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Animation within Mobile Multimedia On-line Services

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Abstract

Suitable concepts have to be identified or developed that guarantee the effective usability of mobile multimedia information and services. A platform dedicated to the mobile infrastructure that bundles such concepts is currently being developed within the European ACTS project *Mobile Media and ENTertainment Services* (MOMENTS). The platform will offer multimedia products – information and services – to end users within service trials in a GSM-/DCS-1800-based mobile infrastructure. Further advanced developments, like wide band user channels, will be shown in a Technological Demonstrator. This paper concentrates on the handling of animation within wireless multimedia services.

Technical requirements on the usage of animation that result from the mobile infrastructure and multimedia on-line services are outlined. The potential of animation within mobile services is illustrated via selected application scenarios. Standardization activities for the modeling and encoding of animation are described. A feasible architecture derived for the handling of animation within wireless multimedia on-line services is outlined.

Keywords

Mobile Multimedia, On-line Services, Animation, VRML, Modeling, Encoding, GSM, DCS1800, Wireless Services, World Wide Web

J. L. Encarnação et al. (eds.), *Mobile Communications*

2.4 Application Communication Manager

The *Application Communication Manager* is an application specific interface to the components of our architecture. It can be realized as a built-in interface in especially designed mobile applications or as a separate component that uses a defined interface of an existing application (see Figure 2). Tasks of the ACoM include the management of a list of all requests and related replies of an application together with applied contexts and the decomposition/composition of complex compound replies. The sending ACoM divides compound replies into several subreplies of certain defined types and hands them over to MHs for type specific exchange. These MHs have to be started by the ACoM. They transfer the subreplies to their counterpart at the receiving site (started by its NS) and hand them over to the receiving ACoM that will reassemble the reply object.

2.5 Message Exchange

The protocol that we use for the communication over the Object Bus is a combination of an efficient protocol for coding header information and the possibility to express the contents of messages in an application dependent format, like SQL, HTTP, MIME, or KQML. Since the content of a message should not be evaluated by the Network Scheduler all data that are necessary for planning the transfer, e.g. priority, size, and QoS demands, have to be part of the header. Our protocol allows splitting of larger messages into smaller pieces and sending them separately. The headers of these pieces are provided with offset values so that a transfer can be continued at this offset without a full retransmission after a disconnection has occurred.

3 USE OF CORBA

The acceptance of a new approach is often measured by its integration in the "real world". Due to this, the use of widely known and accepted standards and the integration of legacy systems into the new environment is crucial. We propose the Common Object Request Broker Architecture (CORBA) of the Object Management Group (OMG, 1991) as a platform for the design of object oriented, distributed systems – even in the context of mobile visualization.

We show, how this standard can be used to support resource poor mobile hosts and minimize the amount of data by optimization of the data flow. To do this we map the abstract architecture of the OBus to CORBA and point out which work is necessary to gain interoperability between standard CORBA and the modified broker architecture implementing the OBus.

3.1 CORBA Motivation

The design of software systems in general and of software for special circumstances like mobile environments in particular is a non trivial and expensive challenge. The problems of today's software engineering can only be faced by the use of modern paradigms and powerful tools that support the user by hiding great parts of the complexity one has to cover. The role of CORBA in this context is a platform for integration and distribution: objects can be used in a comfortable way independent of their location in the network, their implementation language

1 INTRODUCTION

Global information management systems – such as the World-Wide Web (WWW) – show that the on-line access to vast amounts of distributed multimedia information is possible not only for the expert, but also for the "naive" end user. At the same time relatively cheap and widely available wireless data communication services are available to the mass-market.

Within the coverage of the cellular network, the vision of information access for "everyone, anytime, anywhere" has become reality. However, because of the low bandwidth of wireless narrowband wide-area networks (such as the 9.6 Kbit/s of GSM, DCS-1800) and the limited resources of mobile hardware, the handling of distributed multimedia applications and services faces severe problems.

Users of mobile systems will expect to get access to all of the multimedia data making up modern information applications including time-dependent data like speech, sound, animation, or video – at least within the limits defined by the mobile system's input and output capabilities. They have become accustomed to comfortable, easy-to-use interactive multimedia systems based on the concepts of direct manipulation. A step backwards in interactivity will cause a serious acceptance problem. So in order to build "everyone, anytime, anywhere" information applications that will be *used*, the problem of how to make these services interactive across a slow data link has to be solved. Suitable concepts have to be identified or developed that guarantee the effective usability of mobile multimedia information and services.

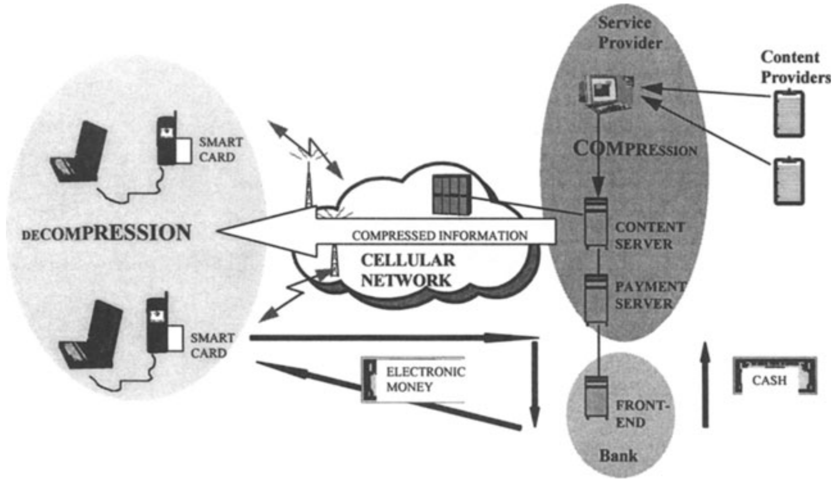

Figure 1 Overall MOMENTS architecture for the projected service trials.

The overall objective of the ACTS* project *MObile Media and ENTertainment Services* (MOMENTS) is to demonstrate the technical feasibility and business viability of a wireless media highway for the distribution of advanced multimedia products. This covers two

* Advanced Communications Technologies and Services.

application categories, on-line services and entertainment. The aim of the project is to contribute significantly to the understanding of the users' perception of the values of wireless multimedia services, identify how commercial exploitation of the services using third generation systems can be accelerated, create new enabling technologies, in particular for the presentation of visual material, and make valuable contribution to standardization.

Figure 1 illustrates the overall MOMENTS architecture for the projected service trials that will be conducted in three different European countries.

MOMENTS will allow a realistic assessment of wireless multimedia services and verify the identified business opportunities. System enhancements will be developed and demonstrated in the Technological Demonstrator to access the benefits of wider band user channels and determine how they can be incorporated into UMTS. New techniques that will be evaluated and applied include presentation technologies, optimized for the inherently narrow cellular user channels; wide band user channels allowing transmission rates of the third generation mobile systems (n x 9.6 Kbit/s, n >= 2). This paper focuses on the handling of animation within wireless multimedia services.

Within Chapter 2, the term animation is briefly defined as used in this paper. Subsequently, a state-of-the-art in regard to existing standards and standardization activities for animation is given. Technical requirements to use animation within wireless multimedia on-line services are outlined in Chapter 3. Furthermore, typical mobile application scenarios are presented. A feasible approach for the efficient handling of animation is outlined in Chapter 4.

2 ANIMATION

As the term animation can be used in various ways it is necessary to briefly describe these definitions first and to point out which of them is applied here. Subsequently, standards and standardization activities in the area of animation are outlined.

2.1 Definition

The definitions of the term animation mainly differ in the kind of data that is transmitted to the user's mobile data terminal (MDT), and the handling of the data on the MDT.

On the one hand, the term animation can refer to the playback of animated sequences on the MDT. Changes within an original graphical scene are rendered and recorded as video images. The resulting sequences are transmitted to and displayed on the MDT.

On the other hand, animation can be regarded as changing the appearance of a graphical scene where the graphical description of the scene and the behavior of the objects of the scene (i.e., non-rendered images) are transmitted to the MDT. The rendering of the data is performed on the MDT.

The use of the term animation within this paper refers to the latter definition. The first definition is rather a transmission of video images. The problem arising here is the size of the rendered images. General video is far too large for transmission over mobile narrowband WANs. However, substantial work is being performed in this area to apply video transmission to mobile networks (Nieweglowski, 1996).

Furthermore, user interactivity is an important feature for multimedia on-line services and therefore is also applied to animation. This interactivity comprises user-oriented navigation through the scene as well as the possibility to interactively change the appearance of a graphical scene.

2.2 State-of-the-Art

The description of any animation, independent of the dimension (2D or 3D), consists of two conceptual functional units:

- *Static scene description:* describing the geometric objects of the scene (static over time). and
- *Behavior description*: describing the behavior of the objects within the scene over time (dynamic over time).

In regard to the static scene descriptions several (de-facto) standards are already available (e.g., CGM (Henderson, 1993), VRML 1.0/1.1, DXF (Autodesk, 1992), etc.). Current standardization activities in the context of VRML focus on extending VRML 1.0 (Bell, 1996) functionality in regard to the dynamic aspects of objects.

Currently, the specification of VRML 2.0 (Mitra, 1996) is still in process and will not be finalized before August 1996. VRML 2.0 enables features like interaction and animation. Interactivity is realized by applying sensors to the scene which possess the ability to set off events. These sensors are either sensitive to user interaction (e.g., moving the mouse pointer in a distinct area of the world or by clicking an object of the world) or to time passing by. Furthermore, VRML 2.0 offers basic animation features such as rotation, translation, etc. and additional features such as interpolating colors, positions etc. by introducing interpolators to VRML. Besides, it provides the possibility of including animation scripts or references to theses scripts (URL) in the scene description. These scripts can be written in a variety of languages including Java and C. The animation effects are achieved by means of events, i.e., a script takes input from sensors (receives an event) and generates events based on that input which then can change other nodes in the world. Passing events to the corresponding nodes within a scene graph is provided by the routing mechanism. Figure 2 illustrates the event routing mechanism in VRML 2.0.

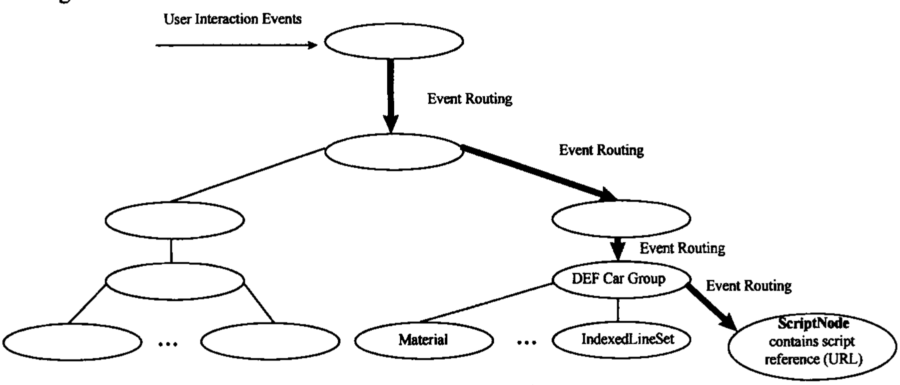

Figure 2: Event routing within a VRML 2.0 scene graph.

In order to reduce the size of VRML 2.0 files, the VRML Architecture Group (VAG) agreed on specifying a binary format for VRML 2.0. Currently, the specification of the binary format based on a proposal by Apple (Pettinati, 1996) is still under development. The specification builds upon the architecture of Apple's 3DMF binary metafile format (Apple, 1996), a file format for 3D applications.

3 ANIMATION WITHIN MOBILE SERVICES

For the usage of animation within mobile multimedia on-line services different technical requirements hold. They are derived from the mobile GSM-/DCS1800-based infrastructure and the MDTs that will be used for the service trials. Furthermore, distinct technical requirements result from the need to use animation with other media simultaneously. Typical application scenarios illustrate the added value that could be achieved with animation.

3.1 Technical requirements

The technical requirements in regard to animation in mobile on-line services are as follows:

- The hardware platform of the MDTs consists of laptops with restricted resources.
- The animation facilities should be oriented on existing (de-facto) standards, if applicable.
- The format for the description of animated graphics should provide sufficient compression to allow "real time operation" at transmission rates of 4.0 Kbit/s and 8 Kbit/s. Then, the transmission rates of GSM or DCS-1800 data channels will allow to transfer other media like speech simultaneously†.
- The integration of the animation facilities into the browser at the MDT is recommended from the user's point of view.
- The system shall be able to synchronize animation with other media, especially speech.

3.2 Application scenarios

Within mobile on-line services animation can be applied to a variety of services. Sample scenarios illustrating the usability of animation are listed below:

- **Entertainment**: In the area of entertainment animation plays the role of an appetizer in order to increase the attractiveness of presented information for the user. Animation can be applied to leisure information services which inform the user about music, movies, TV programs, etc. Furthermore, animation as an appetizer can entertain the user during waiting periods (e.g., downloading data from the server to the user terminal). Animation during such downloading processes does not only entertain the user but additionally gives feedback to the user that the downloading is still in process. An example for such an appetizer presented to the user during a downloading process is illustrated in Figure 3.
- **Location dependent information**: Information provided on city maps, restaurant guides, traffic jams, etc. belong to this area. As an example, animation in the field of city

† Simultaneous voice and data calls are not possible.

maps could be performed by highlighting in a certain color the route a user has to follow in order to reach a certain target or by letting a car or small figure drive/walk along the streets to a target.

- **Financial information**: Financial information comprises economic indicators, interest rates, stock exchange rates, etc. Within such a service the user would be able to receive on demand a 3D presentation of distinct stock exchange rates over a certain period. It might be interesting for the user to compare the presented rates with those over the same period last year or watch the profits/losses he/she would gain with these exchange rates. This additional information could be presented by including it in the former 3D presentation.

Figure 3 Example of an appetizer presented to the user during a downloading process.

4 HANDLING OF ANIMATION WITHIN MOBILE ENVIRONMENTS

A feasible approach in regard to the handling of multimedia information in mobile services should use existing (de-facto) standards wherever possible (see Chapter 3.1).

The geometric objects of a scene are defined by a standardized graphical modeling language. The behavior of the scene's objects is realized by a script that references the objects of the scene. This script can be either directly hooked into the scene description itself or can be stored separately. The advantage of this concept is the potential to define several object behaviors or animations in the context of one scene description. Furthermore, the animation script may encompass additional static components that update or extend the current scene description. Figure 4 illustrates this principle.

On the MDT the following steps are performed to present the animation to the user:

1. The scene description (those parts needed) is transmitted and successively parsed.
2. The scene is rendered (at least partially) as a starting point of the animation.
3. The animation script is executed step by step, whereby the changes of the scene are continuously re-rendered. Those objects of the scene that are needed and that were not transferred so far to the MDT are transmitted and parsed.

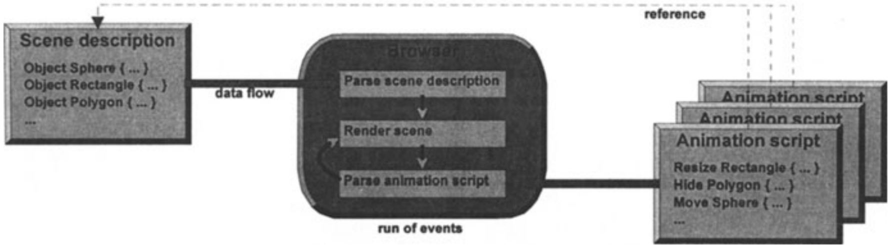

Figure 4 Principle of animation presentation on the MDT (within a browser); several animation scripts can refer to one scene description.

The overall scene is managed on the MDT via a scene graph that can be updated and extended according to events triggered by the user or the system (e.g., predefined updates at distinct time slots that constitute parts of the animation). The following example illustrates this mechanism.

Let us suppose an initial scene description contains elements like a globe (see Figure 5). For every service that the user is able to select an external script is available. These scripts contain information about the elements which represent a 3D presentation of the service selected and their behaviors (e.g., rotation commands). If the user selects a service (e.g., financial information) an event is triggered that initiates the respective external script. The script is responsible for including the elements – describing the 3D presentation of the service selected (e.g., financial information) – in the scene graph (see Figure 5). The scene graph contains additionally now a subtree of nodes that starts for example with *DEF FinancialInformation* – representing the 3D presentation of the financial information service selected by the user. The newly included elements will then be animated, e.g., letting the 3D presentation of the financial information service orbiting the globe (see Figure 6).

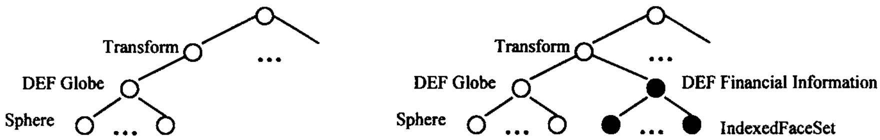

Figure 5 Example of a scene graph that is updated and extended via event triggering with an external script. The script encompasses both additional static scene components and new behavior descriptions.

The previously described approach could be based on VRML 2.0 principles applied to the mobile environment. The separation of the static scene description from its behavior description and the separation of one overall scene into several components illustrate the objective on the modeling level. To optimize the transfer of the animation to the mobile terminal encoding issues have to be considered. Comparable to vector graphics formats like CGM – CGM specifies three different encodings: binary, clear text and character encoding – one encoding that is optimized for the mobile environment may have to be specified. When specifying a new encoding, the impacts on lower layers (supporting e.g., TCP header optimization, LZW packet coding, etc.) have to be considered.

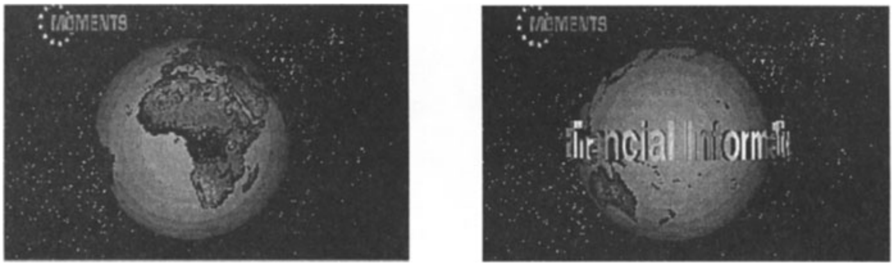

Figure 6 Example for an animated presentation of the service currently selected by the user.

5 SUMMARY

In this paper, an approach to handle animation as an integral part of mobile multimedia services has been presented.

Relevant standardization activities in regard to the usage of animation within on-line services have been outlined. Requirements derived from the mobile GSM-/DCS1800-based infrastructure and the MDTs used for the projected service trials have been depicted. Typical application scenarios illustrate the added value that could be achieved with animation.

The approach defined for animation within multimedia services could be based on VRML 2.0 principles applied to the mobile environment. The separation of the static scene description from its behavior description and the separation of one overall scene into several components illustrate the objective on the modeling level. Examples illustrate the approach described.

To optimize the transfer of the animation to the mobile terminal encoding issues have to be considered.

6 ACKNOWLEDGMENTS

This work has been performed in the framework of the project ACTS AC002 MOMENTS, which is partly funded by the European Community. The authors would like to acknowledge the contributions of their colleagues from: Nokia Telecommunications Oy, Bertelsmann AG, Citicorp Kartenservice GmbH, DataNord Multimedia SrL, E-Plus Mobilfunk GmbH, Gemplus, Omnitel Pronto Italia S.p.A, Orange PCS Ltd., Reuters AG, and Zentrum für Graphische Datenverarbeitung e.V.

The authors would also like to thank Hewlett-Packard, the information technologies provider of the project.

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8 BIOGRAPHY

Constance Belz received a diploma in computer science in 1995 from Darmstadt Technical University (THD). Since November 1995 she is working as a research assistant at the Computer Graphics Center (ZGDV) in Darmstadt. Her work as a staff member of the R&D Dept. "Mobile Information Visualization" concentrates on mobile multimedia applications in general and the modeling and handling of animation for a mobile environment in particular.

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Since April 1995 he is head of the R&D Dept. "Mobile Information Visualization" at the Computer Graphics Center (ZGDV) in Darmstadt. At ZGDV he is responsible for research and development in the areas of mobile computing and distributed multimedia information systems. This includes the coordination of several industrial and scientific projects.