DESIGN OF THE SIMULATION PLATFORM FOR M-LEARNING ENVIRONMENT USING OPNET

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ABSTRACT

e widespread use of mobile devices, such as mobile phones, sonal digital assistants (PDAs), or laptop, along with ances in wireless communication technologies, such as S, GSM, GPRS, 3G and satellite systems, has nourished a w learning paradigm known as the mobile learning (m-arning). A key character of m-learning that allows the ner can learn at any time anywhere in a non-predetermined hion has caught attentions in fields like vocational and cational training, museum and art galleries, etc. In this er, a simulation platform based on the MOBIlearn mework is being developed using OPNET Modeler to study mework.

dex Terms— M-Learning, OPNET, MOBIlearn Simulation tform

I. INTRODUCTION

e rapid development of mobile and wireless technologies given rise to a widespread use of mobile devices such as l phones, PDAs, laptops, among others. These devices, g with those wireless transmission technologies, constitute ew pedagogy of mobile learning (m-Learning).

In our day to day life, it's not uncommon to see people king/studying in any place when possible. Such nomenon of spending time reading/learning on the go is origin of m-Learning, also known as e-learning via mobile handheld devices using wireless transmission. Today, e are many research activities in this area that explore the erent architectures of mobile devices and wireless smission to support learning process. These architectures erally fall into the following categories:

- Server side approaches
- Client side approaches
- Hybrid approaches

The server side approaches target on the built-in Internet wsers on the mobile devices so that the setup on client side be minimized. According to [1], direct accessing to the al learning environments (VLEs) only provided limited w; therefore, an improvement is to use the XSLT and XSL itch to appropriate XML representation base on a set of efined device profile stored at the server side.

The client side approaches often requires mobile users to ll a specialized application that is tailored and stored on eted devices. With this intelligent application, the users can store their preferences locally but the downside is that it requires extra processing on the mobile devices and only a smaller range of devices are targeted [1].

A hybrid approach presented in [1] was done by combining the server side and client side approaches to bring together their benefits. Instead of target on built-in browsers, it uses J2ME client side application to establish a communication channel between client and server using web services. A MOBIlearn database system is used to store sequences of generated granules so that the mobile learners can access to these content base on their preferences stored locally.

The organization of the paper is as follows. In section II, an overview of the evolution of MOBIlearn Project is given. In section III, we discuss the overall design of the simulation model. Our analytical report base on the simulation data is discussed in section IV and we will draw to conclusion in section V.

II. MOBILEARN PROJECT

1. Project scope and Objectives

MOBIlearn is a European-led research project that exploring context-sensitive approaches to informal learning with the advances in mobile technologies. The MOBIlearn project consists of 24 partners from all over the world like Europe, Israel, Switzerland, USA and Australia. Their competencies are integrated and extended by a special interest group that is composed by 250 world's leading organizations in information technology industry [2].

The integration of new technologies, such as mobile devices and adaptive interaction, in education and training, not only changed people but also changed our learning environment. Since one of the key idea of MOBIlearn project is the free circulation of knowledge in forms that are appropriate to the learners, the MOBIlearn project aimed at improving ubiquitous access to learning objects (LOs) for targeted mobile workers and learning citizens [3].

2. Pedagogical research

At the initial development of the MOBIlearn project, a research on of mobile learning was conducted to identify the following items - an effective pedagogy model that enables developers, tutors and learners incorporated in such 'learning space', and the key elements that are unique to m-learning. At the end, this research produced - a guideline for learning, teaching, and tutoring in mobile environment, an instructional design and content guideline for m-leanring, a study of mobile learning practices, and a roadmap for further research on pedagogical issues.

During the development of the MOBIlearn project, three representative user groups were surveyed. First, the worker group whose job requirement needs them to continuously update their knowledge. Second, members of culture (learning citizens) who improve their learning experience by exploring historical sites, museums, or art galleries. Third, family members who desired to access simple medical information for everyday needs.

Taking these scenarios as starting projects, the MOBIlearn project identified a number of components required by various types of users -- m-learners, tutors, learning content authors and administrators. The top level components identified are:

- *Mobile Device* like PDA, mobile phone, or a laptop to communicate to the learning systems.
- *Portal Service*, the entry point for user to access to services.
- *Content Management System* for managing the learning materials and user preferences.
- *Location and Navigation* identification by using GPS.
- *Collaboration and Communication* to provide session for collaboration between two or more persons.
- *Context* to provide indexing services for providing context based data to user.
- *Multimedia Delivery* to deliver the content and annotations.

Since the entire system is not dependent up on one type of device or communication system, the components listed above requires software tools to enable the interoperability between various components. Rather than targeting a single architectural implementation, the MOBIlearn project focusing on the interfaces between different layers to ensure the services interoperability. On the basis on this concept, the Open Mobile Abstract Framework was developed.

3. The Open Mobile Abstract Framework (OMAF)

3.1. OKIA Stack

This framework proposed in [5] uses service based architecture. This does not enable single reusable service on different mobile applications however it offers opportunities for third party services thus improving the MOBILearn system. This approach uses existing practices including Open Knowledge Initiative Architecture (OKIA) and the Abstract Learning Framework (ALF).

Learning applications are authoring, individual quizzing and learning management capabilities. It provides central admin system such as human resource, student information and directory management. Academic systems include digital repositories and educational materials. The adaptively defined in MOBIlearn is a form of adaptation that automatically regulates and organizes its functioning, appearance and information it offers. In m-learning environment, adaptivity can be applied to the learning content, the user interface or both and two different methods identified for such adaptivity are:

1) *Content-Based Modeling* where people's action in the system is monitored.
2) *Collaboratory Modeling* where the action of a person is checked against the search pattern of m-learners of the system of the same interests.

3.2. Mobile content management

Ideally, the MOBIlearn servers transform the LOs into the existing content management standards ad specifications formats to support various mobile devices. For example, these standards could be:

- HTML for laptops and Tablet PCs
- PHTML (pocket HTML) for PDAs
- MHTML (HTML for mobile phone) for Opera Browser in Nokia 6600 mobile phones

In order to enrich the mobile learning experience, the delivery process also needs to take the air interfaces technologies (i.e. WiFi, GPRS, UMTS, etc.) as well as the traditional fixed infrastructure that are suitable to the diverse destination devices into consideration. In general, MOBIlearn system have been considered Personalization, which is based on user preferences, and Customization (AKA transcoding), which tailors the web content base on the capabilities of the client device and network connection.

3.3. Multimedia delivery

The MOBIlearn architecture includes Multimedia Delivery Subsystem (MMDS) to support streaming of multimedia contents in a reliable way to the devices. The components of the MMDS prototype include (1) managing media content, (2) streaming and download server capability for delivering the media, and (3) media players that support cellular technology allowing access by handheld devices.

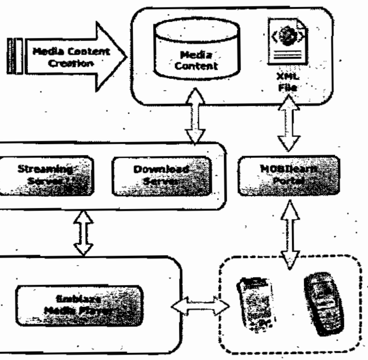

Fig. 1 Mobile Media Delivery Subsystem [3]

The media content component stores the media content and provides an interface for MOBIlearn portal to access the content. The component is implemented by the suitable rvice in OMAF framework, which creates an XML file used r integration with MOBIlearn portal (Fig. 2).

The components are the media content management vironment, the media server that contains streaming pabilities, and the media players installed on the handheld vices. Streaming and download servers deliver the rich ntent to m-learner's mobile devices. For streaming delivery, e default mechanism is UDP streaming; however if for any ason the UDP streaming is not available then the media rver should fallback to HTTP streaming, then to HTTP nneling, then to HTTP download.

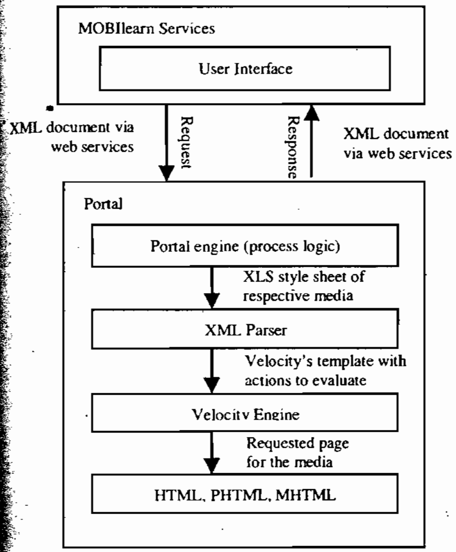

Fig. 2 MOBIlearn portal and services integration [3]

dagogical content for m-learning

the research conducted by MOBIlearn indicates there is siderable potential in supporting learning "on the go" will d the learning process from formal to informal. Hence, the areness of blending the granular learning experience with e-rning, knowledge management and performance support erges from the horizon.

Nevertheless, most of the digital library and Internet ltimedia content in the existing applications are designed h desktop and high-speed networks in mind, which may not suitable for mobile devices with limited process power, play capability and network bandwidth. Therefore, the lity of media presentation needs to be adjusted to ording to the capability of their mobile devices.

The approach used in MOBIlearn to address this issue is entify the requirements for the LOs and then documented a range of different formats. For example, a possibility to break down each subject into LOs for museum visitors contain an introduction, an on-screen index, a brief iption, interesting facts, and a critical analysis for more wledgeable visitors

III. DESIGN OF SIMULATION SYSTEM

Our simulation is tailored for the m-learner using PDA to access to LOs resided at campus network via access points. In our configuration (Fig. 3) there are four subnets, Stratford, Wilton Park, Fairfield Internet café and the campus network. Each of the client subnet consists of one or more number of PDA's and one access point.

The campus network consists of four servers, course database server, media streaming server, security server, and a proxy server (Fig. 4).

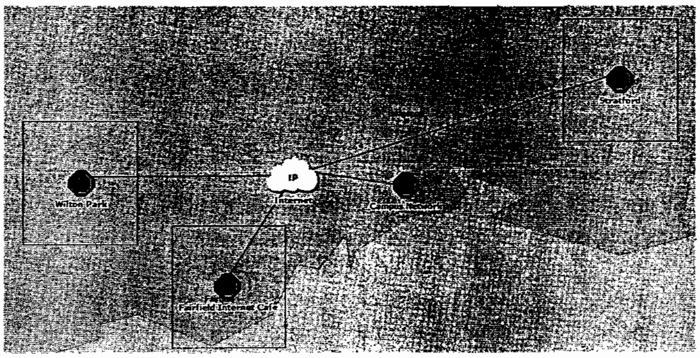

Fig. 3 Overall regional networks

Since the portal service serves as the single access channel for m-learners to access MOBIlear system, we deployed the portal service to the proxy server so that the portal service can generate a XML client descriptor to describe the mobile device along with the user preference and then pass down to the MOBIlearn servers. The course databases in our simulation served as the digital repository of the LOs which could be library, research and educational materials. The media server has the capability of streaming the multimedia video using UDP.

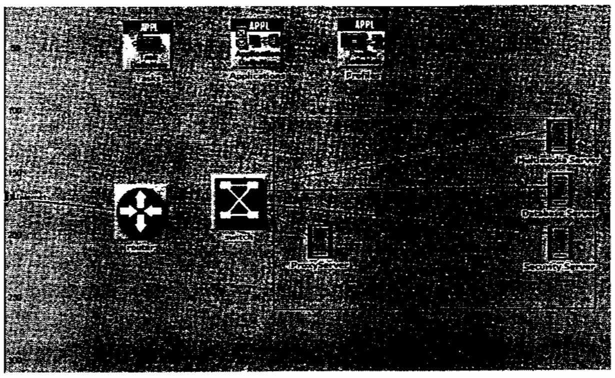

Fig. 4 MOBIlearn deployed at campus

A brief intercommunication among the servers can be found in Fig 5. Once the portal service receives m-learner's request, it first forward the client identity to security server to authenticate the validity of the m-learner, then it dispatch the request to appropriate MOBIlearn server along with the XML client descriptor. In our simulation, each MOBIlearn server is deployed with a co-located content management service and once the co-located content management service digests the client descriptor, it generates appropriate output and responds directly back to the m-learning.

Unidirectional traffic is generated by configuring the custom application. The traffic that is generated is defined in the Task Config object. In the Task Config we have two tasks one for media and the other for database. According to [4], the memory size of a PDA ranges from 128 ~ 8 MB, our simulation for media streaming is to generate around 3MB of the video content.

Once the task has been defined they are used in the Application Config object to build the custom application. Once the custom application is defined, it will be used in the profile Config object.

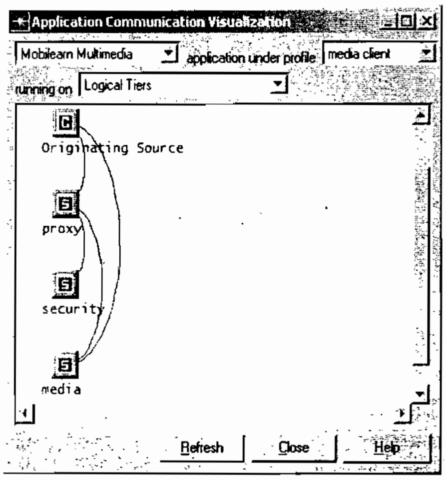

Fig. 5 Visualized application communication

Once the proxy sends request to the security server it authenticate the user sends back to the proxy server then proxy server will decide weather that request should sent to either multimedia server or the database server and server sends the data to the originating source.

IV. RESULT ANALYSIS

Multimedia Los streaming using UDP

Although the media streaming throughput generated from the media server for each m-learner at the Fairfield is around 400k bps, while the buffer size of the access point is small, we can easily found that some of the packets are dropped hence higher data error occurred at the mobile node sides (Fig. 6). By comparing the traffic generated at the media server end with the total throughput at the client side access point (Fig. 7), it is obvious that the throughput is way less then the actual data traffic generated at server side. To overcome this issue, we increased the buffer size at the client side access point and found that the data dropping problem disappeared hence the mobile nodes were able to receive the media data without losing of the data (Fig. 8).

Fig.9 shows the total throughput generated by the media server and received at the access point after increasing buffer size. This graph show that there is no packet loss the access point is receiving all the data that is generated by the media server object. This trial allow indicates that as the number of mobile clients increases, the client side access point needs to adjust the buffer size to handle the data volume properly.

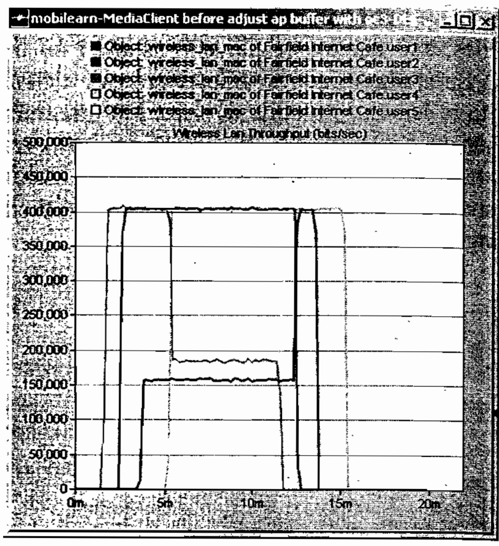

Fig.6 Traffic generated before adjusting the buffer size

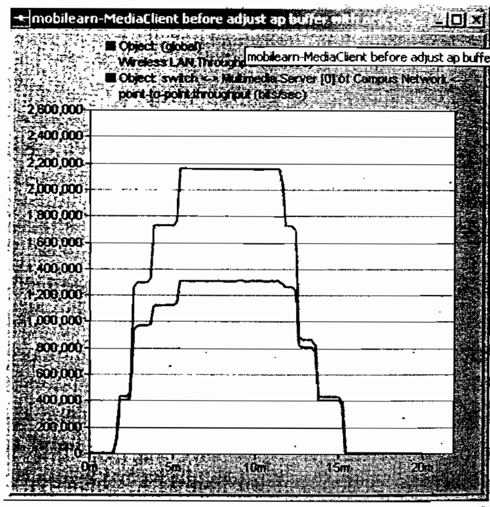

Fig.7 Traffic generated by the media server and the AP

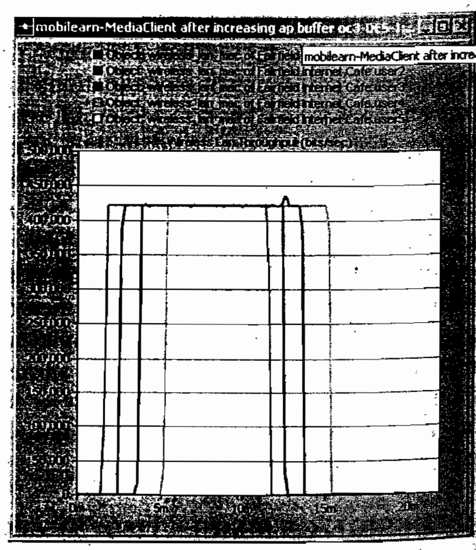

Fig.8 Traffic received at the individual users

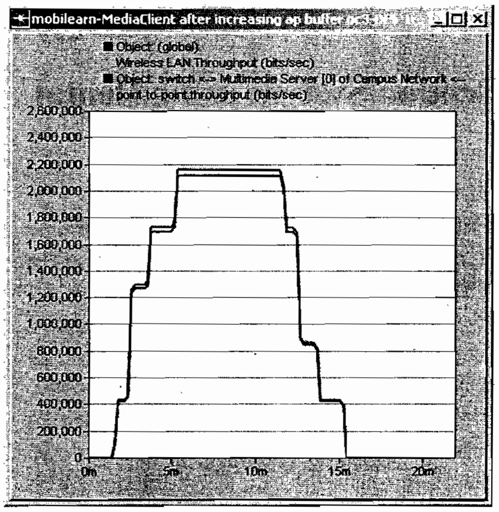

Fig.9 Throughput from media server.

ithentication for Each M-learning Session

e second scenario is to simulate the authentication process each session. Since most of the LOs are targeted for a ecific group of members, it's likely accessing to these local ources requires authentication procedure. We added the thentication procedure as part of our simulation scenario. In g. 10 the first chart from top indicates the request to the urity server. As indicated in the chart, authentication ays occurs first and then the media server responds back to bile node with the multimedia content.

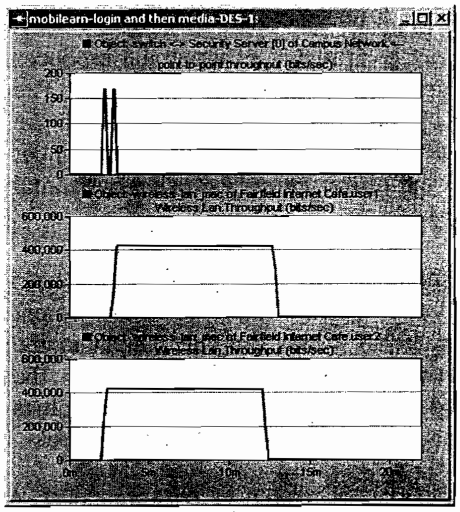

Fig.10 Authentication request

I. CONCLUSION AND FUTURE WORK

initial idea of this simulation is to develop a simulation form based on the MOBIlearn framework in OPNET deler. This simulation tells how the client applications mmunicate with the server, the internal process mmunication between the servers and response from the er to the originating source. During the development of imulation we found that the buffer size of the access point affects the reliability of the data transmission. In the access point if there are more users using the multimedia streaming then the administrator should increase the buffer size of the access point according to the number of users.

Overall we are pleased by the simulation results. Our simulation platform is flexible and extendable. In the future we can enhance our platform by creating clusters of mobile learn servers , so that the number of mobile nodes increases the servers should able to handle the all requests that are generated by the mobile nodes. Our next phase of work is to implement the system based on the guidelines.

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