BROADCAST

Basic Research On Advanced Distributed Computing: from Algorithms to SysTems

Esprit Basic Research Project 6360

BROADCAST will develop the principles for understanding, designing, and implementing large scale distributed computing systems (LSDCS), in three broad areas:

- **Fundamental concepts.** *Evaluate and design computational paradigms (such as ordering, causality, consensus); structuring models (groups and fragmented objects); and algorithms (especially for consistency).*
- **Systems Architecture.** *Develop the architecture of LSDCS, in the areas of: naming, identification, binding and locating objects in LSDCS; resource management (e.g. garbage collection); communication and group management. Solutions should scale and take into account fragmentation, and recent technological developments (disconnectable devices and 64-bit address spaces).*
- **Systems Engineering.** *Efficiently supporting the architecture, exploiting the concepts and algorithms developed earlier, as kernel and storage support for numerous fine-grain complex objects; and programming support tools for building distributed applications.*

The BROADCAST partners are: École Polytechnique Fédérale de Lausanne (EPFL, Lausanne, Switzerland), Université Joseph Fourier, Institut d'Informatique et de Mathématiques Appliquées de Grenoble (IMAG, Grenoble, France), Instituto de Engenharia de Sistemas e Computadores (INESC, Lisboa, Portugal), Institut National de Recherche en Informatique et Automatique (INRIA, Rocquencourt, France), Institut de Recherche en Informatique et Sytèmes Aléatoires (IRISA, Rennes, France), Università di Bologna (Italy), University of Newcastle-upon-Tyne (United Kingdom), and Universiteit van Twente (the Netherlands).

For information, copies of the Broadcast Technical Reports, or to be put on the Broadcast mailing list, please contact: Broadcast Secretariat, Department of Computing Science, University of Newcastle-upon-Tyne, Claremont Road, Newcastle-upon-Tyne NE1 7RU, UK. Tel.: +44 (91) 222-7827. Fax: +44 (91) 222-8232. E-mail: nick.cook@newcastle.ac.uk.

Cooperative Working

Pedro Antunes
Technical University of Lisboa - INESC

1 Introduction

One opinion which has been prevalent in the literature about Computer Supported Cooperative Work is that the characteristics of the field are complex to define. This happens mostly because CSCW uniquely combines organizations, groups, individuals, applications, groupware, systems and involves a diversity of perspectives ranging from distributed systems, communications, human-computer interaction, artificial intelligence to social theory.

From the distributed systems perspective, systems have been evolving with the goal of increasing connectivity between computing systems, enlarging available resources and providing more flexible communication infrastructures. Cooperative work, which spawns from synchronous to asynchronous and distributed to co-located cooperations, challenges distributed systems towards more prompt, flexible, interactive and loosely coupling support.

The consequence to the research activities within the BROADCAST project results in a collection of papers addressing different problems and giving different views of the field. This summary outlines two such problems:

1. The implications of large scale integration on the cooperative work support.
2. The support for multiuser interactions as a means of achieving synchronous cooperation.

2 Large Scale Integration

As Pacull, Sandoz and Schiper point out "large scale implies heterogeneity, unpredictable communication delays, and failures, and leads to inefficient implementations of techniques traditionally used [...] in local area networks."

Current approaches to large scale integration have been addressed with systems designed for asynchronous cooperations. This, however, presents a cost which has to be paid with reduced interactivity and awareness, resulting in increased disconnected cooperations which are difficult to coordinate.

The paper "Duplex: A Distributed Collaborative Editing Environment in Large Scale" describes a collaborative editor designed for asynchronous interactions but with a set of facilities that try to avoid some of the problems posed by the asynchronous nature. Duplex also explores two directions to make the system scalable. The first one defines document decomposition and consistency criterions that limit the conflicts between users and allow an adaptive concurrency control. The second direction concerns to the support for concurrent access, global consistency, fault-tolerance, continued access and disconnected mode in a large scale distributed environment.

We should highlight to the reader two important characteristics of Duplex: (1) The structured decomposition of documents allows to optimize the concurrency control. (2) The system is a set of library routines designed for heterogeneous environments and editing tools.

The paper "Concepts and Architecture for Loosely Coupled Integration of Hyperbases" also focus on the necessity of integrating large scale and heterogeneous systems but is rather concentrated in providing an "Organizational Information Glue" that binds together different databases and allows hypermedia and query-based information discovery.

Large scale consideration results in a proposal for loosely coupled access to information that avoids explicit knowledge of the available servers but rather relies on queries to an "hypergroup."

The reader may note the usage of group membership at the core of hypergroups: A user sends queries to hypergroups and the servers which, at that moment, are able to respond to the particular query instantiate a new hypergroup.

3 Support for Multiuser Interactions

Interactive systems and applications have evolved with the objective of providing better communication between human users and computing systems, by improving the usability of the user interfaces and increasing the bandwidth of the person-machine communication. These characteristics should not be lost when evolving from a single user environment towards a multiuser, cooperative and distributed environment.

In this respect, the paper "Multiuser Interface Design in CSCW Systems" describes a set of constraints and interdependencies between the successful design of multiuser interface systems and the underlying distributed systems. Particularly, a large scale communications system has a strong impact on the individual feedback of user's inputs and on the awareness of users' activities. Several strategies, which rely on distributed information and concurrency control mechanisms have been devised to reduce that impact.

The technologies available for executing cooperative tasks range from the simplest communication-only tasks, to information sharing tasks and ending in *process* tasks, which require communication, information sharing and also synchronization and coordination. The paper "A Distributed Model and Architecture for Interactive Cooperation" describes a system where coordination between users is achieved through artifacts. Artifacts are small user interfaces with embedded semantics that can be interactively created and distributed between users' workstations by using a tool.

An interesting concept under the notion of artifact is that sending it can be viewed as a request for action to a user or a group of users but the description of that action is sent along with the artifact.