# THE DESIGN AND DEVELOPMENT OF ADVANCED NETWORK SERVICES OVER THE PATRAS UNIVERSITY CAMPUS NETWORK

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**Abstract:** This paper presents some results of the initial phases of a big internal project running at the University of Patras. In this project - which is co-funded by the European Union - our team is responsible for the development of the Advanced Network Services over the Campus Network, which is being established during the project. In the following chapters we first present the general perspective and the architecture of the integrated system which offers the set of advanced services to the University community. We then describe in detail the different services (WWW and Intranet, On-line teletraining, Computer supported cooperative work, and Off-line teletraining). A key characteristic of the system is the integration of existing commercial tools, with tools that we are developing for the specific needs of the foreseen users. It is evident that this system can be considered as a pilot project for large and demanding user communities, as is the case with the University of Patras.

## 1. INTRODUCTION

The introduction of advanced network services into a university environment is today a basic need, the satisfaction of which enables the leverage of the campus administrative operations, the collaboration between different scientific groups within the university providing new means of communication and introduces the use of new teaching methodologies via the network. However, it is not an easy task since it has to overcome the traditional ways of administration, information sharing, and teaching. Moreover, it needs an effective user-oriented implementation and support mechanism in order to assure its widest acceptance and use by the academic community.

The majority of the universities all over the world supports a wide range of advanced network services based on WWW technology. According to our research:

?? The use of Internet for the provision of information and the support of administrative operations within the campus environment is very wide.

?? Intranet technology has not yet been widely exploited and a limited number of universities mainly in USA have developed Intranets [2] [3], but the current trends show that they will be widely used in the next years [Bernard, 1996] [1].
?? Teletraining (off-line and on-line) and teleworking systems are extensively used and in the last few years they are adjusted in using WWW technology.
?? CSCW (Computer Supported Cooperative Work) systems are widely used and especially joint editing as well as videoconferencing systems [4].
?? In the Greek universities the use of advanced network services is in a quite precocious status and the services that have been developed are in an experimental level [Bouras, 1996] [Bouras, 1995].

The basic aim of our project is to provide a set of advanced network services in the campus of Patras. The key point in this effort is to provide the whole set of services under a uniform platform that is to integrate the services into a system using WWW technology. Beyond the basic services (e-mail, ftp etc.) that are going to be implemented within this project the final system will integrate the following set of advanced services:
?? A WWW-based information service.
?? Intranet services to support the administrative operations within the campus.
?? Distance learning by means of on-line and on-line teletraining via the Web.
?? Teleworking facilities.
?? Videoconferencing facilities.
?? Applications supporting collaborative work.

The whole system will be realized through the use of the University network which will be based on the TCP/IP protocol technologies enhanced by the 100Mbit speed, obtained by the fiber optic lines (FDDI) used to connect the University backbone. Two ATM switches will be exploited to connect the high demand real-time applications such as video conferencing.

## 2. THE OVERALL SYSTEM ARCHITECTURE

The overall set of services will use the Client - Server model so as to take advantage of its ability to distribute data and processing chores across the campus network [Nikolaou, 1990]. The main parts of the application and services run on a centralized server and any user may have control using special client software designed for this purpose. The main parts of the application and services run on centralized servers and any user may have control using special client software designed for this purpose. Thus, a number of servers has to be implemented for the provision of the vast volume of information for every department of the University of Patras. Storing and distributing this information using only one server, is not a good solution for a number of reasons:
?? the ever growing volume of information originating from the large number of departments of the university, will certainly pose storage problems
?? the expected large number of visitors in the web pages of the university server is expected to slow down considerably its network performance
?? possible malfunction of the central server will result in the total suspension of every WWW service

In general, the architecture of figure 1 has been chosen for the implementation of the services.

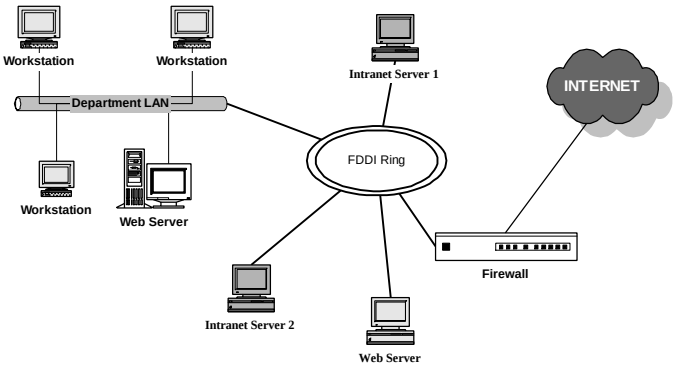


*Figure 1 : Representation of the overall System Architecture*

A central server will store general information concerning the University (historic, geographic information) and links to other servers, which operate in every department of the campus. Similarly, the servers of each department will contain information for the department and links to laboratory WWW servers. Each laboratory will use a separate server for the publication of its research achievements, along with various technical and educational information.

It should be noted that a laboratory server is not a dedicated WWW machine. Due to the relevant low traffic expected for each laboratory server, standard computer equipment will be used for this purpose. Another alternative is the virtual host implementation, where multiple laboratory servers will be hosted in a single machine. Department servers may also be temporarily hosted in the central university server.

The WWW clients are installed in workstations (personal computers or Unix machines) and every user can access both local and remote WWW servers (of other departments or universities). The implementation of the network services requires the use of special transport and control protocols for the handling of information. TCP/IP will be used as the standard communication protocol and HTTP (HyperText Transfer Protocol) for the transfer of data. A number of protocols including the T 120 ITU set of protocols for transport-independent multipoint data conferencing, the RTP/RTCP IETF packet format for sending real-time information across the network, the LDAP IETF set for directory access and the H.323 conferencing standard for video conferencing and audio support will also be used in this implementation [Wolfinger, 1991].

In the physical layer, the university WAN uses FDDI, ISDN, and in the near future, ATM technology. As far as data security is concerned, the use of special transport protocols such as SSL (Secure Sockets Layer) or/and S-HTTP (Secure HTTP), authentication based on the source network address, passwords and firewalls ensure the transfer of confidential information through secure channels. The mail services will use a variety of protocols including SMTP, MIME and POP3. These protocols will be used for the transfer of messages via e-mail or distribution mailing lists. The inclusion of MIME

enables the transfer of not only text but multimedia messages. Finally, the Intranet architecture will use the client - server model and the same protocols as the web services.

## 3. SERVICES AND TOOLS PROVIDED BY THE SYSTEM

In what follows we present the basic services and tools that are going to be developed within the project life cycle. More specifically, we present the WWW and Intranet services as well as the teletraining tools and the teleworking facilities.

### 3.1 WWW & Intranet in the University of Patras

The University of Patras (UP) will provide all the information concerning its activities through the platform and tools of the World Wide Web (WWW). WWW is the most advanced networking way of presenting multimedia information to naive or experienced users. All user categories will be facilitated by the uniform platform of the developed web interface either they belong to the Intranet community or from outside the university.

The central web server of the university will contain the following set of information:

?? Historical and geographical information concerning the university territory.
?? Various matters concerning students and educational information provided by the UP and facilities inside the university.
?? Advanced mail and name search catalogue of all the University staff and an up-to-date link catalogue to all other departmental Intranet servers.
?? A flexible search engine to traverse all web servers of the UP and return the most prominent information web server.

The web server used is the freeware APACHE Web Server for UNIX. This server provides plenty of performance enhancements and enables the creation of dynamic hyper-documents. Considering the HTTP V1.1 support, its native capability to connect to databases and its support for Microsoft Frontpage Server Extensions, APACHE is the best choice as a web server. In case the web server meets high data traffic, the rotating DNS option will be exploited to face the network starvation and packet congestion.

Despite the fact that a part of the material will be publicly available, most of the web server contents will be available after authentication. Using usernames, password, host names or combined methods, access will be granted upon request. Special research groups will communicate sharing ideas as a closed user group. Subscribers can only view that particular information. Building an Intranet is a resolved technical issue. Firewalls are used to filter data packets to and from the inside network. Successful configuration of them makes the entire network run smoothly.

### 3.2 On-line Teletraining and the Computer Supported Cooperative Work Tools

#### *3.2.1 The Computer Supported Co-operative Work (CSCW) Tool*

The on-line teletraining and the Computer Supported Cooperative Work tools use, as a platform, the Microsoft NetMeeting communication environment. This is a multipoint data conferencing product that supports application sharing and real time voice communications over the Internet and corporate Intranets. The NetMeeting environment [5] provides an open, standards-based operating system platform which offers audio, video and multipoint data conferencing services, all based on industry standards. It runs over a modem Internet connection, IP over ISDN connection, or a local area network.

The set of services provided by the Computer Supported Cooperative Work system [Grudin, 1995] developed for the University of Patras are:

1. A shared workspace for the co-writing of documents - papers - books.
2. Communication capabilities (email, chatboard, whiteboard teleconferencing).
3. Shared Applications.
4. File exchange (even for multimedia files).

The primitive feature of the tool is the first one, which provides a friendly shared workspace between remote users working together writing a report or a book. Access control mechanisms for the assigning of permissions for each user, concerning access right over a document (or a portion of the document), are used to establish a collaboration protocol. These access rights are:

?? *Write* for the capability of full interference over the document
?? *Read* for only reading the document
?? *Manager* for the assigning of access rights
?? *Null* for no right at all
?? *Annotate* for the creation of annotations over a document

#### *3.2.2 On-line Teletraining Tool*

The on-line teletraining tool, is a tool that achieves the realisation of real-time courses via computers and computer networks. The main idea behind the concept of on-line teletraining is that the teacher is able to communicate with the students as if they were in the same classroom at the same time. Therefore there is a need of a more realistic approach. In order to achieve it, the tool provides a set of functionalities such as :

?? *Application sharing*. There is be a way for both the teacher and the students to communicate with each other using some applications such as a text editor, or a tool for the transparencies presentation.
?? *Shared whiteboard*. The teacher is able to provide a realistic way of communication if there is a need to demonstrate something different from the originally designed presentation.
?? *Audio communication*. We can’t think of a realistic way for conducting a lesson without using audio. It is the most important aspect of a teletraining tool and of course it is included as a functionality of this tool too.

?? *Video communication*. The addition of the video feature in teletraining tool will significantly improve the quality of this tool.

For the implementation of this tool the Microsoft Netmeeting platform was found very helpful. Apart from the original Microsoft product, there is a software development kit (SDK) which provides a set of API's for development of videoconferencing and application sharing tools.

#### *3.2.3 System Architecture of the Services*

At the core of the developed on-line teletraining and Computer Supported Co-operative Work system architecture is a series of data, audio and video conferencing and directory services standards. These standards work together with transport, application and user interface components to form overall architecture, which is shown in figure 2.

### 3.3 Off-line Teletraining Tool

Lectures in universities' classrooms are complemented by this kind of service. Teachers can provide additional lessons by means of off-line teletraining and students can use this service any time of the day except from attending the lessons in classrooms. Its only drawback, compared to on-line teletraining is that it provides static content material while there is no direct interaction between the teacher and the students. On the other hand the teaching material can be enriched with various types of media such as text, images, sounds and video. The presentation of the lessons can also be enhanced with various scenarios defined by the author.

Off-line teletraining is going to be developed in the University of Patras by means of a *WWW server* and a *media server*. The media server will be based on the RealMedia architecture for providing video and audio content in the lessons.

#### *3.3.1 What is the RealMedia Architecture?*

RealMedia Architecture (RMA) [6] provides an open platform for development of real-time streaming media applications as well as a market and distribution channel for streaming products and content.

The RealMedia Architecture combines RealAudio and RealVideo into a platform for the development of streaming media applications that is designed specifically for the existing infrastructure of the Internet. It is an open framework of client and server plug-ins and APIs whereby Application Developers can build plug-ins for the RMA which stream and play time based media, including audio, video, MIDI, text, images, animation and presentations.

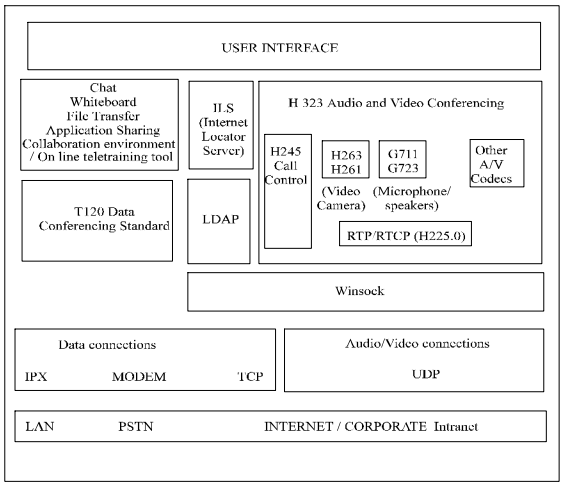


*Figure 2 : On line teletraining and Computer Supported Co-operative Work system architecture*

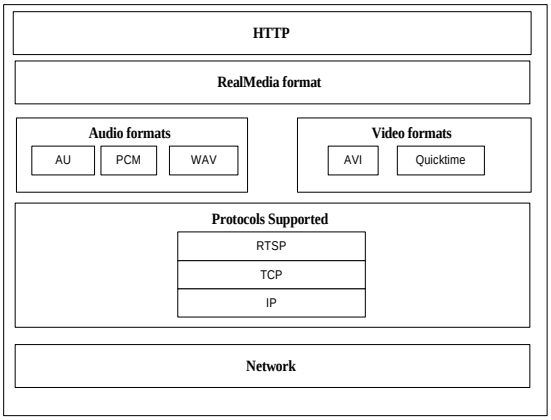


*Figure 3 : RealMedia Architecture*

### *3.3.2 System Architecture of the Service*

The architecture of the off-line teletraining service is based on the client-server model. In figure 3, the various components (protocols, formats, etc) that comprise the RealMedia architecture are depicted. The basic components that comprise it are the following ones:

?? *WWW server* where the lessons are stored. For every lesson a presentation scenario is associated. The presentation scenario of a lesson actually describes the spatio-temporal relationships among various media objects (text, images, voice and video). The inline audio/video objects are stored in the RealMedia server. When a lesson request is triggered, the specific server where that lesson resides on is contacted. The server searches the database of provided lessons and locates the requested lesson.

?? *RealMedia server* in which video/audio objects are stored. The RealMedia server is activated by the WWW server when the lesson contains video/audio presentations. The video/audio files are stored in RealMedia format and transmitted on on-demand basis. That means that no hard-disk space is required in order for the video/audio to be played on the user's side.

?? *Browser* is the integrated graphical environment through which the user interacts with the service by retrieving and browsing lessons. The browsers also manage the synchronised presentation of the requested lesson.

## 4. CONCLUSIONS

At the University of Patras there will be developed a set of advanced services to facilitate academic and research activities. Internet applications are worldwide used to support all relevant activities. Web pages developed will include a number of information and search engines will be used to provide access to these pages. Although, Intranets are not widely used in academic environments, but recently a tension has aroused in developing such services (especially in the USA) to support intercommunication between the different departments of the University of Patras. The service to be developed will serve as a guideline for all relevant applications to be developed in the future in Greece.

Teletraining and Computer Supported Co-operative Work (CSCW) tools are widely used by Universities although recently they tend to use or adjust existing tools to the WWW. Tools supporting the provision of off-line teletraining are more commonly used rather than tools offering on-line teletraining. CSCW tools used in academic environments usually are shared editors. In Greece the application of advanced network services is limited to experimental systems and no real applications can be reported. The development of these tools will be the first actual integration of teletraining and CSCW tools in an academic environment.

The services to be developed at the University of Patras will facilitate and support all research and academic activities providing one of the most enhanced communication environment worldwide.

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