A TCP/IP Daemon that allows Inter-Application Communication across the Internet

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Abstract: This paper describes the specification and architecture of a remote teaching system developed in the COPERNICUS Project "Learning and Educational Access using Remote Networks - Enabling the Disabled" (LEARN-ED). It is a TCP/IP based system that allows inter-application messages to be passed between computers connected to the Internet. The use of the system is illustrated with a distance education service - a multiplatform lecturing system that allows the display of lecture slides (pages) on remote machines to be controlled by the lecturer.

1 Introduction

Development of a suitable method for remote teaching was a key task in the LEARN-ED project aimed at finding ways of improving the access to University or Higher Education studies for students with disabilities. Nevertheless our method can be empoyed by able bodied people as well, because its usability by handicapped persons is mostly the matter of terminal adaptations. The project itself dealt with the problem how telecommunications technology can be used to enable teaching activities and information to be available to students, even when the students are not physically at the site of the teaching activity and information. To support remote education the consortium dealt with both access to persistent information and access to live activities. This paper is focused on the second type of activities.

2 Functional Specification

The requirements involve relaying events to another location on campus, using the campus LAN, but also to an off-campus location, using ISDN, PSTN, or radio links. The core events of interest are the teaching events, when common information being presented or discussed should be available to the remote student. In addition, the student should be able to participate in the discussion by receiving and presenting audio, live text chat, and, if possible, video. The principle functional components of the required service are:

- Audio conferencing between each remote student and the participants in the same venue as the event
- Video conferencing between each remote student and the participants in the same venue as the event
- Text conference abilities to allow specific detailed data to be exchanged (e.g. e-mail or URL addresses)
- Whiteboard facilities to allow all participants to view and annotate commonly visible documents
- Teaching material display to all local and remote participants (the timing and sequence of material to be displayed should be under the control of the director of the teaching event, e.g. the lecturer or the tutorial leader).

3 Technical Specification

3.1 Videophone

The functional requirement for video, audio, and text chatting facilities will need to be provided over low bandwidth links. Some systems have been developed to provide these functiona across TCP/IP Internet links. This is attractive because the same network technologies could be used for the information and the conferencing services. Systems are required that will allow information to be shared on MS Windows, MacOS, and UNIX platforms. The *CU-SeeMe* videoconferencing system meets these requirements and is available for both Windows and Macintosh computers. For interaction with UNIX systems, the *vat* audio conferencing system and the *nv* video conferencing system can be used.

3.2 Controllers and Daemons

To provide a suitable remote teaching system the LAERN-ED consortium developed a set of programs for all the commonly used platforms (MS Windows, MacOS, UNIX, and also KA9Q).

Both the information distribution service and the live conferencing service use the TCP/IP communication protocol. The information services depends on providing information in the form of HTML pages. This medium could also be used to present the lecture slides. In this case, there is a requirement for a mechanism for controlling the display of the slides on the remote machine as well as the local machine. The remote WWW browsers should accept a message telling them to load a new slide, based on its URL. This mechanism is available through the Application Programming Interface (API) of the Netscape Navigator WWW browser. The advantage of such a system would be that it would provide high quality detailed slides direct to the desktop of the remote students as well as for projection to the local students. This could be achieved at a much lower bandwidth than a video slide display system as traffic is confined to inter-application messages and the HTML definition of the slide and its dependent pictures.

The LEARN-ED remote teaching system should function within an Internet Protocol (IP) transport infrastructure, the most prevalent infrastructure within universities. The services are intended to be accessed by individual students using a desktop personal computer or workstation. The hardware requirements are relatively low to keep the costs of the equipment to realistic levels.

3.2.1 Architecture

Basically there are these three types of programs within the system:

- Controllers
- Daemons
- Controlled applications

A *controller* sends messages to a *daemon* running on the same machine as the controller. The daemon relays them to daemons on remote machines. The messages are then forwarded to the appropriate applications (*controlled applications*), e.g. Netscape. Remote daemon(s) send responses back to the originating daemon that sends them to the controller.

More than one conversation of this type can take place on the same set of machines, i.e. it is possible to run more controllers together with more controlled applications on the same machine. As a rule, each machine runs one daemon. Messages sent from the controller and relayed by the daemon are platform-specific messages encoded as text. The links between daemons are TCP links. The format of the messages is uniform, so daemons for all supported platforms are interoperable.

Conceptually, the daemon is a simple component. It just relays messages and does not translate them between formats required for each platform. It is the responsibility of individual controllers to knows which operating system is running on each remote host and to send suitable messages. Each remote machine informs the controller of its type when a connection is established.

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