Accessing SMIL-based Dynamically Adaptable Multimedia Presentations from Mobile Devices

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Abstract

Current business presentations are commonly multimedia-based and with the realization of the mobile enterprise, accessing of such presentations stored on servers from mobile devices will become increasingly common. However as a roaming mobile device user moves, factors that change include the local wireless network technology, the available bandwidth, the currently closest source of the media files and even the continuity of wireless access. The XML-based standard, Synchronized Multimedia Integration Language (SMIL), provides a format to specify the display sequence and layout of media files in a multimedia presentation. In this paper we present a SMIL-based system for mobile devices that is able to dynamically adapt presentations in response to such changing mobile computing-related factors as those given above.

1. Introduction

As a mobile device user moves a number of factors change that can affect their access to a multimedia presentation. Firstly, the server that is currently the closest or fastest from which to access a multimedia file from may change. As such, ideally, in order to improve network performance a mobile device should change its access source during a presentation to choose the most efficient multimedia source.

Secondly, the speed of wireless access may change. For example a device may pass from a Wi-Fi [11] or Bluetooth [1] area into an area with just GPRS [6] access. As bandwidth changes the same sized multimedia files may not be able to be delivered to the mobile device. Thirdly, a mobile device may pass out of wireless communication completely so it will need to adapt to this scenario also. A final problem is that a complete multimedia presentation may be too large to store in its entirety on a mobile device and hence will need to be downloaded and viewed incrementally.

2. Background

Synchronized Multimedia Integration Language (SMIL) (pronounced smile) [3] is an XML-based [2, 4, 9] standard. XML provides a customizable format for specifying meta-information about data. Its textual nature makes it human readable and also easy to process and manipulate. XML is also well-suited to communication in mobile computing systems [10] due to the high heterogeneity of such systems and the platform independence of XML.

SMIL can be used to provide meta-information about multimedia presentations (see Figure 1). It can be employed by Web site creators to specify how multimedia elements (video, sound, still images) can be presented and played in sequence/ parallel as part of a Web presentation. Table 1 lists the advantages implied by various SMIL features. Because SMIL allows for the sending of multiple movies, still images, and sound separately in a coordinated fashion the researchers believe its flexibility is well suited to the dynamic aspects of mobile computing. Each media object is accessed with a unique Uniform Resource Locator (URL), which means each can be retrieved from a different source and different sources can be used as time moves forward.

The methodology used in this research considers two alternatives for delivering a multimedia presentation to a mobile device: as a monolithic multimedia file or as a SMIL-based presentation. We identify the assumed mobile computing architecture (combination of e.g. WiFi and GPRS connectivity), identify aspects of this architecture that effect the access of multimedia presentations from mobile devices and devise new techniques that make use of SMIL to improve such access to multimedia presentations. We consider how these new techniques compare with a monolithic multimedia file-based approach.

Amazon v. Audio Pod
US Patent 10,805,111
Amazon EX-1029

Table 1: Key features of SMIL [8]

Feature	Advantage
Multiple version storage	Allows for each version to have a different bandwidth for a variety of users. Allows individual components of a presentation to be choreographed across a timeline in relation to each other. Allows for control of the layout, appearance, and exit time of each file.
Multiple language versions	Useful for global users – more versions of soundtracks
Extra track (layer of content within single audio and video file)	Allows for closed captioning for people with hearing impairments. [5]
Simple, vendor-neutral markup language	Easy to learn - uses three XML elements that may be written in a simple text editor [2]
It does not work well with non-linear presentations	Useful for slideshow-style mixed media presentations
Easy to create low-bandwidth, TV-like content on the Web	Because the media files exist outside of the SMIL file, they retain their individual file sizes. No file-size expansion to slow download times.[8]
Different from other multimedia presentation tools as, instead of forcing each component into a single video file, the text-based SMIL file merely references each file by its URL	To change an audio component within a complex after a presentation begins, simply edit the SMIL file. Not necessary to rebuild the entire presentation from scratch.

```
<smil>
 <head>
 <meta name="copyright" content="sample" />
 <layout>
   <!-- layout tags -->
   <root-layout width="600" height="300" background-color="white" />
 </layout>
 </head>
 <body>
  <!-- media and synchronization tags -->
  <par>
   <audio src="voice.wav" clip-begin="7s" alt="speaker voice" dur="360s" />
   <seq>
    <img src="title.gif" alt="The presentation title" dur="6s"/>
    <video src="slides.mpg" clip-begin="7s" alt="slides" dur="360s" />
   </seq>
  </par>
 </body>
</smil>
```

Figure 1: Example SMIL file

3. A SMIL-based System for Dynamically Adaptable Multimedia Presentations

3.1 System Architecture

The mobile computing architecture assumed for the proposed system for dynamically adaptable multimedia presentations (see Figure 2):

- A central server that is continually accessible from mobile devices via GPRS and which acts as a resource lookup server
- Many WiFi local access points scattered at various possibly non-adjacent locations
- At each access point there is an associated server that has a high-speed Internet connection. These servers act as proxy Web servers.
- Multiple servers storing multimedia files. Certain multimedia files may be duplicated at many servers.
- WiFi and GPRS-enabled mobile devices each with a device-based agent carried by roaming users

3.2. Accessing SMIL-based Dynamically Adaptable Multimedia Presentations

In the proposed system an XML SMIL file specifies what multimedia files must be accessed in a multimedia presentation including how and where they are to be displayed in the presentation window. SMIL does not embed all of the multimedia files in one monolithic file for the presentation but rather just provides references (URLs) for the multimedia files and these can be downloaded separately from these specified URLs.

Each mobile device will have an agent [7] that will manage the retrieval and display of the SMIL-based multimedia presentation. An agent dynamically manages aspects of multimedia resource retrieval such as what files to retrieve and when by following the statements of the SMIL file but also making some decisions based on its knowledge of the current state of the mobile device and wireless connection.

As a mobile device passes through a WiFi access area and requests a multimedia presentation the XML SMIL file representing this presentation will be sent to the mobile device. The agent will identify the first multimedia file(s) to be displayed and make a request to their URLs (see Figure 3). This request will be routed through the local access point server which will act as a proxy Web server (Step 1). This proxy server will then make a request to the central server (the resource lookup server in particular) (Step 2). This lookup server will know the location of the closest copy of the requested multimedia file and will return the URL of this copy to the proxy Web server (Step 4). The proxy Web server will then request this file from the URL indicated by the central lookup server. The proxy server will then return

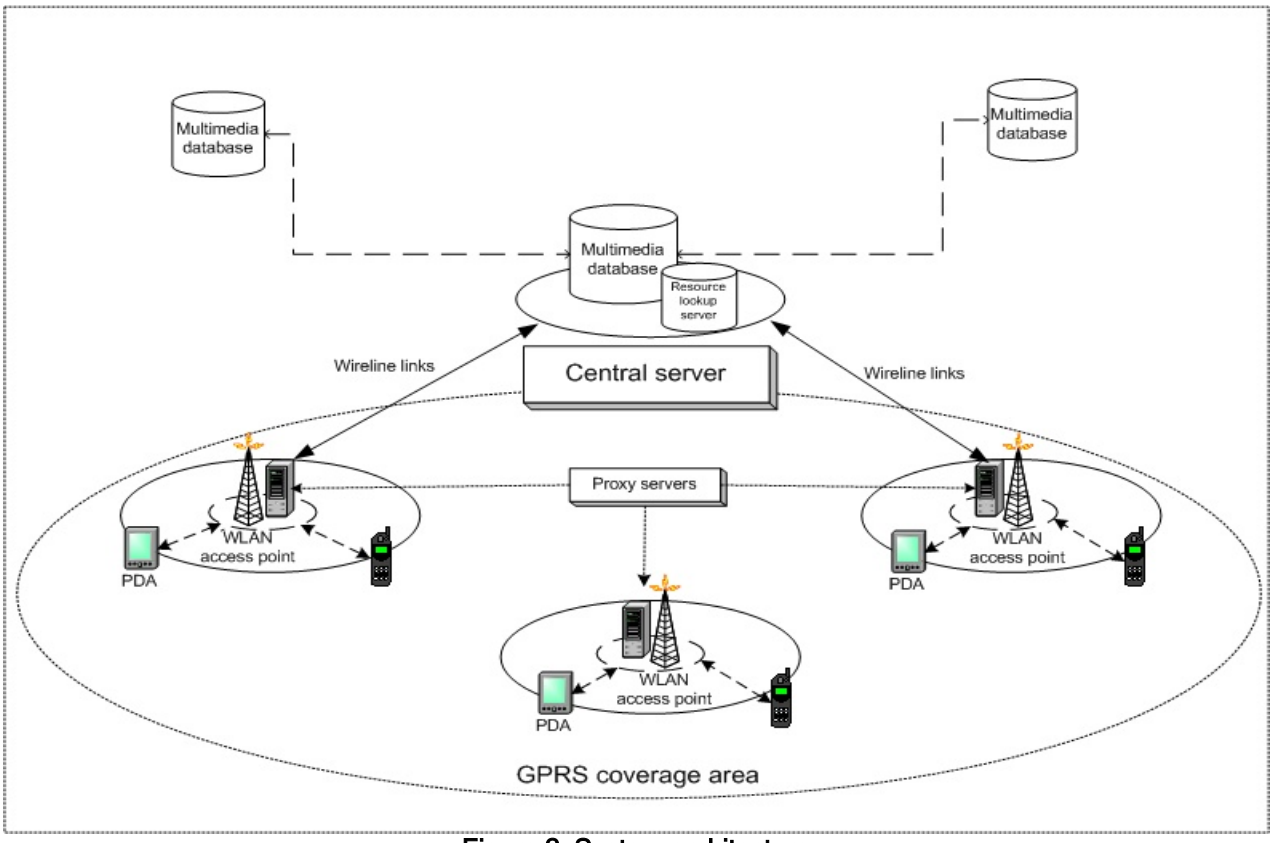

Figure 2: System architecture

this multimedia file to the requesting mobile device (Steps 5 and 6). Figure 4 shows how this corresponds to the contents of a SMIL presentation file.

Via the use of a proxy and lookup server, the file will be retrieved from the closest/ fastest source for the multimedia file. The importance of providing the best source of the presentation elements has several aspects.

Given that multimedia files can be quite large, accessing the file from the most efficient server is important. Redirecting user requests to the optimal source for each particular multimedia file improves not only the user's experience but the performance of the system as a whole. Accessing the source for which there is the "best" network link decreases possible transmission disturbance and as a result, improves the presentation quality. In addition, the central lookup server can serve source suggestions based on its global knowledge and thereby improve the whole-of-system performance.

As a mobile device moves the sequence of definitions of multimedia resources in the SMIL file dictates what new multimedia files will be requested. The requests are performed by the device-based agent which contacts the proxy server to request the file from the most appropriate server – this server may differ from the server previously used.

As a mobile device passes out of a WiFi access area the device-based agent will detect this. For example the device may now pass into a GPRS access area. This situation of lower bandwidth connectivity can be accommodated for by (1) multimedia presentation providers or (2) automatically adapted to by the system.

In the first case the presentation provider during construction of the SMIL file can prepare the presentation in such a way that its elements are decomposed into smaller parts referenced separately in the presentation description. By doing this, the chance that the download of a particular file will be interrupted mid-stream by a change in connectivity is decreased.

In addition the presentation provider can provide different alternative multimedia files that will be used depending on the current network connectivity at the mobile device's location e.g. Wi-Fi, GPRS. In practice this could be achieved using the SMIL <switch> tag. The switch tag allows differing tags to be evaluated depending on Boolean conditions. In the case of GPRS-only access, a smaller/ lower fidelity file can be the alternative or, for example, a sequence of gif images could be provided instead of a movie (e.g. mpg) file.

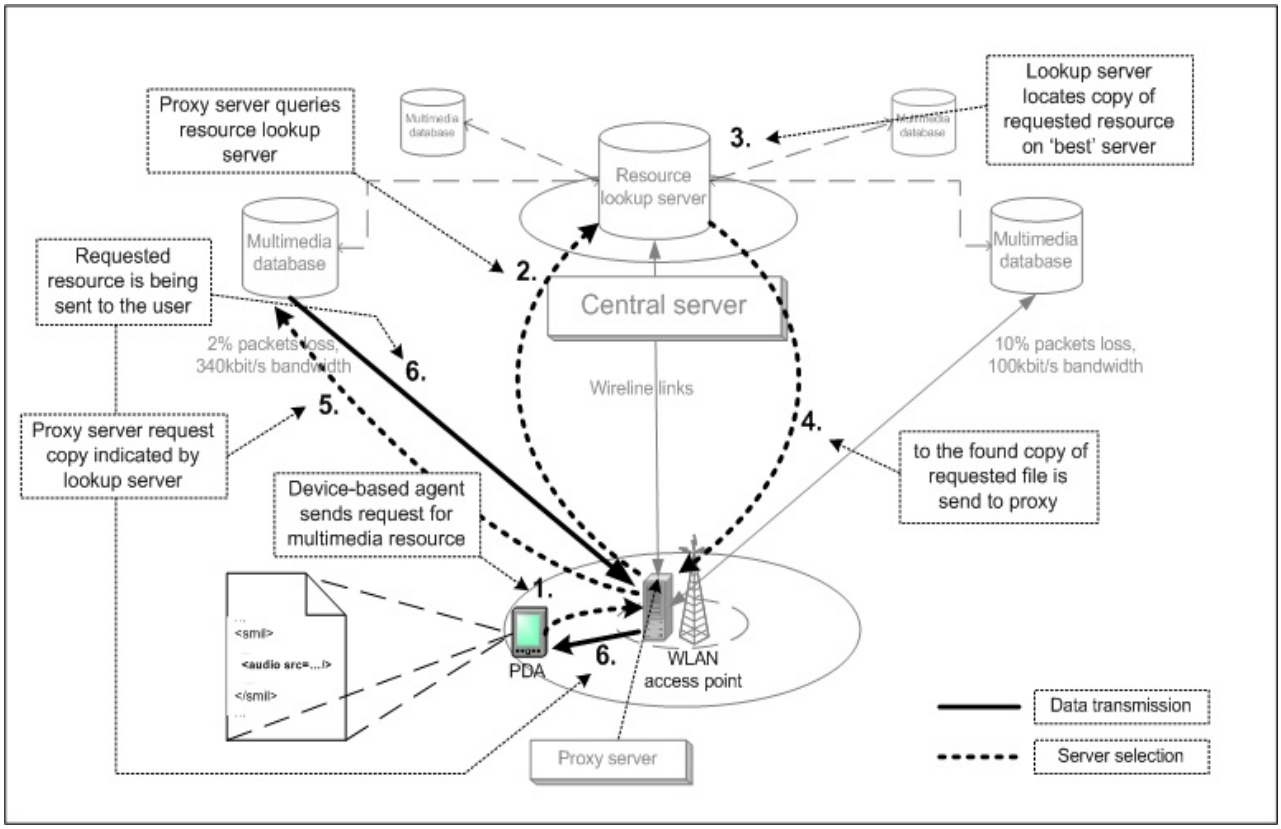

Figure 3: Server selection procedure

```
<smil>
 <head>
  <layout>
   <root-layout width="300" height="200" background-color="white" />
   <region id="footnote" left="50" top="175" width="150" height="25" />
   <region id="slides" left="25" top="25" width="250" height="170" />
  </layout>
 </head>

 <body>
  <switch>

  <!-- fully functional presentation when user is in WLAN coverage area -->
  <par system-bitrate="300000">
   <seq>
     <video src="http://www.foomedia.com.au/slides_300k.mpg" alt="slides" dur="3600s"
        region="slides" />
   </seq>
   <seq>
     <video src="http://www.foomedia.com.au/examples_300k.mpg" alt="examples" dur="360s"
        region="slides" />
   </seq>
  </par>

  <!-- only voice when user uses GPRS connection-->
  <par system-bitrate="100000">
   <audio src="http://www.foomedia.com.au/lecturer_56k.wav" alt="voice" dur="3960s" />
  </par>
  </switch>
  <par>
   <text src="footnote.txt" region="footnote" />
  </par>
 </body>
</smil>
```

E.g.: lookup server maps the requested resource to this URL:
http://node1.multimedia-database.au/slides_300k.mpg

E.g.: lookup server maps the requested resource to this URL:
http://node5.multimedia-database.au/examples_300k.mpg

E.g.: lookup server maps the requested resource to this URL:
http://node1.multimedia-database.au/lecturer_56k.wav

Figure 4: Example SMIL document

In the second case where the presentation provider has made no alternative multimedia file options the device-based agent can make dynamic changes to the SMIL file itself. It can request the specified file from the central server (via GPRS) providing an option that indicates that an alternative file is sought. In this case the central server's knowledge of alternative files is used. It can be aware of these alternatives to the current file by examining its history of alternatives that were previously used for this file, possibly in other multimedia presentations.

Alternative instances of the same multimedia element can be used when requesting devices are in the presence of differing network connectivity but it can also be used for providing additional system reliability when there is a (sudden) decrease of bandwidth in the network link to the multimedia database or network congestion.

The alternative files for multimedia such as voice or video could be encoded with lower bit rate. Even though this alternative would mean lower quality it will preserve continuity of presentation which in most cases is the preferred option.

The ability to access the same multimedia file but with different quality can be extended by substitution of the initially requested resource with different file type but presenting the same element of the presentation. Such substitution can be useful when the mobile device is not able to present the initially selected resource e.g.

presenting only voice or text data instead of video, because of a poor quality connection.

If there are no alternative files known then the device-based agent can extend the display time of the current multimedia file.

The new SMIL-based techniques proposed above provide significant advantages over a monolithic multimedia file-based approach. In the case of a monolithic file-based approach it is difficult to dynamically swap servers as the mobile device moves (leading to a worse user experience and worse network efficiency), there is no easy way to vary multimedia fidelity/ file size to account for changed network connectivity mid-presentation and there is no way to substitute alternative file types (e.g. sound for video) for a sub-part of a presentation if connectivity varies.

4. Conclusion

Being able to access multimedia-based presentations from a mobile device will become increasingly important and commonplace. However, given the high bandwidth and device demands of multimedia content and the fact that as a mobile device user roams the wireless network technology can change, bandwidth can vary and the best server from which to source multimedia content can change, there are significant difficulties in enabling such mobile device access of multimedia presentations. In this paper we have proposed a system that makes use of the SMIL standard to dynamically adapt how a presentation is composed and its constituent files retrieved so as to cope with the difficulties mentioned above.

6. References

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