ENABLING USER-TAILORED MMS DELIVERY IN HETEROGENEOUS ACCESS SCENARIOS

Dirk Trossen, Hemant Chaskar
Nokia Research Center Boston, 5 Wayside Road, Burlington, MA 01803
Phone: (781) 993 3605 Fax: (781) 993 1907
{Dirk.Trossen,Hemant.Chaskar}@nokia.com

Abstract
Tailoring services and applications to the user’s needs and environment is becoming an important feature to support in future mobile services. New techniques and functionalities need to be deployed to enable such features. Recently, multimedia messaging is evolving to be a major service to be supported in wireless networks. However today, multimedia messages are limitedly adapted in their delivery with respect to the user preferences and the current context the user is in, including the access network the user is currently using. In this paper, we will outline scenarios that motivate the need for more sophisticated adaptation means that will particularly suit heterogeneous access scenarios. We propose an architecture and the specific information to be used in order to enable tailored delivery of multimedia messages.

INTRODUCTION
There seems to be a general consensus in research and industry that future mobile services will need to be user-tailored. Awareness of the user’s needs, preferences, and current environment while offering services, constitutes what is called context awareness [2]. Context awareness techniques can provide the required means for creating customized services. Most of the prior work in context awareness has been done mainly in the application area. However, taking into account user’s preferences and context at communication layer is also important for the delivery of context aware services. The delivery and communication platforms today rarely support such feature. Multimedia messaging service (MMS) has attracted much attention recently as a service to provide the required momentum for the mobile industry. Recent service deployments worldwide as well as availability of terminals with color displays and cameras are making this service grow at fast rate. However, there is still a significant lack of message adaptation features beyond mere content format, size and resolution. The current MMS systems merely take into account the device’s capabilities in displaying the received information as well as subscription details of the user. More sophisticated information, both from sender’s and individual receiver’s side, but also from network’s side is not supported. Further, there are no means in place to define rules of delivery, which could be defined individually for each user.

In this paper, we motivate the need for more sophisticated message delivery adaptation means by outlining specific scenarios that particularly focus on heterogeneous access environment. We then introduce architectural extensions that enable user-tailored delivery of multimedia messages in such environment. We describe the information that is taken into account for delivery as well as how the actual delivery is adapted when using this information.

The remainder of the paper is organized as follows. In the following section, scenarios are outlined as motivation for our work. We will then present our solution in order to enable the presented scenarios, including an illustrative example, before we conclude the paper.

THE SCENARIOS
To motivate our work, let us consider the following scenarios that are not possible within the current MMS architecture.

News Scenario
Suppose that a sender (such as a news server) frequently provides certain topic-related information to a set of users, for instance to a soccer news group. The text portion of the message contains a brief description of the entire message. The recipient desires to configure the delivery in a way that only the text portion is sent when being in 2.5G coverage. If there is enough interest on the recipient’s side, he or she might request the entire content to be fully delivered. Alternatively, the recipient can instruct the Multimedia Messaging Service Center (MMSC) to deliver the entire message upon change in the user’s status, which might for instance be arriving at cheaper or faster access. On the other hand, when the recipient is currently in a WLAN coverage area, he may wish to instantly receive the message from the news server, while at the same time not exceeding 10kB per message. With this, it is possible for the end user to subscribe to certain services without the worry of being flooded with a number of large messages.
Rebate Scenario

The sender might encode the urgency of the message in the message itself by using a user-friendly messaging interface on the phone. MMSC can now delay the delivery of this message to the recipient in hope that the recipient will arrive in some operator WLAN coverage area before the message delivery deadline. If it does, the message is delivered over operator WLAN and a credit is given to the sender since the delivery costs are cheaper than over cellular access. If the recipient does not arrive in an operator WLAN coverage before the message deadline expires, it is delivered over cellular network, and no credit is given to the sender.

Transcoding Scenario

Suppose that the sender desires to send a sports clip, including text, video, and audio commentary. Further, suppose that the message needs to be delivered to the recipient over a congested 2.5G network. As a consequence, it may not be possible to deliver the full message, i.e., the entire sports clip, due to bandwidth limitations or because the recipient chose not to receive large messages when connected to a cellular network. In such a case, it will be beneficial to transcode the multimedia content of the message before being delivered to the recipient. Since the message is a sports clip, video is more important than audio, and therefore audio should be removed first before tampering with the video content in order to reduce the size of the overall message. However, the MMSC (or the transcoder providing service to MMSC) has in general no means of knowing this. For example, if the message were a song clip instead, audio would be more important than video, and then, MMSC should first remove video before tampering with audio. Hence, it would be beneficial if the sender could include relative importance of various multimedia objects at the time of message creation. If some of these objects are removed by the network before being delivered to the recipient, a corresponding credit may be given to the sender.

In the light of the outlined scenarios, it is apparent that a customized delivery of messages is required that goes beyond the current MMS specifications.

THE SOLUTION

In this section, we will first describe the architecture for MMS delivery that we assume for our solution before we outline the information that is taken into account for such user-tailored delivery as described in the scenarios. We will then present in more detail the signaling for information provisioning and delivery.

The Architecture

Figure 1 shows the architecture of our solution, based on the current MMS architecture as defined in 3GPP [3]. Apart from the sender and the recipient(s) of the message, the Multimedia Messaging Service Center (MMSC) implements the delivery and forwarding mechanisms. In addition to the current specifications [3], it integrates a preferences processor that executes a script, defining the delivery rules for this particular recipient. Multiple recipients might exist, each of which has its own script. Each script is transferred from a database, i.e., the profile server in Figure 1, to the MMSC upon reception of a message for a particular receiver. This profile server could be collocated with the HSS functionality in 3G.

What Information is Provided?

Different kind of information is used to tailor the delivery of each message that arrives at the MMSC.

Sender’s Preferences

Sender information may comprise of message deadline (urgency) and relative importance of objects in the message. For the latter, say an MPEG video object in sports clip is more important than accompanying audio commentary, while audio is more important than video in the popular song. Providing a user-friendly messaging interface on the MMS client in the phone or feature-enabled programming interface for bulk message creation could enable definition of this information on the sender side. This sender information is included directly within the message, for instance using known multimedia description formats.

Recipient’s State

The recipient’s current state is an important piece of information to tailor the delivery of the message. For instance, the current connectivity, such as 3G or WLAN, can be defined as state information to be used for the tailoring of the message delivery. Or the current activity of the recipient, can be defined as state information to tailor
the delivery as well. The recipient’s state is uploaded to the MMSC upon changes in the value of this state. The trigger for state updates usually depends on recipient-internal application semantics. For the upload, the recipient sends an appropriate message to the MMSC, containing the updated state information. For instance, the state could be sent as simple SMS messages to the MMSC. For representing the state information, one can envision to use XML, defining a language element that expresses the current state of the recipient as a simple string, such as

```xml
<state>
  "string"
</state>
```

**Network Information**

The delivery can also be based upon current information of the network that is supposed to be used for delivery. For instance, if the network does not allow the full delivery of the message within a certain deadline, the delivery might either be diverted to another access network, if possible, or the information is reduced through partial transcoding the content. This network information might be, among others, congestion state, maximum transfer time, available bandwidth to user, etc. and is provided to the MMSC by appropriate network entities over SMS or IP bearers.

**User-specific Rules**

As already mentioned above, user-specific delivery rules are used to invoke certain actions based on the provided information, i.e., sender’s input, recipient’s state, and available network information. Examples for such actions are, among others:

- **Reduce** the size of the message through transcoding parts of its content, such as video or audio. The transcoding might be implemented within the MMSC or through an external application server. Different parameters might be given for the action, such as maximum message size, bandwidth constraint, part of message to be reduced.

- **Deliver** either the entire message or parts of it to the recipient. Usually, the recipient’s address is given as parameter (which might be different for different access types, e.g., phone number of 3G and IP address for WLAN). In the case of partial delivery, the message is still stored internally for future delivery.

- **Store** the message internally for future delivery.

The user-specific rules are provided as a script that is invoked within the MMSC through the preference processor upon arrival of a message for the particular recipient. An XML-based notation, similar to the Call Processing Language (CPL [1]) is proposed in order to specify the rules. In Section 4, an example script is presented that is based on such XML notation. As for the definition of the scripts through the user, graphical means, such as developed in [5], are the most likely form of input in order to facilitate user-friendly definition of these rules. These scripts can be defined either directly on the mobile phone or from the user’s desktop, using a web-based tool.

The generated delivery rules can then be provided to the MMSC in different ways. For instance, the script can be directly uploaded from the recipient to the MMSC, e.g., by using SMS messages, for upload of pre-defined scripts to the MMSC. The script might also be stored in the user’s profile, e.g., within the HSS, and uploaded from the HSS to the MMSC upon the arrival of an MM. The script might also be uploaded directly from the desktop to the MMSC, e.g., by sending the script via an Internet SMS gateway.

**The Delivery: How is the Signaling Done?**

The abovementioned information is used together with the user-specific rules for the tailored delivery as shown in the following description of the signaling communication.

Four cases are distinguished, representing changes in each piece of provided information. The resulting signaling for all cases is shown in Figure 2.

```
<table>
<thead>
<tr>
<th>Sender</th>
<th>MMSC</th>
<th>Recipient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: Signalling Communication for MM Delivery
```

**Case 1: Reception of New Message**

This case represents the change of sender preferences by sending a new message. Since sender preferences are encoded in the message itself, each new message can potentially have different sender preferences. Upon arrival of message 1 in Figure 2 at MMSC, the script for the particular recipient of the message, is executed. Based on the result of actions defined therein, the message is delivered, either transcoded, partially, or entirely, to the recipient (message 2 in Figure 3). However, it might also be possible that the message is stored at the MMSC for future considerations as a result of the user-specific rules. In that case, message 2 is not sent.

1 - 275
Case 2: Change of Recipient’s State

This case represents the change of recipient’s state information. As per the signaling in Figure 2, the recipient updates the state information by sending message 3 to the MMSC, acknowledged by message 4. The new state information is stored in the MMSC. If there are any messages stored for the recipient at the MMSC, the latter executes the user-specific rules, i.e., the script, taking into account the newly received recipient state.

Based on the result of the actions defined in the script, one or more of the stored messages may be delivered, either transcoded, partially, or entirely, to the recipient (message 5). However, it might also be possible that the message is not considered for delivery and therefore continued to be stored at the MMSC for future considerations. In that case, message 5 is not sent.

Case 3: Change of Network Information

This case represents the reception of new or changed access network information. If there are any messages stored at the MMSC, the latter executes the appropriate script for the recipient of the stored message and takes into account the changed access network information.

Based on the result of the actions defined in the script, one or more of the stored messages might be delivered, either transcoded, partially, or entirely, to the recipient (message 6). However, it might also be possible that the message is not considered for delivery and therefore continued to be stored at the MMSC for future considerations. In that case, message 6 is not sent.

Case 4: Change of Delivery Rules

This case represents the change of the delivery rules as a result of an upload of updated rules to the MMSC. If there are any messages stored at the MMSC for this particular user, the latter executes the appropriate script, for those stored message(s) and applies the updated rules. Based on the result of the actions defined in the (updated) script, one or more of the stored messages might be delivered, either transcoded, partially, or entirely, to the recipient (message 7). However, it might also be possible that the message is not considered for delivery and therefore continued to be stored at the MMSC for future considerations. In that case, message 7 is not sent.

Example

The following example intends to outline the specification of the delivery rules, i.e., the user-specific script. The used notation in this example is similar to CPL as defined in [1].

```
<msmsg>
  <state-switch>
    <state is "WLAN">  # deliver all message right away if in WLAN
      <deliver url="joe.cool@wlan.att.com"/>
    </state>
  </state-switch>
</msmsg>
```

Figure 3: Example Script for Tailoring MM Delivery

The example implements a sender/priority delivery of messages, based on the user’s information whether connected to WLAN or 3G. The latter information is given as state information, i.e., uploaded by the recipient.

CONCLUSIONS

This paper presented a solution to enable user-tailored delivery of multimedia messages in 3G networks. For this, we outlined scenarios in which plain delivery of the message to the user either does not suffice or leads to reduced user satisfaction. In order to enable the outlined scenarios, we proposed an extension to the current MMS architecture in 3G by implementing a preference processor in the MMSC that takes into account a variety of information when making a decision as to what information to deliver.

In the future, we will be addressing the integration of the proposal in deployed systems, and we will further study other scenarios for such user-tailored delivery as defined by our proposal in this paper.

REFERENCES