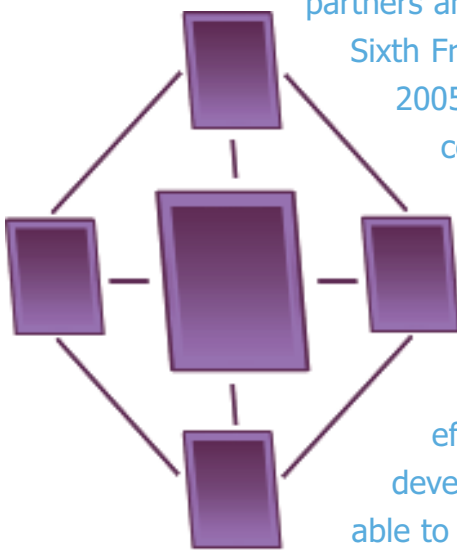


Lifecycle Support for Networked Ontologies

Annual Report 2008

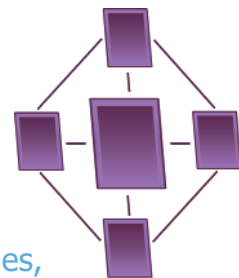
Lifecycle Support for Networked Ontologies

NeOn is a 14.7 million Euros, four year 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.



The aim of NeOn is to advance the state of the art in Ontology Engineering and Semantic Web technologies by providing effective methodological and tool support for developing a new breed of semantic applications, able to exploit effectively the large amounts of data, which are now becoming available on the Web.

We are currently in the third year of the project and already most of our solutions are in place, including methodological guidelines and a new OWL-compliant platform for ontology engineering (the NeOn Toolkit), as well as methods for managing networks of ontologies, reusing best practices in ontology engineering, and locating, accessing and reusing content from the Semantic Web.



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 viewpoints, or *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 continuously evolve and would need to be kept up-to-date within the changing application environments.

Our scope for innovation

The main challenge and innovation in NeOn is 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 in 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 neither open to the Semantic Web, (e.g. it is not possible easily to import entities from the Semantic Web into these environments) 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
- Developing methods for reasoning with local inconsistencies in networked ontologies

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

Deployment and product development

- An improved management of Fisheries knowledge base to support expert decision making and fish stock depletion assessment, in the context of the Food and Agriculture Organisation of the United Nations (FAO).
- An infrastructure for e-Invoice exchange and management in the Pharmaceutical sector in the context of the Pharmainnova Cluster
- A platform for integrating and sharing information about pharmaceutical products in the context of Atos Origin's semantic nomenclature applications.

Our achievements to date

In the past 12 months we have made very good progress in all areas of the project, releasing a new version of the NeOn Toolkit, completing the key elements of the NeOn methodology, developing the first versions of our applications testbeds, and developing new methods and tools for managing networks of ontologies, supporting collaborative ontology engineering, and customizing ontologies in accordance with user needs. We have also stepped up our outreach activities, showcasing NeOn technologies in a variety of international events, targeting both academic and industrial communities. In particular, following the NeOn Glowfest promotion in Korea, an agreement was signed to open a

NeOn Technology Support Centre in Asia to help local developers to contribute localized modules and plugins to the NeOn Toolkit.

System-level contributions

NeOn Toolkit available in Open Source

The NeOn Toolkit is our solution to the need for a new-generation engineering environment to support the design and development of web-aware, semantically enriched applications. The NeOn 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.

In October 2008 the NeOn Toolkit was released in its second version, which provides full modelling support for OWL-DL ontologies. The NeOn Toolkit is freely available in open source (under the Eclipse Public License, EPL) as the reference implementation of the NeOn architecture. Building on the Eclipse platform, the NeOn Toolkit offers an development environment familiar to software engineers, as well as an open framework for plugin developers - www.neon-toolkit.org

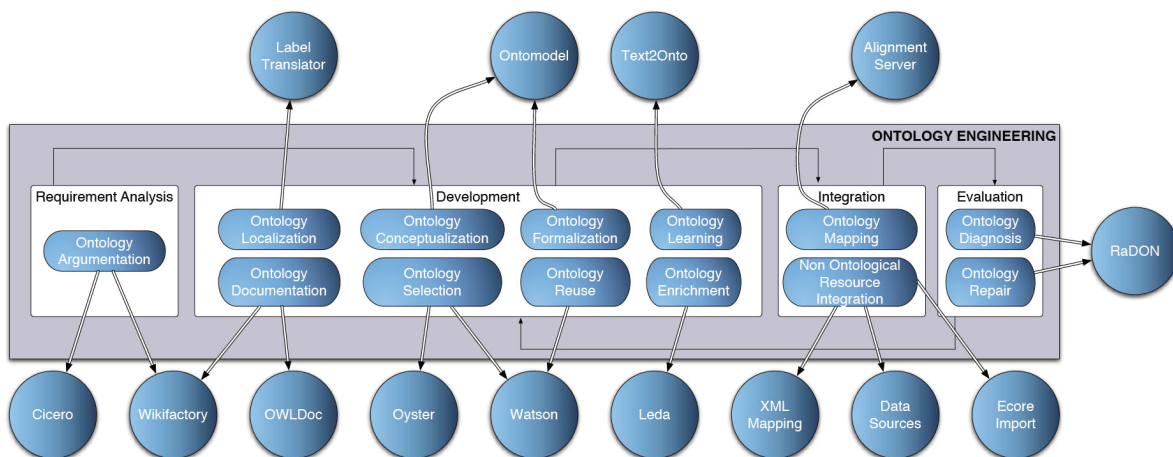


Figure 1. NeOn Toolkit plugins supporting ontology engineering activities along the lifecycle of networked ontologies

Plugins for the NeOn Toolkit

A typical NeOn Toolkit plugin consists of a set of Eclipse extensions that encapsulate particular ontology engineering functionalities and interact with other plugins to support the entire ontology lifecycle. The plugin mechanism makes the NeOn platform very flexible, as not only does it support predefined extensions that fit into certain slots, but also future extensions of current functionalities. The NeOn Toolkit also supports the integration of distributed plugins, which include, for example, plugins based on web service standards to access remote components of the NeOn infrastructure.

The NeOn community was very active in 2007/2008: a number of plugins addressing different ontology lifecycle activities were developed and released. These include, e.g. support for visual modelling, for ontology reuse, for ontology learning, for ontology alignment, and for ontology

diagnosis and repair. At the time of writing 32 plugins are available for the NeOn Toolkit, which can be found at – www.neon-toolkit.org/wiki

Contributions to foundational research

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

RaDON

An important problem when dealing with networked ontologies is handling potential inconsistencies. While the individual ontologies may be locally consistent, they easily become inconsistent when integrated into a network.

RaDON (Repair and Diagnosis of Ontology Networks) provides a set of techniques for dealing with inconsistencies on ontologies. Extending the capabilities of existing reasoners, RaDON supports novel strategies and consistency models for distributed and networked environments. Specifically, the functionalities provided by RaDON include: (1) debugging inconsistent ontologies to explain the source of inconsistency, and (2) repairing an ontology, either automatically or manually, based on the results of the diagnosis. Needless to say, RaDON is available as a plugin for the NeOn Toolkit.

CICERO

Designing an ontology is a complex task that requires the collaboration of domain experts and ontology engineers. The participants in the engineering process share and discuss their different viewpoints and this discussion needs some facilitation in an efficient manner. The argumentation tool Cicero, aims to improve both the efficiency and the robustness of the collaborative, argumentative process. Cicero is implemented as an extension of the Semantic MediaWiki and its functionality is integrated into the NeOn Toolkit by means of a plugin.

The Alignment Server

Ontology reconciliation involves identifying the correspondences between entities occurring in different ontologies. A set of such correspondences is called an *alignment*. Our RDF format allows the expression of alignments in a standardised way, and makes it possible to share them through an Alignment Server. The Alignment Server is extensible and integrates several novel ontology matching techniques developed within NeOn, such as the Scarlet relation discovery service.

The Alignment Server provides the following services, which are also available in the NeOn Toolkit by means of an alignment plugin:

- Storing, locating, customising, comparing and sharing alignments
- Creating new services by combining existing alignments algorithms
- Output processing (using transformations, axioms, rules)

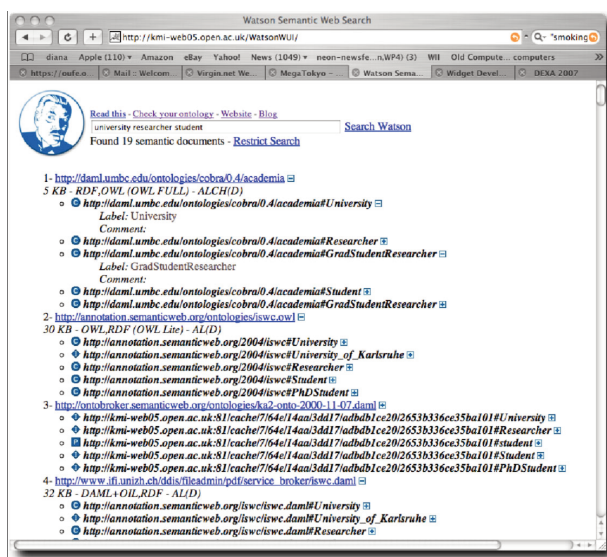
Ontology Design Patterns (ODP)

OntologyDesignPattern.org is a public portal dedicated to ontology design patterns (ODP's) for the Semantic Web. ODP's express the best practices in ontology engineering by defining high quality

modelling solutions to typical problems that can be encountered when building an ontology. Our portal is thus a unique platform supporting the sharing and dissemination of best practices. OntologyDesignPattern.org also supports open rating and traditional reviewing facilities for the evaluation of its content, and includes an official catalogue, which is validated by two Editors in Chief and the ODP Quality Assurance Committee.

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 with its capability to provide a range of interfaces to allow both users and applications to locate and explore Semantic Web content. The core functionalities 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. Watson is also available as a plugin 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 middle of Year Three, we have completed the prototypes for the three planned applications in the Pharmaceutical and Fisheries domains, which act as use cases for assessing the performance of the NeOn technology in concrete real-world scenarios.

NeOn and networked ontologies in the Pharmaceutical use cases

NeOn's activity in the Pharmaceutical domain is focused on two different segments of the market. First, we aim at cataloguing information about pharmaceutical products in order to enable pharmacies in Spain and also Europe-wide associations of pharmacy professionals to access to homogenized information repositories on such products. NeOn technology enables the maintainers of the distributed repositories to leverage integration

of their heterogeneous pharmaceutical content. 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 co-operation in 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 to broader uptake of this cost-saving business interaction 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. The technologies provided by NeOn enable the different peers involved in a commercial transaction to automatically process arbitrary invoices by abstracting the underlying information from the particular data streams, representation formats and proprietary styles championed by different ERP systems.

Considerable progress has already been made in recent months and in particular a network of ontologies resulting from the methodical integration of existing resources in the Pharmaceutical domain has been prototyped. In addition, a suite of best practices about the development of new ontologies, the reuse and extension of existing ones, and the formalization of non-ontological resources has been defined to facilitate the sustainable transfer of this know-how to practitioners in this area.

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 policies. FAO, as a knowledge organization with constant growth in available resources, on its website, has as a major goal, to provide information to 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 to this goal. FAO participates in NeOn to enhance the semantics that underpins the 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 contributes to the NeOn project in the context of 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 not only provides access to its worldwide Fisheries information, but its

ICT's specialists are also actively developing these new information access systems. Progress on this case study includes an inventory of over a hundred, heterogeneous 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 by reusing and reengineering the existing 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 put particular emphasis on dissemination activities.

The NeOn website www.neon-project.org is the primary showcase of the project's outputs. These include technologies and publications, in the form of project reports, papers presented at scientific conferences, lectures delivered at industrial or academic events and articles published in scientific journals and magazines, as well as news about the project and the sector in general.

The NeOn community portal www.neon-toolkit.org 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 for accessing information about the NeOn Toolkit (be it for the end users, knowledge modellers or plugin developers). Its goals are:

- Making 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
- Enabling users and developers to discuss questions and problems around the NeOn Toolkit
- Providing a platform for the developers to contribute plugins that extend the functionalities of the NeOn Toolkit
- Informing the community about relevant events, activities and other news.

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

- Download area for releases and updates of the NeOn Toolkit
- Resource area with documentations, tutorials, FAQs
- Mailing lists, forums and wikis for users and plugin developers
- Bug reporting and management

NeOn Glowfests

In 2007 NeOn launched the Glowfest series of events that are designed to bring together 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 focus of the first two Glowfests, which took place at the 4th European Semantic Web Conference (ESWC2007) and the 6th International Semantic Web Conference (ISWC2007), was to launch the first versions of the NeOn Toolkit and to promote its step towards Open Source development. The third Glowfest, co-located with the Asian Semantic Web Conference (ASWC2008), will focus on a more active and participative aspect: we have invited talented developers from around the world to enter a challenge for the best NeOn Toolkit plugin.

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. Now in its third year, this 4-year project has produced a solid base of interesting, exploitable results and generated massive interest.

In the final phase of the project, a review will be undertaken of the NeOn Toolkit's technical features, its overall usability and the economic viability of the NeOn approach. More concretely, the Project Consortium plans to explore appropriate ways to reach out to the IT and Pharmaceutical industry. We will take advantage of the generated synergies in demonstration, training, exploitation and dissemination activities.

Looking ahead

Work in the final year of the NeOn project 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.

In particular, we expect a number a new plugins to be finalized and released to the end users, including a more powerful support for managing networks of ontologies, an integrated support for collaborative ontology engineering, and several new forms of contextual reasoning, e.g. to manage trust, access rights, editorial workflow, and data reuse. One of the planned highlights is the implementation of a better visualization support based on ontology summaries to improve the navigation and the analysis of large semantic models.

While the first release of the NeOn Methodology focused on providing guidance for ontology reuse and data reengineering from legacy formats (including XML and DB), planned extensions to the NeOn Methodology include guidance for building contextualised ontology networks, for working with

ontology design patterns, and for creating and merging modules for large-scale ontology networks. Of particular importance is the operationalization of the methodological guidance in the form of a plugin for the NeOn Toolkit, which will open up ontology engineering to a wider user base, as well as providing a way to facilitate principled ontology engineering and ontology maintenance in the context of the testbed applications 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

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