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Rapid development of distributed applications using high-level communication support

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ABSTRACT

This paper proposes a communication system that enables simple and fast development of network support for multi-user applications. Even though existing middleware and development tools provide much functionality to realize distributed applications, they are purely low-level services passing most development responsibility to developers or too specialized for a specific application. The challenging issue is how to provide sufficient support and general high-level mechanisms using middleware for the rapid development of distributed multi-user applications. Our approach addresses various possibilities of the communication architecture, user membership management, content transmission mechanism and event management to meet different networking and interaction requirements of multiple users. The proposed middleware supports these features with several options through application-level APIs and configuration. Thus, the different interaction needs of a multi-user application can be easily and quickly accomplished from the developers' view point.

1. Introduction

The Internet has become a common infrastructure to connect many users (or nodes) interacting with each other with various ways to share their contexts. It has become prevalent to develop multi-user applications in both academic and industrial societies, such as instant messaging services, multi-user online games, and networked virtual communities. This trend also extends existing stand-alone applications for single user and has evolved to ones for multiple users. If an application developer wants to develop a multi-user system or change a single-user application for the multiple users, he/she has to take into consideration the intrinsic functionalities of the system and how communicating nodes can connect and communicate with each other.

The developer could perform pure socket level network programming or use other application level communication toolkits or middleware to implement the multi-user communication support. However, in the case of socket level programming, application developers have to take care of everything relating to communication from low-level socket management to high-level aspects of distribution to users. Although some existing communication middleware systems provide high-level wrappers of basic functionalities for network programming, they still need to improve in terms of easy and fast development of multi-user systems. Some communication environments still put many responsibilities onto developers, instead of supporting diversities of fundamental communication facilities. Conversely, other toolkits focus on specific applications and it is difficult to use them for other systems.

In this paper, we propose an application-level communication middleware that enables developers to make multi-user applications in an easy and fast way, considering a common step to implement them. To this end, we extract general requirements to develop a distributed application in terms of communication architecture, user membership management, event management, message delivery and process, and support for various content transmissions. Existing middleware and socket-level approaches support some or none of these fundamental requirements, which causes long development time and application codes for the multi-user supports. Our proposed communication middleware provides applications with simple high-level application programming interfaces (APIs) to support required functionalities. Using the proposed communication middleware, developers can implement a fundamental communication environment for multi-user applications with a few function calls and configuration files. They can easily change parameters of functions and configuration files if they need different options of fundamental requirements. As most communication supports are provided by our middleware, distributed applications can be established with less development time and codes.

The communication middleware consists of three main manager modules: communication manager, event manager and

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