Network Technology for Mobile Learning

Mr. Anwer Adel Mohammed
Department of Communication Engineering

University of Diyala, Iraq , March 2006

anwerday@yahoo.com

Abstract

The paper concentrates on the technological architectures, the current official standards, mobile end-user devices, and how this technology can improve the learning process. Mobile devices are becoming more and more important in the context of e-learning. This requires appropriate models for structuring and delivering content to be used on various devices. This paper, propose a model for structuring content that allows rendering for mobile phones. This approach allows adaptation of content (device, granularity of content, content selection based on didactic concepts) at run time to specific needs in a particular learning situation.

Due to mobile device proliferation, content providers can no longer deliver only one version of their content to the users, as they need to deliver an appropriate form of

content depending on the capabilities of the viewing devices. Web authors either create multiple versions of the same content for each device, or depend on some

intermediaries to do the transformation. This paper, propose a new approach to the adaptive mobile content delivery based on the XML metadata.

Results from this paper shows that mobile e-learning services can be secured to users by using a developed software to distribute contents through negotiating device capabilities realizing m-learning services using multi-channels to improve the learning outcomes and to utilize a service that increases the user's learning capabilities .

1. Introduction

The term mobile learning (m-learning) refers to the use of mobile and handheld intelligent tutorial IT devices, such as PDAs, mobile phones, laptops and tablet PCs, in teaching and learning. As computers and the internet become essential educational tools, the technologies become more portable, affordable, effective and easy to use. This provides many opportunities for widening participation in and access to intelligent learning tutorial ILT, and in particular the internet[1]. Mobile devices such as phones and PDAs are much more reasonably priced than desktops, and therefore represent a less expensive method of accessing the internet (though the cost of connection can be higher), and the introduction of tablet PCs now allow mobile internet access with equal, if not more, functionality than desktops, "Mobile" vs. "Wireless" e-Learning "Mobile" e-Learning is a much more appropriate term for training using such devices than another term commonly used: "wireless" e-Learning. Although some mobile devices can access training content through wireless network connections, others do not. For instance, even within one well-known brand of personal digital assistants, some models feature wireless network access. Other similar models, although not wireless, can access training content through the addition of a wireless modem, a conventional modem attached to a telephone line, or through a physical cable connection to a laptop or desktop computer. Many mobile devices can, in effect, be "filled up" with hours upon hours of training and require no connection to a network, wireless or otherwise, until the time comes to replace old training content with fresh content, or to upload the results of assessments to a learning management system capable of tracking mobile learners. In many training situations, the learning experience for the student is largely unaffected by the way the mobile device accesses information, wireless or otherwise. Rather, what differentiates mobile e-Learning from conventional e-Learning is the nature of the mobile device itself [2,3].

Mobile devices are different from conventional laptop or desktop computers. Mobile devices are small, portable and compact. They can often fit in a pocket or purse. Unlike laptop computers, which are expensive, heavy and power hungry, mobile devices are relatively low cost , lightweight, and some work a very long time on a charge or a couple of standard disposable or rechargeable batteries.

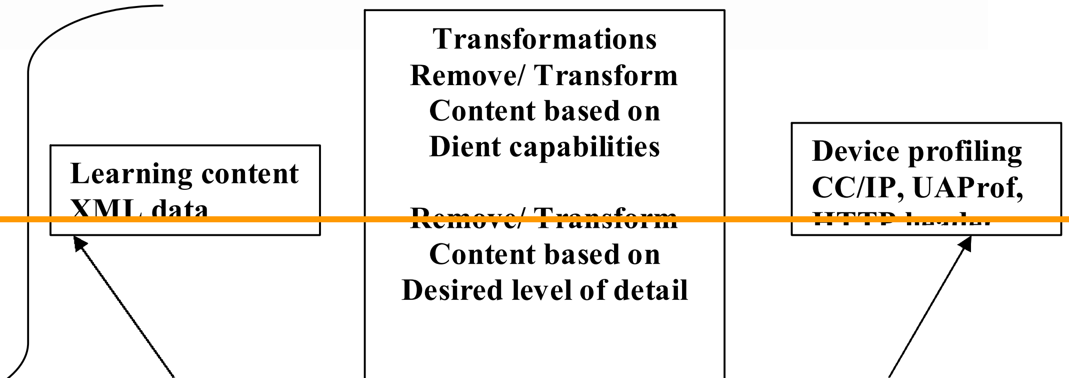
In communication theory I want to focus on the elements that can influence the quality of the message through different kind of media. There are two major aspects that can affect the message; the physical delivery of the content such as network or phone lines and the comprehension of the message [4].

2. Architectural Design

Content stored as XML has one essential aspect: using di_erent transformation processes it is possible to convert any XML-coded data into various widely used structured document formats (XHTML, SMIL, PDF, etc.), in a quite common architecture for multi channel delivery systems for e-learning is presented. In that model XML coded data is adapted to the capabilities of the requesting device via appropriate transformation processes. In the MobiLearn project we expanded the transformation part of that model as we needed transformation processes considering all the three key concepts of the project shows figure (1).Thus such a model of multi channel delivery systems enables the adaptation of learning content to device, desired level of details of content and semantic aspects. The model proves some remarkable advantages [5]:-

1. MobiLearn learning units are XML coded data. Hence interoperability is guaranteed between systems understanding the MobiLearn approach and structure of learning units fixed by a pre-defined Document Type Definition (DTD).
2. The XML approach allows the definition of transformation processes (e.g. using the XML transformation language - XSLT, XSL-FO, or the XML query language - XQuery). Such transformations enable easy adaptation of learning content to given requirements.
3. Transformation processes enable delivery on the fly as well as delivery of o_ine content. Delivery on the fly is used for online access to the content, where a quick adaptation to learners' requirements is requested.

   Still a lot of experts show significant preference for traditional printed material for reading, because learning online significantly reduces learning e_ciency and speeds up the fatigues of the learners. An example for o_ine content are the traditional printed scripts. Still some advantages of the online content, i.e., its interactivity, potential animation, video or audio, are lost in printed material. For printed material, an easy connection to the lost multimedia elements was enabled by the idea of so called Paper Links. Paper Links establish relationships between locations identified by e.g. barcodes in printed material and digital content.



3. *Display Lectures in the Mobile*

Our approach to transforming existing workstation-based display lectures to mobile devices is based on using an open generic specification language for which interpreters (players) exist for the target devices. Given the multimedia content of on-line lectures, we chose SMIL 2.0, an XML-based language for describing rich time-based multimedia content (W3C 2001), as that specification language. By building a converter from the current specification language of on-line lectures to SMIL we are able to:

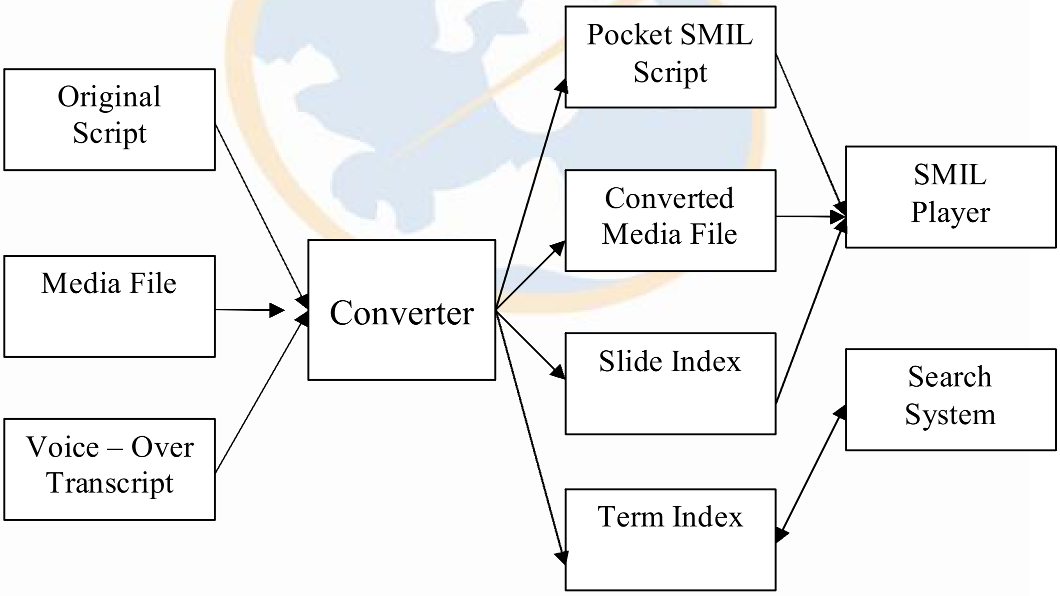
• make use of the current set of software tools for generating on-line lecture scripts and related media

• produce output that can be delivered to any device that supports a SMIL 2.0 player

• potentially integrate materials from other sources, such as Microsoft PowerPoint,
Macromedia Flash, etc.

In contrast to the display lectures in the mobile that require a workstation or laptop, a Mobile On-Line Lecture is executed as a SMIL script via a SMIL2.0 player running on a handheld Pocket PC device. The script "choreographs" the presentation of full screen slides and their animated overlays (stored in GIF, JPEG or BMP formats) with music and voice-over (stored in either MP3 or WAV formats). Control of the lecture presentation is handled via a set of small iconic buttons in a narrow "bar" at the top of the display. The navigation buttons currently available are: "move forward a slide", "move back a slide", "play the current slide", and "go to the slide index" .

Additionally, a search system runs in parallel with the Pocket SMIL player and enables a user to search for text occurrences in the voice-over. The search system returns references to the slides, and animation sequences within the slides, where the queried text occurs [6].



Figure(2) The Lectures Display in Mobile System Architecture

Lecture generation is performed by a converter program, figure(2), taking as input the original On-Line Lecture script file that specifies "calls" to media elements, including images, overlay images, audio files, slide text and slide narratives (as well as a number of other pieces of information). The converter automatically detects and extracts slide titles and includes them in a slide index file; this is used to provide a "table of contents" for that lecture. The transcript of the voice-over text is scanned to create an index of terms for the search system; in building the index the converter removes punctuation marks, removes some stop words, and then applies stemming. The original script file is then converted to a SMIL-compatible script file suitable for display on a handheld computer. During this process, the slide and overlay images are rotated and the audio files converted to MP3 from the original uncompressed AIFF format. The MP3 files require about one eighth of the storage space that is required for the AIFF files. Very roughly, the run-time of an on-line lecture is about half the time it takes to present in the lecture theatre (with no audience participation). A live lecture that fills a one-hour lecture slot, occupies about 12 megabytes of handheld storage [7].

4. Proposed System : Multi-channel service

The proposed system illustrates how content can be distributed through a multi-channel service. A channel is defined as an architecture that can carry content to a device through specific interaction software.

Following channels have been investigated in this discussion [8, 9, 10]:

- Mobile phones using the WML markup-language
- Laptops using the HTML markup-language
- PDA using the SMIL markup-language

The application description for system illustrates in figure (3), the access to the application is made by two stages, client and proxy, each one with different functionalities.

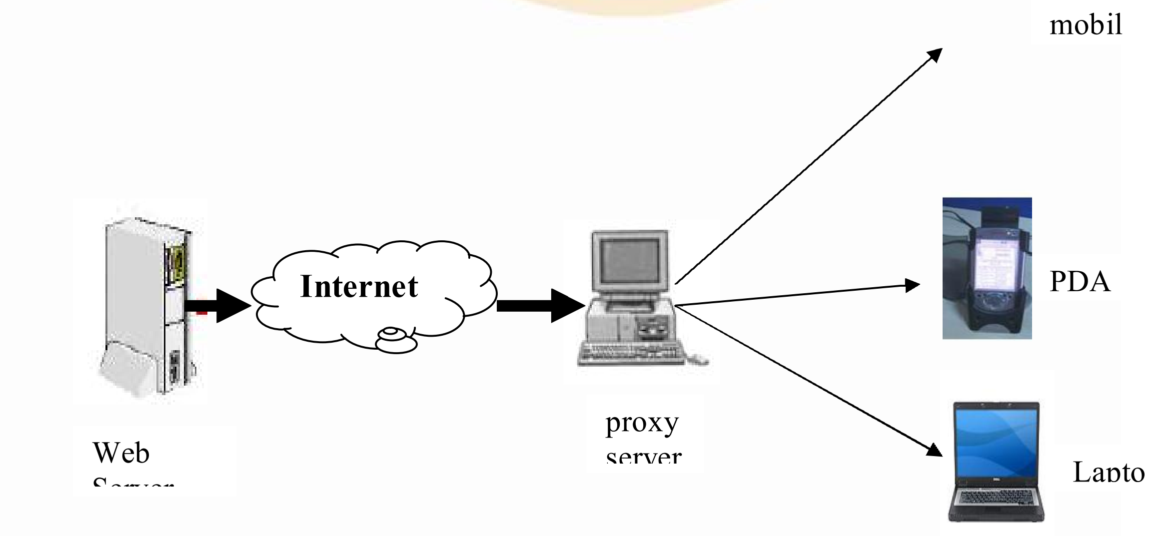


Figure (3) Proposed System

I made some assumptions and limitations:

- I am not focusing on the XML vocabulary used to store the content and the storage architecture.
- I am not focusing on design and layout of the web page, but the underlying technology
- The multi-channel service has support for browsers that handles one of the following markup-languages:
  - HTML
  - SMIL
  - WML

I assume that the Quality of Service is ideal, in order to reach device adaptation, it is needed to build interface-related ontology, and the ontology based automatic adaptation is discussed. In Onto Edu1.0, the client can be PDA or PC, and the server can distinguish the different kinds of access devices. With the content control-technology such as CC/PP protocol, the server gets the device and browser features and returns back the proper interface presentation.

5. *Experimental Test for Multi-Channel System*

On the client side, three types of wireless devices were used. The fist is Nokia – N92 cellular phone. It uses Asiacell service which provides a maximum 13 kbps transfer rate. This is considered as a low-end device in terms of network performance, CPU power, and display size. The second one is an HP-portable computer Pentium IV, with processor 2.4MHz, RAM 256MB which uses a 802.11b compatible wireless card to connect to the access point in the lab. The connection rate was at 11 Mbps. This is considered to be a high-end device. The third one is an IPAQ 3800 PDA and uses the same network adaptor and network connection as the laptop but with less computation power and memory.

The proxy server is programmed and let it run as a workstation. The proxy code includes several modules as a normal proxy server does. They are a server side module, responsible for setting up a connection with the web server; a client side module, in charge of the connection with clients; a cache management module; and a PFML parser. The web server used is google.com .The HTML page of google.com is less than 3k and rarely change, as in figure (3) above, three cases are designed to download a portion of the web page to he client which is about 900k size.

In the remote case the page is downloaded from the origin site. The client sends out a request to our, then the proxy relays the request to the origin site, having received the whole page from the web, the proxy extracts the first 900k data and forwards it to the client, in the extracted case the pages of the web sites were put onto the proxy server's local disk, and inserted some pairs of <Priority …></ Priority>tags into the origin pages. Upon the user's request, the parts marked with < Priority value="1">are extracted and sent back to the client, and the cashed case an extracted copy of the web site is put on the proxy, which is about 900k. When the user's request came, the copy was sent out immediately.

Figure (4) shows the total time measured between the user's sending out the request and receiving the desired page. The performances of cached and extracted cases are very similar, whereas the remote case has two or three orders of magnitude of larger retrieving time. Each node represents the average time collected from 7 runs in the day of the test. According to the experimental results, the average time to process a cache hit is about 4ms, to fragment a 3k google.com home page is about 5ms, and to download it from the web is approximately 600ms. The 600ms is due its relatively long expiration time which results from pages downloaded from nearby proxy servers. The first observation is that to fragment a page on the local cache server is much faster than retrieving it.

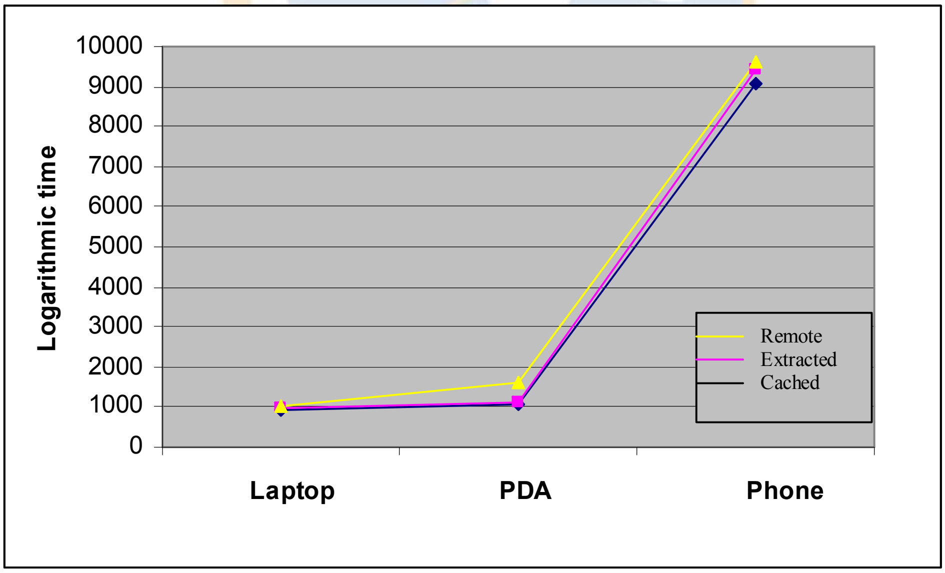


Figure (4) Comparison of total time to down load Google web page for different device.

6. Conclusion

The primary focus of our future work is to find out the threshold of network speed that can significantly offset the benefits of our approaches on a wireless network based on our experiments. The Successful implementation of programs in our paper to build learning content and distribute it through multi-channels to different users, those programs were tested successfully in transmission and reception of educational contents, the use of handheld devices can provide new opportunities for learning and communicating in local environment.

In comparison with local developing steps towards e-learning, m-learning using local applications may consider as a step forward. Live video is one of the most challenging media type, today, wired devices can provide a reasonable quality but mobile devices provide vary and poor quality, thus on-line lectures of power point type are mostly sufficient. The different combinations of media types require more of the underlying networks, such combinations will probably have diverse requirements to delay, bandwidth, and jitter for maximum performance.

Because of different device capabilities, an adaptation of the content and the presentation is needed before it can be presented to the user. This adaptation can be done on the server, on a proxy or on the client.

7. References

1	Gavriel Salomon, "Interaction of Media, Cognition and Learning", 1994.
2	Friedl, R.; Klas, W.; Westermann, U.; Rose, T.; Tremper, J.; Stracke, S.; Godje,O.; Hannekum, A.; Preisack, M.B.: The CardioOP-Data Clas (CDC). Development and application of a thesaurus for content management and multi-user teleteaching in cardiac surgery. Methods Inf Med. 2003; 42(1):68-78. PMID: 12695798 (2003).
3	www.brandon-hall.com
4	Loretta Mirelli, "Introduction to Networking Technologies", International Technical Support Organization, Raleigh Center, First Edition, 1994.
5	Maia Zaharieva, Wolfgang Klas," MobiLearn: An Open Approach for Structuring Content for Mobile Learning Environments Dept. of Computer Science and Business Informatics, University of Vienna, Austria, 2004.
6	Smeaton, A, & Crimmins, F. (1997). Virtual Lectures For Undergraduate Teaching: Delivery Using RealAudio and the WWW, Proceedings of ED-MEDIA '97 World Conference on Educational Multimedia and Hypermedia, Calgary, Canada, 990-995.
7	Soares, L.F.G., Rodrigues, R.F. & Saade, D.C.M. (2000). Modelling, Authoring

	And Formatting Hypermedia Documents in the HyperProp System, Multimedia Systems, 8(2), 118-134.
8	XML http://www.w3.org/XML/
9	HTML http://www.w3.org/MarkUp/
10	SMIL http://www.w3.org/AudioVideo/