



Chapter IX

Personal Peer-to-Peer Collaboration Based on Shared Objects

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Abstract

This chapter describes the design and system architecture of a new peer-to-peer technology for personal collaboration based on the notion of shared objects. This approach allows users to collaborate in a rich but lightweight manner by organizing different types of shared artifacts into semistructured activities with dynamic membership, hierarchical object-relationships, and synchronous and asynchronous collaboration. This approach goes beyond simple peer-to-peer file sharing. It requires data replication and sophisticated consistency control to keep data consistent in a blended synchronous and asynchronous environment. The authors present the

design of a prototype system and then develop an enhanced consistency control algorithm that is tailored to the needs of this new environment. Simulation results demonstrate the performance of this approach. This chapter aims at informing researchers about both the potential and the complexity of more advanced peer-to-peer applications and shows the trade-offs in the design and implementation of these systems.

Introduction

Peer-to-peer applications are often equated with file sharing software where users who are part of a peer-to-peer network grant access to files stored on their local computer. While being very popular, file sharing is only one type of application that can be built using peer-to-peer technologies. Peer-to-peer is not file sharing but rather a programming model in which each client in the network also becomes a server at the same time. This model can be used to implement much richer collaborative applications than file sharing.

This chapter describes a new peer-to-peer application for personal collaboration that sits midway between the informality of e-mail and the formality of shared workspaces. E-mail and other ad hoc collaboration systems are typically lightweight and flexible, but build up an unmanageable clutter of copied objects. At the other extreme, shared workspaces provide formal, structured collaboration, but are too heavyweight for users to set up. To bridge this gap between the ad hoc and formal, our approach introduces the notion of “object-centric sharing,” where users collaborate in a lightweight manner but aggregate and organize different types of shared artifacts into semistructured activities with dynamic membership, hierarchical object relationships, as well as synchronous and asynchronous collaboration. Based on these principles, we have designed and built a peer-to-peer prototype system that does not burden the user with the overhead of manually creating shared workspaces or setting up conferences on centralized servers; it provides rich collaboration combined with the lightweight characteristics of e-mail by leveraging local processing power and storage and through direct peer-to-peer communication.

This chapter focuses on the peer-to-peer architecture and implementation of this system and the technical challenges that our design philosophy poses. Keeping replicated data consistent in an architecture that supports real-time and asynchronous collaboration at the same time is not trivial, and relatively little research has been done in addressing this problem. Our approach enhances a popular consistency control algorithm, which had been originally designed for real-time collaboration. We present and discuss various strategies for how this algorithm also can be used to maintain consistency in asynchronous modes or when people

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