Collective Knowledge Composition in a P2P Network

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INTRODUCTION

Today’s data and information management tools enable massive accumulation and storage of knowledge that is produced through scientific advancements, personal and corporate experiences, communications, interactions, and so forth. In addition, the increase in the volume of this data and knowledge continues to accelerate. The willingness and the ability to share and use this information are key factors for realizing the full potential of this knowledge scattered over many distributed computing devices and human beings. By correlating these isolated islands of knowledge, individuals can gain new insights, discover new relations (Sheth, Arpinar & Kashyap, 2003), and produce more knowledge. Despite the abundance of information, knowledge starvation still exists because most of the information cannot be used effectively for decision-making and problem-solving purposes. This is in part due to the lack of easy to use knowledge sharing and collective discovery mechanisms. Thus, there is an emerging need for knowledge tools that will enable users to collectively create, share, browse, and query their knowledge.

For example, many complex scientific problems increasingly require collaboration between teams of scientists who are distributed across space and time and who belong to diverse disciplines (Loser et al., 2003; Pike et al., 2003). Effective collaboration remains dependent, however, on how individual scientists (i.e., peers) can represent their meaningful knowledge, how they can query and browse each others’ knowledge space (knowledge map), and, most importantly, how they can compose their local knowledge pieces together collectively to discover new insights that are not evident to each peer locally.

A common metaphor for knowledge is that it consists of separate little factoids and that these knowledge “atoms” can be collected, stored, and passed along (Lakoff & Johnson, 1983). Views like this are what underlie the notion that an important part of knowledge management is getting access to the “right knowledge.”

While the state of the art is not at the point where we can duplicate the accomplishments of a Shakespeare or Einstein on demand, research developments allow us to craft technological and methodological support to increase the creation of new knowledge, both by individuals and by groups (Thomas, Kellogg & Erickson, 2001).

A Peer-to-Peer (P2P) network can facilitate scalable composition of knowledge compared to a centralized architecture where local knowledge maps are extracted and collected in a server periodically to find possible compositions. This kind of vision can be realized by exploiting advances in various fields. Background and enabling technologies include semantic metadata extraction and annotation, and knowledge discovery and composition. Figure 1 shows these components for an ontology-based P2P query subsystem.

Figure 1. Part of an ontology-based P2P query subsystem