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DEFINE BLUETOOTH AS A WAY OF BROADCASTING CHANNEL

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ABSTRACT

This Paper Defines Bluetooth as a way of broadcasting Channel and study shows that Bluetooth broadcasting would be appropriate for any file types not exceeding 500 KB in size. The effect of several parameters such as data file types and sizes, distance, barriers and interference from other wireless technologies on the system were tested. The software was written in Java in order to allow interoperability across multiple platforms. It was programmed to discover all Bluetooth-enabled devices within its range irrespective of the number of devices present and then broadcast multimedia content to these devices. It was further noted that performance degrades in conditions where there is interference due to Wi-Fi and Bluetooth as well as obstruction due to barriers and in broad sunlight.

KEYWORDS: wireless networks, Bluetooth, mobile devices, wireless devices.

INTRODUCTION

Mauritius is rapidly developing towards a knowledge-based society where exchange of information is mandatory for all activities. However, the cost of communication technologies is still expensive. Therefore, there is a need to find low cost and simple transmission technologies. The use of wireless communication technologies is an attractive opportunity, especially in view of the fact that in Mauritius, mobile devices including laptops, PDAs and sophisticated mobile phones are becoming widespread among the population and increasing every year. This medium was originally developed as a mean for cable replacement for communication between mobile phones and related accessories; and consequently increases their functionalities. But, nowadays another purpose of the latter is starting to gain momentum that includes broadcasting.

Due to lack of information concerning the performance of this new born feature, the present and future broadcasting potential of Bluetooth is uncertain.

The aim of the study is to show that Bluetooth is a potential medium for broadcasting that can be used to send data files at low operating cost. It also investigates the ability of Bluetooth in performing this function efficiently and effectively. The paper is organised as follows: Section 2 describes a brief overview on Bluetooth, related work in discussed in section 3, section 4 presents the operation of the developed software, section 5 describes all the experimental scenarios that have been setup, section 6 shows the results obtained during the course of the experiments and section 7 concludes the paper.

BLUETOOTH OVERVIEW

Bluetooth is a short-range wireless technology for local area and personal area networking to interconnect low-power devices and portable computers [1]. Since its inception in early 1998 [2], it has been accepted and utilised worldwide; however since it is a fairly new technology it still has to be further improved to increase its functionalities. Bluetooth operates at 2.4 GHz in the ISM band. Some key attributes of Bluetooth are [3]:

Open Specification
Bluetooth technology is available for everyone and is royalty free.

Short Range Communication
Bluetooth embedded devices normally communicate over relatively short distances. It has three ranges of transmission distance; 0-1m, 0-10m and 0-100m using radio waves.

Low Power
Bluetooth uses low power radio which is more likely to suit portable and battery operated devices.

Robustness
It can face interference without affecting its operation from other devices, for e.g. cordless phones, microwaves ovens and WLANs that also makes use of the free ISM frequency band.

BLUETOOTH LIMITATIONS IN BROADCASTING
Bluetooth was originally intended as a cable replacement between battery- operated devices [4] and was not designed for broadcasting purposes as a Bluetooth emitter can only send data to seven devices simultaneously [5]. Moreover, Bluetooth has a relatively low transfer rate, 721Kbps in version 1.2 and 1Mbps in version 2.0 (without EDR); consequently broadcasting of data is restricted and this slow transfer rate is only apparent when very large files are being sent [6]. Finally, the discovery time by Bluetooth is long. According to [7], for Bluetooth version 1.x, the time required is about 20 seconds while for version 2.x it may take less than 10 seconds.

RELATED WORK

Using Bluetooth as broadcasting medium is still an innovative field where very little studies have been performed. However, there are some researchers who have described and investigated Bluetooth broadcasting.

Several testing have been conducted in the past to evaluate the effect of the interference of Wi-Fi (IEEE 802.11) with Bluetooth devices. Early attempts to quantify the mutual interference effects have been based on simple geometric models of Bluetooth deployment rather than actual usage models.

In [7], the usefulness and practical issues related to Bluetooth broadcasting have been investigated and the experience from developing and exploring a broadcasting system (Baloo) has been described. However Baloo was not tested in real life situations.

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In Ennis, the investigation focused on the problem of calculating the probability of an overlap, in both time and frequency, of a continuous sequence of Bluetooth packets and an IEEE 802.11b direct sequence 11-Mb/sec packet. Relative power levels between the Bluetooth and IEEE 802.11b packets were not considered.

Zyren and others made several refinements on previous assumptions. These efforts, however, did not examine in detail the ramifications of the physical (PHY) layer such as hopping, spectral masks, and filter selectivity, nor did they discuss implementation.

In addition, the geometries studied did not necessarily correspond to practical usage models [8].

Moreover, Punnoose et al. [9] performed some experiments to evaluate the effect of 802.11b signal on Bluetooth. They had found that Bluetooth to overlap in frequency and time with the 802.11b at most 1/3 of the time. Moreover, from the results obtained, it was deduced that Bluetooth performance starts to degrade rapidly when the interfering 802.11b signal is comparable to the desired signal [9].

SYSTEM'S OPERATION

A broadcasting system named BluPhox was developed that can broadcast any data file type such as text, image, audio and video. The software has been coded in Java thus enabling it to run on multiple platforms such as Windows and Linux. Libraries such as BluecoveJSR82 [10] and avetanaObex [11] were used to manage connectivity and to send files.

The broadcasting system requires Bluetooth capability to broadcast contents to devices in its range. The administrator will have to login as a security measure to use the system, he/she can choose any file and broadcast it to nearby Bluetooth devices. An interface is also provided to type a short quick message and broadcast it. The system first discovers devices in its range (10m), prompts the client if it wants to receive file from the broadcasting system and if the client accepts to receive the file, the file is then sent. This way of broadcasting content eliminates the problem of spamming.

Our system achieves broadcasting in a serial manner, i.e. sending contents to clients one after the other by (i) connecting to the first device and then send the content, (ii) closing the connection after the content has been received by the device, and (iii) move to the next device and repeat steps 1 and 2 until content has been broadcast to all devices. The above method transmits the same file to each of the devices one after the other and it uses unicasting as a means to achieve broadcasting. This method of broadcasting allows maximum usage of bandwidth since only one connection is made per transfer of the file to the device whereby all the necessary resources are allocated to the device in use and only after the file is sent or rejected that a new connection will be made.

While for the case of broadcasting to multiple devices simultaneously at a given point in time, the bandwidth will be shared among them making users to wait for more time to receive the file [12].

TESTING SCENARIOS

Despite the increasing usage of Bluetooth, the features that affect its performance are still unknown. Past studies have showed that efficiency of Bluetooth is affected by wi-fi and Bluetooth interference [6]. According to the wave theory [8], when two waves overlap, they either superimpose constructively or destructively; moreover, when a wave passes through a surface, its intensity decreases greatly. Therefore, several test scenarios were devised in order to evaluate the effectiveness of the Bluetooth device in performing its purpose in situations where there are barriers and interference from wireless devices. Hence, these results can be used by organisations that are interested to implement systems that use Bluetooth as a communication medium and where the reliability of Bluetooth is important for the application to be useful.

PERFORMANCE ANALYSIS

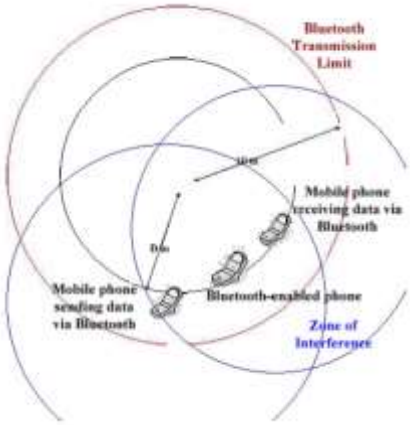
During testing, the metric used to evaluate performance was throughput. This is defined as the amount of data that can be transmitted during a specific time interval. The simulation times and throughputs were based on the aggregate performance of all the Bluetooth mobile phones used during the testing. Therefore, each phone was tested in order to ensure that all models were able to handle large files well and they would not degrade the performance of the entire group. Moreover, during on site testing it was noted that when it was performed in open air, under direct exposure to sunlight, the Bluetooth range varied from 4m to 7m depending on the model of the device being used. Due to this fact, the experiments were carried out indoor

EFFECT OF MOBILE PHONE MODEL ON BLUETOOTH DISCOVERY

The testing was done by using 10 mobile phones of different models placed at 1 m intervals from a Bluetooth-enabled laptop running BluPhox. The order by which the discovered devices displayed was noted. The experiment was repeated and each time the position of the mobiles was interchanged.

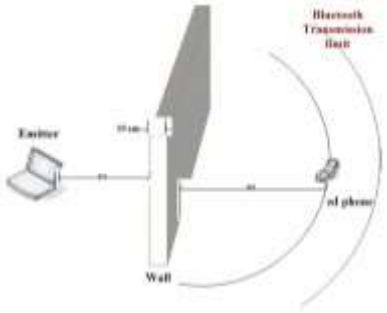
EFFECT OF INTERFERENCE ON TRANSMISSION RATE AND THROUGHPUT

Bluetooth uses a frequency range which is similar to microwave, Wi-Fi and infra-red. However the probability of the occurrence of each wave varies according to the place of application of the broadcasting device activated Bluetooth mobile and a laptop connected to a Table 6.1: Order of Broadcast WLAN. The setup used is demonstrated by Figure 5.1



EFFECT OF BARRIER ON TRANSMISSION RATE AND THROUGHPUT

An informal survey was done initially and it was found that the common barriers that are present are: window panes, concrete walls, wooden and metal doors. The effect of these four barriers on the transmission time was determined.



RESULTS

BROADCASTING SEQUENCE

During the preliminary testing, the internal functionalities of Bluetooth were assessed in order to understand its pathway of connection. From Table 6.1, it can be concluded that the BluPhox will broadcast data to Bluetooth devices discovered within its range, i.e. within 10 m, based on their Bluetooth addresses irrespective of their position, model and functionalities. The device with the lowest address will be the first to receive the data file while the one with the highest address will receive it last.

This implies that Bluetooth will discover and send files to any Bluetooth devices in the vicinity of the emitter based on the order of addresses without considering the brand and version of the mobile phones as well as there average distance from the emitter.

TRANSMISSION AND THROUGHPUT AGAINST DISTANCE FOR VARIOUS SIZES

From Figure 6.1, it can be observed that for small data size the transmission time remains more or less constant at 7s, 14s and 42s for 11KB, 100KB, and 500KB respectively. However, as the size of the file increases, a drastic increase is noted in the transmission time. This indicates that for data size higher than 500KB, the relationship between transmission time and distance is non-linear. It becomes hectic for data larger than 2000KB. For small data size, the increase in transmission time above 7m is negligible as compared to data size above 500KB, this is why for small values the transmission time is more or less constant. However, if the range is expanded, those with small data size will also give similar results as those above 500KB. The same results were reported by Steele (2006) [6]. ture of the Hamming distance d that can be considered. To accommodate a different distance, additional metadata would need to

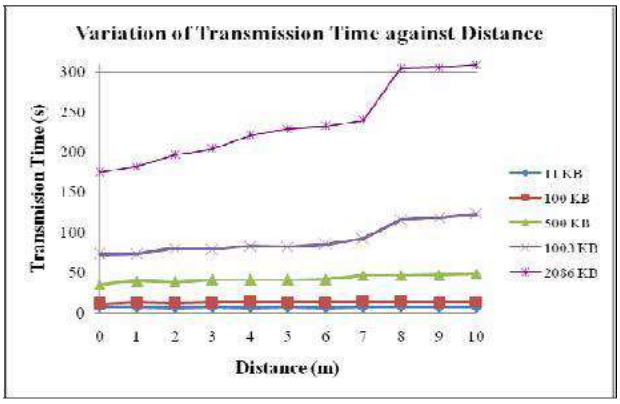


Figure 6.1: Variation of Transmission Time against Size

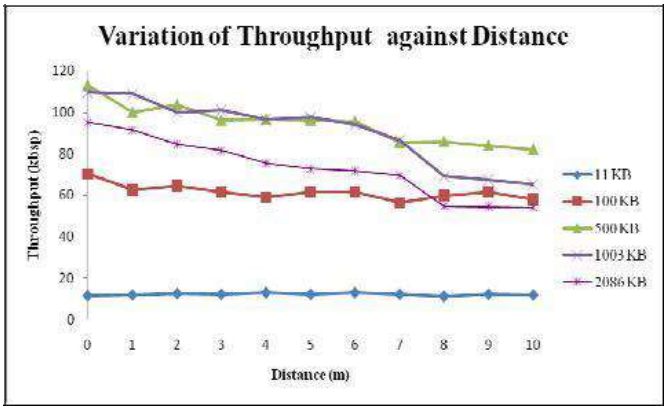


Figure 6.2: Variation of Throughput against Distance

CONCLUSIONS

The effect of data types and size was assessed. However, it was observed that the data transmission was dependent only on data size. The potential of using Bluetooth as a broadcasting medium for transmission of data has been described in this paper. The results from the different test scenarios indicate that the performance of Bluetooth is highly dependent on the Bluetooth devices being used the type of data used had no effect on transmission time. Moreover, it was noted that for small data sizes, the effect on transmission time was negligible and it became more

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