

# Network Middleware for Large Scale Mobile and Pervasive Augmented Reality Games

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## ABSTRACT

Ubiquitous or pervasive computing is a new kind of computing, where specialized elements of hardware and software will have such high level of deployment that their use will be fully integrated with the environment.

Augmented reality extends reality with virtual elements but tries to place the computer in a relatively unobtrusive, assistive role. To our knowledge, there is no specialized network middleware solution for large-scale mobile and pervasive augmented reality games. We describe here in general work on a Phd focusing on the creation of such network middleware for mobile and pervasive entertainment, applied to the area of large scale augmented reality games.

## Categories and Subject Descriptors

C.2.0 [General]: Data communications – Security and protection

C.2.1 [Network architecture and design]: Wireless communication

C.2.3 [Network operations]: Network management

C.2.4 [Distributed Systems]: Distributed applications

## General Terms

Management, Performance, Design, Reliability, Experimentation, Security, Theory.

## Keywords

Pervasive networking, augmented reality, middleware, entertainment, gaming.

## 1. INTRODUCTION

Mark Weiser [1] theorized about a new kind of computing, called ubiquitous or pervasive computing, where specialized elements of

hardware and software would be so ubiquitous no one would notice their presence.

A significant requirement of pervasive applications is fast service development and deployment [2], which implies the introduction of various service and application frameworks and platforms. For this, middleware is a common solution.

It is now becoming quite clear that entertainment, and more specifically mobile gaming, will be one of the killer applications of future wireless networks [3], however, mobile gaming applications face issues that are different from fixed network applications.

Augmented reality extends reality with virtual elements while keeping the computer in a assistive, unobtrusive role [4]. It is possible to create games that place the user in the physical world through geographically aware applications. The latest mobile phones are being equipped with GPS receivers and there are software and hardware tendencies from the largest manufacturers to equip mobile phones with more advanced context - aware technology. All the latest mobile phones are equipped with cameras and some of the latest ones are coming with some form of 3D rendering technology [5][6]. Bluetooth technology and increasing miniaturization makes possible, in the near future, specialized pervasive equipment for augmented reality.

## 2. OBJECTIVES

The main objective of this work is the creation of a network middleware for mobile communications that will enable integrated large-scale augmented reality applications to be built around it.

The middleware that is being created evolves from previous work from the author in the area of interactive distributed multimedia, more specifically in state transmission for a collaborative virtual environment middleware platform, the Status Transmission Framework (STF)[7][8]. This platform extends the ARMS platform - Augmented Reliable corba Multicast System[9] - with capabilities for the handling of state transmission for distributed collaborative virtual environments.

In this context mechanisms are being studied, proposed and evaluated to deal with issues ranging from networking issues to architectural issues.

The networking issues are mobility (such as fluctuating connectivity, host mobility and handling of multiple simultaneous network connections), quality of Service (QoS, such as minimizing delay and jitter, and reliability), security (such as authentication and prevention of cheating), management of Networks and Services, discovery; ad-hoc networking and dynamic configuration, geospatial location and orientation. The architectural issues are: scalability, consistency, multimedia data heterogeneity, data distribution and replication.

### 3. THE SYSTEM

Work on this PhD focus on the creation of network middleware for mobile and pervasive entertainment, applied to the area of large scale augmented reality games. There is a tremendous opportunity for research and development in the area of massive multiplayer games applied to augmented reality, from the point of view of multimedia and communications. The installed infrastructure of mobile operators makes it possible to install distributed solutions directly linked to geographical locations bounded by its transmission cells. Solutions extending the work envisioned in [10] and applying map subdivision like in [11] may be useful. The need for killer applications to justify the overwhelming investments made is another important factor to consider. But the difficulties exist, because of the current characteristics of the mobile networks [12]. Bandwidth on mobile networks, though increasing, is a scarce resource when compared to fixed networks. Adding to this, both transient and persistent storage spaces on the mobile host are very limited. There are also the problems of mobility handling and disconnected operation. We may consider that distributed collaborative virtual environments have network requirements that will in its majority be common to augmented reality environments. The fundamental problem for collaborative virtual environments is how to maintain a consistent shared state of the virtual reality world [7][8]. Another research topic is, from a quality of service point of view, how to efficiently transmit update messages so as to provide scalability, minimized delay, consistency and reliability. Collaborative virtual environments also have the requirement of being able to handle multiple types of data, which may be multimedia data, state update and control data. The system that will be built will be based on Java technology, and will make use of the Java Technology for the Wireless Industry related APIs, like the location API, the SIP API, the Bluetooth API and others, and will be designed to utilize a 3GPP network as the base mobile network for the system. The system will have three levels: The central level, the distributed server level and the personal area network level.

### 4. CONCLUSIONS

In this work we hope to be able to create and test the middleware and with it contribute with a platform that solves the network needs of large scale mobile and pervasive augmented reality game applications.

### 5. ACKNOWLEDGMENTS

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