

Project Bluetooth, engaging and supporting Computing First Years through mobile phones

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<http://www.learninglab.org.uk> <http://www.projectBluetooth.wlv.ac.uk>

Abstract

In this paper, we present a novel approach to supporting first year computing students by exploiting widespread ownership of Bluetooth enabled devices, specifically, but not restricted to, mobile phones. The combined software and hardware solution described allows delivery of information with low set-up costs and zero transmission overhead. We show how this system can be used to provide different types and formats of information, from basic textual information such as timetabling alerts and reminders, to richer content like presentations, audio and video files. We then go on to provide examples of the system in practice, including its application to other disciplines. Finally we look at developments in the system that have been undertaken since the project and collaborations that are under discussion.

Keywords

Bluetooth, Mobile, Support, Podcasts

Introduction

The University of Wolverhampton as an institution is committed to increased participation, especially amongst currently under-represented groups and the Learning Lab as part of the School of Computing & IT understands that "In particular, the widespread acceptance and ownership of sophisticated mobile phones allows educators to design learning that encourages participation in e-learning amongst groups often under-represented in formal learning" (Kukulsha-Hulme & Traxler, 2007). Furthermore, it seems obvious that personalised learning, where students have the greatest sense of 'ownership' and control, is most likely to be effectively delivered using devices that are actually chosen, bought, owned and valued by students, namely their phones, rather than devices bought in thousands by the university. Earlier work (Traxler & Riordan, 2004) showed the sharp difference in attitudes to personal and University devices in this respect, and there is distinct possibility that students will resist carrying a second device, a university one, in addition to their own. Experience has shown that this, the university device, is likely to be left behind at home unless it is integrated into, and in constant use in, their learning.

At an institutional level, the University has worked with JISC to provide a SMS delivery and discussion system, MELaS (MELaS, 2006), exploiting the near-universal ownership of 2nd generation mobile phones and the fact that students require little or no training in the use of SMS. From an institutional perspective, the main detriment is the transmission cost, but there is also the

question of how engaging information can be conveyed within 160 characters of text. One solution to this problem of richness and amount of information sent is to make use of multimedia messaging (mms) commonly found on modern mobile phones, but this does not solve the cost issues, which must be addressed if these systems are ever going to make it past the large-scale trials stage. It also raises the assumed level of functionality and with problems about equity.

Besides mms, another technology, Bluetooth, has seen widespread adoption by mobile phone manufacturers in recent years. This technology provides the user with the opportunity to create a Personal Area Network (PAN) of their various mobile and static devices, but also to communicate with other users and devices in the vicinity.

Project Bluetooth

Project Bluetooth has been developed as a complementary platform to the university's existing SMS transmission technology. It bridges the divide between distance and richness of information and learning materials. Once the system has been set up, transmission costs are nil.

The system makes use of inexpensive and widely available Bluetooth Universal Serial Bus (USB) 'dongles' and open source software to provide a communications link between staff and students that requires nothing else, other than a computer, to create a transmission hub.

Bluetooth Technology in Brief

Bluetooth is a license free communications protocol transmitting in the Industrial, Scientific and Medical band and designed for short range *ad hoc* networking. Its operation in this band means that it competes with transmissions of all other license free short range systems like Wi-Fi. Originally developed by Ericsson in 1994, the standard is now under the control of the Bluetooth Special Interest Group (SIG). The technology first came to prominence (and is still most commonly associated) with the provision of wireless headsets for mobile phones, but has since been used in a multitude of applications from wireless computer mice to streaming audio.

As an outline, the Bluetooth v1.2 transmission system uses spread spectrum techniques to reduce the effect of other technologies working in the same band (Wi-Fi being a prime example) on transmitted packets. Transmitting on one frequency for such a short amount of time means that multiple packets are less likely to encounter distortion and there is therefore a reduced need for error control overhead, although a rate 1/3 repetition code and a rate 2/3 block code are available as well as Automatic Repeat Request (ARQ). To further reduce the likelihood of interference, problem frequencies (for instance, those used by static wireless transmitters) are avoided by the systems adaptive algorithm which takes note of frequencies that regularly cause interference to Bluetooth transmission and avoids them for future packet transmissions. Gaussian Frequency Shift Keying (GFSK), a simple and robust digital modulation technique is used for data transmission in Bluetooth v1.2. To increase data throughput, Bluetooth v2.0 uses GFSK only for header

information, favouring the increased rate of Quadrature Phase Shift Keying (QPSK), with a guard and synchronisation word, for the payload. This payload rate is further increased through the use of 8-PSK for the Enhanced Data Rate (EDR) that has recently come to market. The *ad hoc* network can take on one of two forms. In the first instance, where less than eight devices are present, a piconet is formed. In this situation, one device becomes the master and the other seven become slaves. All of these devices can communicate with one another simultaneously. If more devices are present, or come within range, slaves can act as masters in other piconets, thus forming a scatternet.

Alongside the radio transmission standard is a range of profiles that are defined by the SIG. These specifications form the backbone to any Bluetooth software development and include profiles for basic services, such as printing and synchronisation, and more involved services, like WAP over Bluetooth and Object Exchange (OBEX).

BlueShoot

One of the goals of this project was to provide a freely available executable for other members of the community to use. Therefore, the transmission software, BlueShoot, is built to run on the Linux operating system using Python 2.4 with a MySQL 5.0.24a database to keep track of group member information, services permitted by each device, files to be transmitted and whether they have been successfully received or not.

The software makes use of a number of freely available libraries, primarily PyBluez, a Python wrapper for the official Linux Bluetooth software stack (Bluez). This library is used for device discovery. To facilitate the transmission of information to devices using OBEX, and to discover more easily the services on a device, a high-level wrapper for PyBluez and OpenOBEX, LightBlue was used.

Software in Practice

Whereas SMS transmission technologies require nothing more complicated than a phone number, Bluetooth devices require considerably more information. Fortunately most of this information can be obtained via the device software; it only requires that the device is made discoverable for a short time and that the correct profile is permitted without pairing. This permitting of access to particular profiles is only an issue with older devices; more recent mobile phones (those that have come to market in the last 12-18 months) offer a less complicated interface. Once the device has been detected, the student device discovery can be disabled.

The most basic use of the software is transmitting particular files to chosen devices in real time. This is accomplished through the manual transmission window. The user can search for all discoverable devices from this window.



Figure 1: BlueShoot Manual Transmission Screen Showing Discovered Devices, Send and File Selection Functions

Once devices have been discovered, the user is given the ability to transmit a chosen file to a particular device, selection of devices or all devices.

A more useful aspect of BlueShoot is the automatic transmission function which allows the user to transmit all information to a group of devices asynchronously. Thus, whenever a device comes within range of the transmission hub, BlueShoot determines what groups (if any) that device is a member of, checks for any files associated with that group that have yet to be successfully sent, and transmits them.

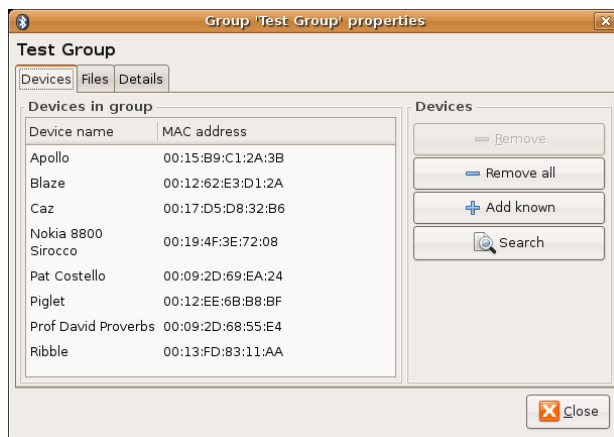


Figure 2: Group Management Screen Showing Devices in Group, Group Properties and File Management Tabs

BlueShoot also allows for group management. Users can add devices from a list of known devices, or search for new ones and add new files to be transmitted to the group. Files can take on any format, although attention should be given to size and type when transmitting to mobile phones. Bluetooth v1.2 permits transmission in the region of 1MB/minute, while Bluetooth v2.0 EDR provides approximately 3 times this speed. Although Blueshoot uses v2.0 EDR, the same cannot be guaranteed for the receiving device, thus, in this instance, smaller files are preferable for asynchronous transmission.

Trials and Results

The system has been fully functional since early February 2007 and delivers pastoral information in the form of .jpeg files harvested from the University VLE to approximately 40% of the full first year cohort. Evaluation, through analysis of user logs suggested that students made repeated use of the system, returning to receive new updates on a fairly regular basis.

Further trials are ongoing with HND cohorts and discussions are ongoing with other universities and colleges. Extended trials highlighted problems with new transmitter hardware (the USB dongle supplier firmware defined the USB Physical Interface Device as an ethernet adapter rather than Bluetooth transmitter). This has been overcome and manuals, CD images and suggested hardware are all available from the project website.

In practice, suitable files for transmission were .jpegs, animated GIF files, audio podcasts (especially those unaffected by reduced bit rate, such as voice).

Future Work

ProjectBluetooth is currently being extended both in the transmission system and with software provided on mobile devices. The transmission system is extended to allow multiple blueshoot hubs to communicate via bluetooth and wired links, allowing the system to add an element of physical and temporal context. Device-side software is also under development to provide a framework that automatically receives data (adding an element of pervasiveness) and automatically detects file formats, thereby simplifying the interface for the user.

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