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ABSTRACT

In this paper, an attempt is made to conceptually unite three different application areas for semantic technologies, namely personal Knowledge Management, social networking, and Peer-to-Peer information-sharing. Until now, semantic technology has been applied to each of these application areas separately or in binary combinations only. By functionally combining all three areas in a single application, it is hoped to sketch a compelling Semantic Web system that will help increase the spread and acceptance of the Semantic Web vision. A concrete usage scenario of a community of researchers is used to demonstrate the approach.

Key words: FOAF, Social-Network, P2P, Knowledge Management, Trust, Authentication.

INTRODUCTION

In this paper we give a short overview of the semantic web and social networks including the FOAF (Friend of a Friend) ontology schema, and we list current changes in Knowledge Management (Section 1.1 – Section 1.3). We sketch weak points of each area (Section 2.) relevant to our purpose and explain how the combination of social networks and Knowledge Management systems into a single functional P2P-architecture can provide a solution to most of the weak points named (Section 4.). The motivation for this specific combination stems from an insight of applied Knowledge Management: Davenport (Davenport et al., 1998) states that "The knowledge market depends on trust, and individuals generally trust the people they know." Social networks can provide the functional prerequisites for people to get to know each other better via the Internet, thereby encouraging the generation of trust and thus stimulating knowledge exchange. In order to underline the practical relevance of our solution, we discuss a concrete usage scenario (Section 3.), namely the exchange of information in a community of researchers, exemplifying the importance of combining social networks and Knowledge Management functions in a single P2P network. Finally, we mention related work (Section 5.) and give a brief conclusion (Section 6.).

The Present Failure of the Semantic Web

Although much research work on the Semantic Web (Berners-Lee et al., 2001) has been done in recent years, Semantic Web technology (http://www.w3.org/2001/sw/) is not yet widely accepted and used on the Internet. It is mainly confined within the periphery of research community. While adding machine-readable semantics to web pages would be rewarding with respect to more precise information retrieval and comprehensible web services, experience has shown that the price of adding semantic annotations to texts is quite high (Decker, 2002). The solutions proposed by the research community thus focus on automatic or semi-automatic annotation (Erdmann et al., 2002) and ontology learning (Maedche, 2002). Concepts and concept references from machine learning approaches for the most part lack semantic sharpness due to information aggregation and correlation in the corresponding learning phase. Popular systems based on automatic classifications such as KIM (Manov et al., 2003) consequently add only more or less encyclopedic or general semantics of limited value to texts. They do not express or reflect the meaning or intention of the annotated text itself. Therefore neither automatic nor manual semantic annotation seems to represent a viable way forward for the Semantic Web as an expression of personal and specific knowledge. While ever more refined web ontology languages and corresponding inference mechanisms are being invented, their practical application is still restricted to knowledge domains where the gain provided in information retrieval effectiveness by far outweighs the pain of metadata creation.

FOAF and Social Networks

Social networking sites (SNS) dedicated to both professional and social pursuits have achieved widespread popularity in recent years (e.g., Friendster, Tribe, LinkedIn, orkut). The basic premise of these sites is that a user creates a network of their immediate friends or associates, and can use this network to connect to those in other networks. Popular uses for SNSs include establishing new business developments and contacts, scheduling meetings offline, dating without any initial real-world communication, and building or managing one's offline social networks online. SNSs still have a number of limitations, including authentication limitations, a reliance on centralised servers and no personal knowledge storage.

FOAF (Friend of a Friend) is an RDF/XML Semantic Web ontology schema (http://www.foaf-project.org/) defined to enable the semantic descriptions of people on the web. Linkage between users is created through the foaf:knows property, where a user can specify an explicit link to another user's FOAF profile. By providing a means to describe people and their friends in a machine readable form, FOAF opens a new horizon in social networks. Networks can be analysed by computers and visualised in a more understandable way. For example, the FOAFSpace (http://www.foafspace.com/) community viewer can leverage a user's foaf:knows relationships to show user's connections to friends and friends-of-friends. However, some fundamental issues with FOAF need to be solved in the areas of schema updates, trust, authentication, and user group definitions (Smarr, 2004).

Changing Perspectives in Knowledge Management

In the past, semantic technology has been increasingly applied in knowledge management. Organisational memories (Schwartz et al., 2000) are built using ontological knowledge engineering methodologies (for an overview see (Gomez-Perez et al., (2002)). In recent years, this central approach to knowledge management has been criticised because a conceptualisation of a domain of knowledge often can not be centrally reflected in a consistent and consensual or, in other words, objectivistic manner because of the subjective epistemological character of knowledge (Bonifacio et al., 2000). Therefore Peer-to-Peer based Knowledge Management systems, e.g. (van Elst et al., 2004), (Bonifacio et al., 2002), (Bonifacio et al., 2003), allowing for local ontological disparities, seem to be a more appropriate alternative to centralised KM systems. However, P2P Knowledge Management systems demand for an evolutionary and communicative perspective on ontology engineering (Tempich et al., 2004) or, for the time being, diverse but static and thus more restricted Ontologies. While domain Ontologies tend to be dynamic and fast changing, Ontologies dealing with social, organisational, and communicative aspects of life are often found to be stable and slow changing. In this respect, FOAF represents a slow changing domain of knowledge, and FOAF can in principle be broadened with knowledge domain extensions specific to the needs of certain communities.

ANALYSIS AND IDENTIFICATION OF WEAK POINTS

Limitations of SNSs and Issues with FOAF

Current social networking sites have a number of limitations. Firstly, there is no usable personal knowledge storage for members. Secondly, social networking applications are centralized and as membership increases they suffer from the usual scalability limitations of centralized systems. Moreover, the centralization of social networks in practice considerably impedes spanning social networks. Thirdly, following the example of FOAF, e-mail addresses are often used to uniquely identify people in social networks, but there is the possibility that a user's e-mail address may change over time (or even possibly be allotted to another person), leading to the conclusion that some more unique ID method may be necessary for members of a social network. Finally, the issue of single sign-on to multiple SNSs remains unresolved.

Some social network sites have begun to make user profile information available in FOAF format, and others (Tribe, Ecademy) have begun to implement facilities for interchangeable FOAF using FOAFNet (http://www.foafnet.org/), using a reduced set of terms from the FOAF vocabulary. FOAFRealm (http://www.foafrealm.org/) is also moving towards a single sign-on FOAF-based mechanism that could be used in social networking applications.

Some issues with FOAF remain in regard to its file-based nature. For example, at the moment any person can place a FOAF file on the web with details such as address, e-mail, phone number, but without actually verifying that they are the person in question. Likewise, there usually is no authentication required to view a FOAF file, which may be needed if certain profile information is to be restricted to certain users or groups. Also, some sites tend to ignore the fact that foaf:knows connections should be confirmed in both directions before a link is shown between users. The replication of several identical FOAF files - for example via search engine caches, different centralised social networks, file attachments to e-mails, etc. - on the Internet makes a consistent maintenance of FOAF information difficult and error-prone.

Weak Points of Knowledge Management

Centralized ontology based Knowledge Management is perceived to be inflexible with respect to local change requests and perceived to be inadequate because of its self-restriction to consensual views. It thus offers insufficient support for personal Knowledge Management and won't support meaning negotiation (Bonifacio et al., 2002). Many weak points of Knowledge Management (and FOAF alike) result from its often document-based character (Tempich et al., 2004). Document files are difficult to maintain because of data replication and de-normalisation of text based information. Documents represent static information serialization and do not offer sufficient means to express semantic relations between documents or information chunks in documents. A related weak point of current Knowledge Management is personally decoupled information through publications and replications, resulting in fragmentation and detachment of information from the author. There is a need for a personal Semantic Web, using semantically rich associative information and semantic browsing to master the information flood and support personal memory and communication.

Usage scenario

This usage scenario focuses on the social side of a research community. Its vision is to provide researchers with dynamically-updated and networked information (mainly based on interrelated personal Knowledge Bases), which supports semantic navigation and querying in a P2P network.
One of the most important tasks for researchers is to create new knowledge and share it through publication, presentation, etc. The way researchers share knowledge has a strong effect on the effectiveness and the efficiency of their work, and it has been changing in recent years due to different enabling technologies. Nowadays, most research publications are usually edited and stored in computer files. Because of the global spread of the Internet, researchers rely more and more on electronic publications. However, the management of electronic publications is a challenge for the research community.

Digital Libraries and Research Communities

One successful approach is to collect thematically related publications within digital libraries to reduce the time researchers need to retrieve required documents. They are usually large-scale central databases (e.g. www.acm.org, www.ieee.org) which have been structured using document-centered metadata information (Raap et al., 2003). The *intelligence* of digital library systems can be increased by adding new functional layers. For example, Feng et al. introduce tactical level and strategic level cognition support for a digital library, which divides its information into two subspaces, i.e., a 'knowledge subspace' and a 'document subspace' (Feng et al., 2005). Although digital libraries provide standard services such as efficient searching based on keywords and refined catalogues, the disadvantages of digital libraries as centralized document-based knowledge management applications are exactly the same as mentioned in Section 1.3. We therefore hypothesize that a distributed knowledge management system could be configured to meet the requirements of research publication and information exchange better than a centralized digital library (Decker, 2002).

Another approach to information exchange is community-oriented collaboration, which is normally based on intranet/Internet communication technology, such as email or file sharing. BSCW (http://www.bscw.de/), SharePoint (http://www.microsoft.com/sharepoint/) etc. are usually convenient and efficient solutions for document sharing, however, problematic due to restrictions in data organization and semantic expressiveness. This led to the idea of semantic web portals combining semantic web technology with information portal technology (Staab et al., 2000).

Bibster (http://bibster.semanticweb.org/) is a Java-based system which assists researchers in managing, searching, and sharing bibliographic metadata (e.g. from BibTeX files) in a peer-to-peer network. It provides a semantic information store with a local RDF repository (Haase et al., 2004). It is well-designed, however, developing and expressing trust as the most important pre-requisite for knowledge exchange within a community is not dealt with. Furthermore, Bibster is based on a fixed ontology schema, which makes it difficult to adapt the system. The Ontologies used, i.e. SWRC and ACM Topic Hierarchy, are not generic. This led to difficulties for developers in extending the application into other domains.

In summary, discussing given solutions, it seems that there is a need for a Web based semantic information exchange application, using a community-oriented approach, to support: (1) Ontologised personal knowledge management (e.g. edit, update of a personal profile with Ontology), (2) trust management, (3) semantic navigation and querying of the information network formed by the community.

Extension of FOAF Vocabulary

In order to combine social networking between researchers and knowledge sharing, an extension of FOAF is necessary to allow for the expression of research community relevant information.
Figure 1 illustrates an example of a FOAF extension. It contains several useful new concepts such as Publication, Journal, Keywords, Organization, etc. Concepts are related with explicitly expressed relationships, such as *hasKeywords*, *hasTitle*, *wasPublishedOn* etc. A choice of attributes and cardinality restrictions are also included in the figure below. Please note that the SiFo namespace is defined as xmlns:SiFo = "http://www.example.org/SiFo#".

```
xmlns:SiFo="http://www.example.org/SiFo#"
<SiFo:publication rdf:about="SiFo-Peers">
        <dc:title>"SiFo-Peers" </dc:title>
        <SiFo:hasAuthor>
                <foaf:person>
                        <foaf:name>Brahmananda Sapkota</foaf:name>
                        <foaf:mailto>brahmananda.sapkota@deri.org</foaf:mailto>
                </foaf:person>
                        <SiFo:affiliation>Digital Enterprise Research Institute</SiFo:affilitation>
        </SiFo:hasAuthor>
        <SiFo:hasAuthor>
                <foaf:person>
                        <foaf:name>Lars Ludwig</foaf:name>
                        <foaf:mailto>lars.ludwig@deri.org</foaf:mailto>
                </foaf:person>
                        <SiFo:affiliation>Digital Enterprise Research Institute</SiFo:affilitation>
        </SiFo:hasAuthor>
        <SiFo:hasAuthor>
                <foaf:person>
                        <foaf:name>John G. Breslin</foaf:name>
                        <foaf:mailto>john.breslin@deri.org</foaf:mailto>
                </foaf:person>
                        <SiFo:affiliation>Digital Enterprise Research Institute</SiFo:affilitation>
        </SiFo:hasAuthor>
        <SiFo:hasKeywords>
                <SiFo:keyWord="SiFo" />
                <SiFo:keyWord="P2P" />
                <SiFo:keyWord="Trust" />
                <SiFo:keyWord="Knowledge Management" />
                <SiFo:keyWord="Authentication" />
        </SiFo:hasKeywords>
        <SiFo:wasPublishedIn="IIMA" />
        <SiFo:wasPublishedOn dc:date ="2005-12-02" />
</SiFo:publication>
```

Figure 1: An exemplary FOAF extensions for publication.

Usage Scenario Description

Based on explicitly-expressed meta-information for researchers, machines can help users to manage knowledge and facilitate communication, e.g. find the right person to discuss, track related research within the same group, or find similar topics being investigated inside the community. As an example, a scenario is presented here of a research community

```
<foaf:Person SiFo:personID="me">
        <foaf:name>Brahmananda Sapkota</foaf:name>
        <foaf:mbox_sha1sum>bbff51a6d70630daafe242c186a6e27fda3e99c7</foaf:mbox_sha1sum>
        <foaf:knows>
                <foaf:Person SiFo:personID="p1">
                <foaf:name>Lars Ludwig</foaf:name>
                </foaf:Person>
        </foaf:knows>
        <foaf:knows>
                <foaf:Person SiFo:personID="p2">
                <foaf:name>John G. Breslin</foaf:name>
                </foaf:Person>
        </foaf:knows>
        <SiFo:worksIn= "Digital Enterprise Research Institute" />
        <SiFo:trusts SiFo:personID="me" />
        <SiFo:deligatesTrust SiFo:personID="p1">
</foaf:Person>
```

Figure 2: An exemplary FOAF extensions for person.

Network Building and Community Maintenance – Research communities are usually dynamic in membership, that is to say, members keep joining and leaving. It is not easy for a freshman to discover the social side of these communities. In our scenario, a researcher (namely 'A', the same as below) should be able to join the network by invitation. The existing profiles of others and the ontology are to be retrievable through the network. 'A' then can adopt the community ontology and add friends from the community.

Access Management – Researcher 'A' manages her publication related information locally and personally. She can share all her publications publicly, i.e., to all members, or share part of the information publicly and provide private information (e.g. his private telephone number) to trusted friends only. As a personal information store, it can be updated if needed, providing current and up-to-date information, and the social network is dynamically evolved as well. An important aspect is that an individual's peer is not limited by the ontology of the community: 'A' can extend her own schema based on specific requirements, which is reasonable and convenient.

Replication Management – Information is replicated across the network based upon the social network. After researcher 'A' updated her information (e.g. her new mobile number or new publications), new or changed information will be replicated automatically and distinctively among various peers in accordance with the access rights granted.

Trust Management – Trust is one of the key issues in this community. For example, peer 'A' can assign a certain trust level to a category of information, classified by an ontology concept, to members of a virtual team. That is to say, it is an individual's choice to update his or her list of trust. On the other hand, if 'A' has a secretary (namely 'S'), 'A' should be able to empower 'S' to assign access rights to confidential information (e.g. budget related) on her behalf, i.e. 'A' should be able to delegate a trust assignment.

Navigation – Members of the community can navigate the information network. For example, if 'A' wants to know the recent publications of one of her friends (namely 'B'), she will retrieve the metadata and data from 'B', and 'A' can also view information of 'C', which is a Friend of 'B', and thus directly related to 'B', by jumping between peers' (public) information in the network.

Query – Querying based on the shared community ontology (letting aside individual extensions that would only be browsable) will help researchers to find the exact information they need. For example, 'A' wants to know what 'E' has written about 'Knowledge Management', using 'Knowledge Management' as a keyword of the publication. The corresponding query will directly point out the paper with that keyword.
In general, these functionalities are essential for a research community, and the communication functionalities are enabled by the P2P layer, which is discussed in Section 4.2.

FUNCTIONAL SOLUTION AND ARCHITECTURE OVERVIEW

Integration with Personal Knowledge Management (PS-KM)

Ludwig et al. (Ludwig et al., 2005) relate Personal Knowledge Management to the Semantic Web and introduce a new concept, Personal Semantic Sub-document Knowledge Management (PS-KM), which allows for an immediate expression of knowledge in semantic relations, called Semantic Webbing. Information is no longer stored in documents but in information chunks, i.e. pieces of text representing thought units (e.g. *problem*, *idea*, *talk*, etc.,) and object concepts (such as *house*, *pizza*, etc.) of different granularity. These information chunks, expressed in ontology resources, can be semantically related and freely serialised into document views. Information chunks can represent given documents or dissolve documents into smaller units. PS-KM strives to solve all the previously mentioned weak points of current knowledge management. For a detailed discussion please see (Ludwig et al., 2005).
However, it seems that only if PS-KM is combined with social networking, it might gain sufficient momentum to form the personal information backbone of the Semantic Web. Ludwig et al. (Ludwig et al., 2005) introduce a web-based prototype system for PS-KM which shall be extended into the functional SIFO-Peer architecture described in this paper. By combining a FOAF-based social network and personal Knowledge Management into a P2P system architecture, we hope to facilitate the creation of trust in social interactions in order to stimulate knowledge exchange enabled by the seamless incorporation of personal knowledge management.

Introduction to P2P Technology for a Simple FOAF-Based Network

SiFo-Peers is a social FOAF based P2P network targeted at enabling distributed Knowledge Management (DKM). It combines three enabling technologies in order to provide an efficient and effective means to enable DKM. This combination makes SiFo-Peers distinct among other similar systems. In contrast to centralised system, P2P system provides more flexibility in terms of knowledge management as peers can decide themselves which of the other peers are given access to its own knowledge repository. Another important aspect of P2P system is that it incurs zero administration cost. This means that, there is no need of separate management cost for managing the network. Similarly, unlike in centralised systems, Ontologies can be created and managed locally without affecting the entire network. Information about such updates can be propagated through peers.

SiFo-Peers follows the hybrid P2P architecture style and therefore consists of peers and super-peers. If a peer in a SiFo-Peers network can provide storage for some other peers to replicate their data, then it is called a super-peer. It allows not only the creation of social networks of users but also allows for the sharing of semantically rich information between them. In addition, it provides users with a means to control the access to their information. We believe that individual user-control is crucial to manage security issues pertaining to users' personal profile as well as their stored knowledge.

A participant in the SiFo-Peers network is called SiFo-Peer and can be identified by a global unique identifier. Participating peers can share their extended FOAF profile with each other. These personal profiles are the key elements in our SiFo-Peers. To maintain consistency of shared profiles, any changes made by a peer are propagated to its neighbour. In addition, SiFo-Peers use these profiles to define an on-the-fly information sharing policy. Sharing policies need to be created in order to ensure risk-free sharing. Security of personal information is considered a serious issue in social networks, and SiFo-Peers is not an exception. It supports peer authentication and trust allocation. Similarly, a SiFo-Peer can declare the level of sensitivity of its own information and specify its replication policy. Also, each SiFo-Peer can share its information either network wide or only on the trust network. A trust network, for a SiFo-Peer "Leon", is a segment of the SiFo-Peers where each peer is trusted by Leon.

Each peer in the SiFo-Peer network consists of four main layers, namely: user interface layer, social network layer, knowledge management layer and P2P communication layer. This layered architecture is sketched in Figure 2. Each peer in SiFo-Peers communicates with other peers through the P2P communication layer. There are management components for security management, FOAF profile management, knowledge management, and extended social networking. These components perform all the management related issues and thus form a crucial part of SiFo-Peer. The User Interface layer serves as an entry point for the peer of the SiFo-Peer. It provides mechanism for joining, leaving and communicating with other peers in the same network. Each of these layers is explained below in more detail.

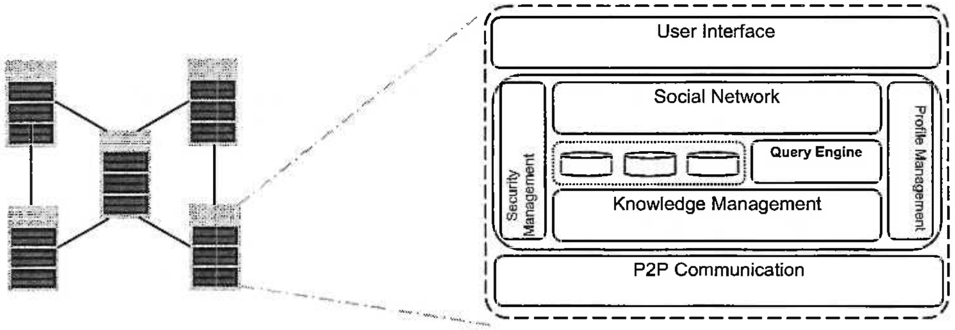

Figure 3: Architecture of a peer in a SiFo-Peer network.

User Interface Layer. This layer provides user access to all functions of SiFo-Peers. Through the user interface, a user can join the social network, create and share information. A new peer who wants to join the network introduces herself by the public parts of her profile (I). Please note roman numbers used in Section 4.2 correspond to those used in Section 3.3 and thus relate the SiFo-Peers functionality with the usage scenario.

Social Network Layer. This layer consists of well-defined semantically enhanced social networking functions and creates a social network of participating peers (I). In order to ensure the participation of peers, it validates the peer-profiles provided by joining peers against a pre-defined extended FOAF schema. A SiFo-Peer is called a semantic-peer if its profile is well formed according to the extended FOAF schema. Together with the profile management component, the Social Network layer generates on-the-fly profile sharing policies. The policy thus created is used to share profiles with other (trusted) peers in the same SiFo-Peers (II). In addition, this layer facilitates peer navigation by linking peers as specified in their profiles (V).

Management Layer. Management related functionalities such as trust management are provided by this layer. This layer consists of four main components namely Knowledge Management, Security Management, Profile Management, and Query Engine. This layer is a crucial part of SiFo-Peers as all managerial activities are handled by this layer.

Knowledge Management. KM is represented by the Artificial Memory prototype (Ludwig, et al., 2005). All information is stored in RDF-compatible triple store guaranteeing data interoperability. Data exchange between the Knowledge Management layer and other layers, especially the P2P layer, is based on RDF interfaces.

Security Management. This component is responsible for assigning sensitiveness to the information stored locally. It also generates on-the-fly policies required to determine which information to share with whom in SiFo-Peers (III) depending on the trust assigned to the other peers. It also maintains and manages the trust profile of its trusted neighbours (IV). Similarly, trust delegation is handled by this component (IV) and it is also responsible for to authenticating the new peers wishing to join the SiFo-Peers.

Profile Management. This component indexes the FOAF profiles of the neighbours. In addition, it generates profile-to-share profiles according to the on-the-fly policies created for each navigating peers. A SiFo-Peer, Leon, is a navigating peer for John, if Leon is linked to John through his neighbour. It further associates profiles of each neighbour with the trust profiles created by a security management component. If profile schema is updated, the profile management component notifies this change to the neighbours (III).

Query Engine. This component facilitates semantic querying. When a query arrives, the query engine evaluates the query against the peer profiles stored locally. When it is unable to answer the query locally it is forwarded to the nearest super-peer through the P2P communication layer (VI).

P2P Communication. This enables message exchange between peers in the SiFo-Peers. This communication takes place according to the P2P communication model. It maintains a list of peers in the SiFo-Peers. This list of peers will be used by the query engine in order to route queries to the super-peers. Similarly, this layer is responsible for checking liveliness of other peers in the SiFo-Peer as well as for recovering SiFo-Peers from failures. Failures can occur, for example, when a SiFo-Peer leaves the SiFo-Peers network.

Architecture Summary

SiFo-Peers combines the functionalities of semantic Social Networks, personal Knowledge Management and P2P networks. It enables semantic navigation and querying of information over a distributed social network promising security to each user's information and or data according to his or her personal wishes. These personal wishes will however have to be specified in their FOAF files explicitly.

RELATED WORK

In this Section, we mention related work which in the future may converge with the SiFo-Peers architecture.

Weblog Peers

Weblogs (online journals or diaries) are websites that are habitually updated by their creators, who provide brief news entries that are presented in chronological order. At the moment, most people host their weblogs on central servers such as LiveJournal, but there are various software packages allowing users to host their own weblogs at a personal site. As the trend continues towards permanent online presence through broadband connections, peers in a FOAF-based peer-to-peer network could maintain their personal weblogs on their own computers, transmitting weblog articles in a knowledge or document exchange.

Distributed Knowledge Management

Recent examples of distributed knowledge management can be found, for example, in agent societies (Bonifacio et al., 2002) or knowledge nodes (Bonifacio et al., 2003) organised into federations (Davenport et al., 1998) for information exchange. Although these, and comparable concepts, and their corresponding systems use P2P networks and technology, they do not focus on trust generation as in social networks and basically restrict the use of semantic technology to document classification. Thus they cannot leverage the synergies aimed at by combining semantic networking with Knowledge Management.

FOAF Repositories

FOAF repositories contain various FOAF profiles in a single data store. Most FOAF repositories are currently stored in relational databases (Plink, FOAFSpace), but the trend is moving towards proper RDF stores as such systems become faster and more efficient (e.g. YARS, http://sw.deri.org/2004/06/yars/yars.html). FOAF repositories will have a number of uses in SiFo-Peer. For example, user A connects to user C through their common friend user B, but when user B drops from the network the connection can be remembered if A and C store B's FOAF profile (containing B's friends, a partial set of A and C's friends-of-friends) in their local repositories.

CONCLUSIONS

It has been shown how in SiFo-Peers different application areas are integrated into a useful combination to solve a concrete user problem. The usage of the FOAF schema as a common shared concept base creates a widely consensual foundation for social networking. The translation of FOAF files into a peer-based database in addition to specific peer-to-peer services tackles crucial weak points of the current usage of FOAF. Extensions to the FOAF schema help to incorporate knowledge management in different user communities. In personal Knowledge Management, individual schema extensions and related resources will still be browsable in SiFo-Peers, although cross-individual and cross-community querying of extensions would demand for meaning negotiation and mapping processes respectively yet little researched and therefore not conceptualised in SiFo-Peers for the time being. Our future work will consist in the creation of a technical architecture for SiFo-Peers integrating former work such as, for example, the Artificial Memory Prototype for personal Knowledge Management. The adaptation of FOAF will ease interoperability between SiFo-Peers and other social networking systems. The development of a repository of extensions to FOAF to enable SiFo-Peers for different user communities forms another goal of our future work. By offering ontological and technical support for the needs of a number of communities with different knowledge management needs, the chances of the Semantic Web spreading will increase. Different SiFo-Peers will offer the opportunity to be combined into ever larger semantic social networks by a grass-root approach to the Semantic Web.

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