

Utilizing Semantic Web as Communication Protocol in Faded Information Field (FIF) Architecture for Information Retrieval and Dissemination

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Abstract

Even though plenty of information is available on the Internet, still there is too little useful information there. For the Internet user one of the important parameter of the network is the speed of the retrieval of files. Since internet is rapidly evolving, new information gets added and modified continuously, thus there is the need to sort, organize and retrieve these resources so as to meet the user's heterogeneous requirements fast and effortlessly. In this paper, a content code is proposed for faded information field (FIF), known as semantic web. This will act as a communication protocol for information transmission and a method of communication among the nodes in the network of FIF.

Categories and Subject Descriptors: C. [Computer Systems Organization]: C.2 Computer-Communication Networks - C.2.1 Network Architecture and Design

General Terms: faded information field, mobile agents, semantic web, information retrieval, autonomous decentralized system.

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1. INTRODUCTION

In the past information was limited and the distribution of information was also very much restricted. With regards to that time, much was need for organization of information. But nowadays the information flow is tremendous. The advancement in the field of network technologies has made it impossible to cover the

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overall information available. New sources of information are added continuously which are of many forms such as HTML, PDF, XML etc. To retrieve any information on internet, the process is not efficient as the information retrieved is not always the one which is required. Thus, there are lot of problems in information search, extraction, representation and interpretation.

Enhancement of information dissemination and retrieval will be of great help for researchers, developers, in addition to corporate, government, healthcare, and higher education. This effective information retrieval can be done through the use of such a network wherein it would be easier for a user to extract information with ease, fast and also efficiently. In this paper, a mechanism is proposed with the help of push and pull mobile agents. The user can consistently obtain the required information at the local nodes in the Faded Information Field (FIF) which uses the semantic web protocol of information broadcasting.

A new approach, know as semantic web, has been evolving which brings powerful AI concept in contact with the web infrastructure. Semantic web is envisioned as an extension of the current web where documents are annotated with meta-information [Davis et al. 2003]. It has the ability to define and link web data in a way that it can be understood and used by machines for automation integration and reuse of data across various applications. Semantic web is the presentation of machine-processable semantics of data on the web. It is a collaborative effort led by W3C Consortium with participation of large number of researchers and industrial partners [Berners et. al. 2001; Jeckle and Zhang 2003].

In essence, the solution to the above problem is based on an approach which links the semantic web with faded information field. This solution is applied on a decentralized network, thereby facilitating in standardizing the information distribution across the network. A lot has been written about the use of FIF [Ahmad et. al. 1999; Arafaoui and Mori 2000; Arafaoui and Mori 2001] but no communication format or the method by which nodes of a FIF network can communicate has been forwarded. This paper describes the use of semantic web technology for use in faded information field architecture in order to create and deliver the technology with Information provision and utilization.

2. FADED INFORMATION FIELD ARCHITECTURE (FIF)

A Faded Information Field is a set of computers around an information provider where the information provider distributes its information contents. Thus, the information of the provider is replicated to surrounding nodes, creating a “field” of information.

The faded information field can be constructed to balance the cost of information allocation performed by push-Mobile Agents and the cost of information retrieval performed by pull-Mobile Agents. Fading improves the reliability of the information in the field, and effectively reduces the burden on the server and the network of maintaining the information field. Conversely, it will mean that some agents will have to travel further in the network to discover the required information [Arfaoui and Mori 2001]. The main goal of the faded information field is to guarantee the assurance of autonomous service provision and autonomous service utilization [Ahmad et. al. 1999; Mori 1999].

The main goal of FIF is to guarantee the assurance of autonomous service provision and autonomous utilization [Arfaoui and Mori 2001]. The trend for information distribution is given in Figure 1. The graph indicates the decrease in information as the distance from the main server. Thus, the nodes which are nearby to the server have more information and in turn are updated more frequently than the nodes which are at a greater distance.

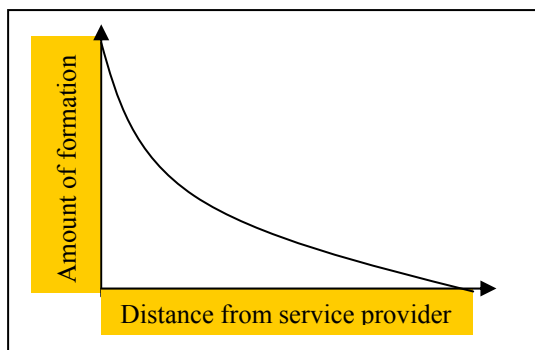


Figure 1: Information distribution in FIF

2.1 Push Mobile Agents and Pull Mobile Agents (PMA's)

A mobile agent is a software program that can be transferred from one location to another in a network environment. The agent is self-sufficient to make decisions with reference to its execution at a host, and it may choose to save its state, move on to another host, and then continue execution. A mobile agent does not need to maintain communication with its source. Therefore, it is an autonomous entity.

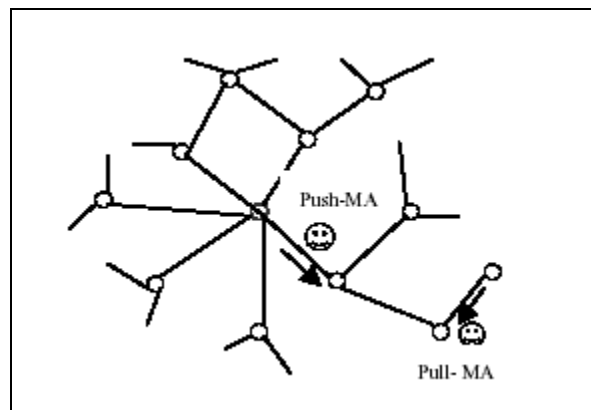


Figure 2: Network Structure and Mobile Agents

By the use of mobile agents, access time for the user to get the appropriate information is improved because the user need not reach the service provider and it can get its required information at the nodes which are close to its premises as shown in the figure 2, thereby enabling Service Provider (SP) to avoid the congestion. The Mobile agents can support each of four main monitoring activities performed in an object based system – generation, processing, dissemination and presentation of information [Ahmad et al. 1999; Sloman 1994]. Mobile agents have a complex nature with respect to their design, implementation and maintenance [Liotta 1999].

2.2 Communication format for FIF

The data is usually sent by conventional methods where in the destination methods are mentioned in the packet. But in FIF, communication is done using the content codes. Content codes (CC) are uniquely defined with respect to the content of the information service. This information is further divided into characteristic codes (CH). CH defines the properties corresponding to CC. Pull mobile agents requests in terms of this CC and CH, thereby enabling pull MA to broadcast [Arfaoui and Mori 2000].

As an example, consider that a user needs information regarding buying a house. The CC would be the purchase of house, and the corresponding CH's can be the place where the user wants to purchase the house, the price, type of house etc. Depending upon the attributes of the search, provided by the user, this format (as depicted in Figure 2) will try to look for any advertisement for sale of house on the web. This streamlined search provides the ultimate and most useful information requisite for the user.

House	Place	KL	Price	200000	Type	Link
CC1	CH1	Data	CH2	Data	CH3	Data

Figure 3: Message Format in FIF

Thus, owing to the fact that the query in faded information field would have the CC and CH's, so the full knowledge format requires certain specific protocol by which this communication can be done. The Semantic Web will bring structure to the meaningful content of Web pages, creating an environment where software agents such as those above mentioned mobile agents roaming from page to page can readily carry out sophisticated tasks for users. As for example the search that we have mentioned above is looking for the information and in Semantic Web format, the whole detail will be provided starting from the location of the house, its price, type and in addition to this certain keywords such as "balcony, swimming pool, rooms", which can be mentioned in the CH's will help in retrieval of specific and more comprehensive data [Arfaoui and Mori 2001].

3. SEMANTIC WEB

To reuse data across the internet, a common framework is needed which allows data to be shared and reused. Ontologies play a major role in supporting information exchange across various networks. Currently, Ontologies applied to the World Wide Web are creating the Semantic Web. Semantic Web is a collaborative effort led by World Wide Web Consortium (W3C) with participation from a large number of researchers and industrial partners. W3C develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential. It is a forum for information, commerce, communication, and collective understanding. Semantic Web is based on the Resource Description Framework (RDF), which integrates a variety of applications using XML (Extensible Markup Language) for syntax and Universal Resource Identifiers (URIs) for naming [W3C 2004; Fensel 2001]. As shown in Figure 3, RDF builds on XML to create descriptions, and descriptions are metadata, that is data about data. It allows anyone to design their own document format and then write a document in that format. RDF is a format to make statements that are meant to show something. It is identified by a unique address called the URI.

According to Tim Berners-Lee, James Hendler, Ora Lassila "*The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation*" [Berners-Lee et. al. 2001]. The Web can reach its full potential only if it becomes a place where data can be shared and processed by automated tools as well as by people. For the Web to scale, tomorrow's programs must be able to share and process data even when these programs have been designed totally independently. The Semantic Web is a vision: the idea of having data on the web defined and linked in a way that it can be used by machines not just for display purposes, but for automation, integration and reuse of data across various applications [W3C 2004].

4. INFORMATION RETRIEVAL AND FILTERING TECHNOLOGY FOR FIF

RDF is a language intended to be used to express propositions using precise formal vocabularies for access and use over the World Wide Web. Technically speaking, Web-enabled languages and technologies are being developed (e.g. RDF-Schema, DAML+OIL, DAML-Rules, Rule-ML), schema and ontology integration techniques are being examined and refined and Web Services Integration Standards are being defined (e.g. UDDI, JINI).

Instead of developing own ontology from scratch, it is suggested to find an existing ontology that is broadly accepted [Abramowicz 2003]. RDF combines terms into triples, sets of three which express basic concepts or statements.

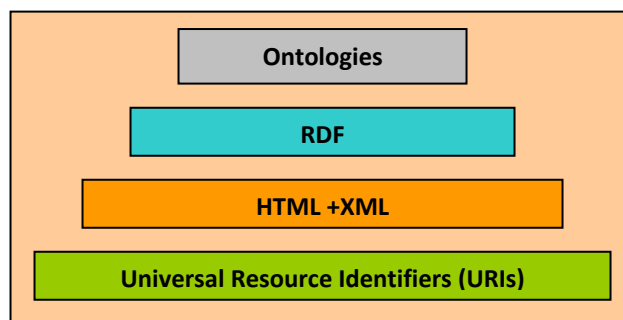


Figure 3: The Semantic Web layers

The Semantic Web adds a type to this link, making it expressed more efficiently, such as the case of retrieval of information regarding house as mentioned in section 2. The query would be expressed as (House, Price, Location). In RDF it can be expressed as:

```

<house> <name> "house" .
<kl> <location> <kl> .
<200000> <price> <200000> .
<Web> <website> <http://www.mzchishti.com/>

```

Semantic Web combines URIs, HTTP and RDF to build a system of machine-to-machine communications for sharing information. Take the example of purchasing a house. To begin with, we need the information about the house;

```

<House> <...location> "KL" .
<House> <...price> "200000" .
<House> <...type> "link" .

```

...
Thus, we can ask for the query for the house as:

```

< http://www.mzchishti.com /> <...wantsouselocatedat> <kl> .
< http://www.mzchishti.com /> <...withprice> "200000" .
< http://www.mzchishti.com /> <...housetype> "link" .

```

By using RDF name space, the information can be shown in simpler way:

```

@prefix : <http:// www.mzchishti.com /rdf/> .
@prefix h: < http://www.mzchishti.com /info/> .
h:1000 :type :Info .
h:1000 :enquiry "house" .
h:1000 :price "200000" .
h:1000 :type "link" .

```

Ontologies are key enabling technology for the Semantic Web. In making Semantic Web as capable communication protocol in FIF architecture requires acquiring ontologies and linking them with data. An RDF schema acts as a repository that provides the storing and maintaining ontologies and their instances. The last step would be querying and browsing semantically enriched information sources. This technology can also be used for electronic knowledge sharing and reuse. This offers a heterogeneous representation of web resources, thereby enabling an extremely knowledgeable system with specialized services [Abramowicz 2003]. Thus, FIF would act as a semantically enriched search engine, browsing and providing support for sharing.

5. EXPLOITING SEMANTIC WEB FOR FIF: A FUTURE PERSPECTIVE

Faded Information Field architecture brings flexibility, reliability and real-time property to the information environment. This research mainly gives a method and is based on a prototype of FIF but the methodology needs to be established well. Effective and efficient protocol for communication in FIF requires an advanced ontology for expression and representation.

According to TimBL, there will be many layers to the Semantic Web, which could take around ten years to complete:

- Unicode and XML
- RDF and other Basic Assertion Languages
- Schema Languages
- Conversion Language

- The Logical Layer
- A Proof Language
- An Evolution Rules Language
- Query Languages for Proof Validation (Swartz, 2006).

A well defined formal semantics has to be established to ensure interoperability. The effectiveness of this protocol will enable the mobile agents, which have been designed specifically for FIF, to work together thereby helping in transferring of data among different MAs. Much of the current work on the Semantic Web centers on a variety of technologies that are already in widespread have to be practical in use, particularly the Resource Description Framework (RDF)—which lets content creators express structured metadata statements describing URIs.

6. CONCLUSION

Faded Information Field has been designed to suit the requirements of service providers and the users as well. Semantic web technology can make an important contribution in acting as communication protocol. Semantic web can work across different networks, thereby helping in communicating across the wide range of networks.

This paper clarifies the rationale that would enable effective, efficient and robust communication between mobile agents in FIF. We have explained the concept and realization of effectual methodology for FIF communication with the help of semantic web for Push/Pull mobile agents.

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