

# Intelligent ubiquitous computing and e-Business solution

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## Abstract

Mobile computing requires reliable mobile computing technologies to support data management services for mobile e-Business. An intelligent architecture is engineered that enriches mobile computers with data management services (mobile database access, secure repositories, internet-related services, etc.) making it possible to use agent technology. To provide Mobile e-Services for mobile computing growth, the architecture combines an indirect interaction model and intelligent mobile agent technology. The indirect interaction model mobile computers will be relieved from rich processing by making use of intermediary element (GSM's GPRS) as agent-based gateway support node (AGSN) to increase their capabilities. Intelligent mobile agent technology will overcome the limitations and performance-related issues of mobile computing for solution optimization. They reduce the workload of mobile computers by representing them in the intermediary element as well as in other places. Major features and architecture of our proposed system are also presented.

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## 1. Introduction

The real sense of mobile computing is now considered through data management services by incorporating Mobile e-Services in a mobile computing environment to fully support real time mobile e-Business/mobile commerce, etc.

The growing use of wireless communication networks, portable computers (PDA) and mobile phones allows a new kind of computation called mobile computing, therefore it is expected that GSM networks (global system for mobile communications) will mostly correspond to data transmission and must incorporate intelligent architecture to provide reliable data services.

Refer to Imielinski and Badrinath (1994), a widely accepted architecture of a system that supports *mobile computing*. By using the indirect interaction model (Badrinath, Bakre, Imielinski, & Marantz, 1993), it is

proposed to extend the architecture with a new element called *agent-based gateway support node* (AGSN).

The AGSN would be configured on the border between wired and wireless. The number of AGSN hosts in the wireless communication network depends on the geographical coverage and the number of users of data services. Every BS has an AGSN as manager, and one AGSN manages one or more BSs, whose cells usually cover a geographical area. AGSN incorporates services and facilities with the intent of relieving the mobile units (MU) from many tasks and increasing their capabilities, in response to their natural resource limitations. Those services and facilities should be offered either by the cellular network service provider or intranet of private corporate network.

In the proposed global mobile e-Business solution, *intelligent agent technology* (Maes, 1997) could be used which provides the following major advantages (Harrison, Chess, & Kershenbaum, 1995).

*Asynchronous:* Communication means that the elements involved into the communication do not have to be connected all the time, rather the MU may decide to be disconnected while the agent is communicating with the other element. This may be interesting, for example,

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when accessing databases where transactions can take a long time.

*Autonomous:* Communication means that the agent has more knowledge about the element of the communication to which it represents and may take some decisions on its behalf. This may be interesting, for example, when accessing databases and some transactions fail.

*Remote:* Communication means that the agent can make use of remote facilities or resources: memory, CPU, less restrictions with bandwidth, etc.

The advantages described here, however, have convinced us to make use of intelligent agent technology. In particular, *intelligent mobile agent technology* is used, and it is believed that the intelligent mobile agent technology is going to grow in popularity and many applications will be converted.

In our proposal, intelligent mobile agents are used to represent the MU on the AGSN, and for carrying out the various tasks on behalf of the MU to make mobile data communication possible, reliable and effective.

Intelligent mobile agent technology, apart from the described advantages, allows the following advantages:

*Migrate processes:* Means that the agent can migrate among different machines together with all of its states which suits the required mobile database computing nature to transaction relocation.

A mobile agent is not bound to the system where it begins execution, it has the unique ability to move from one system in a network to another system that contains an object with which the agent wants to interact and take advantage of being in the same host as the object.

Functionalities of intelligent mobile agents are provided using Aglets (Clements, Papaioannou, & Edwards, 1997); a Java mobile agent platform and library that allows a developer to build mobile agents and to embed the Aglets technology in their applications that eases the development of agent-based applications. Aglets is *simple*, since it follows *an applet like* developing paradigm where you are in charge only of defining a few methods to implement the behavior of your agents, *secure*, because it is developed in Java and is compliant to the Java 2 Security Manager, *flexible*, since it allows you to extend the platform in order to implement new functionalities, also able to autonomously and spontaneously move from one host to another and possesses typical structure and context.

For provision of customized data management services our proposed system will be configured in a computer that is in charge of monitoring the access to a private corporate network therefore AGSN (e.g., GSM's GPRS) will be the part of the intranet of a company and services can be customized according to their mobile worker needs.

In the rest of this paper problems in mobile computing are presented first followed by the features of our proposed architecture then the basic structure of the mobile agent-based operational system is clearly shown and finally a solution through AGSN to specified problems is discussed.

## 2. Architectural components features

This section describes the features of MU and a new proposed element introduced, the AGSN.

### 2.1. Agent-based gateway support node

AGSN as an intermediary element in the communications between the MU under its coverage and all other hosts of the network, control communications such that MU behaves like a fixed computer to the rest of the network and provides the following general and customized services.

#### 2.1.1. Database access

Allows mobile users to perform queries and updates in any distributed databases at any fixed host (FH) of their organization or access information from WWW distributed databases.

#### 2.1.2. Recovery

Allows mobile users to recover either mobile database transaction due to theft and damage or MSA's state and process activation due to long disconnection.

#### 2.1.3. Access to fixed host (FH)

Allows information access stored in FH and allows a user to get and store files in any host of the fixed network having access privileges.

2.1.3.1. *e-Mail.* Allows mobile users to get and send e-mail to any e-mail server.

2.1.3.2. *Bulletin-board message service.* Stores general interest messages, which the users can obtain in several ways.

2.1.3.3. *Broadcasting.* Disseminating such data asked for most of the MUs, such as local traffic conditions weather forecasts financial information, etc.

2.1.3.4. *Yellow pages.* It provides access to different data repositories with local general interest information, such as local restaurants, hospitals, hotels, etc. or other location dependent information (e.g., business promotion).

2.1.3.5. *Access to internet.* Obtain web pages, cache them in the AGSN and provide information to the mobile users. In our architecture, the use of push technology to access information channels would be too expensive for the MU; the AGSN can do it for them. With this functionality the AGSN provides mobile users with information about subject of their interest.

2.1.3.6. *Available software for MU to use.* Such as freeware software, software for rent, or filter libraries.

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