MULTIMEDIA CONTENT DISTRIBUTION OVER BLUETOOTH ENABLED MOBILE DEVICES
blueG

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Abstract: Infocommunication market and advertising services of multimedia contents in mobile devices faces the need to keep up to technology development in order to satisfy the public's needs by providing more and better information technology. This market has become more demanding and selective, which makes this process more competitive and innovative. A combination of information technology innovations and a changing local, global business environment and personal demands makes the role of IT more significant than before. The main issues in this study were creating a system supported by bluetooth technology allowing us to reach the public with mobile devices in order to succeed in the delivery of multimedia contents, considering mobility as being part of the future. All main relevant technological problems were considered, as well as its resolution suggestions in order to maximize and optimize the developed system. This article focus on a system which intents to reach it real time a large group of people who will receive digital information in a mobile environment, addressing its issues such as different mobile clients, loss of signal, multi threaded sending capabilities and such. Moreover, a final case study is presented to evaluate blueG scenario effectiveness and some conclusions and future work are drawn as final words.

1 INTRODUCTION

This document portrays a summary of the work developed under an MSc Thesis on multimedia and digital content distribution on mobile environments over Bluetooth enabled devices.
A thorough description of implementation process, with all the stages this thesis went through, from context analysis to case study implementation, all the way through problem, proposal and implementation definition is described.

The blueG is a multimedia content distribution system that works with mobile devices and users, making easier their access to information.
Available market information devices tend to be more distinct and growing in number, forcing its acquisition and learning by their users, conducting most of the times to rejection, miss usage or lack of knowledge about their existence.
Commonly each person achieves the information individually, therefore we need to support on mechanisms that allow transferring it to others without the loss of integrity.
Most often the flow of information is done by the request of the receiving user to its provider, obliging them to search and filter specific contents they want in an environment of distinct interests and with over headed information.
The global information service growth and change makes it difficult for its potential users to understand the availability and potential of resources nearby. To defeat this problem and enlarge providers of knowledge and information profit, they must find ways to easily achieve users with filtered information they value, elimination their search effort.
Most of the information broadcast technology and methods evolve cost to end users, reducing this market and its acceptance.
According to Wersig, communication must be done with information transfer in the best and simpler way to its receivers. In this way, it is in the hand of enterprises to produce interaction means with available technology, creating new channels to provide publicity of service and value, enhancing company visibility to the world.

One way to accomplish one possible solution to this requisite is to prospect the market with a well-accepted mobile device technology such as Bluetooth in order to develop a simple, effective and capable content distribution system with minimum requirements on receiver's side.
Most of existing technologies exploring this solution depend on middleware applications on the client device in order to conduct information transfer.
This solution provides simplicity by using manufacturer provided software on mobile devices, easing user interaction and investment by avoiding software retrieve and installation, as well as model compatibility limitations.

Since this project involved an external enterprise with existing communication channels of information broadcast, to which this system is a complement, its development demanded a collaborative work among student and company client and analysts. Thus, a few tools and methodologies were adapted in order to avoid a counter-productive development process:

- Steady communication;
- Issue tracking (for the prototype);
- Code refactoring;
- Continuous integration (a eXtreme Programming practice);
- Concurrent version control system;
- Use of design patterns;
- Concern about software quality.

This paper is structured in the following way: at first is described a proposal for addressing the problem of content distribution over Bluetooth, afterwards is described the proposal's implementation under the infocommunication enterprise specific objectives and ultimately exposed a case study for support.

2 PROPOSAL

The blueG is an innovative approach for a communication service in which information and entertainment are shared.
Because this system introduces a new business concept, we'll overview it's objectives and supported functionalities.

BlueG implements management of sending and distribution of multimedia contents in a way that resembles a broadcast service or, adopting this technology words, 'bluecast'.

Terminals that have a range of detection of devices nearby, to whom they'll send information, support the system. The receivers are contacted without any request of information, simplifying the users interaction.
Its goal is to 'bluecast' major population, based on the fact that this technology is spread in our day-to-day living and usage and hold in effortless usage of mobile devices or cellular phones.

This platform consist of one or more emission and diffusion points (terminals) who can be easily configured to act as a localized activity or a central and synchronized solution, avoiding repeating sends of content to the same receivers and optimizing individual terminal activity. To make this possible, each terminal must retain information captured during interactions about detected clients, sends and rejections in order to minimize terminal repeated actions and user annoyance. This information is then shared, if configured to do so, with other terminals to improve campaign success and get the most of the number of sends, by the means of a central server system. We can program one whole campaign or distinct content distribution with different publicity content distribution. We'll detail this option on further chapters. By doing this we can use same terminals to broadcast publicity of different campaigns at the same time.

This proposal statement is organized in four main sections with the intention of focusing the reader on the problem-solving task. So first of all, it is described the main concepts of a terminal; on the following section will be presented our centralized solution; the follow section defines our approach for managing and schedule content sending with play lists, and for last how we manage client status, rejections and incompatibilities.

2.1 Terminal

A blueG terminal contains all data relative to each particular campaign in course such, which can me locally inserted and configured or remotely updated.

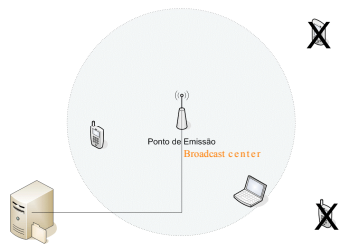

Figure 1 – Example of a blueG Terminal and antenna

It's detection and sending range depends on the Bluetooth antennas used at that moment, which can go up to 100 metres. This terminal can be heavily parameterized with options such as:

- Activate/Standby terminal activity
- Configure remote sync
- Number of maximum simultaneous sends
- Time between searches
- Search antenna
- Sending antennas
- Specific timeouts for types of files and operations

2.2 Centralized solution

Terminal synchronization is done from terminal to central system.
Campaigns configuration and distribution in other way, is done at central system and transmitted automatically to terminals. In those cases where we choose for disconnected terminals (local campaigns), that configuration is generated automatically by the server or manually and inserted the same way in the terminal, such as the respective contents and scheduling. At the limit, the system cas work as one hole synchronizing information between different terminals at separate geographic regions so that there can be consistency in the sent contents to devices, avoiding repeated requests to user and terminals working with the same campaigns.

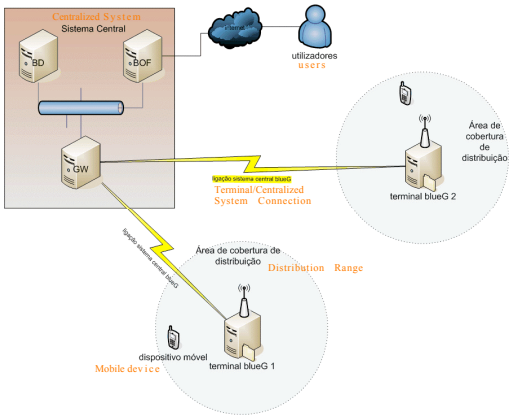

Figure 2 –blueG Centralized Solution

2.3 Play list

We'll introduce the concept of a list of contents for shipment or play list. The fields of the table filled with the value-/ (in) "correspond to parameters that do not apply to the subject in question.

This list, known by each bluecast terminal, contains information on the files to send in a given space or time.

	name	file type	max. send tries	start campaign date	end camp. date	order
[config. playlist]	-/(na)	-/(na)	5	-/(na)	-/(na)	-/(na)
file1	snd3.wmv	music	1	01/04/07	05/04/07	2
file2	vid56.3gp	video	2	03/23/07	05/23/08	1

Figure 3 –Example of a blueG play list

It is well known in that mobile and wireless networks, the communication fails by times on the grounds of range, barriers or obstacles, interferences of signal, implementation errors or technology normalization disrespect at connection nodes, among other reasons. For this motive, blueG system supports a resending of messages management when it detects one of the problems referred, during content distribution. This information, relative to the activity interaction with devices, can be synchronized to central system so that other broadcast terminals can use updated info about surrounding devices, the contents they received, errors occurred, etc., in order to avoid terminal overloads and devices spamming.

In th play list we can how many attempts must be made in case of rejection, error or distraction until giving up on a specific device. The maximum number of attempts can be made by content or by campaign (play list).

Each content has a sending order as well as a the period to in which the campaign is valid and the contents associated to it also valid to be delivered.

This period doesn't have to correspond to current dates but can be assigned to future dates.

2.4 Black List

There are two types of blacklist:

The blacklist of the devices set devices that should not be contacted again as it was not possible to obtain the list of services or because it was detected that they exceed the defined timeout values during the transmission of content.

The black list of contents by device relates to the content in which an error of transmission ocurred and is associated with a particular device. If an error ocurrs in the sending of the content and if the number of attempts to retry exceeds the maximum set by play list, the content is added to this list and the device will not be contacted again about the content in question, but may be contacted about others.

If the maximum number of attempts to resend a file is set by play list and is exceeded, all of the contents of the play list will be added to the blacklist of the device even if only some of them have been sent and have caused error. Otherwise, the maximum number of sending re-entries used will be the ones associated with each content and they will be added individually to the blacklist in case of error with that content.

3 IMPLEMENTATION

Given the problem stated on this paper, this chapter, will focus on a summary of decisions taken at implementation time in order to carry out an optimized solution to the problem described.

3.1 Issues detected

It is important to filter the information already received by each individual in order not to repeat its send.

Due to the operation of the protocol bluetooth and devices that use this technology, it's not advisable to run searches simultaneously with the process of sending since it originates failures in the detection of devices to reach.

The presence of problematic/incompatible devices for the application leads to decrease of guarantee delivery of content and successfully undertake the proper functioning of this system.

The identification of these devices in advance is not possible.

After the system contact with the device, the acceptance / rejection of the request is carried out on the side of the receiver and, as such, the end of the connection is also performed on the side of this device. Although there are devices configured with a maximum time for this activity (acceptance, rejection or explicit rejection automatically after a time), there are others who do not close the connection while the user receiver doesn't indicate their desire. This implies that while the device does not close the connection, the system will be kept blocked waiting for this device to close connection, preventing other devices within reach of being detected and contacted.

Some of the devices, or by saving energy, and for not respecting the standard or for security reasons, only allow the method of connectivity (page scan asset-acceptance of connections) for a short period of time, soon after being contacted through a request for discovery of devices to reach (inquiry). This implies that it is not possible to send content to the device by not having obtained the services of this list. This is because the search service will be held long after the device be detected due to the fact that the devices are in a list of waiting to receive content, and in this case, the device may already have switched off the mode of connectivity denying any operation of connection. Similarly, the researches with longer duration are also those that relate more failure.

It is recognized that when there are devices in the limit of range of the search antenna / transmission of content, the exchange of data with these sometimes is not possible due to the weak signal created by the distance between sender and receiver. There is no simple and effective way to measure the distance from the device to the system issuer nor is the value of reliable strength of the signal detected for each device.

There are steps that must be controlled in terms of time since it delays the process of distribution of content.

The use of antennas with connections up to 6 devices is not effective and causes many errors, contributing to the low rate of success in the transmission of content. The synchronization with the 6 devices is not feasible in public and mobile environments.

There are devices that come out of the reach and as such are placed in the blacklist for not having been able to get in touch with them after discovered.

3.2 Issues Resolution

Since the activity of posting content is waiting for the response of the device for a certain time, it became evident the need to test first if the device was still within reach to avoid these activities begin with devices not present (in range).

Also, to reduce the flaw in devices that are in the limit of maximum range of the distribution of content, a policy of rapid exchange of short information has been introduced.

This policy is to ask whether this device is still within reach, testing at once if he is still in power and is able to exchange packages (proximity within the minimum limit).
This procedure to be effective has to be done in a short time so the answer has to be accepted on a space of time of a few seconds, if not the device is given as unreachable (for having left the acceptable range). Due to the success of this implementation, in the event of errors in the content sending or in search of services, it is always found this way if the device came out of reach as it is a reliable and fast process. This also avoids erroneous placing of devices the blacklist in cases of devices that got out of range.

It was also used to resolve the issue of the failure to obtain the list of services.

To make it more efficient to obtain the list of services, a process was implemented that determines the maximum time to wait for the response of the end of which returns error in the discovery. This situation has occurred despite the fact that it may sacrifice one or another device slower in responding to the list of services request, proved to increase the overall performance of the application and as such the rate of shipments successfully. Thus optimization has occurred in steps process of distribution of content with introduction of parameterized timeouts.

On the issue of simultaneous research and send, it was necessary to separate the processes in search followed by sending in order to attract a larger number of devices. Also it allows saving resources as, an antenna used in the research of devices can then also be later used in the transmission of content.

To maximize the number of devices contacted simultaneously by the system we restructured the application and api's module in order to support more than one antenna radio, expanding the number of simultaneous connections with devices.
This allowed identifying and isolating problems in the communication. Each antenna only interacts with one device at a time, and the devices at different moments could interact with different antennas, depending on the placement and management of the distribution the content from the system.

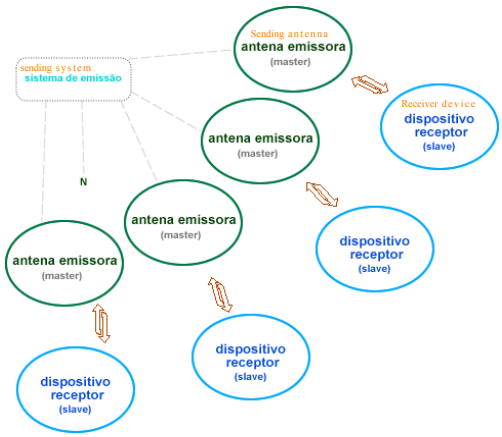

Figure 4 –blueG multithread distribution implementation

4 CASE STUDY

The results we present in this section refer to tests performed in an area with large quantities of devices to reach, in an environment of high mobility and without publicity to sending content from the issuing entity through posters, or other digital screens.

The venue chosen for this purpose was the Lisbon Airport, in the area of landing passenger. The place for above conditions is not what best contributes to the achievement of results of success however, you can get an idea of the behaviour of the system in the worst cases, in view of the problems identified on many devices to reach (Bluetooth pollution - Somil Asthana e Dimitris N. Kalofonos), errors of implementation of technology, mobility, leading to the distraction of receivers rejection (bounce unintentional), among others.

Whereas the concept of distribution of content adopted and implemented, the rate of success is presented in Figure 5, to hold a send we must ask the list of services to the device or know it because of previous contact with the device so that we can validate if this the service for the exchange of content is available and active. The results of success in this process are around the 60%, relative to the devices found at the site and contacted for the purpose.

Followed the process of obtaining services by device, is the distribution of content for sending also identified by device. The figures raised this stage are 10% of success in sending a content and

approximately 4% in the case where there is more than one content to be sent.

The development of prototypes to its final version has optimized the process of distribution in terms of time and can present values in the order of 47 seconds of gain. These figures are only a reference and depend on the configuration applied since the application allows the manipulation of time for maximum process and sub-processes so, the amendment of these may increase or decrease the total time of distribution. However, the fact that we pre-set values, enabled increase the efficiency of the system and cases of success of submission.

In environments with fewer devices figures sending successfully increase, stating the problem cited in other chapters on pollution in environments Bluetooth (Somil Asthana e Dimitris N. Kalofonos).

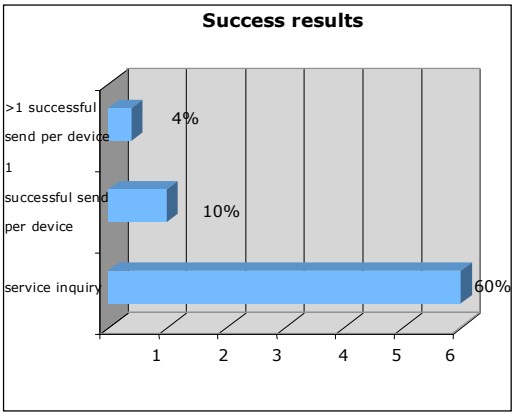

Figure 5 –blueG case study sucessfull sending results

In Figure 6 shows the identification of the types of errors occurred in the interaction with the devices in the process of distribution (search + sending) of content.

While we factors in the order of 30%, we consider that the output of power should not be considered an absolute error since this or other issuer can contact the device later.

In case of errors occurring in obtaining services (40% - Figure 4.1), its value is in most cases subject to restrictions by the receiver and in fewer cases to the application. We can identify devices that many still do not support the delivery of content (for being disabled or not to be implemented by the manufacturer = 30% to 40%), which have left the range (about 16% of 40%) or that will slow long in response to the request done (4% of 40%).

In cases of rejection (25%), it is difficult to identify whether this occurred by explicit indication of the receiver, for incompatibility of the receiving device, in response time exceeded the user receiver or exceeded capacity on the device.

In other cases (10%), we can consider the devices that keep the connection active forever, others who block during shipment, are without battery, among other less relevant.

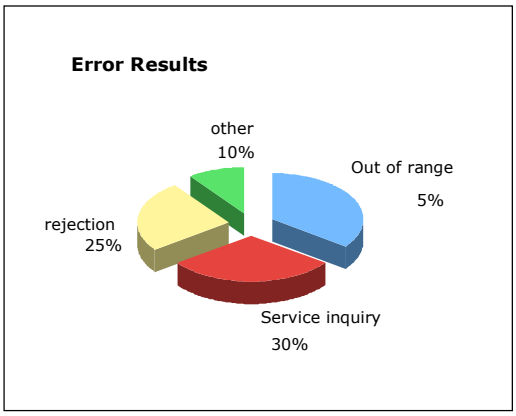

Figure 6 –blueG error results

5 CONCLUSION

As described in the introduction to this thesis dissertation, the demand for innovation in the markets and services uses current methods, techniques and technologies that get the ability to deploy and to achieve new goals and objectives.

The infocomunication will always be directly dependent on the technology accepted by the market and as such, the operation of its capabilities at the highest level.

The bluetooth technology emerged as a liaison and exchange of information between devices, simplified features distinct but united in the same context - that of mobility. Because of its characteristics and low cost, the acceptance of the technology was significant and adopted on a large scale in any type of devices which influenced the conduct of the study on the system that this is support for the distribution of multimedia content on mobile devices. The effort that the system performs to circumvent many of the problems that the bluetooth presents and does not respond in this context is some and has its positive and negative points.

From a technological one would realize that the technology adopted has many limitations in the context in which this study has been applied and implemented the system.

In organizational terms we developed an innovative product in the domestic market, with characteristics common to other systems already in production but also with other innovative characteristics and with the possibility of adapting the system to the surroundings. This product created a new channel for advertising and information service, and begun to have some demand from other organizations.

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