Chapter 6
Sharing Resources through Ontology Alignments in a Semantic Peer-to-Peer System

Jérôme Euzenat
INRIA & LIG, France

Onyeari Mbanefo
INRIA & LIG, France

Arun Sharma
INRIA & LIG, France

EXECUTIVE SUMMARY

In heterogeneous semantic peer-to-peer systems, peers describe their resources through ontologies that they can adapt to their particular needs. In order to interoperate, queries need to be transformed with respect to alignments between their ontologies before being evaluated. Alignments are thus critical for sharing resources in such systems. The authors report an experiment that explores how such alignments can be obtained in a natural way. In particular, asking users to provide alignments is a heavy constraint that must be relaxed as much as possible. This can be attempted through automatic matching. However, the authors suggest other possible solutions.

BACKGROUND: SEMANTIC PEER-TO-PEER SYSTEMS

The semantic web can be described as a web for machines. For that purpose, it requires the expression of formalised knowledge on the web (in languages like RDF). This is aimed at bringing more precision to the knowledge gathered from the web than automatically indexing text documents. However, the semantic web suffers from a bootstrap problem: it can only start providing benefits when there is enough knowledge available and people will not provide knowledge if this does not return benefits.

DOI: 10.4018/978-1-60566-894-9.ch006
In order to overcome this problem, we want to provide tools that allow people to start using semantic web technologies locally, for personal purposes and personal benefits, and that can spread through global and social communication. On the one hand, peer-to-peer (P2P) systems are suited for this purpose since their use for sharing resources on the web is widespread and such systems can be used by many untrained users. On the other hand, such tools are restricted in the freedom of expression given to the user: most of them do not provide much expressiveness in resource annotations or they rely on a one-size-fits-all metadata vocabulary. This restricts the precision of shared item descriptions and thus prevent their full retrieval, e.g., “Finding all recordings in which Eric Dolphy is playing flute” or “All pictures featuring a member of your family and a horse”.

We describe a kind of semantic peer-to-peer system in which users can start locally to develop the annotation scheme that suits them best. They can customise ontologies, either imported from the web or home made, so as to organise their resources the way they want. Then, users can offer their resources and annotations to their friends and relatives through peer-to-peer sharing. However, because ontologies have been designed locally, it is more difficult to interoperate between peers: therefore, alignments between ontologies are necessary. An alignment is a set of assertions, called correspondences, which express the relation between entities of two ontologies. They can be used for translating queries from one ontology to the other, as well as for other purposes (Euzenat and Shvaiko, 2007). With alignments, interaction and sharing can take place, and users do not have to abandon their own view on resources.

This chapter presents the PicSter picture sharing system. This description highlights the need for alignments in such systems. Then we elaborate on several possible solutions for obtaining these alignments and the difficulties facing these solutions. We do so through the description of an experiment.

Related Work

In principle, peer-to-peer systems are distributed systems which do not rely, in their communication, on centralised resources. In practice, they often rely on some directory for joining a network. Once they have joined, all communication goes through adjacent peers. Peer-to-peer systems are well known as resource sharing devices in which peers offer resources and can query other peers for particular resources. We are concerned with this type of systems (other systems may be built on a publish and subscribe protocol, for instance).

Semantic peer-to-peer systems are peer-to-peer systems using semantic technologies for describing shared resources. The use of ontologies allows a richer description framework for resources than tags and simple categories. In particular, it allows querying the other peers with more precise queries (“Give me the Portraits depicting Paul Cezanne”) instead of (“Portrait” and “Cezanne”). It also allows peers to draw inferences from the query and their ontology. For instance, something classified as a “Self-portrait” will be qualified as an answer for the above query if a “Self-portrait” is defined as a “Portrait”. Similarly, a “Painting displaying Paul Cezanne” may be considered a “Portrait of Paul Cezanne” if “Portrait” is defined as a “Painting displaying some person”. In summary, semantic peer-to-peer systems aim at providing a more complete and more precise answer to the queries that are exchanged between peers.

There have been several such systems. (Staab and Stuckenschmidt, 2006) provides a good overview of issues in such systems.

Edutella (Nejdl et al., 2002) was an early project for sharing educational resources. The
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