# A PLATFORM FOR THE IMPLEMENTATION OF THE SERVICES OF AN EDUCATIONAL NETWORK

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*Abstract*

*Multimedia and hypermedia had and still have a tremendous impact on the evolution of educational software. In this paper we propose a platform for the implementation of the services of an educational network over TCP/IP networks such as the Internet. Our proposal aims at providing an integrated communicational environment which supplies the communicative needs of one educational community, using the latest telecommunication and multimedia information processing technology. We propose various kinds of communication forms for the interaction between the participants.*

## 1. Introduction

The rapid development of Internet technologies and multimedia information processing technologies has provided the opportunity for building innovative applications which lead people to a totally different way of acquiring knowledge and collaboration.

Nowadays computer based learning has become more powerful. The integration of multiple media into computer systems has enhanced the effectiveness of the educational software by providing a more lively and expressive way to represent knowledge. On the other hand in the educational community there is a need for collaboration from a distance, instead of the traditional interaction between trainers and trainees.

Among all the existent technologies on the Internet, the Web provides the most capabilities for distance learning ([2]). The use of the Web as a communication medium for an educational community has many advantages ([6]). The Web can be used either for synchronous or asynchronous learning. By the term synchronous learning we mean the educational process in which the trainer interacts with the trainees in real time. On the contrary by the term asynchronous learning we mean the educational process in which the trainer does not interact directly with the trainees.

The subject of distant learning and collaboration has engaged researches all over the world. Many solutions have been proposed for distant learning and collaboration over the Internet. Indicative commercial tools for collaboration over the Internet are Microsoft NetMeeting and White Pine Enhanced CU-SeeMe. Various methods have been proposed for synchronous learning ([4], [9], [1]), asynchronous learning ([11], [14]), or asynchronous learning with an on-line facilitator ([13]). Various models for collaborative environments that come to cover the communicational needs of collaborative work in a learning environment either synchronous ([5], [3], [10]), or asynchronous ([12]) have also been proposed.

The most prominent feature of our proposal that makes it better among the above mentioned existing implementations is its fully integrated environment, which is flexible and adaptive to many possible requirements. In other words, our proposal aims at covering a wide range of related applications instead of limiting its capabilities to a specific operation, which is the case with other existing tools. For instance, the model that we propose can be used for virtual lectures, virtual conferences, collaborative work on projects shared among institutions, exchange of useful material and experiences among teachers, circulation of research results and conclusions as well as versatile and more attractive presentations of the subjects taught. Our proposal is based on the needs of an educational network as they are described in the next section.

## 2. Motivation factors

An *Educational Network* is a large distributed multimedia information network, that allows its users to communicate, interact and receive various services aiming at the upgrade of the offered educational services. In such a network, information is located in some central points, which are administered, maintained and updated by authorized entities, thus offering educational and instructional services to a community of learners worldwide. Such a setting, enables Open and Distance Learning (ODL) to be adopted and exploited.

Open and Distance Learning can be regarded as learning by means of Telematics (i.e. the combination of means of telecommunications, information technology and multimedia).

### 2.1. Services of an Educational Network

The services offered by an educational network fall in the following major categories (potential end users' needs as expressed in various projects addressing the introduction of ICT in the learning process, have been used for this classification):

1. Interpersonal communication services. Electronic mail (E-mail) service with the extension of handling multimedia information should be offered to the users of an educational network, as well as "fora" for discussion and debates on various educational subjects via a news service.

2. Creation and maintenance of a Web server, providing information to the users of the educational network. Access to sources of information existing on the Internet, as well as other educational networks, via a Web browser.
3. Video distribution of lessons, that reside in remote servers. These lessons will contain multimedia information and will offer the equivalent of an electronic textbook.
4. Multimedia teletraining tool. This tool will allow the on-line delivery of remote training sessions from the trainer to the trainees.

The basic idea of a centralized architecture is that there exists a *"Training Entity"* that holds all the interaction required between trainers and trainees and will play the role of the educational services provider in an *Educational Network Environment*.

The architecture proposed in this paper, addresses the issue of an authorized training entity that offers uniform and integrated provision of the afore-mentioned services, under a common platform. This platform incorporates widely available Internet technologies (WWW, Java) for the realization of educational services, thus facilitating access to these services from almost every interested user. The approach of a centralized architecture, using of a common platform for the provision of educational services, has the following advantages:

- The training entity can be hosted on the premises of an educational authority, who will be responsible for the content and the model of the offered services.
- The technical support will be much more efficient if the hardware and the software modules involved reside in the same place.
- The access to the educational services is offered to almost everyone interested uniformly (through his Internet connection and Web browser).

## 3. Model description

Our proposal aims at offering a common platform for the services of the educational network which is described in the previous section. Our proposal gives students and teacher the ability to communicate, exchange ideas, access educational material and other educational networks and collaborate having as a goal, the acquisition of knowledge, through the CSCL/W (Computer Supported Collaborative Learning/Work) capabilities.

The main concept of our proposal is the *Session*. Session is a CSCL/W activity that is handled in our proposal. The participant who creates a session has full permissions on that session and manages that session. We call that participant the *Leader* participant. The other participants (the participants except the leader participant) have the permissions that the leader participant has given to them.

In order to achieve the above goals our proposal is based on the following concepts:

- An integrated communication environment that covers the communicational needs of a group of participants.

- A client-server model. We propose a model that has one server and multiple participant clients.
- An open platform architecture in order to support different operating platforms.
- International accepted standards.
- Access through Web pages.
- One server, which can support multiple sessions.
- Modular design to achieve the goal of easy extension.
- Widely accepted (standard) network protocols for the interaction between the clients and the server.

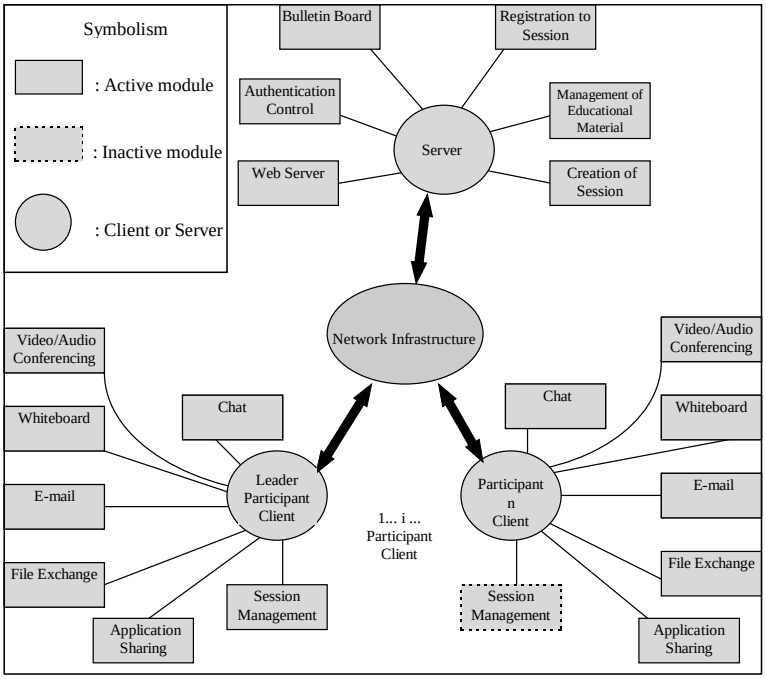


**Figure 1: Proposal architecture**

In *figure 1* we can see the proposed architecture and the modules with which the server and the clients are composed.

By adopting the above architectural issues we have the following advantages:

- One integrated communication environment can be used to cover different communication needs.
- Interactive communication with the use of video, audio and other data types through TCP/IP networks like Internet.
- Independence from the operating platform. The basic characteristics of our proposal can work over any platform supporting Web technology.
- User friendly and familiar user interface. The participant's client environment in our proposal is accessed through a Web browser, with which many users are familiar.
- Reduced cost for development and administration as well as increased flexibility. The latter implies that a single server is capable of taking over multiple sessions.

## 4. Functionalities

Due to the various kinds of communication in a classic situation of learning or collaboration, different mechanisms must be established for sufficing the needs of an educational community over the Internet by our proposal. Our proposal will attempt to broaden the horizons of learning and collaboration. Thereby, optimized integration with simple operation mechanisms is an essential necessity. In order to create a complete communicational system, able to satisfy the needs of an educational network, our proposal is designed as a simulation of a real situation.
As it has been already stated, our proposal follows the client-server architecture and has two environments, the server environment and the participant environment. In the following sections we describe separately the functionalities of each environment.

### 4.1. Functionalities of the server environment

The server acts like a meeting point for the participants. The server is saddled with the functions of management of educational material, session creation, session announcement, session registration and authentication control. Through the server, participants can be informed of the several sessions, register to one session, join one session or create their sessions. The functionalities proposed for the server are:

- *Management of educational material:* The server with the association of the Web server, where the educational material is stored in the form of Web pages, offers the participants the capability to access the educational material of the educational network.
- *Session creation*: One participant can create one session and become leader participant of that session. Through the session creation procedure the leader participant gives the necessary information for the announcement of the session in the bulletin board. Through the session creation the leader participant gets a login and a password, that helps the server to recognize him through the authentication control.
- *Bulletin board for sessions announcement*: The server has a bulletin board in order to inform the participants of the different sessions.
- *Session registration*: When a participant finds a session that interests him, he can register for it through a session registration procedure. The session registration procedure gives each participant a login and a password in order to join the session. It also gives the leader participant the ability to know the other participants that register to his session.
- *Authentication control for a session:* A participant has to pass the authentication control in order to join a session. After the authentication control the participant can access the pages of the session that he has joined. With the authentication control the server can recognize the leader

participant and enable his session management module. The authentication control is handled by the server.

### 4.2. Functionalities of the participant client environment

Through the participant client students and teachers access the capabilities of the educational network. All the participants use the same client environment. The difference between the leader participant and the other participants is that in the leader participant client, the session management module is active and in other participants' clients the session management module is not active. We follow the above mentioned approach because a simple participant, in one session, can be leader participant in one other session and the reverse. The participant environment should be user friendly. For the participant client we propose the following functionalities:

- *Video/Audio conferencing*: A participant can have visual contact with the other participants through video windows, if the necessary bandwidth is available. Through this capability participants can communicate as if they were in the same physical place.
- *Whiteboard*: By using the whiteboard one participant can broadcast information to other participants, like slides, shapes, etc. With the whiteboard the participants can exchange ideas. More specifically whiteboard is an effective way for communication.
- *Chat*: The chat function can work together with the audio capability or solely when the audio communication is not feasible. The chat function gives us a flexible solution for communication when the available bandwidth is limited.
- *Ability for bi-directional and multi-directional independent communication*: A participant has the authority to select which participants he is addressing.
- *File exchange*: The ability to exchange files between the participants contributes to the learning procedure.
- *Application sharing*: The ability of application sharing enhances the collaboration procedure. Through this capability the participants can share applications and collaborate as if they were in the same physical place.
- *E-mail*: The ability of the tool to support typical e-mail functions (send and receive e-mails) helps to create the integrated communication environment we want to provide.
- *Session management:* This capability is active only in the leader participant client. Through this capability, the leader participant can manage the session and determine the permissions of each participant.

## 5. Implementation issues

In this section we present some ideas about the implementation of our proposal. To ensure the independence of the operating platform, on the programming level of the implementation, we have

to use a programming language which is independent of operating platforms. Such a programming language is Java. With the use of Java our proposal can be accessed by different machines like Windows based or Unix based machines. The server part of the application can be a Java application. The server as a Java servelet which cooperates with the Web server, used to store educational material in the form of Web pages, manages the sessions. The participant client may consist of a number of Java applets. Each applet will be responsible for one particular module. That is, we propose different but cooperating applets for the video/audio conferencing, chat, whiteboard, e-mail, application sharing, file exchange and session management modules. A participant, after the authentication control procedure, will access the service of our proposal by calling the applets of the client through a familiar Web based user interface.

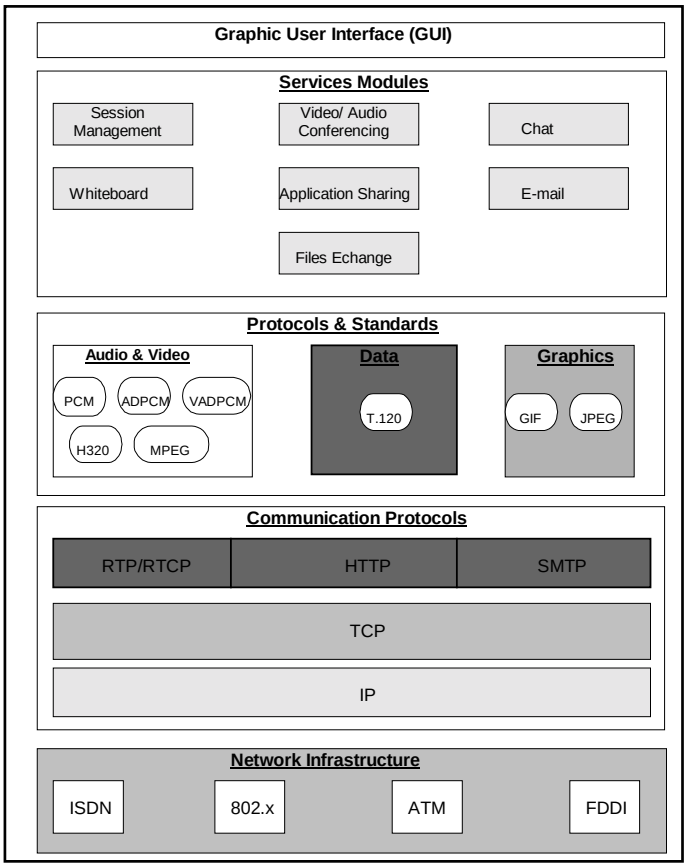


**Figure 2: Protocols, standards and structure of our proposal**

The Web pages of the server may use a language like Javascript or DHTML to overcome the Web pages static features, and provide more attractive ways of presenting the content.

In *figure 2*, we can see the protocols, standards and structure of a possible implementation of our proposal.

The protocols that will be used for the implementation are based on the TCP/IP protocols suite and include HTTP, RTP/RTCP, SMTP.

Standards will be used so that the implementation will be open include GIF/JPEG for the compression of the graphical material, PCM/ADPCM/VADPCM for the compression of the audio, MPEG for the compression of the video, H.323 for the real time transmission of the multimedia information and T.120 for data exchange.

## 6. Usage Scenarios

Our proposal is well suited for the communication needs of an educational community for various situations. In this section we describe scenarios of use, of our proposal, for teaching and collaborative work for a project.

In the scenario of teaching we have a teacher and his students who want to communicate through distance learning. Before the lecture the teacher has to create a session through the session creation capability and become the leader participant for that session. The new session and information for it (like theme, teacher, day and time) is announced in the bulletin board of the server. The students can register to the session through the register procedure of the server, and the register procedure gives them a login and a password for joining the session. After the registration procedure, students become participants of the session. The arranged day and time of the lecture, the teacher and the students join the session through the authentication control. With the authentication control the server recognizes the leader participant, in this case the teacher. The teacher as the leader participant can determine, through the session management, the authorities of each student. The teacher can make his lecture with the video/audio applications and can use the whiteboard which simulates the blackboard of a traditional classroom. The teacher may project educational material in the whiteboard, seen by all the students and annotate this material during his lecture. The other functionalities of the client can help the learning process. Apart from a teacher's lecture, students can access the educational material on their own without the need of teachers being present (asynchronous learning scenario).

In the scenario of collaborative work for a project we have a group of participants who want to communicate through the distance collaborative work. One participant creates a session and becomes the leader participant of that session. The other participants register to that session and receive a login and a password in order to join the meeting. All the participants join the session through the authentication procedure. The leader participant determines the permissions of each participant. The participants can work and collaborate through the capabilities of the participant client. The participants can communicate through the video/audio capability, represent their thoughts in the whiteboard and share applications and collaborate as if they were in the same physical place.

## 7. Conclusion - Future Work

With the advancement of technologies, learning and collaborative work in the future can become radically different from what it is today. Although no one can expect that educational networks will totally replace the traditional lecture and traditional collaborative work, it is likely that such applications will obtain more and more positive ground in the future. On the other hand with the use of our proposal the participants will have an integrated communication environment to cover several communicational needs like CSCL/W. With our proposal the user is free of those constraints brought by location and operating platform.

Our next step is to implement a tool that realizes our proposal and evaluate its usage in a real world.

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