has progressed from closed, relatively data-poor applications, to open, large-scale applications for accessing, integrating and re-using the vast amounts of information available on the Web, or on corporate intranets.

A key premise of the NeOn project is that the current infrastructure for building semantic applications is not adequate to support this new generation of knowledge-based applications in the context defined by the Semantic Web. In particular, current ontology engineering environments are not open to the Semantic Web, nor are they able to support the whole application development lifecycle.

Therefore, to support the design and development of this new generation of semantically enriched applications, new methods, techniques and tools are needed. NeOn aims to provide more efficient and scalable support for the entire lifecycle of networked ontologies. In particular, the project investigates methods and tools for managing the evolution of networked ontologies, for supporting the collaborative development of ontologies, and for the contextual adaptation of semantic resources. In addition, the project aims to ensure that not only the solutions we develop are good enough to tackle these problems, but that they are also cost-effective.

The NeOn Toolkit and the NeOn Methodology lie at the core of the NeOn vision, aiming to define the standard reference infrastructure and the standard development process for creating and maintaining large-scale semantic applications.



## Important areas of our work

### Ontology dynamics

- Formally developing the notion of networked ontologies
- Developing methods for managing the evolution of networked ontologies
- Identifying methodologies for support of the construction of networked ontologies in distributed environments

### Collaborative aspects

- Investigating community-centred ontology design, ontology design patterns, and design rationale capture and management
- Developing effective methods for automatically selecting and integrating ontologies and their modules, in response to application needs

### Context awareness

- Formalizing and reasoning with the notion of context in semantic applications
- Developing methods for ontology alignment which do not require global consistency but can work with contextualized notions of local consistency

### Human-ontology interaction

- Investigating and understanding user needs in current ontology engineering practice
- Customising, personalising & adapting networked ontologies to different user needs
- Supporting multilingual user interaction in the NeOn Testbeds
- Assisting in improved management of Fisheries knowledge to support expert decision-making and fish stock depletion data support, in the context of the Food and Agriculture Organisation of the United Nations (FAO)
- Supporting E-Invoice exchange and management in the pharmaceutical sector in the context of the PharmaInnova Cluster
- Integrating and sharing information about pharmaceutical products in the context of Atos Origin's nomenclature applications

## Our achievements to date

During the first 18 months we have made very good progress in all areas of the project, completing all the various requirement gathering and needs analysis tasks, developing initial methods for managing networked ontologies, defining and implementing methods and tools to support collaboration, integration and reuse in ontology engineering, and completing the analysis and design of our main testbeds. In addition, we have also completed the specification of the NeOn architecture, released the initial open-source version of the NeOn Toolkit, and completed the initial building blocks of the NeOn Methodology. We have also been very active on the dissemination side, showcasing NeOn technology in a variety of venues. In particular, the first NeOn Glowfests – our flagship NeOn community-building events – saw the launch of the NeOn Toolkit in May 2007, and the showcasing of the open-source version of the Toolkit in November 2007.

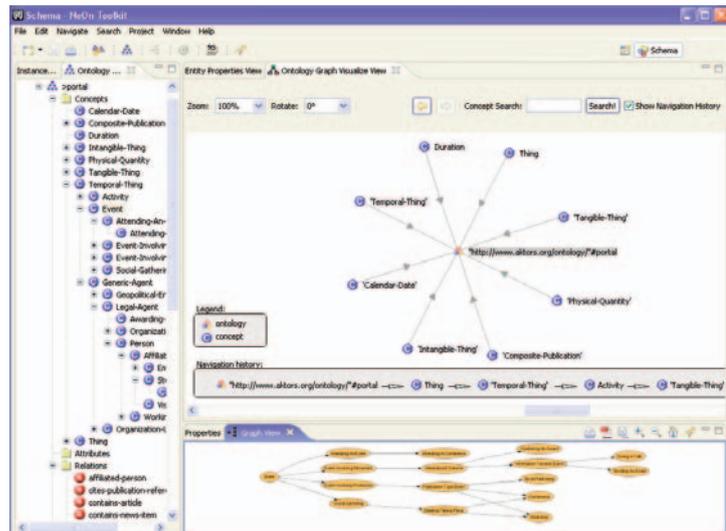
## System-level contributions

NeOn is seeking to create an open, service-centred reference architecture for managing the complete lifecycle of networked ontologies and meta-data. This architecture will be realised through the NeOn (ontology-development) Toolkit and will be complemented by the NeOn methodology for system development using networked ontologies.

### NeOn Toolkit launched

The first version of the NeOn Toolkit was launched in May 2007 and is available for download. It provides a new generation ontology engineering environment for semantic applications. The Toolkit is designed around an open and modular architecture, which includes infrastructure services, such as registry and repository, and supports distributed components for ontology management, reasoning and collaboration in networked ontologies. The NeOn Toolkit is freely available in

open source as the reference implementation of the NeOn architecture. Building on the Eclipse platform, the Toolkit provides an open framework for plug-in developers – [www.neon-toolkit.org](http://www.neon-toolkit.org)



### NeOn Methodology in progress

The first version of the NeOn Methodology for building networks of ontologies collaboratively will be available in February 2008. In the meantime, the outputs achieved to support the methodology include:

- An initial inventory of the NeOn modelling components, which describes a collection of ontology design patterns to be used when teams model ontology networks collaboratively
- The NeOn Glossary of Activities Version 1, which identifies and defines the activities carried out when ontology networks are collaboratively built by teams
- An initial identification and definition of different scenarios for building ontology networks collaboratively with special emphasis on reuse, reengineering and merging
- Initial guidelines for selecting an appropriate lifecycle for a specific ontology engineering project

## Contributions to foundational research

NeOn is contributing to the body of knowledge in several disciplines e.g. computer science, web science, software and system development. Of particular value are methods and tools for working with evolving and contextually grounded networked ontologies. Examples of key activities and outputs to date include:

### A user study of ontology engineers

The problems confronted by ontology engineers tackling NeOn-related scenarios were observed and empirically analysed during Year 1. The results of this study, which were presented at the [OWL-ED workshop \(2006\)](#) have produced a concrete set of requirements, which are driving the development of the NeOn Toolkit. Among the key findings were issues in dealing with the support for formulating complex logical statements (e.g. "a group is either an organizational entity or can be defined by a membership of at least three people"). Another set of issues concerned the balance between the amount of information shown by a tool and its value in a particular engineering task (e.g., it is good to see a list of properties when defining logical restrictions but this list is distracting if shown during the definition of new concepts).

### Model for managing networked ontologies

A formal model for characterizing and reasoning with networked ontologies was established. This will be used as a reference within the entire project. The formalization was defined in terms of a MOF (Meta Object Facility) metamodel, whose semantics is provided via specified groundings in a number of logical formalisms. The metamodel consists of a number of packages, including a metamodel of the OWL (Web Ontology Language) language, which provides the core building block of the model, as well as metamodels for rules, ontology mappings and modular ontologies, which are defined as extensions of the OWL metamodel. In addition, operators for composing modules and extracting modules from existing ontologies have also been defined and studied.

### Context representation

A model for characterizing two specific forms of context has been defined: Provenance and Arguments. Provenance includes context information about when and how ontology elements were introduced, from which information sources they have been obtained and information about the confidence an agent has assigned to specific ontology elements. Arguments are used to capture the reasons why particular elements in the ontology have been introduced in a particular way, as well as decision procedures for handling disagreements about aspects of an ontology.

### RaDON

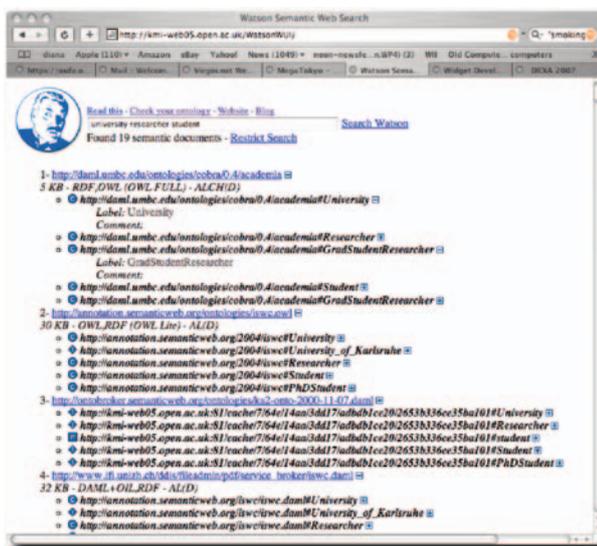
A novel approach for resolving inconsistency and incoherence in ontologies, was implemented in a software prototype called RaDON (Repair and Diagnosis for Ontology Networks).

### C-ODO

This is an ontology which supports the process of modelling requirements and solutions related to the collaborative design of networked ontologies.

## Watson

Watson is a new generation gateway to the Semantic Web: it collects, analyses and indexes the semantic content available online and provides a variety of access mechanisms supporting the selection and use of semantic data and ontologies. Hence, Watson is a key element of the emerging infrastructure for the Semantic Web. Watson provides a range of interfaces for users to locate and explore Semantic Web content. These include both a web user and a web service interface, which enable efficient retrieval and use of semantic content. In addition, a SPARQL (Sample Protocol And Query Language) end point is provided to support access to semantic information through formal queries. In addition, Watson is also available as a plug-in for the NeOn Toolkit, thus supporting ontology development from reusable components.



## Sector and community-level contributions

NeOn will apply its theoretical outcomes to a number of innovative test beds in two early adopter sectors, namely, in the Pharmaceutical and the Agriculture/Fisheries sectors.

By the end of Year 1, we had completed the software designs for the three planned applications in the Pharmaceutical and Fisheries domains, which will act as use cases for assessing the performance of the NeOn technology in concrete real-world scenarios. Further details of the aims and progress of the Use Cases are described below:



### Ontologies for the Pharmaceutical use cases

NeOn's activity in the Pharmaceutical domain is focused on two different areas of the market. First, we aim at cataloguing information about Pharmaceutical products in order to provide pharmacies in Spain and Europe-wide associations of pharmacy professionals with access to homogenized information repositories on such products. NeOn technology will be key to leverage integration of different and heterogeneous Pharmaceutical repositories. Information about chemicals and their regulations for human consumption is highly distributed and pharmacies do not have real-time access to it. As a solution to this problem, NeOn will produce a global vademecum where distributed databases and regulations can be integrated and kept up-to-date with the databases containing the official and approved information about medicines.

NeOn is also tackling the financial side of the Pharmaceutical sector. Since a European directive in 2002 authorised the use of digitally signed invoices for commercial transactions, the use of electronic invoices has grown exponentially. However, the main obstacle is the heterogeneity of the means to represent and exchange invoice information, as well as limited take up of invoicing standards by the main players in the sector. Networked ontologies will enable the different peers involved in a commercial transaction to automatically process arbitrary invoices by abstracting the underlying information from the details of their particular representation formats and technologies.

Considerable progress has already been made towards cataloguing the ontologies which have been developed so far in the context of the NeOn Pharmaceutical use cases. These encompass the following issues: i) application of the NeOn methodology to the Pharmaceutical use cases and, in return, how the use cases have contributed in practice to the development of this methodology; ii) inventory of existing knowledge resources, either ontological or non-ontological; iii) ontologies resulting from the application of this methodology to the Pharmaceutical domain; and iv) how the development of new ontologies, together with reutilization and extension of existing ones and the formalization of non-ontological resources contribute to improving the problems addressed by the case studies.

#### Ontologies for the Fisheries use case

The Food and Agriculture Organization of the United Nations (FAO) leads international efforts to defeat hunger. Serving both developed and developing countries, FAO acts as a forum where nations meet to negotiate agreements and debate policy. FAO, as a knowledge organization with constant growth in available resources on its website, has as a major goal, to put data, information and knowledge within easy reach of users in the most efficient and accurate manner possible.



Extending the capability of computers to understand information better and deliver the best results to the users is fundamental. FAO participates in NeOn to enhance the semantics that organise technical information to make it easier for its stakeholders to gather and analyze the data they need. FAO's expertise in global Fisheries information systems will contribute to the NeOn project in developing a decision support system to aid in assessing possibly depleted fish stocks. This case-study will be used to test a new approach to compiling, sharing and disseminating electronic information. FAO will not only provide access to its worldwide Fisheries information, but FAO ICT's specialists are also working to help develop these new systems. Progress on this case study includes an inventory of over a hundred Fisheries information systems that may be used within the Fish Stock Depletion Assessment System (FSDAS), as well as, a set of medium-to-large scale ontologies developed based on Fisheries classification systems. These ontologies were made publicly available in August 2007 from the FAO website, at <http://www.fao.org/aims/neon.jsp>.

## User involvement, promotion and awareness

NeOn aims to become a focal point for the European Semantic Web community, so the project's dissemination activities are being managed in a way to keep both the partners and the wider public informed about our achievements as well as stimulating the creation of a user community.

In order to support the above goal, NeOn's industrial partners - who include leaders in semantic technologies, iSOCO and Ontoprise, as well as major IT companies ATOS and Software AG - are strongly committed to the dissemination and the exploitation of the project outcomes. In addition, the different work areas are encouraged to collaborate on specific tasks in order to take advantage of the generated synergies in demonstration, training and exploitation activities. These activities are set out in our Dissemination Plan and include an annual events plan and project presentations.

**The NeOn website** [www.neon-project.org](http://www.neon-project.org) contains information, news and details of our publications, including project reports, papers presented at scientific conferences/lectures or published in online or printed scientific and academic journals and magazines.

**The NeOn community portal** [www.neon-toolkit.org](http://www.neon-toolkit.org) went live in May 2007 and plays a central role in the community building activities around the NeOn toolkit. It is intended to serve as the focal point for distributing and accessing information around the NeOn toolkit.

Its goals are to:

- Make the toolkit software and other resources such as documentation, and tutorial information available to the community
- Support the user in finding help in the case of questions or problems
- Let users and developers discuss questions and problems around the toolkit
- Let developers contribute plugins that extend the functionalities of the toolkit
- Inform about events, activities and other news

In addition, the portal is equipped with the following features and functionalities:

- Download area for releases of the toolkit
- Resource area with documentations, tutorials, FAQs
- Mailing lists for users and developers
- Forum for discussions
- News
- Bug management
- Wiki for maintaining information about plugins

## Glowfests



NeOn has launched the Glowfest series of events that will gather the members – users and developers – of the NeOn community. Each Glowfest is designed to disseminate information about a specific aspect and/or stage of the NeOn project.

The first Glowfest took place at the 4th European Semantic Web Conference (ESWC 2007) and introduced potential users and developers to the NeOn Toolkit. This interactive session invited participants to download the toolkit and evaluate it for themselves. A second Glowfest – the NeOn

Toolkit goes Open Source – took place at the 6th International Semantic Web Conference (ISWC2007) in Korea and included demonstrations of the latest plug-ins.

## Contribution to outreach and standardisation

Participation in W3C Semantic Web Education & Outreach Interest Group

## Sponsorships

- 1st European Semantic Technology Conference (ESTC2007) – silver sponsor
- 6th International Semantic Web Conference (ISWC), November 2007, Busan, Korea - as a silver sponsor and sponsor of the best student paper.

## Exploitation prospects

NeOn is a flagship EU project integrating a vision for exploiting large-scale semantics, cutting edge work on advanced research issues, a concrete development and exploitation strategy and challenging test cases. The project has started well and has already produced some interesting results and generated massive interest.

Market intelligence for NeOn and NeOn-like tools has been gathered in order to produce an initial market assessment. This involved conducting a market study on ontology and ontology tool usage and carrying out an analysis of the competitor situation and potentials for new markets where NeOn might act as enabler. Presently, the activities address the economic viability of the NeOn approach and technology in order to create a compelling basis for further exploitation activities and, more concretely, to find the appropriate way to approach the industry. We will take advantage of the generated synergies in demonstration, training, exploitation and dissemination activities.

## Looking ahead

Work in the next year will cover the whole spectrum of NeOn activities, aiming to push the boundaries of semantic technologies at all levels, from the management of network dynamics to the methodological support for industrial development of semantic applications. Among the highlights, we should list the new version of the NeOn Toolkit, which will be available next spring, as well as a number of new plug-ins, including more powerful support for managing network ontologies, for collaborative ontology engineering, and for contextual reasoning. We also plan to develop better visualization support, to improve the navigation and analysis of very large semantic models. Next spring will also see the release of the first version of the NeOn methodology for building contextualized ontology networks, as well as the first version of the testbeds in the Fisheries and Pharmaceutical domains.

### Further information

Coordinating partner:  
The Open University (United Kingdom)

#### Partners:

- Universität Karlsruhe TH (Germany)
- Universidad Politécnica de Madrid (Spain)
- Software AG (Germany)
- Intelligent Software Components SA (Spain)
- Institute 'Jozef Stefan' (Slovenia)
- University of Sheffield (United Kingdom)
- Institut National de Recherche en Informatique et en Automatique (France)
- Universität Koblenz-Landau (Germany)
- Ontoprise GmbH (Germany)
- Consiglio Nazionale delle Ricerche (Italy)
- Food and Agriculture Organization of the United Nations (Italy)
- Laboratorios Kin (Spain)
- Atos Origin SAE (Spain)

### For more information

Email Project Administrator: [contact@neon-project.org](mailto:contact@neon-project.org)  
Visit project web site: [www.neon-project.org](http://www.neon-project.org)

