The Impact of Semantic Web on E-Commerce

Karim Heidari

Abstract—Semantic Web Technologies enable machines to interpret data published in a machine-interpretable form on the web. At the present time, only human beings are able to understand the product information published online. The emerging semantic Web technologies have the potential to deeply influence the further development of the Internet Economy. In this paper we propose a scenario based research approach to predict the effects of these new technologies on electronic markets and business models of traders and intermediaries and customers. Over 300 million searches are conducted everyday on the Internet by people trying to find what they need. A majority of these searches are in the domain of consumer ecommerce, where a web user is looking for something to buy. This represents a huge cost in terms of people hours and an enormous drain of resources. Agent enabled semantic search will have a dramatic impact on the precision of these searches. It will reduce and possibly eliminate information asymmetry where a better informed buyer gets the best value. By impacting this key determinant of market prices semantic web will foster the evolution of different business and economic models. We submit that there is a need for developing these futuristic models based on our current understanding of e-commerce models and nascent semantic web technologies. We believe these business models will encourage mainstream web developers and businesses to join the "semantic web revolution."

Keywords—E-Commerce, E-Business, Semantic Web, XML.

I. INTRODUCTION

SEMANTIC web technologies will give digital assistants and agents the ability to search the web for products that correspond best to the specific needs of a certain user. While consumers today have to rely on the limited number of offers available on centralized e-commerce portals when looking for products, future applications will be able to provide users with a search process based on product attributes, which will include all products published in this form on the Internet. Furthermore, in a next step semantic web services will enable digital assistants to handle business processes like selling and buying or even negotiations automatically. The success of semantic web relies heavily on its wide spread adoption by the mainstream web development community. Unfortunately, a successful application of semantic web needs a large amount of semantic data, which is difficult for the small knowledge representation and semantic web community to provide. In this position paper we describe the current state of the art e-business transaction. We show the information asymmetry

Karim Heidari is with the Islamic Azad University, Zarghan, Iran (phone: +98 9173151343 ; e-mail: karim.heydari@engineer.com).

that exists in current ecommerce and how this creates market inefficiencies. We then describe how this model will be revolutionized on a semantic web. We submit that this futuristic scenario will help generate enthusiasm among mainstream web developer by exposing them to the potentials of a semantic web.

II. E-COMMERCE

Electronic commerce, commonly known as e-commerce or eCommerce, consists of the buying and selling of products or services over electronic systems such as the Internet and other computer networks. The amount of trade conducted electronically has grown extraordinarily with wide-spread Internet usage. A wide variety of commerce is conducted in this way, spurring and drawing on innovations in electronic funds transfer, supply chain management, Internet marketing, online transaction processing, electronic data interchange (EDI), inventory management systems, and automated data collection systems. Modern electronic commerce typically uses the World Wide Web at least at some point in the transaction's lifecycle, although it can encompass a wider range of technologies such as e-mail as well.

III. SEMANTIC WEB

The Semantic Web is an evolving extension of the World Wide Web in which the semantics of information and services on the web is defined, making it possible for the web to understand and satisfy the requests of people and machines to use the web content. It derives from World Wide Web Consortium director Sir Tim Berners-Lee's vision of the Web as a universal medium for data, information, and knowledge exchange.

IV. AGENT

A program performs some information gathering or processing task in the background. Typically, an agent is given a very small and well-defined task. Although the theory behind agents has been around for some time, agents have become more prominent with the growth of the Internet. Many companies now sell software that enables us to configure an agent to search the Internet for certain types of information.

A personal agent on the Semantic Web (figure 1) will receive some tasks and preferences from the person, seek information from Web sources, communicate with other agents, compare information about user requirements and preferences, select certain choices, and give answers to the user [1].
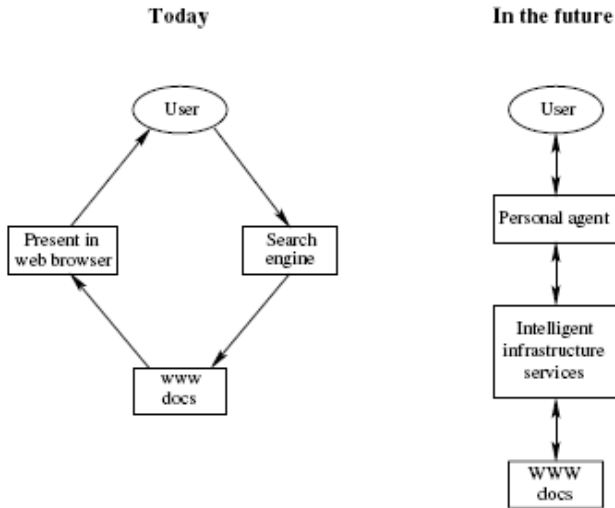
Today

In the future

Fig. 1 Personal Agent

It should be noted that agents will not replace human users on the Semantic Web, nor will they necessarily make decisions. In many, if not most, cases their role will be to collect and organize information, and present choices for the users to select from those [1].

V. CURRENT E-COMMERCE

Information asymmetries create situations where a better informed buyer gets the best value. For a specific example in the context of E-commerce; let's take the case of an actual price search for a specific model of a handy camera: Sony DCR-SR62. There are several websites that sell the exactly same product at different prices. A consumer, new to online purchasing may go to Amazon and buy the product for 499.99. A consumer who is more educated about internet searches is able to do a quick but detailed search through websites such as www.dealtime.com or www.pricegrabber.com or www.dgkala.ir (Iranian site). In this manner, she identifies the same product being sold at http://www.tristatecamera.com for a cost of 409.99 and total with shipping for 433.22. The total savings is $66.77. There is a significant gain due to the information asymmetry, this is price dispersion. Price dispersion implies that households and firms must spend time and energy in looking for the best value. Search is considered an important and costly economic activity. As it is costly it will stop before the consumer has all the information she needs and may result in poor bargains. As the opportunity cost of a search increases with each additional unit of time, the amount of search will be at the exact point where the marginal benefit equals the marginal cost. With an increase in the phenomenon of price dispersion (i.e. same good, different prices), the search amount increases [2].

Fig. 2 Search and dispersion curve

Thus we see that a problem created by information asymmetry and price dispersion is that he costly economic activity of search takes place; which can be seen as a loss in precious resources as well as an inefficiency in the market. Another problem is that consumers do not get the best value for their money if they place a high value on their time. When this happens, firms that offer good quality for the consumer dollars may lose out. They are also adversely impacted because it takes time for the market to absorb price reduction information. The current search engines are contributing somewhat to reduction in information asymmetry; but because they still require the consumers to be fairly adept in searches, the information asymmetry still results in price dispersion.[2]

VI. THE IMPACT OF SEMANTIC WEB ON CONSUMERS

The popularity of Electronic Commerce is experiencing rapid growth and the importance of the Internet as a sales channel for suppliers and dealers is irresistibly rising. A search for a product or product offers is the starting point for most ecommerce transactions. However, the quality of the current search engines is far from perfect. Search engines, the most popular point of entry into the product purchasing process, deliver links to pages in which the searched phrases appear, but these links are often not helpful from a customer's perspective. As an example, a consumer searching on Google for: " 'mobile phone' camera email download ringtones", will normally end up with a list of links to websites offering ringtones, in addition to some links to websites of mobile phone manufacturers or vendors. However, the search will most certainly not return a list containing all mobile phones with a camera, email function and the ability to download ringtones. On the other hand, if the consumer decides to make use of an e-commerce portal like Ebay to search for a mobile phone, he would end up with a list of thousands of mobile phones. Nevertheless, the search result will not clearly distinguish between the phones that offer the desired features and those of no interest to the consumer. Hence, internet users would be able to find a large number of offers by a large number of dealers by following the above-mentioned approaches, but would probably have to browse many differently structured web pages to find the product providing the needed features and the best possible offer. Today

consumers drown in an incredible amount of unstructured information about products and offers. The common search engines and e-commerce portals do not have the ability to facilitate this challenge for the users. This represents a huge cost in terms of people hours and an enormous drain of resources. The semantic web will transform millions of dumb (read "un-searchable") web pages into intelligent, semantically annotated web pages where search for a particular product or service will be comprehensive and precise. In near term a fatal blow will be dealt to competition among search engines as all search engines will give relatively similar results, in long term agents will replace the search functions completely. Price differentials will also be driven down as a result. The additional advantage possessed by consumers with search engine skills will disappear while the premium that customers had been hitherto willing to pay for convenience will decrease. Under this scenario, anyone looking for a Sony DCR-SR62 Digital Camcorder will know that the lowest price available for this product is $433.22. Consumers who then choose Amazon over Tristate Camera will be consciously paying the additional $66.67 for conveniences such as customer service, support, reliability etc. – advantages that Amazon has due to brand recognition. In this way, through the Semantic web, price dispersion is likely to decrease significantly. It may not reduce to zero as there will still be a difference in the perceived quality and reliability of the providers as well as the value placed on the search time and convenience. The significant decrease in price dispersion caused by the Semantic Web will increase the efficiency of the e-market and provide increased utility to consumers and e-firms [3].

VII. How Semantic Web System is Going to Work?

The semantic web initiative was started by Sir Tim Berners Lee who is the famous inventor of the World Wide Web and today's director of the World Wide Web Consortium W3C, the planet's leading standardisation and development organization for Internet technologies. From the very beginning, the Semantic Web was part of his general vision of the World Wide Web. Since then, researchers and Internet pioneers have been developing the technological groundwork to make this vision come true.The technical principle of the Semantic Web is rather simple. It is based on the consensus that every object or term of the "real world" is to be referred to by a Unified Resource Identifier (URI). Other key principles of the Semantic Web include RDF and OWL, which are W3C standardized languages used to express information in a machine interpretable form. Manufacturers and vendors of goods and services will be able to publish their product- and service descriptions in this standardized form based on product- and service ontologies. Technically ontology can be seen as an enhanced standardized taxonomy, which is used to describe or model aspects of reality. These ontologies will enable companies to publish product- and service descriptions in a machine interpretable way on their own website, parallel to their normal HTML-Websites. Simultaneously, it allows vendors to describe their offers in a

machine interpretable form by using offer ontologies. Consequently, all semantic search engines are able to find, retrieve and interpret those products and offers for their users. For the reasoning part, description logics can be used to describe general and specific rules to conclude new knowledge from the information of these websites [3].

VIII. Consumers and Semantic Web in E-Commerce

Up until now, consumers have had to utilise centralized e-commerce platforms to compare prices of various dealers for a certain product. However, those platforms can only suggest offers, which have been published there previously by suppliers or dealers. Consequently, offers on such virtual market places will always be limited to a certain percentage of all offers available on the market, as a supplier cannot know all of these platforms, not to mention, offer his products on every single platform. Semantic search engines retrieve their product offers directly from the supplier's web pages and can therefore include all offers published in a machine-interpretable form on the web. Hence, they can potentially provide consumers with the whole picture of the market, as they will not only feature suppliers willing to pay fees to centralized ecommerce platforms, but every single offer published on the web.Only a few e-commerce platforms allow consumers to do a feature based product comparison between different manufacturers and their range of models. Semantic Web technologies, on the other hand, enable search assistants to analyze the attributes of all products on the market and to compare them against each other.Consequently, consumers will be able to state specifically what they want. Therefore,to come back to the example mentioned above, the consumer is now able to specify that he is looking for a mobile phone that supports e-mail and downloading of ring tones, and has a camera. A semantic search engine will only provide the user with product models, which correspond to the expressed needs. Hence, the consumers get the opportunity to consider the maximum amount of possible products allowing them to find the solutions, which fit their individual requirements best. Furthermore, the possibility to perform reasoning on the Semantic Web data, will allow search engines to display the aggregated information in a much more user-friendly way. Accordingly, the strongly increased transparency of the market will maximise the chance of finding the best and cheapest offer. In the future, semantic web services will enable search assistants to order products for a user at a dealer's web shop. This means that users do not have to get accustomed to the user interface of yet another platform. They just have to register once on the platform of the semantic search assistant and this assistant can then interact with the dealers' websites on behalf of the consumer, and order for example a certain mobile phone.

IX. Conclusion

The technological groundwork for a broad realization of Semantic Web Technologies in E-Commerce has been implemented. In the near future two big questions will have to be solved to facilitate a rapid expansion of this technology in

innovation driven markets. The first challenge to solve is the process of creating standardized ontologies for the different product areas. One of the in the short-term most promising approaches is the transformation of existing international standards like eclass, EDIFACT, ebXML into Ontologies. These standards allow the description of properties of products and services. Nevertheless, experiences show that the process of defining industry standards for product areas in international standardization committees is too slow and not flexible enough to keep pace with the developments. Therefore, the need to develop new approaches should be encouraged by allowing real time online development of such standards by companies, experts and interested consumers. At the present time, a research project is planned tackling this challenge. A second problem is that anyone can publish information about anything in the semantic web. Mechanisms have to be put into practice guaranteeing authenticity of authors. Semantic web will help society make major gains in reducing information asymmetries. Reduction of information asymmetry results in markets getting closer to the model of perfect information and by extension, a step closer towards perfect competition. In this paper we have looked at the economic impact of evolving semantic web and attempted to predict the future ecommerce model.

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