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Dynamic Integration of Distributed Semantic Services: Infrastructure for Process Queries and Question Answering

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1 The IR2P Prototype

The DARPA IXO mission is to develop "systems for real-time sensing, exploitation, and decision making in a rich tactical environment". The mission includes the development of individual technologies for sensors, sensor exploitation and command/control as well as the technology of information integration. Our research focuses on how to integrate distributed services in a dynamic networked environment to support IXO applications. This dynamic networked environment should include the following capabilities (DARPA, 2002):

- Information users should have scalable dynamically changing subscription services to heterogeneous information services;
- Information providers should have scalable publishing services for their dynamically changing information products;
- Scalable intelligent middleware to dynamically broker, compose, and manage the intermediate services necessary to connect information users to the right information products at the right time.

While some of these capabilities can be realized with existing technologies, several challenging problems, particularly in the areas of scalability, semantic interoperability and dynamic extensibility, may need 5 or 10 years basic research efforts to adequately address. The Information Integration Research Prototype (I2RP) we describe is a vehicle for exploring which new paradigms and frameworks are most promising for future investment while calibrating what existing technologies can do today (Jiang et al., 2002). This demonstration illustrates the I2RP architecture and the underlying technology approaches. In six months, we implemented an extensible prototype system with basic capability as a proof-of-concept to show some fundamental new ideas for implementing next generation dynamic information integration systems.

2 Current Status

IR2P is an information integration research prototype built with commercial-off-shelf technologies. With the prototype system, the declaration-composition-production process of semantic integration has been investigated, with specific emphasis on semantic interoperability issues (Sirin et al., 2002). A target-tracking scenario was developed to test the system and all components in the I2RP were successfully integrated "on the fly" to support this mission. Meanwhile we proposed and analyzed some metrics to quantify the semantic integration process such as semantic depth, markup complexity and information fluidity. From different aspects, we built some models to analyze the relationship between semantic depth and markup complexity, and between semantic interoperability and information fluidity.

3 Process Queries and Natural Language Queries

The work on IR2P has evolved into a more general engine for tracking, fusing, and querying processes. We are presently developing a generic process querying capability that can be used to retrieve information about objects as diverse as physical objects on a battlefield or worms propagating through the Internet. Later we plan to build a natural language querying capability as proposed by Lulich and Thompson (2002).

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