USING ADAPTIVE MULTIMEDIA MOBILE AGENT IN HETEROGENEOUS WIRELESS NETWORKS

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Abstract

The new developed mobile network generations are expected to support multimedia applications (such as video, audio stream). As such, it is important that these networks provide Quality of Service (QoS)-guarantees. QoS-availability varies from network to network. Also, QoS may vary over time on the same system, due to the need to share resources among variable number of other users. Therefore, it is important, before or during the operation of an application, to be aware of the processes by which QoS can be determined, negotiated and varied. For 4G, we introduce a concept that considers the Quality of Service requirements for multimedia communication systems, as the use of source characterization in resource allocation and the characteristics of multimedia traffic. The concept is based on multimedia mobile agent (MMA) which operates autonomy. This autonomy makes an increase in flexibility to deal with new situations in traffic load and with non-regular network, as well as, it makes a decrease of the information load on the network. This increases the robustness of the network as a whole, distributes the knowledge and allows negotiations when conflicts occur. Furthermore, the multimedia mobile agent play a major task in next mobile generation in order to overcome the wireless networks heterogeneous, and the difference in attributes between the present Generation and NextG.

Keywords: Multimedia Mobile Agent, Mobile Management, QoS-Negotiation.

Presenting Author's biography

Jamal Raiyn received the MS degree in mathematics and computer science from Hannover University in Germany, in 2000. From January 2001 to April 2002, he worked in institute for Data Communications System at the University of Siegen in Germany. Since September 2002 till now, he is a lecturer in computer science department at the Al-Qasemi Academy in Israel and he is working toward PhD degree at Leibniz Hannover University in Germany.

1. Introduction and Motivation

Mobile wireless communication has turned to be a major means of voice communication (telephony). Nowadays it is becoming a viable solution to transfer data among mobile users who are on the move, introducing new mobile services like multimedia and real time data communications. This usage of such data services is expected to exponentially increase in the future. In the next generation mobile communication system, it is envisioned that mobile user will be able to access heterogeneous networks for various services and multimedia sessions via a set of heterogeneous personal devices. Consequently, there will be at least three new types of high-level mobility: service mobility, session mobility and personal mobility. Various mobility management (MM) [1] schemes have been proposed. However, several studies have shown that the traditional MM architectures are a single-layer specific and can hardly meet multi-layer mobility, e.g. Mobile Internet Protocol (MIP) which has been standardized but is only suitable for terminal mobility and can hardly support the high-level mobility, also the SIP which does not directly support Quality of Service (QoS) management. Therefore, the SIP approach alone for a complete mobility support seems to be questionable. Hybrid architecture of MIP and SIP schemes did not meet any across-layer design, i.e. So far there is no intrinsic integration across the protocol stack has been achieved. In addition, according to our experience, a single-layer-specific MM architecture can hardly provide the advanced mobility support required by the next generation networks. General, the major deficiency of the fixed scheme is that it cannot accommodate spatial and temporal traffic variations efficiently. The centralized methods which are used in fixed scheme may achieve the optimum performance in whole system: the maximum capacity or minimum blocking probability with certain interference level. However, as the number of cells increases, the centralized computation may become mathematically intractable. The method is also impractical under highly-varying traffic because of the difficulty in measuring actual condition. In addition, the measurement and transmission of current local state information and control instruction may occupy some spectrum resource and cause a large penalty in system capacity. In addition the centralized scheme is impractical for implementation because it requires system-wide information and the complexity of searching all possible reallocations is computationally hard. In this paper, we introduce a multi-layer management architecture using a cross-layer based on intelligent methodology, i.e. the multimedia mobile agent. The major advantage of using multimedia mobile agent in MM exists in the ability of the multimedia mobile agent to move from one place to another autonomously and to carry out its tasks, to manage a dynamic negotiation with other mobile agents, to conclude a plausible reasoning after updating its local information, and to develop itself in the future as appropriate to the new implemented service in the system, in order to deal with their affiliated QoS-requirement, Thus, it can support services like telemedicine mobile, medicine devices (e.g. a mobile tele-trauma system) and more. Furthermore, the mobile agent has the ability to manage three or more types of high-level mobility, terminal mobility in a homogeneous environment, multimedia session and heterogeneous personal device, simultaneously and optimally. Several studies and analysis, which we have carried out, show that the heterogeneous wireless networks (UMTS, HiperLAN, WLAN, GPRS, and Bluetooth) offer a different Quality of Service (QoS) characteristics (e.g. bit rate, delay, and bandwidth), and the session mobility has different attributes (e.g. display size, processing time, and memory). In addition, the multimedia session (MPEG, H.323) [2-3] has different attributes (i.e. jitter, delay). However, the situation is made more complex by the fact that the QoS available varies from network to network, and may also vary over time on the same system, due to the need to share resource between a variable numbers of other users. Based on mobile agent attributes [5-7-9,13-19], the mobile agent can smoothly overcome the variation of QoS attributes in three types of high-level mobility mentioned above. On the other hand, multimedia mobile agent manages and optimizes the resource (e.g. time slots, frequency channel, and smart antenna resource) allocation of a wireless network as well as the handoff process in wireless networks based on QoS-requirements by reducing the call blocking probability [10-12]. The multimedia mobile agent first calculates the co-channel interferences and the delay every determined time interval, hence, the multimedia mobile agent fulfills and manages the total activity's demand (e.g. multimedia, video conferencing, and audio) of the cellular system by allocating the channels according to mobile user's preference. The paper is organized as follows. Section 1 addresses a related works and discusses the Quality of Service requirements for multimedia communication systems. Section 2 presents our Multimedia Mobile Architecture (MMA). Section 3 presents the implementation of MMA. Section 4 concludes and outlines the future works.

2. MMA-Architecture

To manage the above mentioned sessions, we introduce the architecture of the multimedia mobile agent for real-time multimedia communication over heterogeneous mobile networks. Figure 1 describes the architecture of the MMA. The MMA architecture is divided to three main parts:

- The Mobile Agent Structure
- Communication Model
- Converting Routine

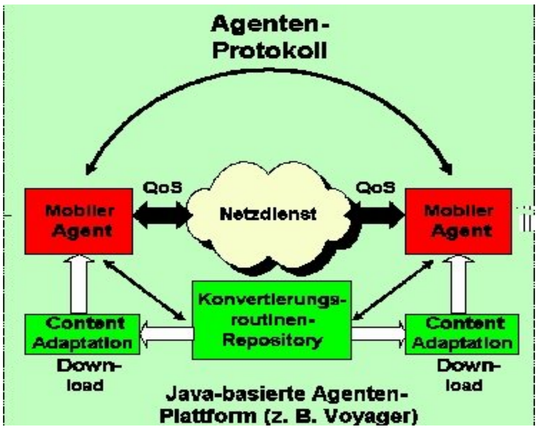

Figure 1: MMA-Architecture

2.1 The MMA-Structure

The mobile agent aims to fulfill user's preferences based on dynamic environment. The mobile agent structure is divided to three parts as follows:

Source code: The program that consists of several classes to define the agent's behavior. In source code we create the backbone agent which is contain the basic rules. Hence, the agent grew and developed itself according to the environment requirements in which it lives.

State: The agent internal variables enable it to resume its activities when the agent found in one of the following states, Offline (sleeping, evolution process), Online (awake), Busy, Waiting (standby), and Dead.

Attributes: Information is describing the agent, its movement history, resource requirements, and authentication keys.

2.2 Communication Model

We use communication model in order to establish multimedia communication over heterogeneous wireless networks based on QoS-parameters and to perform useful tasks. The agents in the system should be able to understand each other, and they should use the same message transport protocol. Messages are a data oriented communication mechanism, generally used to transfer data between processes. Messages are either asynchronous or synchronous. In the system the communication model is layered into three parts.

MH-to-MMA: The MH-agent communicates over the wireless link with it is assigned multimedia mobile agent. The MH sends the kind of mobile device (e.g. mobile phone, PDA, Laptop), and its attributes (e.g. display size, memory, processing time) to the multimedia mobile agent. Furthermore, the MH sends the kind of wireless network which the MH-agent is used (e.g. GPRS, WLAN, HIPERLAN, UMTS, Bluetooth), and the wireless network characteristics (e.g. bit rate, delay) to the multimedia mobile agent.

MMA-to-MMA: Multimedia mobile agent negotiates over fixed network with the receiver multimedia mobile agent. Based on the attributes of the two mobile devices, the multimedia mobile agent selects the appropriately converting routine.

MMA-to-MMA platform: On behalf the MMA-platform the MMA able to migration with the mobile host to serve it in other agent platforms.

2.3 Converting Routine

Our analyze which we have carried out in second section shows that the available bandwidth in wireless links is narrow compared to wireline access, and the mobile devices such as cellular phones and PDAs are restricted for portability. In recent years, several transcoding proxies [4] have been proposed in order to overcome these restrictions. Transcoding, as described in figure 2, is the process of converting a data in one representation into another, and has three process types: format conversion, data size reduction, and tailoring. If a mobile device cannot support a type of format, a proxy needs to convert a data format into a format that the device supports. The task of the MMA is to match between the different mobile devices according to their characteristics (E.g. display size, memory, processing time).

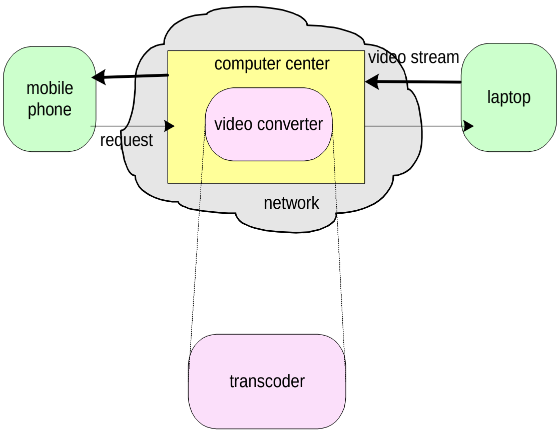

Figure 2: Video Signal Transcoding

2.4 MH-Roaming vs. MMA–Migration

The term "roaming" originates from the GSM sphere. Traditional GSM Roaming is defined as the ability for a cellular customer to automatically make and receive voice calls, send and receive data, or access other services, including home data services, when travelling outside the geographical coverage area of the home networks, by means of using a visited network. Furthermore, roaming refers to the ability to move to a foreign service provider's network. It is, consequently, of particular interest to international tourists and business travellers (international roaming). Each mobile host is assigned an ID-Number in the form of address, which it is consisting of the following parameters:

AgentName@HomeHost.HomePlatform.HomeCount.

As well as the mobile host moves from one place to other for instance, from Tel-Aviv to Berlin, the MMA migrates with it too. The moved MMA in the new environment grew and works under the exist condition.

3. Implementation

This section describes some further design and implementation details of multimedia mobile Agent components on behalf of the java applet and J2EE. We concentrate on some of the main processing components of generic multimedia mobile agent e. g, the multimedia mobile agent characteristics, mobile multimedia agent behaviors, and the communication mechanisms. Figure 3 illustrates the MMA communication model based on messaging protocol. The MMA uses the messaging protocol to collect information to update its local information and to manage negotiation with other MMA. The MMA uses two kinds of messages to communicate with other MMA: The SendRequest-Message and the receivedRequest-Message that is used for responding to MMA’s request. The SendRequest-Message includes agent name, communication type, wireless network attributes, and mobile devices attributes. Figure 4 describes the mobile agent behavior by migration to foreign countries. By roaming the mobile device aboard, the MMA will be moved to new the wireless networks based on addressing strategy. Hence, the MMA should include a high degree of autonomy in distributed dynamic cellular system, which means, the MMA is able to migrate from host to host on a network under its own control. The MMA chooses when and where it will migrate and may interrupt its own execution and continue elsewhere on the network. Figure 5 describes the negotiation process between two MMAs to perform the task. MMAs often need to interact in order to improve their performance. The goal of negotiation is the maximization of the utility of a future decision. In distributed dynamic environment, each MMA has an objective that specifies its intention to acquire a free channel for call establishment and multimedia data communication. That objective should be achieved in a certain amount of time, specified by a deadline. Negotiation stops when this deadline is reached.

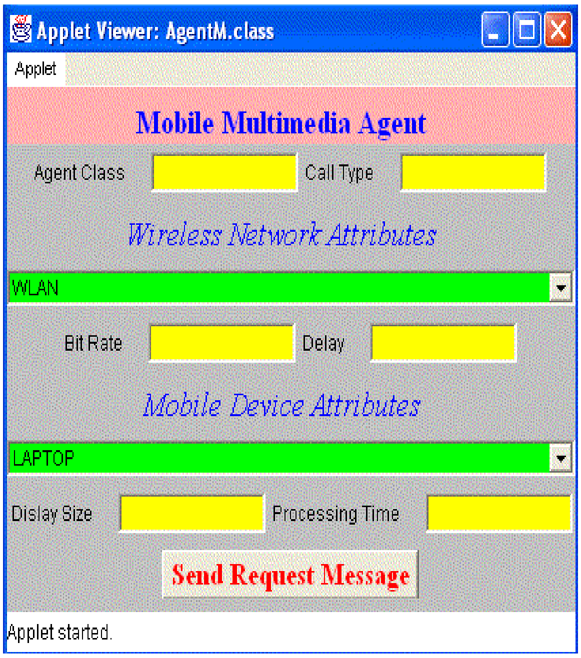

Figure 3: MMA-Design Approach

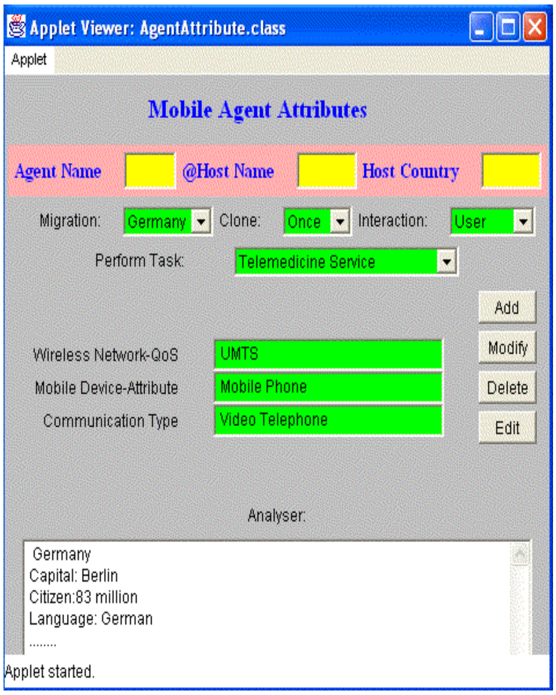

Figure 4: MMA-Behavior

Figure 5: MMA-Negotiation

4. Conclusion

In this paper we have proposed and discussed the use of the mobile agent in dynamic and complex systems according to environmental requirements. In the future work, we aim to develop the mobile agent to implement new tools based on prediction mechanism.

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