EVOLUTION TOWARDS M-LEARNING: DEVELOPMENT OF MULTIMEDIA TOOLS AND METHODS

M. Olabe, X. Basogain, K. Espinosa, C. Rouèche* and J.C. Olabe+
*Information and Communications Technology, ESIGELEC – Rouen, France
+Electrical and Computer Engineering, CBU (USA)
Escuela Superior de Ingeniería de Bilbao, EHU
Grupo Multimedia-EHU
http://multimedia.ehu.es
Bilbao/Spain
miguelangel.olabe@ehu.es

Abstract

The Grupo Multimedia of EHU has been working in the area of on line higher education during the last ten years, focusing in the creation of video/multimedia as an integral element of the teaching process [1].

The Grupo Multimedia has developed several types of models for multimedia courses. These models include in different arrangements the video presentation of the professor and/or the computer activity used during the lectures [2].

In the implementation of project [3] the Group has analyzed the multiple factors with a significant impact on the migration from systems of e-learning using video to systems of m-learning (mobile-learning).

The factors include the services provided by mobile PDA's and mobile telephones, the services and limitations of video streaming platforms and servers, video encoders, and others.

This analysis produced a roadmap for the implementation of the process of migration from one system to another, including tasks of change of multimedia formats, codecs, and the set server-client [4].

In this project the Group developed a set of tests for different types of videos over wireless networks Wi-Fi and wireless digital telephone networks 3G in order to evaluate the capacity and limitations of mobile devices (HP iPAQ, hw6915, and the phone Pocket PC HTC TyTN 3G) in the process of receiving and reproducing the video signals.

The performance results of these tests support the conclusion that the current state of networks and devices is appropriate for the development and deployment of m-learning applications.

Keywords
E-learning, m-learning, education, multimedia, communications.

1. INTRODUCTION

The concept of streaming develops when computers have the ability to process video signals. Internet was in its initials steps in university environments and the possibility of having access to multimedia content via ftp access was at the same time tempting and inefficient. The videos required a great bandwidth for its transmission and it was necessary to download the files via low bandwidth lines, which was at the time frustrating and not optimized.

The technology of streaming allows to expedite the task of downloading audio an video from the web, and allows to listen and view files as they are being downloaded. If we do not use

streaming to provide access to content on the web, we must download first the complete file into our computer before executing the file and finally viewing and hearing the content of the file.

Streaming, however, allows the task to be implemented in a faster manner, allowing listening and viewing the content during the download.

The next step proposed is the application of this technology in education. The possibilities provided by streaming in spreading knowledge are in fact countless. This gives the possibility to assist the lectures taught by professors without leaving their homes, and at the same time have access to content in a permanent way, since it can be stored and in this way made accessible. This manner to provide education is identified as e-learning.

The notable advance experienced in mobile multimedia devices lately and the possibilities provided by connectivity in the areas of wireless communications, such as IEEE 802.11 (a, b o g) and UMTS, that have allowed that the user changes its habits.

This makes evident that both concepts, content and mobility, sooner or later will converge, resulting in a synergy between them, and from which we can obtain multiple benefits from their mobility, added to the know independence of the binomial space-time already provided by e-learning. The result of this concept is m-learning.

Inside some buildings, such as universities or work centres, the cover includes the complete building and its environments, which means that the user has the freedom of complete movement, and where this is not accessibility, one can use the access to UMTS provided by their own provider.

The results shown in this work are the result of the work of the Multimedia Group to translate the contents developed in the last yeas of development in e-learning into a now scenario based on the philosophy of m-learning.

2. ARCHITECTURE

Figure 1 illustrates the scenario of e-learning used as a base reference. This reference allows us to implement the task of: content generation (both on demand and live implementation), coding, transmission (live and on demand) and receiving from fixed clients.

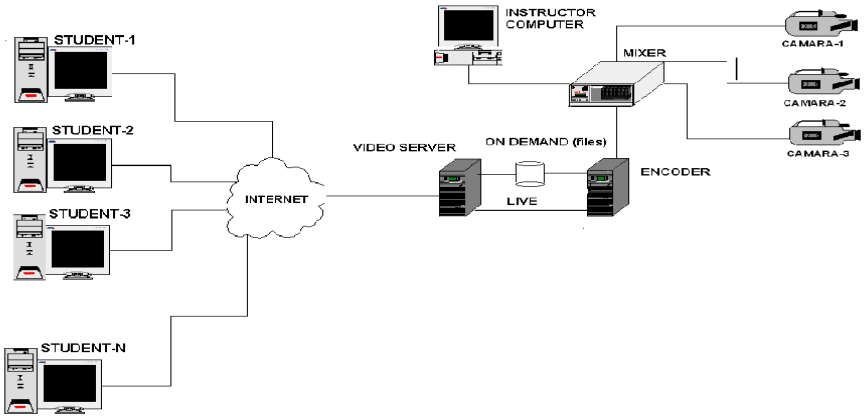

Figure 1.– E-learning scenario.

Figure 2 represents the scenario of m-learning which complement the previous scenario with the new functionalities of mobility offered by the new mobile devices and the new technologies of wireless networking, IEEE 802.11 and UMTS.

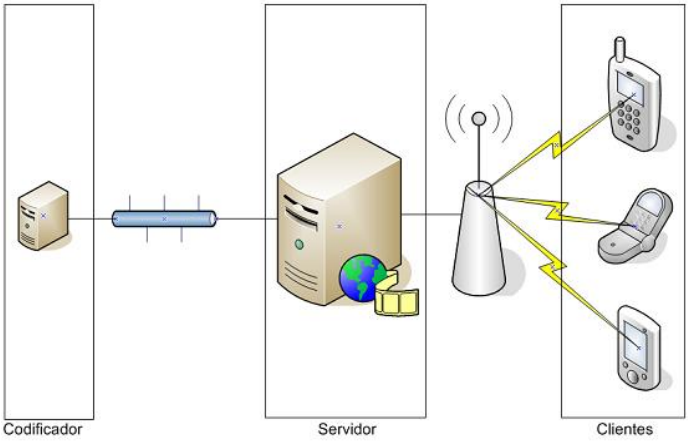

Figure 2.- Scenario of m-learning.

To achieve this new scenario it is necessary to modify the tools used in the past, since our current needs are different:

The portable devices have a screen of smaller dimensions and resolution of fixed equipment used up to the current time, and this includes a change in the aspect ratio different to traditional formats (3:4 versus 4:3, 16:9 or 2,35 to 1) used in movies and television. This resolution is normally 240x320 or 180x240. Due to the success of multimedia applications, some manufactures have decided to allow the possibilities to have the screen to be seen in a format 3:4 or 4:3, depending on the needs of the user.

The PDA has wireless WiFi integrated access. However, Smartphones can only use the connectivity provided by the operator, which means only GPRS can be used (with a deficient transmission rate) and in the most favorable cases, UMTS.

The quality of the multimedia hardware (audio and video) is lesser to that of a desktop computer, which means that there are not necessarily demanding the qualities of video and audio, lowering in this way the demands of bit rates.

The contents created, and the platform to which we migrate, must be mobile devices, and at the same time compatible with the traditional desktop systems.

2.1 Dimensioning

An essential factor in any evolution is the clear definition of the initial and final conditions of the process.

In the case presented here, a real case of implementation of this evolution [3], we use an e-learning platform used as a mean of research, with a volume of traffic medium-low, which is real sample of the potential of the use of this technology applied to education.

The final characteristics of the m-learning service established in this particular case [3] include:
Principal method of use: transmission of content on demand.
Maximum number of simultaneous users: On demand: 5 , Broadcast: 10
Frequency of transmission live: occasionally, low frequency
Quantity of available content: 500 multimedia archives
Disk Size required: 8 Gb

Once identified the characteristics of the service, the next step is the dimensioning of the hardware resources.

The server is, of all the components, the most important when implementing analysis tasks, since it is an element which defines all the other components. In this case it is critical to contemplate the requirements of the elements according to the developer which normally exceed the standard requirements.

Concerning the coder, in order to include all the options (on demand and broadcast), it is recommended to have a system able to provide compression in real time, even in non continuous mode.

2.2 Alternatives

In the proposed architecture there were analysis in the possible alternatives for dimensioning and specifications or server and coder.

The streaming servers are created from the need to implement a certain quality of transmission for video in the net, due to the poor reliability of UDP as delivery form – using TCP in this form of transmission makes no sense-. In this manner, it is found over UDP a streaming protocol which substitutes HTTP. Currently there are two protocols, of similar characteristics, RTSP (Real Time Streaming Protocol) and MMS (Microsoft Multimedia Streaming.)

The selection of proprietary software is a critical point the design of the architecture. It is the program that really manages the communication and traffic, and adopts the most appropriate policy in each moment to guarantee correct transmission.

Currently there are four complete platforms providing streaming services, even if they are not optimized to provide specific services for mobile devices. The four platforms are: Real Networks, Microsoft, Apple Quicktime, and Macromedia.

From the point of view of the coder there are coders studied corresponding to the platforms previously mentioned, Helix Mobile Producer Plus, Windows Media Encoder, Quiktime Pro, Macromedia Flash MX, and Camtasia Studio, of wide use.

The coder is the device that determines the quality of the signals to be reproduced as video or audio in the client device. These codecs are normally proprietary, although based on other standard models, and are created specifically to give the best quality for low and medium bit rates.

2.3 Selection

Following the including elements of selection for the platform for the server: compatible formats, availability of operating systems, stability, cost of software, the server selected for the m-learning platform was the Real Helix Universal Mobile Server.

The evaluation of the encoder included the following criteria: quality of the image, compression speed, flexibility of codification, output formats, application cost. The selected software for compression of files is Camtasia Studio.

To complete the architecture it is necessary to define the client, specifically, the applications Plug-in for the decoding of the streaming multimedia content and the browser for the navigation of the mobile pages. The selection corresponding to this application was the operating system Windows Mobile including two types of services at the application level.

2.4 Results

Currently the system is operating in a trial stage. This phase of trials has as its goal to determine the different parameters intervening in the quality of transmission of streaming contents in mobile networks.

The evaluation has a double objective: 1) the quantitative evaluation (bandwidth, video frames per second, image resolution, etc.); and 2) qualitative evaluation of the user (level of satisfaction with the video image, quality perceived in the audio signal, ease of navigation in the mobile environment…)

As an illustrative example of the obtained results one can observe figures 3 and 4 corresponding to the transmission of an original session of e-learning converted into a scenario m-learning using a UMTS connectivity. The session m-learning presents a quality similar to its corresponding e-learning.

These tests confirm the scenario m-learning based on streaming as a new step in the development of online education.

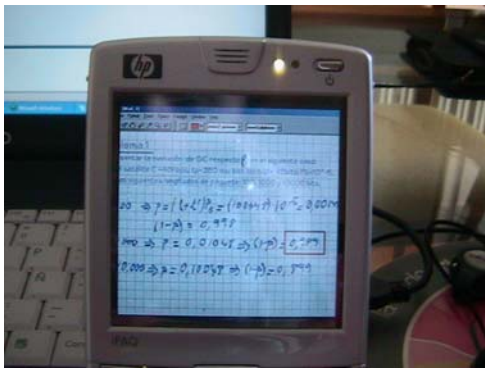

Figure 3.- Application Client of a mobile device with a 3G telephone connection.

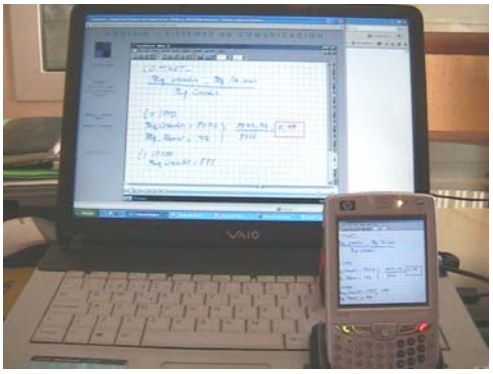

Figure 4.- Comparison e-learning and m-learning sessions.

3. CONCLUSIONS

In this work there were analyzed factors with a significant impact in the migration of an e-learning system using video to a system m-learning (mobile-learning). These factors include the services provided by PDAs of the last generation allowing WiFi and 3G telephony, and the services and limitations of the servers and platforms of video streaming, codecs etc.

This analysis allows the design and implementation of a process of migration from one system to the next, including tasks of change of multimedia format, codecs, and the configuration of server and client applications.

Acknowledgments

The authors of this paper would like to thank particularly the collaboration of two institutions in the area of online higher education teamwork. These institutions are Christian Brothers University (CBU, www.cbu.edu) in Memphis, Tennessee, USA, and the Escuela Superior de Ingeniería de Bilbao (http://www.ingenierosbilbao.com), Bizkaia, Spain. They would also like to acknowledge the research financial support of the University of the Basque Country (www.ehu.es) in this project (Project: 1/UPV 00147.345-T-15950/ 2004)

References

[1] X. Basogain, M. Olabe, K. Espinosa, C. Rouèche and J.C. Olabe, “Engineering Courses On Line: International Collaborative Project”. IADAT-e2006: 3rd International Conference in Education. Proceedings of congress, pages 87-90. Barcelona 2006

[2] X. Basogain, K. Espinosa, M. Olabe, C. Rouèche and J.C. Olabe, “Modelos de Vídeo para Cursos en Red”. I Congreso Internacional CampusRed . Bilbao 2005. http://www.campusred.net/congreso/pdfscomunicaciones/xbasogain.pdf

[3] Proyecto: “Generación y Distribución de Media Digital para clientes Móviles – Mediamóvil”. 1/UPV 00147.345-T-15950/ 2004

[4] David Velasco. PFC: “Migración de un sistema de enseñanza electrónica basado en vídeos a dispositivos móviles (m-Learning)”. Escuela Superior de Ingeniería Bilbao. Sep-2006