Synchronized Events in Mobile Systems Physically Nearby

Nelson Marques* and Filipe Meneses**

Dept. of Information Systems, University of Minho

Guimarães, Portugal

* Email: a48064@alunos.uminho.pt

** Email: meneses@dsi.uminho.pt

Abstract— **The advances and convergence of information technology and communication technologies in mobile devices, enables the creation of ubiquitous applications for these devices. In this paper, we propose a system capable of producing a certain coordinate effect between the mobile devices of the spectators present at an event.**

Keywords— **Mobile and Wireless Computing; Events; Location; Broadcast**

I. Introduction

In this modem era, finding someone that doesn't carry a mobile phone is increasingly an exception. With technological progress, in a short space of time, mobile phones have gone from devices designed to ensure only voice communication to open systems, capable of providing voice and video communications, sending and receiving messages, run applications, access to Internet and many others.

When a space is filled with spectators to attend an event is common for people to carry out some choreography and chants, showing their support and appreciation to the athletes or performers. For example, normally in a football stadium, spectators raise their arms in a coordinated movement to produce a visual effect called "wave".

The purpose of this study is to develop a system that allows spectators at an event to be able to accomplish a particular coordinated effect through their mobile phones. For example, reducing the illumination of the stadium the spectators may put in the air their mobile phones and create "a wave". The difference to the model with the arms in the air is that now the wave is created, for example, by turns on and off in a coordinated manner, the display or the keyboard of the mobile devices.

II. Challenges and solutions

The proposed work present a number of challenges: getting an event spread in useful timing through a large number of mobile phones, getting the event to occur in a synchronized way, dealing with the heterogeneity of the devices in terms of operating systems, processing capabilities and communication. In order to implement an application there are several aspects that should be considered, as well as combined solutions that address the challenges. In this section, we discuss two possible approaches to solve the challenges of the presented work (figure 1).

A. Ad hoc aproach

The recent penetration of new technologies like Bluetooth (BT) and IEEE 802.11 in mobile devices enables the creation of Mobile *Ad hoc* Networks (MANET) [1]. In this kind of approach, the devices can freely and dynamically organize into network topologies arbitrary and temporary, enabling communication between them without the need for a pre-defined infrastructure [2].

In this particular case, viewers/users only need to be within range for participate in the event. Unlike other technologies of information transmission, BT provides direct information to all persons who are in the area instead of a group of known people.

One of the disadvantages of combining the BT technology with this model is the great complexity of the nodes forming the network. Despite the maturity of BT, the initial connection, even in the newer versions, are still consuming too much time [2] [3] [5] and even after a connection is establish, each device has it's way of dealing with incoming messages [6]. Besides that, the union of the *ad hoc* model with BT technology is likely to partitioning the network.

B. Approach with infrastructure

These networks are configured so that the nodes can't communicate directly with each other, making the communication only with access points. A node wishing
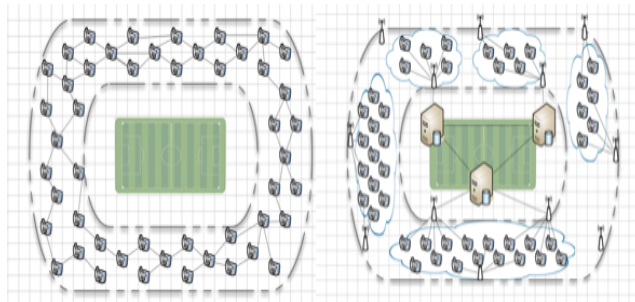

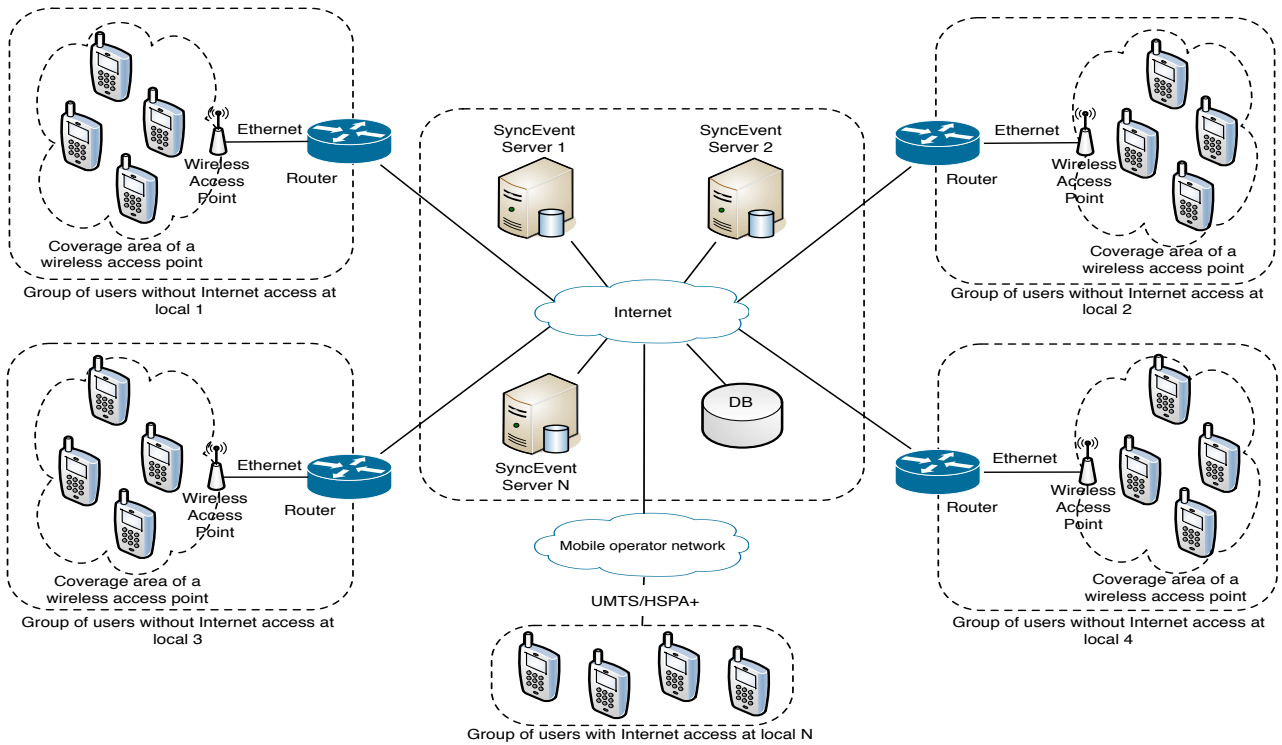**Figure 1: (A) *Ad hoc* approach. (B) Approach with infrastructure.**

Figure 2: Global system.

to transmit must wait for the authorization from the access point. As the access point is the only responsible for controlling environment access, it has the authority to regulate the access by the nodes and ensures communication to all of them.

The approach with infrastructure reduces the complexity in the applications of the devices. Although it involves the creation of an infrastructure, today, their costs are reduced. A major advantage of infrastructure based solution is the existence of a central system that avoids the activation of multiple events simultaneously and the creation of multiple networks (which may easily happen in *ah hoc* approach).

III. SYSTEM OVERVIEW

The Synchronized Events in Mobile Systems Physically Nearby (SyncEvent) should be able to disseminate information of a particular event for a large group of mobile devices through a wireless communication technology. To achieve this, it uses a central server (with Internet access) to verify the entire process of generating events. To participate in a particular event, users can communicate with the server via a Wi-Fi infrastructure that will be found in the area or directly through other Internet access technology that mobile devices have such as UMTS or HSPA.

For the overall architecture is assumed that it may need more than one access point to cover the entire area of each site and more than one server to respond more effectively to the needs of all users. Figure 2 shows how different components relate to. The servers are responsible for storing information from various events and the various places. The client application is responsible for establishing a connection to the server

through which it provides the user location to receive information about the available events.

The server holds a list of users and sends a message to each of them with the event information. That message includes the type of event (single wave, double wave, etc.) and the execution time. The execution time is computed according to the user's location in the stadium. That time is different for each place, depending on user's location.

A. Device's Location

The high computational cost associated with the different positioning technologies existing today, the complexity of implementation, the variation in results over the times and context-dependency makes its use in this project not the most appropriate solution. Instead, we propose an approach where the devices can be found in a explicitly or estimated way. In the explicitly way, is up to the user to specify his/her position in the stadium. Alternatively we consider the use of BT to discover it's neighbors and based on that information the system will be able to estimate its location.

B. Event broadcast

The distribution of messages associated with a particular event and a specific physical location, where the event is active should occur in a way so that all (or the majority) that is interested in participating in the event is informed in useful timing. The transmission of information occurs within a limited space, following the request of the mobile devices that are within the covered area. Requests can be made through various supports of transmission, and received exclusively by one mobile device owned by a user who is on the site.

IV. CONCLUSIONS AND FUTURE WORK

Through the scenario presented, the targets of this work are focus on mobile devices, specifically for smartphones. Knowing that majority of the devices has the BT technology, its use was addressed in this work. However, from a technological point of view it's easy to realize that the BT technology, even after considerable progress can still be considered underutilized since it has characteristics that hinder the creation of an *ad hoc* mobile network on a large scale.

Therefore, we choose an approach based on infrastructure. This approach meets the requirements and becomes more appealing from a commercial point of view. With the location of the devices in the stadium we can create "advanced" effects enabling the use of the system as way of advertising.

Implementing the SyncEvent application for mobile devices and the development of application server that will coordinate the execution of all events are future work. It's also expected, the possibility of performing tests with a considerable quantity of devices making the system face complex environments, for more thorough analysis.

REFERENCES

[1] I. Chlamtac, M. Conti, and J. Liu, "Mobile ad hoc networking: imperatives and challenges", Ad Hoc Networks Journal, Elsevier, vol. 1, no. 1, pp. 13–64, Jul. 2003.

[2] M. Frodigh, P. Johansson, and P. Larsson, "Wireless ad hoc networking-The art of networking without a network", Ericsson Review, no. 4, 2000, pp. 248-63.

[3] T. Thamrin and S. Sahib, "The Inquiry and Page Procedure in Bluetooth Connection", in *International Conference of Soft Computing and Pattern Recognition* (SOCPAR '09)*, 2009, pp. 218-222.

[4] Bluetooth SIG, *Bluetooth Baseband Specification, Version 4.0, Vol 2*. 2010.

[5] S. Asthana and D. N. Kalofonos, "The Problem of Bluetooth Pollution and Accelerating Connectivity in Bluetooth Ad-Hoc Networks", in Proceedings of the Third IEEE International Conference on Pervasive Computing and Communications (PERCOM '05), 2005, pp. 200-207.

[6] M. Aiello, R. de Jong, and J. de Nes, "Bluetooth broadcasting: How far can we go? An experimental study", in *JCPC '09: Joint Conferences on Pervasive Computing*, 2009, pp. 471-476.