Streaming Technology for University Digital Radio

Edwin Jovanny Acevedo Clavijo*, edwinjovanny@gmail.com, professor of Universidad Cooperativa de Colombia; Sorey Hernández Chacón**, paohernandez_2007@hotmail.com, professor of Universidad Cooperativa de Colombia; and ***Edison Cardoza Vasquez, edinson1988@gmail.com, professor of Universidad Cooperativa de Colombia

Abstract - Based on the need to use Information Systems as key tools in university teaching-learning activities, the Barrancabermeja campus of Universidad Cooperativa de Colombia (UCC) is working to improve processes, methodologies and tools to achieve the objectives of university education. To do so, it has implemented the Digital Radio proposal, considering its mission to train professionals to have creative, supportive political criteria, in order for them to be motivators of change and entrepreneurs. This paper discusses the progress of a project whose purpose is to satisfy the need raised above and its objective is to design a Web platform using a Streaming server on a Linux operating system, to publish radio and educational material of the Barrancabermeja UCC. To do so, work was focused on evaluating the various software used as servers, considering their features, benefits and ease of application on open platforms.

Keywords— Streaming, server, Internet, audiovisual material, digital radio, Linux platform

Abstract— Based on the need for Information Systems as key tools in the teaching-learning university, the Universidad Cooperativa de Colombia (UCC) based Barrancabermeja seeks to improve the processes, methodologies and tools to achieve the objectives of the college education. Therefore, launches the proposed Digital Radio, considering its mission to train professionals with creative and supportive political criteria that are motivating change agents and entrepreneurs. This article shows the progress of a project that aims to satisfy the above question need and which aims to design a Web platform using a Streaming Server on a Linux operating system, where education and radial material UCC Barrancabermeja is published. For this, the work focused on the evaluation of different software used as servers, considering its features, benefits and ease to engage in free platform.

Keywords: Streaming, server, Internet, audiovisual materials, digital radio, Linux platform

I. INTRODUCTION

Research for innovation and the transfer of new and emerging technologies is essential for modern education, where information and communication technologies are part of the scientific activity proposed by the University. The purpose of this paper is to publish the progress made in research on digital radio and streaming technology at the Barrancabermeja Campus of Universidad Cooperativa de Colombia.

In the national context, Universidad del Bosque in Bogotá carried out a Streaming audio project through mobile devices using J2ME [1].

EAFIT University in Medellín implemented a Streaming video tool and its application on a Bimodal course in plastic processes, in addition to the design of a digital Video Library [2][3].

The Sergio Arboleda University in Bogotá, Colombia carried out a project to implement a Streaming radio server with OpenIMS for the same university [4].

In 2009, the students of the School of Systems Engineering, Dina Julieth Parra Toloza and Walter Winkler Hernandez of the Universidad Cooperativa de Colombia, carried out a project of: Publication of Audiovisual Materials through a Streaming server, in which different servers were implemented to observe their performance and behavior on the regional campus' technology platform. The result of the project was the implementation of Windows Server 2003 where several Streaming technology services were applied such as the publication of video material. [5].

In summary, there are 16 Colombian universities where the digital radio Streaming server is being implemented. One of them is the Universidad Pontificia Javeriana, which implemented Internet Radio as a result of the systematization of this experience in communications [6].

However, the need to demonstrate the contribution of New Information Technologies to today's educational system is clear. It consists of going from a one-way training model, where knowledge, in general, lies in the professor or, in the absence thereof, a text book, to more open, flexible models. This is where the use of the Internet and interactive platforms to carry out teaching-learning processes play a role, where information tends to be shared between various students. This new environment requires students to be more concerned about the process than the result, prepared to make decisions and choose their own pathway to learning. In short, this requires students prepared for self-education [7].
The implications of Web 2.0 in the field of education today are very common and widely used due to the numerous advantages of its environment in handling educational tools because it allows online searching, sharing and interaction. In addition, it can be focused on independent and collaborative work, it generates more participation in group activities, allows the research and sharing of resources and makes new learning and evaluation activities possible, among other important characteristics that lead the teaching-learning process to find new updates and provide itself with feedback by finding access to new information technologies [8].

Accordingly, the use and importance acquired by VLO (Virtual Learning Objects) make it necessary to implement this new teaching mechanism at the university level of education because they make the teaching-learning process more dynamic, and they are useful in the process of training in the various areas of knowledge.

Universidad Cooperativa de Colombia manages a Moodle platform for the teaching-learning process. However, this platform does not manage the use of educational audiovisual material in real time. It does not allow video conferencing or video tutorials, nor has it been welcomed by the university community. In addition, it does not implement the transmission of digital radio.

II. STREAMING TECHNOLOGY

A. Advantages of Streaming Technology

Streaming technology reduces data transmission wait time because it broadcasts live. The importance of this technology lies in the fact that it allows real-time audio and video transmission, as well as permanent student-professor communication in order for the learning process to take place inside as well as outside the classroom.

The development cost of this technology is minimal, because it is implemented using free software, thus increasing the profitability of use. In addition to being profitable, it is secure, considering that the free software of the GNU/Linux community provide high-benefit in the management of security and licensing is free. Last but not least, they support high-performance servers for online applications of Streaming technology.

It contributes to professors’ role, no longer as transmitters of knowledge, but in the development of skills for their continuous updating, not only as regards content, but also in being prepared to design new learning strategies, focused on university students in their educational work. [9]

The role of Information and Communication Technologies (ICTs) in teaching and how they can contribute to the improvement of the educational process in different fields and areas of knowledge requires a good understanding of the different technological media used for professor-student communication, which will allow the extraction of positive work guidelines between them and should improve and increase educational quality [10].

Technology plays an important role in distance learning in the Video Streaming environment, which consists of the transmission of audio as well as video over IP networks, to be viewed by users on their PCs. Audio and video content, whether it is in real time or pre-recorded, is coded. That means it is digitalized and compressed, and transmitted over the Internet or Intranet as an information package. The information is received and decoded by the end user using a player (Windows Media Player, Quick Time, and Real Player. [11].

This allows access to large quantities of information such as academic book and keynote video conferences, among others, which entail extensive wait times when using traditional file download techniques. This information is essentially audiovisual, although it can also be just audio or just video. It plays an important role in distance learning [12].

Video Streaming is an efficient means of transmission that can reach an unlimited number of users and it is highly scalable, thus creating an "any time, any place" scenario, and it can support the three types of video distribution. Therefore, it is ideal for groups with a large number of students and encourages interdisciplinary and collaborative work.

It supports learning processes with audiovisual education based on video tutorials and can be adapted for university students [13].

B. Structure and Architecture of Streaming Technology

The structure of Streaming technology is illustrated in the following basic outline that represents and illustrates the most important steps, from development to distribution, by network to reach the end user and to develop and implement Streaming video technology. [14].

---

[9] [10] [11] [12] [13] [14]
Figure 2 demonstrates how Video Streaming is established and controlled in an educational environment and the main players necessary, which can be afforded by Colombian Institutions of Higher Education (IHE): Web browser, Internet and WEB and RTMP servers. [15].

The protocols used to do so are: UDP, TCP/IP and RTPM, TCP/IP, which provide reliability, order and security. UDP carries out operations without any major controls, as they are widely used to transmit of multimedia traffic in real time and RTPM protocol designed for real-time traffic, typically audio, video and derived data, promoting end-to-end transmission by packaging traffic [16].

It is also the most appropriate server for the intended platform, in this case the Apache HTTP server, although it does not specify the version used, but it is known to be free open-source software for several platforms including Linux, it is continuously updated and adapted to new HTTP protocols. It is the server most widely used by websites in the world, which makes it easy to get support. At present, version 2.0 of the Apache server is on the market, with new functionalities and characteristics, thus ensuring the benefit of this server. [17].

C. Comparison of Streaming technology with other operating systems

The following table compares the different operating systems used by Streaming systems in which the application can be carried out and those in which it cannot. The use of the Streaming system as a universal means of telecommunication aims to break down geographic and accessibility barriers to be able to send information, using the Internet as the means of transport for users to get what they expect, in this case, the educational audiovisual material being transmitted. The Streaming media systems consider the distribution of content in a corporate Intranet environment, as well as over the Internet. Content can be pre-stored on an on-demand video server (on-demand video, Streaming media), or it can be created at the time of broadcasting (live media Streaming). [18].

### TABLE 1

<table>
<thead>
<tr>
<th>NOMBRE</th>
<th>Windows</th>
<th>Mac OS X</th>
<th>Linux</th>
<th>BSD Unix</th>
<th>Solaris</th>
<th>Other Unix</th>
</tr>
</thead>
<tbody>
<tr>
<td>PeerCast</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Darwin Streaming Server</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
<td>Si</td>
</tr>
<tr>
<td>Helix DNA Server</td>
<td>Si</td>
<td>No</td>
<td>Si</td>
<td>Si</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Windows Media Server</td>
<td>Si</td>
<td>No</td>
<td>Ne</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Source: Parra, Winkler – 2009

III. DISCUSSION OF OUTCOMES

A. Listing of Requirements

Use Case Design: the design of use cases is based on the characteristics of the system designed in UML. The main plays on the platform, including: portal administrators, broadcasters, programmers and end users. The figure below illustrates the Administrator use case.
The Administrator has the following characteristics: it is the agent that plays the roles of system supervisor and coordinator; this is the role that will bear all the responsibility of the system; it can handle duties, validate users, change cable, design programming and manage the designed advertising tray, according to the administrative protocols, based on the fulfillment of the advertising and marketing conditions of the university, which in this case is the Universidad Cooperativa de Colombia.

### TABLE 2

<table>
<thead>
<tr>
<th>Name</th>
<th>Enter the system and validate user</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authors</td>
<td>Administrator, broadcaster, user</td>
</tr>
<tr>
<td>Date</td>
<td>10-13-2010</td>
</tr>
<tr>
<td>Description:</td>
<td>It is in charge of allowing entry in the system and it is launched by the administrator, broadcaster and user</td>
</tr>
<tr>
<td>Players:</td>
<td>administrator, broadcaster, user</td>
</tr>
<tr>
<td>Precondition:</td>
<td>Open the home page</td>
</tr>
</tbody>
</table>
| Normal Flow:              | 1. The user enters his/her login and password  
2. The system validates the data  
3. The system displays the main menu depending on the type of user |
| Alternate Flow:           | 1. If the user does not enter his/her login or password, the system sends an Error message reporting that the fields are empty.  
2. If the login or password are incorrect, the system sends an error message reporting that the login and password are incorrect |

Postconditions: the system displays the window with the options that can be performed by the user who enters.

Source: own

Two players are identified in the system: programmer and users. The programmer is the agent identified as the broadcaster, who should have a degree in social communication or a related profession, preferably with pedagogical knowledge and teaching experience, who will carry out the programming of Digital Radio. This agent also designs the entire process of system production and dissemination, and coordinates the academic and scientific programs developed by the School's students and professors.

User: is the agent that will use the academic - scientific and training information developed in the Digital Radio system. This information is aimed mainly to the University Community - Students, Professors and Administrative Employees, as the first agents of the information dissemination process; and in the second place, any virtual community interested in the topics developed on the Digital Radio platform.

### B. Entity - Relation Model

The MySQL Workbench tool was used to design the entity relation model, establishing the tables with the respective fields and relations; after that, the code generated by the tool was exported for use in MySQL front, which is where the database will be developed.

![Entity-Relation Model](http://ora-flashes.blogspot.com/)

### C. Development of Web Application

The following tools were used for the development of the web application: MySQL (system database manager), Artisteer 2 (software to design the web interface), Dreamweaver CS5 (software for WebApp programming), and xammp (local Apache server and php v5.2.6)
MySQL Front

Freely distributable software, obtained from the Internet and used to create and modify the databases used to store and distribute the information.

MySQL Front was used to develop the database tables where the respective system information is handled (Users, Accounts, and Transmission Programs). The following is the code that was used to create the final database and tables.

```
<? if ($_SESSION['autentificado'] == 'SI') {?>
<li><a href="administrador/usuarios/autenticacion/salir.php">Cerrar Sesión</a></li>
<? } else { ?>
<form action="administrador/usuarios/autenticacion/control.php" method="POST">
<table align="center" width="225" cellspacing="2" cellpadding="2" border="0">
<tr>
<td colspan="2" align="center" bgcolor="#cccccc"><span style="color:ffffff"><b>Introduce tu clave de acceso</b></span></td>
</tr>
<tr>
<label for="nombre_usuario">NOMBRE DE USUARIO</label><br />
<input id="nombre_usuario" type="text" name="nombre_usuario" class="inputbox" alt="nombre_usuario" size="18" />
</tr>
<tr>
<label for="contrasena">PASSWORD</label><br />
<input id="contrasena" type="password" name="contrasena" class="inputbox" size="18" alt="contrasena" />
</tr>
<td colspan="2" align="center"><input name="aceptar" type="Submit" value="INICIAR SESION"></td>
</tr>
</table>
<? } else { ?>
bgcolor=red><span style="color:ffffff"><b>Datos incorrectos</b></span>
<? }else{ ?>
</form>
```

The above code was designed to create the PROGRAM table with the respective fields.

**ARTISTEER 2**: is a Web design automation product that creates templates for Websites developed by Extensoft, Inc. The base templates of the WebApp were designed and developed with this software. After designing the template, it is exported in HTML.

**DREAMWEAVER CS5**

The programming of the WebApp was carried out using DreamWeaver CS5, in which the Artisteer screen was imported and the corresponding code was added for running the application.

The following code is designed to present the operation of the main interface.

Login Code:

```
<? if ($_SESSION['autentificado'] == 'SI') {?>
```

Fig. 5. Code to create the program table
Source: own
D. Preliminary Design of the Web Interface

- Characteristics of the Web Interface: at the top, buttons are designed for work group information and project description (home - who we are - project description); on the left, there is the user validation menu, news and university wellbeing link. On the right, there is the online media player of the digital radio, which runs when the application is opened; in the same column, there is a regular calendar and then, an institutional calendar. Finally, the middle of the application is designed to post news, information and academic events of the Universidad Cooperativa de Colombia, which will be fed on a regular basis.

Fig. 6. Index Page
Source: own

E. Field tests

- OBJECTIVE. Check the operation of the Digital Radio Streaming System on the Intranet of the Universidad Cooperativa de Colombia, Barrancabermeja Campus.
-PROCEDURE

1. Installation of the Linux Ubuntu Server 10.04
2. Installation and Configuration of ICECAST 2
3. FileZilla FTP Client (FTP Document Manager)
4. Access the Web application on the Server and Develop Local audio transmission
5. Access Isa-Server to analyze the results of the trial transmission

The transmission was successfully carried out as the conditions required for the test were met. Five clients were contacted, who effectively received the audio transmission. The Digital System met all the requirements for a platform with streaming technology and the purpose of transmitting digital radio live.

On April 27, 2011, the field tests began, and at 3:15 p.m. the local tests were launched with five computers in Multimedia Room 1 with IP address:

192.168.2.35
192.168.2.36
192.168.2.37
192.168.2.59
192.168.2.46

Link 192.168.2.10 is entered to connect to the server located in Room 5. The transmission is carried out from the server using the ICECAST2 streaming server, where the audio was broadcast for one hour.

The following web users generated the most application traffic through the ISA server during the reporting period. The network addresses are listed when the ISA server does not recognize the usernames (SecureNAT clients). The application traffic contains all the traffic, except for the Web traffic resulting in a consumption of 35 MB per computer during the hour of transmission as illustrated in the image below:

Fig. 8 Observation of traffic by the server to the computers that were connected.
Source: own

The analysis of the traffic from the live audio digital transmission leads to the conclusion that the system does not consume much broadband resource; therefore, it can be implemented without inconvenience to the data transmission flow on the network of the Universidad Cooperativa de Colombia, Barrancabermeja campus.

IV CONCLUSIONS

The Ubuntu server was chosen because it is a free platform system, the ease of configuration, the performance of the application and the low consumption of resources. This is all of great relevance to Colombian Institutions of Higher Education.

The ICECAST server was chosen due to its compatibility with the operating system, ease of configuration and security. In addition, due to the extensive information on ICECAST on the Web, information was acquired rapidly on the streaming technology, the applications and configurations of the ICECAST server, by the educational community of the University.

The IWeb methodology was validated for the design of the university digital radio system because it is the most effective process to develop high-quality web applications. This methodology starts out with the formulation of the problem (on-line radio) and models the design and system requirements of
the Web application (Databases and Interfaces). The development of the IWeb methodology generated an application that was more commensurate with the system requirements.

The digital radio system (Digital System) consists of a Linux Ubuntu operating system, which integrates database, Web application and the ICECAST Streaming Server, which meets the requirements for on-line digital radio transmission for the educational community of the Universidad Cooperativa de Colombia, Barrancabermeja campus, and can be applied in similar Institutions of Higher Education in teaching-learning processes.

V. REFERENCES


