

# CONTEXT AWARE COLLABORATION IN ENTERPRISES

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Keywords: Context, Collaboration, Agents

Abstract: Providing the most relevant information at the most appropriate time at the most appropriate location helps in improving the overall enterprise productivity. In this paper, we discuss the various aspects of a context and the ways and means of tracking the same so as to exploit the most recent and expectedly accurate description of the business situation in delivering the information to assist in collaboration. Further, we discuss the role of data and app grids in meeting the real-time delivery requirements.

## 1 INTRODUCTION

To build products and services of highest quality in challenging time period and lower production costs that enterprises need to collaborate with partners / suppliers (O'Keefe 2001). With advancement of technology as the driving force, virtual collaborations are increasingly being adapted across enterprises. Several commercial collaboration tools like eRoom, NetMeeting are available.

While the utilities of intra-organization and inter-organization collaboration activities are desirable, there are several factors that impede its practice. These factors comprise both technological as well as social issues. Heterogeneity - in communication networks, communication devices, and information sources across organizations imposes challenges on creating effective collaboration technology. Also, collaboration essentially requires large-scale video and audio conferencing, transcoding to facilitate communication through devices with diverse characteristics, and such applications need high computational resources. Further, with advancement in mobile communication, service representatives who are frequently travelling require coordinated collaboration across departmental and corporate boundaries for sustaining competitive advantage and reducing business processing cycle times. As a result, large enterprises are challenged to simultaneously provide a unified solution to support

enterprise integration, mobile applications, and collaboration. Such technological complexities in large-scale multi-party collaboration could be handled using grid technologies (Hinde S *et al* 2002). Grid technology provides highly efficient resource sharing mechanisms in addition to security, reliability, and fault tolerant mechanisms in heterogeneous resource environments. Data grid (Chervenak A *et al* 1999, Avaki 2003) provides an efficient, scalable access to real-time data that is globally distributed and in different formats. Data and computational grids provide an easy way of handling heterogeneity issues as well as computational issues.

Technology enabled on-line collaboration requires systems that keep track of all activities, often real-time events — providing real-time visibility and control of information by the collaborators involved. Technology provides several support systems like ERP, CRM, and several workflow systems to coordinate tasks that aid enterprises in procedurally oriented transactions. These systems coordinate asks, but do not provide support for individuals or groups working with them.

Effective knowledge sharing enhances the efficiency of collaboration (Perkins J *et al* 2003). Kammanahalli *et al* (Kammanahalli H *et al* 2003) have discussed a system that facilitates effective interactions during a synchronous collaborative

session by using proactive triggering based on

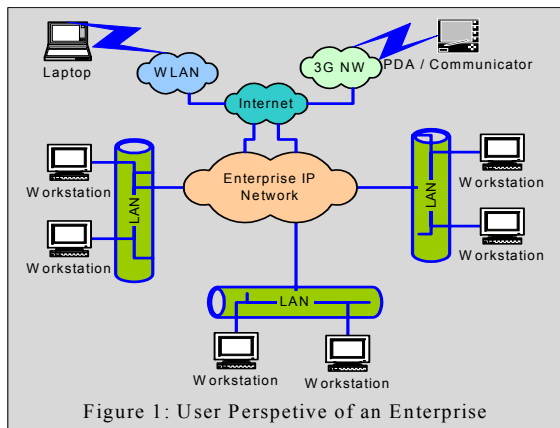


Figure 1: User Perspective of an Enterprise

context (Abowd G. C *et al* 1999) information.

This paper highlights our solutions to address effective context relevant knowledge management through a system sitting on top of the grid architecture, comprising data and app grids, to facilitate effective collaboration. Since information is accessed from different business scenarios there is a need for contextual information. The knowledge sharing among collaborators is achieved through multiple collaborating agents that are specifically related to the various aspects of a context in an enterprise.

## 2 CONTEXT IN ENTERPRISES

A typical user and data perspective of an enterprise is depicted in Figs. 1. An overall network of an enterprise (a) covering globally distributed offices, and (b) to provide global access to enterprise resources for its employees comprises multiple, heterogeneous sub-networks. Data is distributed over these sub-networks and in order to provide efficient, real-time, and ubiquitous access to data, it is appropriate to set up dedicated data grids. There are two distinct kinds of grids, namely, Department data grids and Enterprise data grid. Department data grids are specific to the different locations of the enterprise and the enterprise data grid interconnects these multiple Department data grids to form a single, connected data network. Data grids are useful especially during audio and videoconferences demanding real-time access to the globally distributed data. We propose multiple, collaborating agents to provide context-aware access to the data stored in data grids. The agents interact with the data grid managers to efficiently retrieve data. In the following, we provide a brief description of an enterprise context to help provide the most relevant information at the most appropriate time to the staff

of the enterprise. Context, as described below, consists of two parts, namely, business context and user context.

*Business Context (BC):* During collaboration across an enterprise, it is very important to integrate information sources that capture all the activities of the domain across the organization. This integration provides different views of the enterprise, relating relevant tasks to be performed by the tools that support them and also, establishing connections between the information sources themselves. Enterprise ontology provides a set of terms covering the various activities of the enterprise. Ontology, that is a communication medium, helps in resolving the ambiguities and creating shared understanding of relevant aspects of business enterprise. Ontology, in an enterprise, contains definitions of several business aspects that include information about people and also information about computational systems across the enterprise. The complete list of enterprise ontology as given by AIAI (The Enterprise Ontology) can form the basis for the definition of Business Context so as to succinctly capture the current business situation.

*User Context (UC):* User's context represents the user's current situation. UC contains user's Current context (CC), defined by the user's current activity and the entities associated with it, and analysed context (AC) gives detailed information about user preferences. Analysing and aggregating user's past contexts generates AC. We consider an activity as a discrete event, for example, receiving an email or attending a meeting. Each context is associated with the following entities: activity being performed, user identity, user's role, location of the user, data being accessed, device being used, time, network communication channel, and network condition.

Together with business context and user's context, the entire enterprise context is captured. Business context provides the most recent and relevant information, from all of the concerned information sources in the current business situation amongst the collaborators, while user's context provides information about which business information is relevant to the user and how best it could be presented to the user.

## 3 CONTEXT IDENTIFICATION

In order to provide the most relevant information at the most appropriate time for a staff of an enterprise, it is essential to track the context associated with the staff on a continuous basis. This is achieved by separately tracking each of the context categories. A

generic, feedback-oriented context identification approach is depicted in Fig. 2.

Observe that the contexts related to the business aspects and user-specific aspects are separately extracted and combined to arrive at an enterprise

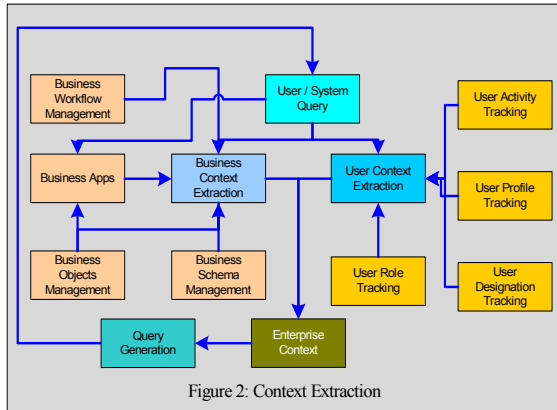


Figure 2: Context Extraction

context.

Business context is obtained based on (a) nature of query inputted by the staff; (b) active tasks part of a workflow; and (c) business schema providing relationship among various business objects and mapping between tasks of a workflow and the business objects.

User context is obtained based on (a) the current role of a staff; note that a staff can play multiple roles at different times; (b) the current designation; this plays a role in the kind of information that can be accessed and provided; (c) the user profile indicating the user-specific requirements; and (d) the user activities that help relevance-based ordering of the information.

Analyses and aggregation of past contexts helps to derive the implicit information and delivery needs of users pursuing a particular activity and the format of presentation of this information in the current context can be captured. This information is used for context-aware information retrieval (Kammanahalli et al 2004).

#### 4 MULTI-AGENT COLLABORATION

We identify distinct agents for each of the context categories in an enterprise. There are basically six broad categories resulting six class of agents: S agents for tracking sensors, P agents for tracking user presence on a network, W agents for tracking user activities with respect to a workflow, A agents for tracking user activities, N agents for tracking agenda items, and G agents for tracking a goal. Agelets (Slets, Plets, and so on), instantiated version

of these agents, are distributed over the enterprise network and they constantly track and provide the changed information to their respective servers. This is depicted in Fig. 3. Observe the both raw data and the analysis results are store in a distributed manner over the enterprise network. For example, SDB corresponds to sensory data and PDB corresponds to presence data (refer to Fig. 3). Agelets can be very thin and can just provide the raw data to the servers. However, in certain cases, especially to reduce the load on the enterprise network, the agelets can undertake some pre-processing before communicating the data to the servers. We further

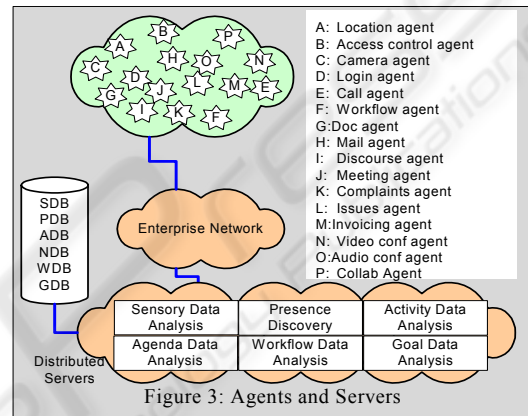


Figure 3: Agents and Servers

discuss this issue later in this section.

In order for agelets to undertake some pre-processing, the data and the available applications within the enterprise are distributed over data grid and app grid respectively. Observe that the app grid contains the enterprise application resources for sharing efficiently the same across the enterprise. Such paired grid architecture helps agelets (that need to operate in real-time) to obtain raw data, get additional data from the data grid, use the appropriate application for pre-processing and required level of analysis, and finally communicate the results to the appropriate DS for context tracking purposes. The collaboration among multiple agents can be either explicit (that is, collaboration in response to a user request) or implicit (that is, collaboration to achieve a system task). An example of these two kinds of collaborations is provided in Fig. 4.

#### 5 DISCUSSION AND CONCLUSION

There is several business scenarios wherein people involved collaborate and negotiate to arrive at a decision. In such situations, providing the right

information for each of the participants helps carry out their tasks more effectively thereby enhancing the overall enterprise productivity. Considering a business scenario in which a group consisting of a purchase manager, an R & D manager, and a finance manager are meeting to negotiate on the procurement of items necessary for a research project requires that the purchase manager is well prepared to answer the queries from both the R & D manager and the finance manager. The required information to help the purchase manager is obtained both from the internal information sources and the external information sources. As described in this paper, both business context and user context are used to retrieve the most relevant information from the multiple information sources. Further, as the meeting progresses and issues get discussed in depth, the context changes and additional information needs to be retrieved and provided to enable the purchase manager to continue to be effective. To achieve this real-time provisioning of information, that may also involve real-time analysis to be performed, combined data and app grids seem to be very appropriate.

In this paper, we have discussed the various aspects of the notion of context in an enterprise and have described approaches for tracking the various aspects of the context in order to provide the most relevant information at the most appropriate time.

We are working on extending a presently under development system for enterprise related business scenarios.

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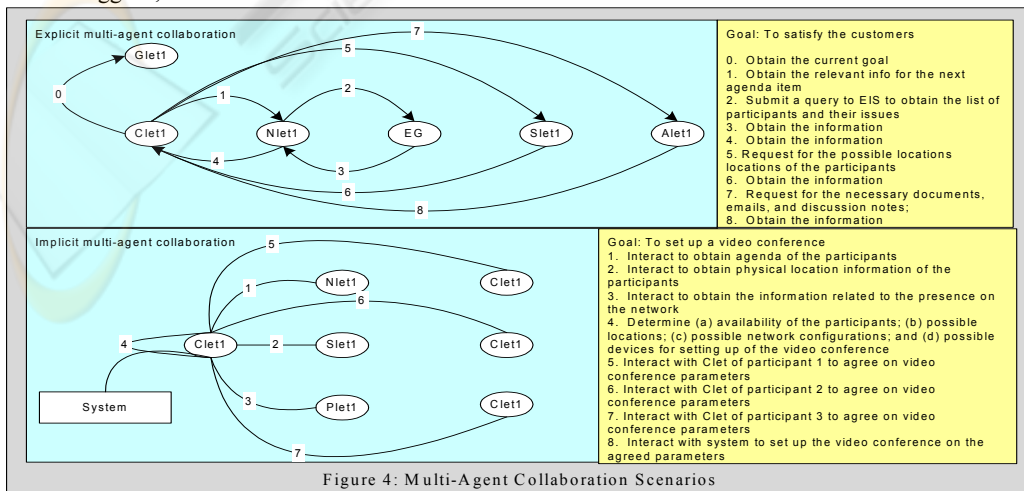


Figure 4: Multi-Agent Collaboration Scenarios