Winter 12-2-2007

Knowledge Sharing and Business Matching in Advertising and Public Relations Services Using Semantic Peer Technology

Ching-Long Yeh

Juo-Fan Yu

Wei-Cheng Chen

Proceedings of The Seventh International Conference on Electronic Business, Taipei, Taiwan, December 2-6, 2007, pp. 352-358

KNOWLEDGE SHARING AND BUSINESS MATCHING IN ADVERTISING AND PUBLIC RELATIONS SERVICES USING SEMANTIC PEER TECHNOLOGY

Ching-Long Yeh, Tatung University, chingyeh@cse.ttu.edu.tw
Juo-Fan Yu, Tatung University, juofan@gmail.com
Wei-Cheng Chen, Tatung University, bows3214@gmail.com

ABSTRACT

We develop semantic peer network aiming at knowledge sharing and business matching for the domain of advertisement and public relations. We top up a knowledge-based layer upon the peer to peer network to make it knowledge base peer. The knowledge base consists of ontology for the application domain and domain instances. We develop user services for resource sharing and business matching based on the knowledge-based layer. A trust management mechanism is built into the knowledge-based layer for making trustable resource sharing and business match making. Also we develop an RDF-based streaming mechanism for automatically pushing newly matched information to appropriate nodes. We made experiment to test the performance of search for the prototype system. The result shows that the addition of knowledge-based layer upon the peer-to-peer network would not result in the decrease of performance. We also investigate future work after the prototype research

Keywords: Semantic Web, peer-to-peer network, knowledge management, RDF, JXTA

INTRODUCTION

Firms in the advertising and public relations services industry prepare advertisements for other companies and organizations and design campaigns to promote the interests and image of their clients[1]. This industry includes media representatives selling advertising spaces, display advertisers designing public display ads, and direct mail advertisers. In Taiwan, the international firms and large domestic firms play the upstream role in the industry. They contract large cases from large companies, do the essential plan and design and, then subcontract the lower tasks of the cases to the domestic medium-small sizes firms. It seems that the industry in Taiwan forms an up-down layered chain of labor division. However there are problems in this chain summarized as follows.

To survive in the industry, the small-medium sized firms are eager to accept cases without considering whether they have the abilities to come up with solution for the cases they take. This would result in the decrease of service level and redundant investments among them in pursuing extra cases. Facing the price competition in the industry, professional firms either lower their service quality or withdraw from the domain. Due to the disorder in the industry, it would be difficult for customers to find out appropriate firms for certain services. An approach to solving the above problems is to create a collaborative environment providing better sharing of information and knowledge and effective business match-making in the industry. The environment must support effective ways of knowledge management for users in the domain. From requesting point of view, this includes obtaining the desired contents and finding out appropriate business partners. As for the provision part, holders should be able to keep their contents within their system while expose what they want to share with by posting the metadata to the public. In brief, to support the environment, we need technology that is able to manage metadata and operate in a distributed way without a centralized site. In this paper, we attempt to employ the semantic peer technology to fulfill the above requirements.

The semantic peer technology is a combination of the Semantic Web [1] and peer-to-peer [2] technology that provides autonomous and intelligent management of knowledge contents created by individuals. The semantic peer system architecture employs an open peer technology as the foundation and above it is a knowledge-based layer created by using the Semantic Web technology. This layer consists of a knowledge base which is constructed based on RDF [3] using OWL [4] as the ontology language and a number of management functions for the knowledge base, including addition, deletion, modification and query. The knowledge sharing and business match-making services for the advertisement and public relation industry are therefore developed upon the knowledge-based layer.

From technical architecture aspect, a peer node, representing a firm or an individual in the domain, can be equipped with a system described above to perform the management functions of the node itself. Otherwise, a peer can be set up to play the specific role of match-maker. The latter accepts the request or profile information in RDF from other peers. It can then create or update the contents to be shared, including the objects and their metadata, at its site and leave them in the site without uploading to web server. Suppose a firm A is preparing a project plan and wants to get references from others who have done the similar topic before. User of firm A can find out the desired content using the conceptual search interface by specifying the category and

[1] Refer to the descriptions of the Department of Labor, U.S., at http://www.bls.gov/oco/cg/cgs030.htm

constraints it wants. On the other hand, s/he can either post the request or leave A's profile information in RDF at a match-making peer and waits for the response of the satisfied result. The matching-making peer takes the request and profile in RDF as the constraints to be satisfies. On the other hand, it keeps on crawling RDF files from the peers in the domain. The crawled RDF files are fetched to the filter built according to the request or profile constrains from users and it disseminates the filtered results to their destination peers. The latter way is a kind of pushing RDF to the appropriate peers. In another use case when a firm B wants to find someone as the collaborative partner to carrying out a project or wants to let others know its abilities for potential business opportunities, B can perform the above match-making procedure by replacing the appropriate request and profile in RDF.

DESIGN OF SEMANTIC PEER NETWORK

By investigating the problems of the domain from three aspects, knowledge sharing and reuse, demand-supply chain management, and industry-academic inter-relationship, we conclude that it needs a collaborative platform that supports effective reuse and sharing of domain knowledge, management of supply-demand chain, and e-learning functions. For the first goal, we need some way to manage the content of the documents in finer grain rather than as a whole bunch. According to the state of the arts, the Semantic Web technology is appropriate to serve the purpose of building the metadata layer for efficiently managing the resources. In this paper, we do not use the client-server architecture to build up the metadata layer. Instead we use the P2P network as the infrastructure of the metadata layer. Compared with the client-server architecture, the P2P network is promising in that it has advantages over resource sharing of various types, instant messaging, content distribution and delivery, collaboration, search, and sharing of CPU and storage. Based on the metadata layer, we can therefore develop advanced services for user to meet the supply-demand chain and e-learning functions as described previously.

In this paper, we employ JXTA[5], a hybrid type of P2P network based on XML, to design the architecture of the semantic peer network. There are two kinds of peer nodes in the network: one is simple peer (S-node) and the other is rendezvous peer (R-node). User of simple peer node can use the access services, such as conceptual search, semantic navigation, information aggregation, to collect resources on semantic peer network. An R-node provides the following services for other peer nodes.

- Peer discovery and brokering: User of S-node uses this service to look for appropriate counterparts. A new peer node first of all has to contact an R-node through this service in order to join the semantic peer network.

- Profile registration: An S-node can register itself to an R-node, either automatically or manually, by sending its profile information to the R-node.

- Information filtering and dissemination: An R-node has is equipped with an information filtering engine which is used to filter out and then disseminate information for appropriate destinations. User first of all registers its favorite items to an R-node.

From the aspect of system architecture, at the bottom is the peer network layer supporting the P2P connections between peer nodes. In the middle is the knowledge-based layer built based on the Semantic Web technology. At the top, the service layer provides user application services which are built using the application interfaces supported by the knowledge-based layer. The system architecture is summarized as shown in Fig. 1.

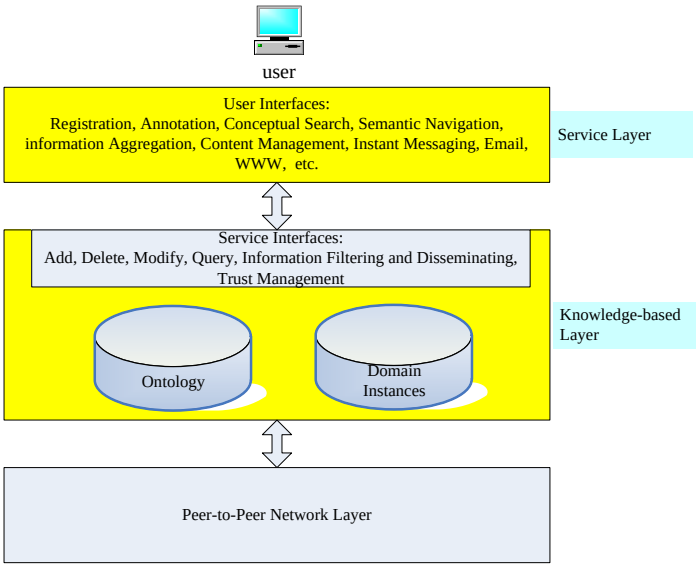

Figure 1: System architecture of semantic peer node

ONTOLOGY FOR THE DOMAIN OF ADVERTISING AND PUBLIC RELATIONS SERVICES

In the system architecture, the knowledge-based layer consists of knowledge base and service interfaces facilitating the sharing of knowledge on the domain. It is thus essential to construct the ontology suitable for the application of the domain in order that user can manage the domain instances. Due to the standard specification of ontology on the Semantic Web, we can acquire and reuse ontology from public Semantic Web portals, like Schemaweb [2] and Swoogle [3]. We can follow knowledge-engineering approach to build up ontology for new application domain. The Protégé project, for example, proposes a simple knowledge-engineering methodology to build up ontology your own purpose [6]. It starts from identifying the domain and scope in the initial step. After realizing the domain purpose competency of the ontology, it strongly recommends to choose existing industrial ontology to satisfy the goal. Otherwise, if no appropriate one exists, we create one for ourselves. The next step is to collect a list of important terms in the domain, which are potentially the concepts and relationships in the domain schema. Part of the list of terms is taken as the classes. We identify the parent-child class relationships in them as well. This forms a class hierarchy. The remaining part of the list of terms is considered as the relationships in the domain and is entered as properties of classes. After the class hierarchy and slots in classes are created, we can enter instances for respect classes. Following the above steps and consulting domain experts, we categorize the terms as six categories and each of them is further classified as sub-categories as summarized in Table 1.

Table 1: Terms of the domain of advertising and public relations services

Category	Sub-category
Design of originality (need to describe the design objects and concepts)	● CF drafts, video, or audio files ● Illustrating figures ● 2D or 3D product design diagrams ● CI or VI design chars ● Commercial cartoons ● 2D or 3D design diagrams for display, activity, or performance,
Project proposals	● Brief, abstracts, project ● Proposals ● Activity PR and SR proposal Marketing proposals ● Operation or management proposal
Reports and research papers	● Market surveys ● Various kinds of data analysis ● Theories about marketing, advertisement, public relationship, brand Social survey of marketing, advertisement, public relationships ● Glossary
Relevant Support	● Training, potential education ● Group activities ● Speech and presentation techniques
Forms	● Various templates of project proposals ● Various kinds of diagrams ● Government or Large-scale company project proposal formats International advertisement company process specification formats
News announcements	● Exhibition information: including Taiwan, Great China, and international areas Activity, competition information: including Taiwan, Great China, and international areas High quality web sites for advertisement, marketing, and public relationships.

According to the categorization, we create class hierarchy for the domain of advertising and public relations. In the hierarchy, there are six level-one classes and under each of them we list the sub-classes for convenience of presentation. Having

[2] http://www.schemaweb.info/default.aspx/
[3] http://swoogle.umbc.edu/

created class hierarchy, we further employ the vocabulary of Dublin Core Metadata Initiative[4] to add feature descriptions for each class. The Dublin Core Element Set defines fifteen elements used to describe digital resources on the Internet. In this paper, we choose eleven elements from the set and give additional descriptions specific for the purpose of the application domain.

TRUST MANAGEMENT AND SELECTIVE DATA DISEEIMNATION

In this paper, the determination of trust is based on the combination of trust of nodes and rank of resources. For the first part, we employ the trust record which is used in [8] for each node about the trust rating of the peer nodes having done transactions with it. A trust record consists of trust vectors each of which enumerate the ratings of transactions having been made. For the second part of the determination of trust, that is, the rank of sharing resources, we maintain in each peer node a list of resource ratings. In the list, each resource, identified by combining the JXTA uuid and directory path as described previously, is associated with a rank from 1 to 10. The rank that is lower than 6 is referred to an unsatisfied sharing, while above that is a positive rating. When user of a peer node, P, would like to know the trust rating of a resource, R, for example, it sends off a query to other peer nodes asking for the ranks they gave to R. After receiving responses from peer nodes, P computes the trust rating of R by using the following formula, $\frac{\sum_{i=1}^{k} t_i f_i}{\sum_{i=1}^{k} t_i}$ where k is the number of responding nodes, t_i is the trust rating of node i and f_i is the rank of the resource given by node i.

The flow of the trust management protocol is summarized in Fig. 6. First of all, user of a peer node sends off query and receives query hits. It then issues another query for the ratings of the received hits. After receiving the ratings, the peer node then retrieves the node trust from the local storage and computes the trust rating of the resource using the above formula. Finally the result is presented for the user to decide whether carry on or not.

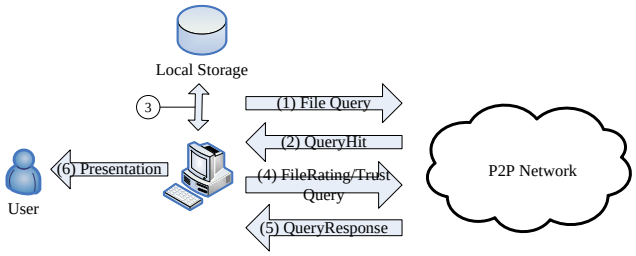

Figure 6: Flow of trust management protocol

In this paper, we design an RDF streaming machine which accepts favorite profile in SPARQL [7] from user, and disseminates matched information to appropriate destinations from the RDF metadata it crawls from various S-nodes. Research and applications on XML streaming have been widely investigated, for example, [9]. For efficiency, finite state automata are commonly used to build their filtering engine. User's profiles are represented in simplified XML paths and are processed to form a finite state machine. The filter engine then accepts the input XML documents, performs filtering, and disseminates the filtered result to appropriate destinations. In this paper, we employ this approach, while RDF and its query language SPARQLE are used to replace XML and the path language. The filter engine in Fig. 7 is kernel of the RDF streaming machine. The favorite profiles in SPARQLE from S-nodes are entered the favorite profile processor which then produces a finite-state automata. The filtering engine control mechanism then is triggered by the RDF events emitting from the event-driven RDF processor to operate on the finite-state machine. The filtered result is then sent to the appropriate user.

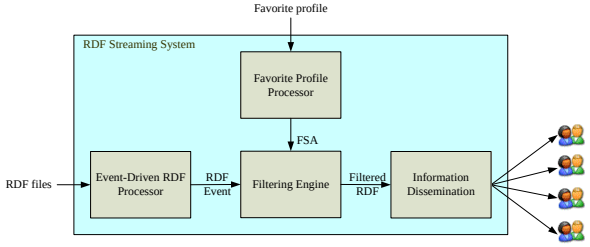

Figure 7: RDF streaming machine for information dissemination

IMPLEMENTATION

We implement a number of services for user of S-node to access the semantic peer network described in order.

[4] http://dublincore.org/

***Official Web Site*:** In this paper, we aim at developing a knowledge sharing and business matching for the advertisement and public relations based on the semantic peer network. We therefore build an official web site as the information center for the application domain to post news announcements, and software update.

***Search*:** The search is based on the ontology we developed for the domain of advertising and public relations in Section 4. To search for certain kinds of resources, user enters suitable values in the fields of GUI, as shown in Fig. 8, and these conditions are used to form SPARQL query which are sent off to other peer nodes. User can choose one of the classes in ontology as the type of resource. User chooses in the subject field one of the industry categories as specified in 104 Job Bank[5]. After processing the query, a peer node wraps the satisfied result in XML as shown below and returns to the source node. After receiving a result, the list in the GUI is updated and a query about the rank of the result is sent off as well. After receiving the ranks from other peer nodes, it then computes the trust rating according to the formula in Section 4 and presents to user.

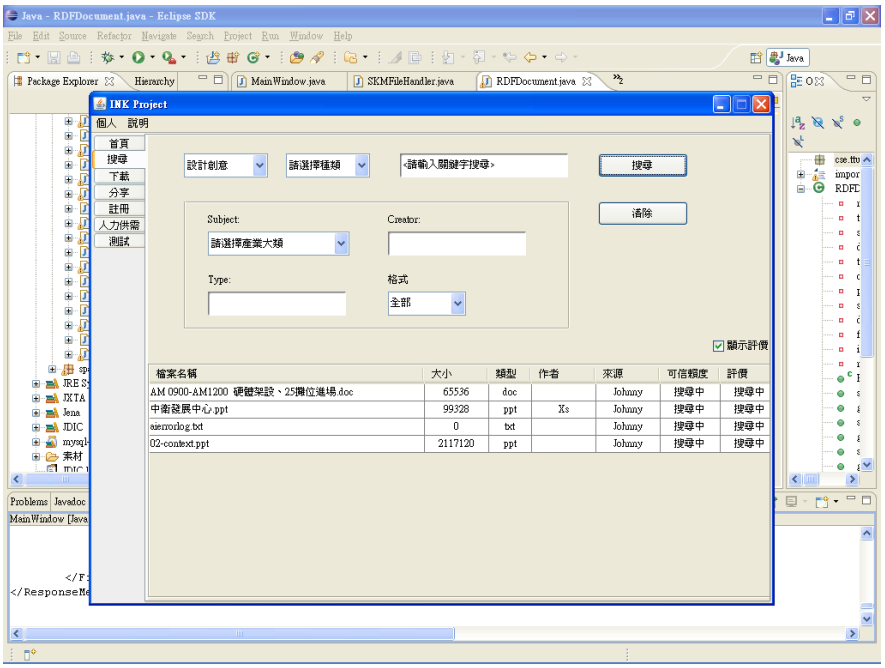

Figure 8: Snapshot of search service

***Download* :** Downloading a file occurs either in the GUI of search result or the notification from the R-node as described later on in the registration service. We use the function of pipe advertisement in JXTA to establish the connection between the providing and receiving peer nodes. The request of downloading a file is then performed through this connection unless the receiving node does have the access right of the file. The access right is determined by consulting the node trust record in the providing node. As described in Section 5, the receiving node has higher rating if it has ever shared more files to other nodes. The node trust rating mechanism thus encourages nodes to share their resources.

***Resource sharing and registration*:** The sharing service consist of three functions for the sharing of resources: new modify, and cancel. Compared with the folder-based sharing used in most P2P sharing applications, we provide file-based sharing because of two reasons. First, each file is associated with an RDF metadata for providing more precise search. Second, when choosing a file to share, user has to enter the associated metadata and this greatly reduces the chance of unwanted sharing in the same directory.

The registration service is used to access the RDF-based selective data dissemination described in Section 6. Through the registration service, user can subscribe her favorite to an R-node which implements the selective data dissemination. User can new, modify and delete a subscription through the service GUI as shown in Fig. 10. User enters the favorite conditions which in turn are used to form profile in SPARQL. The profile is processed to be as a part of filter in the streaming machine of R-node. The streaming machine continuously acquires RDF metadata about new resources to be shared from peer nodes, and disseminates the filtered information to the destination nodes.

[5] www.104.com.tw

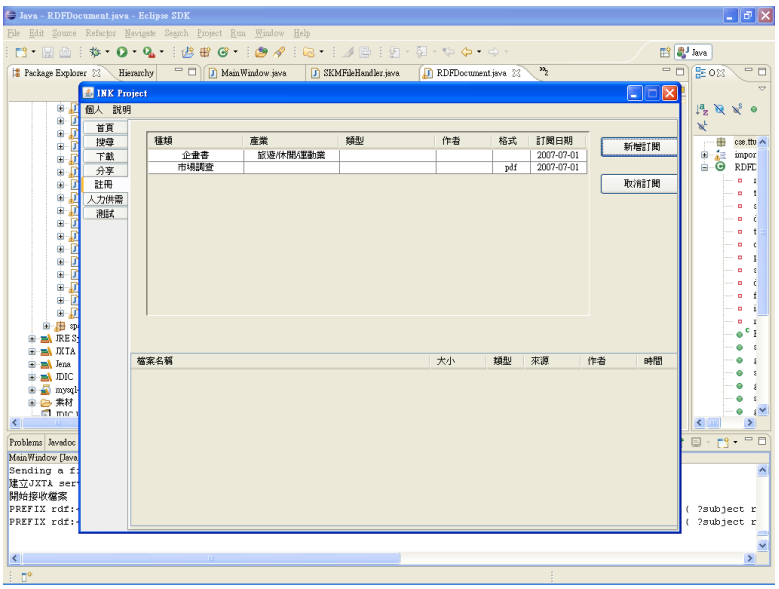

Figure 10: Snapshot of registration service

Manpower Demand-And-Supply And Personal Management: Manpower demand-and-supply service consists of two functions: looking for job and looking for talented person. Job seeker can look for employment opportunity either by using the search or registration service described previously. Similarly, company looking for talented person can achieve its goal by using the search and registration service as well.

Personal profile can be used in network community to introduce oneself. Using the personal management service, user can create or modify her personal profile. We consult FOAF [10] and trust ontology [11] to design the attributes in the profile, including basic information like name, sex, birthday, email, working and school information, and friends. Based on the profile, we can build social network which will be used in further study. An example of profile is shown as below.

CONCLUSIONS

In this paper we design and implement a knowledge management platform by combining the Semantic Web technology and peer-to-peer network. We take advertising and public relation as the target domain and build knowledge-based layer for the application domain. Based on the layer, we develop management services for user to access the domain knowledge in the semantic peer network. JXTA, an XML-based peer-to-peer network, is used to develop the connection for the knowledge-based layer in each peer node. We develop a trust management mechanism for the trust reference of peer nodes and resources to be downloaded. We also develop an RDF-based streaming system that automatically push newly matched item to the target node according to user profiles. We have collected documents of classes in domain ontology to test the performance of pull and push information. The initial result is promising but we need to scale up the test environment to see how it performs in practice.

In brief, we have successfully stepped towards the development of semantic peer network for distributed knowledge management. In the future, we need to carry out further investigations about the work we have done in this paper to improve the performance and capability of the semantic peer network, including efficient search, trust social network, maintenance of knowledge scheme, mobile peers, learning content management, and business models.

ACKNOWLEDGEMENT

Financial support of this research by Tatung University, Taipei, Taiwan, under the grant B96-I04-030 is gratefully acknowledged.

REFERENCES

[1] Nigel Shadbolt, Tim Berners-Lee and Wendy Hall. (2006) “The Semantic Web Revisited”, *IEEE Intelligent Systems* , Vol. 21,No.3, pp. 96-101.

[2] Stephanos Androutsellis-Theotokis and Diomidis Spinellis. (2004) “A survey of peer-to-peer content distribution technologies”, *ACM Computing Surveys*, Vol. 36, No.4, pp.335–371.

[3] W3C. (2004) “W3C. RDF/XML Syntax Specification (Revised)”, 10 February, http://www.w3.org/TR/rdf-syntax-grammar/

[4] W3C. (2004) “W3C. OWL Web Ontology Language Reference”, 10 February, http://www.w3.org/TR/owl-ref/

[5] Daniel Brookshier, Navaneeth Krishnan, Darren Govoni and Juan Carlos Soto. (2002) *JXTA: Java P2P Programming*, SAMS.

[6] Natalya F. N. and Deborah L. M. (2001) "Ontology Development 101: A Guide to Creating Your First Ontology", *Stanford Knowledge Systems Laboratory Technical Report KSL-01-05 and Stanford Medical Informatics Technical Report SMI-2001-0880*.

[7] W3C. (2007) "SPARQL Query Language for RDF",14 June, http://www.w3.org/TR/rdf-sparql-query/

[8] Selcuk A.A, Uzun E, and Pariente M.R. (2004) "A Reputation-Based Trust Management System for P2P Networks", *In 4th IEEE/ACM International Symposium on Cluster Computing and the Grid*.

[9] Y. Diao, P. Fischer, M. Franklin, and R. To.(2002) "YFilter: Efficient and Scalable Filtering of Xml Documents", *In Proceedings of the International Conference on Data Engineering*, San Jose, California.

[10] "The Friend of a Friend(FOAF) project", http://www.foaf-project.org/index.html

[11] "The Trust Ontology", http://trust.mindswap.org/trustOnt.shtml